Managing Strategic Investments Decisions: the Impacts of their IT Content, the Effectiveness of Decisions and a Protocol for Evaluation

by

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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 in the period from April 1995 to March 1998, a number of conference papers were prepared as listed below. The remaining parts of the thesis are unpublished.

[1] Chou, T., Dyson, R. and Powell, P. '*A framework for the evaluation of strategic IT investment decisions*', Operational Research Society Conference (OR38 Conference), Warwick University, UK, September, 1996

[2] Chou, T., Dyson, R. and Powell, P. '*Managing strategic information technology investment decisions: from involvement to effectiveness*', Operational Research Society Conference (OR39 Conference), Bath University, September, 1997

[3] Chou, T., Dyson, R. and Powell, P. '*Does information technology matter? s study of IT involvement in strategic investment decisions*', Proceedings of the Fourth European Conference of the Evaluation on Information Technology, 23-35, Delft, The Netherlands, October, 1997

[4] Chou, T., Dyson, R. and Powell, P. '*Managing strategic IT investment decisions: from involvement to effectivenes*', forthcoming, Proceedings of Sixth European Conference of Information Systems, Aix-en-Provence, France, June, 1998. This paper also was submitted to the Journal of Management Information Systems and is now under review.

[5] Chou, T., Dyson, R. and Powell, P. '*An empirical study of the impact of IT intensity in strategic investment decisions*', paper submitted to Technology Analysis and Strategic Management Journal and now under review

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

Signature: ______________________.

Date:___________________________.

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Abstract

The strategic potential of information technology (IT) is now well recognised, but strategic IT projects have high failure rates. The present study proposes the concept of the degree of IT intensity of SIDs and aims to answer the question of whether the degree of IT intensity matters in relation to the decision process, decision content, decision outcome and evaluation methods. Furthermore, critical factors which impact on the effectiveness of SIDs are explored, and a protocol is proposed by mapping the quantitative findings to state-of-art evaluation approaches.

A structured questionnaire was developed, and empirical work was undertaken among Taiwanese manufacturers. Experts in two professional associations, the Chinese Association for Industrial Technology Advancement and the Chinese Productivity Centre, helped to identify organisations considered to be representative of the population. 270 organisations were selected and 94 responded. Of these, 80 were valid for further analysis.

Several variables are found to be significantly correlated to IT intensity. The Hypotheses testing shows that interaction, the accuracy of information and strategic considerations are mediators in the linkage of IT involvement and the effectiveness of SIDs but the direct link from IT intensity to the effectiveness of SIDs proved to be weak. Consequently, the stepwise variable selecting procedure was employed to reveal the critical variables which impact significantly on the effectiveness of SIDs. The present study seeks to develop a protocol which addresses the practical aspect of SIDs and SITIDs in terms of rules and to integrate these rules to form a model for evaluation. Five major mechanisms of this model are discussed: the scanning mechanism, the strategic flexibility mechanism, the evaluation mechanism, the proactive mechanism, and the feedback mechanism.

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Chapter 1. Introduction

1.1 Introduction

This chapter provides an overview of the study. The motivation section (1.2) outlines the broad field of study, and this leads to a consideration of the focus of the main research problems. Then the research objectives and questions are proposed as a basis for addressing these problems (1.3). Following this, the general research process, scope, strategy and method are presented and the delimitations of the study are discussed (1.4). Finally, the expected research contributions are discussed and the structural organisation of the thesis is explained (1.5 and 1.6).

1.2 Motivation

Strategic investment decision (SID) making has long been a topic of great interest in organisation theory, strategic management and financial management. SIDs have major long-term implications for the firm and include decisions about new products, markets, technologies, and capacity; vertical integration and acquisitions; and major investments in marketing, research and personnel. These decisions are strategic in the sense that they significantly help to shape the firm's long-term future (Barwise et al., 1987). Therefore, it is of critical importance to manage strategic investment decisions (SIDs) effectively.

Meanwhile, the strategic potential of information technology (IT) is now well recognised. The application orientation of information technology has changed from tactical to strategic while, at the same time, the financial view of IT has changed from one of IT as a cost to one of IT as an investment (Earl, 1989). Since a large amount of investment capital has been absorbed by strategic IT (Porter and Millar, 1985), strategic IT investments have realised increasing importance as part of organisations' strategic investments. For example, investments in IT constitute more than 50% of all new capital investment by major firms in the USA (Barua et al., 1995), and the top 100 firms in Europe invested over 38 billion ECU ($47 billion) in 1996 (*Information Strategy*, October, 1996). Indeed, IT is now said to be of capital importance (Willcocks, 1994a).

Although strategic information technology investment decisions (SITIDs) are a subset of SIDs, a number of phenomena show the problematic nature of IT investment. *First, It is more difficult than many other investment decisions (Powell, 1993) and management now face a dilemma concerning the strategic use of IT.* Willcocks (1994b) indicates that many organisations find themselves in a 'catch 22' position. For competitive reasons they cannot afford not to invest in IT, but economically they cannot find sufficient justification, and evaluation practice cannot provide enough underpinning, for making such an investment. Organisations thus fall into the 'IT productivity paradox' problem (Brynjolfsson and Hitt, 1996) of failing to identify IS/IT benefits and productivity.

Second, the outcomes of strategic IT investment projects are often poor. Some cases, e.g. that of the London Ambulance System, have reported failure in the use of IT (Hougham, 1996). Further, Hochstrasser and Griffiths (1991) show that only 31% of companies reported that the introduction of IT had been very successful. For the London Ambulance Service, as Hougham (1996) shows, the single most important factor was the inadequacy of the organisation to control such a large and technically complex operation. Also, sometimes, there are no gains even if the system is successful, since it so dramatically alters the environment that all assumptions about costs and benefits are rendered obsolete (Parker, 1996).

Third, it has been widely recognised that financial appraisal techniques cannot be used to evaluate IT investments effectively. Willcocks (1994) indicates the common problems of IT investment, such as inappropriate measures and the neglect of intangible benefits. However, it is not clear why IT causes so many problems, and there is still no certainty as to how to improve the situation. Obviously, existing evaluation techniques are too narrow (for example, they are mainly financially based) and lack an alignment mechanism.

However, previous research has neglected the continuous nature of decisions. SITIDs form part of corporate strategic investment decisions (SIDs). Most previous research has concentrated on either SITIDs or SIDs, ignoring the continuous nature of decisions (Simon, 1977). Decisions can be distinguished according to several dimensions, including the strategic/ operational, structured/ unstructured, and dependent/ independent alternatives. SIDs have different degrees of IT intensity in investments and this is an important feature of the IT/non-IT continuum. The discussion of this section leads to an interesting question: ***'does IT matter?'*** The impact on SIDs of their IT content has not yet been thoroughly explored. Therefore, further investigation is needed.

1.3 Research Objectives and Research Questions

The general aim of this study is to extend our knowledge of both strategic investments and strategic IT investments, and to facilitate the effective management of SIDs and SITIDs. This study places emphasis on the potential impacts on SIDs of their IT content. It first seeks to link this issue to the problems of investment decisions. This research also aims to explore the distinguishing variables of SIDs in relation to different degrees of IT intensity. It is important to know what factors are changed because of IT intensity so that these differences can be taken account of in the evaluation and management of SITIDs. An effort is then made to propose a suitable approach for conducting IT investment projects in particular, and strategic investment projects in general. Thus, the main objectives of this study are as follows.

(1) To clarify the definitions of SIDs and SITIDs.

(2) To clarify the potential impacts on SIDs of their IT content.

(3) To investigate the factors which may impact on the effectiveness of SIDs and SITIDs.

(4) To propose a protocol for the effective management and evaluation of SIDs and SITIDs.

Accordingly, to achieve those objectives, the following research questions need to be addressed:

(1) What is a strategic investment decision? What is a strategic IT investment decision?

(2) In comparison with other SIDs, what is different about strategic IT investment decisions? Are they different in nature and scope? Are there different uncertainties ?

(3) In comparison with other SIDs, are SITIDs different in terms of the effectiveness of decisions? If so, how can an organisation tailor its decision-making process to achieve a better outcome? If not, what are the critical factors which impact significantly on the effectiveness of SIDs?

(4) What are the implications for the management and evaluation of investments?

1.4 Process, Scope, Strategy and Method of the Study

The major focus of this study is on strategic investment projects and one of their subsets, strategic IT investment projects. The study is divided into three stages. In the first stage, the aim is to develop a theory linking the outcomes of SIDs and IT investment intensity in SIDs (Chapter 3). In the second stage, the impact of IT intensity on the decision-making process and its outcome is examined through an analysis of the survey data (Chapter 5). Based on the findings in stages 1 and 2, the impact on SIDs of their IT content will be clearly explored. Consequently, the aim is then to provide a protocol by which to conduct strategic investment decisions taking account of any peculiarities of SITIDs.

The following two delimitations have served as the boundaries of the research scope. First, the required strategic investment information is confidential, and this has restricted the data collection design. In the pre-testing of the questionnaire, some managers commented that the questionnaire was 'ambitious'. Another concern is the accessibility of the research population. Ideally, the population should be accessible to the researcher and should produce an acceptable response rate. The researcher should know the overall industrial environment well. In order to get a sufficient number of suitable corporations involved in this study, Taiwan, the researcher's home country, was selected as the focal area for conducting fieldwork; and experts in two professional associations, the Chinese Association for Industrial Technology Advancement (CAITA) and the Chinese Productivity Centre (CPC), helped to select organisations considered to be representative of the population. This choice inevitably limits the population and sampling range.

Second, the study focuses on IT investment projects not information system (IS) investment projects. IT here refers to the supply of information-based technologies. That is, the research does not specifically consider how IT becomes translated into information systems which deliver the information needed by the organisation and its stakeholders.

The literature provides sufficient knowledge to construct a theory, and the constructs can be measured objectively by using a questionnaire or another instrument. Accordingly, to fulfill the above research objectives, this study examines the industrial experiences of strategic investment decisions based on a real-world survey. Empirical work was undertaken among Taiwanese manufacturers. The constructs were operationalised in the form of a questionnaire. In order to increase the expected response rate, judgmental sampling was used.

A postal questionnaire and a reference letter from CAITA and CPC experts were sent directly to named individuals in the selected organisations. The respondents were all at management level and involved in investment decision-making processes. The unit of analysis here is a single strategic investment decision, since complexity and uncertainty are related to the decision issue rather than the organisation itself (Hickson et al., 1986). Respondents were asked to evaluate propositions based on a strategic investment project, developed and implemented in the last five years, of which they had direct experience.

Strategic investment decisions are defined as investment decisions with major long-term implications for firms, including decisions about new products, markets, technologies and capacity; vertical integration and acquisitions; and major investments in marketing, research or personnel. These decisions are strategic in the sense that they help significantly to shape a firm's long-term future. The major concern is with the formulation, evaluation and the outcomes of these strategic investment decisions. 270 organisations were selected and 94 responded. Of these, 80 responses were valid for further analysis. The data were analysed using the SPSS software package. Descriptive statistical methods such as means and standard deviations, as well as multivariate analysis such as factor analysis and multiple regression analysis were employed. Chapter 4 discusses more fully the research scope and research methodology for the current study.

1.5 Contribution of the Study

The identification of the impact on SIDs of their IT content is an important contribution of this study. Managers should be aware that the features of an investment project may vary according to IT intensity. The problematical nature of strategic IT suggests the need to amend the management process of the investment project. The effectiveness model attempts to explain the relationships which influence the effectiveness of decisions. Indeed, outcomes are what managers are mainly concerned with. With this effectiveness model, managers can realise the critical factors which impact on decision outcomes. Actions can then be taken to improve the outcome.

Compared with other investment projects, management know much less about IT investment projects. Investigation of the impact of IT intensity on decision making will extend management's understanding of the nature of SIDs and SITIDs. The study adopts a survey approach to the collection of empirical data about the strategic investment decision-making process. The research findings will not only broaden our understanding of the practical conduct of investment decisions, but will also help to bridge the gap between strategic investment decision theory, strategic IT investment decision theory, and real-world practice.

1.6 Outline of the Thesis

The thesis consists of seven chapters. Chapter 1 presents an overview of the main research problem. The motivation and purpose of the research are introduced. The theoretical rationale of the research is outlined. The method, research scope, and significance of the research are discussed.

Chapter 2 reviews the theoretical background of strategic investment decisions and strategic IT investment decisions. An analytical model of the literature review is proposed, and the analysis of SITIDs is seen to include theories from organisational decision-making, financial management, and information management. These parent disciplines provide a valuable background for this study.

Chapter 3 focuses on other parts of the model with the aim of constructing a theoretical framework for the research. The rationale and assumptions about linking IT intensity and effectiveness are discussed. The study employs concepts from the contextualism school which integrate process, content, and context in order to study investment decisions. The nature of the proposed theory and the hypothesised relationships are derived from the relevant literature.

Chapter 4 is a research design chapter which describes the plan, structure and strategy of investigation conceived so as to obtain answers to the key research questions. This chapter first discusses the selection of a suitable paradigm to guide the current study. Following this, there is a discussion of the sources of data and the sampling design, the procedure of instrument design and the operationalisation of research variables, the administration of the instrument, the limitations of the research method, a scheme for data analysis, statistical analytical techniques, and ethical issues. The questionnaire used is presented in the Appendix 1.

Chapter 5 focuses mainly on exploring relationships and testing the hypotheses of the current study. The nature of the data is first explored and a correlation test is employed to explore the distinguishing variables of SIDs in terms of IT intensity. Then, the theoretical model proposed in Chapter 3 is empirically tested by multi-variate regression analysis. By extending the findings of the previous two sections, the critical factors which impact on the effectiveness of SIDs are identified. This chapter reports the data analysis and discusses the main findings, and a brief summary of this chapter and the key research questions is also presented.

Chapter 6 proposes a protocol for the management and evaluation of SIDs and SITIDs. It focuses on two issues: the derivation and the integration of the rules of the protocol. The protocol for SIDs is derived by mapping the findings from a quantitative survey to the literature in Chapters 2 and 3. The protocol is also for SITIDs in particular because those distinguishing factors explored are examined thoroughly to ascertain their suitability for SITIDs. Then, the effort is made to integrate these rules to form a model for strategic evaluation. This model aims to provide a holistic picture of the management of investment projects. From the evaluation perspective, the study suggests the integration of scenario analysis, balanced scorecard and analytical hierarchy process (AHP) along with cost-benefit analysis or gap analysis. An example of this integration is presented in this chapter under multiple involvement, multiple objectives, multiple criteria, and multiple alternatives conditions. The operation of AHP is presented in the Appendix 2.

Chapter 7 is the conclusion, presenting a brief summary of the research. The results of research questions, and the contributions and managerial implications of the research findings are discussed. A critique of the work conducted and suggestions for further research are also provided.

Chapter 2. Theoretical Foundations of SIDs and SITIDs

2.1 Introduction

This chapter presents a review of the literature dealing with the theoretical foundations of SIDs and SITIDs. The purpose of this chapter is to bridge the gap between previous research and the present study. Relevant literature is selected and organised in order to extract the critical information which is of significance for the present research. As suggested by Perry (1995), a 'mind map' can help researchers to map research problems to their immediate and parent disciplines. Following this suggestion, an analytical model of the literature review is shown in Figure 2.1.

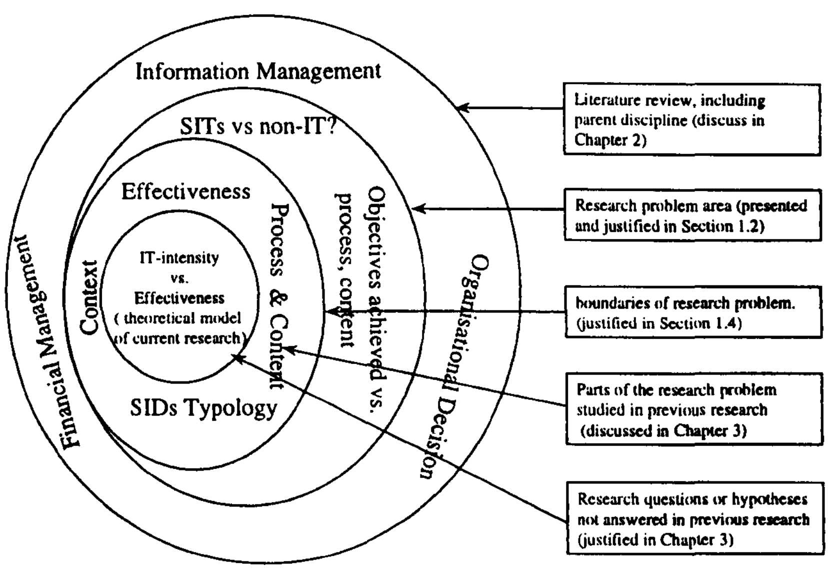

Figure 2.1 An Analytical Model of the Literature Review

Because of the need for a multidisciplinary focus, the analysis of SIDs and SITIDs should include theories from organisational decision-making, financial management, and information management. These parent disciplines provide different perspectives for the study of investment projects. Organisational decision theories support the definition, nature and process of decision-making. A review of organisational decision-making theories will thus provide a background against which the present study can consider the problem of investment decisions more thoroughly.

As strategic decisions become the major investment decisions in corporations, financial theories help to understand the financial evaluation process for SIDs and SITIDs. Capital investment appraisal techniques and the impact of uncertainties on investment decisions are reviewed below. The limits of the use of capital investment appraisal techniques, and criticisms of those techniques are also discussed.

From the information management perspective, SITIDs belong to the control dimension of information management. An IT investment project has its own characteristics which differ from those of other investment projects. The information management perspective provides a detailed examination of the nature and introduction of IT, and the evaluation of IT, which can contribute to the analysis of SITIDs. These parent disciplines provide valuable background knowledge for this study. Chapter 2 focuses on these parent disciplines. Chapter 3 focuses on other parts of the model with the aim of constructing a theoretical framework for the research.

2.2 Organisational Decision-making theories

Decision-making is one of the most important activities for managers in organisations, and the study of organisational decision-making has a long history. Butler et al. (1993) indicate that interest in studying the processes of organisational decision-making can be seen to have originated from Barnard's book, *The Functions of the Executive*, published in 1938. However, until the 1950s the idea of decision-making remained the received doctrine (March,1988). Simon (1947) in his book, *Administrative Behavior*, outlined a more explicit theory of decision-making. Mintzberg (1976: 246) notes that:

> A decision can be defined as a specific commitment to action and a decision process as a set of actions and dynamic factors that begins with the identification of a stimulus for action and ends with the specific commitment to action.

To make a decision is not an easy activity because the decision-making process involves complex behaviour in the organisational context. Clemen (1996) indicates that the problems of decision-making arise from its inherent complexity, its inherent uncertainty, multiple objectives, and multiple involvement. This also leads to difficulties in studying organisational decision-making behaviour. Fortunately, many researchers (e.g. Eisenhardt and Zbaracki, 1992; Butler et al., 1993) have suggested valuable paradigms for the study of the organisational models of decision-making, including the rational model, the bounded rational model, the politics and power model, and the garbage can model. These models provide a clearer map for the study of organisational decision-making. A review of these models is, therefore, essential for the study of SITIDs.

2.2.1 Models of Decision-Making

2.2.1.1 The Rational Model

The rational model requires decision-makers to search for all possible options, to compare and evaluate them and then choose the optimal one. For example, Simon (1960) proposes a model for describing the decision-making process in terms of intelligence, design and choice. The intelligence phase aims to search the environment for conditions which call for decisions. Data inputs are obtained, processed and examined for clues that may identify problems or opportunities. The design phase aims to invent, develop and analyse possible courses of action. This involves processes to understand the problem, generate solutions, and test solutions for feasibility. The choice phase aims to select an alternative course of action from those available. A choice is made and implemented. Mintzberg et al. (1976) identify the stages of decision-making as recognition, diagnosis, search, design, evaluation, choice, authorisation and implementation. No matter how many particular stages are identified, the basic assumption of the ration model is action as rational choice.

2.2.1.2 The Bounded-Rational Model

The basic assumption of the rationed model, action as rational choice, ignores the cognitive limitations of decision-makers (Eisenhardt and Zbaracki, 1992). Some writers (e.g. Simon, 1960; Cyert and March, 1963) propose an alternative model termed the bounded-rational model. The essential point about this model is that it emphasises the need for managers to make decisions on the basis of incomplete information, under time pressures, with disagreements over goals, and then an optimal solution cannot always be achieved with these constraints (Butler et al. 1993). Butler et al. further summarise a number of features which are contrary to the rational model, including:

Problem search rather than complete alertness occurs. This means that managers respond to problems rather than going out of their way to find them.

- Cognitive limits exist in this process, meaning that the human mind is limited in its comprehension of problems, thereby making it impossible to achieve the synoptic ideal of mapping out the complete decision tree showing the paths to all possible solutions.
- Time pressure frequently cuts short complete research. A decision has to be made even with incomplete information.
- Disjointedness and incrementalism often occur (Lindblom, 1959), meaning that problems get attended to sporadically and solutions are implemented only partially, instead of decisions occurring through the smooth continuous process of the rational model.
- Intuition and judgement rather than computation may have to be the basis for making a decision.
- Satisfying, rather than optimal, solutions are arrived at. The word satisfying is suggested to describe the idea that managers will accept satisfactory solutions rather than continuously searching for the ideal one (Simon, 1957).

2.2.1.3 The Political Model

The bounded model incorporates the economic assumption that organisations possess a single, superordinate goal. However, decisions could be the result of a process in which decision-makers have different goals, where conflict is involved, and where there is great influence by the preferences of the most powerful person. The roots of the political perspective on strategic decision-making lie in the political science literature of the1950s (Eisenhardt and Zbaracki, 1992). The political model sees the processes of organisational decision-making as involving shifting coalitions of interests and the temporary alliance of decision-makers who can, for the purpose of a decision, come together and sufficiently submerge their differences to make a decision (Cyert and March, 1993). Butler et al. (1993) summarise several kinds of processes related to the political model including:

- *Bargaining*: whereby individuals compete for resources and try to get the best deal for themselves.
- *Guile*: which can range from economising with the truth (not disclosing all information relevant to an issue) to lying. Information can be selectively disclosed or distorted (Pettigrew, 1973; Hickson et al. 1986).
- *Coalition building*: in order to get support for an issue, people combine with others in trade-offs. Of great help here is the ability to build networks of trusted individuals who can be called upon when appropriate.
- *Biasing*: the ability to make the rules of the game by which decisions are assessed can give particular interests tremendous power.

2.2.1.4 The Garbage Can Model

Cohen et al. (1972) propose a garbage can model which identifies four streams and a set of garbage processing assumptions. The four streams are (a) a stream of choices, (2) a stream of problems, (3) a rate of flow of solutions, and (4) a stream of energy from participants. Three key behavioral assumptions are specified. The first is an assumption about the additivity of energy requirements; the second specifies the way in which energy is allocated to choices, and the third describes the way in which problems are attached to choices. An important characteristic of the garbage can model is that the decision process is not a sequence of steps. Four independent streams of activity create patterns in organisational decision-making. Problems, solutions, participants and choices flow through the organisation, with the organisation acting as a garbage can in which these streams are stirred, and problems, solutions, participants and choices lead to the possibility of connecting. In this way problems may get solved.

These four models represent the complexity of the study of strategic investment decisions. However, making a decision may not just simply follow any one of these particular models. It may be that these models describe organisational decision-making behaviour from different viewpoints. For investment decisions, the decision-making process involves multi-objectives, the rational analysis to choose, incomplete information, multiple involvement, conflict and negotiation. The current study will not focus on any one model but will examine the strategic (IT) investment decision-making process as one which involves rational analysis, timing pressure, uncertainty of information, multiple interested units, conflict and negotiation.

2.2.2 Strategic Decision-Making

Decisions in organisations range on a continuum from operational and tactical to strategic decisions. There is, of course, no sharp division between different categories of decisions, but strategic decisions can perhaps be characterised by the extent to which they have enduring effects, are broad in scope, and are difficult to reverse (Dyson, 1990). Quinn (1995: 5)defines strategic decisions as follow:

> Strategic decisions are those that determine the overall direction of an enterprise and its ultimate viability in light of the predictable, the unpredictable and the unknowable changes that may occur in its most important surrounding environment.

Based on this definition and these characteristics, a strategic decision can be seen to play a bigger rather than a smaller part in shaping what happens for a long time afterwards, and in short, it is relatively unusual, substantial and all-pervading (Hickson et al., 1986). This may also imply that the decisions are innovative (Pettigrew, 1973) rather than routine ones.

From a strategic decision-making prospective, Mintzberg (1976) notes that strategic decision processes are 'unstructured', and that strategic simply means important in terms of the actions taken, the resources committed, or the precedents set. Further, Mintzberg (1976) states that a strategic decision process is characterized by novelty, complexity, and openendedness; by the fact that an organization usually begins with little understanding of the decision situation or the route to its solution; and only a vague idea of what that solution might be and how it will be evaluated when it is developed. This is not the decision making under uncertainty of the textbook, where alternatives are given even if their consequences are not, but decision making under ambiguity, where almost nothing is given or easily determined.

The study of strategic decisions is a major issue in organisational decision-making. The decision process is still the focus of attention, but from different perspectives. Mintzberg et al. (1976), Eisenhardt and Zbaracki (1992) and Fahey (1981) focus on the strategic decision-making process and the decision-making models which have been discussed in the previous section. These researchers show that the bounded-rational model and the political model need to be linked in the discussion of strategic decisions. The concept of the garbage can model may be involved but only implicitly. Priem et al. (1995) and Rajagopalan et al. (1993) identify the factors and environmental dynamics which affect decision-making. Sabherwal and King (1995) and Cray et al. (1988) aim to distinguish different types of strategic decision-making process. Hitt and Tyler (1991) and Eisenhardt (1989) focus on the characteristics and speed of decision-making. Table 2.1 summarises the main purposes, methodologies and findings to emerge from previous research.

The previous studies which clearly depict the nature, characteristics and processes of strategic decisions provide a fundamental background for the study of SIDs and SITIDs. These studies indicate several critical factors which impact on SIDs and SITIDs, e.g. environmental factors, organisational factors, process characteristics (duration, information flow, formal analysis, leadership style, etc.), decision-specific characteristics, and outcomes. This valuable information should therefore be included in the present study.

Table 2.1: Studies of Strategic Decisions

Sources	Major Purpose	Method, Size and Characteristics of Samples	Key Determinants of Strategic Decision Process	Major Findings
Priem et al. (1995)	To examine the relationship between rationality in strategic decision process, and how firm's performance may be moderated by environmental dynamics.	Multiple respondent, questionnaire survey 101 manufacturing firms	Rationality, environmental dynamism, performance measures	A positive rationality- performance relationship for firms facing dynamic environments, but no relationship between rationality and performance for firms facing stable environment.
Hitt and Tyler (1991)	To examine and hypothesise the effects of factors associated with models of strategic acquisition decisions.	Questionnaire 65 firms	Organisational, environmental, decision process, characteristics.	Strategic decision models were found to vary by industry and executive characteristics.
Sabherwal and King (1995)	To generate an empirical taxonomy of making strategic IS decisions	Questionnaire 447 IS executives selected 85 responded	The topic of decision making, context of decision, the attributes of the decision-making process	5 decision-making processes, namely planed, provincial, incremental, fluid and political, seem quite distinct.
Fahey (1981)	Attempts to bridge the divide between rational/ analytical and behavioural/ political concepts of strategic decision-making in order to trace strategic energy decision through the organisational structure.	Interviews with a structured research instrument in 11 large multi-divisional firms.	Decision types, organisational structure, and decision process	The findings of this study particularly emphasise that the behavioural and political processes can critically impact any stage of decision making system or phase of a specific decision process.
Rajagopalan et al. (1993)	To identify the relationship between affecting factors of strategic decision-making process	Literature review	Environmental, organisational, decision-specific characteristics process outcomes economic outcomes	Useful implications for theory building, research methods, and managerial practice are identified and several directions for future research are presented.
Langley (1990)	To examine how formal analysis is used in strategic decision-making.	In-depth case study in 3 organisations	Formal analysis, structural types, leadership style	Formal analysis is used for a variety of purposes in an organisation, and the way in which it is used varies from organisation to organisation.
Eisenhardt and Zbaracki (1992)	Reviews the strategic decision-making literature by focusing on dominant paradigms, and examines emergent debates within each paradigm.	Literature review	3 dominant paradigms: rationality and bounded rationality, politics and power, and garbage can.	Strategic decision makers are boundedly rational, believing that power wins battles of choice, and that chance matters. These paradigms rest on unrealistic assumptions and tired controversies which are no longer relevant.
Cray et al. (1988)	Uses a large number of cases to examine strategic decision-making process.	136 cases of SIDs in 30 organisations	Scrutiny Interaction Flow Duration	Three distinct types of decision-making process are found, including sporadic, fluid and constricted.
Mintzberg et al. (1976)	Uses empirical research to suggest a basic framework that describes unstructured, strategic decision processes.	25 strategic decision processes (6 in manufacturing firms, 9 in service firms, 5 in quasi-government institutions, and 5 in government agencies) interviews	Duration, type of organisation, type of decision process, number of steps reported	3 central phases: identification, development, selection. 3 sets of supporting routines: decision control, decision communication, political routines. 6 sets of dynamic factors: interruptions, scheduling delays, feedback delays, time delays and speedups, comprehension cycles, allure recycles
Eisenhardt (1989)	To explore how executive teams actually make fast strategic decisions and link decision speed to performance.	Interviews, questionnaires, and secondary source, 8 microcomputer firms selected	Duration, decision performance (subjective)	Fast decision-makers use more, not less, information than do slow decision-makers. They also develop more, not fewer, alternatives. Centralised decision-making is not necessarily fast but a layered advice process.

2.2.3 Strategic Investment Decision-Making

This section focuses on strategic investment decisions (SIDs), which may be regarded as a subset of SDs. However, Dyson (1990) indicates that SDs often involve major capital investments. That is, every strategic decision involves the commitment of capital, at least implicitly (Barwise et al., 1986). Therefore, strategic investment decisions inherit the characteristics of strategic decisions, but also have there own characteristics. They can be defined as follows:

> Strategic investment decisions have major long-term implications for the firm and include decisions about new products, markets, technologies, and capacity; vertical integration and acquisitions; and major investments in marketing, research or personnel These decisions are strategic in the sense that they significantly help shape the firm's long-term future (Barwise et al., 1987: 1).

However, to identify an investment project and define it as a strategic investment may not be easy. In the most recent writings on business strategy the link between strategy and a specific decision to invest is unclear (Barwise et al., 1987). It is assumed that investment projects can somehow be subordinated to prior definitions of strategy, i.e. that they should flow from a sound strategic plan or even that they are seen as a mere problem of implementation. Clearly, strategic investment decision-making is an important and interesting unit of strategic analysis (Barwise et al., 1986). It is necessary to identify and access the strategic process before the decisions are taken and before the outcome is known. Barwise et al. found that they could apply the label 'strategic' only to those decisions which are described as such, and perceived as being of key importance by the managers involved at the time.

For an investment, the outcome of the investment project is critical. The outcome may be measured according to organisational performance or pure decision outcome. For organisational performance, many researchers (e.g., Woolridge and Snow, 1990) have investigated empirically the relationship between strategic investment announcements and stock price. The results show that when corporations announce strategic investment plans, the stock market usually reacts positively. They focus on the relationship between announcements and decisions, not on the outcomes of these decisions. Although organisations announce their strategic investment plans, and the stock market usually reacts positively, the actual outcomes are unknown. The pure outcome of the investment project can be measured by items such as project success, correct choice, unexpected negative outcomes, overall learning, and satisfactory process (Butler et al., 1993). Butler et al. further define effectiveness in terms of objectives-attainment and learning.

Previous research (e.g. King, 1975; Mintzberg et al., 1976) suggests that decision-making in large organisations is a diffuse process involving many players at multiple levels, and because of the strategic nature of the investment project, project evaluation becomes problematic so that it is not easy to measure the costs and benefits. Researchers (e.g. Papadakis, 1995; Grundy and Johnson, 1993; Carr et al, 1993) focus on the link between strategic and formal appraisal. However, the use of financial control and capital budgeting techniques in handling strategic choice is still critical. Table 2.2 summarises the purposes, methods and findings of several studies of strategic investment decisions. Taking the previous discussion further, research has examined the organisational context characteristics of strategic investment decisions (e.g. Keats, 1991 and Butler et al., 1991).

Table 2.2: Studies of the Strategic Investment Decision Process

Sources	Major Purpose	Method, Size and Characteristics of Samples	Major Factors to be Examined	Major Findings
Carr et al. (1993)	A comparison of UK and German practices in the motor components industry.	Case studies 49 cases in 42 vehicle component companies, split equally between the UK and Germany	Financial control styles, capital budgeting procedures, and strategic investment management	In the strategic investment decision-making process, UK and German companies presented many differences in terms of financial control style, capital budgeting procedures, and strategic investment management.
Keats (1991)	Develops empirical models of the specific structures of decision heuristics in the context of a strategic reinvestment decision.	65 MBA students	Historical, future-oriented, environmental and organisational variables	86 per cent of respondents demonstrated consistent judgement models. The results provide clear empirical evidence of the restricted range of variables used in the decision process.
Butler et al. (1991)	An investigation into the process of strategic investment decision-making.	Semistructured interviews 3 Cases	Organisation context, decision characteristics, uncertainty, investment decision behaviour factors	Inspirational decision mode would be seen as a result of attempting to cope with uncertainties and disagreements.
Grundy and Johnson (1993)	Linking strategic and financial appraisal for major investment decisions in terms of managers' perspectives	Preinterviews (workshop) 8 managers from four organizations	Value factors, uncertainty, interdependence evaluation, controls, judgement, feeling	Considerable diversity and complexity existed within managers' perspectives are confirmed.
Papadakis (1995)	To investigate linkage between formal planning systems and characteristics of the strategic investment decision-making process.	Interviews, questionnaire, secondary sources. 70 SIDs drawn from 38 industrial enterprises operating in Greece	Formal planning dimensions: planning horizon, depth of analysis, formalisation. SID processes: rationality, group behaviour, centralisation, formalisation, impedance, duration	Strong associations are found between certain attributes of the system employed in forward planning and the decision-making process used in handling strategic choice.
Woolridge and Snow (1990)	To examine the stock market□ reaction to public announcements of corporate strategic investment decisions.	767 strategic investment decisions announced by 248 companies in 102 industries from the Wall Street Journal	Three different types of strategic investment decisions and stock market□ reaction.	The stock market does not penalise management for making well-conceived, long-run strategic decisions.

These previous studies, which clearly depict the features of strategic investment decisions, provide a useful basis for the study of SIDs and SITIDs from an investment perspective. These studies indicate the major issues which must be taken into account in the study of SIDs and SITIDs, such as capital budgeting techniques, uncertainties and disagreements, organisational context and decision characteristics. This valuable information will also be incorporated in the study.

2.2.4 Strategic IT Investment Decision-Making

Inheriting the characteristics from ODs, SDs, SIDs, and strategic IT, the process of IT investment and the relationship of IT and strategy are major issues for researchers (e.g. Sheppard, 1990; Gatian et al., 1995), and many of them (e.g., Powell, 1993) confirm the difficulty of IT investment decisions. Willcocks (1992a) examines emerging problems of IT investments, including inappropriate measures, budgeting practice concealing full costs, understating human and organisational cost, understating knock-on costs, overstating costs, neglecting intangible benefits, not fully investigating risk, failure to devote evaluation time and effort to a major capital asset, and failure to take into account time-scale of likely benefits. The measurement problems are therefore extremely critical for SITIDs, and that is the reason why so many researchers (e.g. Barua et al., 1995; Lederer and Mirani, 1995; Mahmood, 1994; Kettinger et al., 1995; Mahmond and Mann, 1993; Ballantine et al., 1994) focus on the measurement or economic performance of SITIDs. A summary of the studies of strategic IT investment is presented in Table 2.3.

Table 2.3: Studies of Strategic IT Investment Decisions

Sources	Major Purpose	Method, Size and Characteristics of Samples	Factors Examined	Major Findings
Sheppard (1990)	Identify the process of IT investment and the relationship of IT and strategies.	Interview 9 cases with key managers	Size of expenditure on IT. Stimulus, expected benefits of IT and appraisal methods. Strategic management of IT investments.	Decisions are based on more informal processes and there exist differing views on the relationship between IT and corporate strategies.
Barua et al. (1991)	To develop an analytical model of the strategic impacts of IT investment.	Modelling/ none	Demand functions, benefits and costs components	A firm may have to invest in IT regardless of its underlying cost structure, in response to the competitor's investment decision.
Kettinger et al. (1995)	To examine the pay-off of strategic systems.	Case survey 60 well-documented cases form published materials	Financial performance and market share	Factors that enhance sustainability and a diagnostic tool for ranking systems are provided
Barua et al. (1995)	Develop a methodology that attempts to circumvent some of the measurement problems.	Database 60 SBUs in U.S. and 20 corporations in Western Europe All in manufacturing sector	Intermediate level variables, final performance variables, economic input variables, industry-specific exogenous variables, macroeconomics exogenous variables	In empirical analysis, IT-related factors showed a significant positive effect on intermediate level variables.
Abdul-Gader et al. (1995)	To examine decision-makers' attitudes and internal beliefs, especially the construct of alienation, with regard to the broader context of IT investment decisions.	97 decision-makers in the US and Saudi Arabia	Buying intention purchasibility, perceived need, computer alienation, computer knowledge, computer experience, education, age, responsiveness to computer news, satisfaction	Decision maker's computer knowledge, experience, and education level are closely associated with alienated beliefs and attitudes toward IT.
Lederer and Mirani (1995)	To examine the anticipated benefits of proposed IS investment.	Questionnaire 178 cases	Improved information, strategic advantage, ROI, reduced technology cost, better applications development, reduced travel cost, reduced workforce costs, business redesign, adherence to government regulations	The 9 anticipated benefit themes can be useful to practitioners.

Table 2.3 Studies of Strategic IT Investment Decisions (Continued)

Sources	Major Purpose	Method, Size and Characteristics of Samples	Factors Examined	Major Findings
Mahmood and Mann (1993)	To examine the relationship between IT investment and organisational strategic and economic performance.	Mail surveys and telephone interviews and database 100 firms	IT investment measure, organisational strategic and economic measure	IT investment appears to be related to organisational strategic and economic performance.
Gatian et al. (1995)	To examine relations among the innovative climate of organisations and the SIS strategies implemented, the perceived success of investments and general end-user involvement.	Questionnaires 60 selected and 26 returned	Climate measurement, strategic thrust measurement, success measurements	Large, competitive firms do actively invest in SIS for the express purpose of improving their relative competitive position. CISs believe their investment has resulted in some form of competitive advantage.
Ballantine et al. (1994)	To examine the application of capital investment appraisal techniques during the feasibility/ evaluation stage of IS/IT project.	Questionnaires 300 UK companies selected, 98 responses	Financial criteria: cost benefit analysis, payback, ROI, IRR, NPV, ROM, productivity index	Financial criteria are still widely used by organisations. Organisations were inclined to use the simpler financial criteria rather than more sophisticated techniques, such as NPV, IRR and PI.
Mahmood (1994)	Relating IT investment to organisational strategic and economic performance through the use of DEA (data envelopment analysis).	DISCLOSURE database 81 firms in the database and organisational economic and strategic performance data are available.	8 IT investment measures were used as inputs and 10 organisational strategic and economic performance ratios were used as outputs for the DEA model.	A clear distinction exists between the efficient group and the inefficient group in terms of IT investment and organisational strategic and economic performance.

These previous studies reveal the problems for SITIDs, such as measurement, the identification of costs and benefits, the conduct of financial evaluation, strategic and economic performance, decision-makers' knowledge. These studies clearly depict the problematic nature of strategic IT investment decisions and provide a useful background for the examination of SIDs in terms of IT intensity.

2.3 Theories of Financial Management

In the previous section, the literature review focused on organisational decision theories. Traditionally, financial decisions are seen to consist of three interrelated areas: (1) money and capital markets decisions, which deal with the securities market and financial institutions; (2) investment decisions, which focus on the decisions of individuals and financial and other institutions as they choose securities for their investment profiles; and (3) financial management, which involves the actual management of non-financial firms (Brigham and Gapenski, 1994). Capital investment appraisal is defined as the financial evaluation of decisions involving capital investment. The essence of capital investment appraisal is to measure the worthiness of proposals to allocate a corporation's long-term funds by comparing the future benefits with the present cost (Dyson and Berry, 1990). Since the future is unknown, and no investment yields a perfectly certain income stream, uncertainty is involved in every capital investment decision.

2.3.1 Capital Investment Appraisal Theory

Dyson and Berry (1998) provide a detailed review of the techniques of capital investment appraisal. The discussion in this section is largely based on their work. The financial appraisal of capital investment usually involves the calculation of a summary measure of a stream of cash flows. Dyson and Berry indicate two of the problems associated with the development of such a measure: the fact that the cash flow occurs at different points in time, and the inherent uncertainty of future cash flows. The summary measures are based on discounting, truncation of the cash flow stream, and the simple response of ignoring the problem. The uncertainty problem is also considered later in this section. The main measures to be considered below are widely discussed in financial management textbooks, including the payback period, the accounting rate of return, the net present value, the profitability index, and the internal rate of return and the fixed interest equivalent.

2.3.1.1 Summary Measure and Decision Rules

Let ***C0, C1, Cj,...,Cn*** be the cash stream representing a capital project with ***n*** years of life, where ***Cj*** is the cash flow in year ***j***. It is assumed the ***Cj*** occurs at the end of year ***J***. ***C0***, or even the first few values of ***Cj***, will represent the cash outflow at the beginning of the project life and as such will be negative. Other ***Cj*** can also be negative, possibly representing some substitution of equipment or, if ***j=n*** , a lagged tax payment or some kind of cleaning up operation.

2.3.1.2 Payback Period

The payback period of a project is the number of years it takes before the cumulative forecast net cash flow equals the initial investment. A payback rule involves comparing the calculated payback period with some predetermined target period. A calculated figure less than the target one indicates that the project should be accepted. If a number of projects are being ranked, the most acceptable will be the one which has the shortest payback period.

Payback is an ad hoc rule. It does not use all the available information, as it ignores the cash flows outside the payback period. It also ignores the order in which cash flows come within the payback period as it does not consider the time value of money for cash flows within that period. It gives no indication of how to set the target payback period. The discounted payback rule uses discounted cash flows before the calculation of the payback period. It is a little better than the undiscounted payback, but does not yet answer the other two criticisms. Nevertheless the payback rule is in common use in combination with other summary measures. Its continued use in practice, despite its major faults, may perhaps be attributed to its being a rough screening device which gives some indication, at an early stage, of whether the project is likely to be acceptable.

2.3.1.3 Accounting Rate of Return

The accounting rate of return (ARR) is another non-discounting method of project appraisal and is based on accounting profit rather than cash flow. The ARR is essentially a ratio and can be computed in many ways differing only in the definitions of the accounting numbers involved. The numerator is the average profit of the project after depreciation and taxes, while the denominator is the average book value of the investment. A decision rule is based on some predetermined target value. A project should be accepted if its calculated ARR is greater than the target value. The summary measure has a number of faults: It uses accounting numbers instead of cash flows; it does not consider the time value of money; it deals in ratios and therefore says nothing about the size of the projects; it does not say how to set the target value. ARR is probably a worse rule than the payback period rule.

2.3.1.4 Net Present Value

The net present value (NPV) is a summary measure of project appraisal based on discounted cash flows. It incorporates the time value of money on discounted cash flows, and the time value of money using a discount factor which is related to the firm□ relevant interest rate in order to bring all future cash flows back to the present decision date. In the absence of interdependencies, a firm should accept all opportunities with a positive NPV and reject those with a negative NPV.

A positive NPV means that the project is yielding a higher return than can be obtained by simply lending at the rate of return ***r***. This interpretation suggests that ***r*** is a minimum acceptable rate of return. That rate of return is also referred to as the discount rate, the hurdle rate of the opportunity cost of capital. NPV is a measure whose use is increasing and is much favoured in financial textbooks. It is cash-flow based and takes all cash flows into account as well as the time value of money. Furthermore, with an appropriate discount rate, the NPV of a project is exactly the same as the increase in shareholder wealth.

A similar measure to NPV, which uses the same discount rate but assesses the value of project at its termination, is the net terminal value (NTV). This is the surplus available at the end of the project after repaying the investment and assuming that the money borrowed and surpluses invested during the life of the project were both made at an interest rate of ***r***. A decision rule to accept any project with a positive NTV would lead to the same decision as the NPV decision rule.

2.1.3.5 Profitability Index

The profitability index (PI), or the benefit/cost ratio as it is sometimes called, is the present value of the forecasted future cash flow divided by the initial investment. The profitability index decision rule is to accept all projects with an index greater than 1. The PI leads to exactly the same decision as the NPV because when PI>1, the present value is greater than the initial investment, so the NPV must be positive. However, the PI can be misleading when there is a need to choose between two mutually exclusive investments because the order of magnitude of the NPV can be very different. This problem can be dealt with by looking at the PI on the incremental investment. The PI very closely resembles the NPV and in some cases can even be the more useful rule. But for most purposes it is safer to work with the NPVs which add up, rather than with profitability indexes that do not.

2.3.1.6 Internal Rate of Return

The internal rate of return (IRR) of a project may be defined as the discount rate at which the present value of all future cash flows, both positive and negative, is equal to the investment cost of the project. Hence, it is the discount rate which makes NPV=0. This means finding the IRR of an investment project lasting n years. The decision rule for capital budgeting on the basis of the IRR is to accept an investment project if the opportunity cost of capital is less than the IRR. The IRR is a profitability measure which depends solely on the amount and timing of the project cash flows. It can be interpreted as the highest rate of interest at which the company could afford to finance the project.

There are some problems with the use of IRR. If there is more than one change in the sign of cash flow C_j, $j=0,\ldots,n$, there can be different rates of return.

There can be as many changes in this rate as there are changes in the sign of *Cj*. There are also cases in which no IRR exists.

2.3.1.7 Fixed Interest Equivalent Rate of Return

The fixed interest equivalent (FIE) rate of return is an alternative interest rate measure which can be obtained, using these assumptions, by computing the NTV of the project and calculating the interest rate required to yield a similar terminal value if the finds were invested in a fixed interest investment. Weston and Brigham (1979) state that if the pattern of investment rates is known, then one should calculate the NTV and IRR (obtained equating NTV to zero) because they are more accurate measures of project profitability than the NPV and IRR.

There are many arguments about the use of capital investment theories for IT evaluation. Galliers (1995) notes that there is more recent evidence to suggest that those firms that do attempt to evaluate their IT investments tend to use simpler financial criteria rather than the more sophisticate techniques such as NPV, IRR or PI (Ballantine et al. 1994). These accounting techniques have been called into question as being inappropriate for IT investment assessment given the unforeseen nature of the business benefits often involved (Willcocks, 1992).

Clemons (1991) finds that although an IT project may have been studied extensively, no formal financial analysis was used to justify proceeding. The system was described as a strategic necessity, and presented without detailed financial analysis, decision trees, pay back period, or sensitivity analysis. Strategic necessity is a compelling argument. When the environmental changes are rapid enough to be considered discontinuous, rapid and flexible organisational response becomes essential. Even when the value of an investment to obtain this flexibility is difficult to express quantitatively, it can be explained in terms of buying an option that may be necessary to ensure the firm's survival. Clemons and Weber (1990) note that the concepts, competitive advantage and strategic necessity, both confound traditional financial analysis.

2.3.2 Risk in Capital Investment Appraisal

In orthodox financial theory four specific approaches can be identified to the handling of uncertainty in capital investment appraisal: (1) the risk analysis approach, (2) the risk preference approach, (3) the beta analysis approach, and (4) option theory. The term 'risk analysis' can be defined as an approach which advocates formal measurement of investment risk before any risk adjustment is made, and the analysis itself does not incorporate the decision-maker's risk preference (Ho and Pike, 1992). Broadly, this should include many probabilistic risk approaches such as sensitivity analysis and the decision tree. Sensitivity analysis does not aim to quantify risk, but rather to identify factors that are potentially risk-sensitive (Pike and Dobbins, 1986). Sensitivity analysis merely provides the decision-makers with answers to a whole range of 'what if' questions.

The best known risk analysis is the Hertz-type risk simulation approach proposed by Hertz (1964). Hertz used the idea of modelling uncertainty by obtaining a forecast of a particular variable's probability density functions. The importance of Hertz's work is that the totality of uncertainty remains at the front of his approach rather than having a single shot view of the future (Dyson 1990).

The second approach aims to measure personal attitudes towards risk through the use of utility functions and the expected utility rule. Utility theory was first formulated by Von Neumann and Morgenstern (1947), who showed that if a decision-maker accepts a certain set of assumptions concerning 'rational choice', then the decision-maker should compare alternatives by use of an expected utility calculation. The approach of utility theory is that a numerical index can be derived to describe an individual's personal preference in risky situations, and that this numerical index, known as a utility function, can be used explicitly as a guide to consistent decision-making.

Third, these is the beta analysis approach, which aims to replace the measure of risk by market sensitivity (beta). The most significant difference between beta analysis and the previous two approaches is that the former is from the shareholders' viewpoint rather than from the management viewpoint. The Capital Asset Pricing Model (CAPM) proposed by Sharpe (1964) defines risk as the co-variability of the security's returns with the market's returns.

The fourth approach is the option theory. As Dixit and Pindyck (1995: 105) state:

> Opportunities are options-rights but not obligations to take some action in the future. Capital investments, then, are essentially about options. Over the past several years, economists including ourselves have explored that basic insight and found that thinking of investment as

options substantially changes the theory and practice of decision making about capital investment.

A company with an opportunity to invest is holding something like a financial call option. This means the company has the right but not the obligation to take real action at a future time of its own choosing. Based on this viewpoint, the problems of investment become a problem of evaluation of opportunities.

Besides the financial methods, O'Brien's (1994) empirical survey indicates that the most frequently mentioned individual approach used to handle risk. is scenario planning. Scenario means an imagined sequence of future events. The imagined sequence provides an alternative approach to access the uncertain future. Reibnitz (1987) illustrates the concept of scenario by a scenario funnel. The open end of a funnel represents the complexity and uncertainty of the future. Taking the present situation and setting up the time horizon, a scenario is a script-like characterisation of a possible future presented in considerable detail, with special emphasis on causal connections, internal consistency and concreteness (Schoemaker, 1991). The scenario method also provides for abruptly occurring disruptive events to be taken into account. The effects of such disruptive events are systematically analysed, and then preventive measures and responses are worked out.

Schoemaker (1993) and Wack (1985) indicate that the scenario method caters to people's preference for certainty by primarily specifying uncertainty across rather than within scenarios. This treatment of uncertainty is quite different from more traditional methods which usually present one model, with uncertainty nested within it. Instead, scenarios present several models which bound the uncertainty range but do not give it probabilistic prominence.

Accordingly, the application of scenario analysis is very flexible, from intuitive logics to the use of statistical techniques such as probabilities distribution and simulation. The wide acceptance of scenario analysis has also captured the attention of academics and scenario researchers, who have proposed many theories to improve the methodology. For example, O'Brien, Dyson and Morris (1992) use probability theory to examine the factors in scenarios; Schoemaker (1991) suggests the use of a key-success-factor matrix at the strategic level and Monte Carlo simulation at the operational level.

2.4 Information Management Theories

Information management comprises the planning, organisation and control of information resources, and effective information management requires planning methods, control procedures and organisational arrangements to be congruent with each other (Earl, 1989). SITIDs belong to the control dimension of information management, which concerns the amount spent on IT, the evaluation of IT proposals and the management of IT projects. There is a voluminous of literature relevant to the evaluation of IT investment.

The discussion in this section selects literature which is most concerned with the following issues: introducing IT, the scope of evaluation, perspectives of evaluation and methods of evaluation. Introducing IT concerns the nature of IT, its purpose and problems while organisations try to use IT strategically. The scope of evaluation examines the different contexts involved in evaluation activities. The perspectives of evaluation present different viewpoints of the evaluation process. Finally, various methods of evaluation are discussed.

2.4.1 Introducing Strategic IT

Since the mid-1980s the understanding of the nature of IT has changed for two reasons. First, there have been rapid advances in the capabilities of IT (technology push). Second, organisations in both the public and private sectors have been subject to severe competitive pressures and turbulence in their spheres of operations (competitive pull) (Farbey, et al., 1993). As a result of technology push and competitive pull, IT now does more than simply automate support processes. When applied in this way, IT achieves wider benefits than cost and manpower reductions. These benefits sometimes amount to competitive advantage. Porter and Millar (1985) advocate the use of information to increase the competitive advantage of an organisation. The case studies describing such achievements are well known: American Airlines, Baxter Hospital Supplies, McKesson, Otis Elevators and many others. But, as the strategic importance of IT has increased, the decisions about where and when to allocate resources to IT programmes have become riskier and more difficult (Clemons and Weber, 1990). The fundamental questions are: What is a strategic IT investment? and why do organisations introduce IT? Unlike strategic decisions or strategic investment decisions, there is no single, universally accepted definition of SITIDs.

Earl (1988b) generalises that IT can be applied strategically in at least four different ways: to gain competitive advantage, to improve productivity and performance, to facilitate new ways of managing and organising, and to develop new businesses. Obviously, introducing IT needs to link IT use and organisational strategy. However, many researchers (e.g. Powell, 1993) reveal the problems with the processes involved in strategic IT investment. Powell (1993) argues that often mere lip service is paid to the strategic nature of IT, and many IT investments labelled strategic appear to be operational in nature. The vicious circle of IT investment proposed by Powell shows that organisations appear to be prone to follow the inner spiral due to circumvention of process.

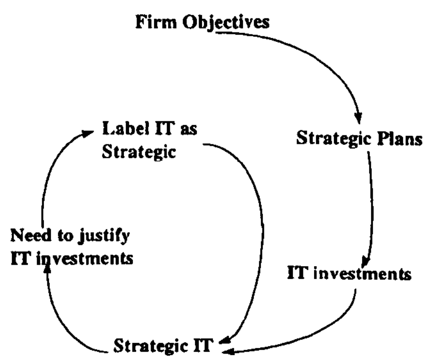

Figure 2.2: The Vicious Circle of IT Investment (Source: Powell, 1993)

The result of this vicious spiral will lead to sub-optimal decisions being taken and this may be difficult to break out of. The problem of introducing IT makes strategic IT investment very difficult, and the strategic purpose is not easy to achieve. Moreover, research (e.g. Galliers et al., 1996) shows that IT alone will not provide sustainable competitive advantage, and outsourcing the IT department is not the only answer to improving the performance of organisational IS services.

Clemons (1991) has also found, in studies of numerous industries in the elsewhere, that sustainable competitive advantage is quite rare and difficult to achieve. These problems blur the nature of SITIDs. To do so, Galliers (1995) suggests putting IT evaluation into the context of business systems strategy, as shown in Figure 2.3

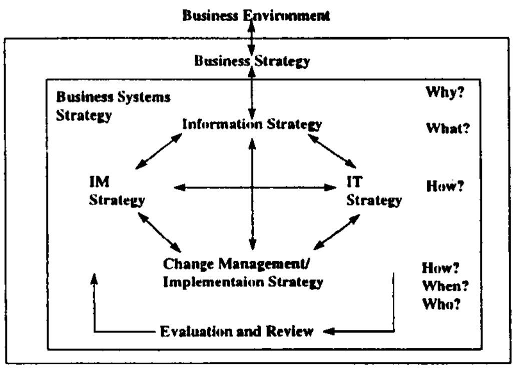

Figure 2.3: Business System Strategy Formulation, Implementation and Review (Source: Galliers, 1995)

In the context of IT investment, Galliers (1995) defines business systems strategy as a corporate management responsibility which is concerned with integrating information system considerations into the business and strategy formulation process, and with providing a direct link between IT acquisition decisions and the applications development process. Galliers suggests the vital importance of the following questions:

- Why is it that the business strategy is appropriate, given our current circumstances and the nature of the business environment?
- What information is necessary to question the assumptions on which our business strategy is based? What information is necessary to enable key business processes and decision to be undertaken?

- How might be utilised by IT to provide this information and improve the efficacy of our business processes? And how might IS be organised our services to enable the business systems strategy to be carried out efficaciously?
- When should IT projects be undertaken? In what order? Within what time-scale?
- Who should be involved? Who should be responsible? What skills are required or need to be developed?

The present study provides another viewpoint which sees strategic IT investment projects as part of corporate strategic investment projects. The introduction of IT is based on the purpose of the strategic investment project. Moreover, strategic investment projects may have different degrees of IT intensity. Accordingly, a so-called strategic IT investment decision is a strategic investment decision which has a high level of IT intensity.

2.4.2 The Scope of the Evaluation of SITIDs

The evaluation of investments in information technology is quite a difficult task (Powell, 1993; Apostolopoulos and Pramataris, 1997), especially for a strategic purpose. Developing a strategic application is fundamentally different from the investment undertaken to automate the back office to reduce expenses or increase capacity (Clemons, 1991). In the previous section, capital investment appraisal techniques were discussed. However, capital investment appraisal only focuses on quantitative values and therefore ignores some values which cannot be quantified. Willcocks (1994: 19)describes evaluation as:

From a management perspective evaluation is most commonly taken to be about establishing, by quantitative and/or qualitative means, the worth of IS to the organisation. Evaluation brings into play notions of cost, benefit, risk and value. It also implies organisational processes by which these are assessed, whether formally or informally. A method of evaluation needs to be reliable, that is consistent in its measurement over time, able to discriminate between good and indifferent investments, able to measure what it purports to measure, and be administratively/ organisationally feasible in its application.

Willcocks' viewpoint broadens the scope of evaluation so that the evaluation approaches may include the capital appraisal method and the other managerial methods. Farbey et al. (1993) indicate that the evaluation problem of IT is really one of alignment, and organisations that are aware of IT's new role have usually made efforts to incorporate IT in their strategic thinking.

Recent trends suggest that evaluation is a social and political process, not simply an economic justification (Avison et al. 1995), and increasingly the concept of contextualism is employed in the discussion of IS/IT evaluation (e.g. Avison et al., 1995; Farbey et al. 1993). From this perspective, much of the literature has discussed IT evaluation from the perspective of contextualism. For example:

- Arribas (1996) indicates that evaluation must be a process which is immersed in the company, inextricably limited by content, context and by the process of organisational change which accompanies the development of the project.

- Symons (1991) indicates that the what of evaluation is encapsulated under the label content, much of the why of the evaluation is derived from investigation in inner and outer context, and the how of evaluation can be understood from an analysis of process.

- Farbey et al. (1993) propose the model of an onion with content-process-context rings of evaluation. In the onion, measurement is at the core of evaluation. The inner ring is content and concerns methodology, revolving around the core of evaluation. The middle ring is process which focuses on the act of evaluation; and the outer ring is the context, including the inner context and the outer context of organisation.

2.4.3 Perspectives on Evaluation

Not only does the scope of IT evaluation vary according to different viewpoints, but approaches to IT evaluation have been categorised in many different ways. Ginzberg and Zmud (1988) distinguish between assessment techniques and the assessment situation. They suggest three characteristics of assessment techniques: the domain, which may be either technical, operational or economic; the time-frame; and the nature of assessment, which may be either summative or formative. A summative evaluation aims to produce a conclusion, judgement or assessment, whereas a formative assessment involves diagnostics and provides information needed to make incremental improvement. Thus, a summative evaluation asks whether goals have been achieved, whereas a formative evaluation is concerned with the process by which objectives are sought, and seeks to improve this.

Ginzberg and Zmud (1988) also categorise the situations, in which assessments take place in terms of the role of IT, stakeholders and the purposes of the evaluation. Two purposes are identified: resource allocation and opportunity surfacing. Howgood and Land (1988) identify a number of purposes which evaluation may serve: as a control function; in planning, diagnostic functions: and the reduction of uncertainty. A contingency view of IS evaluation (Avison et al. 1995) leads to the conclusion that it is not an objective, rational activity, but one which depends upon the motives of the people undertaking the evaluation. The political and organisational issues are an essential consideration of any IS evaluation. Avision et al. (1995) categorise the major approaches to IS (equally applicable to IT) as follows: impact analysis, measure of effectiveness, economic approaches, user satisfaction, usage, utility, standards, usability, technical factors, process evaluation.

2.4.4 Methods of Evaluation

The previous section reviewed perspectives on evaluation. However, most of the approaches use single or multiple methods to accomplish their purpose. This section, therefore, focuses on the review of the most common methods of evaluation, but does not go into the detail of how each method is used. Each of these methods requires the collection of different data (or estimates) for measurement and different decision-making processes. Attention is drawn to the critical measurement information used in these methods e.g. cash flows, cost of capital of investment projects. The discussion is based on Farbey et al. (1993), who summarise ten evaluation methods which are widely used in practice. Although there are many different evaluation methods, measurement is still the core of evaluation (Farbey, 1993). Attention should therefore be focused on the information needed to facilitate measurement.

- *Cost/Revenue Analysis*

The most basic and widely used method is cost/revenue analysis. This uses conventional cost and management accounting procedures, including the types of measurement and valuation methods used in cost accounting. The data required to conduct cost/revenue analysis includes the cost of developing and implementing the system, the expected life of the system, the cost of operating the system, and the value of the benefits the system should generate.

- *Return on Investment*

The ROI approach is supported by capital investment measurements such as NPV, and IRR. The hurdle is established as decision criteria to accept or reject the proposed investment project. Therefore, the information required for ROI includes cash flows, hurdle rate, duration, IRR.

- *Cost-Benefit Analysis*

Cost-benefit analysis is one version of cost-revenue analysis and seeks to overcome the problem of valuing intangibles by imputing a money value for each element contributing to the costs and benefits of an IT project. This method is the most comprehensive form of economic appraisal which seeks to quantify in money terms as many of the costs and benefits of a proposal as possible (Willcock, 1994). The requirements needed to conduct cost-benefit analysis include costs, benefits, duration, intangible costs, intangible benefits.

- *Return on Management*

Return on management is based on the notion that the real value of an investment is that which enhances management productivity (Farbey et al., 1993). This relies on obtaining estimates of cash flows from standard evaluation methods and financial statements and assigning the value added from each systems feature to a part of the value chain. Any value left over is the value imputed to management. The data required to conduct return on management are accounting data, e.g. total revenue, total cost.

- *Boundary Values*

Boundary values are intended to provide a crude but simple view of how an enterprise or one division within an enterprise compares to its peer enterprise in the same industrial sector. Typical ratios include total IT expenditure against the value of sale, total labour costs, total operating expenses, total value of assets and total value of deposits.

- *Information Economics*

The Information Economics approach (Parker et al., 1988) attempts to deal with IT evaluation from the perspective of both methodology and process. The approach proposes the notion of value based on business performance and the strategic impact on the company. Benefit is a discrete economic effect, whilst value is seen as a broader concept based on the effect the IT investment has on the business performance of the enterprise (Willcocks, 1992). Information Economics has expanded the ideal of value to six classes: enhanced ROI, strategic match, competitive advantage, management information, competitive responses, and strategic IS architecture.

- *Multi-Objective, Multi-Criteria Methods (MOMCs)*

MOMCs are often regarded as alternatives to cost-benefit analysis since they recognise that there are measures of worth apart from money values. The methods attempt to define a general measure of utility, seen as the satisfaction of an individual's revealed preferences.

- *Value Analysis*

Value analysis is another way of attempting to establish a value for the outputs of the system. The method emphasises benefits rather than costs and is used primarily for evaluating concepts such as better information. It begins with the observation that most successful innovations are based on enhancing value added rather than on saving costs.

- *Critical Success Factors*

One of the most popular methods for exploring the potential value of IS is based on Rockart's (1979) notion of critical success factors. The method invites the analyst to explore with executives those factors which are in their opinion critical to the success of the business, in particular those that are important for the functions or activities for which executives are responsible.

- *Experimental Methods*

The use of experimental methods is a recent development in the context of information systems project evaluation, through some of the methods have been used for evaluation in other situations. The main experimental methods include prototyping, simulation, game playing and role playing.

To sum up, the most critical information for measurement includes investment, project duration, cost of capital (hurdle rate), NPV of cash flow, payback period, accounting rate of return, profit, productive, intangible cost and intangible benefit, and strategic objectives.

Besides these approaches, in recent years there have been numerous studies that attempt to estimate the economic impacts of information technology investment. Besides business performance, some researchers (e.g. Hitt and Brynjolfsson 1996) use productivity and consumer surplus as different measures of information technology's contribution. By assuming a particular form of production function, it is possible econometrically to estimate the contribution of each input to total output in terms of the gross marginal benefit. The measure of consumer surplus represents the benefit of information technology investment gained by the consumer. Barua et al. (1995) state that measuring the economic contribution of IT investment is a key activity that can shape the very nature of business through its influence on corporate strategies and future investment in technology. Some researchers (e.g. Dixit and Pindyck 1995, Smith and Nau 1995) adopt financial options theory to guide decision-making in the management of information technology investments. The option approach emphasises the need effectively to align the business and IS strategies with financial strategy and a firm's objectives to maximise shareholder value. It also uses productivity and flexibility as measurements of IS's contribution to business value.

2.4.5 The New Trend to Confront Uncertainty - Strategic Flexibility

Obviously, the uncertainties of investment projects cannot be avoided, but, the question is: how can we change the way of confronting them. Many researchers (e.g. Evans, 1991; Whipp, Rosenfeld and Pettigrew, 1989, Sanchez, 1995) suggest the need for 'strategic flexibility' to manage strategic change in organisations. Strategic flexibility may be defined as the ability of the organisation to adapt to substantial, uncertain and fast-occurring (relative to required reaction time) environmental changes that have a meaningful impact on the organisational performance (Aaker and Mascarenhas, 1984). The definition of flexibility includes the words 'adapt' and 'change'. The former emphasises the ability to maintain a status quo despite a change which may be internal or external to the firm. The latter emphasises the ability to instigate change rather than simply to react to it.

Whipp et al. (1989) report that firms which have been relatively successful in regenerating themselves and sustaining growth depend on a basic strategic flexibility which is supported by an internal coherence between strategic and operational change and the active management of the process of change. Rosenhead (1989) examined the robustness of decisions to withstand future change. He notes that the criteria for the initial decision of a plan involve choosing the highest robustness index and allowing the other sequential decisions to maintain flexibility. That is, 'keep your options open.' Powell (1995) notes that implementing any fuzzy strategy is likely to be difficult; and implementing IT projects, given their need for more complete specifications and their low tolerance of flexibility, will be even more problematic. The concept of strategic flexibility is critical in the IT investment project because the strategic nature of IT investment is essentially fuzzy. In other words, a more flexible structure and management process can facilitate the creation of strategies and then lead to a better outcome of IT investment.

Upton (1994) emphasises that most situations demand types of flexibility which allow change which is both reactive and proactive: the source of the need for change depends on one's point of view, but this is a separate issue form the ability to change. In this case, the next question is: what flexibility needs to be taken into account? The present study proposes six types of flexibility in different stages. In the formulation stage, alignment and time-scale flexibility are suggested; in the evaluation stage, decision hierarchy flexibility, measurement and criteria flexibility, and sourcing flexibility are suggested; and in the implementation stage, organisational flexibility is suggested. The following sections provide a discussion of each of these.

2.4.5.1 Alignment Flexibility

Obviously, introducing IT needs to link IT use and organisational strategy. Farbey et al. (1993) indicate that the evaluation problem of IT is really one of alignment, and organisations that are aware of IT's new role have usually made efforts to incorporate IT in their strategic thinking. The planning process needs to identify business needs and maintain the flexibility of the IT function to ensure a fit with those needs. The structure and management process part of the strategic alignment function can be integrated by organisational flexibility. The alignment mechanism can be achieved by using business systems strategy as proposed by Galliers (1995). The business systems strategy is concerned with integrating information systems considerations into the business and strategy formulation process, and with providing a direct link between IT acquisition decisions and the applications development process.

2.4.5.2 Time-Scale Flexibility

The time-scale is also extremely important in IT investment planning. Barwise et al. (1986) indicate that strategic decisions are themselves bounded in time because, in a competitive world, all profitable opportunities are temporary, and the firm must act before the strategic window closes. Clemons (1991) indicates that often the strategic programmes being undertaken have extremely long lead times. In particular, during the time between making the investment decision and the strategic programme coming on-line, the environment itself may have changed, thereby confounding analysis and adding considerable uncertainty. For example, after the IT investment, it may no longer be what the user wants because the environment has changed during the time of implementation and the original technology is not longer functionally appropriate.

Willcocks (1994) also indicates that failure to take into account the time-scale of likely benefits is the major problem faced by IT evaluation. Even if the system is successful, and may so dramatically alter the environment. All assumptions about costs and benefits are rendered obsolete because. Thus, the timing problem leads to functionality risk and systemic risk.

Galliers (1995) seeks to identify the time-scale in the business systems strategy model. Accordingly, time-scale flexibility is critical for the planning process. One premise of time-scale flexibility is a flexible IT architecture, i.e. one that can easily adapt to organisational change, geographic shifts, and alternative forces of centralisation and decentralisation (Madnick, 1987). To design such a flexible architecture, the main components of the systems need to be identified, and the incremental investment project of these components must also be identified along the time-scale. Therefore, time-scale flexibility aims to reduce the problem of the time-scale. For example, if the organisation is likely to face a turbulent scenario, the time-scale for investment planning should be on a short-term basis.

2.4.5.3 Decision Hierarchy Flexibility

Decision hierarchy flexibility aims to structure complexity in a hierarchy. The immense scope of hierarchical classification is clear. It is the most powerful method of classification used by the human brain in ordering experience, observation, entities and information (Whyte, 1969). In fact, hierarchy is the adaptive form for finite intelligence to assume in the face of complexity (Simon, 1964). Accordingly, the hierarchical arrangement has been found to be the best way for human beings to cope with complexity (Forman, 1990).

For these reasons, the present study suggests that, in the evaluation process, the organisation should retain decision hierarchy flexibility. That is, it is important to try to break down the decision problem in terms of the decision's characteristics and the organisation's characteristics. However, hierarchy is not a decision tree (Saaty, 1990). Each level may represent a different cut of the problem. One level may represent social factors and another level may represent political factors. Further, a decision maker can insert or eliminate levels and elements as necessary to clarify the tasks.

2.4.5.4 Measurement and Criteria Flexibility

Evaluation activities vary according to their different purposes, scope and perspectives, and each evaluation approach has its own decision-making process. However, the selection of measurements and criteria are thought to be critical and prior to all other evaluation activities (Keeney, 1994).

In the context of strategic IT evaluation, the fundamental values of measurement and criteria information are essential activities that must occur prior to evaluation and must guide the selection of evaluation methods. Measurement is the core of evaluation (Farbey, 1993). Measurement information is prior to measurement activities and is essential and must be taken into account for the selection of an evaluation approach. According to this viewpoint, measurement and criteria selection should be keep flexible, i.e. it is necessary to identify the value of measurements and criteria with respect to the investment, and the selection of measurements and criteria vary according to the different objectives of investment projects.

2.4.5.5 Sourcing Flexibility

In the evaluation stage, the scanning of sourcing feasibility refers to the exploration of the sourcing opportunity and sourcing strategy of the investment project. Sourcing flexibility means keeping a flexible sourcing strategy i.e. through buying or making. After identifying IT opportunities, it is necessary to determine whether the supporting technology is available or not. Sometimes, this includes skill and expertise outside the organisation. Lacity et al. (1996) identify three factors related to the sourcing strategy: business factors, economic factors and technical factors. Business factors identify the role of each major strand of IT activity on which the future of the business may depend; technical factors guide the choice of supply source and form of supply arrangements; and economic factors capture the economics of IT activities for the sourcing decision. These factors may lead to an in-house sourcing strategy or an outsourcing strategy.

The outsourcing of an IT project leads to the transmission of the technical risk and project risk (which is caused by the complexity of the project form) to the external organisations. Outsourcing may also contribute to the long lead time problem in ensuring the strategic characteristics of the investment. Accordingly, in order to catch the strategic nature of the IT which is still there when introducing IT, outsourcing should be considered. This probably involves employing knowledge from experts or from the software package which has been developed. However, it is also necessary to consider decision hierarchy flexibility so as to employ an outer actor in the decision-making process, and organisational flexibility so as to adopt the well-developed package. Sometimes the adjustment of organisational structure is required.

2.4.5.6 Organisational Flexibility

Organisational flexibility refers to flexible capital, human resources, management process and organisational structure. In terms of capital flexibility, Whipp et al. (1989) note that successful firms have responded by devoting more attention to the capital requirements of their strategic and operational objectives as well as the sensitivity of their financial performance to international flows of funds: for example, by seeking alternative ways to circumvent capital needs or using sophisticated financial management techniques to tap into diverse capital markets.

Whipp et al. found that successful firms are aware of the time value of new skills and strive to create an environment which nurtures and supports innovation. For example, there may be an organisational need for flexible personnel who are able to cross over function specialisation; human resources strategy and planning may be required to mesh strategic need with operational requirements. Whipp et al. further point out that the structure of successful organisations differs from that of less successful ones, and that these differences are not necessarily reflected on organisational charts.

Organisations which are better able to respond to competitive pressures tend to view their structures as temporary and malleable, changing them continuously to line up with strategic and operational requirements. Scott Morton (1991) shows that organisations have to restructure, invest heavily in human resources, and adopt totally new concepts of managing. Only then will they be able to create new strategies that will allow them to get closer to customers' needs, and only then will their investment in IT pay off.

Organisational flexibility is an important mechanism for incorporating IT into strategic alignment. In fact, structure, management process, and individuals and roles represent three of the five sets of forces in the MIT90s model (Scott Morton, 1991) and, they form a cultural dimension which links strategy and technology. In other words, they perform a mediating role in the alignment of strategy and technology. The successful application of IT will require a change in management and organisational structure and investment in new skills for employees. Therefore, the implementing stage involves the modification of organisational structures and management processes to ensure that planned results are obtained.

2.5 Conclusion

The necessary first step in any research is a review of literature. This chapter has reviewed the parent disciplines of SIDs and SITIDs including organisational decision-making, financial management, and information management. This part of the review provides an historical picture of what has been learned in SIDs and SITID's parent disciplines. The literature review can be assumed to be comprehensive enough to cover most of the key issues relevant to the current study. Based on the review of these parent disciplines, the next chapter focuses on elaborating the theoretical model of the current study.

Chapter 3. Towards an Explanatory Theory of the Effectiveness of SIDs

3.1 Introduction

In the previous chapter, the theoretical background of SIDs and SITIDs was presented. The purpose of this chapter is to explain the theory construction process and the theory itself. To improve the quality of theory, the present study first analyses the actual practice of social scientists and compares it with the requirements for theory. Strategic IT investment decision-making is now a topic of great interest in information management. Many studies (e.g. Clemons and Weber, 1990; Clemons, 1991) have described some guidelines or lessons for strategic IT investment. However, there is limited evidence to identify the impacts on SIDs of their IT content.

This chapter proposes a theoretical model and suggests hypotheses for further statistical testing. The literature on theory construction is first reviewed. Then, the rationale and assumptions linking the dependent and independent variables of the present study are discussed. The focus then moves to the process of constructing the theoretical model for the present study. To enrich the analysis, this study employs concepts from the contextualism school which integrate process, content and context to study investment decisions. The nature of the proposed theory and hypothesised relationships is derived from the relevant literature. Finally, this chapter also briefly examines the proposed model according to several criteria of evaluation.

3.2 Theory Construction

The aim of the present study is to construct a theory to address the issue of the effectiveness of SIDs. This is a very practical concern. A central mission of scholars is to conduct research that contributes knowledge to a scientific discipline on the one hand, and to apply that knowledge to the practice of management as a profession, on the other (Simon, 1967). Many authors (e.g. Van de Ven, 1989) emphasise that nothing is quite so practical as good theory. Accordingly, theory building is probably the most important discipline for all researchers. However, the challenge confronting the researcher is not only that of knowing what is a theory or what is the function of a theory, but also of how to construct a good theory. Unfortunately, the literature on these topics is sparse and uneven, and tends to focus on outcomes and products rather than process (Weick, 1989). To address this problem, this section reviews previous studies to answer these questions in order to establish a basis for constructing the theory of the present study. This section mainly focuses on the nature of theory and theory construction, and the detailed discussion of research design is provided in the next chapter.

Kerlinger (1973) defines a theory as a set of interrelated constructs (concepts), definitions, and propositions that present a systematic view of phenomena by specifying relations among variables, with the purpose of explaining and predicting phenomena. This definition clearly indicates that the fundamental purpose of a theory is to describe, explain and predict observed or experienced phenomena. That is, the aim of theory construction is not simply to describe certain behaviour, for example how management may make strategic investment decisions. Theory must be related to the phenomena of the empirical world and the reality known to us directly or indirectly through our senses (Chafftz, 1978). The relationships between different concepts must also be explained, which in turn makes prediction possible.

Theory building refers to the process or cycle by which such representations are generated, tested and refined. The major purpose of the present study is to establish a theory which links IT intensity in SIDs with effectiveness of SIDs so as to address the question: what impact on the effectiveness of IT investment projects? Obviously, IT intensity is not the only cause of IT failure. However, the theory provides a new perspective of managing IT investment projects. As suggested by Dubin (1978), a theory must contain three essential elements in terms of what, how and why questions.

The 'what' question refers to the factors (variables, constructs, concepts) which should logically be considered as part of the explanation of the social or individual phenomenon of interest. Whetten (1989) suggests the use of comprehensiveness (i.e. are all relevant factors included?) and parsimony (i.e. should some factors be deleted because they add little additional value to understanding?) as two criteria for the selection of factors to be included in a theory. The constructs selection therefore needs to consider both comprehensiveness and parsimony.

The present study employs the concept of contextualism (see section 3.4) to ensure the comprehensiveness of the theory. However, not all the constructs related to the process, content and context of investment decisions are involved in the theoretical model because some of them are not relevant to the linkage of IT intensity and effectiveness. The selection of appropriate constructs therefore needs to employ parsimony. Two criteria (see section 3.4) are here employed for the selection process and will be discussed.

The 'how' question refers to how the constructs are related. Operationally this involves using arrows to connect constructs in order to provide conceptualisation by explicitly delineating the patterns involved. Theoretically, it is necessary to identify clearly the functions of these factors. In the linkage between IT intensity and the effectiveness of SIDs, the precise roles of decision process, content and context are not clear. In the social sciences, moderator and mediator have long been identified as two functions of third variables. It is therefore necessary to know which function is appropriate in the current research context.

The 'why' question refers to the underlying psychological, economic and social dynamics that justify the selection of factors and the proposed causal relationships. This rationale constitutes the theory's assumptions - the theory glue that welds the model together. The assumption of theory must be convincingly demonstrated to ensure that the propositions make sense and contribute to the practice of research. To do so, the present study first discusses the assumptions of the theoretical model in section 3.3.

These three elements provide the major principles on which to build a theory. Whetten (1989) suggests that a good theory includes a plausible, cogent explanation for why we should expect certain relationships in our data. Together these three elements provide the essential ingredients of simple theory: description and explanation. However, to achieve such a good theory is not easy and relies on the following requirements being fulfilled.

First, a theory needs an appropriate process of different levels of abstraction. All words and concepts are, to some degree, abstractions. Humans abstract certain common elements from a number of concrete cases and are thus able to identify particular cases as part of a class of objects (Chafetz: 1978). The scientific process involves the ability to move back and forth along the continuum of abstractness (Chafetz, 1978). Since the essential function of a theory is to help to explain that which we know about empirical reality, the effort of theory construction needs to ensure that the abstraction of theoretical concepts must be closely related to the concrete world. Thus, researchers need to become comfortable in moving back and forth along the continuum of abstractness. However, for a junior (e.g. doctoral) researcher, the abstraction process may be difficult because of a lack of research experience. To overcome this shortage, junior researchers must rely heavily on the previous research which uses similar concepts (constructs) or definitions.

Second, a theory must be useful. Lindblom (1987, quoted by Weick, 1989) points out that theorists often produce trivial theory because their process of theory construction is hemmed in by methodological strictures that favour validation rather than usefulness. These strictures weaken theorising because they de-emphasise the contribution that imagination, representation and selection make to the process, and they diminish the importance of alternative theorising activities such as mapping, conceptual development, and speculative thought (Weick, 1989).

Third, a theory must rely on an appropriate scope which is constrainted by assumptions and limitations. Poole and Van de Ven (1989) define a good theory as a theory which is a limited and fairly precise picture. It does not attempt to cover everything and would fail to meet the parsimony criterion if it did. The empirical world is comprised of almost infinite variety. The limitations of the human brain mean that a complex event requires a good theory which is organised parsimoniously and communicated clearly. Simplicity and clarity are important guidelines for theory construction.

Poole and Van de Ven (1989) state that less evident, but just as effective, is the reliance on a limited, carefully prescribed set of assumptions and explanatory principles. These assumptions and explanations implicitly state what is relevant and what is not. The authors indicate that one of the canons of good theory construction is to recognise these limitations.

Fourth, a theory must select an appropriate research paradigm. A paradigm is a general perspective or way of thinking that reflects fundamental beliefs and assumptions about the nature of organisations. Different paradigms are grounded in fundamentally different assumptions, and produce markedly different ways of approaching the building of theory (Gioia and Pitre, 1990). As Creswell (1994: 1) explains:

> Paradigms in the human and social sciences help us understand phenomena: They advance assumptions about the social world, how science should be conducted, and what constitutes legitimate problems, solutions, and criteria of proof. As such, paradigms encompass both theories and methods.

The selection of an appropriate paradigm depends on the different fundamental assumptions which arise from different philosophical views, including the nature of organisational phenomena (ontology), the nature of knowledge about those phenomena (epistemology), and the nature of ways of studying those phenomena (methodology) (Gioia and Pitre, 1990). Based on these viewpoints, paradigms can be categorised according to different perspectives, for example quantitative versus qualitative paradigms.

Alternatively, Burrell and Morgan (1979) have organised these viewpoints along the subjective-objective and regulation-radical change dimensions, which yields a matrix comprising four different research paradigms, including radical humanist, radical structuralist, interpretivist and functionalist. Approaches to theory building that are grounded in appropriate paradigmatic assumptions are better suited to the study of those organisational phenomena that are consistent with such ground assumptions (Gioia and Pitre, 1990). This study discusses the paradigm issue in Chapter 4.

Fifth, a theory must be easy to apply. The function of a theory is to prevent the observer from being dazzled by the full blown complexity of natural or concrete events, and therefore the purpose of theoretical statements is twofold: to organise parsimoniously and to communicate clearly (Bacharach, 1989). Gioia and Pitre (1990) indicate that this definition of theory is necessary to encompass the wide scope of theoretical representations found in alternative paradigms. Accordingly, the theory constructor should recognise that a theory must be highly conceptualised to represent the complexity of concrete events and to facilitate application. That is, a theory should not use complex statements to 'describe' complex events (or even simple events) and should always be applied. Otherwise, the theory is likely to create a new problem rather than solving an old one.

The present study emphasises the importance of explanatory theory. In fact, a theory is a dimension rather than a category (Mohr, 1982). An explanatory theory may be defined as a theory which is developed in order to explain why and how general, recurring social phenomena come about. It should be distinguished from a normative theory which is developed in order to show how an organisation should behave in order to be effective and efficient. Mohr (1982) argues that explanatory theory carries the connotation of being 'unproved, and tentative', whereas laws, by contrast, carry the connotation of being 'certain and invariable.' Thus, explanatory theory rests partly on the ambiguity inherent in four of its characteristics: the highly relevance to practice, the ability to explain the issue, the better defined the scope, and the more important the behaviour. Because of this ambiguity, theory becomes a dimension rather than a category, so that the more an explanatory generalisation satisfies these criteria, then the more it deserves the label 'theory'. The nature of explanatory theory must be clearly appreciated before the present study can start to construct an appropriate theory of its own.

As mentioned in the beginning of this section, the purpose of a theory is for the explaining and predicting phenomena. It is obvious that explanation and prediction can subsumed under theory. However, some researchers may say that the adequacy of a theory is its predictive power and only prediction is necessary. That is, if a theory can be used to predict successfully, this is enough. However, Kerlinger

(1973) argues that a theoretical explanation implies prediction. Scientific explanation boils down to specifying the relations between one class of empirical events and another. For example, IT intensity is negatively related to the effectiveness of SIDs. In the sense, this is prediction. Accordingly, theory for prediction implies an explanation function and theory for explanation implies a prediction function. Possibly, the only distinction is the main purpose to construct it.

According to these discussions, the present study first considers the rationale and assumptions for the linkage of IT intensity and effectiveness and the research scope and analytical process. After the hypotheses are proposed, in the final section of this chapter, the present study employs several criteria to examine the theoretical contributions of the proposed model.

3.3 The Rationale and Assumptions for the Linkage of IT Intensity and Effectiveness[1]

The link between the extent of IT intensity in SIDs and the effectiveness of SIDs has not yet been convincingly demonstrated. Decision effectiveness represents the extent to which strategic objectives are achieved. Such an assessment is sometimes unavoidably subjective. Dean and Sharfman (1996) point out that management may use different processes in order to make different types of decisions. Further, Mohr (1982) argues that the link between decision process and decision outcome is so intimate that the process is itself an outcome.

[1] The discussion and the theoretical model presented in this section have been published in the Proceedings of the European Conference of Information Systems, Aix-en-Provence, France, 1998.

Taken together, these two arguments may imply that the link between IT intensity and the effectiveness of SIDs is not a direct one, and that the impact of IT intensity may be through the decision process itself. Accordingly, the linkage of IT intensity and effectiveness rests on two assumptions: (1) that different degrees of IT intensity lead to different processes, which is to say that IT intensity influences the process of decision-making; and (2) that different processes lead to different outcomes. For the SID IT intensity-effectiveness link to exist, both assumptions must be true (see Figure 3.1).

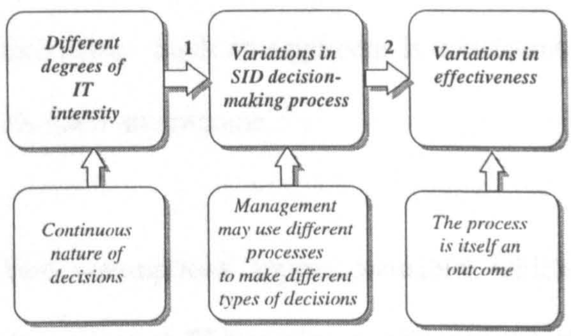

Figure 3.1: Assumptions of the Current Study

The first assumption is that the degree of IT intensity is related to the strategic decision-making process. Sabherwal and King (1995) and Hickson et al., (1986) show that process differences do relate to different topics of decisions. Dean and Sharfman (1996) also point out that management may use different processes in order to make different types of decisions. The next question is whether intended IT intensity can be seen as one dimension of the typology of SIDs. Decisions can be distinguished according to several perspectives, including the strategic/operational, structured/unstructured, and dependent/independent. These perspectives all rest on the continuous nature of decisions (Simon, 1977). Since SITIDs form part of corporate strategic investment decisions (SIDs), the latter may have different degrees of IT intensity in investments, and this may possibly form an important viewpoint of the IT/non-IT continuum.

The second assumption is that decision processes are related to the effectiveness of decisions. A recently published paper has indicated that decision-making processes are indeed related to decision success (Dean and Sharfman, 1996). The authors seek to identify the influence of strategic decision-making processes on the effectiveness of decisions. Such an argument is consistent with Mohr's (1982) view that the process is itself an outcome.

Thus, these two assumptions appear plausible, which suggests that it is reasonable to expect the extent of IT intensity to influence the effectiveness of SIDs. However, the assumptions may suggest that the link between IT intensity and the effectiveness of SIDs is not a direct one, and that the impact of IT intensity may be through the decision process. Of course, the decision process may not be the only issue in the linkage. The next section will start to address the question of how the present study systematically defines the scope of the theoretical model.

3.4 Scope and Analytical Process

A theoretical model is a conceptual scheme that shows how one theorises the relationships among several factors that have been identified as important to the research problem. The focal research topic here is a multidisciplinary research issue relating to organisational behaviour, information management, financial management, and strategy management. As Dess et al. (1993) state, the multidimensionality of constructs used to describe strategy phenomena has always posed challenges for research. The challenges include not only developing meaningful constructs and relationships but also measuring them with a high degree of validity and reliability. Accordingly, it is vitally important to select appropriate constructs for building a theory for this research. In view of the previous discussion, the constructs used here are the independent variable of IT intensity and the dependent variable of effectiveness.

SITIDs can be studied vertically. That is, SITIDs are part of corporate strategic investment decision (SIDs); SIDs are part of strategic decisions (SDs); and strategic decisions are part of organisational decisions (ODs). A review of decision-making theories of ODs, SDs and SIDs provide a background against which we can more specifically consider the problem of SITIDs in detail. As a result of the examination of relevant studies in Chapter 2, two conclusions emerge. First, the vertical view of the decision issue should be integrated into the research model; and second, not only the decision process but also the decision content and decision context should be examined.

In order to study SIDs and SITIDs, the present study employs the concept of 'contextualism' as advocated by Pettigrew et al. (1988) and adopted by Symons (1991), Farbey et al. (1993), and Ketchen, Thomas and McDaniel (1996). This school integrates process, content and context to study organisational decision-making. Based on Pettigrew's argument (1988), content refers to the particular decision under study. This dimension explores the basic nature and scope of SIDs. The process of decision-making refers to the actions, reactions and interactions of the various interested parties as they seek to make a commitment to allocate corporate resources. This dimension incorporates both the formulation and evaluation processes. The context includes the outer context, which refers to the national economic, political and social contexts of an organisation, and the inner context, which refers to the ongoing strategy, structure, culture, management and political process of the organisation. This dimension helps to shape the process of decision-making. Accordingly, contextualism's view of SITIDs is shown in Figure 3.2.

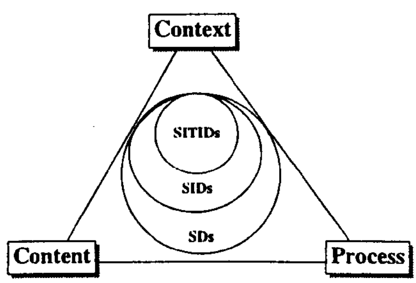

Figure 3.2: Contextualism's View of SITIDs

In the linkage between IT intensity and the effectiveness of SIDs, the precise roles of decision process, content and context are not clear. In the social sciences, moderator and mediator have long been identified as two functions of third variables. Baron and Kenny (1986: 1173) explain these two functions as follows:

> The moderator function of third variables, which partitions a focal independent variable into subgroups that establish its domains of maximal effectiveness in regard to a given dependent variables, and the mediator function of a third variable, which represents the

generative mechanism through which the focal independent variable is able to influence the dependent variable of interest.

As discussed in the previous section, the impact of IT intensity on the effectiveness of SIDs is through the decision process. Accordingly, the process constructs should have a mediating effect in the linkage. Greater IT intensity will lead to a more technically-oriented project which has a different impact upon the effectiveness of SIDs. The decision content, therefore, can also have a mediating effect between the linkage of IT intensity and the effectiveness of SIDs. As part of the decision context, the organisational investment context has an impact on the outcome of investment. Therefore, the context constructs should act as covariances which impact upon the effectiveness of SIDs. Decision context, decision content and decision process may involve too many constructs and some of them may not be related to IT intensity. Accordingly, the analytical model which guides the present study of the effectiveness of SIDs is shown in Figure 3.3. The detail of this model is discussed in the following section.

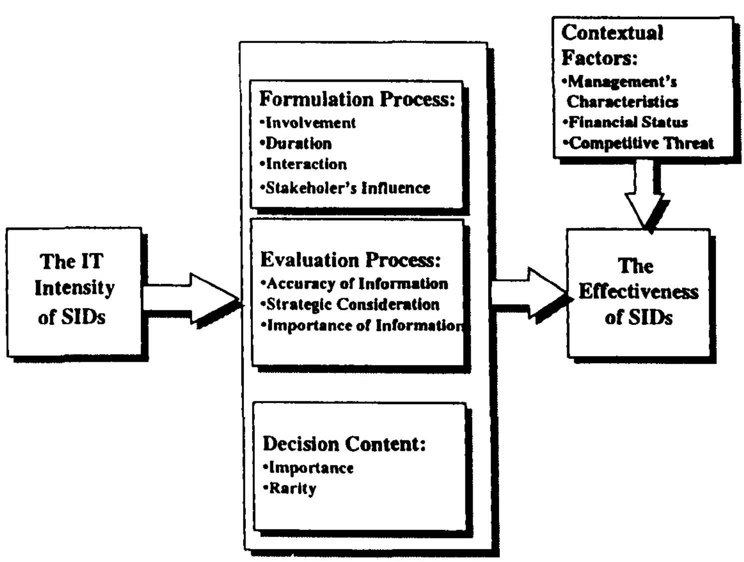

Figure 3.3: Outline Analytical Model of SITIDs

Two criteria are employed for the selection of constructs and these form the hypothesised relationships for further investigation. First, the construct must be predicted according to different degrees of IT intensity. For example, the importance of decisions is a key characteristic for defining all strategic decisions (Eisenhardt and Zbaracki, 1992). All strategic investment decisions are critical for the corporation, no matter whether IT is involved or not. Therefore, the present study will not predict any hypothesised relationships concerned with the importance of decisions.

Second, the construct must be impacted upon the decision level, not the organisational level. For example, a 'competitive threat' is a pressure for the whole organisation, not just for the outcome of specific decisions. This study, therefore, will not predict and hypothesise this relationship.

3.5 The Hypotheses of this Study

3.5.1 Dependent Variable: Decision Effectiveness

The research relating to effectiveness can be categorised into two groups. The first is concerned with organisational effectiveness and focuses on the relationship between investment decisions and organisational performance. For example, empirical studies investigate the relationship between strategic investment announcements and stock price (e.g. Woolridge and Snow, 1990). They focus on the relationship between announcements and decisions, not the outcomes of these decisions. Although organisations announce their strategic investment plans and the stock market usually reacts positively, the outcomes are unknown.

The current work belongs to the second group which focuses on decision effectiveness. Many authors have clearly defined decision effectiveness. For example, Willcocks (1994a) defines decision effectiveness as a comparison of actual performance against planned, whether original or subsequently chosen, targets/outputs, outcomes and policy objectives (Willcocks, 1994a). Dean and Sharfman (1996) define strategic decision effectiveness as the extent to which a decision achieves the objectives established by management at the time it is made. Butler et al. (1993) define effectiveness in terms of objectives-attainment and learning. The objectives-attainment approach is the definition which is most widely accepted by previous researchers and is adopted in this study.

3.5.2 Independent Variable: IT Investment Intensity

This research employs a concept of IT investment intensity as a dimension of strategic investments termed 'IT intensity'. The concept of IT investment intensity is similar to, but also somewhat different from, the concept of information intensity. Information intensity may be defined as the degree to which information is present in the product or service of a business (Porter and Millar, 1985). The degree to which IT is present in an investment decision reflects the IT level of intensity of that decision. IT investment intensity has been used for several other researches. For example, McFarlan et al. (1983 quoted by Harris and Katz) characterise the IT investment ratio as one measure of the degree of operating dependency on technology.

Harris and Katz (1991) examine empirically the correlation between firm size and the ratio of information technology expense to total operation expense, more specifically information technology investment intensity in the life insurance industry. In this research, IT intensity is defined as the ratio of spending on IT to total investment. Obviously, the higher the IT intensity, the more important IT is to the whole investment. Accordingly, a so-called strategic IT investment decision is a strategic investment decision which has a high level of IT intensity. It is more difficult than many other investment decisions (Powell, 1993), and because of the high failure rate of IT investment projects (Hochstrasser and Griffiths, 1991), this study expects that a higher IT intensity in a SID is likely to be associated with the reduced effectiveness of SIDs.

Hypothesis 1: Different degrees of IT intensity are negatively related to the effectiveness of SIDs.

3.5.3 Decision Context

The investment context (or investment climate) is affected by the financial health and market position of the organisation, industry sector pressures, the management and decision-making culture, and the business strategy and direction (Butler Cox, 1990). As Cooke and Slack (1984) indicate, in terms of decision effectiveness, it may be more appropriate to choose a management style on the basis of the particular decision being faced, and only then to overlay this with longer term consideration.

The SID, like Pettigrew's (1973) definition of a non-programmed innovative decision, needs to adopt a change which is new to the organisation and to the relevant environment. This characteristic seems more suited to managers who have an innovative attitude to risk. From the perspective of decision-making style, the quality of the decisions reached by any decision-making process is dependent on the resources which the leader is able to utilise (Vroom and Yetton, 1973). Consensus-driven management seems to be able to acquire more information than directive management, and this also leads to a more effective decision. Management's attitude to risk and decision-making style is predicted to relate to the effectiveness of SIDs since the other factors will impact upon the general organisational level of performance, not upon a specific decision.

3.5.4 Decision Process

Many researchers have focused on the importance of the decision process (e.g. Hitt and Tyler, 1991; Sabherwal and King, 1995; Mintzberg et al., 1976; Fahey, 1981; Papadakis, 1995; Sheppard, 1990). The strategic decision process involves several characteristics, including comprehensiveness, the extent of rational activity, participation/involvement, duration and type of conflict (Rajagopalan et al., 1993).

From a procedural rationality perspective, comprehensiveness is a measure of rationality and has been defined as the extent to which the organisation attempts to be exhaustive or inclusive in making and integrating strategic decisions (Fredrickson and Mitchell, 1984). This should include such elements as the extent of formal meetings, the assignment of primary responsibility, information-seeking and analytical activities, the systematic use of external sources, the involvement of stakeholders, the use of specialised consultants, the extensiveness of historical data, the functional expertise of people involved (Fredrickson, 1984 and Papadakis, 1995), and the extent of informal interaction (Sheppard, 1990).

The political nature of organisational decision-making is also widely discussed (e.g. Pettigrew, 1973; Eisenhardt and Zbaracki, 1992; Hickson et al. 1986). Hickson et al. (1986) define 'politicality' as the degree to which influence is exerted on the outcome through a decision-making process. The decision-set of interests involving interest groups brings politicality into decision-making. It is evident from the data that strategic decision-making is not simply a matter of explicating alternatives and choosing between them on the basis of readily available criteria which all decision participants have perceived identified as appropriate (Fahey, 1981). Amongst these process-related constructs, it is predicted that interaction and involvement are related to IT intensity.

Interactions are contacts between two or more members of the group and are of importance in the development of group behaviour (Cooke and Slack, 1984). It may be expected that higher degrees of IT intensity will reduce interaction and that this will lead to the reduced effectiveness of SIDs. Decision-makers' computer knowledge, experience and educational levels are all closely associated with alienated beliefs and attitudes towards IT (Abdul-Gader et al., 1995). Higher IT intensity leads to a more technically-oriented project. Without IT knowledge and experience, managers cannot discuss the project in depth. It therefore reduces the interaction between members and then impacts upon the quality of decision. For the same reason, the current study also predicts that a higher degree of IT intensity will reduce involvement, and this will lead to the reduced effectiveness of SIDs. Less involvement will lead to less collective information and thus reduce the effectiveness of decisions.

Hypothesis 2: IT intensity will reduce interaction and will thus have an adverse impact on the effectiveness of decisions.

Hypothesis 3: IT intensity will reduce involvement and will thus have an adverse impact on the effectiveness of decisions.

The evaluation process can be seen as part of the overall decision process, but it is particularly important for investment decisions. An IT investment decision is more difficult than many other investment decisions because the costs and benefits are hard to identify and quantify, and intangible factors present are likely to significant (Powell, 1993). Therefore, the uncertainty of information used in evaluating IT investment is greater than in relation to other investments. The higher the uncertainty of information, the lower the accuracy of information. The present study expects that lower accuracy of information also contributes to the reduced effectiveness of decisions.

The evaluation problem of IT is really one of alignment, and organisations that are aware of IT's new role have usually made efforts to incorporate IT in their strategic thinking (Farbey et al., 1993). Thus, strategic considerations are critical to the evaluation process. As Barua et al. (1993) indicate, a firm may have to invest in

IT, regardless of its underlying cost structure, in response to a competitor's investment. However, there are differing views of the relationship between IT and corporate strategies (Sheppard, 1990).

Powell's (1993) idea of the vicious circle of IT investment highlights the problem of the alignment of IT and business strategy. The vicious circle may lead to sub-optimal decisions. Accordingly, the study expects that management may fail to link the strategic purpose of IT with the corporation's strategy, and that this will lead to the reduced effectiveness of decision-making.

Hypothesis 4: IT intensity will reduce the accuracy of information and will thus have an adverse impact on the effectiveness of decisions.

Hypothesis 5: IT intensity will reduce the strategic considerations and will thus have an adverse impact on the effectiveness of decisions.

3.5.5 Decision Content

Decision content refers to the particular decision under investigation and has been the focus of much previous research (Butler et al., 1991; Grundy and Johnson, 1993: Carr et al., 1993: Eisenhardt, 1989). A strategic decision is characterised by novelty, complexity and by the fact that the organisation usually begins with little understanding of the decision situation or the route to its solution, and with only a vague idea of what that solution might be and how it will be evaluated when it is developed (Mintzberg, 1976).

Complexity is a major characteristic of strategic decision-making. Complexity relates to the number and variety of factors in the decision unit's environment that impinge on its decision-making behaviour (Pettigrew, 1973). SIDs do not exist is isolation; they evolve out of the organisational context and have characteristics of their own. Constructs that contribute to the complexity of decision-making include rarity and importance (Hickson et al., 1986). The problem of uncertainty is therefore due to the rarity and performance of a decision (Butler et al., 1993).

Strategic investment decisions are decisions which have a significant impact on the firm as a whole and on its long-term performance (Marsh et al., 1988) and are necessary for the firm's survival. Here, the two constructs, rarity and importance, are employed to test IT intensity and the effectiveness of SIDs. All the SIDs are important to corporations irrespective of the degree of IT intensity. Rarity is the novelty of the decision to the participants (Butler et al., 1993: 36).

For example, Ashford, Dyson and Hodges (1988) state that new technologies often require investments of a different nature because of their high uncertainty, more widespread organisational impact, and greater strategic importance. Even compared with other new technologies, the life cycle of IT is extremely short. The present study, therefore, expects that the higher the IT intensity, the higher the rarity of decision which in turn leads to the reduced effectiveness of decisions.

Hypothesis 6: IT intensity will heighten the rarity of decisions and will thus have an adverse impact on the effectiveness of decisions.

Accordingly, Figure 3.3 presents a theoretical model of the constructs in this study and the hypothesised pattern of relationships among them. The results of an empirical test of the hypotheses are presented in the following chapters.

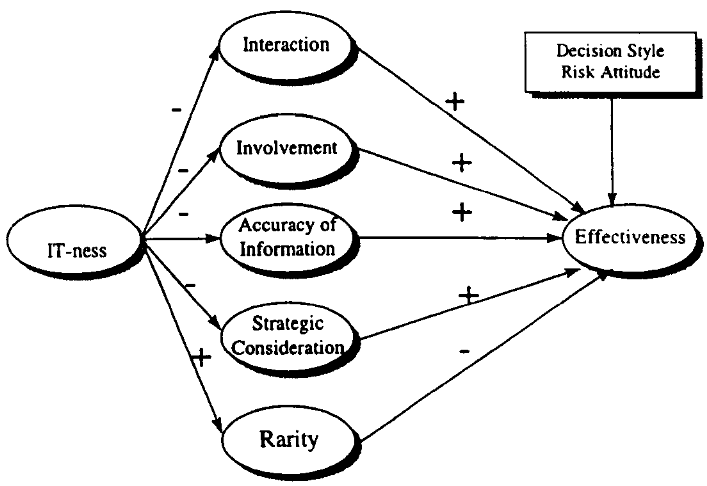

Figure 3.4: Theoretical Model of the Current Study

3.6 A Brief Examination of the Theoretical Model

The present study proposes a theoretical model (Figure 3.4) consisting of five concepts: effectiveness of decisions, decision process, decision content, decision context, and the extent of IT intensity in strategic investment decisions. In this model, decision process constructs (including the formulating process and the evaluating process) and decision content constructs play a mediating role between the dependent variable (effectiveness) and the independent variable (IT intensity). In this research, the model also includes contextual factors (investment climate factors) as covariances which have an impact upon the effectiveness of decisions. To test these mediating variables, the current study employs multiple regression analysis to examine the relationships between effectiveness and IT intensity.

An hypothesis is a specific statement of prediction. It describes in concrete (rather than theoretical) terms what is expected to happen in an investigation. Not all studies have hypotheses. Sometimes a study is designed to be exploratory (in the form of inductive research), in which case there is no formal hypothesis, and perhaps the purpose of the study is to explore some area more thoroughly in order to develop some specific hypothesis or prediction that can be tested in future research. A single study may have one or many hypotheses. If the prediction specifies a direction, such as that in the present study, and the null hypothesis is therefore the no difference prediction and the prediction of the opposite direction, termed one-tailed hypothesis.

According to Baron and Kenny (1986), three regression equations provide the tests of the linkage of the mediation model:

(1) regressing the mediator on the independent variable, and the independent variable must affect the mediator in the first equation;

(2) regressing the dependent variable on the independent variable, and the independent variable must be shown to affect the dependent variable in the second equation; and

(3) regressing the dependent variable on both the independent variable and on the mediator, and the mediator must affect the dependent variable in the third

equation. If these conditions all hold in the predicted direction, then the effect of the independent variable on the dependent variable must be less in the third equation than in the second.

Therefore, each of the hypotheses except for the first one in fact implies at least four hypothesised relationships. For example, Hypothesis 2 is 'IT intensity will reduce interaction and will thus have an adverse impact on the effectiveness of decisions.' This hypothesis involves the following hypothesised relationships:

(1) Effectiveness is hypothesised to be negatively related to IT intensity.

(2) IT intensity is hypothesised to be negatively related to interaction.

(3) Effectiveness is hypothesised to be negatively related to IT intensity, even when the covariances are added in.

(4) Effectiveness is hypothesised to be positively related to interaction but not to have any further relationship with IT intensity.

The previous sections discussed the process of theory building and derived a theoretical model for the effectiveness of SIDs. Whetten (1989) suggests a list of seven key questions, roughly in the order of frequency in which they are invoked, and summarises the concerns raised most frequently by the reviewers of the *Academy of Management Review*. These questions are What's new? So what? Why so? Well done? Done well? Why now? Who cares? Together these questions constitute a summary answer to the broad questions what constitutes a publishable theory paper? The present study employs these questions to examine the theoretical contributions of the proposed model because the ultimate purpose is that the research will be published. This section aims to examine whether this model meets the criteria.

- *What's new?*

This criterion examines whether the proposed theory makes a significant, value-added contribution to current thinking. The present study can make a significant contribution to current thinking for several reasons. First, it is a new theory which links IT intensity and the effectiveness of SIDs, not a modification of a previous theory. Second, it identifies the important dimension of the degree of IT intensity in the study of IT investment decisions. Third, it employs the ideas of the contextualism school to broaden the study of IT investment. Finally, it identifies several tentative meditating constructs in the linkage. All these will extend the current thinking of IT investment management.

- *So what?*

This criterion examines whether the proposed theory is likely to change the practice of organisational science in this area. That is, the purpose of a standard theoretical paper should be to alter research practice, not simply to tweak a conceptual model in ways that are of little consequence (Whetten, 1989). The theory of the present model is highly related to practice for several reason. First, the motivation of such a theory is from both the theoretical and practical viewpoints. Second, it explains a phenomenon which is currently faced by management. Third, it is empirically testable and the result will give a management focus on the nature of IT investment projects. Fourth, it forms a basis for further research in IT investment practice. Accordingly, this model may change the present perspective of IT practice.

- *Why so?*

According to Whetten (1989), theory development papers should be built on a foundation of convincing argumentation and grounded in reasonable, explicit views of human nature and organisational practice. In the present study, the assumptions are presented explicitly; the scope of the model is based on a well-recognised school - contextualism; the analysis is based on an analytical model which integrates the hierarchy characteristics of SITIDs into the concepts of contextualism; the constructs are discussed through a review of the literature and are selected accordingly to two criteria; the hypotheses are constructs based on reasoned deductions. Therefore, the study is based on a convincing argumentation process.

- *Well done?*

According to Whetten (1989), papers should (1) reflect seasoned thinking, (2) convey completeness and thoroughness and be conceptually well-rounded, (3) reflect a broad understanding of the subject, (4) avoid any glaring logical flaws, and (5) use propositions properly. As discussed previously, the present study employs quite a strict rule to construct the theoretical model. The effort should therefore meet this criteria.

- *Done well?*

This criterion examines whether the paper is well written. This includes the flow, the accessibility of the central idea, the appropriate span, and the issue of whether it fulfils professional standards. The answer to such a question may appear to be quite subjective. However, an effort has been made, starting from the review of the literature of theory constructions, in order to develop a theory which corresponds to professional standards.

- *Why now?*

According to Whetten (1989), the topic should be of contemporary interest to scholars so that it is likely to advance current discussion, stimulate new discussions or revitalise old discussions. The emergence of a strategic role for IT in organisations changes the way of thinking about IT from one stressing expense to one stressing investment. This is probably a new IT phenomenon. However, evidence (see Chapter 1) reveals the critical importance of managing strategic information technology investment decisions (SITIDs) effectively. The present study extends previous studies and incorporates the questions: 'does IT matter?' and 'how does IT matter?' This should be deemed to be an important issue and a basis for further study.

- *Who cares?*

According to Whetten (1989), papers should be linked to core management or organisational concepts and problems. A paper may be technically adequate but inherently uninteresting to most of a broad audience. As shown in Chapter 1, strategic IT investment is now of capital importance. However, organisations find themselves in a 'Catch 22' position. Accordingly, the present study issue is indeed a core organisational problem. It has attracted many professional scholars, and there are many professional conferences which focus on it. The current study issues should therefore of interest to a broad audience of academies and practices.

3.7 Summary

This chapter is vitally important for the whole of the present study. It mainly focuses on the task of theory construction. This chapter first reviews the literature of theory construction. The theory construction process needs to be broadly understood so that the researcher can develop a theory which is both efficient and effective. This effort is made in order to ensure the theory construction of the present study is on the right track. Then, the rationale, assumptions and analytical process are presented, and the theoretical model and hypotheses are proposed. Finally, the criteria for judging theoretical contributions are employed to examine the proposed theory.

This chapter has proposed the relationship between IT intensity and effectiveness of SIDs. It is only the first part of the study, but it is a crucial component because later sections can be seen as extensions of this section's arguments. The following chapter present the research design and the empirical testing of the theoretical model is presented in Chapter 5.

Chapter 4. Research Design

4.1 Introduction

In the previous chapter, the theory construction process, the theoretical model and hypotheses were derived from the extensive literature. The theoretical model is the core of the present study. This chapter is the research design chapter of the present study and is used to structure the research, to show how all of the major parts of the research project (the samples or groups, measures, treatments or programmes, and methods of assignment) work together to address the central research questions.

The presentation of this chapter generally follows Perry's (1995) suggestions. It first discusses the selection (4.2) of a suitable paradigm to guide the current study. Following this, the sources of data and sampling design (4.3), the operation and the measurement of research variables (4.4), the instrument design and administration (4.5), the limitations of the research design (4.6), the scheme for data analysis(4.7), statistical analytical techniques (4.8), and ethical issues (4.9) are presented. The last section (4.10) is the chapter summary which outlines this study's research design.

4.2 Justification of the Paradigms and Methods

This section first focuses on the selection of research paradigms and methods for the study to ensure that it is 'doing the right thing.' The specific methods chosen to deal with research problems depend upon the specific discipline and the nature of the specific problem (Rudestam and Newton, 1992). As discussed in Chapter 3, paradigms can be distinguished according to different perspectives such as quantitative versus qualitative paradigms. The methods also can be distinguished such as action research, cases study, experiments and survey (Blaxter et.al., 1996).

4.3.1 Qualitative versus Quantitative Research

The quantitative and qualitative paradigms are widely used social investigations. A study must therefore choose a quantitative paradigm, a qualitative paradigm, or a mixed paradigm as the first step to conducting research. Epistemology and methodology are most frequently cited criteria in the selection of paradigms. In simple terms, epistemology is the philosophy of knowledge, or of how we come to know. Methodology is also concerned with how we come to know, but is much more practical in nature. Methodology is focused on the specific ways - the methods - that we can use to try to understand our world. Epistemology and methodology are intimately related: the former involves the philosophy of how we come to know the world and the latter involves the practice. In Table 4.1, Creswell (1994) presents the assumptions of the quantitative and qualitative paradigms based on ontological, epistemological, axiological, rhetorical and methodological approaches.

Accordingly, the choice of a qualitative/quantitative study should be consistent with the assumptions of the qualitative/quantitative paradigm. The right-hand column of Table 4.1 shows the situation of the current study in terms of these assumptions. It suggests that a quantitative paradigm is more suitable. Minztberg (1976: 248) also shows that the strategic decision process may be researched by observation, by the study of organisational records, and by interviews or questionnaires. Accordingly, the quantitative paradigm is seen to fit the situation of the study.

Table 4.1: Quantitative and Qualitative Paradigm Assumptions

Assumption	Question	Quantitative	Qualitative	The Present Study
Ontological assumption	What is the nature of reality?	Reality is objective and singular, apart from the researcher	Reality is subjective and multiple as seen by participants in a study	The current study seeks to explain the relationships between the linkage of IT intensity and effectiveness. The constructs can be measured objectively by using questionnaires or an instrument. Accordingly, the nature of the study is positivist and reality is quite objective.
Epistemological assumption	What is the relationship of the researcher to that researched?	Researcher is independent from that being researched	Researcher interacts with that being researched	Researcher should remain distant and independent of that being researched. Thus in surveys, research attempts to control for bias, select a systematic sample, and be objective in assessing a situation.
Axiological assumption	What is the role of values?	Value-free and unbiased	Value-laden and biased	The researcher's values are kept out of the study. This feat is accomplished by entirely omitting statements about values from the written report, using impersonal language, and reporting the facts, arguing closely from the evidence gathered in the study.
Rhetorical assumption	What is the language of research?	Formal Based on set definitions Impersonal voice Use of accepted quantitative words	Informal Evolving decisions Personal voice Accepted qualitative words	The language should be not only impersonal and formal but also based on accepted words such as relationship and comparison. Concepts and variables are well defined from accepted definitions.
Methodological assumption	What is the process of research	Deductive process Cause and effect Static design-categories isolated before study Context-free Generalisations leading to prediction, explanation, and understanding Accurate and reliable through validity and reliability	Inductive process Mutual simultaneous shaping of factors Emerging design-categories identified during research process Context-bound Patterns, theories developed for understanding Accurate and reliable through verification	A deductive form of logic wherein theories and hypotheses are tested in a cause and effect order. Concepts, variables, and hypotheses are chosen before the study begins and remain fixed throughout the study. The intent of the study is to develop generalisations that contribute to the theory and that enable one to better predict, explain, and understand phenomena.

Source: Adopted from Creswell (1994: 5)

4.2.2 Deskwork versus Fieldwork

According to Blaxter et. al. (1996), deskwork consists of those research processes which do not necessitate going into the field. It consists, literally, of those things which can be done while sitting at a desk. Fieldwork refers to the process of going out to collect research data. Such data may be described as original or empirical, and cannot be accessed without the researcher engaging in some kind of expedition.

The distinction between deskwork and fieldwork is not entirely satisfactory, since most research projects make use of both approaches. As Blaxter et.al. (1996: 62) state 'no matter how much time a researcher spends in the field, it is difficult to avoid some deskwork, even if this only consists of writing up results'. Accordingly, it may be said that this study involves both deskwork and fieldwok.

4.2.3 Research Approaches

4.2.3.1 Action Research

Action research might be defined as 'the study of a social situation with a view to improving the quality of action within it' (Eilliott, 1991: 69). It aims to apply practical judgment to concrete situations, and the validity of the theories or hypotheses it generates depends not so much on 'scientific' tests of truth as on their usefulness in helping people to act more intelligently and skillfully. In action research theories are not validated independently and then applied to practice, but rather they are validated through practice. It is rationally empowering when undertaken by participants collaboratively, though it is often undertaken by individuals, and sometimes in co-operation with outsiders. Obviously, this approach is more suitable for improvement and involvement problems. It's also deals with individuals as members of social groups (Hart and Bond, 1995). These features suggest that action research are not suitable for the current research context.

4.2.3.2 Case Study

The case study approach uses a mixture of methods: personal observation, which for some periods or events may develop into participation; the use of informants for current and historical data; straightforward interviewing; and the tracing and study of relevant documents and records from local and central government, etc (Casley and Lury, 1987). It is the chosen method when the phenomenon under study is not readily distinguishable from its context (Yin, 1993). In the current research context, the constructs and variables can be defined clearly by reviewing on the relevant literature. Therefore, this study does not adopt case-study approach.

4.2.3.3 Experiments

In the social sciences, there are two broad traditions of research: experimental and non-experimental. These two approaches differ critically in the amount of control they exercise over the data. Experimentalists manipulate variables suspected of producing an effect, while non-experimentalists observe these variables. An experiment involves the creation of an artificial situation in which events that generally go together are pulled apart. The participants in an experiment are called subjects (Sommer and Sommer, 1991). The elements or factors included in the study are termed variables. Independent variables are those that are systematically altered by the experimenter. Those items that are affected by the experimental treatment are the dependent variables. In the current research context, the independent variable cannot be manipulated. Thus, this study belongs to the category of non-experimental research.

4.2.3.4 Survey

Survey research is the method of collecting information by asking a set of formulated questions in a predetermined sequence in a structured questionnaire to a sample of individuals drawn so as to be representative of a defined population (Hutton, 1990). Most surveys are based on samples of a specified target population - the group of persons in whom interest is expressed. The researcher often seeks to generalise the results obtained from the samples to the population from which the samples were drawn. Following the discussion in the previous section (4.1), the survey approach is adopted by this study.

4.3 Sampling Procedure

Sampling is the process of selecting units (e.g. people, organisations) from a population of interest so that, by studying the sample, the study may fairly generalise the results back to the population from which they were chosen. The discussion of the sampling procedure includes the unit of analysis, the sample size, sampling frame, and sampling design.

4.3.1 Unit of Analysis

One of the most important ideas in a research project is the unit of analysis. The unit of analysis is the major entity analysed in the study. For instance, any of the following could be a unit of analysis in a study: individuals, groups, artifacts (books, photos, newspapers), geographical units (town, census tract, state), social interactions (dyadic relations, divorces, arrests). A single unit of analysis has been determined through examination of the research questions and consideration of the outcomes sought from the research. If the unit of analysis is the discrete decision event, abstracted from the series of decisions and other actions of which it is a part, this can be a severe analytical and empirical limitation (Pettigrew, 1990). Accordingly, a single strategic investment project is sought to avoid the discrete decision event. From another perspective, as the research questions are directed at the decision level, the unit of analysis here is a single strategic investment decision because the major concern is one decision at issue rather than the organisation itself.

4.3.2 Sample Size

The major constraint of conducting inductive statistics is the assumption of the normality of research data sets. This is because the basic statistics, such as t-statistic or F-statistic, underlying most statistical inference techniques are based on the normality assumption. Accordingly, to achieve basic normality, a large sample size with a well designed representative sampling process is essential.

The basic sampling strategy of the study is to acquire a sufficient sample size for multivariate analysis through a representative sampling design. A sample size with a minimum of 30 observations is sufficient for the univariate normality assumption. In order to provide more in-depth discussion of the results of the hypotheses, the cases are divided into two groups in terms of IT intensity. A project with an IT intensity of more than 50% is classed as 'high IT intensity', otherwise it is considered low 'IT intensity'. Accordingly, a minimum of 60 observations are necessary for the study.

4.3.3 Sampling Frame

The sampling frame refers to the listing of the accessible population from which the study will draw the samples. Taiwan was selected as the focal area for conducting fieldwork. As discussed in section 1.4, the main concerns are the accessibility of the research population and an acceptable response rate. The sampling frame for the study is defined as a population that has the following attributes:

(1) The basic unit of the research cases is the complete strategic investment project within the previous 5 years. Uncompleted projects are therefore not considered as the focal objectives of the study.

(2) The objectives of the investment are of critical importance for the firm' long-term survival.

(3) The manufacturing sector is chosen as the focal sector to avoid the cross-sector influence. Thus, other sectors, such as service sector, are excluded from the research design.

4.3.4 Sampling Design

The current study uses an expert sampling design for collecting research data in order to increase the expected response rate. Experts in two professional associations, the Chinese Association for Industrial Technology Advancement and the Chinese Productivity Centre, helped to select organisations considered to be representative of the population. Such expert sampling is achieved by a two-stage process: the first stage identifies the focal companies for the study by consulting the opinions of experts, and the second stage selects SID projects for data collection.

270 firms were suggested by the experts and were identified as satisfying the above criteria. A postal questionnaire and a reference letter from the experts were sent directly to named individuals in the selected organisations. The respondents were all at management level and involved in investment decision-making processes. Respondents were asked to evaluate propositions based on a strategic investment project developed and implemented in the last five years of which they had experience.

4.4 Operational Definitions and Measurement

In research design, two classes of defining should be distinguished: constitutive and operational definitions. A constitutive definition defines a construct with other constructs, and an operational definition assigns meaning to a construct by specifying the activities or operations necessary to measure it (Kerlinger, 1973). Constitutive defining is roughly similar to dictionary defining. However, operational defining involves specifying (1) the class of persons, objectives, events or states to be observed; (2) the environmental conditions under which the observation takes place; (3) the operations to be performed in making the observations; (4) the instruments to be used to perform the operations; and (5) the observation to be made (Green et al., 1988). This section discusses the operational definitions of constructs which were discussed in Chapter 3 and also the definitions of SID and SID process.

Before discussing the operational definition, the concept of measurement and scaling needs to be clarified because measurement and operational definition often go together, and scaling is the branch of measurement that involves the construction of an instrument that associates qualitative constructs with quantitative metric units. Measurement is the general process through which numbers are assigned to objectives in such a fashion that it is also understood just what kinds of mathematical operations can legitimately be used, given the nature of the physical operations that have been used to justify or rationalise this assignment of numbers to objectives (Blalock, 1982). It is a way of obtaining symbols to represent the properties of persons, objectives, events or states.

Measurement can be distinguished in terms of level, according to the characteristics of order, distance and origin (Green et al., 1988), and the primary types of scales of measurement are nominal, ordinal, interval and ratio. Each scale differs in mathematical group structure and permissible statistics. That is, these scales reflect different levels of measurement, according to the number of characteristics of real number series (order, distance, origin) possessed by a scale type (Green et al., 1988).

Scaling is the assignment of objects to numbers according to a rule, and the approaches to developing scales are referred to as scaling techniques. In most scaling, the objects are text statements, usually statements of attitude or belief. To scale these statements, numbers must then assigned to them. In the current study, the semantic differential scaling technique is selected to investigate systematic stimuli variation. The respondent may be given a set of pairs of antonyms, with the extremes of each pair being separated by seven intervals. For each pair of adjectives, the respondent is asked to judge the corporation along the seven-point scale with descriptive phrases such as (1) very short, (2) short, (3) moderately short, (4) about average, (5) moderately long, (6) long, and (7) very long.

4.4.1 Strategic Investment Decisions

Barwise et al. (1987) indicate that SIDs are investment decisions with major long-term implications for the firm. SIDs may include decisions about new products, markets, technologies and capacity; vertical integration and acquisitions; and major investments in marketing, research or personnel. These decisions are strategic in the sense that they significantly help shape the firm's long-term future. A strategic IT investment decision is a strategic investment decision which has a high level of IT intensity. There are some problems here. First, the management may identify an investment project which is important for a firm's long-term future; however, it may not be seen in this way by other managers. That is, the selection of a project is quite subjective. Second, since the study requires the respondents to identify the outcome of the project, the project needs to be finished. The reliability of retrospection depends on the memory of each manager. These two constraints seem unavoidable. Therefore, in the study, respondents are clearly required to provide cases which are of well-recognised critical importance and which should be implemented within 5 years.

4.4.2 The Strategic Investment Decision-Making Process

Butler et al. (1993) indicate that strategic investment decision-making is both a formal rational process of trying to optimise financial returns to the organisation, and an organisational behavioural process in which local interests, informal interactions, hunches and other aspects of human behaviour that may, to an outside observer, appear as non-rational, play a vital part. Accordingly, the study employs constructs from both the rational school and political school to represent the decision-making process. Although the process is divided into stages including formulation, evaluation and performance measurement, there is no clear dividing line between each of the stages. The political factors, i.e. stakeholders' influence, may impact on the formulation process and the evaluation process. To avoid duplicating the questions, the political factors are surveyed in the formulation process only.

4.4.3 The Independent Variable - IT Intensity

The degree of IT intensity of an investment is measured by the ratio of IT spending to the total investment *(spend on IT/ spend on the whole project).* The informants were requested to give a certain ratio representing IT investment intensity in the case provided.

4.4.4 The Dependent Variable - Effectiveness

As discussed in Chapter 3, in this study, the effectiveness of SID refers to a performance indicator of objectives-attainment. However, the measure of the effectiveness of SIDs is unavoidably subjective. Dean and Sharfman (1996) calculate decision effectiveness in terms of the extent to which each objective has been attained and the weight of each objective and this approach is followed in this study for the following reasons. First, this approach is similar to the a multiattribute utility model (MAU) for the decision analysis. Reagan-Cirincione et al. (1991) indicate that the MAU approach is valuable for the decision modelling. Similarly, it ensure a thorough and equitable evaluation of all objectives under consideration, enhances accountablility by making explicit the criteria by which evaluations are made, and allows decision makers to readily compare the importance of the objectives. Second, the weight of each objective must reflect the potential contribution of the objective to the future value of the organisation.

Accordingly, twelve pre-defined strategic investment objectives were provided for the informants with a request that they should rate the importance (weight) of each objective as well as the performance of the investment projects in achieving these objectives. Then, the effectiveness of SIDs can be calculated by the following equation:

$$Effectiveness = \frac{\sum_{1}^{j} (I_j * A_j)}{n}$$

where Ij = the perceived importance of the jth objective,

Aj = the extent to which the jth objective is achieved, and

n = the total number of different objectives which respondents seek to attain.

4.4.5 Process, Content and Context Constructs

Based on a survey of the literature, Tables 4.2 to 4.5 show the operationalisation and sources of the formulation process, evaluation process, content and context constructs.

Table 4.2 Operationalisation and Sources of Formulation Process Constructs

Constructs	Variables	Operational definition	Sources
Duration	Process time	Time from formal proposal to implementation (1= very short, 7= very long)	Cray et al. (1988) Papadakis (1995) Hickson et al. (1986)
	Gestation time	Time to become a formal proposal (1= very short, 7= very long)	Cray et al. (1988) Papadakis (1995) Hickson et al. (1986)
	Disruption	Process interrupted by delay (1= no delay, 7= frequent delay)	Cray et al. (1988) Papadakis (1995) Hickson et al. (1986)
Organisational involvement	External involvement	Number of external organisations involved (1= few, 7= many)	Fredrickson (1984) Papadakis (1995) Astley et al. (1982)
	Internal involvement	Number of internal departments involved (1= few, 7= many)	Papadakis (1995) Astley et al. (1982)
Interaction	Quality of interaction	Quality of communication in formal meetings (1= poor, 7= very high)	Miller (1995)
	Information interaction	Discussions held outside the formal meetings (1= few, 7= many)	Cray et al. (1988) Skivington and Daft (1991) Hickson et al. (1986)
	Formal interaction	Formal meetings required (1=few, 7=very many)	Cray et al. (1988) Skivington and Daft (1991) Hickson et al. (1986)
	Scope for involvement	Scope for involvement in formal meetings (1= little, 7= considerable)	Fredrickson (1984) Papadakis (1995)
	Disagreement	Level of disagreement (1= very low, 7= very high)	Papadakis (1995) Amason (1996) Butler et al. (1991)
	Negotiation	Scope for negotiation (1= little, 7= considerable)	Dean and Sharfman (1996) Papadakis (1995) Cray et al (1988) Dean and Sharfman (1993) Hickson et al. (1986)
	Authority	Level of hierarchy involved (1= very low, 7=, very high)	Cray et al. (1988) Papadakis (1995) Hickson et al. (1986)
Stakeholder influence	Imbalance	Total pressure uneven across interested units (1= balanced influence, 7= imbalance)	Hickson et al. (1986)
	Contention	How far the interested units that exerted influence did so in opposite directions (1= strong opposition, 7= strong agreement)	Dean and Sharfman (1996) Petttigrew (1973) Dean and Sharfman (1993) Hickson et al. (1986)
	Pressure of influence	Weight of influence was exerted by interested units (1= little, 7= a lot)	Dean and Sharfman (1996) Mintzberg (1976) Fredrickson (1984) Hickson et al. (1986)

Table 4.3 Operationalisation and Sources of Evaluation Process Constructs

Constructs	Variables	Operational definition	Sources
Strategic deliberation	Consistency	Consistency of business strategy (1= unimportant, 7= very important)	Sabherwal and King (1995)
	Market growth rate	Growth rate of market related project (1= unimportant, 7= very important)	Sabherwal and King (1995)
	Competitive position	Competitive position of company (1= unimportant, 7= very important)	Papadakis (1995)
	Performance	Performance of company (1= unimportant, 7= very important)	Priem et al. (1995)
Information	Certainty / importance of information	1. Cost of investment 2. Cash flow at end of each subsequent period 3. Project duration 4. Cost of capital 5. The NPV of cash flow 6. The payback period 7. ARR 8. Profit 9. Productivity 10. Intangible costs 11. Intabgible benefit For accuracy (1= highly uncertain, 7= certain) For importance (1= unimportant , 7= important) For source (internal and/or external)	Dean and Sharfman (1996), Mintzberg et al. (1989), Langley (1989)
	Sources of information	Internal versus external	Fredrickson (1984) Papadakis (1995)

Table 4.4 Operationalisation and Sources of Content Constructs

Constructs	Variables	Operational definition	Sources
Decision importance	Precursiveness	Decision likely to impact on subsequent decisions (1= not at all, 7= a lot)	Hickson et al. (1986)
	Seriousness	How serious the consequences if this project goes wrong (1= not at all, 7= serious)	Hickson et al. (1986)
	Urgency	How urgent the decision was (1= not at all, 7= very urgent)	Rajagopalan et al. (1993)
	Radicalism	How radical the consequences if the project changes things (1= not at all, 7= radical)	Hickson et al. (1986)
	Openness	Decision influenced by previous decisions (1= weak, 7= very strong)	Hickson et al. (1986)
	Endurance	How far ahead people looked when making the decision (1= short term, 7= long term)	Hickson et al. (1986)
Rarity	Rarity	Frequency with which a similar project recurs (1= seldom, 7= very often)	Hickson et al. (1986)

Table 4.5 Operationalisation and Sources of Context Constructs

Constructs	Variables	Operational definition	Sources
Financial condition	Economic state	The economic state of industry (1= recession, 7= rapid growth)	Butler Cox (1990)
	Financial state	The financial state of the organisation (1= poor, 7= excellent)	Butler Cox (1990)
Competitive threat	Market situation	Your market situation. (1=very weak, 7=very strong)	Sharfman and Dean, Jr. (1997) Butler Cox (1990)
	Competitive climate	Strength of competition in the industry. (1= low, 7= high)	Butler Cox (1990)
Decision-making culture	Attitude to risk	Senior management□ attitude to risk (1= conservative, 7= innovative)	Butler Cox (1990)
	Decision-making style	Senior management□ decision-making style (1= directive, 7= consensus-driven)	Amason (1996) Butler Cox (1990)

4.5 Instrument Design and Administration

This section of the research involves using a questionnaire to collect quantitative data. The questionnaire serves as the tool for gathering larger-scale data needed to test the research hypotheses.

4.5.1 Questionnaire Design

The researcher could not find in the literature an existing instrument available for the purpose of the study. Therefore, a self-designed questionnaire was required. In the questionnaire (see Appendix 1), the top part of the front page comprised the name of Warwick Business School, the school logo, as well as a statement about strict confidentiality.

These pieces of information were given to show the identity and legitimacy of the institution carrying out the research. Underneath was a short explanation of the objectives of the survey, and also included were instructions regarding the completion of the questionnaire and operational definitions of some relevant terms.

The main body of the questionnaire consisted of five parts. The first part, **<u>Specific Strategic Investment Project</u>** (Q.1-8), contained questions about general profiles of the investment decision. The purpose of the first part was to collect information concerning the context of the organisation, IT intensity, and the importance and objectives of these IT in the investment projects.

The second part, **<u>Project Formulating Process Details</u>** (Q9, 10), covered questions about duration, interaction, involvement, and stakeholders' influence when the investment project was formulated.

The third part, **<u>Project Evaluation Process Details</u>** (Q11 - 13), included questions concerning strategic considerations, the accuracy of information, the importance of information, and uncertainty handling techniques used in the evaluation process. The purpose of this section was to gather crucial information relating to the evaluation activities.

The fourth part, **<u>Examines the Consequences of the Strategic Investment Project</u>** (Q14 - 16), asked respondents to identify the strategic objectives which were perceived as important before project implementation, the objectives attained after project implementation, unexpected outcomes and learning for future decision-making. The purpose of this section was to obtain data to measure the effectiveness of the proposed investment project.

Finally, the fifth part, **Corporate and Respondent's Details** (Q17 - 22), contained questions about company demographic data such as total capital of the organisation, and respondent's personal data including position level and reporting level to CEO. Again, a statement was presented to remind respondents that their information would be treated as strictly confidential.

4.5.2 Reliability and Validity

The process of developing the questionnaire involved other aspects beyond appearance, wording and layout. Of particular concern were the reliability and validity of the research. As stated by Kelinger (1973), if one does not know the reliability and validity of one's data, little faith can be put in the results obtained and the conclusions drawn from the results. Therefore, it is of vital importance to consider reliability and validity issues so as to ensure the quality of the research.

4.5.2.1 Reliability of the Instrument Design

According to Carmines and Zeller (1994), reliability concerns the extent to which an experiment, test or any measuring procedure yields the same results on repeated trials. Kerlinger (1973) proposes some general guidelines to improve the reliability of a research instrument, including writing the items of the measuring instruments unambiguously, adding more items of equal kind and quality, and providing clear and standard instructions for answering the questions.

In accordance with Kerlinger's guidance, pre-tests (see 4.5.3) were conducted prior to actual questionnaire delivery to ensure the reliablity of the research instrument. The pre-tests greatly helped the fine-tuning of the questionnaire so that the questions were easy to answer and the logic easy to follow. Reliability is different from criterion validity because of the focus of examination is the reliability of the measurement, in which the instrument is re-test by the same informants and results from both tests should be similar. An alternative way is through statistical techniques that examine the internal consistency of variables in the same data set, e.g. Cronbach Alpha test.

4.5.2.2 Validity of Instrument Design

According to Green et al. (1988:250), three different types of validity are generally used in testing an instrument: content validity, criterion validity and construct validity. Each of these will be dealt with in here.

- *Content Validity*

Content validity is concerned with how representative an instrument is of the universe of the content of the property or characteristics being measured (Green et al. 1988). This type of validity implies that all aspects of the attribute being measured are considered by the instrument. An instrument can be said to possess content validity if there is general agreement amongst experts in the field that the constituent items cover all aspects of the variable being measured.

To ensure high validity, the measuring instruments of the research were developed based on a comprehensive review of the literature, industrial experience obtained from pilot interviews with practitioners, and detailed evaluations by two academics and five managers. The research instruments can be said to have high content validity, although to some extent this is always a subjective opinion.

- *Criterion Validity*

Criterion validity is sometimes referred to as concurrent validity, external validity or predictive validity. Nunnally (1967) notes that it is at issue when the purpose is to use an instrument to estimate some important form of behavior, the latter being referred to as the criterion. He illustrates the concept with an example of a test employed to select college freshmen. The test, whatever it is like, is useful in that situation only if it accurately estimates successful performance in college. After the criterion is obtained, the validity of a prediction function is straightforwardly, rather easily, determined. Nunnally (1967) suggests that criterion validity, primarily consists of correlating scores on the predictor test with scores on the criterion variable. The size of correlation is a direct indication of the level of validity.

In the study, the criterion validity of the process, content and context constructs would be demonstrated if the score on the measures highly and positively correlate with the level of effectiveness.

- *Construct Validity*

Construct validity is concerned not only with the question 'does it work?' but also with the development of criteria that permit answering theoretical questions about why it works and what deductions can be made concerning the theory underlying the instrument (Green et al. 1988). So, construct validity in the study involves knowing well that all the constructs work; it also involves knowing that the measures work. To check the construct validity of the research instrument, factor analysis can be used. This is an approach widely used by researchers. The KMO index and Bartlett's test of the sphericity of factor analysis can be calculated to validate the constructs. Section 4.9.2.1 will discuss these techniques in detailed.

4.5.3 Administration of Instruments or Procedure

4.5.3.1 Pre-test

A pre-test to enhance the reliability and validity of the research was conducted before the final delivery of the questionnaire. The objective of the pre-test was to check whether respondents would have any difficulty in answering the questions. The pre-test also checked the comprehensiveness of the questionnaire. The sample for the pre-test included two academic researchers in Taiwan (one professor and one assistant professor), all with survey experience, and five investment managers from different corporations in Taiwan's manufacturing sector.

The questionnaires were first handed to the participants for them to look at and fill in. They were encouraged to include any remarks or suggestions deemed necessary. Also they were asked to evaluate the instruments for leading questions, clarity, relevance, biases and ambiguity. The pre-test showed that some changes were necessary. The participants later checked and approved the revisions.

4.5.3.2 Response Rate

The fieldwork of this research was conducted during 1996 and 1997. Thus, the sample projects resulted in project implementation between 1992 and 1996. In order to increase the expected response rate, judgment sampling was used. Experts in two professional associations, the Chinese Association for Industrial Technology Advancement and the Chinese Productivity Centre, helped to select organisations considered to be representative of the population. A postal questionnaire and a reference letter from the experts were sent directly to named individuals in the selected organisations. The respondents were all at management level and involved directly in investment decision-making processes. Respondents were asked to evaluate propositions based on a strategic investment project developed and implemented in the last five years of which they had experience. 270 organisations were selected and 94 responded, i.e. there was 34.8 percent response rate. Of these, 80 were valid for further analysis.

4.6 Limitations of the Research Design

Although a great deal of effort was made to ensure the quality of the research design, there are inevitably limitations owing to the constraints of available research resources. Any interpretation of the generalisation of findings from the study is subject to the following limitations: (1) the limitations caused by the research approach, and (2) the limitations caused by the sample design.

4.6.1 The Limitations Caused by the Research Approach

The major concern here is the use of a post hoc research design. Informants were requested to recall the project details that occurred during the previous five years. Limits of memory recall mean that project information provided by informants might be distorted. Furthermore, only significant information flows could be recorded. Stern (1979) contends that memories can be distorted to fit the view that makers a person most comfortable in the present. Another concern is the accuracy of the answers provided by respondents' participating in the questionnaire survey. Assael and Keon (1982) refer to this as response error. This type of error is important as, even taking into account the problems of recall ability and reliability, the respondents may still, intentionally or intentionally, provide false information. Nevertheless, these are the inevitable limitations of any post hoc research.

4.6.2 The Limitations Caused by the Sample Design

- *The Population*

The results from the study can only be applied to Taiwanese firms that show similar characteristics to the response firms in the study. Any generalisation of the research results to other populations would be premature. However, the findings do provide insights into the IT investment phenomenon which can contribute to the extension of knowledge in both theory and practice.

- *Possible Sampling Bias*

Sampling errors are related to the sampling design itself. Such bias may occur because of the under- or over-representation of particular types of cases in the sample compared with the population as a whole. In particular, the study uses expert sampling. There is bound to be some expert bias in choosing the cases. For example, they may choose only those cases with which they are familiar. The quality of such a list, based on the experts' personal perceptions of qualified cases, was beyond the control of the researcher. Possibly the list merely represented the experts' preference in selecting cases rather than the full picture.

- *Possible Non-Sampling Bias*

Non-sampling bias arises in the implementation of the sampling design. Non-response errors may occur when the views of non-respondents are distinct from those of respondents, and when the number of non-respondents is large enough to outweigh the common view drawn from respondents. Face-to-face interviews or contact by telephone with a sub-sample of the people who do not return their questionnaires can be used to investigate the reasons for non-response. An effort was made to contact sub-sample (12 cases); however, only 8 out of the 12 cases were available. Several reasons for non-response were given: (1) 3 cases indicated that only the office spokesperson could answer the question, (2) 2 indicated that the topic was too confidential, (3) 1 case indicated that there no such investment case could be provided, and (4) 2 cases indicated that they dis not have the knowledge to answer the questionnaire. As the study achieved a 30% response rate, this problem was minimised. At the same time, special caution has to be taken when trying to generalise research findings.

- *Non-Experimental Bias*

Because of its non-experimental nature, the present research is unable to control the independent variable. Also it lacks the power to randomise the independent variable. Thus, the hypothesised relationships between the independent variable and the dependent variable cannot be asserted with the confidence of an experimental situation. Therefore, any interpretation of definite causal relationships between the two variables would be premature. This bias is always an issue in non-experimental research.

4.7 Analytical Techniques

The data analysis consists of four steps presented in this study. The first step is to understand the characteristics of the returned questionnaires and the nature of variables. Descriptive statistics are used to get a clear view of the sample. The second step investigates the distinguishing variables in strategic investment decisions (SIDs) according to the extent of IT intensity in the project. The third step aims to validate the proposed constructs in the theoretical framework. Factor analysis is then used to validate constructs. The fourth step is to test the relationships amongst IT intensity, decision process, decision content, decision context, and the effectiveness of SIDs. Regression analysis is employed in this part of the analysis.

4.7.1 The Testing of Normality

Normality is the degree to which the distribution of the sample data corresponds to the normal distribution. Testing for normality of the data is a necessary step before the application of correlation analysis in step 2. To examine the shape of the distribution, a histogram can be used. This is a graphical representation of data that reveals the frequency of data values within data categories. The histogram provides a visual basis for checking normality. In addition, it is often desirable to compute a statistical test of the hypothesis that the data are from a normal distribution. One commonly used test is the ***Lilliefors*** test, which is based on a modification of the ***Komogorov-Smirnov*** test.

Appendix 2 shows the results of the ***Lilliefors*** test for the variables in the survey data. From the small observed significant level, the hypothesis of normality should be rejected for most of the variables. The results of the tests of normality needs to be considered in the selection of appropriate statistical techniques, which will be discussed later.

4.7.2 Univariate Analysis

Univariate analysis, as in descriptive statistics, chi-square Test, *t*-Test, and one-way ANOVA (analysis of variance), offers useful tools for exploring the nature of data sets acquired form empirical fieldwork. The current study uses descriptive statistics (e.g. frequencies, means, standard deviations) to validate the correctness of data coding, reveal the characteristics of sample profile, and portray a general picture of decision-making behaviour of the sample cases.

4.7.3 Bivariate Analysis

Correlation analysis is a widely used tool for examining relationships (e.g. IT intensity and effectiveness) between variables. Bivariate correlation analysis assumes a linear relationship between variables (e.g., X and Y) if the covariance of these two variables is not zero. Such a relationship is represented by the linear correlation coefficient, which is directly derived from the covariance of the two variables. One of the commonly adopted correlation measures is the ***Pearson*** correlation coefficient which is applicable where the variables are normally distributed. The absolute value of ***r*** indicates the strength of the linear relationship between the variables ***X*** and ***Y***. The ***r*** has a range between -1 and +1. A positive ***r*** means a positive linear relationship between the two variables, while a negative ***r*** denotes a negative linear relationship. However, a zero ***r*** does not mean that there is no relationship between the two variables. Rather, it only suggests that there is no linear relationship. It is possible that there is strong non-linear relationship between the two variables.

The ***Spearman*** correlation is a non-parametric version of the ***Pearson*** correlation coefficient. The ***Spearman*** correlation is based on the ranks of the data rather than the actual values. It is appropriate for ordinal data or for interval data that do not satisfy the normality assumption. Accordingly, this study will employ the ***Spearman*** correlation rather than the ***Pearson*** correlation as a measure of linear association of IT intensity and variables. In this case, the measurement level of IT intensity will be downgraded to the ordinal level before proceeding with the correlation test.

4.7.4 Multivariate Statistics

Multivariate statistics is a general term used to describe a group of mathematical and statistical methods the purpose of which is to analyse multiple measures of N individuals (Kerlinger 1986). The particular phenomena which a research project wishes to study and explain may be complex. There may be many variables which influence such phenomena, and multivariate methods are ways of studying the multiple influences of several independent variables on one or more dependent variables. In measuring many variables, multivariate techniques enable a researcher to perform a single analysis instead of a series of univariate or bivariate analyses (Tabachnick and Fidell, 1989). There are many kinds of multiple techniques including multiple ANOVA, multiple regression, canonical correlation, factor analysis, cluster analysis, and so on. In this section, only those analyses that are relevant to the current study are discussed. These include factor analysis and multiple regression.

4.7.4.1 Factor Analysis

Factor analysis is a multivariate statistical technique that is concerned with defining new factor variates as linear transformations of original correlated variables (Overall and Klett, 1972). This study conducts a principal components factor analysis with varimax rotation to assess convergence within and divergence between scales. Items composing the various power scales are factor analysed to assess their convergent and discriminant validity.

One way to test the appropriateness of applying factor analysis is through the Kaiser-Meyer-Olkin Measure of Sampling Adequacy (known as ***KMO*** or ***MSA***). Small values for ***KMO*** measures mean that the simple correlation coefficient between variables is small and the partial correlation coefficient is large. Here this means that correlations between pairs of variables cannot be explained by the other variables. As a result, a factor analysis of the variables may not be a good idea. To test the appropriateness of applying factor analysis, Kaiser (1974:35) proposes the following index for reference:

Table 4-6 Interpretation of KMO Index

KMO Index	Suitability for Factor Analysis
in the 0.90s	marvelous
in the 0.80s	meritorious
in the 0.70s	middling
in the 0.60s	mediocre
in the 0.50s	miserable
below 0.50	unacceptable

One important issue in using factor analysis is deciding which factor loadings are worth considering when it comes to interpreting the factors. As a rule of thumb, loadings with a value of 0.3 or greater can be taken as significant if the sample size is greater than 100 (Child, 1990). Hair et al. (1995) propose following more accurate criteria: factor loadings greater than 0.3 are considered significant; those greater than 0.4 are considered more important; and if the loading are 0.5 or above, they are considered very significant. The larger the absolute size of factor loading, the more significant the loading is in interpreting the factor matrix.

The methods of extracting factors described so far are sometimes referred to as direct methods because the factor matrix obtained arises directly from correlation matrix by the application of a specified mathematical model. Most factor analysts are now agreed that some direct solutions are not adequate (e.g. Child, 1990; Steward, 1981). In most cases, adjustment of the frames of reference of the direct method improves the interpretation of the results. The process of manipulating the reference axes is known as rotation. According to Everitt and Dunn (1991), this is a procedure which allows new axes to be chosen so that the positions of the points can be described as simply as possible. The results of rotation methods are sometimes referred to as derived solutions because they are obtained as a second stage from the results of direct solutions (Child, 1990).

4.7.4.2 Multiple Regression

Multiple regression refers to a regression model in which the fitted value of the response variable (*Y*) is a function of the values of one or more predictor (*X*) variables. The most common form of multiple regression is multiple linear regression, a linear regression model with more than one *X* variable. That is, multiple linear regression fits a response variable as a linear combination of multiple *X* variables by the method of least squares.

Regression analysis usually proceeds in four steps: (1) identifying the objective of regression analysis; (2) searching violations for assumptions; (3) estimating the regression model and assessing overall fit; and (4) interpreting the regression variate. These issues will be discussed in turn.

Objective of Multiple Regression. The application of multiple regression falls into two broad classes of research problems: prediction and explanation. For prediction, multiple regression provides an objective means of assessing the predictive power of a set of independent variables. In applications focused on this aim, the research is primarily interested in achieving maximum prediction. For explanation, the most direct interpretation of regression variate is a determination of the relative importance of each independent variable in the prediction of the dependent measure. Regression analysis then provides a means of objectively assessing the magnitude and direction (positive or negative) of each independent variable's relationship. For this study, the regression model will be employed to test the hypothesised relationships between constructs, that is, the regression model is used mainly for explanation rather than prediction.

<u>Assumptions in Multiple Regression Analysis.</u> This step focuses on examining the variate and its relationship with the dependent variable for meeting the assumption of multiple regression. The method of least squares analysis is quite robust in that small or minor violations of the underlying assumptions do not invalidate the inferences or conclusion drawn from the analysis (Chatterjee and Price, 1991). However, any gross violation of the model's assumptions can seriously distort the conclusion.

A simple and effective method for detecting violations of the model's assumptions is by examining the residuals (Chatterjee and Price, 1991) which represent error in predicting the sample data. The residuals will sum to zero, but they will not have the same variance. To overcome this deficiency, standardised residuals which transformed residuals into new measurement variables with a mean of 0 and a standard deviation 1. The standardised residuals do not sum to zero, but they have the same variance. With a moderately large sample, these residuals should be distributed approximately as independent, normal deviates. Chatterjee and Price (1991) suggest the use of residual plots to examine violations of the model's assumptions. An appropriate graph of the residuals will often expose gross model violations when they are present. The inferences about population values from the sample results are based on the following assumptions (Hair et al. 1995):

- **The linearity**

The linearity of the relationship between the dependent variable and independent variables represents the degree to which change in the dependent variable associated with the predictor variable is constant across the range of values for the independent variables. *Diagnosis is made with residual plots which standardise residuals against the predicted criterion value and predictors.* Violations can be identified by typical patterns of the residuals.

- **The constant variance of the error terms (Homoscedastic)**

When the variance of the error terms appears constant over a range of predictor variables, the variables are said to be homoscedastic. When the error terms have increasing or modulating variance, the data are said to heteroscedatic. *Diagnosis is made with residual plots which standardise residuals against the predicted criterion value.* Violations can be identified by specific patterns of the residuals.

- **The independence of the error terms**

Whenever the data are collected and recorded sequentially, this can influence the residuals. In regression, the predicted values are assumed to be statistically independent of each other. That is, they are not sequenced by any variable. If the residuals are independent, the pattern should appear randomly when plotting residuals against any possible sequencing variable. Violations will be identified by a consistent pattern in the residuals. Alternatively, the ***Durbin-Watson*** statistic, a test for the serial correlation of adjacent error terms, can be used to test the independence of error terms. Since this study did not collect data sequentially, this assumption will not be violated. Accordingly, no effort will be made to test for this assumption.

- **The normality of the error term distribution**

The simplest diagnostic for the sets of predictor variables in the equation is a histogram of residuals, with a visual check for a distribution approximating the normal distribution. Alternatively, the ***Lilliefors*** tests of normality can be employed to test the normality of error term distribution. This study will present both a histogram of residuals and the ***Lilliefors*** test to test the normality assumption.

Estimating the Regression Model and Assessing Overall Fit. Having specified the objectives of the regression analysis and assessed the variables for meeting the assumptions of regression, the next step is to (1) select a method for specifying the regression to be estimated, (2) assess the statistical significance of the overall model, and (3) determine whether any of the observations exert an undue influence on the results.

Variable selection can be conducted by confirmatory specification, which completely specifies the set of independent variables or by sequential search approaches (e.g., backward elimination, stepwise estimation), in which a set of variables are selectively added or deleted until some overall criterion measure is achieved. In this study, confirmatory specification is used first since this study has already specified several constructs (e.g., IT intensity) for regression. Then, the sequential search approaches will be employed to explore the critical variables and explain the effectiveness of DIS.

The statistical significance of the overall model can be examined by the coefficient of determination, F statistic, which is from the analysis of variance. The analysis of variance shows both the residual sum of squares and the regression sum of squares and degree of freedom. The mean square for each entry is the sum of squares divided by the degrees of freedom. If the regressions are met, the ratio of the mean square regression to the mean square residual is distributed as an F statistic. This serves to test how well the regression model fits the data.

The goodness-of-fit of the model to the observed data (prediction fit) can be evaluated by the sample correlation coefficient, (***R***), coefficient of determination (***R^2***), adjusted coefficient of determination (***adjusted R^2***) and standard error of the estimation. The ***R^2*** is a positively biased estimate of the proportion of the variance of the dependent variable accounted for by regression. The ***Adjusted R^2*** is a modified measure of the ***R^2*** that takes into account the number of predictor variables included in the regression model. The ***adjusted R^2*** value is particularly useful in comparing across regression equations involving different numbers of predictors or different sample sizes, because it makes allowance for the specific number of predictors. Unlike the ***R^2***, the ***adjusted R^2*** cannot be interpreted as a proportion of total variation in dependent variable explained by the regression model (Chatterjee and Price, 1991). The stand error is the standard deviation of the residuals which is a measure of the variation in the predicted values that can be used to develop a confidence interval around any predicted value.

Influential observations contain three basic types: outliers, leverage points, and influentials. Outliers are observations that have large residual values and can be identified only with respect to a specific regression. Leverage points are observations that are distinctive from the remaining observations based on their independent variable values. Their impact is particularly noticeable in the estimated coefficients for one or more predictor variables. Influential observation is the broadest category, including all observations that have a disproportionate effect on the regression results. Influential observations potentially include outliers and leverage points, but not all outliers and leverage points are necessary.

Outliers have traditionally been the only form of influential observations considered in the regression model. For simple regression in this study, any cases found with a standardised residual greater than ± 2 standard deviations will be deleted from the model building procedure. However, the leverage and influence measures (Cook's distance) are particularly useful in multiple regression situations when we are dealing with several repressors (Chatterjee and Price, 1991). Both leverage and influence plots will be employed for the multiple regression model. Points with high leverage that are not influential do not cause problems, and points with a substantially but not high leverage point do not necessarily have a harmful effect on the fit. Therefore, points with both high leverage and a substantially different influence will be deleted form the model building procedure.

Chatterjee and Price (1991) suggest that any point has be identified as influential observation, is should be carefully examined for accuracy (gross error, transcription error), relevancy (whether it belongs to the data set), and special significance (abnormal condition, unique situation). Although the objective of the deleting action is to produce the most representative sample data to reflect the population fit, the deletion action may also lead to a reduction of goodness-of–fit and may reduce the effect of the independent variable on the dependent variable. In this case, as suggested by Chatterjee and Price (1991), it may be most valuable to try to understand the special circumstances that generated the extreme response. That is, as stated by Hair et al. (1995), the analyst is encouraged to delete truly exceptional observations but must still guard against deleting observations that, while different, are representative of the population.

Interpreting the Regression Variate. In interpreting the regression equation and associated statistics, the analyst must show the variables in the model along with the regression coefficient (B), standard error of the regression coefficient, and the standardised regression coefficient (β) and multicollinearity.

The estimated regression coefficients are used to calculate the predicted value for each observation and to express the expected change in the dependent variable for each unit change in the independent variables. The standardised regression coefficient is the slope of the least-squares line when **X** and **Y** are expressed as **Z** scores and serves as a guide to the relative importance of the predictor variables included in the regression model.

A key issue in interpreting the regression variate is the correlation among the predictor variables. High multicollinearity results in a large portion of shared variance and lower levels of unique variance from which the effects of the individual predictor variables can be determined. The simplest and most obvious means of identifying collinearity is an examination of the correlation matrix for the independent variables. Hair et al. (1995) suggest that the presence of high correlation (generally of 0.90 and above) is the first indication of substantial collinerarity. Moreover, two of the more common measures for assessing collinearity are the tolerance value and its inverse, the variance inflation factor (VIF). Tolerance is the amount of variability of the selected independent variable not explained by the other independent variables. Thus, very small tolerance (and large VIF values) denote high collinerarity. A common cut-off threshold is a tolerance value of 0.10, which corresponds to a VIF value of 10.

4.8 Ethical Issues

Ethical issues are often confronted in data collection, for example in maintaining the confidentiality of the data, in gaining access to the field, and in avoiding deception as the role of researcher (Baker, 1994). In the present study, the required strategic investment information is confidential. In fact, there were several organisations which sent the questionnaire back and stated that for confidential reasons, they could not get involved in the research. By contrast to these organisations, some organisations completed and returned questionnaires with an extra sheet which asked the researcher to ensure that all data remained confidential. Accordingly, ethical issues are important in the study, and they should be addressed.

Essentially, this means that prospective research participants must be fully informed about the procedures and risks involved in the research and must give their consent to participate. Ethical standards also require that researchers do not put participants in a situation where they might be at risk of harm as a result of their participation. There is one standard rule that is applied in order to help protect the privacy of research participants. Almost all research guarantees the participants confidentiality; they are assured that identifiable information will not be made available to anyone who is not directly involved in the study. As mentioned in the questionnaire design section, a strictly confidential statement is given to remind respondents not to worry about this problem:

> *The results will be treated confidentially. Individual respondents and organisations will* <u>*not*</u> *be named in the report. Participants will receive a complimentary copy of the final report. Please complete the following corporate and respondent's details.*

Another rule is the principle of anonymity, which essentially means that the participants will remain anonymous throughout the research. Clearly, anonymity is a stronger guarantee of privacy. The study also follows this rule.

4.9 Summary

A research project is a sequence of highly interrelated activities. It requires careful planning in an orderly investigation to ensure quality. This chapter has illustrated the efforts made for the study. Table 4.7 outlines the research design and research procedure. The research proceeds in a series of three interrelated phases: theory construction, empirical testing, and further examination of implications.

To collect data, a survey method was adopted. Issues important to ensuring that reliable data were obtained have already been explained including instrument design, pre-test, reliability and validity. The testing process for detailed hypotheses and further examination of the impacts of IT intensity will be reported in Chapter 5. The implications of the theory and survey findings and their extension in terms of IT evaluation are reported in Chapter 6.

Table 4-7 Outline of the Research Design and Research Procedure

Steps		Method	Sections
Phase I: Theory construction			
1	Identification of constructs which may impact on the effectiveness of SIDs	Literature Review	3.3
Phase II: Empirical Testing			
2	Development of the questionnaire to be sent to managers to collect relevant data	Review of the literature Consulting academics scholars Pretesting, modification of the questionnaire	4.4
3	Sampling and data collection.	Expert sampling Mail survey Questionnaire completed by managers	4.3
4	Validating constructs	Factor analysis Cronbach's Alpha Test Correlation analysis	5.2
5	Test of the influence of IT intensity on variables	Correlation analysis	5.2
6	Test of mediating effect between the linkage of IT involvement and effectiveness of SIDs	Factor analysis Regression analysis	5.3
7	Clearly explores the critical factors for the effectiveness of SIDs	Regression analysis (stepwise)	5.4
Phase III: Extending the Quantitative Findings			
8	Derive a protocol for SIDs.	Mapping chapter to literature review and discussion	6.2
9	Integrate the rules of the protocol into a model	Literature review and discussion	6.3
10	Conclusion, managerial implication, critiques and recommendations	Discussion	7.2

Chapter 5. Investigation of the Impacts of IT Intensity

5.1 Introduction

This chapter presents the profiles of the survey data and investigates the impacts of IT intensity from three perspectives. First, the nature of the data is explored and a **Spearman** correlation test is employed to explore the distinguishing variables of SIDs in terms of IT intensity. Second, the theoretical model proposed in Chapter 3 is empirically tested by multi-variate regression analysis. Third, by extending the findings of the previous two sections, the critical factors which impact on the effectiveness of SIDs are identified.

Section 5.2 briefly describes the sample profiles of the survey data. Descriptive statistics may be useful for exploring the nature of data sets acquired from empirical fieldwork and for revealing the characteristics of the sample profile. This section also investigates the distinguishing variables in strategic investment decisions (SIDs) according to the extent of IT intensity in the project. IT intensity is assessed in relation to a number of dimensions such as decision process and decision content.

Section 5.3 focuses on the testing of hypotheses. It first discusses the validating and reliability of measurement. Then, a principal components factor analysis with varimax rotation is conducted to assess convergence within and divergence between scales. This section then focuses on testing the linkage of IT intensity and the effectiveness of SIDs; the aim is to test the mediating effects of process and content constructs. An in-depth discussion of this part of the findings is also presented.

Section 5.4 explores the critical factors which can be used to explain the effectiveness of SIDs. Unlike section 5.3, this section uses the variables of survey data rather than the constructs in order to avoid the loss of information which results from the use of factor analysis. One of the sequential search approaches, stepwise estimation, is employed to select variables to fit the regression model. The implication of these variables will be discussed in the next chapter.

5.2 Descriptive Statistics and the Impact of IT Intensity on Variable Level[2]

5.2.1 Sample Profiles

5.2.1.1 Topics of Decision

The project's name in the questionnaire is used as a means of distinguishing different decision topics. According to the categories used by Hickson et al. (1986), there are five decision topics from the survey data, including new technologies (representing investment in equipment and/or premises), control (representing planning, budgeting and requisite data-processing), domain (representing investment

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[2] The early version of the analysis and findings in this section have been published in Proceeding of the Fourth European Conference of Evaluation of Information Technology, Delft, the Netherlands, 1997.

in marketing and distribution), products (representing investment in new products), and locations (representing investment in new sites and sites dispersal).

Table 5.1 shows that the decision topics involve new technologies (35%), control (13.8%), domains (3.8%), products (11.3%), and locations (13.8%). 22% of cases did not identify their project's name. All these different characteristics fit the nature of SIDs. These categories shows that the survey data cover a wide range of SIDs.

Table 5.1: Decision Topics

Decision topics	Frequency	Percentage
New technologies	28	35
Controls	11	13.8
Domains	3	3.8
Products	9	11.3
Locations	11	13.8
Missing	18	22.5

5.2.1.2 Organisational Level of the SID Process

The fourth question of the questionnaire (see Appendix 1) explores the organisational level at which the SID process occurs. The results of question 4 are shown in Table 5.2. The majority of corporations have their SID processes at the corporate level (85%); only 3.75% at the business level and 7% at the divisional level (see Table 5.2). By contrast, Marsh et al. (1988) indicate that most of the processing and analysis of strategic investment decisions, except for major acquisitions, occurs at the divisional level and the final authority for major investments is vested in top management. Two possible reasons can be given to explain this difference. First, by examining the decision topics shown in Table 5.1, it can seen that most of the collected data are related to purchasing i.e. new technologies and new locations. Second, Marsh et al. focused on large, diversified companies and used small-scale case research. The current study involves both large, medium and small sized companies (see Table 5.3).

Table 5.2: Organisational Level of the SID Process

Organisational level of the SID process (Q4)	Frequency	Percentage
Corporate	68	85
Business	3	3.75
Division	7	8.75
Other	1	1.25
Missing	1	1.25

5.2.1.3 Capital

Capital represents the size of respondent companies. Table 5.3 presents the result and shows that the respondents' capital represents a wide range of organisational size. The exchange rate in the survey period (December 1996 to March 1997) was approximately 1 GBP= 45 NT Dollars.

Table 5.3: Corporate Registered Capital

Corporate Registered Capital (Q18)	Frequency	Percentages
Under 100 Million NT	13	16.25
100 M - 250 M	15	18.75
251M - 600 M	15	18.75
601M - 2500M	13	16.25
2501M- 6000M	8	10
60001M- 20000M	6	7.5
Missing	10	12.5

5.2.1.4 Respondents' Hierarchical Level and Reporting Level to CEO

In addition to obtaining information regarding the decision topics and size of respondent organisations, the current study is also interested in the details of the individuals who completed the research instrument. To this end, the following information was sought: position held in the organisational structure and the number of reporting levels existing between the respondent and chief executive. The majority of respondents are employed within top management (55%). 35% of the respondents are in the middle level of management. Only 10% hold low level management positions. The results in Table 5.4 also show that respondents are employed within reasonably high managerial levels, with 42% reporting directly to the CEO, and 18.8% within one reporting level, 16.7% within two reporting levels, and only 10.2% within three or more levels.

Table 5.4 Respondents' Hierarchical Level and Reporting Level to CEO

Respondents' hierarchical level (Q22)	Frequency	Percentage
Top management	44	55
Middle level management	28	35
Lower level management	8	10
Respondents' reporting level to the CEO (Q23)		
Direct link	42	52.5
One level	15	18.8
Two levels	13	16.7
Three or more levels	8	10.2
Missing Data	2	2.5

5.2.2 Specific Strategic Investment Projects

This section describes the general findings relating to specific strategic investment projects and deals with two independent constructs (the investment context, the degrees of IT intensity), the importance of IT and the role of IT infrastructure, and the major purposes of IT in the investment project. A summarised discussion is given below.

5.2.2.1 The Investment Context

The organisational investment context (see Table 4.5 also Q3 of questionnaire, see Appendix 1) has an impact on how investment is organised and conducted, and on what priorities are assigned to different IT investment proposals. The results of a descriptive statistical analysis of the six variables which are deemed to be important for the investment decision are shown in Table 5.5. All these variables were measured on a seven-point interval scale.

The mean for all these variables is higher than the mid-score point. The data also show that these corporations are all in a very good financial state (mean = 5.241) and enjoy a high competitive strength in the industry (mean = 5.025) when they decide to allocate their resources for long-term survival. The senior management's attitude to risk (mean = 4.675) also shows the innovative nature of management. This finding complements one of the SIDs' characteristics: higher uncertainty than in other investment decisions.

Table 5.5: (Q3.) The Investment Context when this Project was Developed

Investment context variables	*Mean*	*Standard Deviation*	*Sample Size*
The economic state of the industry	4.188	1.662	80
Financial state of company	5.241	1.579	79
Market situation of company	4.600	1.635	80
Strength of competition in the industry	5.025	1.222	80
Senior management's attitude to risk	4.675	1.581	80
Senior management's decision-making style	4.463	1.509	80

5.2.2.2 The Degrees of IT Intensity in SIDs

The different degrees of IT intensity in SIDs (Q5 of the questionnaire, see Appendix 1) were measured by the ratio of spending on IT to the total investment (see Section 4.4.3). Within the theoretical model, IT intensity is the most important construct in the current study. Table 5.6 presents the results (frequency and percentage) of IT intensity. These show that the level of IT intensity is very widely spread.

However, based on the distribution of frequency, IT intensity seems to focus on the two extremes: 24 cases involve no IT, and 21 cases involve a level of at least 80% of IT. The other cases are distributed between these two extremes. Thus, the distribution is quite unlike the bell share distribution and corresponds to a 'U' share distribution. Of course, this may reflect the real distribution of the population but it is more likely to be caused by the difficulty of measuring of IT intensity. In the instructions provided with the questionnaire, the respondents were asked to supply details of a strategic investment project. The guidance notes defined 'SIDs' and 'IT' but did not give any clue about 'SITIDs'. Possibly, the tendency to select either extremely low or extremely high IT investment projects was due to the fact that respondents could more easily identify the ratio for IT intensity in these cases.

In the next section, the ***Spearman Correlation Test*** is employed to test the correlation between the different degrees of IT intensity and investment decision-making variables. The aim of this test is to explore whether the nature of strategic investment decisions does vary according to different degrees of IT investment. This part of the research relates to research question 2 (see Section 1.3). This study will discuss the findings from the tests in Section 5.2.10 rather than in the Sections 5.2.3 to 5.2.9.

Table 5.6: (Q5.) Ratio of spend on IT to total investment

IT Intensity	*Frequency*	*Percentage*	*Cum. Percent*
0	24	30.0	30.0
1	1	1.3	31.3
2	1	1.3	32.5
3	1	1.3	33.8
5	2	2.5	36.3
10	5	6.3	42.5
15	1	1.3	43.8
18	1	1.3	45.0
20	2	2.5	47.5
30	4	5.0	52.5
31	1	1.3	53.8
40	1	1.3	55.0
45	1	1.3	56.3
50	9	11.3	67.5
60	2	2.5	70.0
70	3	3.8	73.8
80	5	6.3	80.0
90	7	8.8	88.8
100	9	11.3	100.0
Total	80	Mean 38.563	Std dev 38.026

5.2.2.3 The Importance of IT and the Role of IT Infrastructure

The current study defines a strategic IT investment decision as one with high IT intensity in a strategic investment decision (see Section 3.4 and Section 4.4.1). This definition implicitly assumes that if a higher IT level is involved in a SID, IT must play an important role in that SID and it can be termed as a strategic IT investment decision. Table 5.7 presents the means and standard deviations of the 'importance of IT' (mean = 3.85, s.d. = 2.8), and 'the extent to which this project relies on existing IT infrastructure' (mean = 4.9, s.d. = 1.6). The correlations between (1) the importance of IT and IT intensity and (2) IT infrastructure and IT intensity are also given in Table 5.7.

The results show that the importance of IT in the whole project is highly positive when correlated to IT intensity (r = .711, Sign. of t = .000). This finding may seem very trivial, but it supports one of the important justifications of the current study in that few researchers have focused on the continuum nature of decisions according to the IT dimension. However, the relationship between IT intensity and IT infrastructure is not significant (r = .140, Sign. of t = .310). This finding of the importance of IT and the role of IT infrastructure is interesting. The mean of importance of IT in the whole project is not very high, but the higher the IT intensity in a strategic investment project, the greater the importance of IT. By contrast, the IT investment may rely heavily on the existing IT infrastructure but without a correlation with IT intensity.

Table 5.7: (Q6, Q7) The importance of IT and the role of IT infrastructure*

IT and Project	*Mean*	*Std Dev.*	*Size*	*Spearman (Sign. of t)*
Importance of IT in the whole project	3.850	2.891	55	.711 (.000)
To what extent does this project rely on existing IT infrastructure?	4.963	1.601	54	.140 (.310)

*: The correlation of the variables with IT intensity are discussed in section 5.2.10.

5.2.2.4 Major Purposes of IT in the Investment Project

Question 8 of the questionnaire (see Appendix 1) about the purposes of IT in the investment project aims to explore the primary function of IT in a SID. Table 5.8 shows the ranking and frequency of the major purposes of IT in the investment project. 'To improve productivity and performance' is ranked first, followed by 'to reduce costs of production' and 'a tool to provide information for the user'. The re-engineering features of the organisation's structure and goals appear at the bottom of the ranking list.

When considering the major purposes of IT, Earl (1988) indicates that IT can be applied strategically in at least four different ways: to gain competitive advantage, to improve productivity and performance, to facilitate new ways of managing and organising, and to develop new business. The results of this study confirm these four different IT applications which fall into the top six of the rankings. The two additional purposes in the top 6 ('to reduce costs of production' and 'as a tool to provide information for the user') can also be deemed as part of competitive advantage and improve productivity and performance. Although IT investment may be part of a broader and risky attempt to re-engineer the major features of an organisation's structure and goals (Coombs, 1995), the priority here is not very high. This is because IT alone will not provide sustainable competitive advantage. IT and re-engineering are not the only factors to be considered in strategic change projects.

Table 5.8: (Q8) Major Purposes of IT in the Investment Project

Purposes	Frequency	Ranking
To improve productivity and performance	38	1
To reduce costs of production	37	2
As a tool to provide information for the user	34	3
To gain competitive advantage	33	4
To develop new business	25	5
To facilitate new ways of managing and organising	23	6
New skills and information are developed to indicate where new market opportunities exist	21	7
Generate new information as a by-product of the basic task	20	8
To re-engineer major features of the organisation's structure and goals	14	9

5.2.3 Decision Process, Content, and IT intensity

5.2.3.1 Decision Process and Decision Content

The process of decision-making (see Table 4.2) refers to the actions, reactions and interactions of the various interested parties as they seek to make a commitment to allocate corporate resources. The content of decision refers to the particular decision under study. Question 9 in the questionnaire (see Appendix 1) explores the decision process and decision content variables in the strategic *investment project formulation process. All these variables are measured on a seven-point scale. The results are shown in Table 5.9. Compared with other* investment decisions, SIDs seem to be less time-consuming because the means of three-time related variables are all below the average score: the time to become a formal proposal (mean = 3.986), the time from formal proposal to implementation (mean = 3.700), and process interrupted by delay (mean = 3.329).

One possible reason for this result is the urgency (mean = 5.165) of the SID. The results also show several important characteristics, which complement the findings in the literature. Compared with other investment decisions, SIDs exhibit a higher level of involvement (mean = 5.823); consequences are seen to be very serious if the project goes wrong (mean = 4.937); and the consequences of the project tend to change things radically (mean = 4.859). This result confirms the assertion that strategic investment decisions are very important for the firm's survival (Hapselaugh, 1982). Furthermore, because of the importance of SIDs, corporations need more interactions when making a SID, including formal meetings (mean = 4.650), a good quality of communication (mean = 4.938), and informal discussions (mean = 4.924).

Marsh et al. (1988) indicate that strategic investment decisions are decisions which have a significant impact on the firm as a whole and on its long-term performance. Therefore, people need to look further when making the decisions (mean = 5.747) and the decisions are likely to impact on subsequent decisions (mean = 5.342). The weight of influence exerted by interested units is very high (mean = 4.684) because strategic investment decisions are seen as political processes, and political considerations are important and significantly influence investment decisions (Marsh et al., 1988; Weill and Olson, 1989). However, the areas of disagreement are below the average. This leads to less conflict between interested units. Accordingly, the total pressure is uneven across interested units (mean = 3.759) and the influence exerted by interested units in opposite directions (mean = 2.692) is also below average.

Table 5.9: (Q9) The Process and Content of Strategic Investments*

Activities	*Mean*	*Std. Dev.*	*Size*	*Spearman (Sign. of t)*
Time to become a formal proposal	3.986	1.612	73	-.098 (.405)
Time from formal proposal to implementation	3.700	1.521	80	-.046 (.681)
Process interrupted by delay	3.329	1.474	79	-.098 (.388)
Level in hierarchy involved in this project	5.823	1.567	80	-.188 (.093)
Formal meetings required	4.650	1.773	80	-.257 (.021)
Quality of communication at informal meetings	4.938	1.426	80	-.160 (.155)
Scope for involvement in formal meeting	4.316	1.590	80	-.142 (.207)
Discussions held outside formal meetings	4.924	1.575	80	-.191 (.088)
Areas of disagreement about project	3.557	1.465	80	.096 (.395)
Scope for negotiation about the project	4.077	1.457	79	-.034 (.764)
Frequency with which a similar project recurs	4.291	1.650	79	.055 (.630)
How radical the consequences are if the project changes things	4.859	1.402	79	-.125 (.270)
How serious the consequences are if the project goes wrong	4.937	1.636	80	.138 (.221)
How far ahead people looked when making the decision	5.747	1.344	80	-.037 (.738)
How urgent the decision was	5.165	1.400	80	-.148 (.190)
Decision likely to impact on subsequent decisions	5.342	1.376	80	-.133 (.239)
Decision influenced by previous decisions	4.231	1.562	80	-.134 (.236)
Number of internal departments involved	4.190	1.755	80	-.122 (.278)
Number of external organisations involved	3.566	1.746	79	-.226 (.045)
Weight of influence exerted by interested units	4.684	1.549	80	.023 (.833)
Total pressure uneven across interested units	3.759	1.407	80	.219 (.050)
How far the interested units that exerted influence did so in opposite directions	2.692	1.231	79	.056 (.620)

*: The correlation of the variables with IT intensity are discussed in section 5.2.10.

5.2.3.2 The Perceived Uncertainties

Of all the uncertainties listed in question 10 in the questionnaire (see Appendix 1), technological uncertainty ranks first (mean = 4.266), followed by market uncertainty (mean = 4.195) and supplier uncertainty (mean = 4.091). The other uncertainties seem to be perceived as less significant by management. Not surprisingly, technological uncertainty is highly correlated with IT intensity, but broadly speaking the other uncertainties are not correlated.

Table 5.10: (Q10.) Uncertainties Perceived*

Uncertainties perceived	*Mean*	*Rank*	*Std. Dev.*	*Sample Size*	*Spearman (Sign. of t)*
Technological uncertainty	4.266	1	1.824	79	.322 (.004)
Market uncertainty	4.195	2	1.747	77	-.142 (.218)
Supplier uncertainty	4.091	3	1.749	78	-.036 (.750)
Cost uncertainty	3.818	4	1.484	77	.040 (.728)
Production uncertainty	3.779	5	1.706	77	-.005 (.963)
Strategic uncertainty	3.734	6	1.730	79	.115 (.920)
Personnel uncertainty	3.449	7	1.799	78	.207 (.068)
External financial uncertainty	3.321	8	1.655	78	-.104 (.362)
Internal financial uncertainty	3.231	9	1.511	78	-.125 (.272)
Industrial relations uncertainty	2.795	10	1.654	78	.083 (.467)
Regulations uncertainty	2.792	11	1.765	77	-.197 (.086)
Other	0.373	12	1.131	51	

*: The correlation of the variables with IT intensity are discussed in section 5.2.10.

5.2.4 Strategic Considerations

Table 5.11 presents the results concerning strategic considerations (see Table 4.3) in the evaluation process of SIDs. All four variables are considered very important when making a SID, and the performance of the company is the single most important factor (mean = 5.785). 'Growth rate of market related to project' and 'competitive position of the company' are negatively associated with IT intensity. These findings are discussed in Section 5.10.

Table 5.11: (Q11.) Strategic Variables*

Strategic Variables	*Mean*	*Std. Dev.*	*Sample Size*	*Spearman (Sign. of t)*
Consistency with business strategy	5.228	1.467	80	-.197 (.079)
Growth rate of market related to project	5.372	1.478	80	-.230 (.040)
Competitive position of the company	5.679	1.372	80	-.285 (.010)
Performance of company	5.785	1.058	80	-.081 (.474)

*: The correlation of the variables with IT intensity are discussed in section 5.2.10.

5.2.5. The Accuracy, Importance and Sources of Information

Table 5.12 presents the results concerning information in the evaluation process (see Table 4.3), including perceived accuracy, perceived importance and sources of information. The lower the score of perceived accuracy, the higher the uncertainty of the information. The cost of investment (mean = 5.303) and cost of capital (mean = 5.299) are two of the most certain forms of information; while payback period (mean = 4.151) and intangible cost (mean = 4.189) are two of the most uncertain forms of information for all SIDs. The higher the score of perceived importance, the higher the importance of the information. Productivity (mean = 5.712) and profit (mean = 5.521) are two of the most important forms of information; the NPV of cash flow (mean = 4.826) and intangible cost (mean = 4.586) are two of the least important. The sources of all this information seem to be mainly internal rather than external. However, intangible benefit (n = 22) and cost of investment (n = 21) are two forms of information which need external support.

5.2.6 Methods Used to Handle Risk

Table 5.13 shows the ranking of methods used to handle risk. The result complements O'Brien's (1994) survey indicating that the most frequently mentioned individual approach is scenario planning.

Table 5.12: (Q12.) Accuracy, Importance and Sources of Information in helping in the Evaluation Process*

INFORMATION	*Perceived accuracy*				*Perceived importance*				*Source*	
	Mean	*Std Dev*	*Size*	*Spearman (Sign. of t)*	*Mean*	*Std Dev*	*Size*	*Spearman (Sign. of t)*	*Inter*	*Exter*
Cost of investment	5.303	1.276	80	-.140 (.215)	5.500	1.172	76	-.171 (.139)	48	21
Cash flow at end of each subsequent period	5.154	1.218	80	-.094 (.405)	5.197	1.286	76	-.273 (.017)	52	8
Project duration	4.863	1.475	80	-.211 (.060)	5.514	1.199	72	-.215 (.069)	47	11
Cost of capital	5.299	1.236	80	-.263 (.018)	5.513	1.378	74	-.451 (.000)	38	16
The NPV of cash flow	4.629	1.299	80	-.298 (.007)	4.826	1.414	69	-.112 (.356)	43	5
The payback period	4.151	1.622	80	-.275 (.013)	5.300	1.301	70	-.188 (.117)	39	14
ARR	4.253	1.434	80	-.238 (.033)	5.319	1.254	72	-.090 (.450)	42	8
Profit	4.542	1.404	80	-.201 (.072)	5.521	1.237	73	-.210 (.074)	43	8
Productivity	5.013	1.511	80	-.235 (.035)	5.712	1.264	73	-.021 (.860)	45	4
Intangible costs	4.189	1.532	80	-.192 (.087)	4.586	1.429	70	-.169 (.161)	41	7
Intangible benefit	4.685	1.615	80	-.182 (.105)	5.070	1.407	71	-.233 (.050)	30	22

*: The correlation of the variables with IT intensity are discussed in section 5.2.10.

Table 5.13: (Q13.) Methods Used to Handle Risk

Methods used to handle risk	*Frequency*	*Rank*
Scenario analysis	48	1
Sensitivity analysis	39	2
Risk premium on discount rate	24	3
Decision tree	22	4
Computer simulation	17	5
Other	1	6

5.2.7 The Effectiveness of SIDs

To measure the effectiveness of SIDs, a multiple scale is employed by using 'perceived importance' as a weighting of the objectives achieved (see Section 4.4.4). Table 5.14 shows the summarised results after calculation and Table 5.15 presents the original strategic objectives. As shown in Table 5.15, gaining competitive advantage (mean = 5.886) and keeping market position (mean = 5.557) are two of the most important objectives for these SIDs, and meeting government regulations (mean = 4.273) is the least important objective. However, improving the corporation's image (mean = 4.937) has the greatest level of achievement and increasing market share (mean = 4.400) the least. Table 5.15 also reveals the rank for these strategic objectives in terms of perceived as important and attained. Based on the rank, the **Spearman** correlation test can be employed to explore the relationship between strategic objectives perceived as important and attained. The Spearman correlation test (r = 0.0876, Sign. of t = 0.787) shows that strategic objectives perceived as important do not associate with their level of attainment perhaps due to the narrow range of the latter mean scores. It may also be the case that the more important objectives such as gaining competitive advantage are also more difficult to achieve.

Table 5.14: Score of Effectiveness

Effectiveness	*Frequency*	*Percentage*	*Cum. Percentage*
Lower than 10	3	3.75	3.75
10 - 19	19	23.75	27.5
20 - 29	35	43.75	71.25
30 - 39	19	23.75	95
40 - 49	4	5	100
Total	80		

Table 5.15: (Q14.) Strategic Objectives Perceived as Important and Attained*

STRATEGIC OBJECTIVES	*Perceived importance*					*Extent to which objectives achieved*				
	Mean	*Rank*	*Std Dev*	*Size*	*Spearman (Sign. Of t)*	*Mean*	*Rank*	*Std Dev*	*Size*	*Spearman (Sign. of t)*
Increase profit	5.513	4	1.375	80	-.242 (.030)	4.456	9	1.457	80	-.120 (.288)
Increase sales	5.519	3	1.405	80	-.344 (.002)	4.468	8	1.431	80	-.092 (.417)
Increase market share	5.418	7	1.346	80	-.399 (.000)	4.400	12	1.393	80	-.171 (.128)
Improve quality	5.163	10	1.418	80	.046 (.684)	4.494	7	1.329	80	-.031 (.782)
Enhance return on investment	5.200	9	1.354	80	-.303 (.006)	4.438	10	1.452	80	-.106 (.347)
Improve corporation's image	5.487	5	1.181	80	-.102 (.364)	4.937	1	1.213	80	-.010 (.924)
Reduce cost	5.363	8	1.512	80	-.130 (.248)	4.563	4	1.422	80	-.207 (.065)
Keep market position	5.557	2	1.366	80	-.315 (.004)	4.582	3	1.447	80	-.177 (.115)
Develop new business	5.474	6	1.509	80	-.172 (.127)	4.550	5	1.574	80	-.046 (.686)
Facilitate new ways of management	5.038	11	1.550	80	.079 (.484)	4.545	6	1.465	80	-.112 (.323)
Gain competitive advantage	5.886	1	1.143	80	-.271 (.015)	4.696	2	1.514	80	-.145 (.198)
Meet government regulations	4.273	12	1.826	80	-.120 (.288)	4.416	11	1.533	80	-.200 (.074)

*: The correlation of the variables with IT intensity are discussed in section 5.2.10.

5.2.8 IT Intensity and Learning

Table 5.16 shows the results of learning leading to future improvements in decision-making. The results show that learning (mean = 5.718) is very useful for future decision-making.

Table 5.16 (Q16.) Learning Leading to Future Improvements in Decision-Making*

IT and Project	*Mean*	*Std Dev.*	*Size*	*Spearman (Sign. of t)*
Learning	5.718	1.068	78	-.078 (.494)

*: The correlation of the variables with IT intensity are discussed in section 5.2.10.

5.2.9 Unexpected Outcomes

Table 5.17 lists several unexpected outcomes detailed by respondents. These were measured on a seven-point scale (1 = negative impact on the project, 7 = positive impact on the project.)

Since the strategic programmes undertaken often have extremely long lead times and a long time between making the investment decision and the strategic programme coming on-line, the environment itself may change, thus confounding analysis and adding considerable uncertainty (Clemons, 1991). Although decision-makers can use several methods to handle uncertainty, the unexpected outcomes represent those uncertainties which are not perceived by decision-makers. Accordingly, the results of unexpected outcomes can be mapped to uncertainties perceived. The following shows this mapping: (-) denotes a negative impact on the setting of objectives while (+) denotes a positive impact on the setting of objectives.

- technical uncertainty: high technical problem (-), break-through in major technology (+)
- market uncertainty: decline of national market (-), growth of international market (+)
- cost uncertainty: floating of foreign exchange rate (-), material cost increase (-)
- strategic uncertainty: only provides short-term benefit (-), improvement of quality (+), product passes certification (-), increase in customers' satisfaction (+)
- personnel: employees' anxiety (-), complaints, resistance, high resignation rate (-), hard to recruit technical employees (-)
- external financial: recession in economic conditions (-)
- competition: emerges of new competitive technology (-), new competitive force (-)
- organisation: co-operative problems between departments (-), improvement in employees' working environment (+)
- content and process: complexity of project (-), delay (-)

- **Table 5.17: Unexpected Outcomes Accordingly to Respondents' Comments**

Unexpected Outcome	Impacts
Foreign exchange change	*negative*
Material cost increase	*negative*
Employees' anxiety	*negative*
Complaints from employees	*negative*
Resistance from employees	*negative*
Leads to high resignation of employees	*negative*
Recession in economic conditions	*negative*
High technological problem	*negative*
The emerge of new competitive technology	*negative*
New competitive force	*negative*
Only provides short-term profit	*negative*
Co-operative problems between departments	*negative*
The rapid decline of national market	*negative*
Project delay	*negative*
Complexity of the project	*negative*
Industrial recession	*negative*
The growth of the international market	**positive**
Hard to recruit technical employees	**positive**
Increasing customers' satisfaction	**positive**
Improving employees' working environment	**positive**
Break-through in major technology	**positive**
Product passes certification	**positive**
Recover from recession	**positive**
Improvement of quality	**positive**

5.2.10 Discussion - Research Question 2 in Section 1.3

This section will discuss findings related to research question 2 (see Section 1.3), which focuses on the distinguishing factors of SIDs according to IT intensity. The findings related to the distinguishing factors in terms of IT are presented in Table 5.18. A detailed discussion of these findings will be given in turn.

Table 5.18: Spearman Correlation Test of Significant Differences According to IT Intensity

	Items	*Spearman (Sign. of t)*	*The higher the IT intensity*
Importance of IT process	Importance of IT in the whole project	.711 (.000)	**More important**
Formulation process	Levels in hierarchy involved in this project	-.188 (.093)	**Fewer levels**
	Formal meetings required	-.257 (.021)	**Fewer required**
	Discussions held outside formal meeting	-.191 (.088)	**Fewer held**
	Number of external organisations involved	-.226 (.045)	**Fewer involved**
Decision Content	Total pressure uneven across interested units	.219 (.050)	**More uneven**
Uncertainties	Technological uncertainty	.322 (.004)	**Highly uncertain**
	Personnel uncertainty	.207 (.068)	**Highly uncertain**
	Regulations uncertainty	-.197 (.086)	More certainty
Strategic consideration	Consistency with business strategy	-.197 (.079)	**Less important**
	Growth rate of market related to project	-.230 (.040)	**Less important**
	Competitive position of company	-.285 (.010)	**Less important**
Information Perceived Accuracy	Project duration	-.211 (.060)	**Highly uncertain**
	Cost of capital	-.263 (.018)	**Highly uncertain**
	The NPV of cash flow	-.298 (.007)	**Highly uncertain**
	Payback period	-.275 (.013)	**Highly uncertain**
	ARR	-.238 (.033)	**Highly uncertain**
	Profit	-.201 (.072)	**Highly uncertain**
	Productivity	-.235 (.035)	**Highly uncertain**
	Intangible costs	-.192 (.087)	**Highly uncertain**
Information – perceived Importance	Cash flow at end of each subsequent period	-.273 (.017)	**Less important**
	Project duration	-.215 (.069)	**Less important**
	Cost of capital	-.451 (.000)	**Less important**
	Profit	-.210 (.074)	**Less important**
	Intangible benefit	-.233 (.050)	**Less important**
Objectives - Perceived Importance	Increase profit	-.242 (.030)	**Less important**
	Increase sales	-.344 (.002)	**Less important**
	Increase market share	-.399 (.000)	**Less important**
	Enhance return on investment	-.303 (.006)	**Less important**
	Keep market position	-.315 (.004)	**Less important**
	Gain Competitive advantage	-.271 (.015)	**Less important**
Objectives Attained	Reduced cost	-.225 (.044)	**Less achieved**
	Compliment government regulations	-.200 (.074)	**Less achieved**

This discussion focuses on whether strategic investment decisions vary according to different degrees of IT investment. The other variables which are not significantly correlated to IT intensity are generic characteristics of all SIDs, no matter what the degree of IT intensity. The results show that the importance of IT in projects is positively correlated to IT intensity. This may seem trivial, but it validates the assumption that, in a strategic investment decision, a high level of IT intensity corresponds to strategic IT investment decisions. The other significant relationships are as follows:

- **The higher the level of IT intensity in a SID, (1) the fewer levels of the hierarchy are involved; (2) the fewer formal meetings are held; (3) the fewer informal discussion are held; (4) the fewer external organisations are involved.**

IT intensity is negatively associated with the number of levels of the hierarchy involved, the formal meeting/informal discussion held and the involvement of external organisations. The findings suggest that IT intensity is likely to reduce the interaction of people in the project formulating process. One possible explanation is that managers' lack of knowledge and experience of IT leads to low involvement in the project, especially for high level managers. Decision-maker's computer knowledge, experience and educational levels are closely associated with alienated beliefs and attitudes toward IT (Abdul-Gader et al., 1995). Higher IT intensity leads to a more technically-oriented project. Without IT knowledge and experience, managers cannot discuss the project in depth. Therefore, fewer formal meetings and informal discussions are held. These results complement Willcocks' (1992) assertion that management now faces a Catch-22 situation with IT investment. They know how important IT is, but they do not know how to evaluate

IT projects. This lack of management involvement may be a contribution to the lower effectiveness of SITIDs. Higher IT also leads to a lower involvement of external organisations. This may be because the project is too confidential to involve such organisations.

- **The higher the level of IT intensity in a SID, the more uneven the total pressure across interested units.**

This is probably because of the technical orientation of the investment project. Interested units which have more IT-related resource and technical knowledge can have a greater influence on the formulation of the investment project.

- **The higher the level of IT intensity in a SID, the higher the technological uncertainty and personnel uncertainty perceived but the fewer the regulations uncertainty perceived.**

The conclusion that a higher level of IT involves higher technological uncertainty is as expected, but it is not clear why higher IT leads to higher personnel uncertainty. One possible explanation is that the use of IT may replace manpower and/or lead to an organisational change, thus increasing employees' anxiety, complaints and resistance. From another perspective, personnel uncertainty might increase due the mobility of IT staff. However, the findings also suggest that IT projects seem to be less related to government regulations. Possibly, this is because IT projects are unlikely to cause to problems, such as air or water pollution, which could be harmful to the environment.

- **The higher the level of IT intensity in a SID, the less important are the strategic considerations of (1) the consistency with business strategy, (2) the growth rate of the market related to the project and (3) the competitive position of the organisation.**

This finding does not fit with Earl's (1988) comment that IT can be applied strategically in at least four different ways: to gain competitive advantage, to improve productivity and performance, to facilitate new ways of managing and organising, and to develop new business. Probably, IT alone will not provide sustainable competitive advantage. However, this confirms that there are different views on the relationship between IT and corporate strategies (Sheppard, 1990). It also agrees with Powell's (1993) view of 'the vicious circle of IT investment' which indicates the problem of alignment of IT and business strategy. The vicious circle may lead to sub-optimal decisions.

- **The higher the level of IT intensity in a SID, the more uncertain are (1) the project duration, (2) cost of capital, (3) NPV of cash flow, (4) payback period, (5) ARR, (6) profit, (7) productivity, and (8) intangible cost.**

Although Ballantine et al. (1994) indicate that firms do attempt to evaluate their IT investments by using simpler financial criteria, e.g. payback and accounting rate of return (ARR), rather than the more sophisticated techniques such as NPV, this finding suggests that the use of major financial criteria, whether sophisticated or not, is problematic when IT intensity is increased. It also suggests that high uncertainty leads to limited use of these techniques. In Section 5.2.6, Table 55.13 shows several methods, which have been employed to handle risk. For example, this study found that over 50% of the respondent cases employ scenario analysis to handle risk. These methods should be able to complement the deficiencies of financial criteria and help management to handle risk.

- **The higher the level of IT intensity in a SID, the less important are (1) cash flow at the end of each subsequent period, (2) project duration, (3) cost of capital, (4) profit, and (5) intangible benefit.**

This seems to suggest that the higher the level of IT intensity, the less important is the financial information for such a project. The possible reason for this is the strategic nature of IT investment. As Barua et al. (1995) indicate, a firm may have to invest in IT, regardless of its underlying cost structure, in response to a competitor's investment. Clemons (1991) also analyses a case which was described in terms of strategic necessity, and which was presented without detailed financial analysis, decision trees, pay back period, or sensitivity analysis. He indicates that 'strategic necessity' is a compelling argument. When the environmental changes are rapid enough to be considered discontinuities, rapid and flexible organisational response becomes essential. Even when the value of an architectural investment to obtain this flexibility is difficult to express quantitatively, it can be explained as buying an option that may be necessary to ensure the firm's survival. Accordingly, these findings do complement those of previous research and reflect the strategic nature of IT investments. This shows that management believe that sustainable competitive advantage is rare and difficult to achieve whatever analysis is used.

- **The higher the level of IT intensity in a SID, the less important are (1) increased profit, (2) increased sales (3) increased market share, (4) enhanced return on investment, (5) the retention of market position, and (6) the achievement of competitive advantage.**

This seems to suggest that in the case of a high level of IT intensity, the investment objectives for strategic investment projects are likely to be blurred. There are two possible reasons for this phenomenon. First, projects with a high level of IT intensity may fail to identify investment objectives. Second, these investment objectives may attract less attention in projects with high IT intensity. At this point, it is not clear which reason is correct, but, without a clear identification of the values of objectives, the resulting decisions are likely to be sub-optimal.

- **In terms of investment objectives, the higher the level of IT intensity in a SID, the lower the cost reduction and the compliance with government regulations which are achieved.**

Except for reduced cost and compliance with government regulations, the data do not reveal much information about significant differences in the objectives attained in relation to IT intensity. Possibly, cost reduction and compliance with government regulations are not major purposes for strategic IT projects, and this leads to less effort to achieve them.

To sum up, this section presents part of the study on the nature and process of SITIDs. The primary finding is that IT intensity impacts on certain aspects of the decision process of SIDs. The most obvious differences according to IT intensity are: the reduced importance of strategic considerations, the high uncertainty of information, the reduced importance of information, and the reduced important of investment objectives. From a theoretical standpoint, the obvious implication is that *IT intensity does matter when viewed from these perspectives.* Hence SITIDs exhibit a number of characteristics different from SIDs in general, which need particular consideration in the management of such projects.

5.3 Hypotheses Testing[3]

The thesis proposes a theoretical model (see Section 3.4) employing a number of constructs: the effectiveness of decisions, interaction and involvement in the decision formulating process, the accuracy of information and strategic considerations in the evaluation process, the rarity of decisions, and IT intensity in strategic investment decisions. This model attempts to explain the relationships which influence the effectiveness of the decisions. Empirical testing of the model is based on a sample of 80 SIDs from Taiwanese enterprises. This section mainly tests the hypotheses of the present study including:

Hypothesis 1:The different degrees of IT intensity are negatively related to the effectiveness of SIDs.

Hypothesis 2: IT intensity will reduce interaction and will thus have an adverse impact on the effectiveness of decisions.

Hypothesis 3: IT intensity will reduce involvement and will thus have an adverse impact on the effectiveness of decisions.

Hypothesis 4: IT intensity will reduce the accuracy of information and will thus have an adverse impact on the effectiveness of decisions.

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[3] The early version of the analysis and findings in this section has been published in the Proceedings of the European Conference of Information Systems, France, 1998.

Hypothesis 5: IT intensity will reduce the strategic considerations and will thus have an adverse impact on the effectiveness of decisions.

Hypothesis 6: IT intensity will heighten the rarity of decisions and will thus have an adverse impact on the effectiveness of decisions.

5.3.1 Validity and Reliability

Since the scales used to assess process and content constructs combine measures from a number of different studies, it is necessary to confirm their dimensionality empirically. This study conducted a principal components factor analysis with varimax rotation to assess convergence within and divergence between scales (see Section 4.9.2.1). This analysis grouped the variables into five factors representing accuracy of information, strategic consideration, interaction, involvement and rarity, each having an eigenvalue above 1.0 and together accounting for 62.6 percent of variance in the data. Table 5.19 shows items and factor loadings. All items are consistently discriminated and are accepted for further analysis.

Table 5.20 presents the means, standard deviations, correlations and coefficient alphas of the proposed constructs. Cronbach's alpha is a commonly used measure of reliability of a set of two or more construct indicators. According to Hair et al. (1995), a commonly used threshold value for acceptable reliability is .70. Cronbach's Alpha values for the four constructs which have two or more indicators range from .74 to .89, suggesting that the instrument is reliable. For the construct validity, KMO Measure of Sampling Adequacy (MSA) and Bartlett Test of Sphericity were calculated. The resultant of MSA (0.7713) and the Significance of Bartlett Test (p <0.0001) suggest a highly stable of instrument design.

Table 5.19: Factor Analysis (Varimax Rotation) of Process and Content Items

	Factor Loadings				
Questionnaire Items	*1*	*2*	*3*	*4*	*5*
1 Accuracy of Information					
Payback	*.80*				
ARR	*.78*				
Productivity	*.69*				
Profit	*.68*				
Time	*.61*				
Intangible benefit	*.61*				
Cost	*.61*				
Intangible cost	*.60*				
Net present value	*.60*				
Capital	*.59*				
Cash	*.47*				
2 Strategic Considerations					
Performance		*.75*			
Competition		*.74*			
Strategic consistence		*.66*			
Grow of market		*.64*			
3 Interaction					
Scope			*.74*	*.42*	
Informal			*.71*		
Quality			*.70*		
Formal			*.65*		
Hierarchy			*.56*		
4 Involvement					
External				*.80*	
Internal				*.78*	
5 Rarity					
Rarity					*-.88*
Eigenvalue	*7.466*	*2.324*	*1.765*	*1.473*	*1.365*
Percentage of Variance	*32.5*	*10.1*	*7.7*	*6.4*	*5.9*

Table 5.20: Intercorrelations among Constructs

	Mean	*S.D.v.*	*Alpha*	*1*	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*
1. IT intensity	38.56	38.02		1.00								
2. Effectiveness	24.93	9.05		-.22*	1.00							
3. Decision style	4.4	1.5		.22*	.15	1.00						
4. Risk attitude	4.6	1.5		.02	.33**	.35**	1.00					
5. Interaction	4.9	1.1	.76	-.22*	.36**	.14	.16	1.00				
6. Involvement	3.9	1.5	.74	-.19	.27*	.04	-.0003	.31**	1.00			
7 Strategic considerations	5.4	1.0	.77	-.27*	.55**	.19	.38**	.37**	.16	1.00		
8. Accuracy of information	4.6	1.9	.89	-.27*	.69**	.29**	.32**	.37**	.28**	.58**	1.00	
9. Rarity	3.7	1.65		.07	-.27*	-.15	-.07	-.12	-.16	-.17	-.19	1.00

5.3.2 Regression Analysis of Hypothesis Testing

Besides Hypothesis 1, all the other Hypotheses aim to test the existence of mediators between IT intensity and the effectiveness of SIDs. As discussed in Chapter 3, the testing of the mediating effect requires three regression models, as suggested by Baron and Kenny (1986). The analysis in this section will follow the sequence for testing the mediating effect.

Step one: Regressing the mediator on the independent variable

A variable functioning as mediator should meet the condition that variations in levels of the independent variable significantly account for variations in the presumed mediator. In this step, the mediator act as a dependent variables in the regression model. Accordingly, in the proposed theoretical model of Chapter 3, this step involves building the following five regression equations:

Model 1: $Interaction = \beta_0 + \beta_1(IT\_Intensity) + \mu$

Model 2: $Involvement = \beta_0 + \beta_1(IT\_Intensity) + \mu$

Model 3: $Accuracy\_of\_Information = \beta_0 + \beta_1(IT\_Intensity) + \mu$

Model 4: $Strategic\_Considerations = \beta_0 + \beta_1(IT\_Intensity) + \mu$

Model 5: $Rarity = \beta_0 + \beta_1(IT\_Intensity) + \mu$

Table 5.21 summarises the results of the first step and the detailed report on these regression models including the summarised model information, the detection of influence points, and the search for any of violation of assumptions. The full results are presented in Appendix 3. Influence points were delected, and modles run on both the full data set, and the reduced data set. As mentioned in Chapter 4, the analyst is encouraged to delete truly exceptional observations but must still guard against deleting observations that are representative of the population. It is not possible to identify special circumstances that generated the extreme responses from the survey data. However, by comparing the results of the full data sets with the results of the reduced data sets, it is shown that the reduced of data sets strengthen the fit of the models. Thus, the discussion in this section is based on the findings produced by the regression models of the reduced data set. The impacts of the deleting action on the findings will discussed later in this section. (It should be noted however that the dropping of influence points, can in general strengthen or weaken the fit, or change the results significantly)

As shown in Table 5.21, the *Lilliefors* test of normality indicates that the distribution of the residuals is abnormal for models 5B. This violation of assumption could be amended by making a transformation on the variable. However, the F statistic of model 5B (F=2,011 , Sign. of F = 0.1411) shows that the overall model is not significant. Accordingly, no further action of transforming data has been taken in this study. This construct will be dropped from further analysis.

The F statistic of model 2B (F=3.942, Sign. of F=.0507) also shows that the overall model is not significant. Accordingly, the construct, involvement, will also be dropped for further analysis. The F statistics of models 1B, 4B, and 5B suggest that these three regression models are statistically significant. Therefore, these three constructs will be employed for further study. However, **the relationships between IT intensity and these constructs are also found to be weak.** This issue needs to be addressed and carefully interpreted later.

Table 5.21: Results of Regression Analyses (step 1)

				Std. Coefficient	Goodness-of-fit index	Overall Fit of the Model	Influence Points	Violation of Assumption	Note
Model		Dependent Variable	Independent Variable	β (Sign. of t)	R^2 (Adjusted R^2)	F (Sign.of F)	Std Res.>± 2	Linearity and Homogenity (Normality)	The Detailed Information Reported in
1	A	Interaction	IT Intensity	-.221 (.0481)	.049 (.036)	4.034 (.0481)	Case 10, 27, 31, 77	✔ (✔)	Appendix 3-1A
	B			-.231 (.0445)	.053 (.040)	4.180 (.0445)		✔ (✔)	Appendix 3-1B
2	A	Involvement	IT Intensity	-.190 (.0923)	.036 (.023)	2.904 (.0923)	Case 31	✔ (✔)	Appendix 3-2A
	B			-.222 (.0507)	.049 (.036)	3.942 (.0507)		✔ (✔)	Appendix 3-2B
3	A	Accuracy of Information	IT Intensity	-.273 (.0140)	.074 (.063)	6.316 (.014)	Case 5 , 9 , 20,25,31, 49	✔ (✔)	Appendix 3-3A
	B			-.453 (.0000)	.205 (.194)	18.673 (.000)		✔ (✔)	Appendix 3-3B
4	A	Strategic Considerations	IT Intensity	-.272 (.0144)	.074 (.062)	6.264 (.0144)	Case 25, 65	✔ (✔)	Appendix 3-4A
	B			-.294 (.0089)	.086 (.074)	7.214 (.0089)		✔ (✔)	Appendix 3-4B
5	A	Rarity	IT Intensity	.074 (.5137)	.005 (-.007)	0.430 (.5137)	Case 46, 65, 79	✔ (✘)	Appendix 3-5A
	B			.169 (.1411)	.028 (.015)	2.011 (.1411)		✔ (✘)	Appendix 3-5B

✔: no violation ✘ : violation **A**: full data set **B**: reduced data set

Step two: Regressing the dependent variable on the independent variable.

The variations in the independent variable must significantly account for variations in the dependent variable to show that the independent variable affects the dependent variable. In this step, the relationship between IT intensity and the effectiveness of SIDs will be established by the following regression model.

Model 6: $The\_Effectiveness\_of\_SIDs = \beta_0 + \beta_1(IT\_Intensity) + \mu$

This regression can also be used to test of hypothesis 1. Additionally, since the theoretical model suggests that two of the context variables, leadership style and management's attitude to risk, will have impacts on the effectiveness of SIDs, the second step must also examine the relationship between IT intensity and the effectiveness of SIDs when leadership style and management's attitude to risk are controlled by the following regression model.

Model 7: $$\begin{aligned} The\_Effectiveness\_of\_SIDs &= \beta_0 + \beta_1(IT\_Intensity) \\ &+ \beta_2(Leadership\_Style) + \beta_3(Attitude\_to\_Risk) + \mu \end{aligned}$$

Table 5.22 shows the summarised results of these two models and a detailed report on the SPSS output is presented in Appendix 3-6A, 3-6B, 3-7A and 3-7B. The F statistics of model 6B (F=10.981, Sign. of F=0.0014) and model 7B (F=6.816, Sign. of F=0.0004) shows that the overall models are statistically significant. The negative sign β shows that IT intensity is negatively associated with the effectiveness of SIDs. Accordingly, the first hypothesis, which predicts a negative relationship between IT intensity and the effectiveness of SIDs is proved. However, IT intensity alone accounts for approximately 13% of the variance of the effectiveness of SIDs (R^2 = 0.129). Thus, the proportion of the variance of the effectiveness of SIDs accounted for by the regression model is not high.

When the control variables, leadership style and management's risk attitude, are added into the model, the adjusted R^2 increases from 0.117 to 0.182, which indicates that the added variables increase the overall fit of the model. IT intensity (sign. of t = 0.0228) and management's attitude to risk (sign. of t= .0022) both contribute significantly to the model. However, the sign. of t of IT intensity is less significant in model 7B (Sign. of t = 0.0228) than in model 6 (Sign. of t= 0.0014). Accordingly, this study can procede to the next step.

Table 5.22: Results of Regression Analyses (step 2)

				Std. Coefficient	Goodness-of-fit index	Overall Fit of the Model		Violation of Assumption	Note
Model		Dependent Variable	Independent Variable	β (Sign. of t)	R^2 (Adjusted R^2)	F (Sign.of F)	Influence Points	Linearity and Homogenity (Normality)	The Detailed Information Reported in
6	A	Effectiveness of SIDs	1. IT Intensity	-.220 (.0493)	.048 (.036)	3.988 (.0493)	Case 5,9,20,53	✔ (✔)	Appendix 3-6A
	B			-.359 (.0014)	.129 (.117)	10.981 (.0014)		✔ (✔)	Appendix 3-6B
7	A	Effectiveness of SIDs	1. IT Intensity 2. Leadership Style 3. Risk Attitude	(1) -.252 (.0212) (2) .108 (.3474) (3) .302 (.0084)	.174 (.141)	5.345 (.0021)	Case 68	✔ (✔)	Appendix 3-7A
	B			(1) -.244 (.0228) (2) .149 (.1816) (3) .341 (.0022)	.214 (.182)	6.816 (.0004)		✔ (✔)	Appendix 3-7B

✔: no violation ✘ : violation **A**: full data set **B**: reduced data set

Step three: ***Regressing the dependent variable on both the independent variable and the mediator. If three steps all hold in the predicted direction, then the effect of the independent variable on the dependent variable must be less in the third equation than in the second.***

The third step is the major step in testing the mediating effects of the proposed constructs. Since only three constructs (interaction, strategic considerations and accuracy of information) have been proposed for further analysis in step one, each of these constructs will be added into model 7B. Therefore, the regression models can be described as follows:

Model 8: $$The\_Effectiveness\_of\_SIDs = \beta_0 + \beta_1(IT\_Intensity) + \beta_2(Leadship\_Style) + \beta_3(Attitude\_to\_Risk) + \beta_4(Interaction) + \mu$$

Model 9: $$The\_Effectiveness\_of\_SIDs = \beta_0 + \beta_1(IT\_Intensity) + \beta_2(Leadship\_Style) + \beta_3(Attitude\_to\_Risk) + \beta_4(Strategic\_Consideration) + \mu$$

Model 10: $$The\_Effectiveness\_of\_SIDs = \beta_0 + \beta_1(IT\_Intensity) + \beta_2(Leadship\_Style) + \beta_3(Attitude\_to\_Risk) + \beta_4(Accuracy\_of\_Information) + \mu$$

Table 5.23 shows the summarised results of these models, and the detailed report on the SPSS output will be presented in Appendices 3-8A, 3-9 and 3-10.

Table 5.23: Results of Regression Analyses (step 3)

				Std. Coefficient	Goodness-of-fit index	Overall Fit of the Model		Violation of Assumption	Note
Model		Dependent Variable	Independent Variable	β (Sign. of t)	R^2 (Adjusted R^2)	F (Sign.of F)	Influence Points	Linearity and Homogenity (Normality)	The Detailed Information Reported in
8	A	Effectiveness of SIDs	1. IT Intensity 2. Leadership Style 3. Attitude to Risk 4. Interaction	(1)-.181 (.0957) (2) .062 (.5817) (3) .272 (.0142) (4) .270 (.0128)	.240 (.199)	5.924 (.0003)	Case 68, 77	✔ (✔)	Appendix 3-8A
	B			(1)-.146 (.1911) (2) .061 (.5885) (3) .293 (.0079) (4) .272 (.0178)	.257 (.217)	6.335 (.0002)		✔ (✔)	Appendix 3-8B
9		Effectiveness of SIDs	1. IT Intensity 2. Leadership Style 3. Attitude to Risk 4. Strategic Consideration	(1)-.105 (.3057) (2) .038 (.7156) (3) .144 (.1817) (4) .465 (.0001)	.337 (.302)	9.548 (.0000)	None	✔ (✔)	Appendix 3-9
10		Effectiveness of SIDs	1. IT Intensity 2. Leadership Style 3. Attitude to Risk 4. Accuracy of Information	(1)-.024 (.7851) (2)-.082 (.3819) (3) .153 (.0930) (4) .659 (.0000)	.499 (.472)	18.703 (.0000)	None	✔ (✔)	Appendix 3-10

✔: no violation ✘ : violation **A**: full data set **B**: reduced data set

The F statistics of models 8B, 9 and 10 show that the overall fit of these regression models is highly statistically significant. The selected predictors can be used to explain 25.7% of the variances of the effectiveness of SIDs in model 8B, 33.7% in model 9, and 49.9% in model 10.

To test the mediating effects of the presumed mediators, it is necessary to compare the impact of IT intensity on the effectiveness of SIDs in the different models. As suggested by the Baron and Kenny (1986), the impact of IT intensity on the effectiveness of SIDs in the model of step 3 must be less than the effect in the model of step 2. In this case, the effect of IT intensity is likely to be replaced by the mediators since the effect of IT intensity is reduced when mediators are added in to the regression models. Perfect mediation holds if the independent variable has no effect when the mediator is controlled.

To test interaction as a mediator, the study compares model 7B and model 8B. The significance of t is 0.0228 in model 7B but 0.1991 in model 8B. At the same time, the effect of interaction in model 8B is significant (Sign. of t = 0.0178); that is, when interaction was added into the regression model, the effect of IT intensity on the effectiveness of SIDs is likely to be replaced by interaction. Thus, interaction has been proved to be a mediator in the linkage of IT intensity and the effectiveness of SIDs. The effect of IT intensity on the effectiveness of SIDs is transmitted by the interaction.

Similarly, the impact of IT intensity on the effectiveness of SIDs is not significant in model 9 (sign. of t = 0.3057) and model 10 (sign. of t = 0.7851), but the impacts of strategic considerations (sign. of t = 0.0001) in model 9 and accuracy of information (sign. of t = 0.0000) in model 10 are highly significant. Therefore, strategic considerations and accuracy of information are also proved to be mediators in the linkage of IT intensity and the effectiveness of SIDs.

5.3.3 Discussion - Research Question 3 in Section 1.3

In this section the findings of the study and their implications are discussed. The degree of IT intensity is negatively associated with the effectiveness of SIDs. The higher the IT intensity, the lower the effectiveness of SIDs. This assumption of the linkage between IT intensity and the effectiveness of SIDs is supported. From a theoretical standpoint, the main implication of the findings is that managers need to pay special attention to the problematic nature of IT intensity in SIDs.

From a statistical perspective, the three proposed constructs (interaction, strategic considerations, and accuracy of information) act as mediating factors in the linkage of IT intensity and the effectiveness of SIDs because the effect of IT intensity on the effectiveness of SIDs is replaced by these mediators. All these constructs are process-related. The findings of this study strongly support the results of two previous investigations which show that decision-making processes are, indeed, related to decision success (Dean and Sharfman, 1996) and that process differences are also related to different topics of decisions (Sabherwal and King, 1995; Hickson et al., 1986).

This study finds that the content-related constructs do not act as mediators in the linkage. Although the rarity of decision is negatively associated with the effectiveness of SIDs, it is not related to IT intensity.

Interaction in the formulating process has a mediating effect on the linkage. Interaction is an important factor in the development of group behaviour (Cooke and Slack, 1984) and it pressures members into line and towards a group decision. IT intensity does lead to a lower interaction of the decision group, and this thereby leads to the reduced effectiveness of SIDs.

Strategic consideration acts as a mediating variable. The results show that the higher the IT intensity, the lower the strategic consideration, and this leads to the reduced effectiveness of SIDs. This finding demonstrates that the evaluation problem of IT is really one of alignment, and organisations that are aware of IT's new role have usually made efforts to incorporate IT in their strategic thinking (Farbey et al., 1993).

The accuracy of information acts as a mediating variable. The results that show the higher the IT intensity, the lower the accuracy of information, and this leads to the reduced effectiveness of SIDs. This finding supports the work of Freeman and Hobbs (1991), who find a high incidence of managers ignoring reject signals given by capital budgeting techniques, and identify senior management's preference for qualitative information and IT investment as an 'act of faith' (Powell, 1995). This suggests that high uncertainty of information leads to a limited use of these techniques.

With a further inspection of these models, in Model 8B, IT intensity is still significant at the 0.1 level when interaction is tested as mediator. This indirect transmission of influence from IT intensity to effectiveness of SIDs via interaction shows that the effect of IT intensity on effectiveness is only partially mediated by interaction. The effect of IT intensity on the effectiveness of SIDs is completely mediated by strategic considerations and accuracy of information, two evaluation-related constructs. This result implies that, in seeking a better outcome of SITIDs, research which focuses on evaluation factors may not be sufficient to capture the complexity of SITIDs but is, indeed, a necessary and critical aspect upon which to focus.

Ballantine et al. (1994) indicate that firms do attempt to evaluate their IT investments by using simpler financial criteria, e.g. payback and accounting rate of return, rather than the more sophisticated techniques such as NPV. However, Clemons (1991) analyses a case described in terms of strategic necessity which was presented without detailed financial analysis, decision trees, pay back or sensitivity analysis. This induces a chicken and egg problem: does strategic necessity leads to the unimportance of information from evaluation? Or, is strategic necessity an excuse because of the lack of information for evaluation?

The present study sheds some light on this problem. The two evaluation-related constructs are highly correlated. That is, from an IT investment perspective, the alignment of information technology and business strategy is problematic if there is a lack of correct information for evaluation. However, the evaluation of IT investments is problematic if there is a lack of alignment of IT and business strategy. To improve the effectiveness of IT investment, management must simultaneously aim to increase the alignment of IT and business strategy and accuracy of information for the evaluation techniques.

5.3.4 Beyond Hypotheses Testing

- **The Deletion of Influential Observations**

In the model-building process, eight out of ten models (Models 1 to 8) were found to involve the deletion of at least one of the influential observations from the data analysis. The following comments can be drawn:

First, these influential observations lie outside the general patterns of the data set or strongly influence the regression results. It is possible that their extreme behaviour is a result of measurement or transcription errors, in which case they should be deleted and forgotten. In Section 5.3, this study used Cronbach's alpha to measure of the reliability of measurement and suggesting that the instrument is reliable. Moreover, the data sets have been double checked to ensure that the data entry is correctly. Accordingly, those influential observations are likely to be valid, but also exceptional, observations.

Second, it is clear that in each case the reduction of data sets strengthened to fit of the models. In this case, since these extreme responses could represent part of the population, it is necessary to pay special attention to them in interpreting the significance of the findings from the regression models. For example, the proportion of the variance of the effectiveness of SIDs accounted for by IT intensity could range from 4.8% (model 6A) to 12.9% (model 6B).

Third, these observations may be the result of extraordinary situations. From managerial perspective, It is always worth exploring such situations if there is no likely explanation. However this study is unable to identify any special features of these cases from the collected information. Fortunately, the deleting action accentuates rather than changes the results, and the deleted points thus are unlikely to lead to the loss of any significant features of the data when omitted from the broad overall analysis.

- **The Managerial Implications of the Findings**

The regression analysis does show that the linkage between IT-ness and effectiveness is meaningful, and that interaction, strategic considerations and accuracy of information act as mediators in the linkage. However, there are two imperfections related to the theoretical model which must be mentioned in relation to these findings. First, despite the fact that the model is significant in predicting the effectiveness of SIDs, the R^2 is rather weak. The R^2 is an estimate of the proportion of the variance of the dependent variable (effectiveness) accounted for by the independent variable (IT intensity). However, in Model 6B, IT intensity can only represent 12.9% of the variance of effectiveness; this is weak, even with the influence points dropped.

Second, a variable functioning as a mediator should meet the condition that variations in levels of the independent variable significantly account for variations in the presumed mediator. The negative sign β shows that IT intensity is negatively associated with the mediators. However, based on the adjusted R^2, IT intensity can explain only 4% of the variance of interaction (Table A3.1B), and 7.4% of the variance of strategic considerations (Table A.3.4B). The low value of the R^2 indicates only a weak linear relationship between IT intensity and these two constructs. IT intensity can explain 19.4% of the variance of accuracy of information (Table A3.3B), thus indicating a rather stronger linear relationship.

From a statistical perspective, the mediating effects do exist. However, from a managerial perspective, the weak linkages have significant impacts on the implications of these findings. Obviously, IT intensity is not the only variable and is probably not the critical one which influences the effectiveness of SIDs. Compared with model 7B, the adjusted R^2 increases by 3.5% (from 18.2 to 21.7%) in model 8B, 12% (from 18.2 to 30.2%) in model 9 and 29% (from 18.2 to 47.2%) in model 10. That is, the overall predicted fit increases only slightly in model 8B but more significantly in model 10. These results show that the accuracy of information is a more important factor in terms of its impact on the effectiveness of SIDs. IT intensity may impact on the mediators but it is not the only variable which does so. For example, accuracy of information may also be influenced by rapid environmental change or political issues.

- **Some Comments on the Contextual Factors**

In Chapter 3 this study indicates that two of the contextual factors, leadership style and management's attitude toward risk, act as covariances which will impact on the effectiveness of SIDs along with IT intensity. Although the main purpose of this section is to test the proposed hypotheses, there is some additional information related to these contextual factors which could also be valuable and which deserves some comment.

First, in model 7B, it is shown that management's attitude toward risk, along with IT intensity, has an effect on the effectiveness of SIDs but not on leadership style; the signs of the coefficients on the leadership style are positive in models 7B to 9, but negative in model 10. Although the effect of leadership style on the effectiveness of SIDs in these models is insignificant, it is a critical factor in relation to the managerial implications of research findings.

Based on models 8B and 9, it can be seen that the leadership style has a positive relationship with interaction, strategic consideration and the effectiveness of SIDs. That is, higher interaction in the formulation of decision and more consensus-driven leadership style is likely to lead to the higher effectiveness of SIDs; a more strategic consideration in the evaluation of decision and the more consensus-driven leadership style is also likely to lead to the higher effectiveness of SIDs. However, according to model 10, greater accuracy of information and a more directive leadership style will lead to the enhanced effectiveness of SIDs. The possible explanation is that a consensus-driven leadership style brings more political issues into the decision-making process. The decision is simply a product of negotiation and power struggle, and this may harm the accuracy of information and the effectiveness of SIDs. Accordingly, the effect of leadership style on the effectiveness of SIDs may vary according to different situations.

Second, compared with interaction (in model 8B) and accuracy of information (in model 10), strategic considerations (in model 9) is the only one, which leads to the management's attitude toward risk insignificant at the 0.1 level. That is, the effect of management's attitude toward risk on the effectiveness of SIDs could be replaced significantly by the strategic considerations. Accordingly, from a managerial viewpoint, this finding may imply that the strengthening of strategic considerations may complement the shortcomings caused by a conservative management style.

To sum up, section 5.3 empirically tested the theoretical model by exploring the mediators in the linkage between different degrees of IT intensity and the effectiveness of SIDs. The findings show that interaction, accuracy of information and strategic considerations are the key factors which mediate the impact of IT intensity. From a theoretical standpoint, the main implication of the findings is that managers need to pay special attention to the problematic nature of IT intensity in SIDs, and should focus in particular on the integration of IT strategy with corporate strategy and improving the accuracy of information in order to pursue better decision outcomes.

However, due to the weak linkage between IT intensity and (1) the effectiveness of SIDs, and (2) the proposed mediators, the findings become less meaningful because the critical factors impacting on the effectiveness of SIDs is still not clear. At this point, it is necessary to conclude that the effort to manage the effectiveness of SIDs is unlikely to have to focus solely on the IT viewpoints since the impact of IT on the effectiveness is not revealed to be particularly significant.

Accordingly, it may be interesting to ask: 'if not IT intensity, what are the critical factors which impact significantly on the effectiveness of SIDs?' To shed light on this question, the next section will focus on the exploration of these factors based on the survey data of this study.

5.4 Identification of the Critical Factors for the Effectiveness of SIDs

In the previous section, the testing of hypothesis showed that the postulated relationship of IT intensity and the effectiveness of SIDs is weak. Thus, it is meaningful to explore the other factors which can impact significantly on the effectiveness of SIDs. From a managerial perspective, these factors should contribute to SIDs including SITIDs.

5.4.1 The Model Building Process

- **Examination of the collinearity of variables**

The first step in building the new model is to examine the collinearity of variables. The simplest way to examine the collinearity problem is by constructing pairwise scatter plots for each variable. However, when the number of explaining variables is large, this may not be feasible. Alternatively, by looking at the correlation matrix, we will be able to identify obvious collinearity problems. The correlation matrix seems more appropriate for this study. The correlation matrix in Table A4-1 (in Appendix 4) shows the results of the Spearman correlation test for all variables, and no obvious collinearity among variables is revealed. Accordingly, no variable will be dropped.

- **Selection of variables in a regression equation**

In the previous section, the variables which enter the regression model have been predetermined by the author in terms of the theoretical model. In this section, there are no theoretical considerations to determine the variables to be included in the equation. Accordingly, one of the sequential search approaches needs to used to select the variables for formulating a regression model. As suggested by Hair et al. (1995), stepwise estimation is the most popular sequential approach to variable selection. This approach allows the analyst to examine the contribution of each predictor variable to the regression model and should be appropriate for this study. All the variables are then fitted into the full linear regression model by the stepwise approach.

- **Identify the influence points**

Figures A4-1 and A4-2 (in Appendix 4-2) present the leverage plot and Cook's distance plot against the observations. Case 25 was found to be an influence point because the point has both high leverage and a substantial influence on the fit. Tables A4-2A in Appendix 4-3A reports the regression analysis of full data set and A4-2B in Appendix 4-3B reports the regression analysis of data set which deleted the Case 25.

As discussed in 5.3.4, the influential observations must be identified to assess their impacts. Unlike the impacts in section 5.3, the deletion of Case 25 does change the results. The regression analysis of the full data set shows that not only R^2 (0.720) and R^2 (0.692), but also the selected variables, have changed. One of the selected variables, competitive position of the firm, in the regression model of the reduced data set is not selected in the regression model of full data set. Possibly, the case (human resources system software) is not really a strategic investment, or there are peculiarities in the software, which has a disproportionate effect on the regression results. Again, the following discussion will mainly focus on the regression model of the reduced data set since it provides a better fit of the mode, if only marginally.

- **Description of The model**

In the reduced data set, 7 of the 43 variables have been selected by the stepwise approach in the regression model including (1) scope of involvement in the project formulation process, (2) competitive position of company, (3) growth rate of the market related to project, (4) perceived accuracy of productivity index, (5) perceived accuracy of profit, (6) how radical the consequences were when the project changed things, and (7) the financial state of the company. Accordingly, this model can be described as :

$$
\begin{aligned}
The\_effectiveness\_of\_SIDs = {} & \beta_0 + \beta_1(Scope\_of\_involvement) \\
& + \beta_2(Competitive\_position) + \beta_3(Market\_growth) \\
& + \beta_4(Perceived\_accuracy\_of\_productivty\_index) \\
& + \beta_5(Perceived\_accuracy\_of\_profit) \\
& + \beta_6(Radicalism\_of\_decision) \\
& + \beta_7(Financial\_state\_of\_company) + \mu
\end{aligned}
$$

The overall fit of the model is highly significant (F=.0000). These seven variables can explain approximately 75% the variance of the effectiveness of SIDs.

- **Searching for violation of assumptions**

Figures A4-3B to A4-10B (in Appendix 4-3B) present the scatterplots of the predicted scores and predictors against residuals. They show no pattern, thereby confirming that the assumptions of linearity and homogeneity of variance have been met. The histogram of standardised residuals is shown in Figure A4-11B (in Appendix

4-2). The grey bars show the frequencies. The superimposed curve is the ideal normal distribution for the residuals. The Lilliefors test of normality (Statistic = 0.0847, df = 77, Sign. >.2000) indicates that the distribution of residuals is normal. Because of the good fit of this model, a further test of the assumptions was made using White's test. This test is not available in SPSS, so the software Eviews (Econometric Views) was used. The White's test (F = 0.844 Sign. F = 0.619) indicates that the errors are both homoskedastic and independent and that a linear specification of the model is correct. Therefore no violation of assumptions of the regression model has been found.

- **The Detection of multicollinearity**

The range of the VIFs (1.075 to 1.668) shows that multicollinearity is not a problem for this regression model.

In this section, a model has been built for explaining the effectiveness of SIDs. The main aim of building such a model is to explore the factors which impact on the effectiveness of SIDs. Seven factors (variables) have been found to be critical in the explanation of the variance of effectiveness of SIDs. This could be important for the management of SIDs, including both IT and non-IT strategic investment projects. However, before the implications of these findings are concluded, the procedure for selecting these variables must be clarified. The process of variable selection should be viewed as an intensive analysis of the correlation structure of the independent variables and how they individually and jointly affect the dependent variable under study (Chatterjee and Price, 1991). The variables which are not selected from the model should not necessarily be thought to be unimportant. Possibly, the variables are excluded simply because the regression coefficient is not significant when they enter the regression model in the selection procedure. The present model shows only one set of variables but there may be others.

The selected variables seem to represent several constructs in the theoretical model. The scope of involvement is part of the interaction of the formulation process. The competitive position of the company and the growth rate of market related to the project belong to the strategic considerations of the evaluation process.

The perceived accuracy of productive index and the perceived accuracy of profit are related to the accuracy of information in the evaluation process. Radicalism is a content factor of decision, and the financial state of the company is a contextual factor. This result may show that the employment of the contextualism's viewpoint (see Chapter 3) in the study of strategic investment decisions is appropriate since the outcome of decisions may be affected by variables from diverse perspectives. The managerial implications of these variables and a protocol for the evaluation of SIDs will be proposed in the next chapter.

5.5 Summary

This chapter has mainly used survey data to answer the proposed research questions. It first showed the overall profiles of SIDs and the distinguishing factors in terms of IT intensity; the hypotheses were tested empirically, and a model with seven variables was then presented which clearly identified the critical factors for the effectiveness of SIDs. The main findings of the quantitative analysis may be summarised as follows:

- **Findings related to the overall profiles of SIDs**

From the perspective of the formulation process, compared with other non-strategic investment projects, SIDs seem to be less time-consuming and exhibit a higher level of involvement; the consequences are seen to be very serious if the project goes wrong; and the consequences of the project tend to change things radically; corporations need more interactions when making a SID, including formal meetings, a good quality of communication, and informal discussions.

When considering the major purposes of IT investment, the results of this study confirm the Earl's (1988) analysis, i.e. the main purposes are to gain competitive advantage, to improve productivity and performance, to facilitate new ways of managing and organising, and to develop new business.

From the perspective of decision content, management need to look further when making decisions, and it is clear that all decisions are likely to impact on subsequent decisions. The weight of influence exerted by interested units is very high because political considerations are important and significantly influence SIDs. However, the areas of disagreement, and the influence exerted by interested units in opposite directions are below the average. This leads to low conflict between interested units. Accordingly, the total pressure is uneven across those units. Technological, market and supplier uncertainties are the main uncertainties perceived by management; all of the strategic considerations are considered to be very important.

From the perspective of information in relation to the evaluation process, the cost of investment and the cost of capital are two of the most certain forms of information for SIDs; while payback period and intangible cost are the two most uncertain forms of information for all SIDs. The productivity index and profit are two of the most important forms of information. The sources of all this information seem to be mainly internal rather than external. However, intangible benefit and the cost of investment are two forms of information which need external support. The most frequently mentioned individual approach to handling risk is scenario planning, and learning is very useful for future decision-making.

- **Findings related to the IT dimension of SIDs**

In section 5.2, this study identified over 30 distinguishing factors of SIDs in terms of IT intensity (see Table 5.18 for detail). From the perspective of decision formulation, only 4 factors (the level of hierarchy, the number of formal meetings, the number of informal discussions, and the extent of external organisational involvement) show differences in terms of IT intensity. Unevenness of total pressure across interested units is the only distinguishing factor in relation to decision content.

From the perspective of evaluation, many more distinguishing factors can be identified including three strategic consideration factors (consistency with business strategy, related growth rate and competitive position of company). Information such as project duration, cost of capital, the NPV, payback period, ARR, profit, productivity index and intangible benefit are negatively associated with the extent of IT intensity in terms of perceived accuracy; information such as cash flow, duration, cost of capital, profit and intangible cost are also negatively associated with IT intensity in terms of perceived importance.

From the perspective of objectives, several objectives (increased profit, increased sales, increased market share, enhanced return on investment, retained market position and achieved competitive advantage) are likely to be less important for IT projects. However, the perceived importance of objectives does not relate to the attainment of objectives, since only two factors (reduced cost and meet government regulations) are to be found as distinguishing factors.

- **Findings related to the testing of hypotheses**

The present study finds that IT intensity is negatively associated with the effectiveness of SIDs. Three out of the five proposed mediators- the level of interaction, the accuracy of information and the strategic considerations- are shown to act as mediators in the link of IT intensity and effectiveness. However, due to the weak linkage between IT intensity, the effectiveness of SIDs, and the proposed mediators, the findings become less meaningful because the critical factors which impact on the effectiveness of SIDs are still not clear.

- **Findings related to the exploration of factors which are critical for the effectiveness of SIDs**

Accordingly, a model with seven variables is then presented which identifies the factors which are critical for the effectiveness of SIDs. These critical factors are: the scope of involvement in the project formulation process, the competitive position of the company, the growth rate of the market related to the project, the perceived accuracy of the productivity index, the perceived accuracy of profit, the radicalism of the consequences, and the financial state of the company. These seven variables can explain approximately 75% of the variance of the effectiveness of SIDs. Based on these findings, in the next chapter, the study proposes a protocol for the evaluation of strategic investment projects.

Overall the findings identify a seven variable model which contributes to an explanation of the effectiveness of SIDs. In the next chapter this model, together with the findings on the overall profile of SIDs and SITIDs, and the link (though weak) from IT intensity to effectiveness, is used as a basis for a protocol for the evaluation strategic investment projects.

Chapter 6. Towards a Protocol for the Evaluation of SIDs and SITIDs

6.1 Introduction

The purpose of the previous chapter was to depict clearly the impacts of IT intensity in order to extend our understanding of SIDs in relation to their IT content. The data analysis first concluded that there are some distinguishing factors in terms of IT intensity. However, it is unlikely that the effort to manage the effectiveness of SIDs will focus particularly on the IT dimension, since the impact of IT content on the effectiveness of SIDs is revealed to be only weakly significant. Then, the various factors which impact significantly on the effectiveness of SIDs were explored.

The major concern of Chapter 6 is to examine two questions: Are current evaluation methods sufficient to handle these findings? If not, how can these methods be improved and integrated? To address these two questions, this chapter proposes a protocol for the evaluation of SIDs in general and SITIDs in particular. A protocol is a system of rules governing formal occasions for the evaluation of SIDs and SIDs. The protocol is for SIDs in general because it is derived from a discussion of those factors, identified in Section 5.4, which impact significantly on the effectiveness of SIDs. The protocol is also for SITIDs in particular because, those distinguishing factors explored in

Section 5.2 are examined thoroughly to ensure that the protocol is applicable for SITIDs. The derivation of the protocol is presented in Section 6.2.

In Section 6.3, the second task is to integrate these rules to form a model for the evaluation of SIDs and SITIDs. This model will provide a holistic picture of the management of strategic investment projects. Although an empirical test of the model is beyond the scope of this thesis, in Section 6.4 an example is presented using simulated data.

6.2 From Quantitative Findings to a Protocol for Evaluation

In Chapter 5, the discussion of the research findings aimed to examine whether they agree or disagree with those of previous studies. In this chapter, the major concern is how to apply these findings to the process of evaluating SIDs and SITIDs. This includes both the management process and the evaluation techniques. In addressing the findings from the quantitative survey, the inadequacies of the management activities and techniques are highlighted, and this leads to the formulation of some rules for SIDs and SITIDs. These rules then form a protocol which can contribute to the conduct of SIDs and SITIDs in practice.

According to Section 5.4, the following factors are deemed to be critical in influencing the outcome of SIDs.

- the scope of organisational involvement in the project formulation process
- the competitive position of the company

- the growth rate of the market related to the project
- the perceived accuracy of the productivity index
- the perceived accuracy of the predicted profit
- how radical the consequences were when the project changed things
- the financial state of the company

The variables seem to represent different perspectives on SIDs in terms of 'strategy', 'investment', and 'decision'. Before the derivation of the protocol, the managerial implications of these variables and possible way of addressing the variables will be summarised:

Strategy. Three variables reflect the strategy perspective: the growth rate of the market related to project, the competitive position of company, and the extent of radicalism of the project's consequence. The first two variables are similar to the two axes of the well-known Growth-Share Matrix, which is an analytical technique for strategic planning developed by Boston Consulting Group (BCG). The market-growth rate can be used as a proxy for the attractiveness of the market for each of the investment projects; the competitive position identifies a business's internal strength in a competitive environment. The regression analysis suggests that where there is a high competitive position and market growth rate SIDs are likely to be effective. If a low competitive position or/and growth rate is perceived, the investment project is less likely to be effective. In this case, the analysis indicates that management may be overoptimistic in the prediction of any anticipated benefits of the investment project and this should be allowed in the evaluation. From another perspective, any project likely to enhance the competitive position and growth rate should have a high priority in the evaluation of multiple alternatives.

As discussed in Chapter 4, SIDs are investment decisions with major long-term implications for the firm, and these decisions are strategic in the sense that they significantly help to shape the firm's long-term future. That is, the consequences of SIDs should always have significant impacts on firms. If not, the decision should not be regarded as a strategic investment, and it may be necessary to re-examine carefully the necessity of the project since the impact of the project is likely to be low. That is, in the evaluation of SIDs, the predicted consequences of projects can be regarded as an indicator of the necessity of the project. A project that can change things radically deserves a higher degree of attention.

Investment. The identification of financial state of the company as a significant variable reflects the importance of the investment climate for the success of a decision. Therefore, a strong financial state of the company will support the complexities of the firm's portfolio of projects; a weak financial state may be harmful to the success of the investment projects so that under those circumstances they should be evaluated cautiously. From another perspective, a project likely to enhance the financial state of the company should have a high priority in the evaluation of investment projects.

Decision. As discussed in Chapter 2, Clemen (1996) indicates that the problems of decision-making arise from its inherent complexity, its inherent uncertainty, multiple objectives, and multiple involvement. So variables such as the scope of organisational involvement, and the perceived accuracy of the productivity index and predicted profit reflect the complexity of the decision.

The turbulent conditions of environmental change are the major factors which cause uncertainty and lead to the reduced accuracy of information of strategic investment projects. This can be due to the economic climate, or responses of competitors threatened or harmed by innovation, or, in extreme cases, to unfavourable regulatory changes made in response to the project's success. However, accuracy of information is usually uncontrollable and unpredictable. The construction of clear alternative futures for a business's environment may lead to greater perceived accuracy of information. Since absolute accuracy of information is impossible, a alternative approach, using 'adaptation' rather than 'prediction' in confronting uncertainty, may reduce the impacts of uncertain information.

From the viewpoint of organisation involvement, a greater level of involvement will contribute to the effectiveness of SIDs because it should overcome the deficiencies of knowledge with regard to the investment project and increase commitment. Unlike the information issue, it is possible to enlarge the scope of involvement, and it is highly recommended to do so.

The selected variables represent constructs from diverse perspectives, including the interaction of the formulation process, the strategic considerations of the evaluation process, the accuracy of information in the evaluation process, the decision content, and the contextual factors. However, as discussed in Section 5.4, the variables which are not selected from the model may still be important. Accordingly, from a managerial perspective, it is meaningful to broaden the discussion to a general conceptual (construct) viewpoint rather than to restrict it to the viewpoint of a single variable.

Accordingly, the discussion in this chapter concentrates on the following tasks:

(1) In order to enhance the perceived accuracy of the productivity index and the perceived accuracy of the predicted profit into account, it is important to enhance the perceived accuracy of information and to adapt to uncertain and changing information.

(2) In order to take the competitive position of the company and growth rate of the market into account, it is suggested that the strategic considerations of the investment project should be strengthened.

(3) In order to take the scope of organisational involvement in the project into account, the level of interaction of the formulation process should be increased.

(4) In order to take the issue of radical change into account, it is important to foresee the possible consequences of the project.

(5) In order to take the financial state of the company into account, the internal and external business environments should be scanned.

The following sections will discuss these five issues in turn.

6.2.1 Enhancing the Perceived Accuracy of Information and Adaptating Uncertain Information

In Chapter 2, this study reviewed financial investment appraisal methods, and specific approaches were identified for the handling of uncertainty in capital investment, such as the risk analysis approach, the risk preference approach, the beta analysis approach, and option theory. Generally speaking, these approaches all try to model uncertainty so as to predict the outcome of input information. These methods are critical in handling uncertain information.

From a positive perspective, the construction of clear alternative futures for a business's environment may lead to greater perceived accuracy of information. As discussed in Chapter 2, one of the flexible planning methods which can contribute to the perceived accuracy of information is scenario planning. In Chapter 5, the study showed the ranking of methods used to handle risk. Scenario planning was seen to be in first position. This result complements O'Brien's (1994) survey, indicating that the most frequently mentioned individual approach is scenario planning. Scenario planning (see Chapter 2 for details) is the process of constructing alternative futures for a business's external environment. The goal of scenario planning is to learn to use these alternative futures to test the resilience of today's action plan. Scenario analysis can present several models which span the uncertainty range. The use of scenario analysis is quite flexible and offers a more appropriate approach in dealing with a turbulent environment.

Rule 1.1 The SID evaluation process needs to incorporate scenario analysis, which caters to people's preference for certainty primarily by specifying uncertainty across scenarios.

From a negative perspective, recent trends have increased the importance of the concept of 'strategic flexibility', which means using 'adaptation' rather than 'prediction' in confronting uncertainty. In fact, flexibility and adaptability are two key attributes associated with the successful execution of a strategic planning exercise (Iliff, 1994). The deliverables should incorporate a flexibly designed set of proposals which will permit adaptation to business imperatives and changes in emphasis and design over time. The plan and decisions presented at the end should be such that they are not invalidated by any predictable change in company emphasis or foreseeable developments in technology. Therefore, the impacts of uncertain information on the SIDs should be reduced by increasing strategic flexibility in the management process.

In Chapter 2, the present study reviewed six types of flexibility in different stages for the SITIDs. In the formulation stage, alignment and time-scale flexibility are suggested; in the evaluation stage, decision hierarchy flexibility, measurement and criteria flexibility, and sourcing flexibility are suggested; and in the implementation stage, organisational flexibility is suggested. Although these different types of flexibility were here discussed with particular reference to strategic IT investment projects, they seem to be equally applicable to SIDs, by helping to derive rules which will help management in conducting SIDs, and by increasing the accuracy of information for the evaluation.

Rule 1.2 The SID decision-making process needs to incorporate alignment flexibility in order to identify business needs and maintain the flexibility of a project's function, thus ensuring a fit with those needs.

Rule 1.3 The SID decision-making process needs to maintain time-scale flexibility in order to reduce the problem of the time-scale.

Rule 1.4 The SID decision-making process needs to break down the decision problem (decision hierarchy flexibility) in terms of the decision's characteristics and the organisation's characteristics.

Rule 1.5 The SID decision-making process needs to identify the value of measures and criteria with respect to the investment, and the selection of measures and criteria must vary according to the different objectives of investment projects.

Rule 1.6 The SID decision-making process needs to maintain the sourcing flexibility which leads to the transmission of some of the technical risks and project risks (which are caused by the complexity of the project form) to the external organisations.

Rule 1.7 The SID decision-making process needs to maintain organisational flexibility in terms of capital, human resources, management process and organisational structure.

From the perspective of SITIDs, rules 1.1 to 1.7 are extremely valuable in relation to the following two sets of distinguishing factors identified in Section 5.2. First, the higher the level of IT intensity in a SID, the higher the technological uncertainty and personnel uncertainty and the lower the perceived regulatory uncertainty perceived. Second, the higher the level of IT intensity in a SID, the more uncertain are (1) the project duration, (2) the cost of capital, (3) the NPV of cash flow, (4) the payback period, (5) ARR, (6) profit, (7) productivity, and (8) intangible cost.

The sourcing flexibility will contribute to technological uncertainty through the transmission of the technical risk to external organisations. The organisational flexibility will adjust the usage of the organisation's human resources to the personnel uncertainty. From the financial information perspective, a consideration of time-scale flexibility is required. For strategic IT projects it seems more appropriate to have a shorter time scale than other strategic projects in order to increase the accuracy of information, since a longer time scale always involves a more unpredictable situation.

To sum up, it is impossible to obtain or produce totally accurate information for evaluation. Hence, the rules are proposed according to the nature and characteristics of strategic investment projects and the incorporation of these rules in the evaluation process should either increase the degree of perceived accuracy of information for evaluation or reduce the impacts of uncertain information.

6.2.2 The Need to Strengthen Strategic Considerations

The quantitative analysis in section 5.4 suggests that it is necessary to strengthen strategic considerations in order to pursue a better outcome of SIDs. In Chapter 2, the present study reviewed several capital budgeting techniques and evaluation approaches. In this case, the discussion of the evaluation of investment projects should go beyond capital budgeting techniques, since the latter only represent the appraisal part of evaluation activities.

Methods discussed in Chapter 2, such as the balanced scorecard, seem more likely to help management to incorporate evaluation activities within the planning context. Dyson and Berry (1998) also suggest the integration of the balanced scorecard method in strategic evaluation. The balanced scorecard complements traditional financial indicators with measures of performance of customers, internal processes, and innovation and improvement activities. Second, the scorecard's measures are grounded in an organisation's strategic objectives and competitive demands. That is, the scorecard as a strategic measurement system links measurements to strategy. Accordingly, based on this discussion, the following rules are proposed in order to strengthen the strategic considerations of SIDs.

Rule 2.1: In order to strengthen the strategic considerations of SIDs, management need to place SIDs in an organisational planning context to achieve consistency with corporate strategy.

Rule 2.2: In order to strengthen the strategic considerations of SIDs, management can use methods such as the balanced scorecard to integrate strategic planning techniques, value measures and performance measures.

From the perspective of SITIDs, these rules will contribute to the following distinguishing factors: the higher the level of IT intensity in a SID, the less important are the strategic considerations of (1) the consistency with business strategy, (2) the growth rate of the market related to the project, and (3) the competitive position of the organisation.

As reviewed in Chapter 2, Farbey et al. (1993) indicate that the evaluation problem of IT is really one of alignment, and organisations that are aware of IT's new role have usually made efforts to incorporate IT in their strategic thinking. Accordingly, SITIDs need more effort to strengthen strategic considerations, and the proposed rules should be extremely valuable in this respect.

Strategic considerations are of importance to all SIDs. However, one problem which may arise if strategic considerations are taken into account is how to integrate these non-financial indicators with financial indicators. Methods should be adopted which can complement traditional financial indicators with measures of performance, and which are grounded in an organisation's strategic objectives and competitive demands.

As the importance of strategic considerations has increased, non-financial information has come to play a critical role in the investment decisions concerning where and when to allocate resources to strategic programmes. In justifying strategic initiatives, it is necessary to incorporate strategic considerations, e.g. the strengthening of market growth with financial evaluation. Difficulty in incorporating financial and non-financial information in the evaluation may have many causes. First, some of the non-financial information is intangible. Second, it is difficult to estimate the monetary value of this information. Third, it is difficult to rely only on current financial capital appraisal methods when taking both financial and non-financial information into account.

In relation to the first difficulty, the balanced scorecard can also be used to identify both financial and non-financial information. Kaplan and Norton (1993) suggest a systematic development plan to create the balanced scorecard and to encourage commitment to the scorecard among senior and mid-level managers. The plan starts with a definition of the business unit for which a top-level scorecard is appropriate. This is followed by three rounds of interviews and executive workshops in order to reach a final consensus on the visions, objectives and measurements, to develop a stretch target for each measure, and to identify preliminary action programmes to achieve the targets. Then, the implementation stage includes linking the measures to databases and information systems in order to communicate the balanced scorecard throughout the organisation. Finally, periodic reviews aim to revise the balanced scorecard method in order to integrate the strategic planning, goal setting, and resource allocation processes.

In relation to the second and third difficulties, Stout et al. (1991) state the reasons for selecting Analytic Hierarchy Process (AHP) for the improvement of the investment justification process. First, AHP allows the systematic consideration and evaluation of multiple decision criteria. These criteria could be financial, non-financial, quantitative or qualitative, tangible or intangible. Second, AHP allows managerial judgements to be included formally and systematically in the investment justification process. Third, as a process, AHP enables managers to focus on those aspects of the decision that need refinement or have the highest degree of uncertainty. It accomplishes this through the use of matrix-weighting techniques. Finally, AHP is well suited to support the growing movement towards group decision-making in business.

However, AHP only addresses the choice phase of the decision-making process and is not a complete methodology for the whole process. Accordingly, this study suggests the application of the AHP model in the proposed strategic planning framework and the integration of AHP with the other methods or concepts such as Kaplan's balanced scorecard, cost-benefit analysis and gap analysis in order to fit the situation of IT investment projects.

Rule 2.3: Management need to translate a company's strategic objectives into a coherent set of performance measures. Management can use the balanced scorecard method as a strategic measurement system which links measurements to strategy in order to identify both financial and non-financial objectives and criteria.

Rule 2.4: Management can use methods such as AHP, which allows the systematic consideration and evaluation of multiple decision criteria that are both financial and non-financial, quantitative and qualitative, tangible and intangible.

Accordingly, it is critical to match investment objectives, measurements and criteria in the evaluation of investment projects and to employ both financial and non-financial information. This could be extremely important for SITIDs, since IT investment projects always attach less importance to financial information, including cash flow, project duration, cost of capital, profit and intangible benefit. Powell (1993) argues that strategic necessity is perhaps only a mask, because management is unable to measure the investment. Accordingly, the neglect of this financial information possibly leads to the poor outcome of an IT investment project. Therefore, Rules 2.3 and 2.4 should be able to contribute significantly to the evaluation of SITIDs.

6.2.3 The Need to Increase Interaction

Interactions are contacts between two or more members of the group and are of importance in the development of group behaviour. As discussed in Chapter 3, management should consider the political nature of organisational decision-making, where influence is exerted on the outcome through a decision-making process. The investment projects are likely to have less interaction, which may lead to a poor outcome of SIDs. In this case, management should recognise that it is critical to increase the level of interaction in order to seek a better outcome of the investment project.

Managers' lack of knowledge and experience related to the investment project will lead to low involvement in the project, especially for high-level managers. Without related knowledge and experience, managers cannot discuss the project in depth. Therefore, the scope of managerial involvement in the project is likely to be reduced.

Accordingly, the key to increasing the level of interaction in the decision-making process is to overcome the inadequacy of management's knowledge by increasing the sources of information and strengthening knowledge accumulation. Although the sources of information can be both internal or external, in dealing with more technically-oriented investment projects, management should put more effort into identifying those external sources which can provide more relevant knowledge.

At the same time, knowledge needs to be accumulated effectively. Thus, organisational learning also contributes to the effectiveness of decision-making. Accordingly, management need to pay careful attention to the monitoring and feedback systems of the organisation in order to enhance the mechanisms of organisation learning.

Rule 3.1. In the evaluation stage, the investment project should recruit members from both internal and external organisations to provide management with more knowledge. Outsourcing is particularly important in the case of more technically-oriented investment projects.

Rule 3.2 Feedback information is critical for management in order to extend their understanding and enhance organisational learning. The monitoring and feedback functions are critical for evaluation activities.

Since these rules address the interaction and organisational issues of decision-making, from the perspective of SITIDs, they should be able to address the following distinguishing factors: the higher the level of IT intensity in a SID, (1) the fewer levels of the hierarchy are involved; (2) the fewer formal meetings are held; (3) the fewer informal discussions are held; (4) the fewer external organisations are involved. Again, this shows that SITIDs need more effort to increase interaction and broader involvement in the decision-making process in order to enhance the outcome of decisions.

6.2.4 The Need to Predict the Possible Consequences of SIDs

In order to take the issue of the extent of radical change issue into account, it is necessary to foresee the possible consequences of the project. The prediction related to the consequences of SIDs needs to be addressed in the current planning context. However, a fundamental planning model may not be adequate, because strategic decisions take time to affect the performance of an organisation (Dyson, 1990). Because of this time lag and the potentially severe consequences of deviating from objectives, a reactive strategic decision-making process is inadequate. Indeed, a new strategic initiative often takes several years to execute fully. If the feedback systems detect problems and deviations from planned results only after they have already occurred, then they will not fit the turbulent conditions of today's environmental change.

To address this problem, Dyson (1990) proposes a proactive strategic decision-making process which is more appropriate for the planning of SIDs. His model clearly depicts the proactive and dynamic features of the strategic decision-making process and is of value in the present study.

Rule 4.1 To fit the turbulent conditions of today's environmental change, the proactive concept should be employed because existing feedback systems tend to detect problems and deviations from planned results only after they have already occurred.

This rule does not address any specific distinguishing factor in terms of IT intensity but is applicable for general strategic investment projects.

6.2.5 The Need to Scan the Business Environment

The detection mechanism refers to the scanning situation of both the internal and external organisational environments. According to both the literature review in Chapter 2 and the summary of quantitative findings presented in Chapter 5, contextual factors have a significant influence on the outcome of SIDs. It is absolutely necessary to obtain a very thorough understanding of business environmental information as a prerequisite of the whole planning process. The scanning of the internal environment (e.g. missions, objectives, strategies, operational activities, information needs, financial state, management's attitude toward risk, leadership style) seeks to ensure that the investment fits the current organisational context. The scanning of the external environment (e.g. the economic state of the industry, the market situation of the company, the strength of competition in the industry) aims to explore opportunities for contributing to business strategy. In the implementation stage, the scanning of resources seek to understand resources such as finance, manpower, raw materials and so on (Dyson, 1990), and strategic planning needs to address the resource allocation plan (e.g. the financial plan or manpower plan) of the organisation. Furthermore, environmental scanning also ensures that the investment objectives match the organisation's current requirements.

Rule 5.1: Environmental scanning (both internal and external) will improve the understanding of business environmental information as a prerequisite of the whole planning process, and will enhance the identification of investment objectives.

Obviously, environmental scanning is a critical mechanism for all investment projects, irrespective of the extent of IT intensity. However, it is particularly important for IT investment projects since the higher the level of IT intensity in a SID, the less importance is attached to investment objectives such as increased profit, increased sales, increased market share, enhanced return on investment, in relation of keep market position, and the achievement of competitive advantage. It is possible that high IT intensity cases will blur their investment objectives. Without a clear identification of the values of objectives, the resulting decisions are likely to be sub-optimal. Accordingly, rule 5.1 helps SITIDs to address the distinguishing factors in SITIDs which are related to the low importance attached to investment objectives.

This section has discussed the quantitative findings in Chapter 5 and the literature review in Chapters 2 and 3. The rules of protocol for SIDs in general and SITIDs in particular suggest the key methods for the evaluation of SIDs and SITIDs. To sum up, these rules contribute to SIDs and are particularly valuable to SITIDs. The next section seeks to provide a holistic view of the protocol by integrating these rules into a planning model. In the next section, any discussion relating to SIDs also relates to SITIDs.

6.3 Towards a Model to Represent the Protocol for SIDs

Generally speaking, a normative model of the strategic planning process may be seen to include three primary stages: formulation, evaluation and implementation (Preble, 1992). The incorporation of investment decisions in a strategic planning framework implies a broader view of investment projects; however, it does not ensure the success of investment projects. Mintzberg (1994) identifies the need for mechanisms which are implicitly linked to claims about planning stimulating creativity as well as providing a means to deal with change in general and turbulent conditions in particular. Accordingly, the study aims to propose a planning model which incorporates fundamental planning processes along with mechanisms to overcome the problematical nature of strategic investment decisions.

Since the major purpose of the protocol is to assist in the evaluation of investment projects, the evaluation mechanism acts as the axis of the model, and the other mechanisms are dynamically interactive within the planning process. Based on the protocol, this study suggests the need for a strategic flexibility mechanism (Rule 1.2 to Rule 1.7), detection mechanism (Rule 5.1), proactive mechanism (Rule 4.1) and feedback mechanism (Rule 3.2) to strengthen the evaluation mechanism of SIDs. In other words, in conducting the evaluation process, the three steps (formulation, evaluation and implementation) need to take those mechanisms into account in order to confront the uncertainty and turbulence of organisational change. Figure 6.1 shows the proposed model. The following sections provide a detailed discussion of this model in terms of its mechanisms.

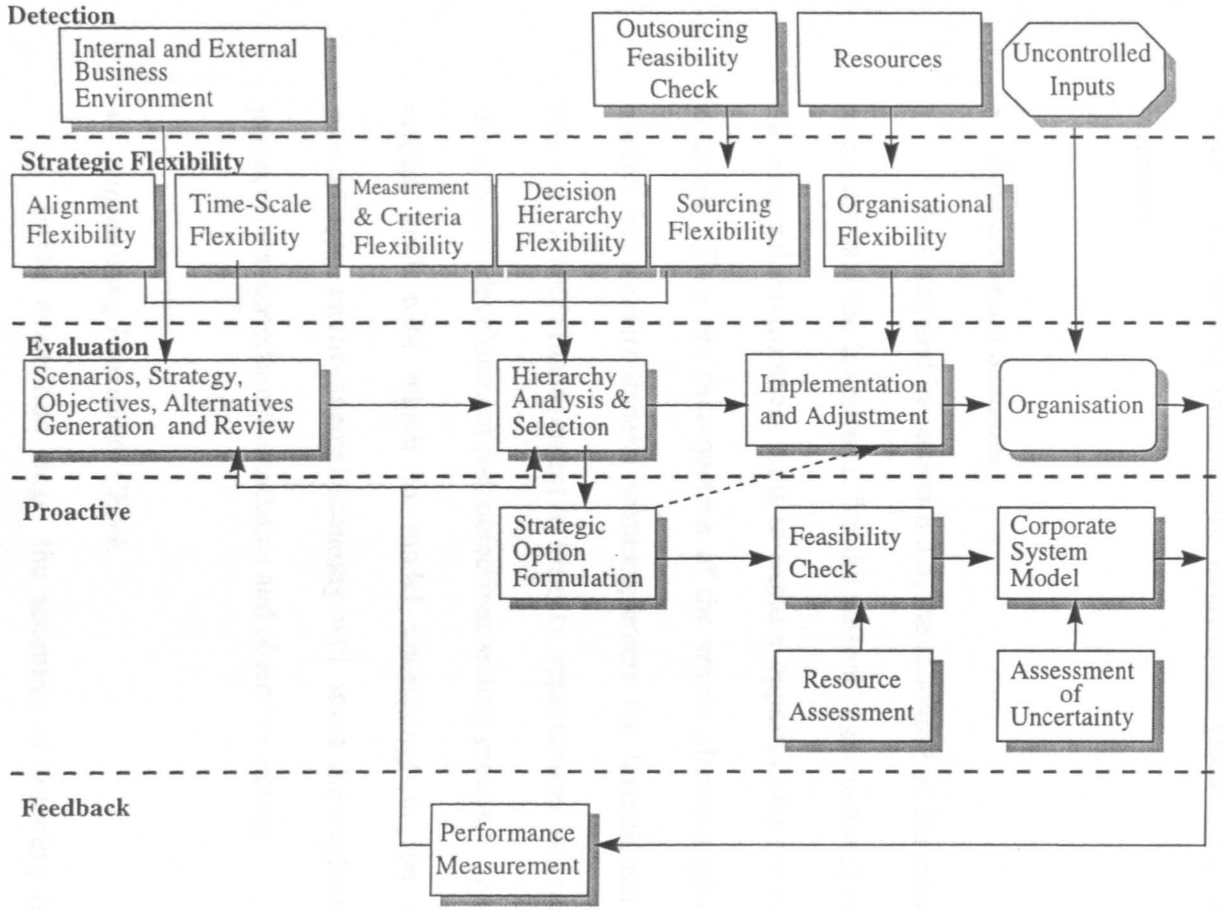

Figure 6.1 A Strategic Planning Model for SIDs

6.3.1 The Detection Mechanism

The major purpose of the detection mechanism is to detect change, and this involves functions such as the environmental scanning of investment opportunities (Rule 5.1), seeking outsourcing alternatives (Rule 3.1), and the assessment of resources.

- *Environmental Scanning*

As discussed in section 6.2.5, the scanning of the internal environment seeks to ensure that the investment fits the current organisational context; the scanning of the external environment aims to explore opportunities for contributing to business strategy. They are prerequisites of the whole planning process. The information gained from environmental scanning enters the formulation stage of the planning process. It helps management to identify opportunities and threats and thus supports the scenario development and objectives setting process. Scenario development is a critical tool with which to model uncertainty in the formulation of SIDs. Accordingly, environmental scanning will assist the evaluation of SIDs from two perspectives: uncertainty avoidance and objective setting.

- *Outsourcing Feasibility Check*

In the evaluation stage, the scanning of sourcing feasibility refers to the exploration of the sourcing opportunities and sourcing strategy of the investment project. Outsourcing is particularly important for technically-oriented projects addressing the interaction and uncertainty problems (see section 5.2.3) by increasing the sources of information and knowledge accumulation (Rule 3.1), and in the transmission of the technical risk to the external organisation (Rule 1.6). That is, the outsourcing strategy will counterbalance the inadequacy of management's knowledge in relation to a technically-oriented investment project. Therefore, the feasibility of any outsourcing opportunities must be thoroughly checked. The information arising from the outsourcing feasibility check strengthens sourcing flexibility.

- *Resources*

The assessment of resources is an essential part of all planning processes in which resources such as finance, manpower, raw materials and so on play a key role. There is an increasing emphasis on the resource-based view of strategic development. The resource-based view of the firm shifts the emphasis from the competitive environment of firms to the resources that firms have developed to compete in that environment (Miller and Shamsie, 1996). From this viewpoint, resources enable companies to pursue opportunities or avoid threats and therefore need to be assessed clearly. The information arising from the assessment provides a basis on which to identify the extent of organisational flexibility and the ability to modify organisational structures and management processes in the implementation stage.

6.3.2 The Flexibility Mechanism

As discussed in Section 6.2.1, strategic flexibility can be used to deal with the problem of the low accuracy of information of SIDs. The major function of the flexibility mechanism is adaptation for change, and this involves alignment, time-scale flexibility, decision hierarchy flexibility, measurement and criteria flexibility, sourcing flexibility, and organisational flexibility.

- *Alignment Flexibility*

Strategic considerations have a critical role in determining the effectiveness of SIDs. The SID decision-making process needs to incorporate alignment flexibility to identify business needs and maintain the flexibility of the investment and thus ensure a fit with those needs (Rule 1.3). Strategic alignment and strategic planning are normally treated as separate approaches (Sauer and Yetton, 1997), and strategic alignment is necessary in strategic planning for linking business needs with the project's function. Accordingly, in the formulation stage, the planning process needs to incorporate alignment flexibility in order to strengthen the strategic considerations. Alignment flexibility information contributes to the objectives setting of investment projects.

- *Time-Scale Flexibility*

The time-scale problem may confound the analysis by adding considerable uncertainty. The SID decision-making process needs to maintain time-scale flexibility (Rule 1.3) in order to strengthen the accuracy of information (see 6.2.1). In the formulation stage, the main components of the project need to be identified, and the incremental investment project of these components must also be identified along the time-scale. Accordingly, in a turbulent scenario, the time-scale for investment planning should be on a short-term basis; in a stable scenario, a longer time-scale may be appropriate. Information about time-scale flexibility also contributes to the objectives setting and formulation of investment projects.

- *Measurement and Criteria Flexibility*

The identification of the fundamental values of measurement and criteria information occurs prior to evaluation and must guide the selection of evaluation methods. The SID evaluation process needs to identify the value of measurements (both financial and non-financial) and criteria with respect to the investment, and the choice of measurements and criteria vary according to the different objectives of investment projects (Rule 1.5). Information relating to measurement and criteria flexibility contributes to the hierarchy analysis and selection of investment projects.

- *Decision Hierarchy Flexibility*

As discussed in Chapter 3, complexity is a major characteristic of strategic decision-making, and constructs that contribute to the complexity of decision-making include rarity and importance. In Chapter 5, the study shows that rarity is negatively related to the effectiveness of SIDs. Decision hierarchy flexibility emphasises that the SID decision-making process needs to break down the decision problem in terms of the decision's characteristics and the organisation's characteristics in order to cope with complexity. Therefore, information relating to decision hierarchy flexibility facilitates the hierarchy analysis and selection of investment projects.

- *Sourcing Flexibility*

After the outsoucing feasibility check, the sourcing opportunity and sourcing strategy of the investment project are explored in the evaluation stage. Sourcing flexibility emphasises that the selection of the investment project may employ either a buy or make strategy. An outsourcing (buying) strategy may lead to the transmission of the technical risk and project risk to the external organisations and ensure the success of investment project. Information relating to sourcing flexibility enters the hierarchy analysis and selection of investment projects.

- *Organisational Flexibility*

In the implementation stage, organisational flexibility emphasises that organisations which are better able to respond to competitive pressures tend to view their organisational resources in terms of capital, human resources, management process and organisational structure. Information about organisational flexibility then contributes to the implementation and organisational adjustment of investment projects.

6.3.3 The Evaluation Mechanism

The evaluation mechanism of strategic planning involves investment objectives setting, alternatives generation, feedback reviewing, hierarchy analysis selection, implementation, and structural adjustment.

- *Objectives Setting*

A key part of the strategic planning process involves setting and reviewing objectives. This involves having an overall mission statement for the organisation and more specific objectives and goals, cascading down to specific quantitative and qualitative targets (Dyson, 1990). In Rule 1.1, the study first suggests that the SID decision-making process needs to incorporate scenario analysis in order to handle risk. Scenario development has a key role in evaluation in terms of modelling uncertainty. At the same time, environmental scanning can support strategic initiative formulation through the identification of opportunities, threats and the capabilities of the organisation. Meanwhile, alignment flexibility helps to identify business needs and the project's function to ensure a fit with business needs; while time-scale flexibility helps to reduce the problem of the time-scale. Accordingly, scenario analysis is a critical step in objective setting, and the alignment and time-flexibility facilitate the conduct of objective setting of SIDs.

- *Hierarchy Analysis and Selection*

Strategic investment projects always involve multi-objectives, multi-measurements and multi-criteria. The evaluation process needs to translate a company's strategic objectives into a coherent set of performance measures and criteria. Hierarchy analysis can help to organise clearly the investment objectives, measurements and criteria into a hierarchical structure, and can then help to fit the characteristics of those identified objectives and information with the evaluation.

In this stage, decision-hierarchy flexibility emphasises the need to break down the decision problem in terms of the decision's characteristics and the organisation's characteristics; measurement and criteria flexibility emphasises the need to identify the values of measurements and criteria with respect to the investment, with the selection of measurements and criteria varying according to the different objectives of investment projects; sourcing flexibility emphasises the need to explore the sourcing opportunities and sourcing strategy of the investment project.

- *Implementation and Adjustment*

In the implementation stage, organisations which are better able to respond to competitive pressures tend to view their structures as temporary and malleable, changing them continuously to line up with strategic and operational requirements. Organisational flexibility emphasises the need to modify the organisational structures and management processes in order to ensure that the planned results are obtained.

6.3.4 The Proactive Mechanism

The major purpose of the proactive mechanism is to catch the prediction of future states of the organisation, and this prediction then feeds back and offers comparisons with investment objectives (see Rule 4.1). As suggested by Dyson (1990), this includes a constant flow of strategic options so that the organisation can adapt to change; the feasibility of any proposed option must be thoroughly checked; an assessment of resources must be made; and the uncertainty associated with uncontrolled inputs to the organisation must be assessed. The strategic options also contribute to the organisational adjustment and implementation of the decision. Dyson (1990) has already reviewed the detailed techniques to achieve the proactive mechanism, such as the TOWS Matrix for strategic option formulation, risk analysis for the assessment of uncertainty, and system dynamic analysis for corporation modelling.

In Figure 6.1, the proposed model involves an additional forward loop enabling the possible future performance of the organisation to be anticipated, thus facilitating timely strategic action, and also allowing selected investment decisions to be tested so that their future impact can be estimated. The broken line in Figure 6.1 indicates that the prediction of change affects implementation. Accordingly, the proactive mechanism is concerned with preparation for change.

6.3.5 The Feedback Mechanism

Finally, the feedback mechanism involves the performance measurement of the organisation (Rule 3.2). It collects information from the investment project which has been implemented in the organisation, and information from the proactive mechanism. The feedback mechanism is concerned primarily with a control process which involves the review and feedback of performance in order to determine if plans, strategies and objectives are being achieved, with the resulting information being used to solve problems or take corrective actions. The feedback mechanism also represents the function of organisational learning. As indicated in Section 5.2.3, organisational learning contributes to knowledge accumulation, which in turn may impact on the interaction of the decision-making process. Accordingly, learning is a source of decision effectiveness and should be incorporated in the planning model. An organisational learning capability can facilitate the formulation, evaluation and implementation of a new investment.

Accordingly, in Figure 6.1, the proposed model retains the feedback system of the simple control model in its outer loop. The control procedure receives the feedback on current and possible future performance, compares this with the objectives, selects or rejects trial projects depending on the extent to which they support the objectives, and may seek to step up the strategic option formulation process if the anticipated gaps are too large. An investment project requiring formal approval will then move to the final implementation stage, thus changing the nature and performance of the organisation.

6.4 An Example of Hierarchy Analysis and Selection

Rea (1969) suggests that an approach to the design of planning systems gives rise to the need not only to identify the functions that must be carried out in the resource allocation process, but also to search for analytical tools that can be employed to carry out these functions. Accordingly, this section describes the integration of the balanced scorecard, analytical hierarchy process along with cost-benefit analysis or gap analysis to the evaluation of a strategic investment project. The mathematical foundation of AHP is presented in Appendix 4. The model developed for this important problem was tested with simulated data. Although it is difficult to generalise from this example, which deals with a single issue, there was nothing unique in the situation where the test was performed. Hence, to fit the real situation of a strategic investment project, the following precedents and assumptions will be considered.

(1) **Multiple alternative assumption**: in the formulation stage, after scenario analysis, strategy formulation and the establishment of investment objectives, four alternatives for evaluation are generated.

(2) **Multiple involvement assumption**: the corporation assigns three managers from different departments including finance, marketing and information systems to be involved in the decision-making process.

(3) **Multiple objectives assumption**: the corporation aims to employ the balanced scorecard method to link strategy and measurement. Major objectives are viewed from different perspectives, including financial, customer, internal business, innovation and learning perspectives. Costs are also identified from three perspectives: initiative cost, maintenance cost, and management cost.

(4) **Multiple criteria assumption**: each of the objectives will be measured according to at least four criteria.

Although the data in the following example are artificial, the real calculations of eigenvalue, eigenvectors, consistency index and consistence rate are based on the data given by the present study. Professional mathematical software, *MathCad,* was used to conduct the calculating process. By using this tool, it is necessary to input the pairwire comparison matrix, and then the outcomes (eigenvalue, eigenvectors) will be calculated automatically.

Step 1: Decomposition

The strategic investment decision problem is broken over into a hierarchy of inter-related decision elements that include multiple involvement, multiple objectives, multiple criteria, and multiple alternatives as shown in Figure 6.2.

The focus on the apex of the hierarchy is directed at the evaluation of investment projects. Following the apex of the hierarchy, the first level of the hierarchy identifies decisions-makers (the actors). The second level shows the need to identify the costs and benefits of the investment project. The third level employs measurements from the balanced scorecard method to represent the benefit side of the project and identify the costs from different dimensions. The fourth level shows the criteria which are chosen for each measurement. Finally, level 5 shows all possible alternatives.

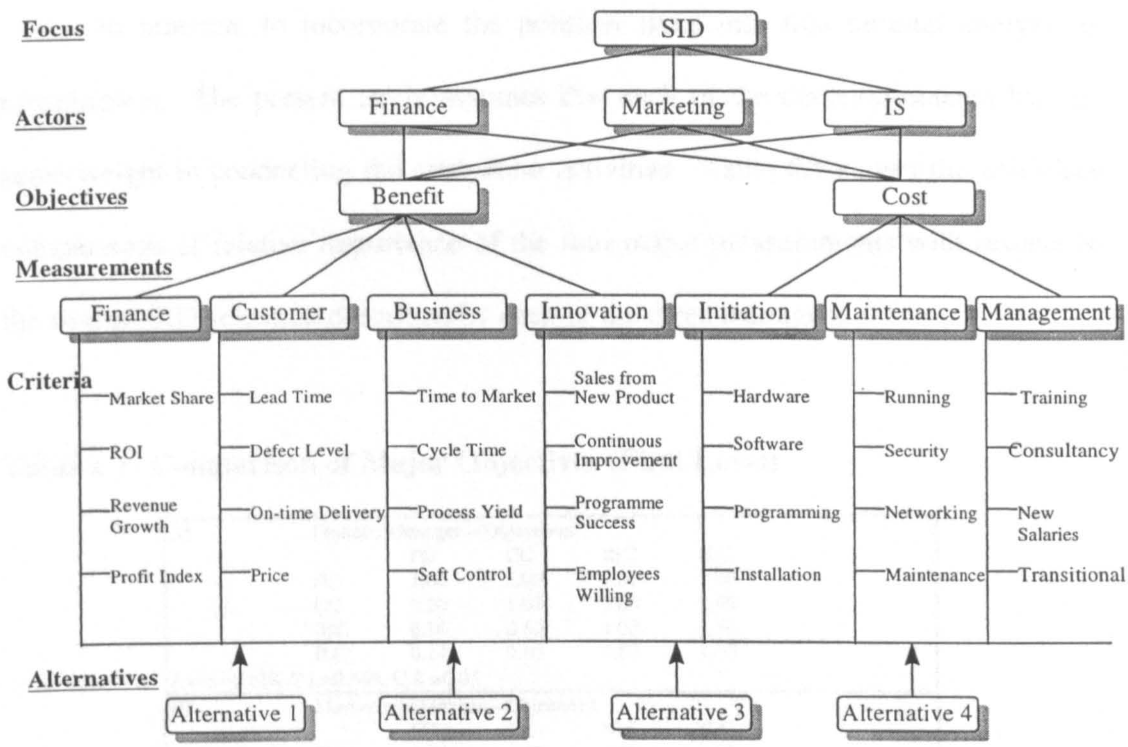

Figure 6.2 The Hierarchy Structure of the Investment Project

Step 2: Pairwise Comparison and Priority Analysis

Once an assessment hierarchy has been established, the next step is concerned with making the pairwise comparisons and the prioritisation of all the elements of the hierarchy. The numerical values of the pairwise comparisons of decision elements by each of the managers are shown in Tables 6.1 to 6.6. However, the first question in this analysis is whether there are different strengths and influences in the case of different decision-makers. This is a political issue.

Theoretically, the analysis process can first assess decision-makers' relative strengths and influences by making the pairwise comparison between decision-makers and then calculating the weight of each decision-maker.

In practice, to incorporate the political issue into this rational analysis is meaningless. The present study assumes that each of the decision-makers has the same weight in conducting the evaluation activities. Table 6.1 shows the pairwises comparisons of relative importance of the four major measurements with respect to the overall SID selection described by each of the three managers.

Table 6.1: Comparison of Major Objectives (First Level)

A)	Finance Manager – Objectives				
		FC	CC	IBC	ILC
	FC	1.00	5.00	6.00	7.00
	CC	0.20	1.00	2.00	2.50
	IBC	0.16	0.50	1.00	1.50
	ILC	0.14	0.40	0.67	1.00
λmax=4.028, C.I.=0.009, C.R.=0.01					

B)	Marketing Manager – Objectives				
		FC	CC	IBC	ILC
	FC	1.00	4.00	6.00	6.00
	CC	0.25	1.00	3.00	4.00
	IBC	0.16	0.33	1.00	1.00
	ILC	0.16	0.25	1.00	1.00
λmax=4.07, C.I.=0.023, C.R.=0.026					

C)	IS Manager – Objectives				
		FC	CC	IBC	ILC
	FC	1.00	5.00	4.00	6.00
	CC	0.20	1.00	2.00	1.50
	IBC	0.25	0.50	1.00	1.50
	ILC	0.16	0.67	0.67	1.00
λmax=4.079, C.I.=0.026, C.R.=0.029					

D)	Aggregate -FC					PV
		FC	CC	IBC	ILC	
	FC	1.00	4.64	5.24	6.32	0.628
	CC	0.22	1.00	2.29	2.47	0.187
	IBC	0.19	0.44	1.00	1.31	0.102
	ILC	0.15	0.40	0.77	1.00	0.083
λmax=4.039, C.I.=0.013, C.R.=0.015						

FC: Financial Measurement, CC: Customer Measurement, IBC: Internal Business Measurement, ILC: Innovation and Learning Measurement

For example, the finance manager indicates that the financial measurement is more strongly preferred to the internal business measurement, and a value of 5 is given and recorded (shown in 6.1_A). Conversely, a reciprocal value (that is, 0.2) is assigned to the internal business measurement when compared to financial measurement. As suggested by Saaty (1985), the value of C.R should be about 10% or less to be acceptable. If the C.R. is not within this range, the participants should study the problem and revise their judgements. After the matrices are accepted, the geometric mean of the comparisons from the three managers is used to derive the aggregate matrix (shown in 6.1_D). This aggregate matrix incorporates the inputs of all the managers. In this case, the priority vector (the weight) for financial measurement is the highest (pv = 0.628), followed by customer measurement (pv = 0.187), internal business measurement (pv = 0.102) and innovation and learning (pv = 0.083).

A similar process is conducted to calculate the weights of the relative importance of the four sub-criteria (Table 6.2), and the relative importance of the four sub-criteria with respect to the alternatives (Table 6.3 - Table 6.6) is also reported.

Table 6.2: Comparison of Benefit Criteria

A) Finance Manager - FC

	MS	ROI	RG	PI
MS	1.00	0.33	0.33	3.00
ROI	3.00	1.00	2.00	7.00
RG	3.00	0.50	1.00	4.00
PI	0.33	0.14	0.25	1.00

λmax=4.065, C.I.=0.022, C.R.=0.024

B) Marketing Manager - FC

	MS	ROI	RG	PI
MS	1.00	0.33	0.33	4.00
ROI	3.00	1.00	3.00	7.00
RG	3.00	0.33	1.00	5.00
PI	0.25	0.14	0.20	1.00

λmax=4.168, C.I.=0.056, C.R.=0.062

C) IS Manager - FC

	MS	ROI	RG	PI
MS	1.00	0.25	0.33	3.00
ROI	4.00	1.00	2.00	8.00
RG	3.00	0.50	1.00	4.00
PI	0.33	0.13	0.25	1.00

λmax=4.07, C.I.=0.023, C.R.=0.026

D) Aggregate -FC

	MS	ROI	RG	PI	PV
MS	1.00	0.30	0.33	3.30	0.142
ROI	3.30	1.00	0.29	7.31	0.511
RG	3.00	0.44	1.00	4.30	0.289
PI	0.30	0.14	0.23	1.00	0.059

λmax=4.088, C.I.=0.029, C.R.=0.033

E) Finance Manager - CC

	LT	DL	OD	PC
LT	1.00	0.33	1.00	3.00
DL	3.00	1.00	2.00	7.00
OD	1.00	0.50	1.00	2.00
PC	0.33	0.14	0.50	1.00

λmax=4.035, C.I.=0.012, C.R.=0.013

F) Marketing Manager - CC

	LT	DL	OD	PC
LT	1.00	0.25	1.00	4.00
DL	4.00	1.00	3.00	8.00
OD	1.00	0.33	1.00	3.00
PC	0.25	0.13	0.33	1.00

λmax=4.049, C.I.=0.016, C.R.=0.018

G) IS Manager - CC

	LT	DL	OD	PC
LT	1.00	0.25	1.00	2.00
DL	4.00	1.00	3.00	6.00
OD	1.00	0.33	1.00	2.00
PC	0.50	0.17	0.50	1.00

λmax=4.013, C.I.=0.004, C.R.=0.005

H) Aggregate -CC

	LT	DL	OD	PC	PV
LT	1.00	0.27	1.00	2.88	0.183
DL	3.63	1.00	2.62	6.95	0.554
OD	1.00	0.38	1.00	2.29	0.188
PC	0.35	0.15	0.44	1.00	0.075

λmax=4.021, C.I.=0.007, C.R.=0.008

I) Finance Manager - IBC

	TM	CT	PY	SC
TM	1.00	3.00	5.00	7.00
CT	0.33	1.00	4.00	6.00
PY	0.20	0.25	1.00	2.00
SC	0.14	0.17	0.50	1.00

λmax=4.114, C.I.=0.038, C.R.=0.042

J) Marketing Manager - IBC

	TM	CT	PY	SC
TM	1.00	4.00	3.00	7.00
CT	0.25	1.00	3.00	3.00
PY	0.33	0.33	1.00	2.00
SC	0.14	0.33	0.50	1.00

λmax=4.162, C.I.=0.054, C.R.=0.06

K) IS Manager - IBC

	TM	CT	PY	SC
TM	1.00	4.00	5.00	7.00
CT	0.25	1.00	3.00	4.00
PY	0.20	0.33	1.00	2.00
SC	0.14	0.25	0.50	1.00

λmax=4.102, C.I.=0.034, C.R.=0.038

L) Aggregate -IBC

	TM	CT	PY	SC	PV
TM	1.00	3.63	4.22	7.00	0.576
CT	0.27	1.00	3.30	4.16	0.249
PY	0.24	0.30	1.00	2.00	0.11
SC	0.14	0.24	0.50	1.00	0.065

λmax=, C.I.=, C.R.=

M) Finance Manager - ILC

	SN	CI	PS	EW
SN	1.00	0.50	0.50	2.00
CI	2.00	1.00	4.00	6.00
PS	2.00	0.25	1.00	2.00
EW	0.50	0.17	0.50	1.00

λmax=4.175, C.I.=0.058, C.R.=0.065

N) Marketing Manager - ILC

	SN	CI	PS	EW
SN	1.00	0.33	1.00	4.00
CI	3.00	1.00	3.00	7.00
PS	1.00	0.33	1.00	3.00
EW	0.25	0.14	0.33	1.00

λmax=4.014, C.I.=0.005, C.R.=0.005

O) IS Manager - ILC

	SN	CI	PS	EW
SN	1.00	0.33	2.00	4.00
CI	3.00	1.00	3.00	8.00
PS	0.50	0.33	1.00	4.00
EW	0.25	0.13	0.25	1.00

λmax=4.089, C.I.=0.03, C.R.=0.033

P) Aggregate -ILC

	SN	CI	PS	EW	PV
SN	1.00	0.38	1.00	3.18	0.203
CI	2.62	1.00	3.30	6.95	0.541
PS	1.00	0.30	1.00	2.88	0.187
EW	0.32	0.15	0.35	1.00	0.069

λmax=4.012, C.I.=0.004, C.R.=0.004

FC: Financial Measurement, CC: Customer Measurement, IBC: Internal Business Measurement, ILC: Innovation and Learning Measurement

MS: Market Share, ROI: Return on Investment, RG: Revenue Growth, PI: Profit Index

LT: Lead Time, DL: Defet Level, OD: On-time Delivery, PC: Price

TM: Time to Market, CT: Cycle Time, PY: Process Yield, SC: Safe Control

SN: Sales from New Product, CI: Continuous Improvement, PS: Programme Success, EW: Employees Willing

Table 6.3: Comparison of Financial Criteria for Alternatives with Multiple Involvement

A) Finance Manager - MS

	At1	At2	At3	At4
At1	1.00	2.00	2.00	3.00
At2	0.50	1.00	1.00	2.00
At3	.050	1.00	1.00	2.00
At4	0.33	0.50	0.50	1.00

λmax=4.007, C.I.=0.002, C.R.=0.003

B) Marketing Manager - MS

	At1	At2	At3	At4
At1	1.00	2.25	5.00	6.20
At2	0.44	1.00	3.30	4.00
At3	0.20	0.30	1.00	3.00
At4	0.16	0.25	0.33	1.00

λmax=4.112, C.I.=0.037, C.R.=0.041

C) IS Manager - MS

	At1	At2	At3	At4
At1	1.00	7.00	2.00	7.00
At2	0.14	1.00	0.25	2.00
At3	0.50	4.00	1.00	3.00
At4	0.14	0.50	0.33	1.00

λmax=4.081, C.I.=0.027, C.R.=0.03

D) Aggregate - MS

	At1	At2	At3	At4	PV
At1	1.00	3.16	2.71	5.07	0.522
At2	0.31	1.00	0.94	2.52	0.189
At3	0.37	1.06	1.00	2.62	0.205
At4	0.20	0.40	0.38	1.00	0.084

λmax=4.012, C.I.=0.004, C.R.=0.004

E) Finance Manager - ROI

	At1	At2	At3	At4
At1	1.00	3.00	5.00	7.00
At2	0.33	1.00	3.00	5.00
At3	0.20	0.33	1.00	2.00
At4	0.14	0.20	0.50	1.00

λmax=4.058, C.I.=0.019, C.R.=0.021

F) Marketing Manager - ROI

	At1	At2	At3	At4
At1	1.00	4.00	5.00	7.00
At2	0.25	1.00	3.00	5.00
At3	0.20	0.33	1.00	2.00
At4	0.14	0.20	0.50	1.00

λmax =4.12, C.I.=0.04, C.R.=0.044

G) IS Manager - ROI

	At1	At2	At3	At4
At1	1.00	6.00	2.00	7.00
At2	0.17	1.00	1.00	3.00
At3	0.50	2.00	2.00	2.00
At4	0.13	0.33	0.33	1.00

λmax=4.141, C.I.=0.047, C.R.=0.052

H) Aggregate - ROI

	At1	At2	At3	At4	PV
At1	1.00	4.06	3.68	7.00	0.588
At2	0.24	1.00	1.65	4.22	0.208
At3	0.27	0.60	1.00	2.00	0.138
At4	0.14	0.24	0.50	1.00	0.065

λmax=4.066, C.I.=0.022, C.R.=0.025

I) Finance Manager - RG

	At1	At2	At3	At4
At1	1.00	0.33	0.25	3.00
At2	3.00	1.00	2.00	8.00
At3	4.00	0.50	1.00	3.00
At4	0.33	0.13	0.33	1.00

λmax=4.193, C.I.=0.064, C.R.=0.071

J) Marketing Manager - RG

	At1	At2	At3	At4
At1	1.00	0.50	0.50	2.00
At2	2.00	1.00	2.00	6.00
At3	2.00	0.50	1.00	4.00
At4	0.50	0.17	0.25	1.00

λmax=4.051, C.I.=0.017, C.R.=0.019

K) IS Manager - RG

	At1	At2	At3	At4
At1	1.00	0.50	1.00	0.50
At2	2.00	1.00	2.00	2.00
At3	1.00	0.50	1.00	2.00
At4	2.00	0.50	0.50	1.00

λmax=4.186, C.I.=0.062, C.R.=0.069

L) Aggregate - RG

	At1	At2	At3	At4	PV
At1	1.00	0.44	0.50	1.44	0.160
At2	2.29	1.00	2.00	4.58	0.458
At3	2.00	0.50	1.00	2.89	0.279
At4	0.70	0.22	0.35	1.00	0.103

λmax=4.032, C.I.=0.011, C.R.=0.012

M) Finance Manager - PI

	At1	At2	At3	At4
At1	1.00	2.00	5.00	5.00
At2	0.50	1.00	3.00	4.00
At3	0.20	0.33	1.00	3.00
At4	0.20	0.25	0.33	1.00

λmax=4.131, C.I.=0.044, C.R.=0.049

N) Marketing Manager - PI

	At1	At2	At3	At4
At1	1.00	3.00	5.00	8.00
At2	0.33	1.00	4.00	4.00
At3	0.20	0.25	1.00	3.00
At4	0.13	0.25	0.33	1.00

λmax=4.17, C.I.=0.057, C.R.=0.063

O) IS Manager - PI

	At1	At2	At3	At4
At1	1.00	3.00	5.00	7.00
At2	0.33	1.00	3.00	5.00
At3	0.20	0.33	1.00	2.00
At4	0.14	0.20	0.50	1.00

λmax=4.058, C.I.=0.019, C.R.=0.021

P) Aggregate - RG

	At1	At2	At3	At4	PV
At1	1.00	2.62	5.00	6.54	0.549
At2	0.38	1.00	3.30	4.31	0.275
At3	0.20	0.30	1.00	2.62	0.114
At4	0.15	0.23	0.38	1.00	0.062

λmax=4.097, C.I.=0.032, C.R.=0.036

MS: Market Share, ROI: Return on Investment, RG: Revenue Growth, PI: Profit Index

At1: Alternative 1, At2: Alternative 2, At3: Alternative 3, At1: Alternative 4

Table 6.4: Comparison of Customer Criteria for Scenarios with Multiple Involvement

A) Finance Manager - LT	At1	At2	At3	At4
At1	1.00	0.33	0.33	2.00
At2	3.00	1.00	2.00	7.00
At3	3.00	0.50	1.00	3.00
At4	0.50	0.14	0.33	1.00

λmax=4.051, C.I.=0.017, C.R.=0.019

B) Marketing Manager - LT	At1	At2	At3	At4
At1	1.00	0.25	0.25	3.00
At2	4.00	1.00	3.00	8.00
At3	4.00	0.33	1.00	4.00
At4	0.33	0.13	0.25	1.00

λmax=4.184, C.I.=0.061, C.R.=0.068

C) IS Manager - LT	Sc1	Sc2	Sc3	Sc4
At1	1.00	0.25	0.33	3.00
At2	4.00	1.00	2.00	7.00
At3	3.00	0.50	1.00	4.00
At4	0.33	0.14	0.25	1.00

λmax=4.062, C.I.=0.021, C.R.=0.023

D) Aggregate - LT	Sc1	Sc2	Sc3	Sc4	PV
At1	1.00	0.27	0.30	2.62	0.128
At2	3.63	1.00	2.29	7.32	0.524
At3	3.30	0.44	1.00	3.63	0.284
At4	0.28	0.14	0.27	1.00	0.065

λmax=4.082, C.I.=0.027, C.R.=0.03

E) Finance Manager - DL	At1	At2	At3	At4
At1	1.00	0.25	1.00	2.00
At2	4.00	1.00	3.00	5.00
At3	1.00	0.33	1.00	2.00
At4	0.50	0.20	0.20	1.00

λmax=4.019, C.I.=0.006, C.R.=0.007

F) Marketing Manager - DL	At1	At2	At3	At4
At1	1.00	0.33	2.00	3.00
At2	3.00	1.00	3.00	8.00
At3	0.50	0.33	1.00	4.00
At4	0.33	0.13	0.25	1.00

λmax=4.106, C.I.=0.035, C.R.=0.039

G) IS Manager - DL	At1	At2	At3	At4
At1	1.00	0.33	1.00	4.00
At2	3.00	1.00	3.00	7.00
At3	1.00	0.33	1.00	2.00
At4	0.25	0.14	0.50	1.00

λmax=4.04, C.I.=0.013, C.R.=0.015

H) Aggregate - DL	At1	At2	At3	At4	PV
At1	1.00	0.30	1.26	2.88	0.199
At2	3.30	1.00	3.00	6.54	0.522
At3	0.79	0.33	1.00	2.52	0.175
At4	0.35	0.15	0.40	1.00	0.074

λmax=4.014, C.I.=0.005, C.R.=0.005

I) Finance Manager - OD	At1	At2	At3	At4
At1	1.00	2.00	2.00	3.00
At2	0.50	1.00	1.00	3.00
At3	0.50	1.00	1.00	2.00
At4	0.33	0.33	0.50	1.00

λmax=4.041, C.I.=0.014, C.R.=0.015

J) Marketing Manager - OD	At1	At2	At3	At4
At1	1.00	3.00	5.00	5.00
At2	0.33	1.00	3.00	5.00
At3	0.20	0.33	1.00	1.00
At4	0.20	0.20	1.00	1.00

λmax=4.111, C.I.=0.037, C.R.=0.041

K) IS Manager - OD	At1	At2	At3	At4
At1	1.00	2.00	5.00	5.00
At2	0.50	1.00	3.00	4.00
At3	0.20	0.33	1.00	2.00
At4	0.20	0.25	0.50	1.00

λmax=4.054, C.I.=0.018, C.R.=0.02

L) Aggregate - OD	At1	At2	At3	At4	PV
At1	1.00	2.29	3.68	4.21	0.495
At2	0.44	1.00	2.08	3.91	0.278
At3	0.27	0.48	1.00	1.59	0.137
At4	0.24	0.26	0.63	1.00	0.09

λmax=4.045, C.I.=0.015, C.R.=0.016

M) Finance Manager - PC	At1	At2	At3	At4
At1	1.00	0.50	0.50	2.00
At2	2.00	1.00	2.00	7.00
At3	2.00	0.50	1.00	4.00
At4	0.50	0.14	0.25	1.00

λmax=4.047, C.I.=0.016, C.R.=0.017

N) Marketing Manager - PC	At1	At2	At3	At4
At1	1.00	0.50	1.00	2.00
At2	2.00	1.00	2.00	2.00
At3	1.00	0.50	1.00	1.00
At4	0.50	0.50	1.00	1.00

λmax=4.061, C.I.=0.02, C.R.=0.022

O) IS Manager - PC	At1	At2	At3	At4
At1	1.00	0.33	1.00	4.00
At2	3.00	1.00	3.00	6.00
At3	1.00	0.33	1.00	2.00
At4	0.25	0.17	0.50	1.00

λmax=4.062, C.I.=0.021, C.R.=0.023

P) Aggregate - PC	At1	At2	At3	At4	PV
At1	1.00	0.44	0.80	2.52	0.208
At2	2.29	1.00	2.29	4.38	0.472
At3	1.26	0.44	1.00	2.00	0.221
At4	0.40	0.29	0.50	1.00	0.099

λmax=4.02, C.I.=0.007, C.R.=0.007

LT: Lead Time, DL: Defet Level, OD: On-time Delivery, PC: Price

At1: Alternative 1, At2: Alternative 2, At3: Alternative 3, At1: Alternative 4

Table 6.5: Comparison of Internal Business Criteria for Scenarios with Multiple Involvement

A) Finance Manager - TM	At1	At2	At3	At4
At1	1.00	5.00	5.00	6.00
At2	0.20	1.00	2.00	3.00
At3	0.20	0.50	1.00	2.00
At4	0.17	0.33	0.50	1.00

λmax=4.11, C.I.=0.037, C.R.=0.041

B) Marketing Manager - TM	At1	At2	At3	At4
At1	1.00	5.00	4.00	6.00
At2	0.20	1.00	2.00	1.50
At3	0.25	0.50	1.00	1.50
At4	0.17	0.67	0.67	1.00

λmax=4.094, C.I.=0.031, C.R.=0.035

C) IS Manager - TM	At1	At2	At3	At4
At1	1..00	4.00	6.00	7.00
At2	0.25	1.00	3.00	4.00
At3	0.17	0.33	1.00	1.00
At4	0.14	0.25	1.00	1.00

λmax=4.078, C.I.=0.026, C.R.=0.029

D) Aggregate - TM	At1	At2	At3	At4	PV
At1	1.00	4.65	4.93	6.32	0.621
At2	0.22	1.00	2.29	2.62	0.191
At3	0.20	0.44	1.00	1.44	0.107
At4	0.16	0.38	0.70	1.00	0.081

λmax=4.07, C.I.=0.024, C.R.=0.027

E)) Finance Manager - CT	At1	At2	At3	At4
At1	1.00	2.00	3.00	7.00
At2	0.50	1.00	4.00	5.00
At3	0.33	0.25	1.00	2.00
At4	0.14	0.20	0.50	1.00

λmax=4.076, C.I.=0.025, C.R.=0.028

F) Marketing Manager - CT	At1	At2	At3	At4
At1	1.00	0.33	0.25	3.00
At2	3.00	1.00	1.00	6.00
At3	4.00	1.00	1.00	8.00
At4	0.33	0.17	0.13	1.00

λmax=4.043, C.I.=0.014, C.R.=0.016

G) IS Manager - CT	At1	At2	At3	At4
At1	1.00	3.00	5.00	7.00
At2	0.33	1.00	3.00	5.00
At3	0.20	0.33	1.00	2.00
At4	0.14	0.20	0.50	1.00

λmax=4.058, C.I.=0.019, C.R.=0.021

H) Aggregate - CT	At1	At2	At3	At4	PV
At1	1.00	1.26	1.55	5.28	0.369
At2	0.79	1.00	2.29	5.31	0.363
At3	0.64	0.44	1.00	3.18	0.2
At4	0.19	0.19	0.32	1.00	0.067

λmax=4.031, C.I.=0.01, C.R.=0.012

I) Finance Manager - PY	At1	At2	At3	At4
At1	1.00	0.33	1.00	4.00
At2	3.00	1.00	3.00	8.00
At3	1.00	0.33	1.00	3.00
At4	0.25	0.13	0.33	1.00

λmax=4.02, C.I.=0.007, C.R.=0.008

J) Marketing Manager - PY	At1	At2	At3	At4
At1	1.00	0.50	0.50	2.00
At2	2.00	1.00	2.00	6.00
At3	5.00	0.50	1.00	4.00
At4	0.50	0.17	0.25	1.00

λmax=4.051, C.I.=0.017, C.R.=0.019

K) IS Manager - PY	At1	At2	At3	At4
At1	1.00	3.00	5.00	6.00
At2	0.33	1.00	3.00	4.00
At3	0.20	0.33	1.00	2.00
At4	0.17	0.25	0.50	1.00

λmax=4.082, C.I.=0.027, C.R.=0.03

L) Aggregate - PY	At1	At2	At3	At4	PV
At1	1.00	0.80	1.36	3.63	0.293
At2	1.26	1.00	2.62	5.77	0.435
At3	1.74	0.28	1.00	2.88	0.197
At4	0.28	0.18	0.35	1.00	0.075

λmax=4.023, C.I.=0.008, C.R.=0.008

M) Finance Manager - SC	At1	At2	At3	At4
At1	1.00	0.33	3.00	4.00
At2	3.00	1.00	6.00	8.00
At3	0.33	0.17	1.00	3.00
At4	0.25	0.13	0.33	1.00

λmax=4.116, C.I.=0.039, C.R.=0.043

N) Marketing Manager - SC	At1	At2	At3	At4
At1	1.00	0.33	1.00	4.00
At2	3.00	1.00	3.00	7.00
At3	1.00	0.33	1.00	3.00
At4	0.25	0.14	0.33	1.00

λmax=4.014, C.I.=0.005, C.R.=0.005

O) IS Manager - SC	At1	At2	At3	At4
At1	1.00	0.50	0.50	2.00
At2	2.00	1.00	3.00	4.00
At3	2.00	0.33	1.00	2.00
At4	0.50	0.25	0.50	1.00

λmax=4.116, C.I.=0.039, C.R.=0.043

P) Aggregate - SC	At1	At2	At3	At4	PV
At1	1.00	0.38	1.15	3.18	0.211
At2	2.62	1.00	3.78	6.07	0.543
At3	0.87	0.27	1.00	2.62	0.172
At4	0.32	0.17	0.38	1.00	0.073

λmax=4.023, C.I.=0.008, C.R.=0.008

TM: Time to Market, CT: Cycle Time, PY: Process Yield, SC: Safe Control

At1: Alternative 1, At2: Alternative 2, At3: Alternative 3, At1: Alternative 4

Table 6.6: Comparison of Innovation and Learning Criteria for Scenarios with Multiple Involvement

A) Finance Manager - SN

	At1	At2	At3	At4
At1	1.00	4.00	3.00	7.00
At2	0.25	1.00	2.00	4.00
At3	0.33	0.50	1.00	2.00
At4	0.14	0.25	0.50	1.00

λmax=4.097, C.I.=0.032, C.R.=0.036

B) Marketing Manager - SN

	At1	At2	At3	At4
At1	1.00	3.00	3.00	5.00
At2	0.33	1.00	1.00	3.00
At3	0.33	1.00	1.00	3.00
At4	0.20	0.33	0.33	1.00

λmax=4.035, C.I.=0.012, C.R.=0.013

C) IS Manager - SN

	At1	At2	At3	At4
At1	1.00	3.00	5.00	7.00
At2	0.33	1.00	3.00	4.00
At3	0.20	0.33	1.00	3.00
At4	0.14	0.25	0.33	1.00

λmax=4.106, C.I.=0.035, C.R.=0.039

D) Aggregate - SN

	At1	At2	At3	At4	PV
At1	1.00	3.30	3.58	6.28	0.556
At2	0.30	1.00	1.82	3.62	0.225
At3	0.28	0.55	1.00	2.62	0.151
At4	0.16	0.27	0.38	1.00	0.068

λmax=4.048, C.I.=0.016, C.R.=0.018

E) Finance Manager - CI

	At1	At2	At3	At4
At1	1.00	0.50	1.00	0.50
At2	2.00	1.00	2.00	0.50
At3	1.00	0.50	1.00	0.50
At4	2.00	2.00	2.00	1.00

λmax=4.061, C.I.=0.02, C.R.=0.022

F) Marketing Manager - CI

	At1	At2	At3	At4
At1	1.00	0.50	0.50	2.00
At2	2.00	1.00	2.00	6.00
At3	2.00	0.50	1.00	4.00
At4	0.50	0.17	0.25	1.00

λmax=4.051, C.I.=0.017, C.R.=0.019

G) IS Manager - CI

	At1	At2	At3	At4
At1	1.00	0.50	0.50	2.00
At2	2.00	1.00	3.00	4.00
At3	2.00	0.33	1.00	2.00
At4	2.00	0.25	0.50	1.00

λmax=4.116, C.I.=0.039, C.R.=0.043

H) Aggregate - CI

	At1	At2	At3	At4	PV
At1	1.00	0.50	0.63	1.26	0.185
At2	2.00	1.00	2.29	2.29	0.418
At3	1.59	0.44	1.00	1.59	0.238
At4	0.79	0.44	0.63	1.00	0.159

λmax=4.041, C.I.=0.014, C.R.=0.015

I) Finance Manager - PS

	At1	At2	At3	At4
At1	1.00	0.33	0.25	3.00
At2	3.00	1.00	2.00	7.00
At3	4.00	0.50	1.00	5.00
At4	0.33	0.14	0.20	1.00

λmax=4.111, C.I.=0.037, C.R.=0.041

J) Marketing Manager - PS

	At1	At2	At3	At4
At1	1.00	2.00	5.00	5.00
At2	0.50	1.00	3.00	4.00
At3	0.20	0.33	1.00	1.00
At4	0.20	0.25	1.00	1.00

λmax=4.019, C.I.=0.006, C.R.=0.007

K) IS Manager - PS

	At1	At2	At3	At4
At1	1.00	3.00	5.00	8.00
At2	0.33	1.00	4.00	5.00
At3	0.20	0.25	1.00	2.00
At4	0.13	0.20	0.50	1.00

λmax=4.101, C.I.=0.034, C.R.=0.037

L) Aggregate - PS

	At1	At2	At3	At4	PV
At1	1.00	1.26	1.84	4.93	0.378
At2	0.79	1.00	2.88	5.19	0.382
At3	0.54	0.35	1.00	2.15	0.164
At4	0.21	0.19	0.46	1.00	0.076

λmax=4.038, C.I.=0.013, C.R.=0.014

M) Finance Manager - EW

	At1	At2	At3	At4
At1	1.00	4.00	6.00	4.00
At2	0.25	1.00	2.00	2.50
At3	0.17	0.50	1.00	2.00
At4	0.25	0.40	0.50	1.00

λmax=4.154, C.I.=0.051, C.R.=0.057

N) Marketing Manager - EW

	At1	At2	At3	At4
At1	1.00	5.00	4.00	6.00
At2	0.20	1.00	2.00	1.50
At3	0.25	0.50	1.00	1.50
At4	0.16	0.67	0.67	1.00

λmax=4.079, C.I.=0.026, C.R.=0.029

O) IS Manager - EW

	At1	At2	At3	At4
At1	1.00	6.00	2.00	7.00
At2	0.17	1.00	0.25	2.00
At3	0.50	4.00	1.00	3.00
At4	0.14	0.50	0.33	1.00

λmax=4.082, C.I.=0.027, C.R.=0.03

P) Aggregate - EW

	At1	At2	At3	At4	PV
At1	1.009	4.93	3.63	5.52	0.598
At2	0.20	1.00	1.00	1.96	0.151
At3	0.27	1.00	1.00	2.08	0.165
At4	0.18	0.51	0.48	1.00	0.087

λmax=4.029 C.I.=0.01, C.R.=0.011

SN: Sales from New Product, CI: Continuous Improvement, PS: Programme Success, EW: Employees Willing

At1: Alternative 1, At2: Alternative 2, At3: Alternative 3, At1: Alternative 4

Following this analysis, Table 6.7 calculates the relative weights of the scenarios for each of the criteria, and these are combined with the weights of the criteria to determine the overall score for each of the measurements with respect to each of the alternatives.

Table 6.7: Aggregate Composite Weight of Scenarios with Respect to Sub-criteria

A)		Weight of Alternatives			
Financial	Weight	At1	At2	At3	At4
MS	0.142	0.522	0.189	0.205	0.084
ROI	0.511	0.588	0.208	0.138	0.006
RG	0.289	0.160	0.458	0.279	0.103
PI	0.059	0.549	0.275	0.114	0.062
	Comp. Score	0.453	0.282	0.187	0.048
B)		Weight of Alternatives			
Customer	Weight	At1	At2	At3	At4
LT	0.183	0.128	0.524	0.284	0.065
DL	0.554	0.199	0.522	0.175	0.074
OD	0.188	0.495	0.278	0.137	0.09
PC	0.075	0.208	0.472	0.001	0.099
	Comp. Score	0.242	0.473	0.175	0.077
C)		Weight of Alternatives			
IBC	Weight	At1	At2	At3	At4
TM	0.576	0.621	0.191	0.107	0.081
CT	0.249	0.369	0.363	0.2	0.067
PY	0.11	0.293	0.435	0.197	0.075
SC	0.065	0.211	0.543	0.172	0.073
	Comp. Score	0.496	0.284	0.144	0.076
D)		Weight of Alternatives			
ILC	Weight	At1	At2	At3	At4
SN	0.203	0.556	0.225	0.151	0.068
CI	0.541	0.185	0.418	0.238	0.159
PS	0.187	0.378	0.382	0.164	0.076
EW	0.069	0.598	0.151	0.165	0.087
	Comp. Score	0.325	0.354	0.201	0.12

$* \, Comp.\_Score = \sum(Weight\_Subcriteria \times Weight\_Scenarios)$

Finally, Table 6.8 calculates the relative weights of the scenarios for each of the measurements, and these are combined with the weights of the measurements to determine the overall score of benefit perspectives with respect to each of the alternatives.

Table 6.8: Aggregate Composite Weight of Scenarios with Respect to Objectives

Measurement	Weight of Measurement	Weight of Scenarios			
		At1	At2	At3	At4
FC	0.628	0.453	0.282	0.187	0.048
CC	0.187	0.242	0.473	0.175	0.077
IBC	0.102	0.496	0.284	0.144	0.076
ILC	0.083	0.325	0.354	0.201	0.12
$Score = \sum(W\_Objective * W\_Scenario)$		**0.407**	**0.324**	**0.182**	**0.062**

As with benefits, the costs of strategic investment can also be decomposed into different levels and the weight score for each alternative can be calculated. The whole process of calculating the weights for cost under multiple involvement, multiple objectives and criteria is similar to the calculation of the benefit weight score. The present study omits this part of the calculation.

Step 3: Project Selection

After the decomposition of the investment project and the hierarchy analysis, the next step is the selection of the project. Cost-benefit analysis and gap analysis are the most popular methods which can be improved by the use of AHP method.

- *Cost-Benefit Analysis*

The aggregation of benefits and costs for different alternatives needs to produces the benefit-cost ratio. Table 6.9 illustrates the cost-benefit analysis according to AHP results. Saaty (1985) suggests that the decision rule for the best alternative is the one with the highest total cost priority which has a benefit-cost ratio greater than a pre-specified standard when compared with all lower cost-priority alternatives. The relative, not absolute, magnitudes are obtained by comparing incremental benefits with incremental costs.

Table 6.9: Cost-Benefit Analysis

Objectives	At1	At2	At3	At4
Benefit Score	0.407	0.324	0.182	0.062
Cost Score	0.312	0.214	0.257	0.219

$$Overall\_Score = \frac{Benefit\_Score}{Cost\_Score}$$

- *Gap Analysis*

Gap analysis has been widely used in the selection of investment projects. Dyson and Berry (1998) suggest that the process of conducting gap analysis involves specifying a desired future position for the organisation in terms of objectives, performance measures and targets; predicting the likely future of the organisation if no new strategic development takes place; and evaluating the multi-dimension gap.

They further suggest that to evaluate the strategic initiative gap, the analysis needs to be extended in two directions. First, the impact of any new initiative on the measures must be evaluated and displayed for each scenario; and second uncertainty needs to be taken into account, for example through the use of a risk-adjusted discount rate. By using the results of AHP, the present strongly suggests that the measures can be assigned for different weights and an overall gap score can then be calculated for the selection of projects. Table 6.10 illustrates the gap analysis to evaluate two initiatives, assuming the same scenarios and measures as in the previous AHP analysis.

Table 6.10: Gap Analysis

			At1		At2		At3		At4	
	Target	Weight	Predict-ion	Gap	Predict-ion	Gap	Predict-ion	Gap	Predict-ion	Gap
	FC	WFC	FCP1	FC-FCP1	FCP2	FC-FCP2	FCP3	FC-FCP3	FCP4	FC-FCP4
Initiative	CC	WCC	CCP1	CC-CCP1	CCP2	CC-CCP2	CCP3	CC-CCP3	CCP4	CC-CCP4
#1	IBC	WIBC	IBP1	IBC-IBCP1	IBP2	IBC-IBCP2	IBP3	IBC-IBCP3	IBP4	IBC-IBCP4
	ILC	WILC	ILP1	ILC-ILCP1	ILP2	ILC-ILCP2	ILP3	ILC-ILCP3	ILP4	ILC-ILCP4
Overall Score				I1_At1		I1_At2		I1_At3		I1_At3
	FC	WFC	FCP1	FC-FCP1	FCP2	FC-FCP2	FCP3	FC-FCP3	FCP4	FC-FCP4
Initiative	CC	WCC	CCP1	CC-CCP1	CCP2	CC-CCP2	CCP3	CC-CCP3	CCP4	CC-CCP4
#2	IBC	WIBC	IBP1	IBC-IBCP1	IBP2	IBC-IBCP2	IBP3	IBC-IBCP3	IBP4	IBC-IBCP4
	ILC	WILC	ILP1	ILC-ILCP1	ILP2	ILC-ILCP2	ILP3	ILC-ILCP3	ILP4	ILC-ILCP4
Overall Score				I2_At1		I2_At2		I2_At3		I2_At4

$$Overall\_Gap\_Score = \sum_{1}^{n}(Weight\_of\_Target * Gap)$$

6.5 Summary

This chapter has extended the findings of the previous chapter to propose a protocol for the evaluation of SIDs and SITIDs and to integrate those rules to form a planning model for evaluation. This chapter starts by linking the quantitative findings with the literature review in Chapters 2 and 3. Several rules for dealing with accuracy of information, strategic considerations, interaction, consequence of decision and contextual factors are proposed to form a protocol for the evaluation of SIDs and SITIDs. Furthermore, the study organises the rules into a planning model to provide a holistic picture of the protocol. Five major mechanisms of the model are discussed: the scanning mechanism, the strategic flexibility mechanism, the evaluation mechanism, the proactive mechanism and the feedback mechanism. From the evaluation perspective, the present study suggests the integration of scenario analysis, balanced scorecard, analytical hierarchy process along with cost-benefit analysis or gap analysis. An example of this integration was presented under multiple involvement, multiple objective, multiple criteria, and multiple alternatives conditions. The next chapter will draws conclusions and implications of this study.

Chapter 7. Conclusions and Implications

7.1 Introduction

The initial motivation of the present study was to depict clearly the potential impact on SIDs of their IT content in order to enhance the outcomes of SIDs and SITIDs. This is important because it focuses on key issues in the control perspective of both information management and financial management. On the one hand, IT is now vitally important as a strategic weapon, but the actual outcome of IT investments is often poor. This is a dilemma for IT investment management. The present study has proposed the concept of the degree of IT intensity of SIDs and has aimed to answer the question of whether the degree of IT intensity matters in relation to the decision process, decision content, and decision outcome. If so, then the key question must be: how can an organisation tailor its decision-making process to achieve a better outcome? If not, then the key question must be: what are the critical factors which impact significantly on the effectiveness of SIDs?

To answer these questions, this study investigated the impacts of different degrees of IT; hypothesised relationships to link IT intensity and effectiveness were proposed and tested; the impacts of IT intensity on evaluation issues were discussed; and a protocol and planning model match with the problematical nature of strategic investment project was proposed. This chapter draws conclusions from the findings based on quantitative analysis and extended discussion. The research process, the research findings, implications, limitations, and suggestions for further research are discussed in the sections which follow.

7.2 Summary and Discussion of the Key Research Questions

7.2.1 Summary

The core of the present study is the concept of the degree of IT intensity of SIDs. It is hypothesised that the degree of IT intensity is one of the most important dimensions of the continuing nature of SIDs. With this core concept, the present study focuses on four issues in the management of strategic information technology investment decisions. First, it examines the outcomes of SIDs according to the degree of IT intensity in the investment project. Second, IT intensity is assessed in relation to a number of dimensions including the decision formulating process, the evaluation process, and the decision content. Third, critical factors which impact on the effectiveness of SIDs are explored. Fourth, a protocol is proposed by mapping the quantitative findings to state-of-art evaluation approaches.

In order to clarify the potential impact on SIDs of their IT content, the present study employs the concept of contextualism, which integrates process, content and context to study organisational decision-making. Through a review of the literature on these perspectives, an initial list of variables was generated to explore the distinguishing variables of SIDs in relation to different degrees of IT intensity. Moreover, the present study proposes a model employing a number of constructs: the effectiveness of decisions, interaction and involvement in the decision-formulating process, the accuracy of information and strategic considerations in the evaluation process, the rarity of decisions, and the degree of IT intensity of an investment in strategic investment decisions. The model attempts to explain the main factors which influence the effectiveness of the decisions.

A structured questionnaire was developed. Empirical work was undertaken among Taiwanese manufacturers. In order to increase the expected response rate, judgement sampling was used. Experts in two professional associations, the Chinese Association for Industrial Technology Advancement and the Chinese Productivity Centre, helped to select organisations considered to be representative of the population. A postal questionnaire and a reference letter from the experts were sent directly to named individuals in the selected organisations. 270 organisations were selected and 94 responded. Of these, 80 responses were valid for further analysis.

By using correlation analysis, several distinguishing variables were explored to assess their significant differences in terms of IT intensity. A principal components factor analysis with varimax rotation was conducted to assess convergence within, and divergence between, scales. Regression analysis was employed to test the hypotheses but the direct link from IT intensity to the effectiveness of SIDs proved to be weak. Consequently, the stepwise variable selecting procedure was employed to reveal the critical variables which impact significantly on the effectiveness of SIDs.

The present study seeks to develop a protocol which addresses the practical aspect of SIDs and SITIDs in terms of rules and to integrate these rules to form a model for evaluation. To incorporate strategic investment projects in the strategic planning context will broaden the scope of the investment and enable the investment project to catch future uncertainties. Five major mechanisms of this model are discussed: the scanning mechanism, the strategic flexibility mechanism, the evaluation mechanism, the proactive mechanism, and the feedback mechanism. Amongst these, the flexibility mechanism and evaluation mechanism are the major foci. The flexible characteristics of this planning process can be used to handle turbulence in the organisation. From the evaluation perspective, the study suggests the integration of scenario analysis, balanced scorecard, analytical hierarchy process along with cost-benefit analysis or gap analysis.

7.2.2 Answers to the Key Research Questions

In this section, the findings in relation to each research question are summarised.

What is a strategic investment decision? What is a strategic IT investment decision?

By reviewing the literature, strategic investment decisions can be defined as investments which have major long-term implications for the firm. They include decisions about new products, markets, technologies, and capacity; vertical integration and acquisitions; and major investments in marketing, research or personnel These decisions are strategic in the sense that they help significantly to shape the firm's long-term future.

This research employs a concept of IT investment intensity as a component of strategic investments. The degree to which IT is present in an investment decision reflects the IT level of intensity of that decision. A so-called strategic IT investment decision is a strategic investment decision which has a high level of IT intensity.

In comparison with other SIDs, what is different about strategic IT investment decisions? Are they different in nature and scope? Are there different uncertainties ?

In examining whether strategic investment decisions vary according to different degrees of IT investment of SIDs, the following findings provide a list of variables which show significant differences in terms of IT intensity.

From the perspective of the decision-formulating process, the study finds that the higher the level of IT intensity in a SID, (1) the fewer levels of the hierarchy are involved, (2) the fewer formal meeting are required, (3) the less informal discussion are held, (4) the fewer external organisations are involved, and (5) the more uneven the total pressure across interested units.

From the perspective of uncertainties perceived, the study finds that the higher the level of IT intensity in a SID, the higher the technological uncertainty and personnel uncertainty perceived but the less regulations uncertainty perceived.

From the perspective of strategic considerations, the study finds that the higher the level of IT intensity in a SID, the less important are the strategic considerations of

(1) the growth rate of the market related to the project, (2) the consistency with business strategy, and (3) the competitive position of the organisation.

From the perspective of financial information, the study finds that the higher the level of IT intensity in a SID, the more uncertain are (1) the project duration, (2) the cost of capital, (3) the NPV of cash flow, (4) the payback period, (5) the ARR, (6) profit, (7) productive index, and (8) intangible cost. In addition, the higher the level of IT intensity in a SID, the less important are (1) the cash flow at the end of each period, (2) project duration, (3) the cost of capital, (4) profit, and (5) intangible benefit.

From the perspective of investment objectives, the study finds that the higher the level of IT intensity in a SID, the less important are (1) increase profit, (2) increase sales, (3) increase market share, (4) enhance return on investment, (5) relation of market position, and (6) enhanced competitive advantage. In addition, the higher the level of IT intensity in a SID, the lower the cost reduction and the compliment with government regulations which was achieved.

In comparison with other SIDs, are SITIDs different in terms of the effectiveness of decisions? If so, then the key question must be: how can an organisation tailor its decision-making process to achieve a better outcome? If not, then the key question must be: what are the critical factors which impact significantly on the effectiveness of SIDs?

The present study finds that IT intensity is negatively associated with the effectiveness of SIDs. Three out of the five proposed mediators are shown to act as mediators in the link of IT intensity and effectiveness. Table 7.1 summarises the results of hypotheses testing.

Table 7.1: Summary of the Results of Hypotheses Testing

	Research Hypotheses	Empirical Evidence
1	*Different degrees of IT intensity are negatively related to the effectiveness of SIDs.*	√
2	*IT intensity will reduce interaction and will thus have an adverse impact on the effectiveness of decisions.*	√
3	*IT intensity will reduce organisational involvement and will thus have an adverse impact on the effectiveness of decisions.*	×
4	*IT intensity will reduce the accuracy of information and will thus have an adverse impact on the effectiveness of decisions.*	√
5	*IT intensity will reduce the strategic considerations and will thus have an adverse impact on the effectiveness of decisions.*	√
6	*IT intensity will heighten the rarity of decisions and will thus have an adverse impact on the effectiveness of decisions*	×

Empirical Results: √ = Accepted; ×= Rejected.

However, due to the weak linkage between IT intensity and (1) the effectiveness of SIDs, and (2) the proposed mediators, the findings become less meaningful because the critical factors which impact on the effectiveness of SIDs are still not clear. Accordingly, it is necessarily to conclude that the effort to manage the effectiveness of SIDs is unlikely to have to focus heavily on the IT dimension since the impact of IT on the effectiveness of SIDs is not revealed to be significant.

A model with seven variables is then presented which clearly explores the critical factors for the effectiveness of SIDs. These critical factors include (1) the scope of involvement in the project formulation process, (2) the competitive position of the company, (3) the growth rate of the market related to the project, (4) the perceived accuracy of the productivity index, (5) the perceived accuracy of profit, (6) the radicalism of the consequences, and (7) the financial state of the company. These seven variables can explain approximately 75% the variances of the effectiveness of SIDs.

What are the implications for the evaluation of investment?

In Chapter 6, the study maps the findings from quantitative analysis to the literature discussed in Chapters 2 and 3. SID and SITID evaluation makes it necessary to enhance the accuracy of information, to strengthen the strategic considerations of the investment project, to increase the level of interaction of the formulation process, to foresee the consequences of the project, and to scan the business environment.

To address these characteristics, the study proposes a protocol for the evaluation of SIDs in general and SITIDs in particular. In order to provide a holistic view of this protocol, a planning model is suggested which incorporates the scanning mechanism, the strategic flexibility mechanism, the evaluation mechanism, the proactive mechanism, and the feedback mechanism. In this model, the detection mechanism is for detecting change; the proactive mechanism is concerned with preparing for change; and the major function of the flexibility mechanism is adaptation for change.

7.3 Contributions to the Theory of Managing SITIDs and SIDs

This research makes seven contributions to both the theory and practice of the management of strategic investment and strategic IT investment projects. Each of these is discussed in turn.

7.3.1 Identification of the Degrees of IT Intensity of SIDs

The first contribution of the present study is towards the identification of the degree of IT intensity of SIDs. As explained in Chapter 1, previous research has concentrated on either SITIDs or SIDs and has ignored the continuous nature of decisions. By contrast, the present study assumes that SIDs may involve different degrees of IT intensity. The survey data of the present study do show that this assumption is valid. That is, the relation of pure SITIDs and non-IT SIDs is similar to that of theory X and theory Y in management theories, in the sense that the real situation is contingent between the two extremes.

7.3.2 The Link between IT intensity and the Effectiveness of SIDs

The second contribution of the present study is to identify the link between the extent of IT intensity in SIDs and the effectiveness of SIDs. The initial motivation in the linkage is based on two assumptions: (1) different degrees of IT intensity lead to different processes, which is to say that IT intensity influences the process of decision-making; and (2) different processes lead to different outcomes. For the SID IT intensity-effectiveness link to exist, both assumptions must be true. The present study indicates that this linkage does exist, but only weakly.

This finding matches the generally poor outcomes of IT investment. If management is aware of the potential impact on SIDs of their IT content, this may well lead to a better outcome of the investment project. However, the weak linkage between IT intensity and the effectiveness of SIDs may suggest that IT intensity is unlikely to be the most critical factor which impacts on the effectiveness of SIDs.

7.3.3 Broadening the Scope of the Study of SIDs and SITIDs

The third contribution of the study is that it broadens the study of the investment topic. As explained in Chapter 1, the present scope of the study of SIDs and SITIDs is too narrow, and the literature focuses mainly on the evaluation perspective of investment projects. Although recent trends suggest that evaluation is a social and political process, not simply an economic justification (Avison et al., 1995), and increasingly the concept of contextualism is employed in the discussion of evaluation (e.g. Avison et al., 1995; Farbey et al. 1993), this study views the whole decision-making process, including formulation and evaluation, as a social and political process. That is, although the evaluation issue is still the focal point of interest, the present study also takes into account the formulation process (both rational and political), decision content and decision context in the study of investment projects.

7.3.4 The Identification of Three Mediators

The fourth contribution is to identify interaction, strategic considerations and the accuracy of information as three critical mediators in the linkage between IT intensity and the effectiveness of SIDs. The concept of mediation has been widely accepted and tested in the field of psychology, but not extensively in information management. From a statistical perspective, the test of the existence of a mediating effect is more difficult than the test of the existence of a moderating effect because it involves more steps. Even in the inference of hypotheses, the indirect relationships are very difficult to predict. As explained in Chapter 3, each hypothesis, in fact, involves three hypothesised relationships.

7.3.5 The Identification of the Distinguishing Variables

The fifth contribution of the present study is that it explores the distinguishing variables of SIDs in relation to different degrees of IT intensity. At the beginning of this research, the author tried to predict these variables before conducting statistical tests of the predictions. Unfortunately, little previous research has explored the distinguishing variables between higher IT intensity SIDs and lower IT intensity SIDs. Accordingly, a prediction of the relationship is unavailable. It is important to know what variables are changed because of IT intensity so that these differences can be taken into account in the evaluation and management of SITIDs. The present study used correlation analysis to test all the variables related to decision process constructs, evaluation constructs, and the investment objectives, and provided a list of variables which can be used to distinguish the characteristics of SIDs in terms of IT intensity. This part of the research is generally data-driven, but this is caused by the constraints of the relevant literature. The contribution of this part of the research should not be ignored.

7.3.6 The Identification of the Critical Factors which Impact on the Effectiveness of SIDs

The sixth contribution is to explore the factors which impact significantly on the effectiveness of SIDs. Seven factors (variables) have been found to be critical in the explanation of the variance of SIDs. This finding shows that in managing the effectiveness of SIDs, it is important to consider the whole range of impacts rather than to focus on a single perspective e.g. evaluation. The scope of involvement is part of the interaction of the formulation process. The competitive position of the company and the growth rate of market related to the project belong to the strategic considerations of the evaluation process. The perceived accuracy of the productivity index and the perceived accuracy of profit are related to the accuracy of information in the evaluation process. Radicalism is a content factor of decision, and the financial state of the company is a contextual factor. The identification of these factors should contribute to the management of SIDs, including SITIDs.

7.3.7 The Development of a Protocol and a Planning Model for SIDs

The final contribution of the present study is to propose a protocol which incorporates strategic investment projects in the strategic planning context. Such a protocol will broaden the scope of the investment and enable the investment project to catch future uncertainties. To represent the protocol, the study proposes a planning model, the originality of which can be seen in the way it identifies five major mechanisms. Most importantly, the flexible characteristics of this planning process can be used to handle the turbulence of the organisation. This planning model can be used for SIDs in general and SITIDs in particular.

7.4 Implications for Practice

This section discusses the practical implications of the present research for management. The present study clearly depicts the nature and scope of SIDs and SITIDs. The findings suggest a number of implications for managers in their strategic investment projects. Although this study was limited to Taiwan's manufacturing industry, the insights obtained may will have similar implications for other industries and other countries. These implications relate to the both conceptual and operational levels. At the conceptual level, this study provides a check-list for management to extend their understanding of what SITIDSs are and how they differ from other SIDs. At the operational level, it provides a framework for the conduct of SIDs, including SITIDs, by management.

7.4.1 Distinguishing Variables which Facilitate the Management of SITIDs

Since the first step in managing IT investment is to know exactly what that investment is (Weill and Olson, 1989), it is necessary for management to clarify the nature of SITIDs. The present study identifies 35 distinguishing variables relating to investment activities in terms IT intensity (see Table 5.18) which can enable companies to become more familiar with the nature and scope of IT investment projects. Other variables can be deemed as general characteristics of SIDs.

It must be stressed that the distinguishing variables list is not a list for management to follow up but a list to allow management to become aware of the problematic nature of IT investment projects. For example, the higher the level of IT intensity in a SID, the less important is cash flow at the end of each period. This only means that in general the cash flow information catches less attention in high IT intensity cases than in low IT intensity cases. This does not mean that the cash flow information is unimportant. Rather, management should be aware that to ignore the cash flow means that a poor outcome of the investment is likely. Accordingly, the distinguishing variables list will enable management to pay special attention to the nature of an IT investment project.

7.4.2 Critical Factors in Explaining the Effectiveness of SIDs

Although the study first identifies interaction, the accuracy of information and strategic considerations as mediators in the linkage of IT intensity and the effectiveness of SIDs, these findings are less meaningful since the linkages among these constructs are weak. The study further explores seven factors which together can address 75% of the variances of the effectiveness of SIDs. Generally speaking, in order to improve the outcome of an investment project, management should increase the interaction at the formulation stage, the accuracy of information and strategic considerations at the evaluation stage, the foresee the consequences of the project, and the scanning of the business environment. In fact, these factors can be deemed to be critical success factors for investment projects because they tend to dominate the effectiveness of SIDs. Understanding these factors should help management to develop, execute and monitor the whole investment process more effectively and thus increase the chances of success.

7.4.3 Implications for the Conduct the SIDs and SITIDs

Although the planning model proposed in Chapter 6 is an extension of the survey findings and does not involve any validation tests, it should nevertheless help management to improve SIDs, including SITIDs, for several reasons. First, the multi-mechanism model provides a panoramic view of managing investment projects. It involves such critical managerial activities as environmental scanning, strategic alignment, financial and non-financial appraisal, monitoring of performance, etc. The model is a simplified representation of a complicated investment process. It presents a concise framework for management to tailor the investment project to fit special organisational needs and strategic purposes.

Moreover, strategic flexibility is incorporated in the planning model so that management can use the model to adapt to substantial, uncertain and fast-occurring environmental changes that have a meaningful impact on organisational performance. Strategic flexibility should be a useful concept in handling the problematic nature of strategic investment projects and in improving the outcomes of investment projects. Here, the emphasis is on strategic flexibility as a concept rather than a method.

Management can apply the concept easily, and it is not necessary to employ any extra activities or complicated calculations in confronting uncertainty.

7.5 Limitations of the Research

A number of biases resulting from the limitations of the research have already been discussed in section 4.6.2. At this stage, it will be useful to examine other limitations of relevance to future research.

7.5.1 Causal Inference

The research questions propose a cause-and-effect relationship between the independent variable (IT intensity) and dependent variable (e.g. effectiveness). However, the study involves a post hoc cross-sectional design. The research design has no overall control of all the independent variables established in the study. Therefore, the conclusions supported by statistical results can only indicate the possibility of the existence of causal relationships between the independent and dependent variables. Additionally, owing to its non-experimental nature, it is impossible for this research to rule out clearly all extraneous factors and conclude that there are no other factors that would account for the effectiveness of SIDs projects.

7.5.2 Small Sample Size

Although the present study collected 94 questionnaires, only 80 were fully completed. If a larger sample had been obtained, the findings for the present study would be more convincing. There is always a probability of difficulties caused by the measurement of certain concepts, but the objectivity, validity, reliability and practicality of the instrument design were all carefully examined and were revealed as unbiased.

7.6 Implications for Further Research

This research has unveiled interesting findings in relation to the management of SIDs and SITIDs. However, much still remains to be discovered. A research agenda is thus proposed for extending the findings from this research. The first two tasks are concerned with the improvement of the research method, and the others are related to the main research implications.

7.6.1 Cross-Population Design and Larger Sample Size

Insights drawn from the present study's findings could become a starting-point for future research investigations. First, the findings uncovered by the present study are based on observation of the Taiwanese industrial experience. The nature of SIDs and SITIDs in other economic sectors and countries may present a totally different picture, but it would also be interesting to know whether there are certain common factors underlying general SID and SITID practices. Therefore, a cross-population investigation of this issue could produce fruitful insights into the management of SIDs and SITIDs. As discussed in the previous section, the sample size in this research is just large enough for the statistical analysis. With a larger sample size, the research would be improved and more convincing results would be provided.

7.6.2 Longitudinal Research Design

Although the present study clearly depicts the impacts on SIDs of their IT content, owing to its resource constraints, it adopts a post hoc cross-sectional method. This is one of the major drawbacks of the research findings. The historical events of each project were not directly observed and recorded in accordance with the contingent strategic movements of the firm. The inherent weaknesses of this approach, such as relying on human memory, reduce the validity of the data sets and limit the capability of the present study to provide a truly complete and accurate picture of SIDs reality. Surely, this is one of the common defects shared by most previous empirical studies because of the limitations of available resources. However, theoretically, a larger-scale longitudinal study, using the present research framework, could provide better insights into the management of SIDs and SITIDs.

7.6.3 The Implementation of the Planning Model

The present study proposes a planning model to incorporate strategic investment projects in the strategic planning context. It emphasises the fact that the flexible characteristics of this planning process can be used to handle the turbulence of the organisation, and it also suggests the integration of scenario analysis, balanced scorecard, analytical hierarchy process along with cost-benefit analysis or gap analysis. Although elements of the model have been implemented, the overall approach would need implementation to fully test its effectiveness.

7.7 Epilogue

As mentioned in Chapter 3, a good research topic should be of contemporary interest to scholars so that it is likely to advance current debate or revitalise old discussions. The author has given papers on the present research study at several conferences and has found that the current research topic is of interest to many people. After three years of study, the author is confident that the topic is of great theoretical value and practical importance.

The key concept of the study is IT intensity. However, where did the initial idea come from? At the beginning of this research programme, the author reviewed the literature relating to SIDs and SITIDs separately and tried to decide which of the two to focus on. But then, after discussion with the author's supervisors, a new idea (IT intensity) evolved because little research had dealt with the difference between IT SIDs and non-IT SIDs, and one question was not clear: 'does IT matter?' The research proposal emerged from this initial question, and the effort has made to conduct the research strictly in relation to this focus. The author has now concluded that 'IT does matter' in some key respects, although it unlikely to be the most critical factor which impacts on the outcomes of investment decisions. So, the research is complete, and hopefully the research findings will help to move a step closer to understanding the nature of SIDs and SITIDs.

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Appendices

Appendix 1: Instrument for the Fieldwork (English Version)

WARWICK
BUSINESS SCHOOL

A1.1: Covering Letter

Dear Sir,

I am a doctoral student at Warwick Business School (WBS) undertaking research into the topic of managing strategic information technology investment projects. I am writing in the hope that you may be of assistance of me in this research.

The main purpose of this questionnaire is to examine how companies make their strategic investment decisions and to discover the distinguishing factors between strategic IT investment projects and strategic non-IT investment projects.

Warwick Business School is leading business school the U.K. This research is under the supervision of Professor Robert Dyson and Dr. Philip Powell. Your assistance with our research activity will be appreciated. Please take a few minutes to answer the following questions and post your completed questionnaire in the stamp addressed enveloped provided. Your reply and all information will be treated as strictly confidential. We will glad to be able to share the results of this research with you. Accordingly, a summary report of this research will send to you.

Thanking you for your generosity and help.

Yours sincerely,

Tzu-Chuan Chou
Doctoral Researcher
Warwick Business School, University of Warwick, United Kingdom

Instructions

Research Purpose

Information Technology (IT) has become a strategic weapon to ensure a firm's survival. Firms can apply IT not only to reduce cost and to enhance productivity, but also to gain long-term advantages. In this case, the financial view of IT has changed from one of IT as a cost to one of IT as an investment. However, according to the literature, the outcomes of strategic IT investment decisions (SITIDs) are often poor. The purpose of this research is to depict clearly the potential impact on strategic investment decisions (SIDs) of their IT content in order to enhance the outcomes of SIDs and SITIDs. Hopefully the research findings will help to move a step closer to understanding the nature of SIDs and SITIDs.

Guidance for Respondents

(1) Please provide detailed information concerning a strategic investment project which was developed and implemented in the last five years and of which you have experience. In this questionnaire, a strategic investment project refers to an investment which has major long-term implications for the firm or is related to ensure the firm's survival; IT refers to computer-related technologies, including hardware, software, networks, workstations, smart chips, and robots.

(2) Please evaluate carefully each proposition in relation to the selected strategic investment project. In this questionnaire, many questions ask you to circle a number between the semantic differential. For example, if the semantic differential is 'very short' versus 'very long', the scale used to measure this variable is:

1	2	3	4	5	6	7
Very short	Short	Moderately short	About average	Moderately long	long	Very long

(3) If you have not been involved in any strategic investment project, please send this questionnaire to someone who has been involved at a managerial level.

(4) If you have many projects which can be regarded as strategic investment projects, please choose the one which has had the most significant impact on your organisation.

A1.2: Questionnaire

WARWICK
BUSINESS SCHOOL

Strictly Confidential!

Section One: Specific Strategic Investment Project

1. Project name (if known) : ________________________.

2. Project duration: from ____/_____ (investment idea emerges) to____/

(review after implementation).

3. Please identify the investment climate when this project was developed:

The economic state of the industry.	recession	1 2 3 4 5 6 7	rapid growth
Your financial state.	poor	1 2 3 4 5 6 7	excellent
Your market situation.	very weak	1 2 3 4 5 6 7	very strong
Strength of competition in the industry.	low	1 2 3 4 5 6 7	high
Senior management's attitude to risk	conservative	1 2 3 4 5 6 7	innovative
Senior management's decision-making style	directive	1 2 3 4 5 6 7	consensus- driven

4. What is the main organisational level at which the investment decision-making process takes place?

Corporate	❑	Business	❑	Division	❑	Other (please specify)

5. Ratio of spend on IT to total investment (spend on IT/ spend on the whole project) __%. (If this project did not involve any IT, please go directly to Question 9.)

6. Importance of IT in the whole project:

unimportant	1 2 3 4 5 6 7	very important

7. To what extent did this project rely on existing IT infrastructure?

not at all	1 2 3 4 5 6 7	highly rely

8. Which of the following describe the major purposes of IT in the project? (multiple choose)

To reduce costs of production e.g. manual operations replaced by machines under computer control	❑
As a tool to provide information for user	❑
Generate new information as a by-product of the basic task	❑
New skills and information are developed to identify new market opportunities exist	❑
To re-engineer major features of organisation's structure and goals	❑
To develop new business	❑
To gain competitive advantage	❑
To improve productivity and performance	❑
To facilitate new ways of managing and organising,	❑
Other (please specify)	❑

Section Two: Details of Project Formulation

The following questions concern the process from the original idea to the formal investment proposal.

9. How did this project compare with those non-strategic investments undertaken by your organisation?

Time to become a formal proposal	very short	1 2 3 4 5 6 7	very long
Time from formal proposal to implementation	very short	1 2 3 4 5 6 7	very long
Process interrupted by delay	no delay	1 2 3 4 5 6 7	frequent delay
Level in hierarchy involved in this project	very low	1 2 3 4 5 6 7	very high
Formal meetings required	few	1 2 3 4 5 6 7	very many
Quality of communication of in formal meetings	poor	1 2 3 4 5 6 7	very high
Scope for involvement in formal meetings	little	1 2 3 4 5 6 7	considerable
Discussions held outside the formal meetings	few	1 2 3 4 5 6 7	many
Areas of disagreement about project	very low	1 2 3 4 5 6 7	very high
Scope for negotiation about the project	little	1 2 3 4 5 6 7	considerable
Frequency with which a similar project recurs	seldom	1 2 3 4 5 6 7	very often
How radical the consequences were when the project changed things	not at all	1 2 3 4 5 6 7	radical
How serious the consequences if this project goes wrong.	not at all	1 2 3 4 5 6 7	serious
How far ahead people looked when making the decision	short term	1 2 3 4 5 6 7	long term
How urgent the decision was	not at all	1 2 3 4 5 6 7	very urgent
Decision likely to impact on subsequent decisions	not at all	1 2 3 4 5 6 7	a lot
Decision influenced by previous decisions	weak	1 2 3 4 5 6 7	very strong
Number of internal departments involved	few	1 2 3 4 5 6 7	many
Number of external organisations involved	few	1 2 3 4 5 6 7	many
Weight of influence exerted by interested units	little	1 2 3 4 5 6 7	a lot
Total pressure uneven across interested units	balanced influence	1 2 3 4 5 6 7	imbalance
How far the interested units that exerted influence did so in opposite directions	strong opposition	1 2 3 4 5 6 7	strong agreement

10 During project formulation, what uncertainties were perceived?

	Perceived
UNCERTAINTY	**not at all** **Consider-able**
Supplier uncertainty (e.g. price changes)	1 2 3 4 5 6 7
Production uncertainty (e.g. product quality)	1 2 3 4 5 6 7
Cost uncertainty (e.g. labour cost)	1 2 3 4 5 6 7
Market uncertainty (e.g. market size, share)	1 2 3 4 5 6 7
Internal financial uncertainty (e.g. meeting required financial return)	1 2 3 4 5 6 7
External financial uncertainty (e.g. cost of capital)	1 2 3 4 5 6 7
Technological uncertainty (e.g. newness)	1 2 3 4 5 6 7
Strategic uncertainty (e.g. strategic objective changes)	1 2 3 4 5 6 7
Industrial relations uncertainty (e.g. strike, wage demands)	1 2 3 4 5 6 7
Personnel uncertainty (e.g. impact on morale, turnover)	1 2 3 4 5 6 7
Regulations uncertainty (e.g. consumer laws, trade policy)	1 2 3 4 5 6 7
Other (please specify)	1 2 3 4 5 6 7

SECTION Three: Details of Project Evaluation Process

This section concerns the evaluation process which include the deliberation of strategic factors, decision criteria, and risk analysis techniques.

11. Please identify the importance of the following strategic factors in the evaluation of this investment project.

Consistency with business strategy.	unimportant	1 2 3 4 5 6 7	very important
Growth rate of market related to project	unimportant	1 2 3 4 5 6 7	very important
Competitive position of company.	unimportant	1 2 3 4 5 6 7	very important
Performance of company	unimportant	1 2 3 4 5 6 7	very important
Other (specify)	unimportant	1 2 3 4 5 6 7	very important

12. How accurate was the information used in the investment project and how important was it in helping in the evaluation process? What was the source of this information?

	Perceived accuracy	Perceived importance	Source	
INFORMATION	highly uncertainty certain	unimportant important	internal	external
Cost of investment	1 2 3 4 5 6 7	1 2 3 4 5 6 7	❑	❑
Cash flow at end of each subsequent period.	1 2 3 4 5 6 7	1 2 3 4 5 6 7	❑	❑
Project duration	1 2 3 4 5 6 7	1 2 3 4 5 6 7	❑	❑
Cost of capital	1 2 3 4 5 6 7	1 2 3 4 5 6 7	❑	❑
The NPV of cash flow	1 2 3 4 5 6 7	1 2 3 4 5 6 7	❑	❑
The payback period of this project	1 2 3 4 5 6 7	1 2 3 4 5 6 7	❑	❑
ARR	1 2 3 4 5 6 7	1 2 3 4 5 6 7	❑	❑
Profit	1 2 3 4 5 6 7	1 2 3 4 5 6 7	❑	❑
Productive	1 2 3 4 5 6 7	1 2 3 4 5 6 7	❑	❑
Intangible costs	1 2 3 4 5 6 7	1 2 3 4 5 6 7	❑	❑
Intangible benefit	1 2 3 4 5 6 7	1 2 3 4 5 6 7	❑	❑
Other (please specify)	1 2 3 4 5 6 7	1 2 3 4 5 6 7	❑	❑

13. Which of the following methods were used to handle risk? (Multiple choice)	Used
Sensitivity analysis	❑
Scenario analysis	❑
PERT	❑
Computer simulation	❑
Decision tree	❑
Risk premium on discount rate	❑
Other (please specify)	❑

Section Four: The Consequences of the Strategic Investment Project

14. What strategic objectives were perceived as important (before project implementation) and attained (after project implementation).

	Perceived importance of these objectives	Extent to which objectives achieved
STRATEGIC OBJECTIVES	unimportant — very important	not at all — completely
Increase profit	1 2 3 4 5 6 7	1 2 3 4 5 6 7
Increase sales	1 2 3 4 5 6 7	1 2 3 4 5 6 7
Increased market share	1 2 3 4 5 6 7	1 2 3 4 5 6 7
Improve quality	1 2 3 4 5 6 7	1 2 3 4 5 6 7
Enhance return on investment	1 2 3 4 5 6 7	1 2 3 4 5 6 7
Improve corporation's image	1 2 3 4 5 6 7	1 2 3 4 5 6 7
Reduce cost	1 2 3 4 5 6 7	1 2 3 4 5 6 7
Keep market position	1 2 3 4 5 6 7	1 2 3 4 5 6 7
Develop new business	1 2 3 4 5 6 7	1 2 3 4 5 6 7
Facilitate new ways of management	1 2 3 4 5 6 7	1 2 3 4 5 6 7
Gain competitive advantage	1 2 3 4 5 6 7	1 2 3 4 5 6 7
Meet government regulations	1 2 3 4 5 6 7	1 2 3 4 5 6 7
Other (please specify)	1 2 3 4 5 6 7	1 2 3 4 5 6 7

15. Were there unexpected outcomes when this project was implemented? What were their impacts on strategic objectives in Question 14?

	Impact
UNEXPECTED OUTCOMES	negative — positive
	1 2 3 4 5 6 7
	1 2 3 4 5 6 7
	1 2 3 4 5 6 7

16. Did the decision process result in useful learning leading to future improvements in decision-making?

no learning	1 2 3 4 5 6 7	very useful

Section Five: Corporate and Respondent's Details

The results will be treated confidentially. Individual respondents and organisations will not be named in the report. Participants will received a complimentary coy of the final report. Please providee the following corporate and respondent's details.

17. Name of organisation:______________________.

18. Total capital of this organisation: ________________.

19. Name of respondent: __________________.

20. Address:____________________________.

21. Telephone number:

22. Indicate you level of management? (Please tick one only)

Top management ❑	Middle management ❑	Low level management ❑	Other(please specify) ❑

23. How many reporting levels are there between you and the Chief Executive (Please tick one only)

Direct link ❑	One level ❑	Two levels ❑	Three or more levels ❑

⁂END OF QUESTIONNAIRE⁂

Thank you

Ref: [ ]

Please return to:
Tzu-Chuan Chou
55 Wansheng Street
Taipei, Taiwan
R.O.C.
TEL: +886 2 9314952

A1.3: Covering Letter (Chinese Version)

WARWICK
BUSINESS SCHOOL

敬啟者：

您好! 我是目前就讀於英國華威大學 (University of Warwick) 商學院博士班之研究生, 刻正著手關於"***策略性資訊科技投資專案***"之探討 o 因研究上需要,想煩請您撥冗填寫問卷, 打擾之處, 尚祈多多包涵!

本問卷之研究宗旨在於探討公司如何從事其策略性投資決策, 以及'決策過程'與'決策成效'是否會因為有無資訊科技而有所差異 o 希冀藉由本研究能夠提供更有效的"***策略性資訊科技投資專案***"管理 o

華威大學商學院在英國所有的商學院中具執牛耳之地位 (1995-96 年度評鑑全英第一) o 本研究係由此專業領域方面經驗卓著之 Robert Dyson 教授及 Philip Powell 博士共同指導 o

您的協助將對於本研究之成效有關鍵性之影響, 請您務必撥出一些時間填寫此問卷, 並煩請將填好的問卷放入回郵信封內擲回 o 您所回答的一切資訊將被嚴格保密, 僅供學術研討之用 o 我們極樂意與您分享研究成果, 是以稍後我們會將本研究的摘要報告郵寄一份供您參考!

感謝您熱心的參與及合作!

耑此敬頌

時祺

研究生
周子銓敬上

A1.4: Instruction (Chinese Version)

研究目的

今日，資訊科技(例如:硬體、軟體、網路、工作站、智慧晶片、以及機械人等)不但是企業生存的利器，更已成為策略性的武器之一。企業不但能運用這些資訊科技來節省成本與提高工作效率，而且能因此而獲取長期的利益與確保公司的生存。因此，當公司投入大量的資本來取得資訊科技時，應被視為一項投資案而非一項採購案。然而根據國外專業期刊之資料顯示，相對於其他投資案，資訊科技投資案常無法達到原先預期的效果。這個結果告訴我們，有可能因為策略性投資案決策過程中，因含有資訊科技造成決策過程成效不彰。本研究之主要目的,即是驗證這個觀點,希冀透過本研究去了解資訊科技投資案之特性、策略性決策的過程與評估方法、與決策的品質三者間的關係。藉由本研究，期能提供實務上與學術界一套更有效的策略性資訊科技投資管理方法。

問卷填寫說明

(1) 本問卷需要您提供壹個策略性投資專案。本問卷所謂之策略性投資專案，是指貴公司預期該投資案具有長期利益，或是基於確保公司之生存, 而投入大量資本之投資。而資訊科技則是指電腦相關之科技，其中包括：硬體、軟體、網路、工作站、智慧晶片、以及機械人等。請您先在過去五年間貴公司的策略性投資專案中挑選出一件投資案，然後請依當時該專案規劃與評估之實際情況來回答問題。

(2) 本問卷需要您圈選一個如下範例中兩邊有極端語意差異(例如:非常少與非常多)的評等尺度。請您依據投資案當時之實際情況圈選出最適合之語意。

非常少	少	只少一點	不多不少	只多一點	多	非常多
1	2	3	4	5	6	7

(3) 如果您本身並不參與任何投資案，煩請將本問卷轉給貴公司中負責投資案之經理級人員作答。

(4) 如果您有許多投資案符合本問卷之條件，請選出金額較大、影響較深遠之投資案來作答。

A1.5: Questionnaire (Chinese Version)

壹：策略性投資專案之規劃

1. 投資專案名稱： .

2. 投資專案期間係由 年 月(投資前初步構想形成) 至 年 月.(投資後檢討成敗)

3. 貴公司於該投資專案發展期間所面臨之企業環境為：

產業經濟景氣狀態	不景氣	1 2 3 4 5 6 7	高速成長
公司財務狀況	欠佳	1 2 3 4 5 6 7	相當良好
公司在市場佔有率	甚低	1 2 3 4 5 6 7	甚高
公司之產業競爭力	甚弱	1 2 3 4 5 6 7	甚強
公司內資深管理階層面對風險之態度	非常保守	1 2 3 4 5 6 7	勇於創新
公司內資深管理者決策時之作風	直接命令式	1 2 3 4 5 6 7	注重全體意見

4. 在貴公司中，投資決策過程主要發生種階層?

總公司❑	分公司❑	部門❑	其它(請指出)

5. 資訊科技之投資金額佔該投資案總額的比率(資訊科技投資金額/總投資金額)約為 %. (若不含資訊科技，請跳至第9題繼續作答)

6. 在該投資案中之資訊科技對於整個投資專案之重要性為：

非常不重要	1 2 3 4 5 6 7	非常重要

7. 公司現有之資訊科技設備對於該投資專案之重要性為：

非常不重要	1 2 3 4 5 6 7	非常重要

8. 請勾選該投資案中含有資訊科技之主要的目的：(可複選)

降低生產成本(例如以電腦控制機械代替人工操作)	❑
當作提供資訊給使用者之工具(例如電腦螢幕提供資訊取代報表)	❑
除了一般的基本作業外也產生新的資訊	❑
為了發掘新商機而發展之新資訊與新技術	❑
重新改造組織結構與組織目標之主要特性	❑
發展新的業務	❑
獲取競爭優勢	❑
改善產能與績效	❑
協助落實新的管理方式與新的組織型態	❑
其它(請指出)	❑

貳：策略性投資專案形成過程

所謂策略性投資專案形成過程，是指一個策略性投資專案，從投資構思出現到投資計劃書完成之整個程序。

9. 相對於貴公司其它非策略性投資專案, 本投資專案於下列之評等為何?

從投資構思出現到完成一個正式投資計劃書之時間	非常短	1 2 3 4 5 6 7	非常長
從一個正式投資計劃到開始執行之時間	非常短	1 2 3 4 5 6 7	非常長
受到耽擱(例如等待資訊)而規劃程序中斷	毫無耽擱	1 2 3 4 5 6 7	經常耽擱
本專案涉及之公司的組織層級	非常低	1 2 3 4 5 6 7	非常高
為了該投資案而招開正式會議之次數	非常少	1 2 3 4 5 6 7	非常多
正式會議時，與會人員之相互溝通	非常不良	1 2 3 4 5 6 7	非常良好
參與正式會議人員之範圍	非常有限	1 2 3 4 5 6 7	非常廣
正式會議外的討論	非常少	1 2 3 4 5 6 7	非常多
該投資案中意見紛歧的議題	非常低	1 2 3 4 5 6 7	非常多
需要協商的議題	非常有限	1 2 3 4 5 6 7	非常廣
類似的投資專案再次發生的頻率	幾乎不會	1 2 3 4 5 6 7	非常頻繁
該投資決策結果對公司改變之程度	毫無改變	1 2 3 4 5 6 7	徹底改變
該投資決策如果出錯會對公司影響程度	毫無影響	1 2 3 4 5 6 7	非常嚴重
該投資決策中決策人員之前瞻性	著眼短期	1 2 3 4 5 6 7	著眼長期
該投資決策之迫切性	毫不迫切	1 2 3 4 5 6 7	非常迫切
該投資決策對後續投資決策之影響	毫無影響	1 2 3 4 5 6 7	影響甚巨
該投資決策受到過去投資決策之影響	非常微弱	1 2 3 4 5 6 7	非常強列
涉及該投資決策之內部部門數目	非常少數	1 2 3 4 5 6 7	非常多
涉及該投資決策之外部組織數目	非常少數	1 2 3 4 5 6 7	非常多
投資案有關部門於規劃期間發揮影響力	幾乎沒有	1 2 3 4 5 6 7	非常強
投資案有關部門間運用影響力之平衡程度	非常平衡	1 2 3 4 5 6 7	非常不平衡
投資案有關部門運用其影響力而產生對立	毫無對立	1 2 3 4 5 6 7	非常對立

10 在計劃過程中, 有那些不確定性因素被考慮到?

不確定的因素	毫無　　非常大
供應商之不確定性 (例如: 價格改變)	1 2 3 4 5 6 7
生產之不確定性 (例如: 生產品質)	1 2 3 4 5 6 7
成本之不確定性 (例如: 勞工成本)	1 2 3 4 5 6 7
市場之不確定性 (例如: 市場大小、佔有率…等)	1 2 3 4 5 6 7
內部財務之不確定性 (例如: 財務報價)	1 2 3 4 5 6 7
外部財務之不確定性 (例如: 資金成本)	1 2 3 4 5 6 7
科技之不確定性 (例如: 科技之嶄新度)	1 2 3 4 5 6 7
策略之不確定性 (例如: 策略目標改變)	1 2 3 4 5 6 7
勞資關係之不確定性 (例如: 罷工、薪資要求 …等)	1 2 3 4 5 6 7
人事之不確定性 (例如: 士氣之影響、人員流動率…等)	1 2 3 4 5 6 7
法規之不確定性 (例如: 消費者保護法、貿易政策)	1 2 3 4 5 6 7
其它(請指出)	1 2 3 4 5 6 7

參: 專案決策之評估過程

本問卷所謂決策評估過程，是指對一個策略性投資專案，所作的經濟性評估，包括了對策略性因素、獲益能力、及風險之分析。

11. 請指出下列各策略性因素在投資案評估時之重要性:

與公司其他策略之一致程度	毫不重要	1 2 3 4 5 6 7	非常重要
與該專案相關之市場成長率	毫不重要	1 2 3 4 5 6 7	非常重要
公司市場競爭地位	毫不重要	1 2 3 4 5 6 7	非常重要
公司總體績效	毫不重要	1 2 3 4 5 6 7	非常重要
其它(請指出)	毫不重要	1 2 3 4 5 6 7	非常重要

12. 請指出下列資訊在該投資專案中之來源、確定性、與其協助評估過程之重要性

資訊類別	確定性 非常不確定　非常確定	重要性 非常不重要　非常重要	來源 內部　外部
投資案投資成本	1 2 3 4 5 6 7	1 2 3 4 5 6 7	❑ ❑
投資案執行時之現金流量	1 2 3 4 5 6 7	1 2 3 4 5 6 7	❑ ❑
投資案持續期間	1 2 3 4 5 6 7	1 2 3 4 5 6 7	❑ ❑
投資案所需資金取得之成本	1 2 3 4 5 6 7	1 2 3 4 5 6 7	❑ ❑
投資案收回其原始投資所需時間長度	1 2 3 4 5 6 7	1 2 3 4 5 6 7	❑ ❑
專案持續期間現金流動折算成現值	1 2 3 4 5 6 7	1 2 3 4 5 6 7	❑ ❑
投資案之每年平均報酬率	1 2 3 4 5 6 7	1 2 3 4 5 6 7	❑ ❑
利潤能力(即是資金成本與報酬率之差)	1 2 3 4 5 6 7	1 2 3 4 5 6 7	❑ ❑
對生產力(例如:節省操作與勞工成本、提高生產效能)之影響	1 2 3 4 5 6 7	1 2 3 4 5 6 7	❑ ❑
不易以一般貨幣衡量標準予以確認之成本(例如閒置資產等)	1 2 3 4 5 6 7	1 2 3 4 5 6 7	❑ ❑
不易以一般貨幣衡量標準予以確認之效益(例如改善公司形象等)	1 2 3 4 5 6 7	1 2 3 4 5 6 7	❑ ❑
其它(請指出)	1 2 3 4 5 6 7	1 2 3 4 5 6 7	❑ ❑

13. 該專案評估過程中是否曾使用用下列何種方式來處理風險?	曾使用
分析主要變數(例如投資案所需資金取得之成本)改變時，測試他們對成本、效益、或資金流量等各數值之影響(即敏感度分析法)。	❑
於投資評估時，對影響該投資案未來發展的不同經濟、技術、市場、政治、社會力量作出評估，並對可能發生的各種情況，擬定因應對策(即遠景方案法)。	❑
預測與投資案相關之活動之機率，並將相關活動以網狀圖連接以便對計劃之進度與成本加以規劃與控制(即計劃評核術)。	❑
考量影響投資案之變數的機率，並以電腦程式模擬如報酬率等投資取決標準可能發生之機率(即電腦模擬法)。	❑
將不同的選擇方法匯總，預測與投資案相關之活動之機率，將可能的選擇聯繫起來，成為決策流程圖以提廣的選擇範圍(即決策樹法)。	❑
提高原先設定之投資報酬率，當作對風險性投資案之額外補貼(即風險貼水法)。	❑
其它(請指出)	❑

肆：策略性投資專案之結果

14. 請勾選該投資對下列策略目標之重要程度(投資前)與其達成程度(投資後)

策略目標	策略目標的重要程度 毫不重要　　非常重要	策略目標的達成程度 毫無達成　　完全達成
增加利潤	1 2 3 4 5 6 7	1 2 3 4 5 6 7
增加銷售額	1 2 3 4 5 6 7	1 2 3 4 5 6 7
增加市場佔有率	1 2 3 4 5 6 7	1 2 3 4 5 6 7
改善品質	1 2 3 4 5 6 7	1 2 3 4 5 6 7
提高投資報酬率	1 2 3 4 5 6 7	1 2 3 4 5 6 7
改善公司形象	1 2 3 4 5 6 7	1 2 3 4 5 6 7
降低成本	1 2 3 4 5 6 7	1 2 3 4 5 6 7
維持市場地位	1 2 3 4 5 6 7	1 2 3 4 5 6 7
發展新業務	1 2 3 4 5 6 7	1 2 3 4 5 6 7
協助新的管理方式	1 2 3 4 5 6 7	1 2 3 4 5 6 7
獲取競爭優勢	1 2 3 4 5 6 7	1 2 3 4 5 6 7
符合政府法規	1 2 3 4 5 6 7	1 2 3 4 5 6 7
其它(請指出)	1 2 3 4 5 6 7	1 2 3 4 5 6 7

15. 該投資案執行後是否出現一些原先未預期出現之結果? 如果有，這些未預期之結果對問題 14 中之策略目標的整體影響為何?

未預期之結果	影響 負面　　正面
	1 2 3 4 5 6 7
	1 2 3 4 5 6 7
	1 2 3 4 5 6 7

16. 該投資案的決策程序是否讓貴公司學習到寶貴的經驗，藉此改善未來決策的品質?

毫無學習	1 2 3 4 5 6 7	非常寶貴的學習

伍: 公司與個人基本資料

您所回答的一切資訊將被嚴格保密，僅供學術研討之用。我們會將本研究的摘要報告郵寄一份供您參考，請您詳細填寫下列基本資料。

17.公司名稱: ________.

18.公司資本額(約): ________.

19.填表人姓名: ________.

20.聯絡住址: ________.

21.聯絡電話: ________.

22.您於該專案期間位屬那一管理階層?(請擇一選擇)

高層管理階級 ❑	中層管理階級 ❑	基層管理階級 ❑	其它(請指出)

23.於該專案期間，您與公司最高主管階層間存有多少報告層級? (請擇一選擇)

直接報告 ❑	一層 ❑	二層 ❑	三層或三層以上 ❑

問卷結束

感謝您的耐心填寫及合作!

問卷編號: ________

敬請擲回下列住址:
周 子 銓
臺北市萬盛街55號
電話: (02)931-4952

Appendix 2: The Operation of AHP

Analytical Hierarchy Process (AHP) is a well known method which can be used to determine optimal decisions in multi-attribute decision problems and has been widely discussed in the operation research (e.g. Winston, 1994) and strategic planning (e.g. Dyson, 1990) textbooks. It has subsequently been adapted to capital budgeting decision-making and has become a standard approach for evaluating capital investment alternatives where it is difficult to quantify criteria (Canada and Sullivan, 1989; Canada, Sullivan and White, 1996).

AHP developed by Saaty (1977, 1980, 1982) is a widely used multi-criteria decision-making method that is based on the decomposition of a complex discrete alternative decision problem into several smaller and easier to handle sub-problems. AHP, the present choice as an approach for strategic IT investment, is aptly described by its name. It is analytical because it breaks down the investment decision into component parts. It is hierarchical because it organises these components into successive levels of importance. Finally, it is a process because it provides a mechanism for evaluating the interrelationships among parts sequentially.

AHP consists of three principles in problem solving: decomposition, comparative judgement, and the synthesis of priorities (Saaty, 1986). By repeating the comparative judgement for all the levels and clusters in the hierarchy, AHP can be used flexibly in different cases.

Step 1: Decomposition

AHP first involves of decomposing a complex problem into its components, organising those components into sets and locating the sets into levels to generate a hierarchical structure. The purpose of constructing such a hierarchy is to determine the impact of low-level elements on an upper level criterion, which is achieved by pairwise comparison provided by the decision-makers.

Step 2: Comparative Judgement

The second principle is comparative judgement. AHP is based on the pairwise comparison method which transforms the subjective value of decision-maker's judgements into the form of quantified data. For example, for each pair of attributes, the decision-maker is asked: what is the relative importance of this attribute with respect to that one? The answers are important ratios using the scale shown in Table A2.1 as suggested by Saaty and Kearns (1985). Accordingly, a traditional AHP pairwise comparison scale has 17 importance ratios: the integers from 1 to 9 and the 8 reciprocals for 1/2 to 1/9. The scale can be made either smaller or larger according to the decision-makers' preference.

Table A2.1 Pairwise Comparison Scale for AHP Preference

Numerical Rating	Verbal Judgement of Preference
1	Equally preferred (or important)
3	Moderately preferred (or important)
5	Strongly preferred (or important)
7	Very strongly preferred (or important)
9	Extremely preferred (or important)
2, 4, 6, 8	Intermediate values

Step 3: The Synthesis of Priority

The third principle is the synthesis of local priority. From the set of pairwise comparisons, the next step is to generate a set of local priorities which express the relative impact of the set of elements on an element immediately above. To do so, Saaty and Kearns (1985) suggests the need to compute a set of eigenvectors for each matrix and then normalise to unity the result in order to obtain the vectors of priorities. Accordingly, the eigenvector is very critical in AHP. The basic mathematical concept can be briefly explained as follows.

Suppose we know the relative weights of objectives (or criteria), we can express them in a pairwise comparison matrix as follows:

$$\underline{A} = \begin{bmatrix} \frac{w_1}{w_1} & \frac{w_1}{w_2} & \cdots & \frac{w_1}{w_n} \\ \frac{w_2}{w_1} & \frac{w_2}{w_2} & \cdots & \frac{w_2}{w_n} \\ \vdots & \vdots & & \vdots \\ \frac{w_n}{w_1} & \frac{w_n}{w_2} & \cdots & \frac{w_n}{w_n} \end{bmatrix}$$

If the vector of weights, $[w_1, w_2, w_3, \cdots, w_n]$, needs to be found given these ratios, it can take the matrix product of matrix $\underline{A}$ with the vector $\underline{w}$ to obtain:

$$\begin{bmatrix} \frac{w_1}{w_1} & \frac{w_1}{w_2} & \cdots & \frac{w_1}{w_n} \\ \frac{w_2}{w_1} & \frac{w_2}{w_2} & \cdots & \frac{w_2}{w_n} \\ \vdots & \vdots & & \vdots \\ \frac{w_n}{w_1} & \frac{w_n}{w_2} & \cdots & \frac{w_n}{w_n} \end{bmatrix} \begin{bmatrix} w_1 \\ w_2 \\ w_3 \\ w_4 \end{bmatrix} = \begin{bmatrix} nw_1 \\ nw_2 \\ nw_3 \\ nw_4 \end{bmatrix}$$

$$\Rightarrow \quad \underline{A} \quad \underline{w} = n\underline{w}$$

If $\underline{A}$ is known, but not $\underline{w}$, $\underline{w}$ can be solved by above formula. The problem of solving for a non-zero solution to this set of equation is know as an eigenvalue problem:

$$\underline{A}\,\underline{w} = \lambda\,\underline{w}$$

The solution to this set of equations is in general found by solving an *n*th order equation for λ. Thus, in general, these can be up to n unique values for λ, with an associated $\underline{w}$ vector for each of the *n* values. In this case, however, the matrix $\underline{A}$ has a special form since each row is a constant multiple of the first row. For such a matrix, the rank of the matrix is one, and all the eigenvalues of $\underline{A}$ are zero, except one. Since the sum of the eigenvalues of a positive matrix is equal to the trace of the matrix, or the sum of the diagonal elements, the non-zero eigenvalue has a value of *n,* the size of the matrix. This eigenvalue is referred to as λmax, which is the largest eigenvalue of the judgement matrix $\underline{A}$.

Note that each column of $\underline{A}$ is a constant multiple of $\underline{w}$. Thus, $\underline{w}$ can be found by normalising any column of $\underline{A}$. The matrix $\underline{A}$ is said to be strongly consistent in that:

$a_{ik}a_{kj} = a_{ij}$ for all i, j.

Now let us consider the case where we do not know $\underline{w}$, and where $\underline{w}$ have only estimates of the a_{ij} s in the matrix $\underline{A}$ and the strong consistency property most probably does not hold. This allows for small errors and inconsistencies in judgement. It has been shown that for all matrices, small perturbations in the entries imply similar perturbations in the eigenvalues. Thus the eigenvalue problem for the inconsistent case is $\underline{A}\ \underline{w} = \lambda max\ \ \underline{w}$, where λmax is greater than or equal to n and the other λ's are close to zero. The estimates of the weights for the objectives can be found by normalising the eigenvaector corresponding to the largest eigenvalue in the above matrix equation. The closer λmax is to n, the more consistent the judgements. Thus, the difference, λmax - n, can be used as a measure of inconsistency. Instead of using the difference directly, Saaty (1985) defines a consistency index as:

$$\text{Consistency Index} = \frac{\lambda_{max} - n}{n - 1}$$

since it represents the average of the remaining eigenvalues.

In order to derive a meaningful interpretation of either the difference or the consistency index, Satty simulates a random pairwise of comparisons for different size matrices, calcuating the consistency indices, and arriving at an average consistency index for random judgements for each size matrix. He then defines the consistency ratio as:

$$\text{Consistency Ratio} = \frac{\text{Consistency Index}}{\text{Random Consistency}}$$

where R. C. denotes random consistency which is decided by the follow matrices

Size of matrix	1	2	3	4	5	6	7	8	9	10
Random consistency	0	0	.58	.90	1.12	1.24	1.32	1.41	1.45	1.49

However, the computing of eigenvectors is probably difficult for most managers and can be time consuming. Saaty and Kearns (1985) suggests the use of a geometric mean method to obtain a good approximation of the priorities. This is done by multiplying the elements in each row and taking their *n*th root, where n is the number of elements. Then normalise to unity the column of numbers thus obtained by dividing each entry by the sum of all entries.

Appendix 3: The Regression Model Building Process

Appendix 3-1A: Regression Interaction on IT intensity (Model 1A)

Table A3.1A: Summary of SPSS Result of Model 1A (Full Data Set)

Description of the Model (Model 1A)

$$Interaction = \beta_0 + \beta_1(IT\_Intensity) + \mu$$

Outliers Detection

Four cases (case 10, 27, 31, 77) were found with standardised residuals greater than ± 2 standard deviations.

Model summary

R	R Square	Adjusted R Square	Std. Error of the Estimate
0.221	0.049	0.036	1.113

Analysis of Variance

Model 1	Sum of Squares	df	Mean Square	F	Sig. of F
Regression	5.002	1	5.002	4.034	0.0481
Residual	96.717	78	1.239		

The Regression Equation and Associated Statistics

	Unstandardised Coefficients		Standardised Coefficients		
Model	B	Std. Error	β	t	Sig. of t
IT intensity	-0.006	0.003	-0.221	-2.008	0.0481
(Constant)	5.177	0.177		29.108	0.0000

Residuals Analysis

	Minimum	Maximum	Mean	Std. Deviation	N
Predicted Value	4.516	5.177	4.922	0.251	80
Residual	-2.977	2.147	.0000	1.106	80
Std. Predicted Value	-1.615	1.014	.0000	1.000	80
Std. Residual	-2.674	2.171	.0000	.9937	80

Searching for Violations of Assumptions

Figures A3-1A and A3-2A (in Appendix 3-1A) are the scatterplots of the predicted scores and predictor against residuals. They shows no pattern, thereby confirming that the assumptions of linearity and homogeneity of variance have been met. The histogram of standardised residuals is shown in Figure A3-3A (in Appendix 3-1A). The grey bars show the frequencies. The superimposed curve is the ideal normal distribution for the residuals. The Lilliefors test of normality (Statistic = 0.0579, df = 80, Sign. >.2000) indicates that the distribution of residual is normal. **Therefore no violation of assumption of the regression model has been found.**

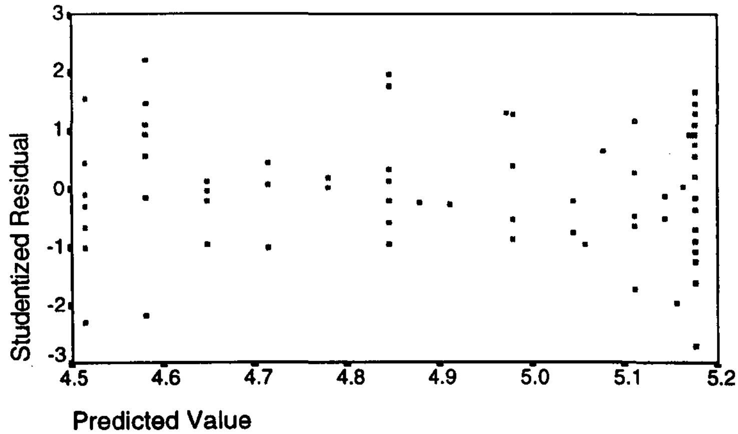

Figure A3-1A: The scatterplot of the predicted scores against residuals (Model 1A)

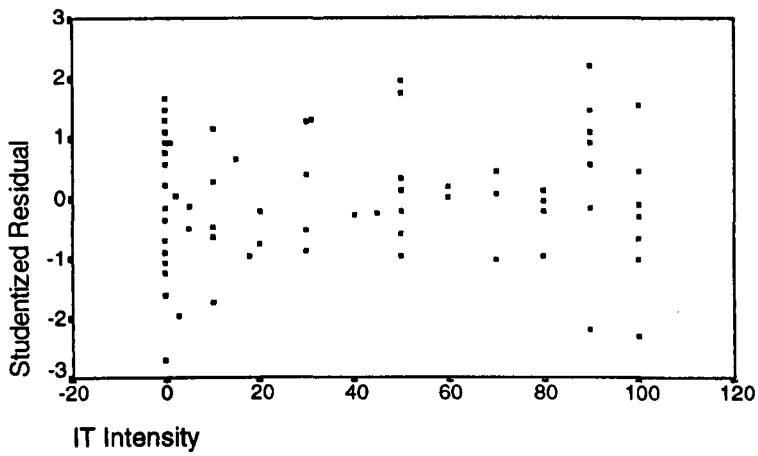

Figure A3-2A: The scatterplot of the independent variable (IT Intensity) against residuals (Model 1A)

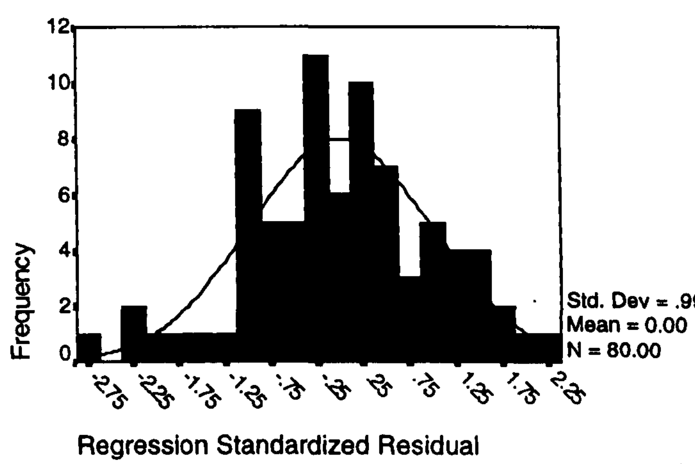

Figure A3-3A: The histogram of standardised residual (Model 1A)

Appendix 3-1B: Regression Interaction on IT intensity (Model 1B)

Table A3.1B: Summary of SPSS Result of Model 1 (Reduced Data Set)

Description of the Model (Model 1B)

$$Interaction = \beta_0 + \beta_1(IT\_Intensity) + \mu$$

Outliers Detection

Four cases (case 10, 27, 31, 77) were found with standardised residuals greater than ± 2 standard deviations. These four data points were deleted from the modelling building procedure.

Model summary

R	R Square	Adjusted R Square	Std. Error of the Estimate
0.231	0.053	0.040	0.969

Analysis of Variance

Model 1	Sum of Squares	df	Mean Square	F	Sig. of F
Regression	3.930	1	3.930	4.180	0.0445
Residual	69.586	74	0.940		

The Regression Equation and Associated Statistics

	Unstandardised Coefficients		Standardised Coefficients		
Model	B	Std. Error	β	t	Sig. of t
IT intensity	-0.006	0.003	-0.231	-2.045	0.0445
(Constant)	5.232	0.157		33.260	0.0000

Residuals Analysis

	Minimum	Maximum	Mean	Std. Deviation	N
Predicted Value	4.616	5.232	5.005	0.228	76
Residual	-2.214	2.075	0.000	0.963	76
Std. Predicted Value	-1.698	0.993	0.000	1.000	76
Std. Residual	-2.283	2.140	0.000	0.993	76

Searching for Violations of Assumptions

Figures A3-1B and A3-2B (in Appendix 3-1B) are the scatterplots of the predicted scores and predictor against residuals. They shows no pattern, thereby confirming that the assumptions of linearity and homogeneity of variance have been met. The histogram of standardised residuals is shown in Figure A3-3B (in Appendix 3-1B). The grey bars show the frequencies. The superimposed curve is the ideal normal distribution for the residuals. The Lilliefors test of normality (Statistic = 0.0627, df = 76, Sign. >.2000) indicates that the distribution of residual is normal. **Therefore no violation of assumption of the regression model has been found.**

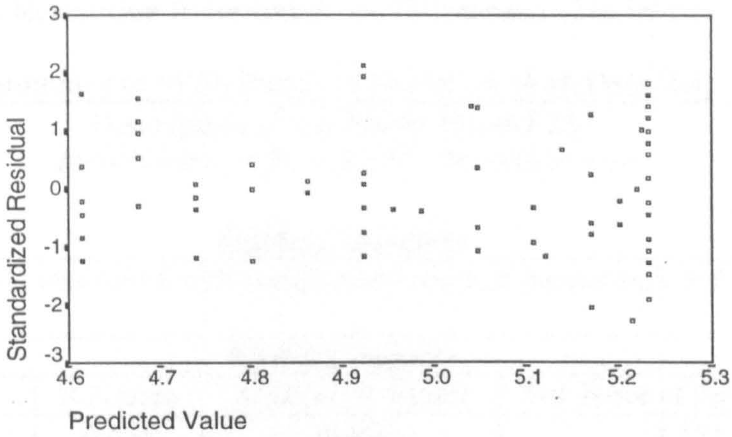

Figure A3-1B: The scatterplot of the predicted scores against residuals (Model 1B)

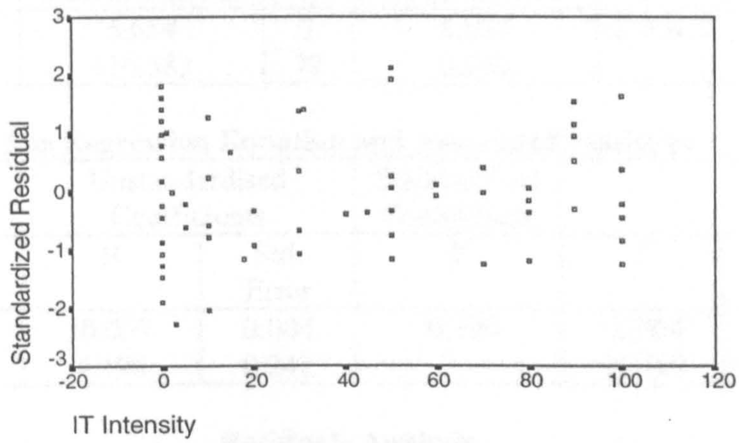

Figure A3-2B: The scatterplot of the independent variable (IT Intensity) against residuals (Model 1B)

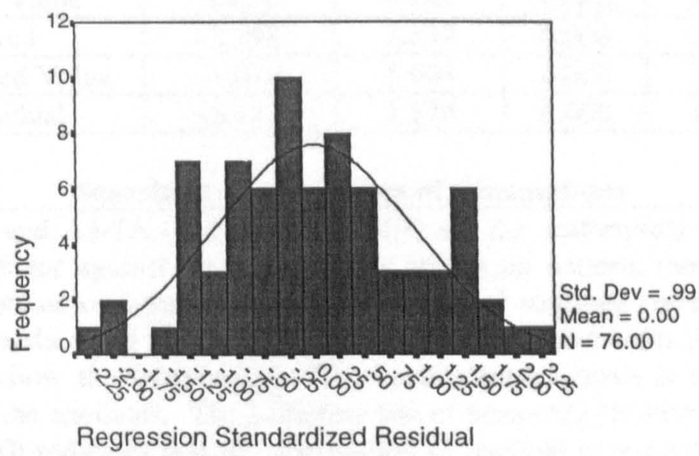

Figure A3-3B: The histogram of standardised residual (Model 1B)

Appendix 3-2A: Regression Involvement on IT intensity (Model 2A)

Table A3.2A: Summary of SPSS Result of Model 2A (Full Data Set)

Description of the Model (Model 2A)

$$Involvement = \beta_0 + \beta_1(IT\_Intensity) + \mu$$

Outliers Detection

One case (case 31) was found with standardised residual greater than ± 2 standard deviations.

Model Summary

R	R Square	Adjusted R Square	Std. Error of the Estimate
0.190	0.036	0.023	1.151

Analysis of Variance

Model	Sum of Squares	df	Mean Square	F	Sig. of F
Regression	6.654	1	6.654	2.904	0.0923
Residual	116.383	77	2.290		

The Regression Equation and Associated Statistics

	Unstandardised Coefficients		Standardised Coefficients		
Model	B	Std. Error	β	t	Sig. of t
IT intensity	-0.007	0.004	-0.190	-1.704	0.0923
(Constant)	4.198	0.242		17.340	0.0000

Residuals Analysis

	Minimum	Maximum	Mean	Std. Deviation	N
Predicted Value	3.434	4.198	3.9405	0.292	79
Residual	-3.198	2.839	0.000	1.503	79
Std. Predicted Value	-1.610	1.004	0.000	1.000	79
Std. Residual	-2.113	1.876	0.000	0.993	79

Searching for Violations of Assumptions

Figures A3-4A and A3-5A (in Appendix 3-2A) are the scatterplots of the predicted scores and predictor against residuals. They shows no pattern, thereby confirming that the assumptions of linearity and homogeneity of variance have been met. The histogram of standardised residuals is shown in Figure A3-6A (in Appendix 3-2A). The grey bars show the frequencies. The superimposed curve is the ideal normal distribution for the residuals. The Lilliefors test of normality (Statistic = 0.0805, df = 79, Sign. >.2000) indicates that the distribution of residual is normal. **Therefore no violation of assumption of the regression model has been found.**

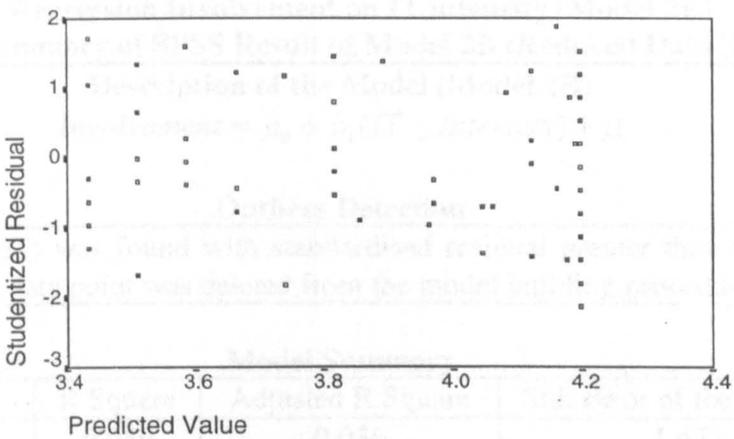

Figure A3-4A: The scatterplot of the predicted scores against residuals (Model 2A)

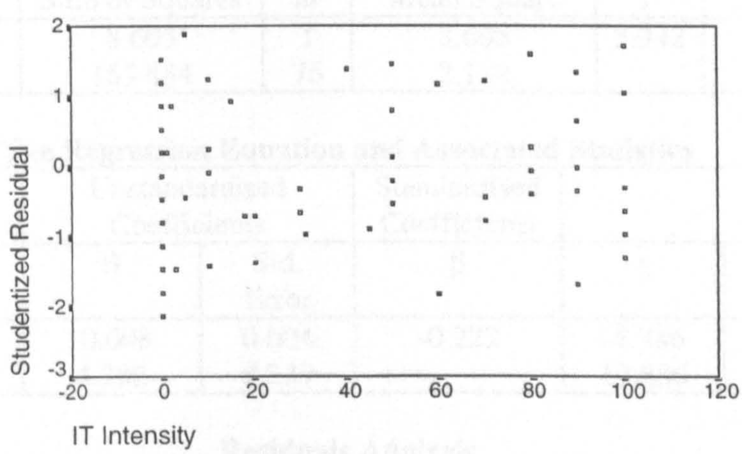

Figure A3-5A: The scatterplot of the independent variable (IT intensity) against residuals (Model 2A)

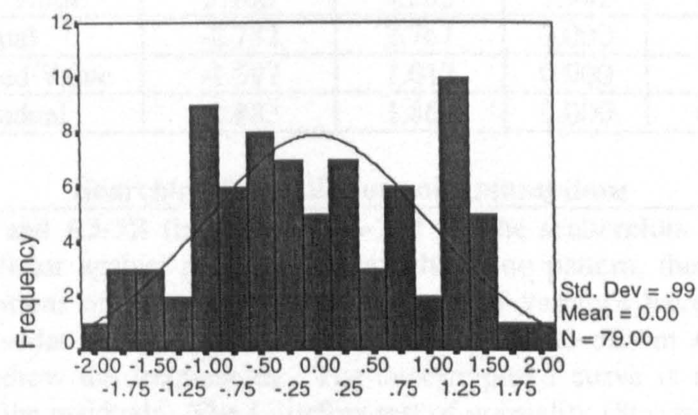

Figure A3-6A: The histogram of standardised residual (Model 2A)

Appendix 3-2B: Regression Involvement on IT intensity (Model 2B)

Table A3.2B: Summary of SPSS Result of Model 2B (Reduced Data Set)

Description of the Model (Model 2B)

$$Involvement = \beta_0 + \beta_1(IT\_Intensity) + \mu$$

Outliers Detection

One case (case 31) was found with standardised residual greater than ± 2 standard deviations. This data point was deleted from the model building procedure.

Model Summary

R	R Square	Adjusted R Square	Std. Error of the Estimate
0.222	0.049	0.036	1.477

Analysis of Variance

Model	Sum of Squares	df	Mean Square	F	Sig. of F
Regression	8.605	1	8.605	3.942	0.0507
Residual	165.884	76	2.182		

The Regression Equation and Associated Statistics

	Unstandardised Coefficients		Standardised Coefficients		
Model	B	Std. Error	β	t	Sig. of t
IT intensity	-0.008	0.004	-0.222	-1.986	0.0507
(Constant)	4.282	0.239		17.886	0.0000

Residuals Analysis

	Minimum	Maximum	Mean	Std. Deviation	N
Predicted Value	3.408	4.282	3.942	0.334	78
Residual	-2.782	2.761	0.000	1.467	78
Std. Predicted Value	-1.597	1.017	0.000	1.000	78
Std. Residual	-1.883	1.869	0.000	0.993	78

Searching for Violations of Assumptions

Figures A3-4B and A3-5B (in Appendix 3-2B) are the scatterplots of the predicted scores and predictor against residuals. They shows no pattern, thereby confirming that the assumptions of linearity and homogeneity of variance have been met. The histogram of standardised residuals is shown in Figure A3-6B (in Appendix 3-2B). The grey bars show the frequencies. The superimposed curve is the ideal normal distribution for the residuals. The Lilliefors test of normality (Statistic = 0.0789, df = 78, Sign. >.2000) indicates that the distribution of residual is normal. **Therefore no violation of assumption of the regression model has been found.**

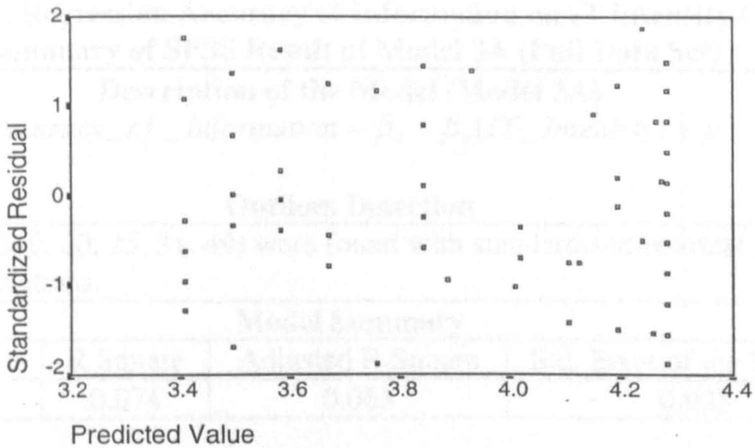

Figure A3-4B: The scatterplot of the predicted scores against residuals (Model 2B)

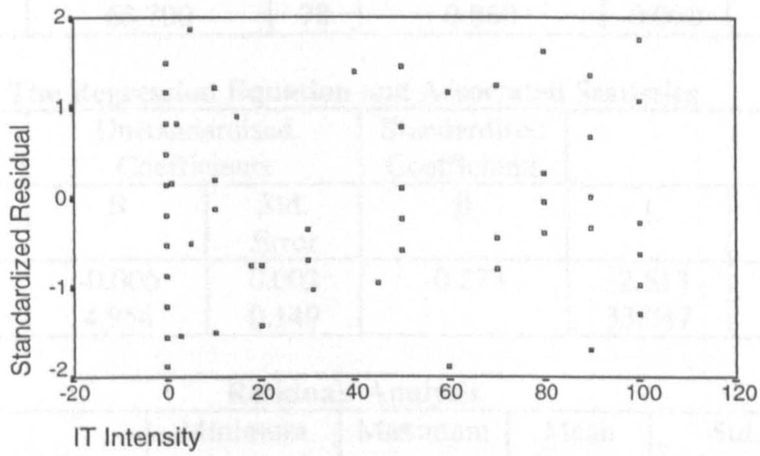

Figure A3-5B: The scatterplot of the independent variable (IT intensity) against residuals (Model 2B)

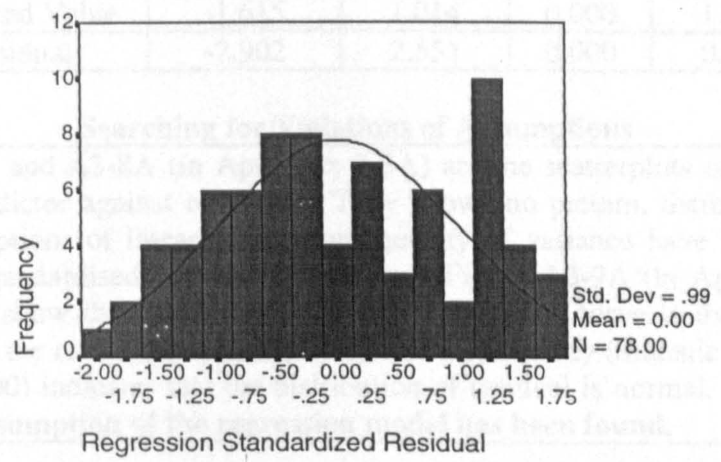

Figure A3-6B: The histogram of standardised residual (Model 2B)

Appendix 3-3A: Regression Accuracy of Information on IT intensity (Model 3A)

Table A3.3A: Summary of SPSS Result of Model 3A (Full Data Set)

Description of the Model (Model 3A)

$$Accuracy\_of\_Information = \beta_0 + \beta_1(IT\_Intensity) + \mu$$

Outliers Detection

Six cases (case 5, 9, 20, 25, 31, 49) were found with standardised residual greater than $\pm$ 2 standard deviations.

Model Summary

R	R Square	Adjusted R Square	Std. Error of the Estimate
0.273	0.074	0.063	0.938

Analysis of Variance

Model	Sum of Squares	df	Mean Square	F	Sig. of F
Regression	5.563	1	5.563	6.316	0.0140
Residual	68.700	78	0.880	0.000	

The Regression Equation and Associated Statistics

	Unstandardised Coefficients		Standardised Coefficients		
Model	B	Std. Error	β	t	Sig. of t
IT intensity	-0.006	0.002	-0.273	-2.513	0.014
(Constant)	4.954	0.149		33.047	0.000

Residuals Analysis

	Minimum	Maximum	Mean	Std. Deviation	N
Predicted Value	4.256	4.954	4.685	0.265	80
Residual	-2.723	2.394	0.000	0.932	80
Std. Predicted Value	-1.615	1.014	0.000	1.000	80
Std. Residual	-2.902	2.551	0.000	0.993	80

Searching for Violations of Assumptions

Figures A3-7A and A3-8A (in Appendix 3-3A) are the scatterplots of the predicted scores and predictor against residuals. They shows no pattern, thereby confirming that the assumptions of linearity and homogeneity of variance have been met. The histogram of standardised residuals is shown in Figure A3-9A (in Appendix 3-3A). The grey bars show the frequencies. The superimposed curve is the ideal normal distribution for the residuals. The Lilliefors test of normality (Statistic = 0.0818, df = 80, Sign. >.2000) indicates that the distribution of residual is normal. **Therefore no violation of assumption of the regression model has been found.**

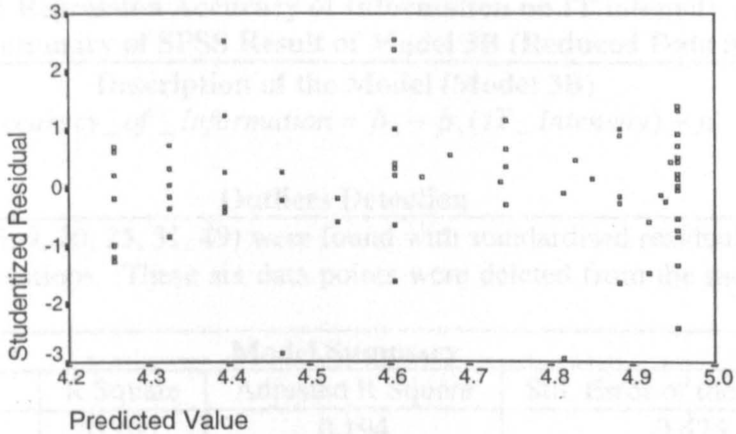

Figure A3-7A: The scatterplot of the predicted scores against residuals (Model 3A)

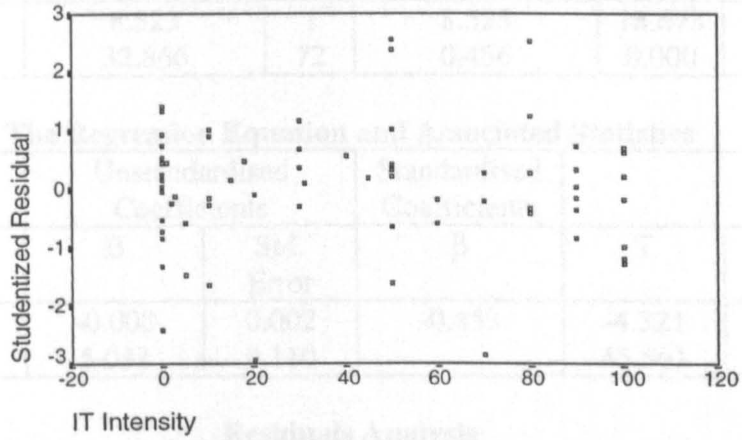

Figure A3-8A: The scatterplot of the independent variable (IT intensity) against residuals (Model 3A)

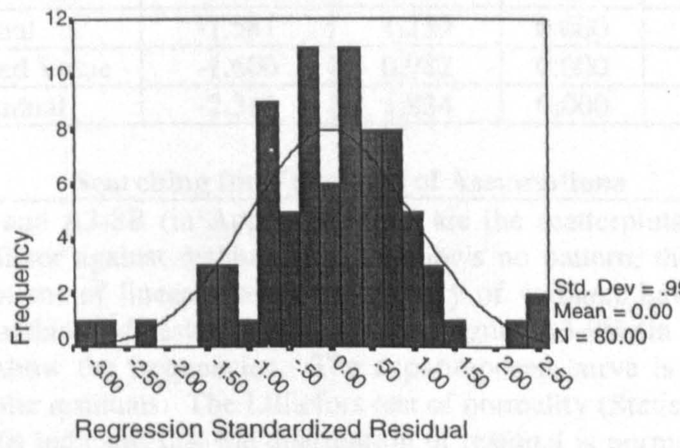

Figure A3-9A: The histogram of standardised residual (Model 3A)

Appendix 3-3B: Regression Accuracy of Information on IT intensity (Model 3B)

Table A3.3B: Summary of SPSS Result of Model 3B (Reduced Data Set)

Description of the Model (Model 3B)

$$Accuracy\_of\_Information = \beta_0 + \beta_1(IT\_Intensity) + \mu$$

Outliers Detection

Six cases (case 5, 9, 20, 25, 31, 49) were found with standardised residual greater than ± 2 standard deviations. These six data points were deleted from the model building procedure.

Model Summary

R	R Square	Adjusted R Square	Std. Error of the Estimate
0.453	0.205	0.194	0.675

Analysis of Variance

Model	Sum of Squares	df	Mean Square	F	Sig. of F
Regression	8.523	1	8.523	18.673	0.0000
Residual	32.866	72	0.456	0.000	

The Regression Equation and Associated Statistics

	Unstandardised Coefficients		Standardised Coefficients		
Model	B	Std. Error	β	T	Sig. of t
IT intensity	-0.008	0.002	-0.453	-4.321	0.000
(Constant)	5.033	0.110		45.561	0.000

Residuals Analysis

	Minimum	Maximum	Mean	Std. Deviation	N
Predicted Value	4.150	5.033	4.697	0.341	74
Residual	-1.581	1.239	0.000	0.671	74
Std. Predicted Value	-1.600	0.982	0.000	1.000	74
Std. Residual	-2.341	1.834	0.000	0.993	74

Searching for Violations of Assumptions

Figures A3-7B and A3-8B (in Appendix 3-3B) are the scatterplots of the predicted scores and predictor against residuals. They shows no pattern, thereby confirming that the assumptions of linearity and homogeneity of variance have been met. The histogram of standardised residuals is shown in Figure A3-9B (in Appendix 3-3B). The grey bars show the frequencies. The superimposed curve is the ideal normal distribution for the residuals. The Lilliefors test of normality (Statistic = 0.0825, df = 73, Sign. >.2000) indicates that the distribution of residual is normal. **Therefore no violation of assumption of the regression model has been found.**

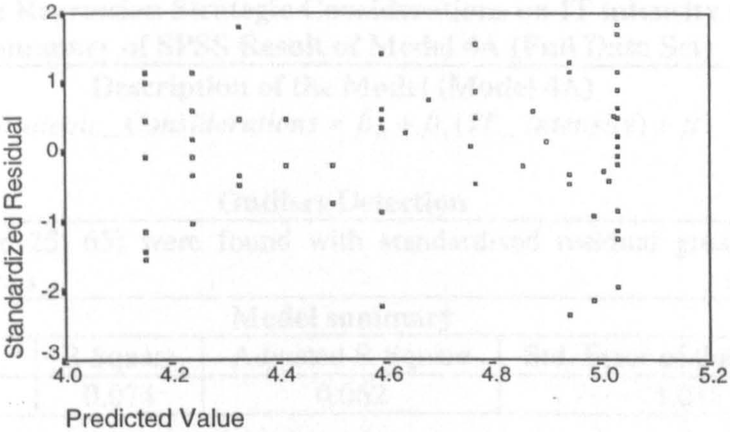

Figure A3-7B: The scatterplot of the predicted scores against residuals (Model 3B)

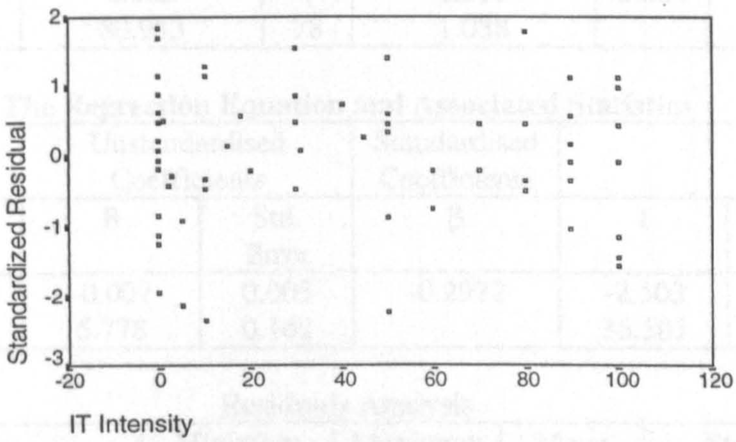

Figure A3-8B: The scatterplot of the independent variable (IT intensity) against residuals (Model 3B)

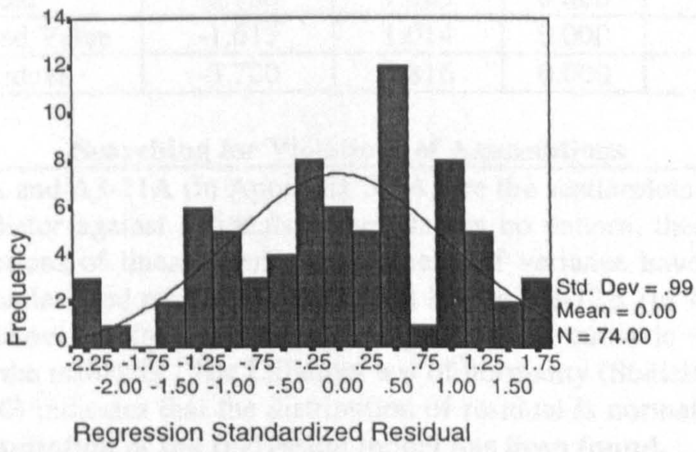

Figure A3-9B: The histogram of standardised residual (Model 3B)

Appendix 3-4A: Regression Strategic Considerations on IT intensity (Model 4A)
Table A3.4A: Summary of SPSS Result of Model 4A (Full Data Set)

Description of the Model (Model 4A)

$$Strategic\_Considerations = \beta_0 + \beta_1 (IT\_Intensity) + \mu$$

Outliers Detection

Two cases (case 25, 65) were found with standardised residual greater than ± 2 standard deviations

Model summary

R	R Square	Adjusted R Square	Std. Error of the Estimate
0.272	0.074	0.062	1.018

Analysis of Variance

Model	Sum of Squares	df	Mean Square	F	Sig. of F
Regression	6.503	1	6.503	6.264	0.0144
Residual	80.983	78	1.038		

The Regression Equation and Associated Statistics

	Unstandardised Coefficients		Standardised Coefficients		
Model	B	Std. Error	β	t	Sig. Of t
IT intensity	-0.007	0.003	-0.2972	-2.503	0.0144
(Constant)	5.778	0.162		35.501	0.0000

Residuals Analysis

	Minimum	Maximum	Mean	Std. Deviation	N
Predicted Value	5.023	5.778	5.487	0.286	80
Residual	-3.750	1.825	0.000	1.012	80
Std. Predicted Value	-1.615	1.014	0.000	1.000	80
Std. Residual	-3.720	1.816	0.000	1.005	80

Searching for Violations of Assumptions

Figures A3-10A and A3-11A (in Appendix 3-4A) are the scatterplots of the predicted scores and predictor against residuals. They shows no pattern, thereby confirming that the assumptions of linearity and homogeneity of variance have been met. The histogram of standardised residuals is shown in Figure A3-12A (in Appendix 3-4A). The grey bars show the frequencies. The superimposed curve is the ideal normal distribution for the residuals. The Lilliefors test of normality (Statistic = 0.0514, df = 80, Sign. >.2000) indicates that the distribution of residual is normal. **Therefore no violation of assumption of the regression model has been found.**

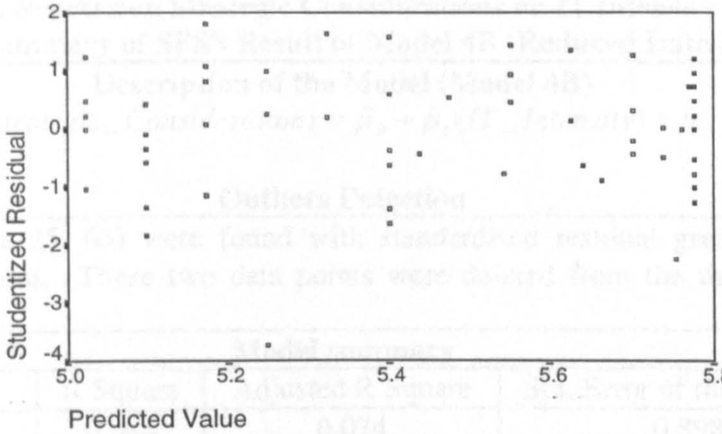

Figure A3-10A: The scatterplot of the predicted scores against residuals (Model 4A)

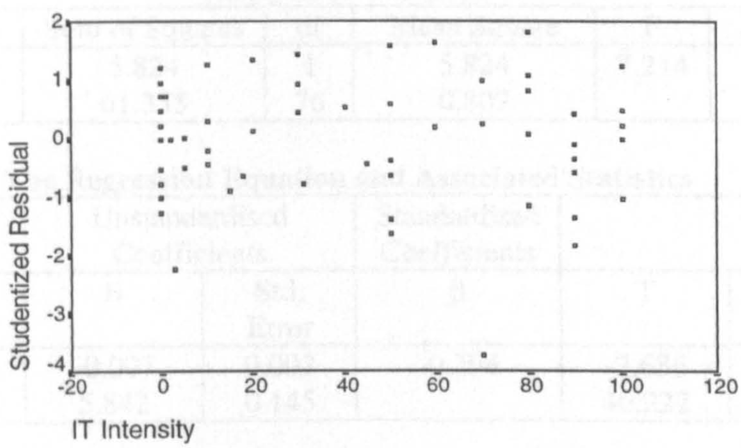

Figure A3-11A: The scatterplot of the independent variable (IT intensity) against residuals (Model 4A)

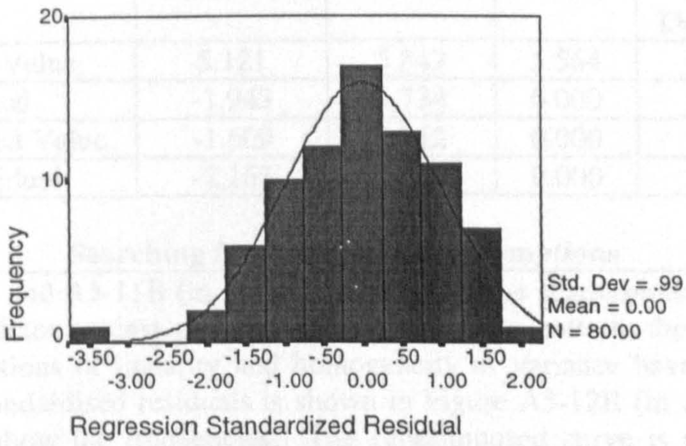

Figure A3-12A: The histogram of standardised residual (Model 4A)

Appendix 3-4B: Regression Strategic Considerations on IT intensity (Model 4B)
Table A3.4B: Summary of SPSS Result of Model 4B (Reduced Data Set)

Description of the Model (Model 4B)

$$Strategic\_Considerations = \beta_0 + \beta_1(IT\_Intensity) + \mu$$

Outliers Detection

Two cases (case 25, 65) were found with standardised residual greater than ± 2 standard deviations. These two data points were deleted from the model building procedure.

Model summary

R	R Square	Adjusted R Square	Std. Error of the Estimate
0.294	0.086	0.074	0.898

Analysis of Variance

Model	Sum of Squares	df	Mean Square	F	Sig. of F
Regression	5.824	1	5.824	7.214	0.0089
Residual	61.355	76	0.807		

The Regression Equation and Associated Statistics

	Unstandardised Coefficients		Standardised Coefficients		
Model	B	Std. Error	β	T	Sig. of t
IT intensity	-0.007	0.002	-0.294	-2.686	0.0089
(Constant)	5.842	0.145		40.222	0.0000

Residuals Analysis

	Minimum	Maximum	Mean	Std. Deviation	N
Predicted Value	5.121	5.842	5.564	0.275	78
Residual	-1.943	1.734	0.000	0.892	78
Std. Predicted Value	-1.609	1.012	0.000	1.000	78
Std. Residual	-2.163	1.930	0.000	0.993	78

Searching for Violations of Assumptions

Figures A3-10B and A3-11B (in Appendix 3-4B) are the scatterplots of the predicted scores and predictor against residuals. They shows no pattern, thereby confirming that the assumptions of linearity and homogeneity of variance have been met. The histogram of standardised residuals is shown in Figure A3-12B (in Appendix 3-4B). The grey bars show the frequencies. The superimposed curve is the ideal normal distribution for the residuals. The Lilliefors test of normality (Statistic = 0.0635, df = 74, Sign. >.2000) indicates that the distribution of residual is normal. **Therefore no violation of assumption of the regression model has been found.**

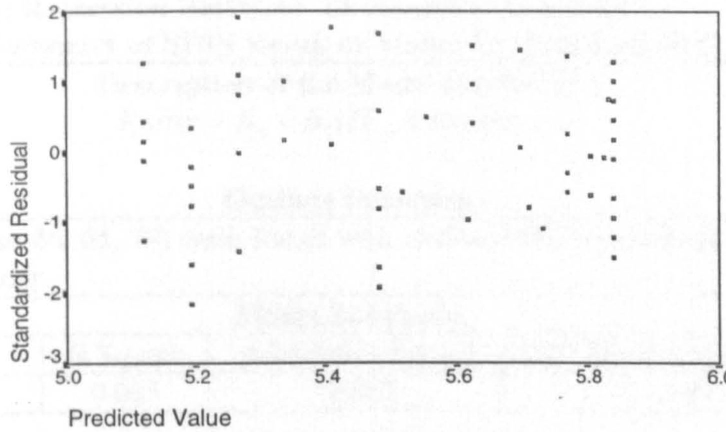

Figure A3-10B: The scatterplot of the predicted scores against residuals (Model 4B)

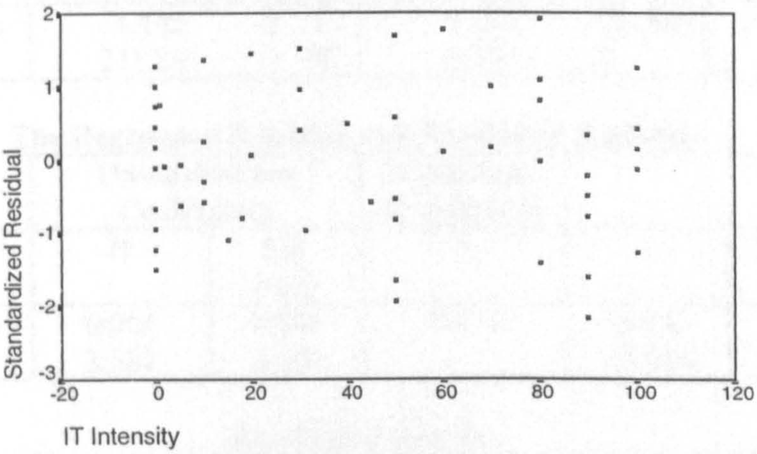

Figure A3-11B: The scatterplot of the independent variable (IT intensity) against residuals (Model 4B)

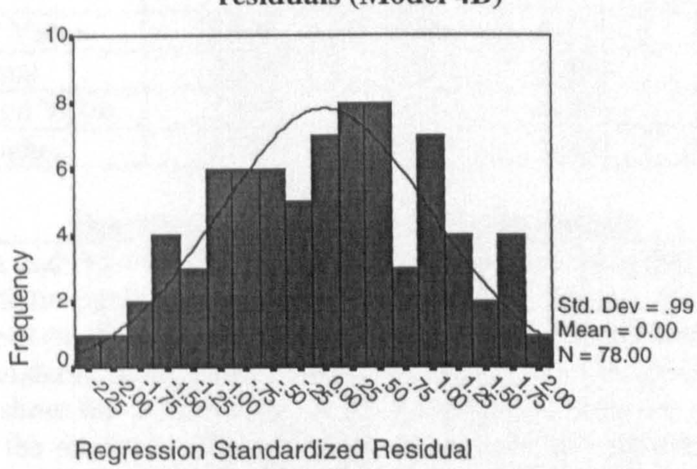

Figure A3-12B: The histogram of standardised residual (Model 4B)

Appendix 3-5A: Regression Rarity on IT intensity (Model 5A)

Table A3.5A: Summary of SPSS Result of Model 5A (Full Data Set)

Description of the Model (Model 5A)

$$Rarity = \beta_0 + \beta_1(IT\_Intensity) + \mu$$

Outliers Detection

Three cases (case 46, 65, 79) were found with standardised residuals greater than ± 2 standard deviations.

Model Summary

R	R Square	Adjusted R Square	Std. Error of the Estimate
0.074	0.005	-0.007	1.645

Analysis of Variance

Model 1	Sum of Squares	df	Mean Square	F	Sig. of F
Regression	1.165	1	1.165	0.430	0.517
Residual	211.221	78	2.707		

The Regression Equation and Associated Statistics

	Unstandardised Coefficients		Standardised Coefficients		
Model	B	Std. Error	β	t	Sig. of t
IT intensity	0.003	0.048	0.074	0.656	0.513
(Constant)	3.589	0.262		13.654	0.0000

Residuals Analysis

	Minimum	Maximum	Mean	Std. Deviation	N
Predicted Value	3.589	3.908	3.712	0.121	80
Residual	-2.876	3.410	0.000	1.635	80
Std. Predicted Value	-1.014	1.615	0.000	1.000	80
Std. Residual	-1.748	2.072	0.000	0.993	80

Searching for Violations of Assumptions

Figures A3-13A and A3-14A (in Appendix 3-5A) are the scatterplots of the predicted scores and predictor against residuals. They shows no pattern, thereby confirming that the assumptions of linearity and homogeneity of variance have been met. The histogram of standardised residuals is shown in Figure A3-15A (in Appendix 3-5A). The grey bars show the frequencies. The superimposed curve is the ideal normal distribution for the residuals. The Lilliefors test of normality (Statistic = 0.165, df = 80, Sign.=.0000) indicates that **the distribution of residual is abnormal.**

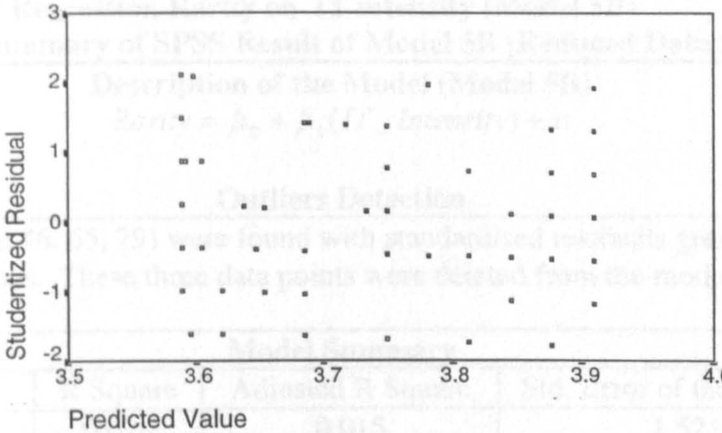

Figure A3-13A: The scatterplot of the predicted scores against residuals (Model 5A)

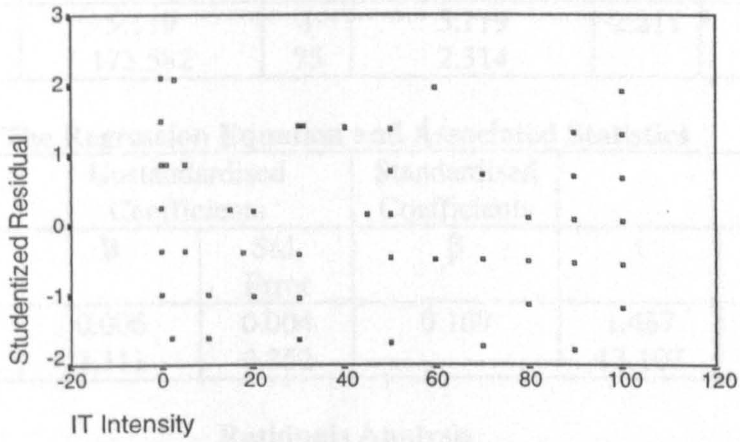

Figure A3-14A: The scatterplot of the independent variable (IT intensity) against residuals (Model 5A)

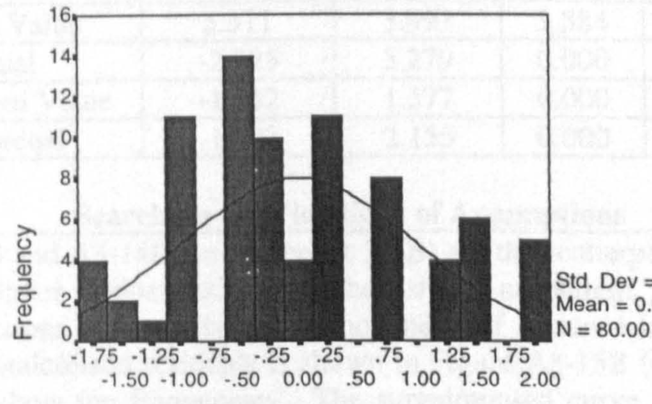

Figure A3-15A: The histogram of standardised residual (Model 5A)

Appendix 3-5B: Regression Rarity on IT intensity (Model 5B)
Table A3.5B: Summary of SPSS Result of Model 5B (Reduced Data Set)

Description of the Model (Model 5B)

$$Rarity = \beta_0 + \beta_1(IT\_Intensity) + \mu$$

Outliers Detection

Three cases (case 46, 65, 79) were found with standardised residuals greater than ± 2 standard deviations. These three data points were deleted from the model building procedure.

Model Summary

R	R Square	Adjusted R Square	Std. Error of the Estimate
0.169	0.028	0.015	1.521

Analysis of Variance

Model 1	Sum of Squares	df	Mean Square	F	Sig. of F
Regression	5.119	1	5.119	2.211	0.1411
Residual	173.582	75	2.314		

The Regression Equation and Associated Statistics

	Unstandardised Coefficients		Standardised Coefficients		
Model	B	Std. Error	β	t	Sig. of t
IT intensity	0.006	0.004	0.169	1.487	0.1411
(Constant)	3.311	0.252		13.107	0.0000

Residuals Analysis

	Minimum	Maximum	Mean	Std. Deviation	N
Predicted Value	3.311	3.993	3.584	0.259	77
Residual	-2.925	3.279	0.000	1.511	77
Std. Predicted Value	-1.052	1.577	0.000	1.000	77
Std. Residual	-1.923	2.155	0.000	0.993	77

Searching for Violations of Assumptions

Figures A3-13B and A3-14B (in Appendix 3-5B) are the scatterplots of the predicted scores and predictor against residuals. They shows no pattern, thereby confirming that the assumptions of linearity and homogeneity of variance have been met. The histogram of standardised residuals is shown in Figure A3-15B (in Appendix 3-5B). The grey bars show the frequencies. The superimposed curve is the ideal normal distribution for the residuals. The Lilliefors test of normality (Statistic = 0.136, df = 73, Sign.=.0018) indicates that **the distribution of residual is abnormal.**

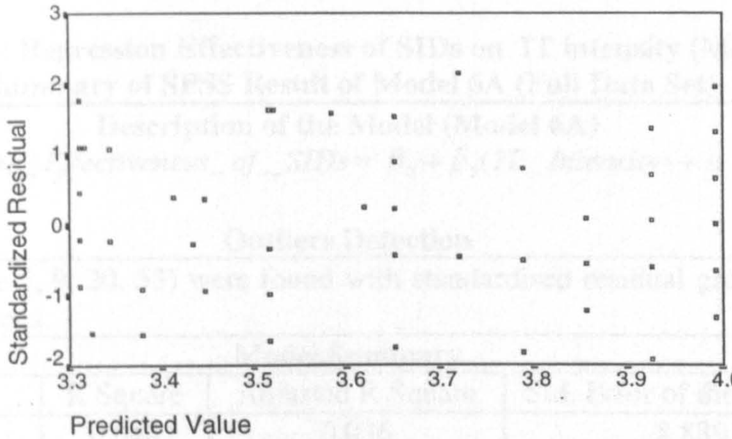

Figure A3-13B: The scatterplot of the predicted scores against residuals (Model 5B)

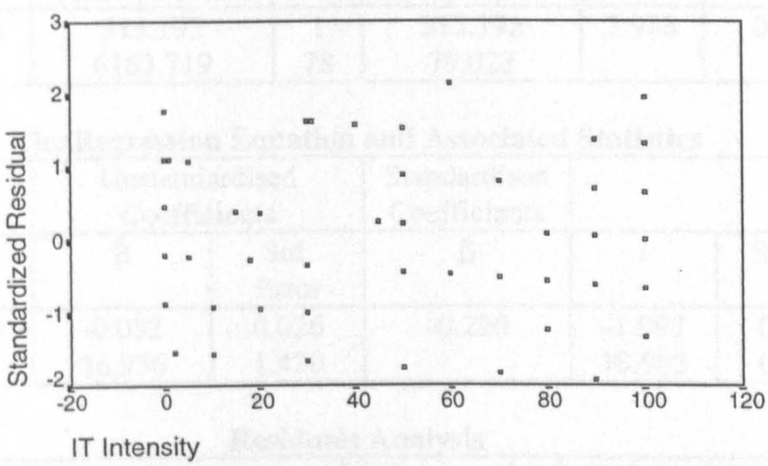

Figure A3-14B: The scatterplot of the independent variable (IT intensity) against residuals (Model 5B)

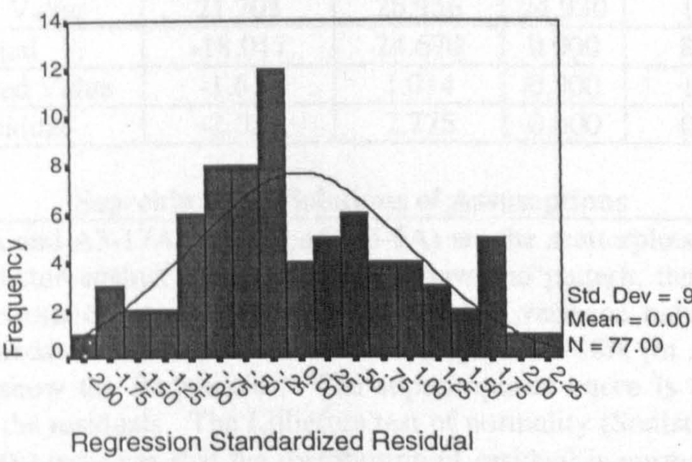

Figure A3-15B: The histogram of standardised residual (Model 5B)

Appendix 3-6A: Regression Effectiveness of SIDs on IT intensity (Model 6A)

Table A3.6A: Summary of SPSS Result of Model 6A (Full Data Set)

Description of the Model (Model 6A)

$$The\_Effectiveness\_of\_SIDs = \beta_0 + \beta_1(IT\_Intensity) + \mu$$

Outliers Detection

Four cases (case 5, 9, 20, 53) were found with standardised residual greater than ± 2 standard deviations.

Model Summary

R	R Square	Adjusted R Square	Std. Error of the Estimate
0.220	0.048	0.036	8.889

Analysis of Variance

Model 1	Sum of Squares	df	Mean Square	F	Sig. of F
Regression	315.192	1	315.192	3.988	0.0493
Residual	6163.719	78	79.022		

The Regression Equation and Associated Statistics

	Unstandardised Coefficients		Standardised Coefficients		
Model	B	Std. Error	β	t	Sig. of t
IT intensity	-0.052	0.026	-0.220	-1.997	0.0493
(Constant)	26.956	1.420		18.983	0.0000

Residuals Analysis

	Minimum	Maximum	Mean	Std. Deviation	N
Predicted Value	21.703	26.956	24.930	1.997	80
Residual	-18.017	24.670	0.000	8.833	80
Std. Predicted Value	-1.615	1.014	0.000	1.000	80
Std. Residual	-2.026	2.775	0.000	0.993	80

Searching for Violations of Assumptions

Figures A3-16A and A3-17A (in Appendix 3-6A) are the scatterplots of the predicted scores and predictor against residuals. They shows no pattern, thereby confirming that the assumptions of linearity and homogeneity of variance have been met. The histogram of standardised residuals is shown in Figure A3-18A (in Appendix 3-6A). The grey bars show the frequencies. The superimposed curve is the ideal normal distribution for the residuals. The Lilliefors test of normality (Statistic = 0.0484, df = 80, Sign. >.2000) indicates that the distribution of residual is normal. **Therefore no violation of assumption of the regression model has been found.**

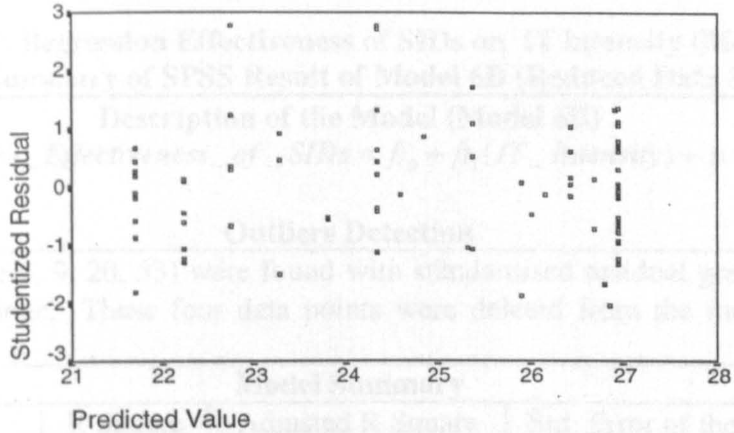

Figure A3-16A: The scatterplot of the predicted scores against residuals (Model 6A)

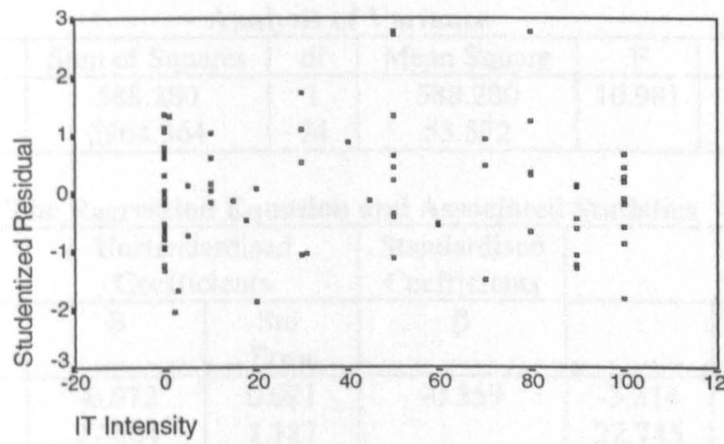

Figure A3-17A: The scatterplot of the independent variable (IT intensity) against residuals (Model 6A)

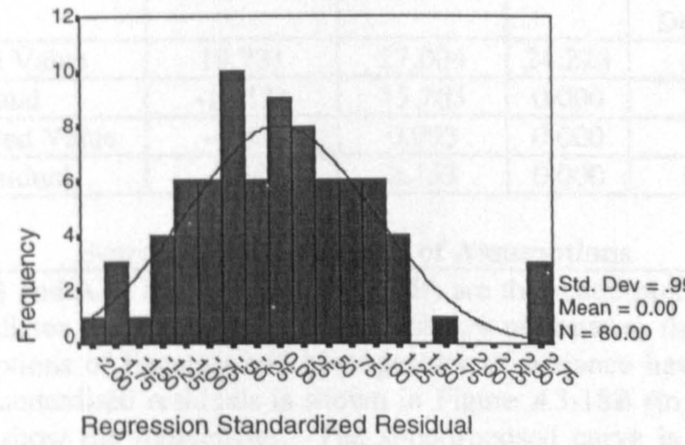

Figure A3-18A: The histogram of standardised residual (Model 6A)

Appendix 3-6B: Regression Effectiveness of SIDs on IT intensity (Model 6B)
Table A3.6B: Summary of SPSS Result of Model 6B (Reduced Data Set)

Description of the Model (Model 6B)

$$The\_Effectiveness\_of\_SIDs = \beta_0 + \beta_1(IT\_Intensity) + \mu$$

Outliers Detection

Four cases (case 5, 9, 20, 53) were found with standardised residual greater than ± 2 standard deviations. These four data points were deleted from the model building procedure.

Model Summary

R	R Square	Adjusted R Square	Std. Error of the Estimate
0.359	0.129	0.117	7.319

Analysis of Variance

Model 1	Sum of Squares	df	Mean Square	F	Sig. of F
Regression	588.280	1	588.280	10.981	0.0014
Residual	3964.364	74	53.572		

The Regression Equation and Associated Statistics

	Unstandardised Coefficients		Standardised Coefficients		
Model	B	Std. Error	β	t	Sig. of t
IT intensity	-0.072	0.021	-0.359	-3.314	0.0014
(Constant)	27.004	1.187		22.745	0.0000

Residuals Analysis

	Minimum	Maximum	Mean	Std. Deviation	N
Predicted Value	19.721	27.004	24.223	2.800	76
Residual	-16.131	15.763	0.000	7.270	76
Std. Predicted Value	-1.607	0.993	0.000	1.000	76
Std. Residual	-2.204	2.153	0.000	0.993	76

Searching for Violations of Assumptions

Figures A3-16B and A3-17B (in Appendix 3-6B) are the scatterplots of the predicted scores and predictor against residuals. They shows no pattern, thereby confirming that the assumptions of linearity and homogeneity of variance have been met. The histogram of standardised residuals is shown in Figure A3-18B (in Appendix 3-6B). The grey bars show the frequencies. The superimposed curve is the ideal normal distribution for the residuals. The Lilliefors test of normality (Statistic = 0.049, df = 76, Sign. >.2000) indicates that the distribution of residual is normal. **Therefore no violation of assumption of the regression model has been found.**

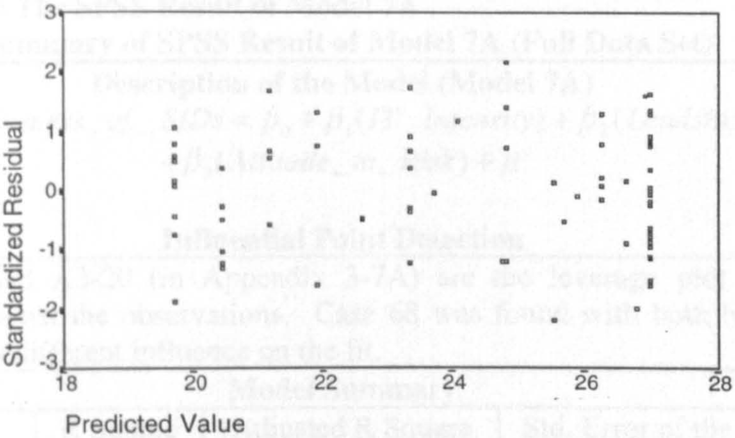

Figure A3-16B: The scatterplot of the predicted scores against residuals (Model 6B)

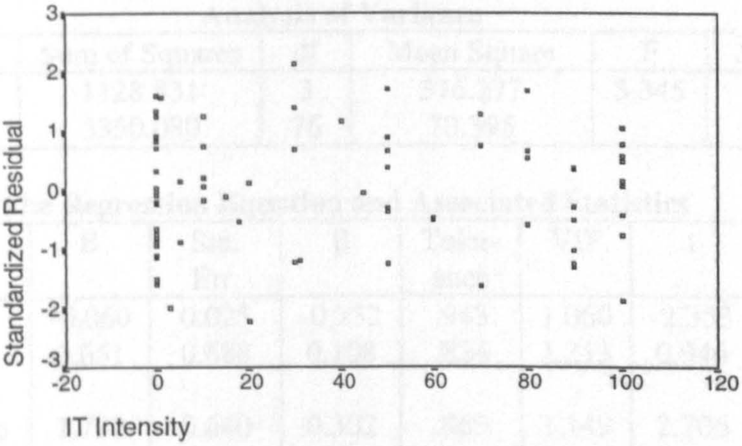

Figure A3-17B: The scatterplot of the independent variable (IT intensity) against residuals (Model 6B)

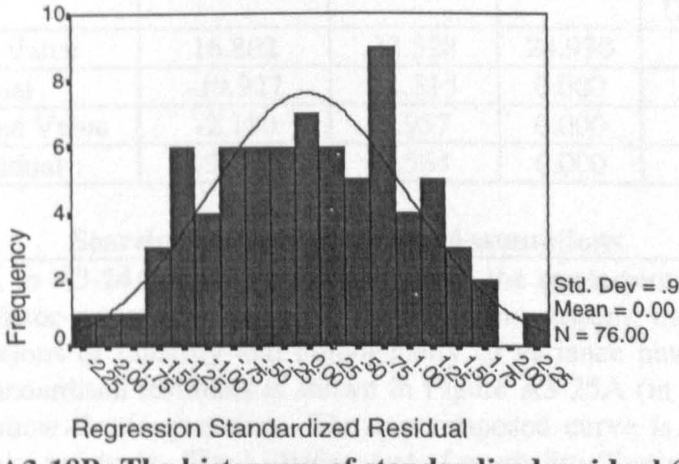

Figure A3-18B: The histogram of standardised residual (Model 6B)

Appendix 3-7A: The SPSS Result of Model 7A

Table A3.7A: Summary of SPSS Result of Model 7A (Full Data Set)

Description of the Model (Model 7A)

$$The\_Effectiveness\_of\_SIDs = \beta_0 + \beta_1(IT\_Intensity) + \beta_2(Leadship\_Style) + \beta_3(Attitude\_to\_Risk) + \mu$$

Influential Point Detection

Figure A3-19 and A3-20 (in Appendix 3-7A) are the leverage plot and Cook's distance plot against the observations. Case 68 was found with both high leverage and substantially different influence on the fit.

Model Summary

R	R Square	Adjusted R Square	Std. Error of the Estimate
0.417	0.174	0.141	8.390

Analysis of Variance

Model 1	Sum of Squares	df	Mean Square	F	Sig. of F
Regression	1128.831	3	376.277	5.345	0.0021
Residual	5350.080	76	70.395		

The Regression Equation and Associated Statistics

Model	B	Std. Err.	β	Tolerance	VIF	t	Sig. t
IT intensity	-0.060	0.025	-0.252	.943	1.060	-2.353	0.0212
Leadership Style	0.651	0.688	0.108	.824	1.213	0.946	0.3474
Risk Attitude	1.732	0.640	0.302	.869	1.149	2.706	0.0084
(Constant)	16.245	3.546				4.581	0.0000

Residuals Analysis

	Minimum	Maximum	Mean	Std. Deviation	N
Predicted Value	16.802	32.328	24.930	3.780	80
Residual	-19.927	21.515	0.000	8.229	80
Std. Predicted Value	-2.150	1.957	0.000	1.000	80
Std. Residual	-2.375	2.564	0.000	0.980	80

Searching for Violations of Assumptions

Figures A3-21A to A3-24A (in Appendix 3-7A) are the scatterplots of the predicted scores and predictor against residuals. They shows no pattern, thereby confirming that the assumptions of linearity and homogeneity of variance have been met. The histogram of standardised residuals is shown in Figure A3-25A (in Appendix 3-7A). The grey bars show the frequencies. The superimposed curve is the ideal normal distribution for the residuals. The Lilliefors test of normality (Statistic = 0.0808, df = 80, Sign. >.2000) indicates that the distribution of residual is normal. **Therefore no violation of assumption of the regression model has been found.**

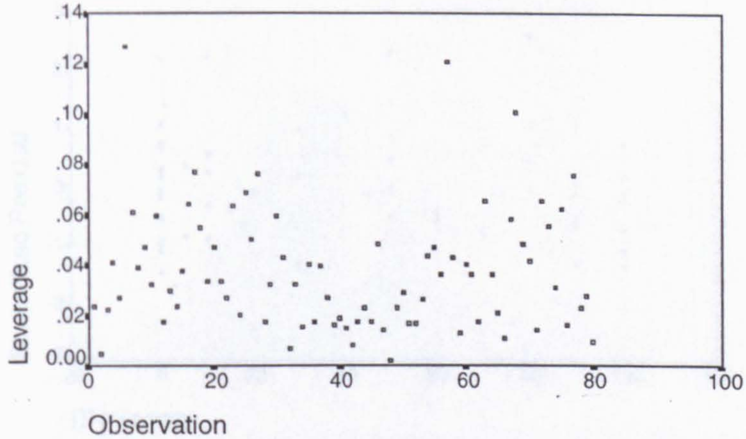

Figure A3-19: The scatterplot of the observations against leverage(Model 7A)

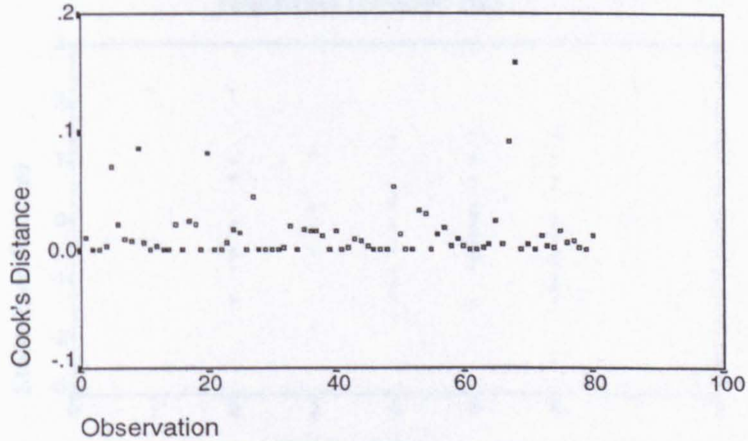

Figure A3-20: The scatterplot of the observation against Cook's distance **(Model 7A)**

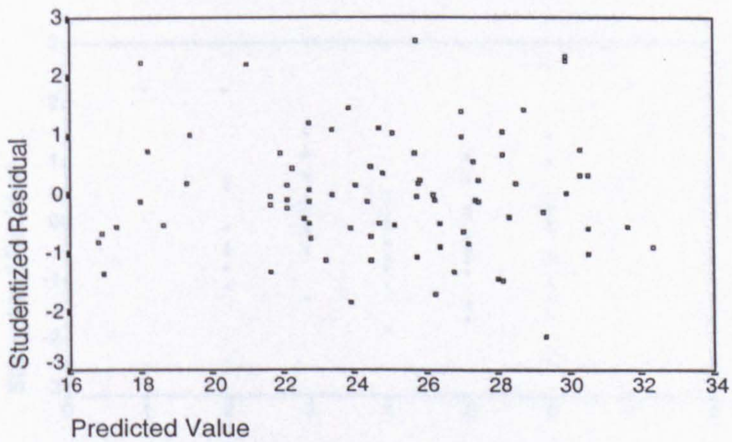

Figure A3-21A: The scatterplot of the predicted scores against residuals (Model 7A)

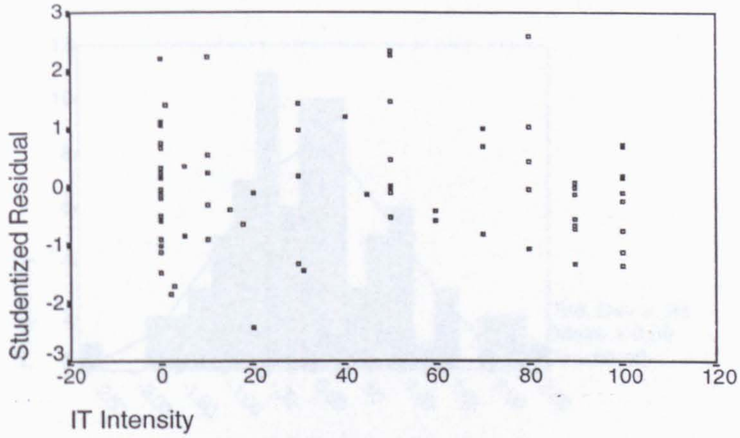

Figure A3-22A: The scatterplot of the independent variable (IT intensity) against residuals (Model 7A)

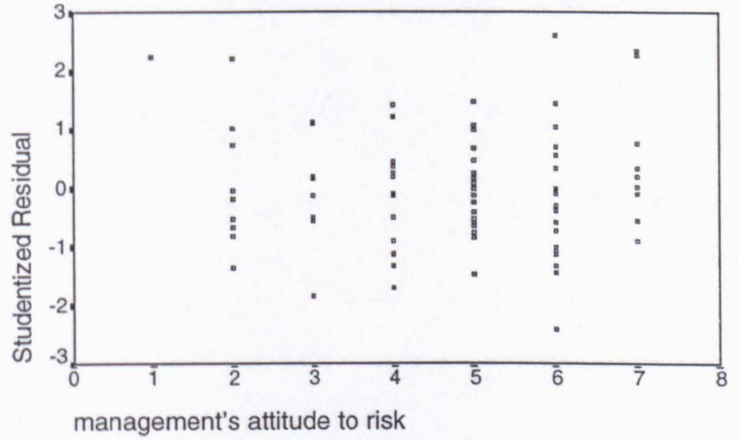

Figure A3-23A: The scatterplot of the independent variable (management's attitude to risk) against residuals (Model 7A)

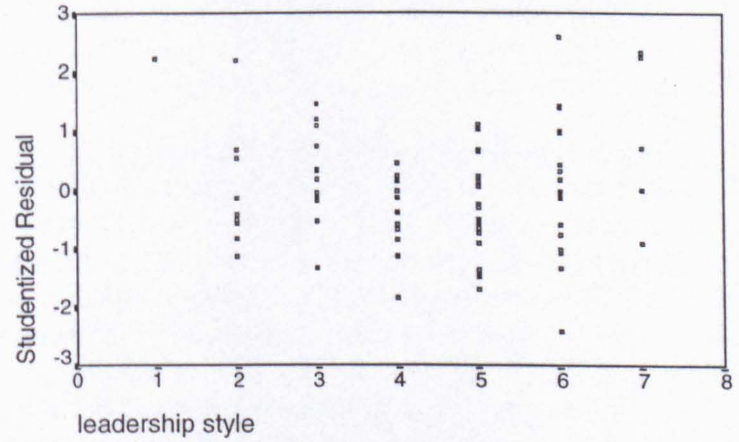

Figure A3-24A: The scatterplot of the independent variable (leadership style) against residuals (Model 7A)

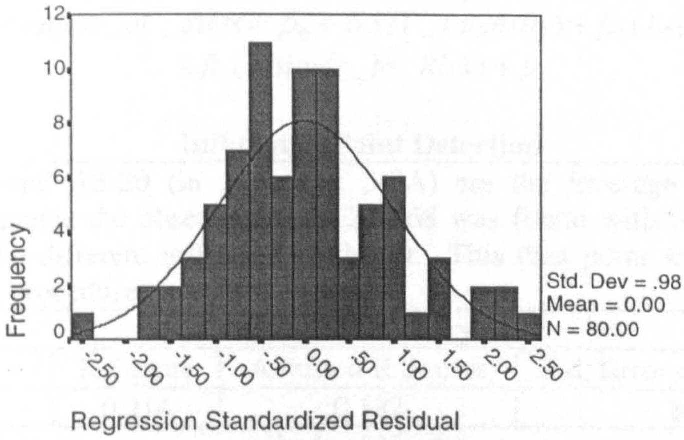

Figure A3-25A: The histogram of standardised residual (Model 7A)

Appendix 3-7B: The SPSS Result of Model 7B

Table A3.7B: Summary of SPSS Result of Model 7B (Reduced Data Set)

Description of the Model (Model 7B)

$$The\_Effectiveness\_of\_SIDs = \beta_0 + \beta_1(IT\_Intensity) + \beta_2(Leadship\_Style) + \beta_3(Attitude\_to\_Risk) + \mu$$

Influential Point Detection

Figure A3-19 and A3-20 (in Appendix 3-7A) are the leverage plot and Cook's distance plot against the observations. Case 68 was found with both high leverage and substantially different influence on the fit. This data point was deleted for the model building procedure.

Model Summary

R	R Square	Adjusted R Square	Std. Error of the Estimate
0.462	0.214	0.182	8.164

Analysis of Variance

Model 1	Sum of Squares	df	Mean Square	F	Sig. of F
Regression	1363.091	3	454.363	6.816	0.0004
Residual	4999.097	75	66.654		

The Regression Equation and Associated Statistics

Model	B	Std. Err.	β	Toler-ance	VIF	t	Sig. t
IT intensity	-0.057	0.024	-0.244	0.948	1.054	-2.325	0.0228
Leadership Style	0.917	0.680	0.148	0.858	1.165	1.348	0.1816
Risk Attitude	2.010	0.634	0.341	0.900	1.111	3.169	0.0022
(Constant)	13.419	3.663				3.663	0.0005

Residuals Analysis

	Minimum	Maximum	Mean	Std. Deviation	N
Predicted Value	15.224	33.337	24.794	4.180	79
Residual	-20.414	20.891	0.000	8.005	79
Std. Predicted Value	-2.289	2.043	0.000	1.000	79
Std. Residual	-2.500	2.558	0.000	0.980	79

Searching for Violations of Assumptions

Figures A3-21B to A3-24B (in Appendix 3-7B) are the scatterplots of the predicted scores and predictor against residuals. They shows no pattern, thereby confirming that the assumptions of linearity and homogeneity of variance have been met. The histogram of standardised residuals is shown in Figure A3-25B (in Appendix 3-7B). The grey bars show the frequencies. The superimposed curve is the ideal normal distribution for the residuals. The Lilliefors test of normality (Statistic = 0.0802, df = 79, Sign. >.2000) indicates that the distribution of residual is normal. **Therefore no violation of assumption of the regression model has been found.**

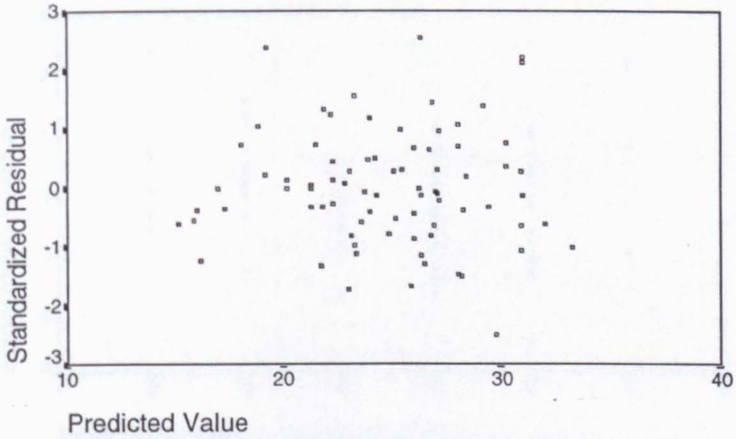

Figure A3-21B: The scatterplot of the predicted scores against residuals (Model 7B)

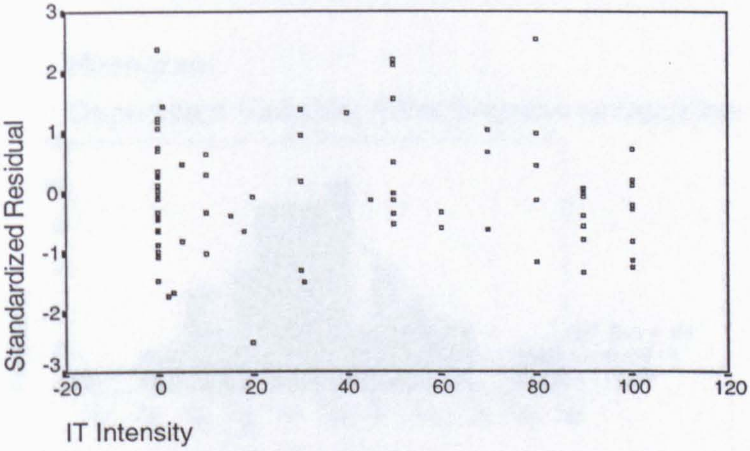

Figure A3-22B: The scatterplot of the independent variable (IT intensity) against residuals (Model 7B)

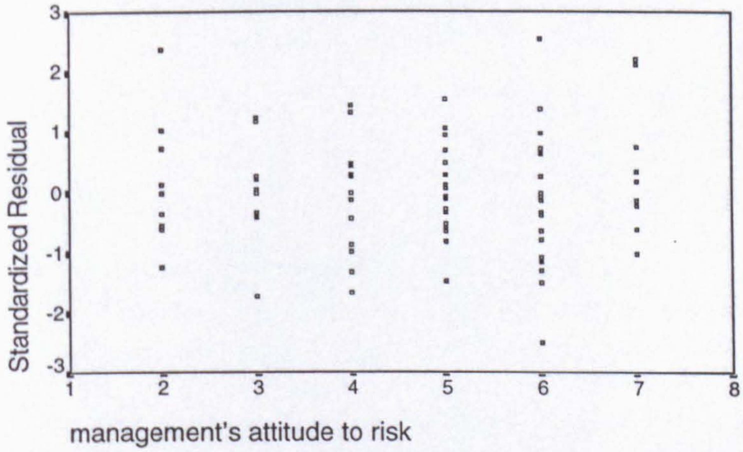

Figure A3-23B: The scatterplot of the independent variable (management's attitude to risk) against residuals (Model 7B)

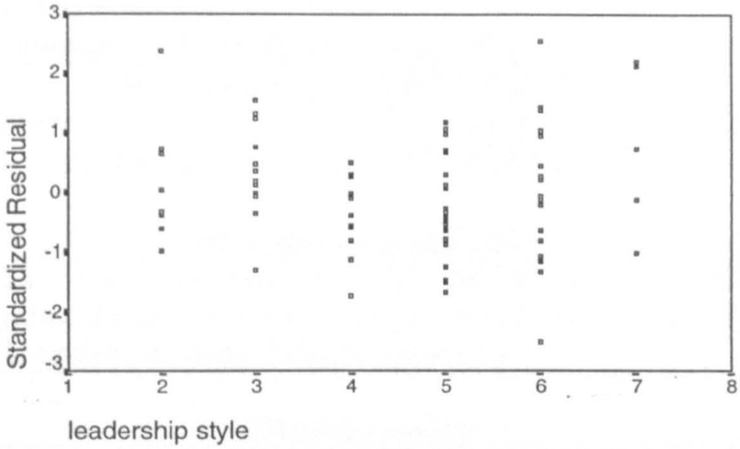

Figure A3-24B: The scatterplot of the independent variable (leadership style) against residuals (Model 7B)

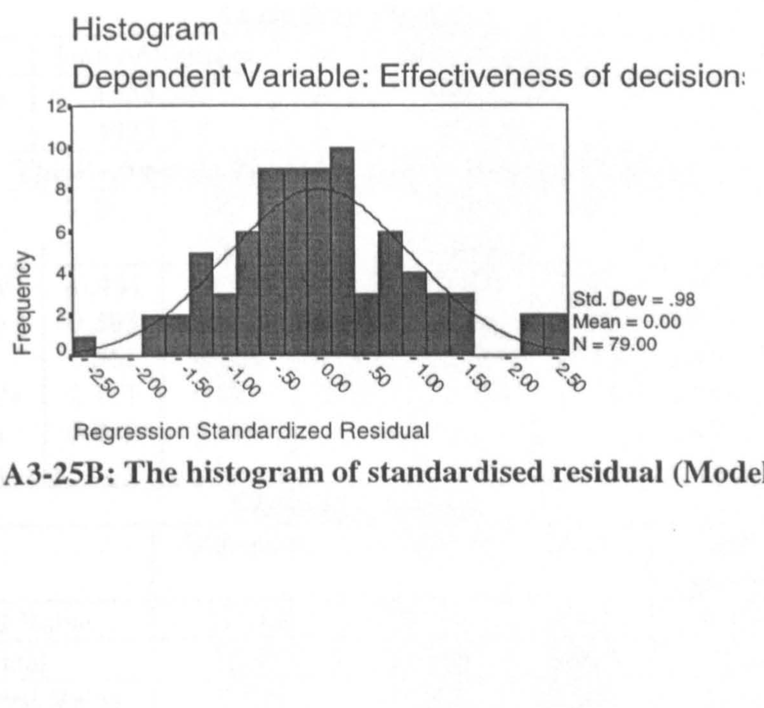

Figure A3-25B: The histogram of standardised residual (Model 7B)

Appendix 3-8A: The SPSS Result of Model 8A

Table A3.8A: Summary of SPSS Result of Model 8A

Description of the Model (Model 8A)

$$The\_Effectiveness\_of\_SIDs = \beta_0 + \beta_1(IT\_Intensity) + \beta_2(Leadship\_Style)$$
$$+\beta_3(Attitude\_to\_Risk) + \beta_4(Interaction) + \mu$$

Influential Point Detection

Figure A3-26 and A3-27 (in Appendix 3-8A) are the leverage plot and Cook's distance plot against the observations. Case 68 and 77 were found with both high leverage and substantially different influence on the fit.

Model Summary

R	R Square	Adjusted R Square	Std. Error of the Estimate
0.490	0.240	0.199	8.102

Analysis of Variance

Model 1	Sum of Squares	df	Mean Square	F	Sig. of F
Regression	1555.591	4	388.897	5.924	0.0003
Residual	4923.320	75	65.644		

The Regression Equation and Associated Statistics

Model	B	Std. Err.	β	Toler-ance	VIF	t	Sig. t
IT intensity	-0.431	0.025	-0.181	0.879	1.138	-1.687	0.0957
Leadership	0.383	0.674	0.062	0.802	1.246	0.553	0.5817
Style	1.561	0.621	0.272	0.859	1.163	2.511	0.0142
Risk Attitude	2.161	0.847	0.270	0.897	1.114	2.550	0.0128
Interaction	5.989	4.990				1.401	0.1655
(Constant)							

Residuals Analysis

	Minimum	Maximum	Mean	Std. Deviation	N
Predicted Value	11.986	33.737	24.930	4.437	80
Residual	-18.691	22.162	0.000	7.894	80
Std. Predicted Value	-2.916	1.984	0.000	1.000	80
Std. Residual	-2.307	2.735	0.000	0.974	80

Searching for Violations of Assumptions

Figures A3-28A to A3-32A (in Appendix 3-8A) are the scatterplots of the predicted scores and predictor against residuals. They shows no pattern, thereby confirming that the assumptions of linearity and homogeneity of variance have been met. The histogram of standardised residuals is shown in Figure A3-33A (in Appendix 3-8A). The grey bars show the frequencies. The superimposed curve is the ideal normal distribution for the residuals. The Lilliefors test of normality (Statistic = 0.0609, df = 80, Sign. >.2000) indicates that the distribution of residual is normal. **Therefore no violation of assumption of the regression model has been found.**

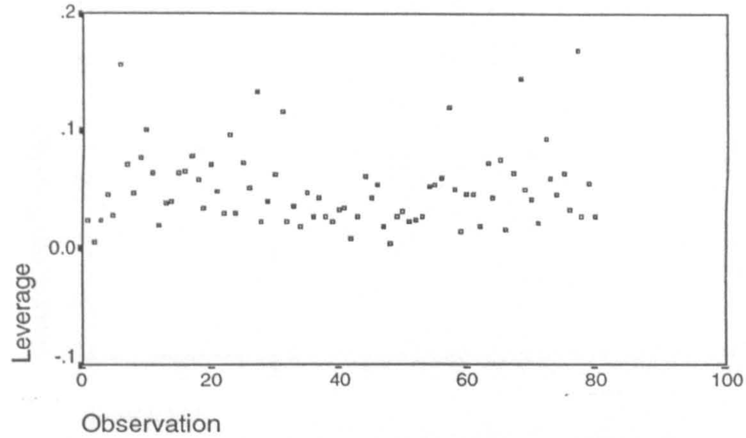

Figure A3-26: The scatterplot of the observations against leverage (Model 8A)

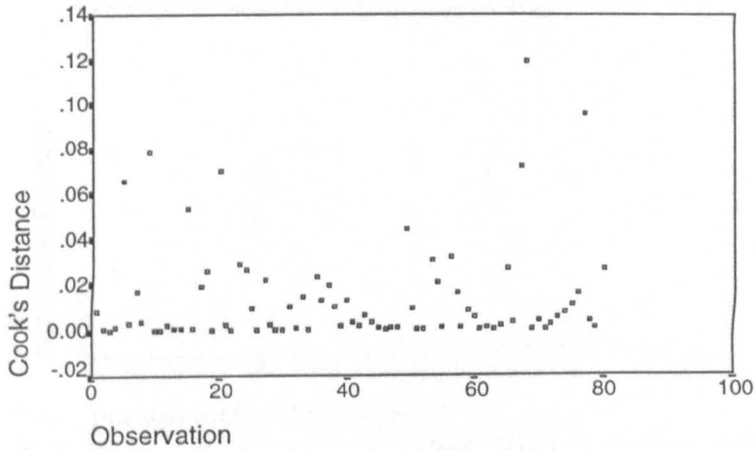

Figure A3-27: The scatterplot of the observation against Cook's distance (Model 8A)

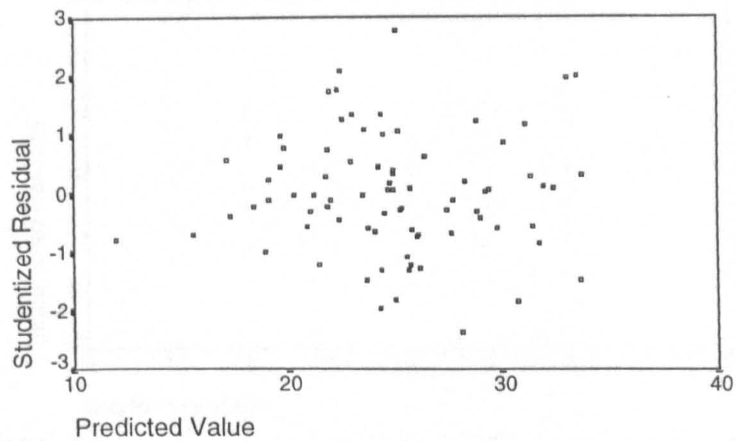

Figure A3-28A: The scatterplot of the predicted scores against residuals (Model 8A)

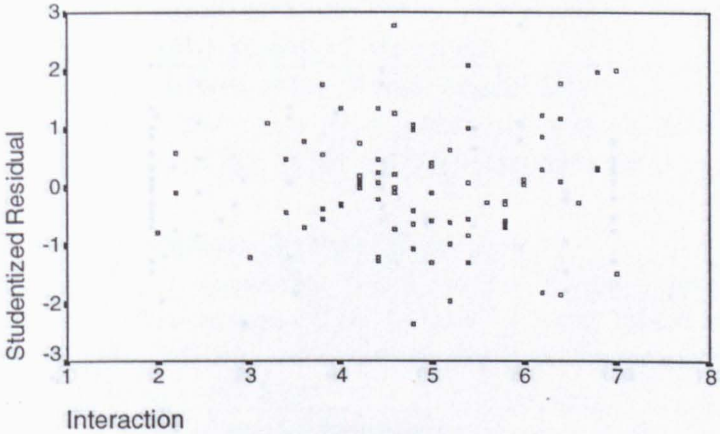

Figure A3-29A: The scatterplot of the independent variable (Interaction) against residuals (Model 8A)

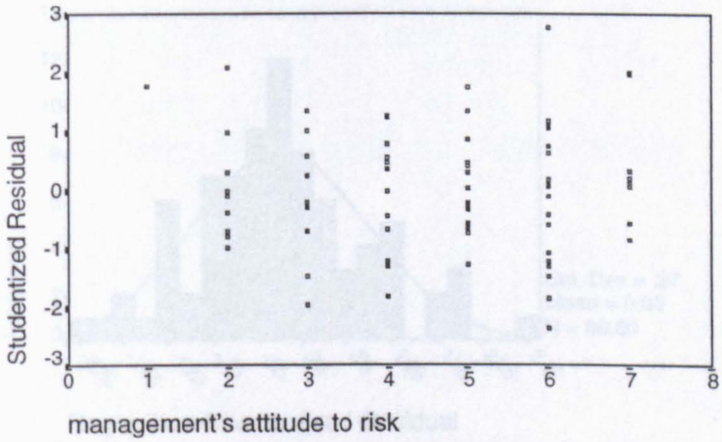

Figure A3-30A: The scatterplot of the independent variable (management's attitude to risk) against residuals (Model 8A)

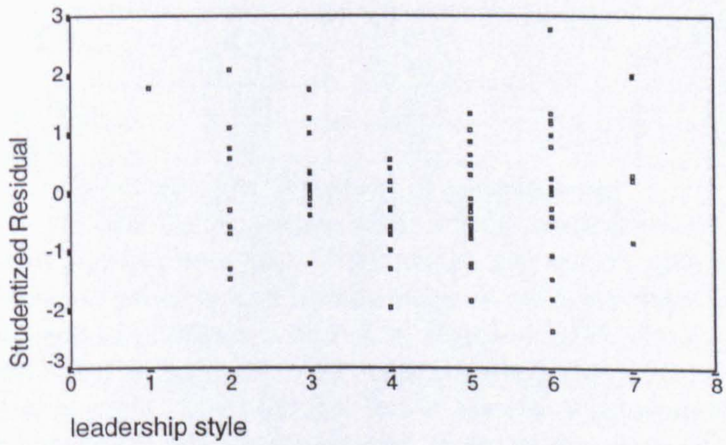

Figure A3-31A: The scatterplot of the independent variable (leadership style) against residuals (Model 8A)

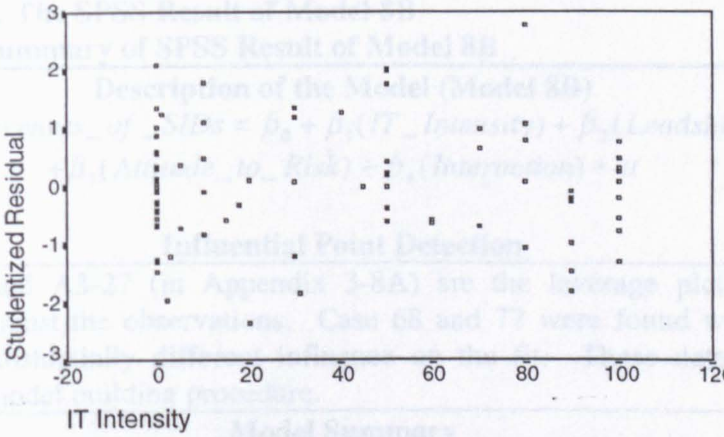

Figure A3-32A: The scatterplot of the independent variable (IT Intensity) against residuals (Model 8A)

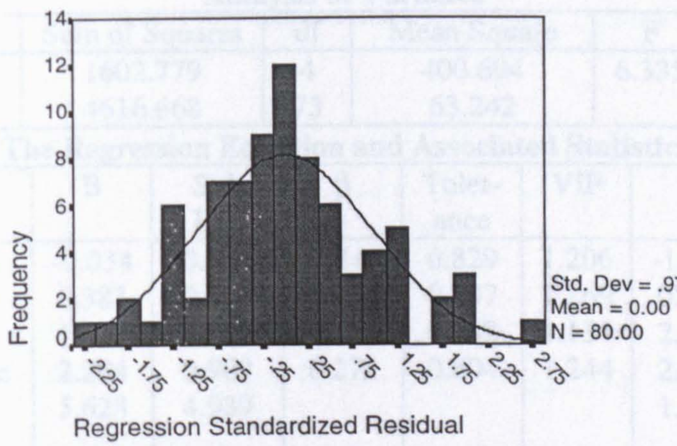

Figure A3-33A: The histogram of standardised residual (Model 8A)

Appendix 3-8B: The SPSS Result of Model 8B

Table A3.8B: Summary of SPSS Result of Model 8B

Description of the Model (Model 8B)

$$The\_Effectiveness\_of\_SIDs = \beta_0 + \beta_1(IT\_Intensity) + \beta_2(Leadship\_Style) + \beta_3(Attitude\_to\_Risk) + \beta_4(Interaction) + \mu$$

Influential Point Detection

Figure A3-26 and A3-27 (in Appendix 3-8A) are the leverage plot and Cook's distance plot against the observations. Case 68 and 77 were found with both high leverage and substantially different influence on the fit. These data points were deleted for the model building procedure.

Model Summary

R	R Square	Adjusted R Square	Std. Error of the Estimate
0.507	0.257	0.217	7.952

Analysis of Variance

Model 1	Sum of Squares	df	Mean Square	F	Sig. of F
Regression	1602.779	4	400.694	6.335	0.0002
Residual	4616.668	73	63.242		

The Regression Equation and Associated Statistics

Model	B	Std. Err.	β	Tolerance	VIF	t	Sig. t
IT intensity	-0.034	0.026	-0.146	0.829	1.206	-1.320	0.1911
Leadership	0.383	0.705	0.061	0.787	1.269	0.543	0.5885
Style	1.718	0.629	0.293	0.882	1.134	2.730	0.0079
Risk Attitude	2.204	0.909	0.272	0.804	1.244	2.424	0.0178
Interaction	5.628	4.939				1.140	0.2582
(Constant)							

Residuals Analysis

	Minimum	Maximum	Mean	Std. Deviation	N
Predicted Value	11.928	34.042	24.946	4.562	78
Residual	-18.712	21.639	0.000	7.743	78
Std. Predicted Value	-2.853	1.993	0.000	1.000	78
Std. Residual	-2.353	2.721	0.000	0.973	78

Searching for Violations of Assumptions

Figures A3-28B to A3-32B (in Appendix 3-8B) are the scatterplots of the predicted scores and predictor against residuals. They shows no pattern, thereby confirming that the assumptions of linearity and homogeneity of variance have been met. The histogram of standardised residuals is shown in Figure A3-33B (in Appendix 3-8B). The grey bars show the frequencies. The superimposed curve is the ideal normal distribution for the residuals. The Lilliefors test of normality (Statistic = 0.0770, df = 78, Sign. >.2000) indicates that the distribution of residual is normal. **Therefore no violation of assumption of the regression model has been found.**

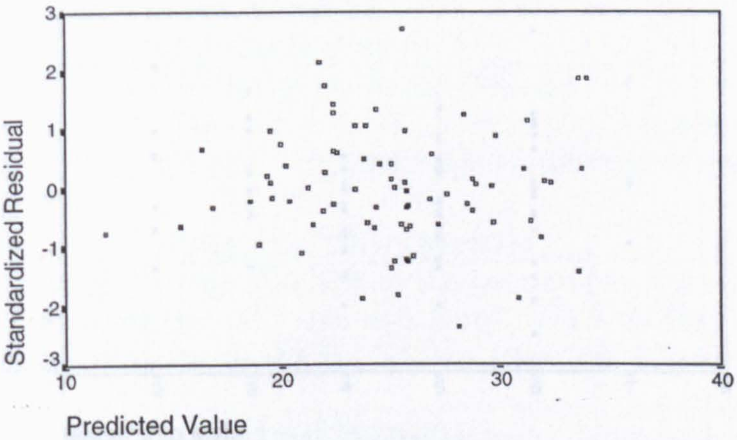

Figure A3-28B: The scatterplot of the predicted scores against residuals (Model 8B)

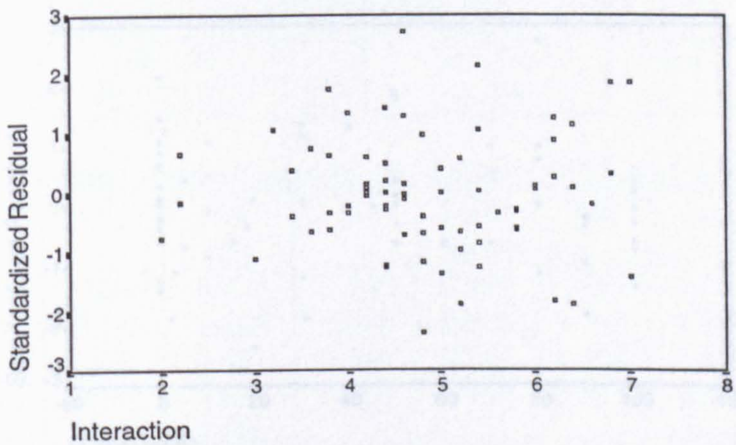

Figure A3-29B: The scatterplot of the independent variable (Interaction) against residuals (Model 8B)

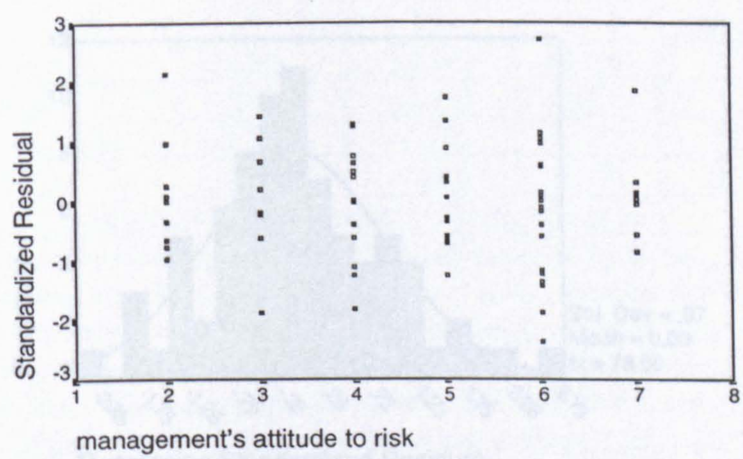

Figure A3-30B: The scatterplot of the independent variable (management's attitude to risk) against residuals (Model 8B)

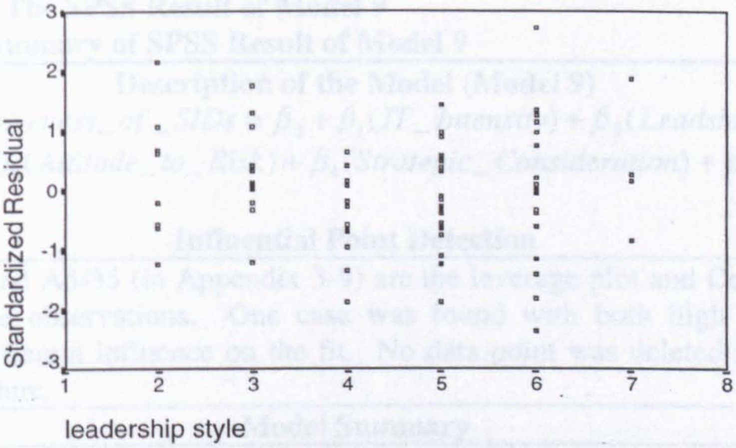

Figure A3-31B: The scatterplot of the independent variable (leadership style) against residuals (Model 8B)

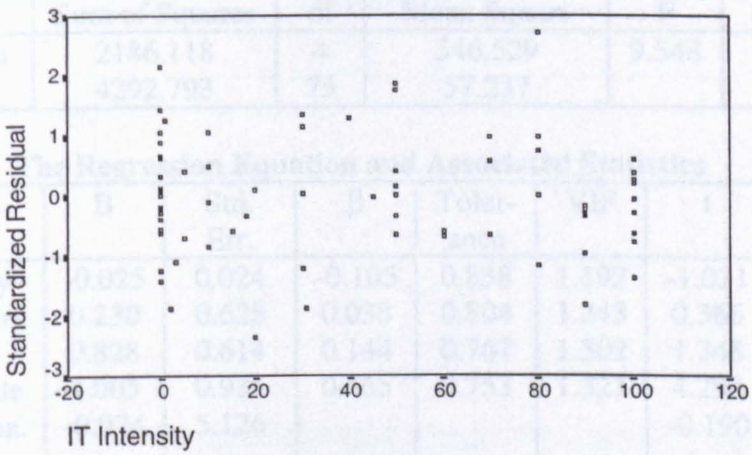

Figure A3-32B: The scatterplot of the independent variable (IT Intensity) against residuals (Model 8B)

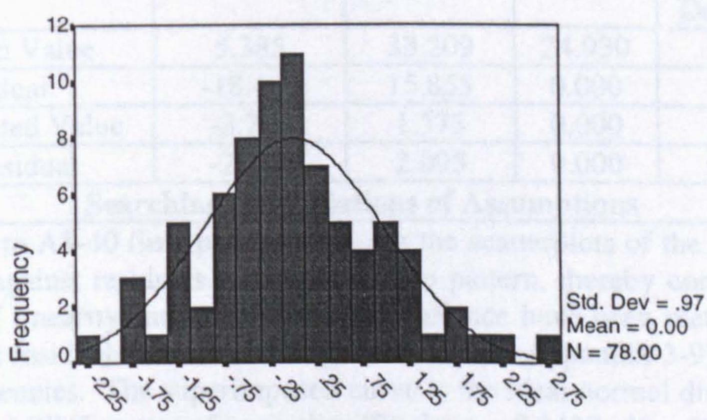

Figure A3-33B: The histogram of standardised residual (Model 8B)

Appendix 3-9: The SPSS Result of Model 9

Table A3.9: Summary of SPSS Result of Model 9

Description of the Model (Model 9)

$$The\_Effectiveness\_of\_SIDs = \beta_0 + \beta_1(IT\_Intensity) + \beta_2(Leadship\_Style) + \beta_3(Attitude\_to\_Risk) + \beta_4(Strategic\_Consideration) + \mu$$

Influential Point Detection

Figure A3-34 and A3-35 (in Appendix 3-9) are the leverage plot and Cook's distance plot against the observations. One case was found with both high leverage and substantially different influence on the fit. No data point was deleted for the model building procedure.

Model Summary

R	R Square	Adjusted R Square	Std. Error of the Estimate
0.580	0.337	0.302	7.565

Analysis of Variance

Model 1	Sum of Squares	df	Mean Square	F	Sig. of F
Regression	2186.118	4	546.529	9.548	0.0000
Residual	4292.793	75	57.237		

The Regression Equation and Associated Statistics

Model	B	Std. Err.	β	Toler-ance	VIF	t	Sig. t
IT intensity	-0.025	0.024	-0.105	0.838	1.192	-1.031	0.3057
Leadership	0.230	0.628	0.038	0.804	1.243	0.366	0.7156
Style	0.828	0.614	0.144	0.767	1.302	1.348	0.1817
Risk Attitude	4.005	0.931	0.465	0.753	1.327	4.298	0.0001
Strategic Con.	-0.974	5.126				-0.190	0.8497
(Constant)							

Residuals Analysis

	Minimum	Maximum	Mean	Std. Deviation	N
Predicted Value	5.385	33.209	24.930	5.260	80
Residual	-18.484	15.855	0.000	7.371	80
Std. Predicted Value	-3.715	1.573	0.000	1.000	80
Std. Residual	-2.443	2.095	0.000	0.974	80

Searching for Violations of Assumptions

Figures A3-36 to A3-40 (in Appendix 3-9) are the scatterplots of the predicted scores and predictor against residuals. They shows no pattern, thereby confirming that the assumptions of linearity and homogeneity of variance have been met. The histogram of standardised residuals is shown in Figure A3-41 (in Appendix 3-9). The grey bars show the frequencies. The superimposed curve is the ideal normal distribution for the residuals. The Lilliefors test of normality (Statistic = 0.0427, df = 80, Sign. >.2000) indicates that the distribution of residual is normal. **Therefore no violation of assumption of the regression model has been found.**

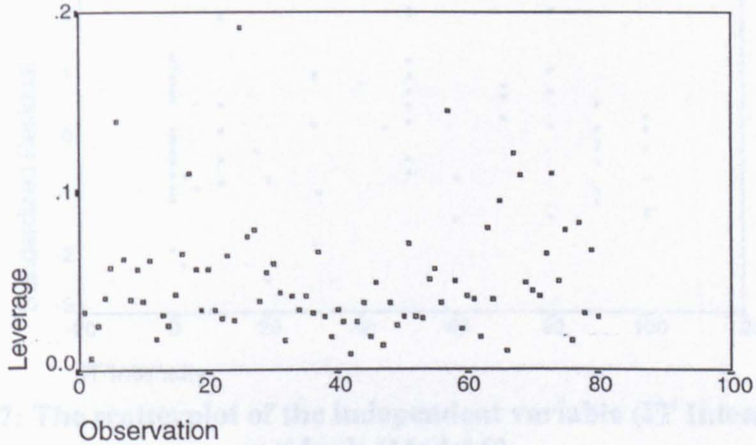

Figure A3-34: The scatterplot of the observations against leverage (Model 9)

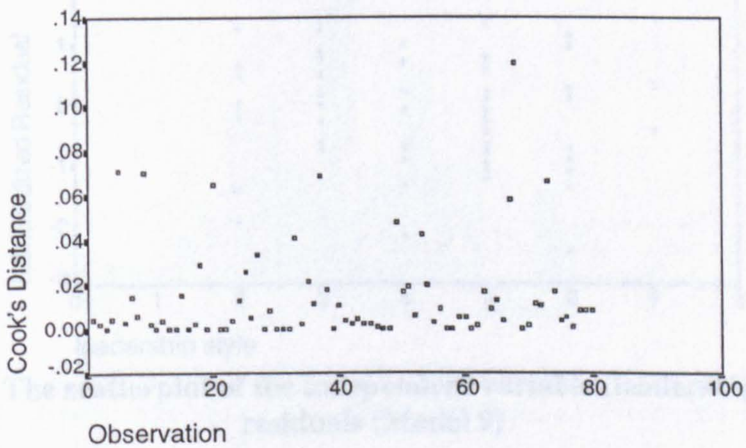

Figure A3-35: The scatterplot of the observation against Cook's distance (Model 9)

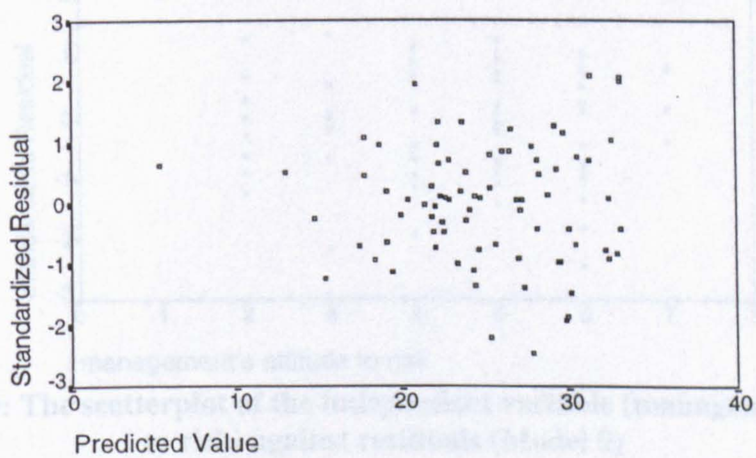

Figure A3-36: The scatterplot of the predicted scores against residuals (Model 9)

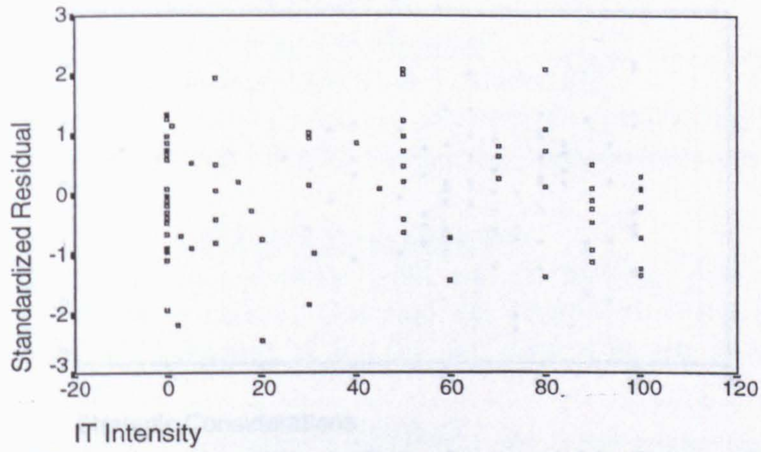

Figure A3-37: The scatterplot of the independent variable (IT Intensity) against residuals (Model 9)

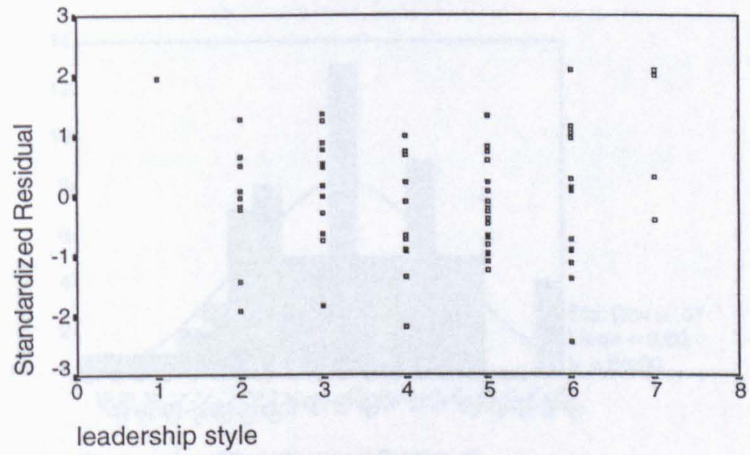

Figure A3-38: The scatterplot of the independent variable (leadership style) against residuals (Model 9)

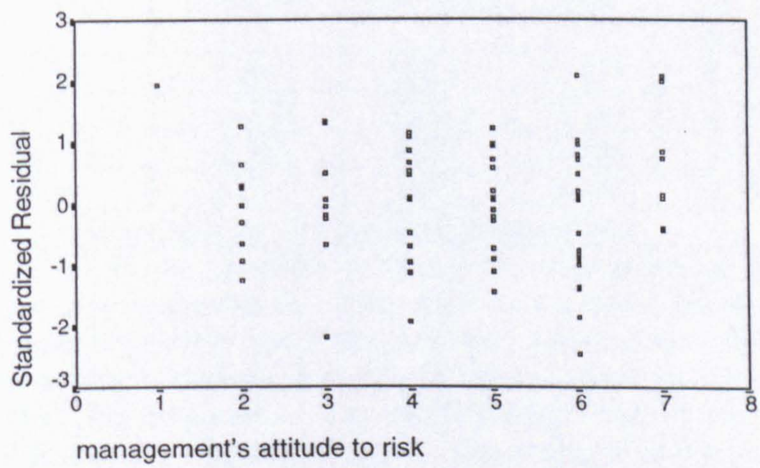

Figure A3-39: The scatterplot of the independent variable (management's attitude to risk) against residuals (Model 9)

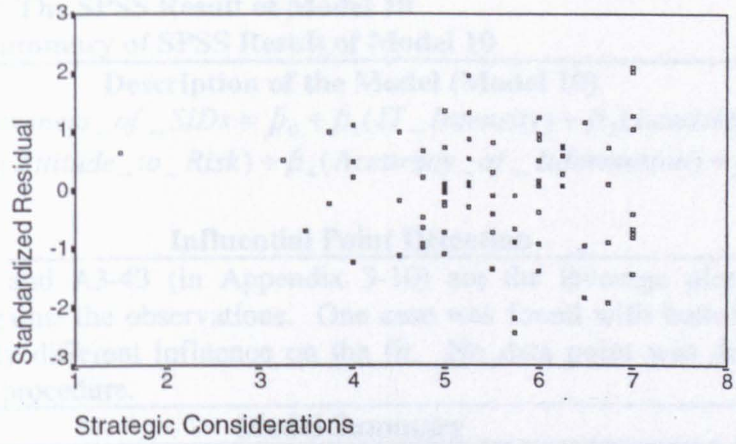

Figure A3-40: The scatterplot of the independent variable (Interaction) against residuals (Model 9)

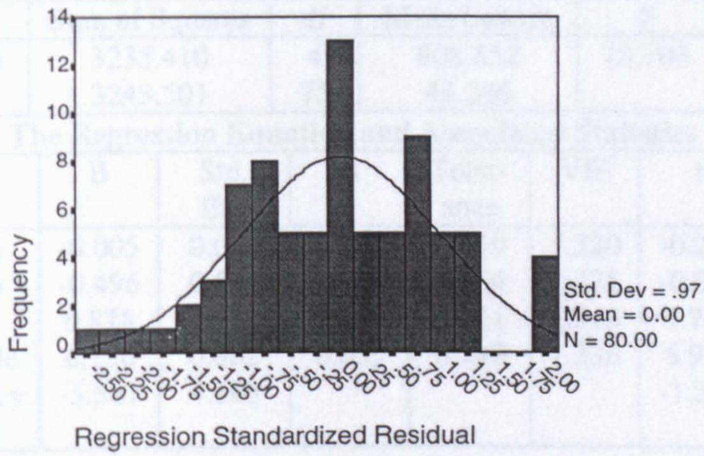

Figure A3-41: The histogram of standardised residual (Model 9)

Appendix 3-10: The SPSS Result of Model 10

Table A3.10: Summary of SPSS Result of Model 10

Description of the Model (Model 10)

$$The\_Effectiveness\_of\_SIDs = \beta_0 + \beta_1(IT\_Intensity) + \beta_2(Leadship\_Style)$$
$$+\beta_3(Attitude\_to\_Risk) + \beta_4(Accuracy\_of\_Information) + \mu$$

Influential Point Detection

Figures A3-42 and A3-43 (in Appendix 3-10) are the leverage plot and Cook's distance plot against the observations. One case was found with both high leverage and substantially different influence on the fit. No data point was deleted for the model building procedure.

Model Summary

R	R Square	Adjusted R Square	Std. Error of the Estimate
0.706	0.499	0.472	6.576

Analysis of Variance

Model 1	Sum of Squares	df	Mean Square	F	Sig. of F
Regression	3235.410	4	808.852	18.703	0.0000
Residual	3243.501	75	43.246		

The Regression Equation and Associated Statistics

Model	B	Std. Err.	β	Tolerance	VIF	t	Sig. t
IT intensity	-0.005	0.021	-0.024	0.819	1.220	-0.274	0.7851
Leadership	-0.496	0.564	-0.082	0.754	1.325	-0.880	0.3819
Style	0.878	0.516	0.153	0.821	1.218	1.702	0.0930
Risk Attitude	6.156	0.882	0.659	0.748	1.336	6.979	0.0000
Info Accuracy	-5.581	4.183				-1.334	0.1863
(Constant)							

Residuals Analysis

	Minimum	Maximum	Mean	Std. Deviation	N
Predicted Value	5.965	39.898	24.930	6.399	80
Residual	-15.329	20.214	0.000	6.407	80
Std. Predicted Value	-2.963	2.338	0.000	1.000	80
Std. Residual	-2.331	3.073	0.000	0.974	80

Searching for Violations of Assumptions

Figures A3-44 to A3-48 (in Appendix 3-10) are the scatterplots of the predicted scores and predictor against residuals. They shows no pattern, thereby confirming that the assumptions of linearity and homogeneity of variance have been met. The histogram of standardised residuals is shown in Figure A3-49 (in Appendix 3-10). The grey bars show the frequencies. The superimposed curve is the ideal normal distribution for the residuals. The Lilliefors test of normality (Statistic = 0.0413, df = 80, Sign. >.2000) indicates that the distribution of residual is normal. **Therefore no violation of assumption of the regression model has been found.**

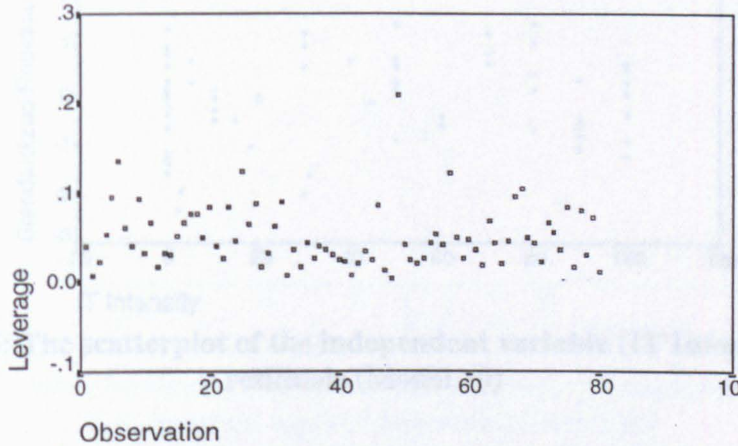

Figure A3-42: The scatterplot of the observations against leverage(Model 10)

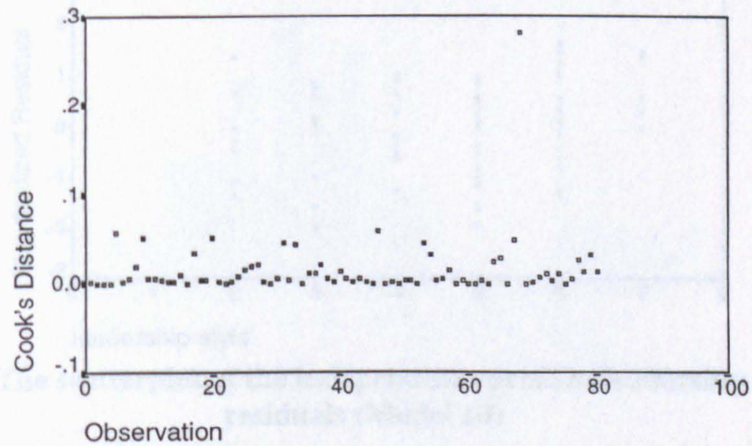

Figure A3-43: The scatterplot of the observation against Cook's distance (Model 10)

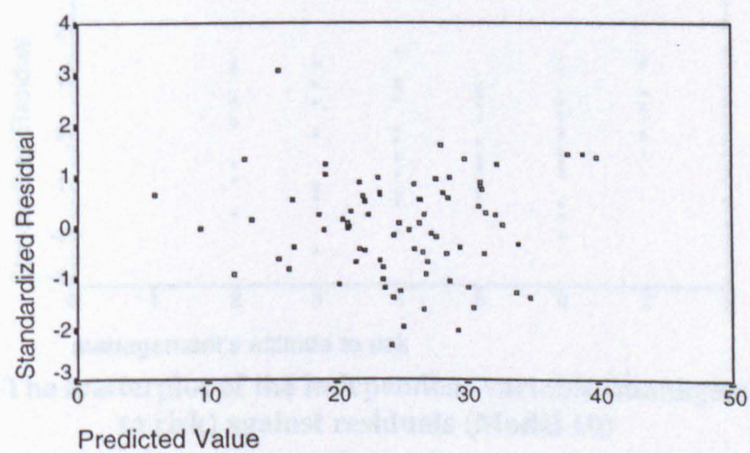

Figure A3-44: The scatterplot of the predicted scores against residuals (Model 10)

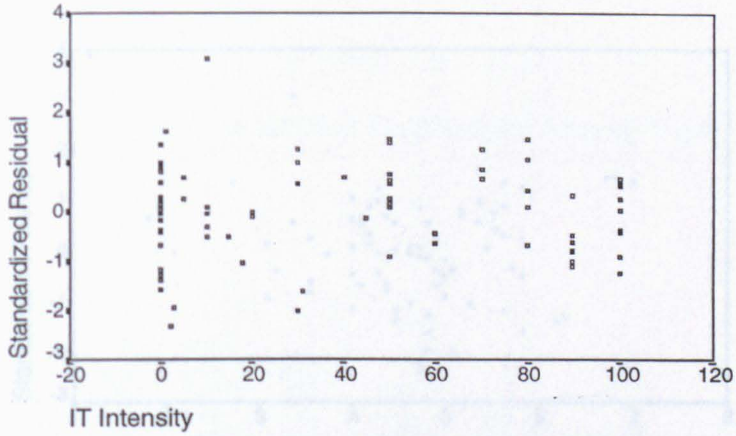

Figure A3-45: The scatterplot of the independent variable (IT Intensity) against residuals (Model 10)

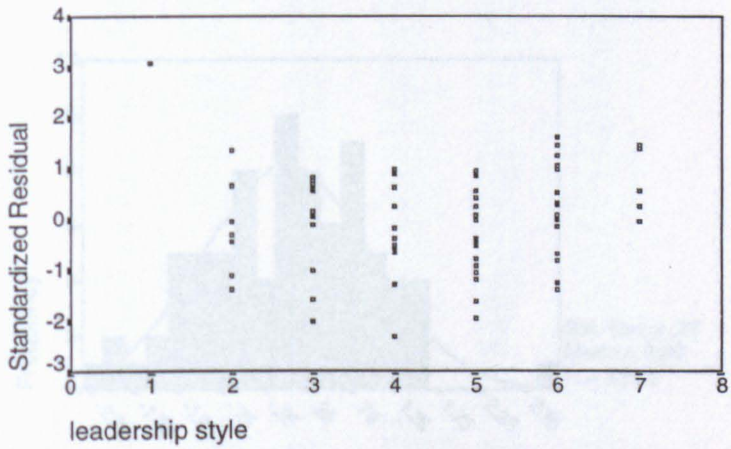

Figure A3-46: The scatterplot of the independent variable (leadership style) against residuals (Model 10)

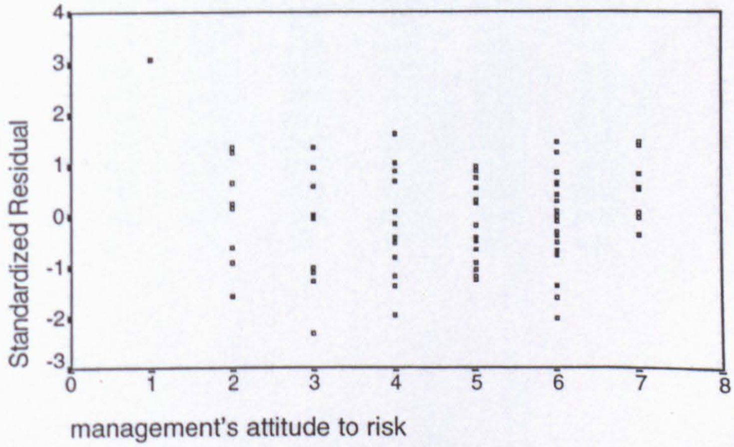

Figure A3-47: The scatterplot of the independent variable (management's attitude to risk) against residuals (Model 10)

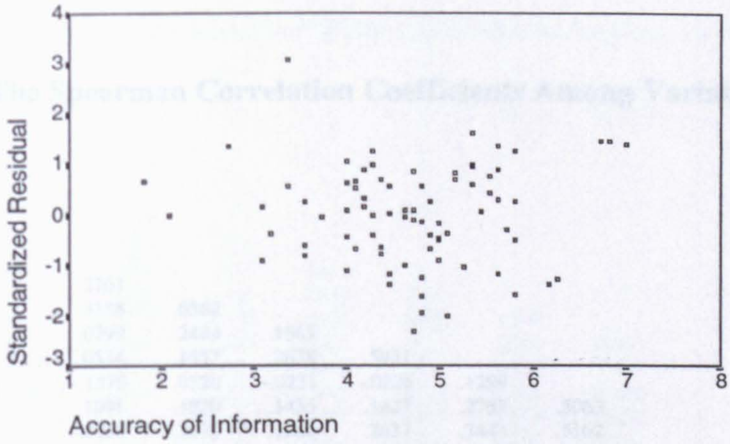

Figure A3-48: The scatterplot of the independent variable (Accuracy of Information) against residuals (Model 10)

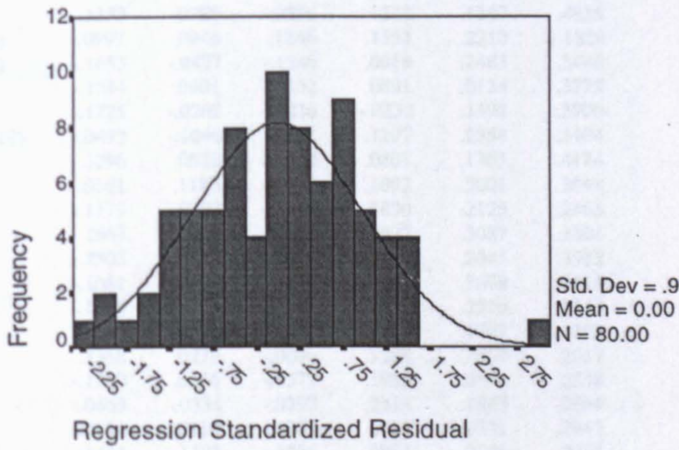

Figure A3-49: The histogram of standardised residual (Model 10)

Appendix 4:

Appendix 4-1: The Spearman Correlation Coefficients Among Variables

Delay (1)						
Gestation time (2)	.2761					
Process time (3)	.3158	.6562				
External organisation (4)	.0799	.2484	.1663			
Internal department (5)	.0534	.1457	.2638	.5931		
Quality of interaction (6)	-.1575	.0520	-.0231	-.0226	.1299	
Informal interaction (7)	.1091	.1820	.1436	.1627	.2767	.5063
Formal interaction (8)	-.1261	.2890	.1268	.2637	.3443	.5162
Scope of involvement (9)	-.0983	.2799	.1475	.3731	.4225	.4419
Disagreement (10)	.3582	.2139	.1932	.1879	.0998	-.1069
Negotiation (11)	.0781	.0304	.0717	.3483	.1340	.0401
Authority (12)	-.0265	.0472	-.1289	-.0879	-.0183	.3411
Contention (13)	.1059	-.0774	.0546	.2110	.2250	-.3567
Imbalance (14)	-.1352	.0286	-.0856	.1572	.1387	.4955
Pressure of influence (15)	.0997	.0944	.1246	.1552	.2210	-.1829
Competitive position (16)	-.1653	-.0427	-.1246	.0618	.2483	.3446
Market growth rate (17)	-.1544	.0401	-.0152	.0881	.0134	.3775
Performance (18)	-.1725	-.0269	-.0216	-.0232	.1498	.3900
Consistency of strategy (19)	-.0492	-.1046	.0332	.1297	.2358	.2404
ARR (20)	-.1296	.0528	-.0642	.0807	.1363	.4174
Payback (21)	-.0381	.1183	-.0326	.1093	.2001	.3048
Cost of Investment (22)	-.1173	-.0592	-.0475	.1830	.2125	.2465
Cash flow (23)	-.2667	.0088	-.0398	.1692	.3087	.3501
Cost of Capital (24)	-.2505	.0489	.0626	.0507	.2041	.3982
Intangible benefit (25)	-.1061	.0923	.0223	.3135	.3678	.1911
Intangible cost (26)	-.1976	-.0259	.0252	.1006	.2516	.3140
NPV (27)	-.2095	.2593	.0521	.1962	.1707	.4229
Productivity Index (28)	-.1858	.0279	-.0090	.1298	.2060	.2017
Profit (29)	-.1350	.0566	-.0577	.1955	.0754	.2548
Duration (30)	-.0663	-.0334	-.0297	.2318	.1690	.0866
Precursiveness (31)	-.0234	.0210	-.1287	.1389	.1771	.2942
Urgency (32)	-.1464	-.1123	-.1566	.0553	.2655	.2993
Seriousness (33)	-.1298	.0290	-.0111	.0290	.1373	.3313
Radicalism (34)	-.2676	-.1530	-.1269	.3309	.1807	.1904
Openness (35)	.0673	.1272	.0796	.2329	.0993	.1273
Endurance (36)	-.2347	-.0206	.0355	-.1089	.0271	.4343
Economic state (37)	-.3263	-.1499	-.1009	-.0474	.1283	.1764
Financial state (38)	-.2461	.1392	.0880	.0430	.1327	.1148
Market situation (39)	.0667	.3044	.1583	.3165	.2937	-.0825
Competitive climate (40)	-.1712	.2589	.0257	.2111	.1215	.0409
Attitude to risk (41)	-.2677	-.1328	-.2249	.0486	-.0768	.2684
Leadership style (42)	-.1362	-.0842	-.0299	-.0424	.0903	.1606
Rarity (43)	.0775	.0036	.0479	-.2123	-.0298	-.0862
Learning (44)	-.3974	.0439	-.1144	.0923	-.0103	.3359
	(1)	(2)	(3)	(4)	(5)	(6)

Informal interaction (7)						
Formal interaction (8)	.4429					
Scope of Involvement (9)	.5172	.6147				
Disagreement (10)	.2279	.0735	.0130			
Negotiation (11)	.2474	.3677	.2710	.4011		
Authority (12)	.2386	.2063	.3387	-.0348	.1254	
Contention (13)	-.1807	-.0931	.0424	.2030	.0385	-.1321
Imbalance (14)	.2640	.2072	.1166	-.0250	-.0285	.0269
Pressure of influence (15)	.0086	-.0449	-.0170	.0935	-.0831	-.1034
Competitive position (16)	.1530	.3139	.1726	-.0610	-.0841	.1837
Market growth rate (17)	.1839	.2891	.0924	-.0335	.0939	.3027
Performance (18)	.2568	.2735	.2767	.0019	-.0113	.3049
Consistency of strategy (19)	.2805	.3213	.1949	-.0640	.0721	.1397
ARR (20)	.0690	.2807	.1193	-.1797	-.1009	.1837
Payback (21)	.0817	.3655	.2006	-.2405	-.0387	.1608
Cost of investment (22)	.0616	.3027	.1020	-.1133	.0827	.0780
Cash flow (23)	.1692	.2213	.1753	-.1230	.0052	.0388
Cost of Capital (24)	.1487	.2559	.1193	-.2562	-.0817	.1075
Intangible benefit (25)	.1402	.3792	.2522	-.0676	-.0125	.1487
Intangible cost (26)	.1815	.3106	.2135	-.1548	-.0195	-.0681
NPV (27)	.2265	.4365	.3401	-.1600	-.0004	.1853
Productivity index (28)	.0824	.2313	.2461	-.4063	-.1452	.0327
Profit (29)	.1293	.2352	.1466	-.0860	-.0123	.1018
TIME (30)	.0345	.2284	.0712	-.1321	.0710	-.0953
Precursiveness (31)	.2020	.3781	.2526	.0683	.1202	.2710
Urgency (32)	.0950	.3462	.2607	-.0965	.0324	.2102
Seriousness (33)	.1979	.4003	.2310	.0998	.1754	.2444
Radicalism (34)	.1177	.3003	.2076	-.0791	.3275	.0823
Opnness (35)	.0150	.1720	.1259	-.0209	.0613	.0287
Endurance (36)	.1172	.4011	.1339	-.1265	.0204	.2740
Economic state (37)	.1294	.0652	.1320	-.1638	-.1153	.0634
Financial state (38)	-.0597	.0580	.0417	-.0022	-.0939	.0804
Market situation (39)	-.1631	.1124	.1970	.0476	.0892	-.0881
Competitive Climate (40)	-.1570	.1059	.2228	-.1025	-.0954	.0988
Attitude to risk (41)	.0326	.1145	.0780	-.1439	.0464	.1375
Leadership style (42)	.1240	.0946	.1730	-.0206	.1313	-.0524
Rarity (43)	-.1611	-.0456	-.0645	-.2125	-.2770	.0174
Learning (44)	.1565	.4039	.3654	-.0171	.0571	.2655
	(7)	(8)	(9)	(10)	(11)	(12)

Contention (13)						
Imbalance (14)	-.1026					
Pressure of influence (15)	.4288	.2911				
Competitive position (16)	.0143	.3507	-.0182			
Market rate of growth (17)	-.1884	.3688	-.0651	.6047		
Performance (18)	-.0824	.2673	.0225	.6328	.5541	
Consistency of strategy (19)	-.0899	.2172	-.0064	.4485	.5497	.5303
ARR (20)	-.2562	.3978	-.0842	.4197	.4764	.3571
Payback (21)	-.1123	.2646	-.0804	.2760	.2270	.1409
Cost of investment (22)	-.1530	.2131	-.0532	.3003	.2488	.2190
Cash flow (23)	-.1032	.2195	-.0555	.4310	.3419	.2976
Cost of capital (24)	-.2915	.2738	.0373	.3468	.4246	.3760
Intangible benefit (25)	.0624	.3047	.1984	.5113	.3965	.4219
Intangible cost (26)	-.1673	.2512	-.0085	.3460	.2866	.3601
NPV (27)	-.1086	.2148	-.0612	.3489	.4412	.3243
Productivity index (28)	.0104	.2301	.0757	.2900	.2238	.2547
Profit (29)	.0358	.3553	.1729	.1981	.3757	.2522
Duration (30)	.0180	.1915	-.0639	.4126	.3752	.2063
Precursiveness (31)	-.0017	.3509	.0383	.5041	.5352	.4683
Urgency (32)	-.0391	.1128	.0393	.4659	.3066	.3886
Seriousness (33)	.0708	.3672	.1740	.2818	.3414	.4100
Radicalism (34)	.1221	.2795	.1640	.1520	.2549	.1411
Openness (35)	-.0561	.1146	.0563	.2094	.2997	.1442
Endurance (36)	-.2666	.4046	-.0526	.3608	.4309	.4328
Economic state (37)	-.0714	.0208	.0731	.1553	-.1116	.0822
Financial state (38)	-.1194	.0549	-.0198	.0390	-.0239	.0584
Market situation (39)	.0002	-.0029	-.0247	.1691	.1074	.0106
Competitive climate (40)	-.1606	.0754	-.0568	.1706	.1346	.2553
Attitude to risk (41)	-.1270	.2623	.0532	.2110	.3228	.3976
Leadership style (42)	-.0135	.2084	-.0462	.0938	.1520	.1946
Rarity (43)	-.1068	-.1784	-.1013	-.1589	-.3677	-.0808
Learning (44)	-.1120	.1200	-.2424	.2722	.4576	.4176
	(13)	(14)	(15)	(16)	(17)	(18)

Consistency of strategy (19)						
ARR (20)	.4124					
Payback (21)	.2268	.6826				
Cost of investment (22)	.3250	.3592	.4730			
Cash flow (23)	.2481	.2833	.1985	.3789		
Cost of capital (24)	.3737	.4296	.3598	.5881	.6127	
Intangible benefit (25)	.3820	.4431	.4333	.4261	.3372	.4827
Intangible cost (26)	.3011	.4713	.3897	.3120	.3782	.3923
NPV (27)	.1454	.4715	.4228	.2669	.4395	.4551
Productivity index (28)	.2953	.4273	.4498	.2994	.3204	.4559
Profit (29)	.3111	.6539	.4243	.2466	.1664	.4301
Duration (30)	.4288	.3433	.4146	.5012	.3325	.3580
Precursiveness (31)	.4345	.3450	.1546	.0268	.2610	.1888
Urgency (32)	.2821	.2928	.2665	.2640	.3219	.3462
Seriousness (33)	.3240	.1989	.1476	.1010	.1309	.1503
Radicalism (34)	.2793	.2218	.2063	.1957	.2575	.1999
Openness (35)	.2775	.2347	.0920	.2139	.2335	.2619
Endurance (36)	.3178	.3663	.2001	.1881	.1684	.3087
Economic state (37)	.1207	.1847	.1022	.2195	.2414	.2500
Financial state (38)	-.1055	.3074	.2009	.3421	.3052 .	.2946
Market situation (39)	.0352	.2229	.1862	.1879	.1531	.1021
Competitive climate (40)	.1976	.2188	.1431	.1909	.1619	.2384
Attitude to risk (41)	.3383	.3691	.1485	.0724	.0753	.2219
Leadership style (42)	.2186	.2738	.2163	.0673	.1719	.1684
Rarity (43)	-.0158	-.0976	.1612	.0722	-.1819	-.0755
Learning (44)	.2269	.2788	.2135	.0932	.2185	.1969
	(19)	(20)	(21)	(22)	(23)	(24)

Intangible benefit (25)						
Intangible cost (26)	.6080					
NPV (27)	.4357	.4195				
Productivity index (28)	.4406	.3484	.4764			
Profit (29)	.4445	.3400	.4115	.4640		
Duration (30)	.4302	.4133	.3645	.4456	.2850	
Precursiveness (31)	.3046	.2182	.3284	.2086	.2688	.1733
Urgency (32)	.3939	.2495	.3903	.2970	.2722	.2386
Seriousness (33)	.3134	.1255	.2308	.2238	.2465	.1174
Radicalism (34)	.2408	.1844	.3168	.3485	.3529	.3713
Openness (35)	.2233	-.0197	.3366	.2142	.2931	.2022
Endurance (36)	.3230	.2746	.3249	.2018	.2561	.1624
Economic state (37)	.1744	.2897	.1864	.2739	.0462	.1228
Financial state (38)	.1059	.1835	.3108	-.0351	.1252	.0105
Market situation (39)	.1705	.2224	.1863	.1050	.0846	.2096
Competitive climate (40)	.2431	.2489	.2908	.1402	.1649	.2036
Attitude to risk (41)	.2607	.1788	.2853	.1622	.4101	.0161
Leadership style (42)	.1216	.2679	.1366	.1263	.1902	.1767
Rarity (43)	-.2494	-.3455	-.1813	-.0908	-.2529	-.1320
Learning (44)	.1942	.1889	.4161	.2703	.1504	.2592
	(25)	(26)	(27)	(28)	(29)	(30)

Precursiveness (31)						
Urgency (32)	.4713					
Seriousness (33)	.6207	.4155				
Radicalism (34)	.3712	.4103	.4648			
Openness (35)	.2551	.2886	.1233	.1151		
Endurance (36)	.5385	.4154	.4684	.2809	.1178	
Economic state (37)	.0774	.0496	.1560	.0983	-.0708	.1042
Financial state (38)	-.0611	.0083	-.1399	-.0648	.1369	.0988
Market situation (39)	.0615	.0090	-.1102	.0526	.0194	-.0548
Competitive climate (40)	.1888	.1419	.0890	.0516	.1835	.2233
Attitude to risk (41)	.3662	.3492	.3433	.4009	.2254	.3600
Leadership style (42)	.0894	.0487	.1242	.2284	-.1752	.0968
Rarity (43)	-.3133	-.1693	-.1305	-.3303	-.0010	-.0408
Learning (44)	.3221	.1330	.2789	.2485	.0705	.2515
	(31)	(32)	(33)	(34)	(35)	(36)

Economic state (37)							
Financial state (38)	.4463						
Market situation (39)	.0731	.3621					
Competitive climate (40)	.1904	.3867	.5820				
Attitude to risk (41)	.1916	.1147	.0046	.2965			
Leadership style (42)	.1822	.1359	.1838	-.0001	.3258		
Rarity (43)	-.0504	-.0433	-.2129	-.0422	-.1940	-.1618	
Learning (44)	.0523	.0206	.0071	.1938	.1782	-.0537	-.1202
	(37)	(38)	(39)	(40)	.. (41)	(42)	(43)

Appendix 4-2: The scatterplots of leverage and Cook's distance for model 11

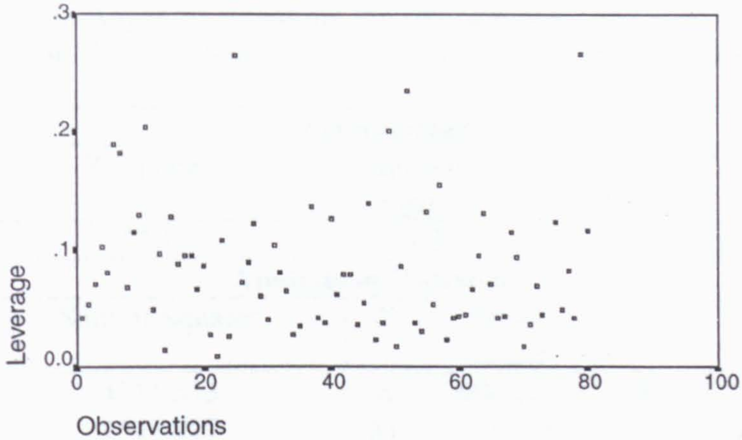

Figure A4-1: The scatterplot of the observations against leverage

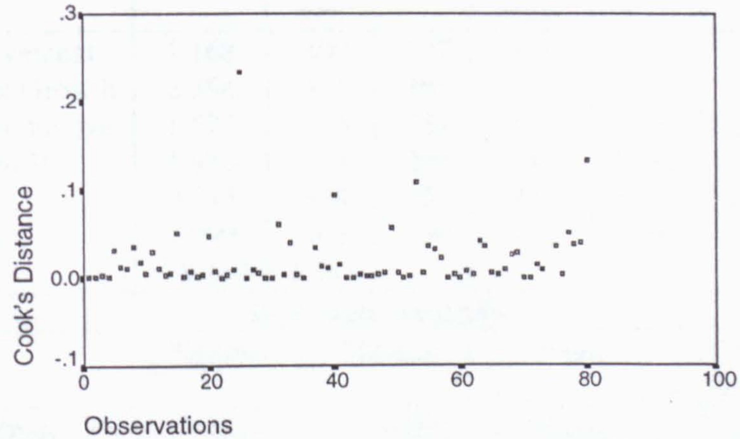

Figure A4-2: The scatterplot of the observation against Cook's distance

Appendix 4-3A: Regression Analysis of Model 11A

Table A4.2A: The Summary of SPSS Result of Model 11A (Full Data Set)

Influential Point Detection

Figure A4-1 and A4-2 (in Appendix 4-2A) are the leverage plot and Cook's distance plot against the observations. Case 25 was found with both high leverage and substantially different influence on the fit.

Model Summary

R	R Square	Adjusted R Square	Std. Error of the Estimate
.848	.720	.692	5.117

Analysis of Variance

Model 1	Sum of Squares	df	Mean Square	F	Sig. of F
Regression	4111.613	6	658.269	26.162	.0000
Residual	1597.777	61	26.193		

The Regression Equation and Associated Statistics

Model	B	Std. Err.	β	Toler-ance	VIF	t	Sig. t
1. Scope of Involvement	1.168	.400	.207	.906	1.103	2.195	.0050
2. Related Market Growth	2.354	.461	.383	.811	1.232	5.102	.0000
3. Certainty of Productive	1.573	.525	.254	.636	1.571	2.995	.0040
4. Certainty of Profit	1.836	.574	.269	.645	1.548	3.195	.0022
5. Radicalism	0.993	.474	.157	.811	1.232	2.102	.0397
6. Financial State	1.099	.405	.190	.926	1.080	2.710	.0087
7. (Constant)	-18.710	3.983				-4.697	.0000

Residuals Analysis

	Minimum	Maximum	Mean	Std. Deviation	N
Predicted Value	1.216	44.469	25.682	7.717	78
Residual	-21.945	9.459	-.651	5.629	78
Std. Predicted Value	-3.059	2.462	0.064	0.985	78
Std. Residual	-4.287	1.848	-0.127	1.100	78

Searching for Violations of Assumptions

Figures A4-3A to A4-9A (in Appendix 4-2A) are the scatterplots of the predicted scores and predictor against residuals. They shows no pattern, thereby confirming that the assumptions of linearity and homogeneity of variance have been met. The histogram of standardised residual is shown in Figure A4-10A (in Appendix 4-2A). The grey bars show the frequencies. The superimposed curve is the ideal normal distribution for the residuals. The Lilliefors test of normality (Statistic = 0.0711, df = 78, Sign. >.2000) indicates that the distribution of residual is normal. The White's test (F = 0.852 Sign. F = 0.597) indicates that the errors are both homoskedastic and independent and that linear specification of the model is correct. **Therefore no violation of assumption of the regression model has been found.**

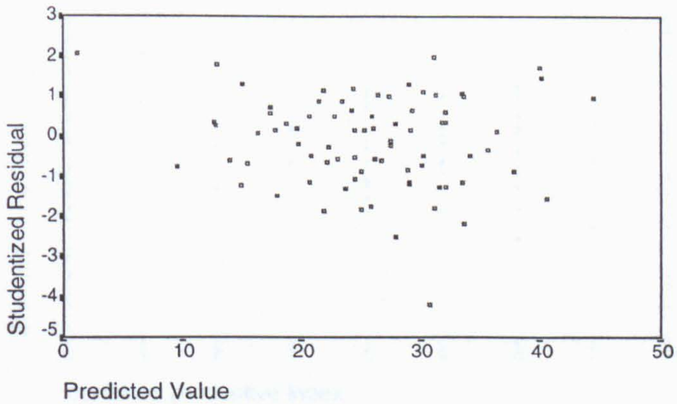

Figure A4-3A: The scatterplot of the Predicted variable of against residuals (Model 11A)

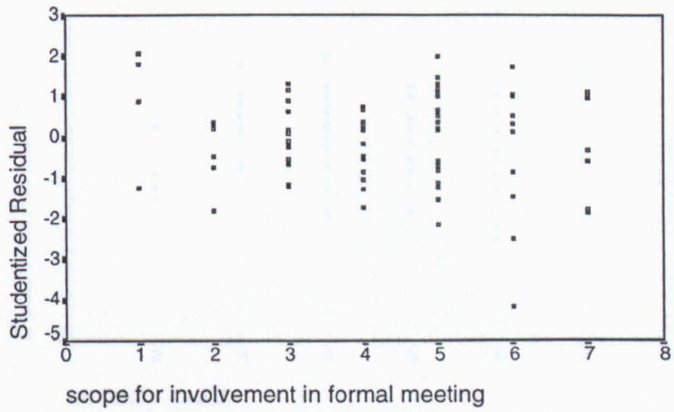

Figure A4-4A: The scatterplot of the independent variable (Scope of Involvement) against residuals (Model 11A)

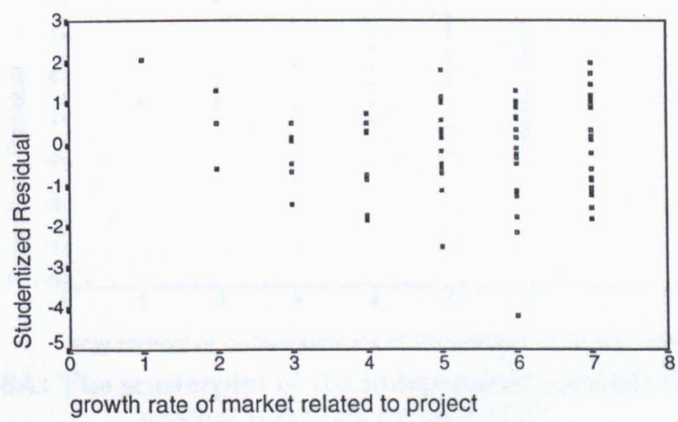

Figure A4-5A: The scatterplot of the independent variable (Growth Rate of Market) against residuals (Model 11A)

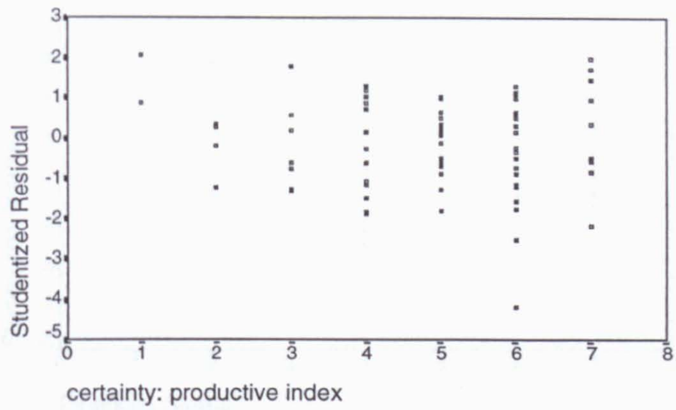

Figure A4-6A: The scatterplot of the independent (Certainty of Productivity) against residuals (Model 11A)

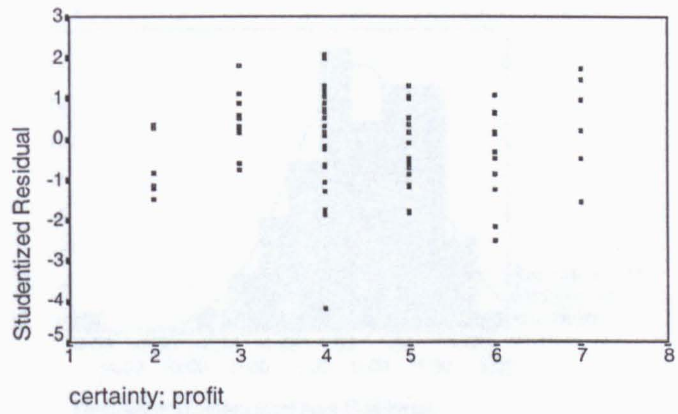

Figure A4-7A: The scatterplot of the independent variable (Certainty of Profit) against residuals (Model 11A)

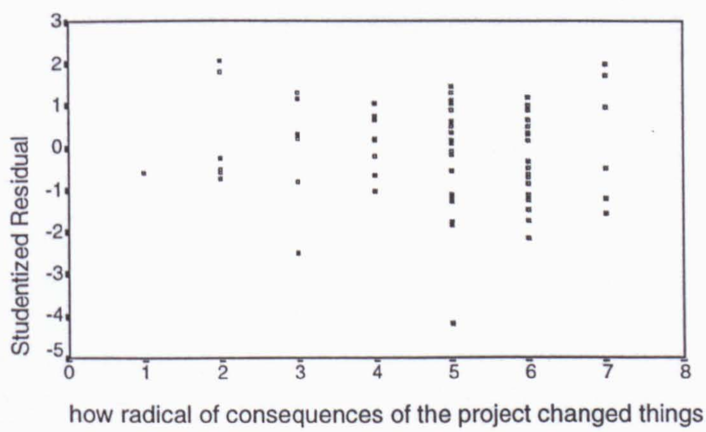

Figure A4-8A: The scatterplot of the independent variable (Radicalism) against residuals (Model 11A)

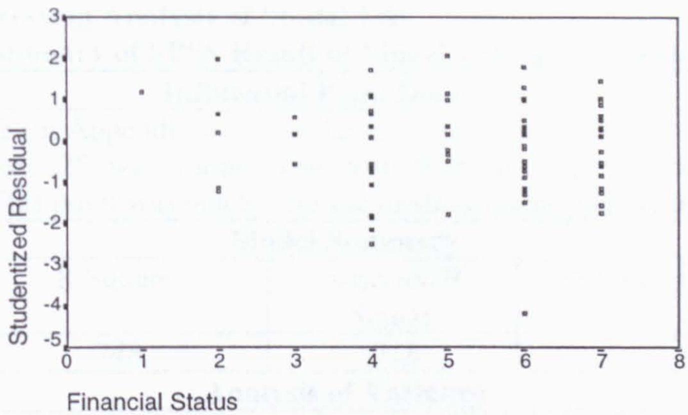

Figure A4-9A: The scatterplot of the independent variable (Financial State) against residuals (Model 11A)

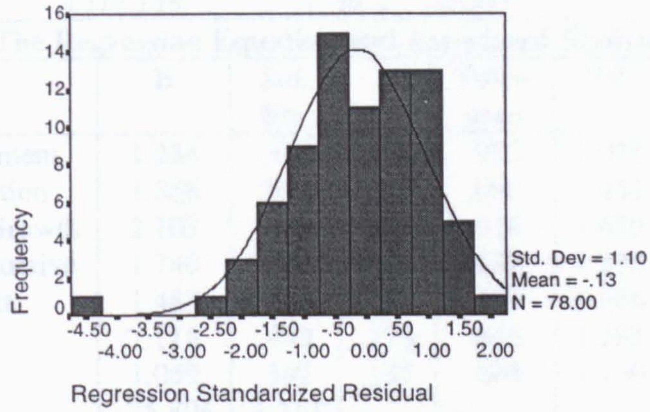

Figure A4-10A: The histogram of standardised residual (Model 11A)

Appendix 4-3B: Regression Analysis of Model 11B

Table A4.2B: The Summary of SPSS Result of Model 11B (Reduced Data Set)

Influential Point Detection

Figure A4-1 and A4-2 (in Appendix 4-2) are the leverage plot and Cook's distance plot against the observations. Case 25 was found with both high leverage and substantially different influence on the fit. This point was deleted for the model building procedure.

Model Summary

R	R Square	Adjusted R Square	Std. Error of the Estimate
.865	.748	.718	4.831

Analysis of Variance

Model 1	Sum of Squares	df	Mean Square	F	Sig. of F
Regression	4103.517	7	586.516	25.115	.0000
Residual	1377.119	59	23.341		

The Regression Equation and Associated Statistics

Model	B	Std. Err.	β	Toler-ance	VIF	t	Sig. t
1. Scope of Involvement	1.234	.385	.216	.930	1.075	3.205	.0022
2. Competitive Position	1.358	.626	.169	.696	1.435	2.166	.0343
3. Related Market Growth	2.103	.539	.326	.614	1.629	3.924	.0002
4. Certainty of Productive	1.740	.517	.271	.652	1.533	3.366	.0013
5. Certainty of Profit	1.487	.563	.237	.599	1.668	2.816	.0066
6. Radicalism	1.118	.449	.176	.845	1.183	2.487	.0157
7. Financial State	1.059	.392	.187	.884	1.130	2.701	.0090
8. (Constant)	-25.804	4.412				-5.848	.0000

Residuals Analysis

	Minimum	Maximum	Mean	Std. Deviation	N
Predicted Value	6.968	45.604	25.711	7.823	77
Residual	-22.277	10.353	-.487	5.453	77
Std. Predicted Value	-2.338	2.561	.0391	.9922	77
Std. Residual	-4.611	2.142	-.1009	1.128	77

Searching for Violations of Assumptions

Figures A4-3B to A4-10B (in Appendix 4-3B) are the scatterplots of the predicted scores and predictor against residuals. They shows no pattern, thereby confirming that the assumptions of linearity and homogeneity of variance have been met. The histogram of standardised residual is shown in Figure A4-11B (in Appendix 4-3B). The grey bars show the frequencies. The superimposed curve is the ideal normal distribution for the residuals. The Lilliefors test of normality (Statistic = 0.0847, df = 77, Sign. >.2000) indicates that the distribution of residual is normal. The White's test (F = 0.844 Sign. F = 0.619) indicates that the errors are both homoskedastic and independent and that linear specification of the model is correct. **Therefore no violation of assumption of the regression model has been found.**

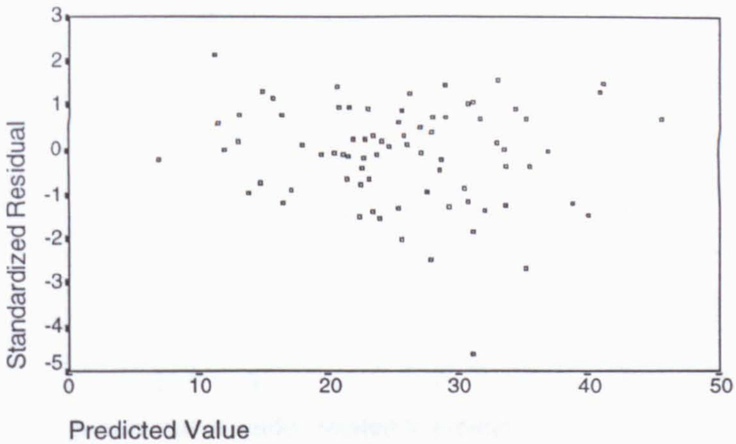

Figure A4-3B: The scatterplot of the Predicted variable of against residuals (Model 11B)

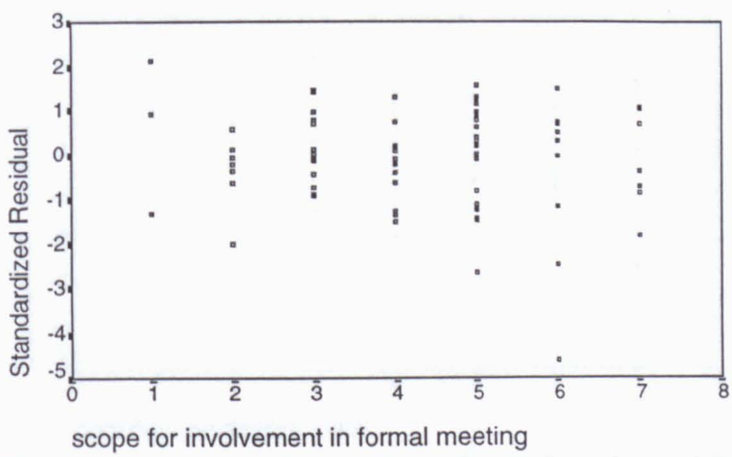

Figure A4-4B: The scatterplot of the independent variable (Scope of Involvement) against residuals (Model 11B)

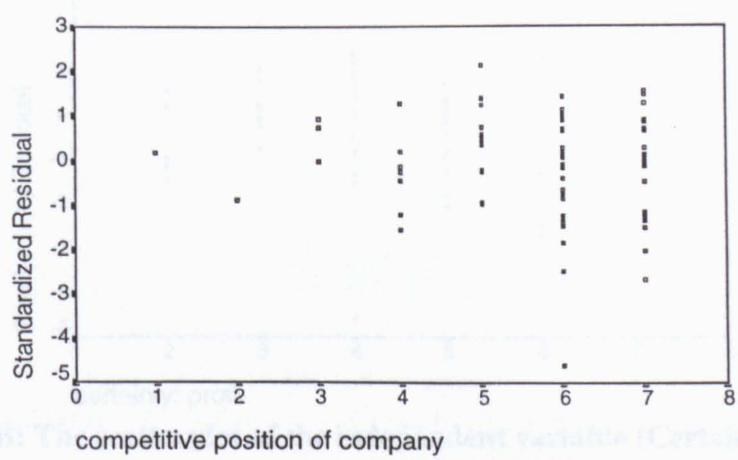

Figure A4-5B: The scatterplot of the independent variable (Competition Position) against residuals (model 11B)

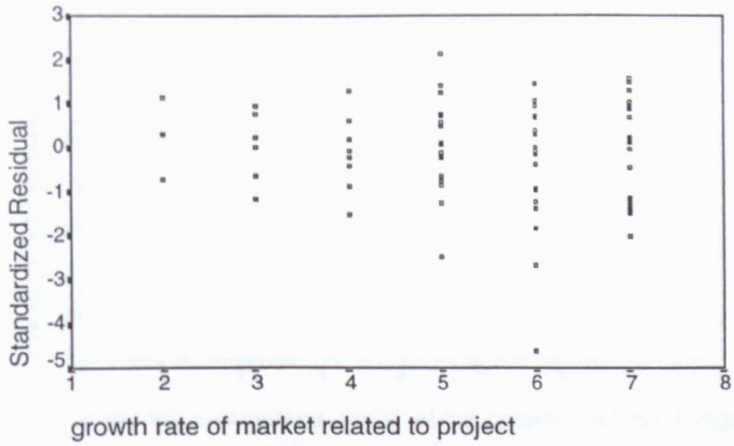

Figure A4-6B: The scatterplot of the independent variable (Growth Rate of Market) against residuals (Model 11B)

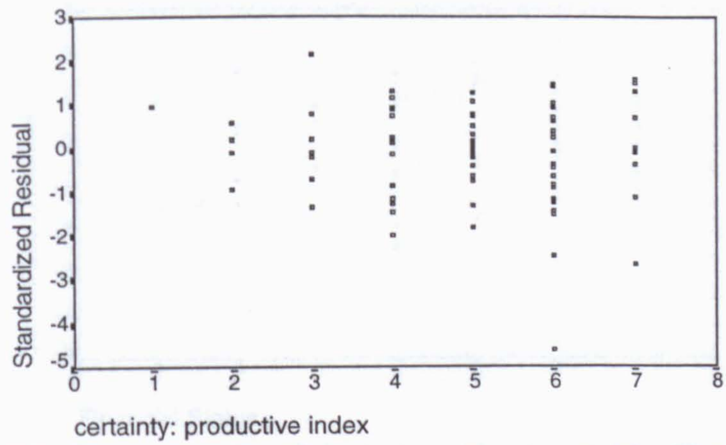

Figure A4-7B: The scatterplot of the independent (Certainty of Productivity) against residuals (Model 11B)

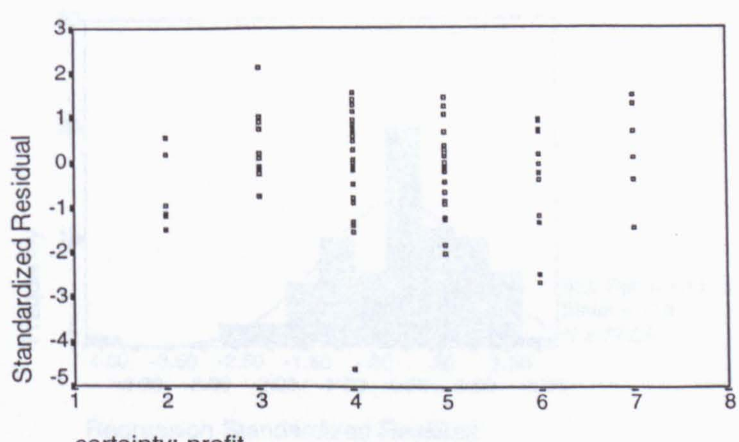

Figure A4-8B: The scatterplot of the independent variable (Certainty of Profit) against residuals (Model 11B)

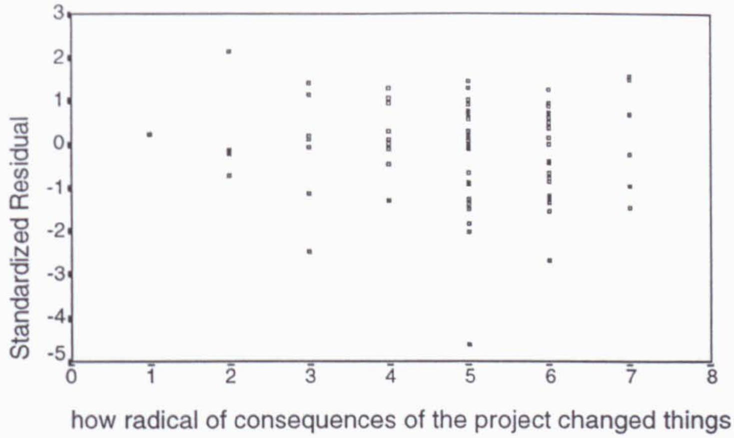

Figure A4-9B: The scatterplot of the independent variable (Radicalism) against residuals (Model 11B)

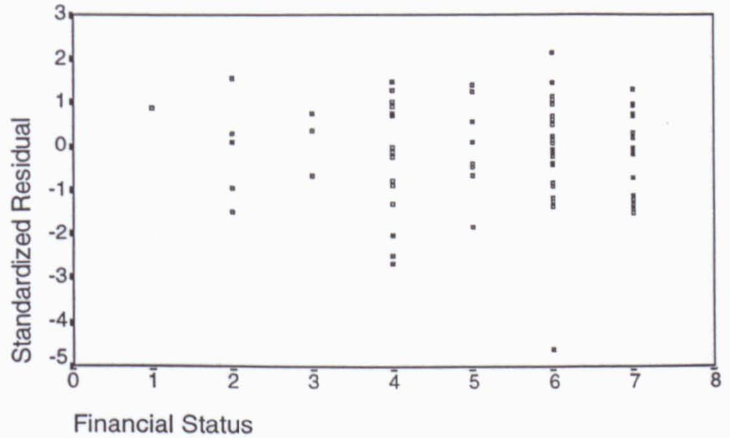

Figure A4-10B: The scatterplot of the independent variable (Financial State) against residuals (Model 11B)

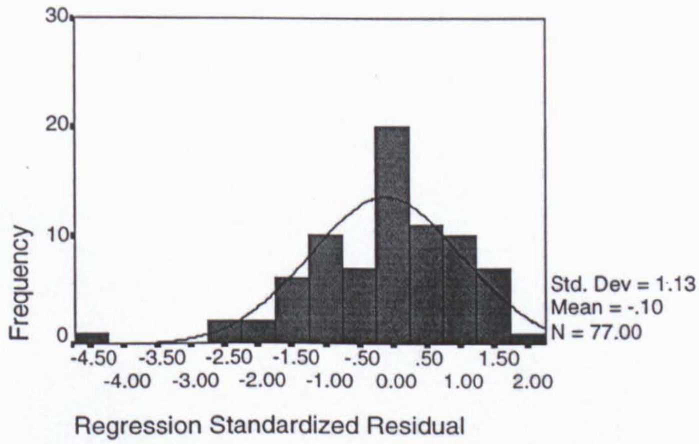

Figure A4-11B: The histogram of standardised residual (Model 11B)