The Value of Transformational IT Investments in South Africa: An Event Study Analysis

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by

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Abstract

Information technology has long been regarded as an important organisational resource and numerous studies of its b usiness value have been conducted over the last two decades. However, the expectations for, and actual results of, investments in IT have seldom found common ground over the years of IT spending. This thesis aims to further the understanding of the conditions under which IT investments add value and conducts a replication of a study by Dehning, Richardson and Zmud (2003) in the context of South Africa. South Africa is a country with very limited research in IT value and so offers a great opportunity for IS research, especially research into the value of IT investments in a developing country.

The key construct investigated by this thesis – IT strategic role – has been found to be very useful in determining what it is about an IT investment which allows it to produce a sustainable competitive advantage. IT strategic role takes the three forms: automate (to replace labour), informate (to provide information to management and employees) and transform (to fundamentally alter the structure and competitive forces of the industry where the firm operates) and the strategic role of both a firm's industry as well as that of IT investments are examined in this thesis.

This study makes use of a relatively new, theoretically sound methodology which has allowed recent research to get beyond some of the problems with previous approaches – event study methodology (ESM). This thesis found significant positive results for IT investment strategic role, which was in line with US research. Where industry strategic role and certain investment–industry interactions were found to also be positive factors in the US, however, they were not found to be so in South Africa.

The conclusions of this study are that future studies which look to analyse the effect of IT-related events on stock prices should incorporate the transformational nature of investments into their analysis. Furthermore, a focus on sustained competitive advantage must be considered and investigated when trying to understand the situations under which IT investments add value. Most importantly, firms who wish to impact on their future performance should look to use information technology to add business value, utilising it in a role which can transform its business and move it into an industry niche where competition is weak, and where high profits can be more easily earned.

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Table of Contents

Table of Figures

Table of Tables

1 Introduction

1.1 Research Topic

Information technology has long been regarded as an important resource in business. Published surveys by the Society for Information Management (Ball & Harris, 1982; Dickson, Leitheiser, Wetherbe & Nechis, 1984; Brancheau & Wetherbe, 1987; Niederman, Brancheau & Wetherbe, 1991; Brancheau, Janz & Wetherbe, 1996; Luftman & McLean, 2004; Luftman, 2005) indicate the key management issues over the last twenty years, and the effectiveness and productivity of IS has consistently been a high-ranking issue. In the academic field as well, the numerous studies of IT value over the last two decades indicates this same level of concern.

However, the expectations for, and actual results of, IT investments have seldom found common ground over the years of IT spending (c.f. The Standish Group, 1995). The initial investigations into this had conflicting results, with much of the early studies examining whether IT had value at all. As the research has matured, evidence has been increasingly supporting the fact that IT does have business value. The focus has now slowly shifted to understanding how and why IT adds value.

As the research focus has changed, so has the role of IT. In the 21st century, the economic environment in which businesses operate is turbulent and competitive (Le Roux, 2001). In this environment businesses have needed to utilise all their available resources efficiently and, most importantly, strategically. IT's role in business has also matured from simply replacing labour and providing information to becoming a strategic resource used to alter traditional business processes and methods. A study published in MIS Quarterly by Dehning, Richardson and Zmud (2003) recognised this and recently tested a construct called *IT strategic role*, which identifies the strategic context of IT investments.

It is the objective of this thesis to further the understanding of the conditions under which IT investments add value using relevant empirical research. Owing to the

relevance of strategy in IS value research and IT's changing role as an enabler of sustainable competitive advantage, this thesis conducts a replication of the Dehning et al. (2003) study, in the context of South Africa, using data from South African firms.

The research question of this thesis is, therefore, stated as: *Is "IT strategic role" a significant factor in predicting the perception of IT investment value by investors in the South African stock market?*

One of the key aspects of this thesis is the use of market valuations. This involves the use of event study methodology (ESM) which has emerged as a valuable tool for investigating IT value and for getting beyond the limitations of the production functions and accounting measures of earlier studies. It has a strong theoretical foundation and has been widely used in fields such as accounting, finance and management (McWilliams & Siegel, 1997) and increasingly in the IS field (e.g. Dos Santos, Peffers & Mauer, 1993; Im, Dow & Grover, 2001; Chatterjee, Richardson & Zmud, 2001; Chatterjee, Pacini & Sambamurthy, 2002; Richardson & Zmud, 2002; Dehning et al., 2003; Hunter, 2003; Hart & Webber, 2005).

In summary, this thesis conducts an IT value event study, which makes use of a well-specified and useful methodology, to specifically examine the strategic role of IT investments; which is both relevant to the practicing business world and to the IS discipline; and which has the goal of furthering the understanding of how and why IT adds value to business.

1.2 Motivation for Research

The use of information technology is prevalent in the world of business and understanding how it can be used effectively in this role is a significant issue. Within the academic discipline of information systems, the issue has been looked at for many years, and a full, rounded comprehension of the business value of IT is still a long way away. The subject matter of this thesis, therefore, is concerned with both business practice and a prominent stream of research in the IS discipline.

This study makes use of a relatively new, theoretically sound methodology which has allowed recent research to get beyond some of the problems with previous approaches. As Dehning and Richardson (2002) report, this methodology has shown promising early results with numerous opportunities for further work. This thesis takes advantage of the event study methodology and the opportunities it affords.

IT value research is fairly developed after more than twenty years of research. However, most of this research concerns developed countries, with the majority generated out of the United States. South Africa's history of IT value research is notably limited, and so this thesis will go some way to contributing to literature focussing on South Africa, and developing countries in general.

The examination of IT investments in South Africa will aid in clarifying the role and applicability of the construct, IT strategic role; it will allow comparison with US results, providing evidence of potential differences between the two types of environment; and it will allow comparison with the only other IS event study in South Africa, that of Hart and Webber (2005).

1.3 Prior South African Research

Previous IT value research in South Africa includes a study of the effects of IT investments by banks on firm, industry and national level performance (Van Aswegan, 1993), IT investment processes of South African firms (Lubbe, 1998) and a study of IT infrastructure investments by Hart and Webber (2005). The use of the event study methodology in South Africa is more prevalent with a study by Knight and Affleck-Graves (1988) and a range of studies by Bhana (1995; 1998; 1999a&b; 2001; 2003; 2005).

To the author's knowledge, the research of this thesis has not been previously conducted in South Africa.

1.4 Thesis Structure

The next chapter in this thesis, Chapter 2, reviews the literature around IT value: where the latest research is being directed, and what problems the study of IT value has encountered in its history. It focuses specifically on understanding the strategic role of IT – how IT can be used to gain a competitive advantage which persists over time. In order to examine this the resource-based view is drawn upon, as is the construct of IT strategic role and a model called the Firm Value Framework (Dehning, Richardson & Stratopoulos, 2005). Event study methodology is then looked at from a theoretical perspective. Based on the discussion in Chapter 2, the hypotheses are then derived. Lastly, a conceptual model of empirical IT value research is used to relate this thesis' focus to the existing body of knowledge which has investigated IT value.

The Literature Review is followed by a discussion of the methodology used in this thesis, in Chapter 3. The event study methodology is specified, including its required assumptions. The various implementation issues are stated along with how they were addressed. The correct process of conducting an event study is then clarified and explained with reference to this study. This includes accounting for the many choices of estimation procedures, parametric and nonparametric tests and the subsequent choices made for the testing framework of this thesis. The procedures used for collecting the necessary data are also highlighted.

Chapter 4 then presents the results. The results reported on include descriptive statistics of the data used in the event study tests; tests of data normality; the findings from the various tests used on all the samples; a multiple regression analysis; an outlier analysis; and, lastly graphs of the cumulative average abnormal returns over time.

The chapter following, Chapter 5, goes on to discuss the results, looking at the support for hypotheses, comparisons with other IS event studies from the United States and the one IS event study from South Africa. The results are then interpreted, taking into account these other studies and IT value theory, and the study's limitations explained.

Lastly, in Chapter 6, the conclusions of this thesis are drawn.

2 Literature Review

2.1 Introduction

The study of IT value has matured much since first gaining prominence. In its beginnings, the focus was around whether there was value in IT at all. In 1987, one of the first major debates started when Steven Roach, then chief economist at Morgan Stanley, developed the concept of the "productivity paradox" (Roach, 1987). He contended that IT investment in the United States was not increasing productivity, on an industry or economy-wide level. In the following years, studies were carried out which disputed this claim (Brynjolfsson & Hitt, 1993; Jorgenson, 2001; Kraemer & Dedrick, 2001; Lichtenberg, 1995) and showed IT's positive contributions to productivity at a national and industry level. These studies answered only initial questions, however.

What followed was the more important question of IT value at the firm-level: do IT investments increase productivity for firms themselves? Early empirical studies found no evidence supporting increased firm-level productivity (Landauer, 1995; Loveman, 1994; Mahmood & Mann, 1993; Weill, 1992; Wilson, 1993) but later studies became more rigorous, using better models and larger datasets, with more positive findings as a result. These later studies showed significant evidence of a positive relationship between IT investments and increased firm-level productivity (Bharadwaj, Bharadwaj & Konsynski, 1999; Brynjolfsson & Hitt, 1995, 1998; Chatterjee et al., 2001; Dewan & Min, 1997; Hitt & Brynjolfsson, 1996; Kudyba & Diwan, 2000; Lehr & Lichtenberg, 1998; Lichtenberg, 1995; Mitra & Chaya, 1996).

Although strong evidence exists from the research above to show *productivity* increases at the firm-level, the more pertinent issue to organisations is *profitability* increases. Studies have had conflicting results in this area, caused by ineffective measures of the effects of IT on firms – ultimately stemming from a poor understanding. What follows is an explanation of the methodological problems related to the conflicting results, as well as a discussion around the more salient issue in the IT value debate: *how* IT investments add value to firms.

2.2 Understanding the Conflicting Results

2.2.1 Methodological Issues

One of the first problems to be identified with profitability studies is the measures used. In much of the earlier IT value research, the measures used are referred to as accounting measures. These measures are broadly based on production economics, using econometric models to relate firm output to a set of "IT inputs" (Dedrick, Gurbaxani & Kraemer, 2003). In an organisation it can be exceptionally difficult to measure the IT inputs for these models: certain IT-related expenses may be aggregated outside of IT measures; accounting rules and standards serve to hide measures; and factors such as worker knowledge and skills, which are important IT inputs, cannot be modelled. Outputs can also be difficult to measure because reliable indices are needed to allow for comparison across time, and often the nature of the output is conceptually difficult to define and measure (Dedrick et al., 2003). Examples of this are software outputs by IT-producing firms and services provided by services firms. Another key problem, noted by Devaraj and Kohli (2000) and Dedrick et al. (2003), is that IT returns, and subsequently the production functions which model them, are affected by time lags. Brynjolfsson and Hitt (2000) found that an IT investment's impact on technical progress – increased output with the same input – is maximised after 4 to 7 years.

Production functions require a large and detailed dataset for significant tests to be conducted, which presents another problem. As a first point, Robey and Boudreau (1999) note that the quality of data has been traditionally poor, but more importantly what is often seen is that the necessary data is extremely difficult to obtain, if it exists at all (Brynjolfsson & Hitt, 2000). This is evidenced by the fact that many key studies following Brynjolfsson and Hitt's (1993) article – one of the first key IT value studies – have had to use the same dataset for lack of other data (Bresnahan, Brynjolfsson & Hitt, 2000, Brynjolfsson & Hitt, 1996, 2000; Dewan & Min, 1997; Hitt & Brynjolfsson, 1996; Lichtenberg, 1995; Rai, Patnayakuni & Patnayakuni, 1997). The lack of substantial, quality data is a significant problem for accounting methodologies.

Following from the successes and failures of research using accounting measures, another set of measures began to be used: market value measures. These are

essentially the stock market's value of firms and can be used to measure the effects of IT investments on firms, and ultimately the value of these IT investments. A methodology which uses market measures, which is mature in fields such as accounting and finance, and which is now being increasingly used in the IS field, is *event study methodology*.

Recent IS event studies using event study methodology have already added new insights to the IT value debate; Dehning and Richardson (2002) report that the market valuation of IT investments has shown promising early results, and that there are numerous opportunities for further work in this area. Because event study methodology is used in this thesis, the existing research and its findings as well as the details of the methodology is discussed further on, in Section 3.1.

2.2.2 Understanding Firm Effects

Another reason for conflicting results has been with the immeasurable factors of production which play a substantial role in converting a firm's IT investment into returns. Early research in IT value did not take these other firm factors into consideration, and so results were misleading. In Brynjolfsson and Hitt's (1995) study, they estimated that these "firm effects" accounted for as much as half of the productivity benefits attributed to IT investment in their earlier work.

Later studies began investigating firm effects to better explain and understand their nature and role in a firm. This focus has slowly come to dominate IT value research and marks a shift in underlying concern – from trying to simply measure IT value, to trying to understand how IT creates value. Many concepts have since been developed. One of these originates from Brynjolfsson et al. (2002) who point out that organisational complements to IT investments are treated by financial markets as *intangible assets*. They found that market valuation effects were highest for firms with high levels of both intangible assets and IT, illustrating a complementarity of the two.

In business literature, noted intangible assets have been product quality, customer service, market orientation, knowledge assets, organisational memory, organisational

learning and synergy (Quinn & Baily, 1994). IT empirical research has also shown various intangible assets to drive firm performance: know-how (Teece, 1998), corporate culture (Barney, 1991), corporate reputation (Vergin & Qoronfleh, 1998) and environmental orientation (Russo & Fouts, 1997).

The identification of this relationship between intangible assets and IT's ability to add firm value resulted in studies on how firms can intervene in this area – to develop these assets. Much recent research exploring how (and why) to do this has looked at *complementary investments* (Avison, Jones, Powell & Wilson, 2004; Barua & Mukhopadhyay, 2000; Brynjolfsson & Yang, 1997; Chatterjee et al., 2001; Cline & Guynes, 2004; Dedrick et al., 2003; Dehning et al., 2003; Kohli & Devaraj, 2004; Richardson & Zmud, 2002). Transforming IT investments into value through creating and implementing complementary investments ultimately comes down to the work and plans of management. And researchers have consistently highlighted the importance of managerial effectiveness in doing this (DeJarnett, Laskey & Trainor, 2004; Kurien, Rahman & Purushottam, 2004). A McKinsey Technology Special Report in 2002 (Manyika & Nevens, 2002: p. 20) speaks specifically of the importance of the IT managerial role for firms:

> "The history of business shows that technological innovations are typically of little use until complementary managerial innovations bring them to life. That is no less true at the present time, when leading companies use IT to create differentiated business models and to reach new heights of performance."

Developing intangible assets to support IT and business has been examined in the IS field in the more holistic, conceptual study of *IT strategy*. The increasing importance of IT strategy in business has seen the elevation of the CIO's position to the company boardroom and IT progressively taking on a more strategic role for organisations (Feeney, Edwards & Simpson, 1992; Ross & Feeny, 2000). An article by the editors of the Harvard Business Review (1995) illustrates this by citing of the perspectives of various CEO's of large US corporations. Bob Martin, CEO of Wal-Mart's International Division says, "At Wal-Mart and at many other companies, technology

has become integrated with every aspect of the business" (1995, p. 37); the CEO of Simon & Schuster, Jonathan Newcomb, points out, "I expect my CIO to have a rock solid business view of technology" (1995, p. 43).

With this emergent IT strategic role, a wider context for IT investments has become apparent in that they are put into perspective with the firm's business strategy and also the firm's competitors and their strategies. By looking at IT in this sense, more diverse and complex relationships have emerged.

Part of the initial problems with capturing and measuring IT's value to firms, especially at the level of profitability, was in identifying these complex relationships. As research has advanced, the study of the business value of IT has grown to include a wide variety of focus areas. The remainder of this literature review will focus specifically on understanding IT and business strategy, using the concept of *IT strategic role*.

2.3 IT Strategic Role

IT strategic role was conceptualised by Schein (1992) and Zuboff (1988). In its beginnings, it was referred to as *strategic IT vision* (Robbins & Duncan, 1988; Zmud, 1988; Venkatraman, 1991; Schein, 1992; Armstrong & Sambamurthy, 1999) which can be defined as the shared, aspired state of the role that IT should play in the firm (Robbins & Duncan, 1988; Zmud, 1988). IT strategic role is also purposeful in nature but is used less to describe management's vision of IT and more to express the actual role taken on by IT, at an industry and firm level. IT strategic role consists of four possibilities: automate, informate up, informate down, and transform.

Automation can be defined as the replacing of human labour with information technology, with the intention being to save money and improve quality, control and continuity (Schein, 1992; Zuboff, 1988). It is the role IT played when first introduced into organisations – Zuboff (1988) mentions one of the earliest examples of automation being the assembly lines of Henry Ford.

Informate is a term coined by Zuboff and refers to IT's ability to "generate information about the underlying processes through which an organisation accomplishes its work" (Zuboff, 1988: p. 8). Schein (1992) refines the term into two forms: informating *up* and informating *down*. Informating up refers to IT providing information to higher levels of the organisation more easily and efficiently, to aid their organisational control and coordination roles. Informating down refers to IT being used to distribute key information to lower levels of the organisation to empower them with relevant knowledge and information (Schein, 1992; Armstrong & Sambamurthy, 1999).

Transform is the most strategic role IT can play for a firm: being a vehicle for fundamentally altering the structure and competitive forces of the industry where the firm operates (Schein, 1992; Armstrong & Sambamurthy, 1999; Chatterjee et al., 2001; Dehning et al., 2003). This role often reflects senior management targeting IT as a means for changing their firm's fundamental relationships with its suppliers and customers; and it can often entail altering the products, markets, organisational structures, organisational boundaries, inter-organisational relationships and even management processes (Schein, 1992).

IT strategic role has been used in empirical research at the firm-level (Armstrong & Sambamurthy, 1999; Farag & Krishnan, 2003; Dehning et al., 2003) and the industry-level (Chatterjee et al., 2001; Dehning et al., 2003). Armstrong and Sambamurthy (1999) used IT strategic role as a moderating factor for testing the success achieved by firms in utilising capabilities of IT, and Chatterjee et al. (2001) used it to test the stock price behaviour of firms announcing newly created CIO positions.

2.4 Frameworks for Discussion

2.4.1 The Resource-Based View (RBV)

The resource-based view of the firm is a robust theory that has received wide acceptance in management fields (Wade & Hulland, 2004). It has only come into prominence in the last twenty years but its origins stem back to the seminal works of Coase (1937), Penrose (1959) and Wrigley (1970). The resource-based view states

that resources are not easily bought or sold and that, therefore, the distribution of resources across organisations is heterogeneous (Barney, 1991). Consequently, organisations have idiosyncratic resources which they can then use to earn *economic rents*.

The term economic rent (also known as Economic Value Added) is defined by Alchian (1987) as the payment for the services of a factor of production in excess of that minimally necessary to call forth its services, or in other words, the surplus earned by scarce resources (Montgomery & Wernerfelt, 1988; Peteraf, 1993). In applying "economic rent" to investments, it can be understood to mean the difference between returns achieved on resources invested and the cost of those resources.

Researchers and practitioners interested in the RBV have used a variety of different terms to talk about a firm's resources, including *competencies* (Prahalad and Hamel, 1990), *skills* (Grant, 1991), *strategic assets* (Amit and Schoemaker, 1993), *assets* (Ross et al., 1996), and *stocks* (Capron and Hulland, 1999). For clarification in the following discussion, "resources" is defined as:

> *Assets* and *capabilities* that are available and useful in detecting and responding to market opportunities or threats (Sanchez, Heene & Thomas, 1996; Christensen & Overdorf, 2000; Dehning et al., 2005).

Assets can serve as inputs to a process, or as the outputs of a process (Srivastava et al., 1998; Teece, Pisano & Shuen, 1997). They can be tangible, such as information systems hardware, or intangible, such as strong vendor relationships (Hall 1997; Itami and Roehl 1987; Srivastava et al., 1998).

Capabilities moderate the process of transforming inputs into outputs of greater worth (Amit and Schoemaker 1993; Capron and Hulland 1999; Christensen and Overdorf 2000; Sanchez et al., 1996; Schoemaker and Amit 1994). They include skills, such as technical or managerial ability, and processes, such as systems development or integration.

Empirical studies of firm performance using the RBV have found differences not only between firms in the same industry (Hansen & Wernerfelt, 1989), but also within the narrower confines of groups within industries (Cool & Schendel, 1988). Related research (Barney, 1986a, b; Bogner & Thomas, 1994; Cool and Schendel, 1988; Hansen & Wernerfelt, 1989; Jacobson, 1988; Rumelt, 1991; Wernerfelt, 1984, 1995; Mahoney and Pandian, 1992) also suggests that the effects of individual, firm-specific resources on performance can be significant.

The resource based-view (RBV) is the most widely accepted framework for analysing the sustainability of a competitive advantage (Barney, 1986a; Barney, 1989; Barney, 1991; Barney, 2001; Dierickx & Cool, 1989; Makadok, 2001; Peteraf, 1993).

2.4.2 The Firm Value Framework (FVF)

Dehning, Richardson and Stratopoulos (2005) developed a model which can be used by both managers and researchers to understand the interrelated effects that IT investments have on firm value, which they call the *Firm Value Framework*. The FVF builds on the process-oriented approach which has been used in past studies (Banker & Kauffman, 1988; Banker, Kauffman & Morey, 1990; Barua, Kriebel & Mukhopadhyay, 1995; Brynjolfsson & Hitt, 1997) to analyse the contribution of IT investments to firm performance through its impact on business processes. It adds to this previous approach through simultaneous evaluation of the factors that affect firm value.

The FVF makes use of the residual income stock price valuation model, also known as the Edwards-Bell-Ohlson Model (Edwards & Bell, 1961; Ohlson, 1995; Feltham & Ohlson. 1995). This model shows that a company's value will be equal to its book value unless it can produce residual income. Dehning et al. (2005) point out that residual income is a better measure of the true operating performance of a company than accounting income, because it includes a charge for the capital employed in the business (in addition to materials and labour). The residual income model denotes firm value as current book value plus the discounted sum of all future residual income – referred to in the FVF as abnormal returns.

Using the residual income model, and other constructs, the FVF is specified as follows:

$$V_0 = BV_0 + \frac{IAE}{r_e} + \frac{FAE - \frac{FAE}{(1+r_e)^n.(1+r_e)^d}}{r_e}$$

where

V_0	=	firm value at time 0
BV_0	=	book value of the firm at time 0
r_e	=	the cost of equity capital
IAE	=	the industry level of abnormal earnings
FAE	=	the firm-specific deviation in abnormal earnings
n	=	the duration of FAE
d	=	the time lag before FAE begins

Industry abnormal earnings (*IAE*) can be attributed to the characteristics of the industry in which the firm operates; if greater than other industries, it can give the industry a competitive advantage relative to other industries. *FAE* is used to denote abnormal returns from firm-specific factors, over a period of time (*n*). The delay construct (*d*) is used to illustrate the time required before IT investments begin to yield benefits. Cost is represented by r_e.

The model allows for the possibility of several strategic outcomes: competitive advantage, competitive parity or competitive disadvantage. When *FAE* is equal to 0, the firm is earning the industry level of profits (competitive parity). When *FAE* is positive, the company has a competitive advantage. And a negative *FAE* implies a competitive disadvantage. The ideal for investments is when they provide a *sustainable* competitive advantage – this is represented in the model by a positive *FAE* with a large *n*.

At this point, it is important to note that sustainable competitive advantage (SCA) can imply two definitions: (1) a competitive advantage "that continues to exist after

efforts to duplicate that advantage have ceased," (Barney, 1991: p. 102); or (2) a competitive advantage that endures for a long period of calendar time (Jacobsen 1988; Porter, 1985; Wade & Hulland, 2004; Dehning et al., 2005). Although the actual length of a long period of calendar time has not been specified, in this thesis it is taken to mean longer than five years. Since the first definition is "virtually impossible to meaningfully operationalise quantitatively" (Wiggins & Ruefli, 2002: p. 84), the second definition is referred to in this thesis.

It is also important to note that book value of firms in the FVF is not determined by the accounting method used for IT-related expenditures. Regardless of whether these expenditures are capitalised as assets or written off (i.e. the accounting method), firm value does not change. It is the benefits of the IT that increase firm value, not the choice of accounting for the IT investment (Dehning et al., 2005).

It is also important to note that in the FVF it is the dynamic of all the variables together which ultimately affects the value of the firm; so even if one variable is contributing to a higher value, the overall effect of all the variables could mean a lower firm value.

2.5 Analysing IT Strategic Role Using the RBV and FVF

The FVF is useful because it allows for an understanding of the factors involved in determining a firm's value, and the impact IT can have in affecting these factors. Each variable can be looked at from the perspective of a new IT investment and its impact. Under each of the variables of the FVF, the RBV and IT strategy literature is discussed to understand how IT acts in a strategic role.

2.5.1 Industry Level of Abnormal Earnings

Abnormal returns from being in an industry (*IAE*) can occur because of the industry characteristics, and its characteristics relative to other industries. Changes to an industry's competitive advantage can result from external or internal factors. External factors can include things such as regulatory actions or changes to tax regimes

(Dehning et al., 2005). Internally, one or more firms may change the industry in which they operate through affecting the level of competition.

From the field of microeconomics, the level of abnormal earnings in an industry can be stable at various levels, according to the level of competition. Industries can be characterised by many competitors and a high level of competition – "perfect competition" – and can decrease in competitiveness through "monopolistic competition" to "oligopoly" and, lastly, "monopoly" where there is no competition (Griffiths & Wall, 2000). When there are many competitors and competition is intense, *IAE* is zero; when there are weak competitive forces, *IAE* is high (Dehning et al., 2005).

The level of industry competition is affected not only by the number of competitors, but also the nature of competition between industry participants. Porter's competitive forces model (Porter, 1979; Porter & Millar, 1985) talks of five forces affecting an industry's level of competition: the bargaining power of buyers, the bargaining power of suppliers, competitive rivalry amongst firms, the threat of new entrants, and the threat of substitute products. Research has shown how the Internet has affected the buying power of buyers and suppliers (Terrile, 1999), the competitive rivalry in an industry and has allowed new entrants to enter markets and industries (Yoffie and Cusumano, 1999).

A well-known example of technology changing an industry's competitive forces is the US company Dell and its use of technology to enter the personal computer market (Dehning et al., 2005). Dell competed fiercely with the other firms by lowering costs through establishing IT enabled partnerships (supply chains). Dell's direct business model, through vertical integration with suppliers, increased the bargaining power of buyers and decreased the bargaining power of suppliers in that market (Magretta, 1998). Furthermore, Dell used its business model, supported strongly by IT, to enter other markets: servers, PDAs, storage, and printers.

Clearly, IT can change the competitiveness of an industry, through disrupting industry structures, increasing or decreasing the number of competitors, and affecting any of Porter's five forces. Therefore, IT can change an industry's abnormal earnings.

2.5.2 Firm-specific Abnormal Returns and the Duration of Competitive Advantage

Firm-specific abnormal returns (*FAE*) can occur due to investments in IT assets and capabilities which create a competitive advantage, and ultimately, produce a time of improved profitability (Anderson, Banker & Ravidran, 2002; Bharadwaj, 2000; Mata, Fuerst & Barney, 1995; McFarlan, 1984; Porter & Millar, 1985; Stratopoulos & Dehning, 2000). Various theoretical models have been developed to explain how this is achieved and how it is sustained (a large *n*).

The model developed by Porter and Millar (1985) uses the *value chain framework* to highlight the role of IT in competition. According to this framework, IT can help companies gain competitive advantage by performing primary and support activities at a lower cost or performing these activities to differentiate themselves and so charge a premium. The *industry structure view*, used by McFarlan (1984), explains how the contribution of IT investments to firm value is attributed to switching costs and the ability of IT to build barriers to entry and even change the basis of competition. Another framework, the *relational view* (Dyer and Singh, 1998; Dyer, Kale & Singh, 2001) focuses more on relationships with the competitive environment, referring to pair or network routines, and argues that companies that possess unique resources are likely to enjoy economies of scale if they combine their resources with unique resources of other firms.

The resource-based view, though, is the most widely accepted framework for evaluating how FAE can be increased and sustained from IT investments (as discussed earlier).

A key to understanding how a firm can enhance and protect its resources is to understand what its resources are. A number of studies, both conceptual and empirical, have tried to identify, define and test IS resources (Clemons & Row, 1991;

Mata et al., 1995; Andreu & Ciborra, 1996; Ross et al., 1996; Powell & Dent-Micallef, 1997; Bharadwaj et al., 1998; Feeny & Willcocks, 1998; Armstrong & Sambamurthy, 1999; Broadbent, Weill & Neo, 1999; Bharadwaj, 2000; Ray et al., 2001; Ravichandran & Lertwongsatien, 2002; Santhanam & Hartono, 2003).

Bharadwaj (2000) formulated a set of asset categories (based on Grant's (1991) classification scheme) as: IT infrastructure, human IT resources and IT-enabled intangibles and she finds empirical evidence supporting these resources impacting on firm performance.

Feeny and Wilcocks (1998) list nine IS capabilities organised into four areas: business and IT vision, design of IT architectures (development), delivery of IS services (implementation, vendor interaction), and a core set of capabilities including leadership and informed buying.

Bharadwaj et al. (1998) tested and validated a measure of IT capability on senior IS executives, which included these dimensions: IT/business partnerships, external IT linkages, business IT strategic thinking, IT business process integration, IT management, and IT infrastructure.

A synthesis of research classifying IT resources is presented by Wade and Hulland (2004) using a resource typology developed by Day (1994). Day argues that that the capabilities held by a firm can be sorted into three types of processes: inside-out, outside-in, and spanning. Inside-out capabilities are deployed from inside the firm in response to market requirements and opportunities, and tend to be internally focused. Outside-in capabilities are externally oriented, placing an emphasis on anticipating market requirements, creating durable customer relationships, and understanding competitors. Spanning capabilities, which involve both internal and external analysis, are needed to integrate the firm's inside-out and outside-in capabilities; they include things such as managing IS/business partnerships and IS management.

Table 1 shows Day's (1994) typology of resources, and Wade and Hulland's (2004) mapping of eight key IT resources (from strategic IT literature) onto it. Each of the

key resources in the table is an amalgamation of the myriad of resources identified by the previous RBV literature.

Table 1 – Mapping of Key IT Resources onto Day's (1994) Typology (Wade & Hulland, 2004)

Outside-In	Spanning	Inside-Out
• External relationship management • Market responsiveness	• IS-business partnerships • IS planning and change management	• IS infrastructure • IS technical skills • IS development • Cost effective IS operations

Having identified what resources are, it is important to identify what makes a resource strategically important. Firms may possess various resources, but that will not necessarily give the firm a competitive advantage. In order to identify what it is about a resource that gives a firm a competitive advantage, RBV theorists have identified *resource attributes*. The linking of firm-specific resources sets to competitive advantage has been looked at by Amit and Schoemaker (1993), Black and Boal (1994), Collis and Montgomery (1995), and Grant (1991).

In discussing resource attributes, a supposition can be used which examines how IT can provide not only a competitive advantage, but a *sustainable* competitive advantage. This has been been supported by various RBV researchers (e.g. Piccoli, Feeny & Ives, 2002; Priem and Butler 2001; Wade & Hulland, 2004) and involves distinguishing between two types of resource attributes: *ex-ante* and *ex-post* (Peteraf, 1993). Ex-ante attributes are those attributes of resources which are required for firms to create a short-term competitive advantage. Ex-post attributes limit competition and allow a firm to sustain its competitive advantage.

Ex-ante attributes are seen as: *value*, *rarity*, and *appropriability*. In an RBV context, resources have value when they enable a firm to implement strategies that improve efficiency and effectiveness (Barney 1991). Secondly, resources that are valuable cannot become sources of competitive advantage if they are in plentiful supply; therefore, rarity is the condition where the resource is not also available to a large number of firms (Amit and Schoemaker 1993). Lastly, appropriability of a resource refers to its rent earning potential and the ability of a firm to appropriate this (Amit

and Schoemaker 1993; Collis and Montgomery 1995; Grant 1991). A resource that has value and is rare may not necessarily have its economic rent fully appropriated by the owning firm; for example, the additional benefit from hiring employees with rare and valuable technical skills may be appropriated away from a firm by the employee through higher than normal wage demands (Wade & Hulland, 2004).

Ex-post attributes are: *imitability*, *substitutability*, and *mobility* (Wade & Hulland, 2004). Imitability refers to the ability of another firm to imitate a resource. According to Barney (1991), three factors can contribute to low imitability: a unique firm history, causal ambiguity, and social complexity. Each firm has a particular history and may only have its current resources because of the paths it followed over its history (path dependence). Causal ambiguity refers to a poorly understood link between a resource and the competitive advantage it confers. Ambiguity may lie in uncertainty about how a resource leads to SCA, or in a lack of clarity about which resource, or combination of resources, leads to SCA (Wade & Hulland, 2004). When there is causal ambiguity competing firms will find it extremely difficult to duplicate a resource or copy the way in which it is deployed (Alchian 1950; Barney 1986a, 1991; Dierickx and Cool 1989; Reed and DeFillipe 1990). The last factor, social complexity, refers to the diverse and complex set of relationships within a firm and between a firm and its shareholders, suppliers, and customers (Klein and Lefler, 1981). The complexity of these relationships makes them difficult to manage and even more difficult to imitate. Even if all the individual elements are in place, the relationships between the elements, and thus its complexity, would likely result in an imperfect substitute (Dierickx and Cool, 1989).

Mobility refers to how commonly or easily exchanged a resource is on the market. Resources can be non-tradable, or perfectly immobile if they cannot be traded (Peteraf, 1993). Barriers to mobility can arise as a result of switching costs (Montgomery and Wernerfelt 1988), resource co-specialization (Teece, 1986), or high transactions costs (Rumelt, 1987). The more imperfectly mobile a resource is, the harder it is for a firm's competitor to acquire it. Thus, a requirement for sustained competitive advantage is that resources are imperfectly mobile or non-tradable (Amit and Schoemaker 1993; Barney 1991; Black and Boal 1994; Dierickx and Cool 1989).

If a resource is not easily acquired, it might be easily substituted. A resource has low substitutability if there are few, or no, strategically equivalent resources that are, themselves, rare and inimitable (Amit and Schoemaker 1993; Black and Boal 1994; Collis and Montgomery 1995), which makes substitutability the last required ex-post resource attribute.

The subsequent conclusion which can be made from the RBV is that only IS resources that are inimitable, non-substitutable, and imperfectly mobile will have a positive effect on competitive position in the long run. Reading further into the analysis of resource attributes using Day's (1994) typology of firm resources, this can be specified further. Based on the common attributes of inside-out, outside-in and spanning resources (Wade & Hulland, 2004, provide an analysis of this), it can also be concluded that outside-in and spanning IS resources will have a stronger impact than inside-out IS resources on initial competitive position. Outside-in and spanning IS resources will also have a more enduring impact on sustainable competitive position. This is because, in general, these resources will have greater value, be rarer (but less appropriable), be more difficult to imitate or acquire, and have fewer strategic substitutes.

Ultimately, the RBV analysis of how firms create a competitive advantage (a high *FAE* in the FVF) and sustain this competitive advantage (a large *n* in the FVF) using IS resources can be summarised as follows:

> "Firms possessing superior external relations, market responsiveness, IS-business partnership, and IS management/planning resources are likely to initially outperform competitors that rely more on... IS infrastructure, technology skills, IS development, and cost efficient operations. Furthermore, because it is harder to imitate, acquire, or find strategic substitutes for the former set of resources than for the latter... (the former) are more likely to maintain their rarity, and thus support a sustainable competitive position for a longer period of time." Wade and Hulland (2004: p. 122)

The RBV gives a good perspective of how a firm can create a sustainable competitive advantage using IT. However, it leaves out some examination of competitors and how they respond to a firm undertaking a new IT investment. Another framework developed by Feeny and Ives (1990) was borrowed by Dehning et al. (2005) to examine this and to further explain *n* in the FVF. Dehning et al. (2005) call it the Competitive Response Model (shown in Figure 1).

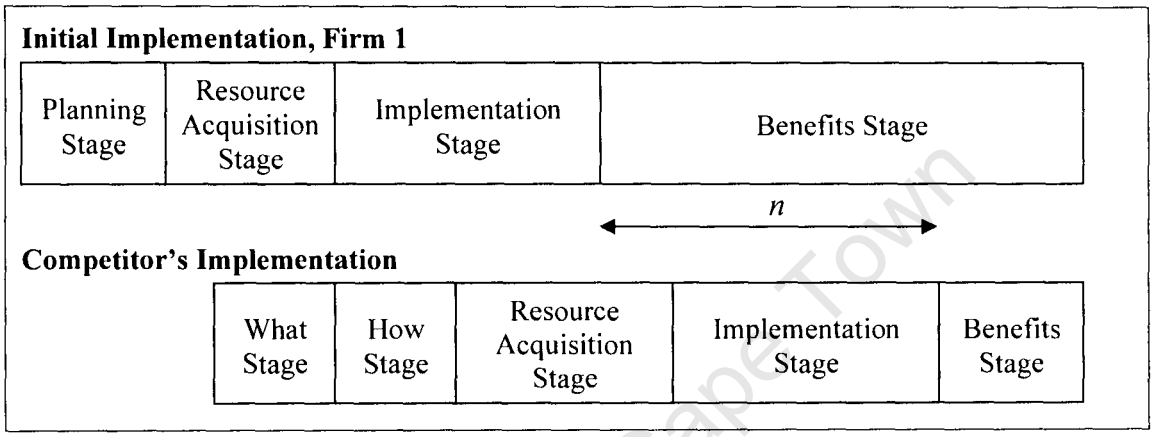


Figure 1 – The Competitive Response Model (Dehning et al., 2005)

Very simply, at some point during the firm's implementation of a new IT investment, competitor firms will try to identify *what* Firm 1 is doing. The start and end of this phase could vary greatly depending on the actions of customers, suppliers or Firm 1's employees and also on how senior management handles the tension between involving stakeholders and keeping initiatives secret from competitors. Once the competitors know what Firm 1 is doing, they then figure out *how* they are going to respond. The response could take the form of imitation – duplicating technology and processes for the same outcome – or substitution – using different technology or processes for the same outcome. After making the how decision, competitors then begin *resource acquisition* for their response. If a competitor cannot acquire the necessary assets and capabilities, they will not be able to respond and Firm 1 may then be able to sustain its competitive advantage. Finally, if the necessary resources are acquired, the *implementation* of the response takes place. This could be shorter than Firm 1's implementation stage because they could have learnt from the mistakes

Firm 1 made by being the "first-mover". Mansfield et al. (1981) found evidence of second-movers duplicating first-movers for 65% of their cost.

Figure 1 shows the process in serial but various stages may run in parallel as well. Each of the competitor's stages may also vary in starting point across the stages of Firm 1.

Based on the above, a firm's resources and their attributes as well as competitors' responses can explain the extent to which a firm can achieve a competitive advantage (leading to higher firm-specific abnormal returns) and, ultimatel y, how long this competitive advantage can be sustained.

2.5.3 The Cost of Equity Capital

This cost of equity capital, represented by r_e, is a direct function of the riskiness of the firm (Dehning et al., 2005). A great deal of business specific literature has dealt with managing risk. In the FVF, this measure refers specifically to the risk associated with IT investments.

The success or failure of new IT is influenced by a wide spectrum of company-specific factors, as well as factors from the company's external environment (Dehning et al., 2005). As a result, implementation of new IT, no matter how well designed or executed, will always be associated with a degree of uncertainty. The higher the degree of uncertainty, the higher the level of risk associated with the IT investment. A well known study, "the CHAOS Report", by the Standish Group (1995) conducted extensive surveys of IT executives and project managers and found that 84% of IT projects fail, illustrating the high risk many IT projects face.

There are three sources of IT risk, which if not properly addressed, may lead to unsuccessful implementation of IT projects and put the company in a position of competitive disadvantage: technical risk (unavailable or inadequate technology), project risk (failure or poor performance of the company's staff), and internal political risk (Clemons & Weber, 1990). The effect on the FVF of a higher r_e is lower

abnormal earnings through a higher cost of investment and future earnings being discounted at a higher rate.

The extent to which a firm can manage its risk will affect how much value an IT investment will add to a firm.

2.5.4 A Delay in Abnormal Returns

Through the principles of time value of money, a delay (*d*) in earnings will result in a lower firm value today. A company's ability to extract the appropriate rent from an IT investment can be delayed by factors such as: time to implement, learning and re-adjustment. Time to implement is affected by poor project planning, poor management, insufficient technical skills, and inadequate technology (Dehning et al., 2005); and period of learning and organisational readjustment is associated with new IT being implemented by a firm (Brynjolfsson, 1993; David, 1990). How well a firm manages these issues will determine how long the delay will be until benefits start accruing, and therefore, how much value the investment will add to the firm.

2.6 Hypotheses Development using IT Strategic Role, the FVF and RBV

The analysis of the effect of IT investments on firms can now be looked at using the IT strategic role construct, in conjunction with the topics discussed above, to form the hypotheses of this thesis. To aid in interpretation and comparability, the hypotheses in this thesis follow those of Dehning et al. (2003). As explained earlier, there are four types of IT strategic role: automate, informate (up and down) and transform.

Automate investments cause improvements in efficiency but most likely only result in small increases in a firm's value. This is because automate investments are involved with, predominantly, inside-out resources, and can, thus, be easily imitated, acquired or substituted. Furthermore, a competitor's response should include quick stages of what, how, resource acquisition and implementation (from the Competitive Response Model), making any competitive advantage gained by the firm short-lived. Looking at

the situation using the FVF, although risk and delay will most likely be small, there would only be a small increase in firm-level abnormal earnings, lasting only a brief time. With no change in industry abnormal returns, the net effect of an automation investment on a firm should be insignificant to its value.

Investments characterised as having an informate-up or -down strategic role involve the use of IT to induce decision-making and decision-taking at, respectively, higher and lower organisational levels (Dehning et al., 2003). These investments, argue Dehning et al. (2003), are not greatly different from automate investments in terms of their ability to add sustainable value. From an RBV perspective, however, informate investments are involved with outside-in and spanning resources. This implies a potentially greater initial and sustained competitive advantage because the investments will be creating resources that have greater value, are rarer, less appropriable, more difficult to imitate or acquire, and have fewer strategic substitutes. From the FVF, firm-level abnormal returns could be the same or higher than automate would have. Risk should not be much higher; delay could be longer, but the length of time over which the investment would bring returns should be somewhat larger. With industry abnormal returns also staying constant, the net effect of an informate investment on a firm is possibly greater than automate investments, but most likely by only a small margin.

A fairly recent polemic, *IT Does not Matter*, by Nicholas Carr (2003), a previous editor of the Harvard Business Review, argued that IT can no longer offer a strategic advantage and describes IT as having become a commodity. According to Carr (2003, p. 42), "IT investments are becoming costs of doing business that must be paid by all but provide distinction to none." This view can be explained when looking at IT investments in an automate or informate strategic role. However, when transformational IT investments are considered, this view no longer applies.

Transformational investments introduce radical business models that disrupt industry practices (e.g. bypassing certain value chain participants) and market structures (e.g. the creation of a new niche) and are a means for firms to position themselves more favourably within an industry (Dehning et al., 2003). Tanriverdi and Ruefli (2004)

describe these investments as redefining the existing complementarities within the firm. Using RBV, it is clear that transformational investments would have a strong effect on outside-in and spanning resources – those resources which are most likely to provide sustainable competitive advantage. It can be argued that successful industry disruption through transformational investments allows a firm to enter a new "sub-industry" entirely (Dehning et al., 2005). From the FVF, this new sub-industry will have few, or no, competitors. With virtually non-existent competitive forces, the firm can operate at a very high profit level (high *IAE*) which is sustainable going forward.

One qualification, though, is that it would not be free of risk. As Weill (1992) and Dehning et al. (2003) point out, such investments often produce high-risk, high-return scenarios; and furthermore, the investment could be marked by a potentially long delay before realising benefits.

This discussion above leads to the first hypothesis:

> ***H1: Firms announcing IT investments characterized as reflecting a transform IT strategic role will experience positive, abnormal changes in market value.***

So far, IT strategic role has been spoken about from the firm level; IT strategic role can also be examined from an industry level. Dehning et al. (2003) describe this construct as capturing the leveragability of the industry context within which a major IT investment is directed. An investment is not viewed in isolation from the structures and strategies of the industry in which the investment occurs. In evaluating a firm's IT investment, one is likely to look through a lens reflecting the role that IT serves in that's firm's industry and the associated likelihood that IT investments will produce a sustainable increase in industry profitability.

In assessing an IT investment occurring in an industry characterised as having an automate IT strategic role, one can argue that the investment would not be seen particularly favourably. Industry abnormal earnings cannot be expected to be high in automate industries, since competitors would have imitated any valuable IT

investments and competed away any competitive advantage. Hitt and Brynjolfsson (1996) examined this empirically and concluded that although IT investments had improved productivity in their sample, there was no significant increase in profitability as firms had competed away the benefits from their IT investments and passed them on to the consumer. Therefore, an automate industry strategic role would result in no higher industry abnormal earnings.

An informating industry should not result in much higher industry abnormal earnings. Competitive forces in an informating industry should limit its abnormal earning potential. Furthermore, investors examining the competitive forces in an industry in the informate stage should not perceive it as having any competitive advantage over other industries. An industry characterised as having an informate strategic role will, therefore, not have high industry abnormal earnings either.

When transforming dominates an industry, however, structural changes in value chains and market niches can take place, which partitions the industry into sets of strategic groups (Dehning et al., 2003) or sub-industries (Dehning et al., 2005), with each sub-group reflecting a unique competitive strategy and higher industry abnormal earnings. Not all firms in the industry will necessarily be engaged in transformational IT investments. The industry, as a whole, though will be transformational and will operate at elevated profit levels relative to other industries. Firms that then make an IT investment announcement should be seen by the market as declaring or reinforcing membership in one of these strategic groups, with the likelihood that the company will successfully transform to realise the benefits from the IT investment (Dehning et al., 2003).

This then leads to the second hypothesis:

> ***H2: Firms announcing IT investments in industries in which the transform IT strategic role dominates will experience positive, abnormal changes in market value.***

The last two hypotheses look at the interactive effect of investment and industry IT strategic role. As Dehning et al. (2003) argue, it is important to recognize that differential effects may be realized when a firm's strategic intent with regard to an IT investment is viewed from the prevailing IT strategic role of that firm's industry. A salient interactive effect might arise when the IT investment strategic role is distinct from (leads or lags) the dominant industry IT strategic role. Following, again, a logic that investors interpreting firms' IT investment announcements will do so through a lens reflecting industry IT strategic role, the last two hypotheses are:

> ***H3: Firms announcing IT investments that lead their industry IT strategic role will experience positive, abnormal changes in market value.***

> ***H4: Firms announcing IT investments that lag their industry IT strategic role will experience negative, abnormal changes in market value.***

2.7 Event Study Methodology

To investigate the above hypotheses, event study methodology (ESM) will be used. This methodology is used to conduct *event studies* and involves analysing the reaction of a stock market to certain announcements. For IT value research it is extremely useful because it obviates the need to analyse accounting-based measures of profit (McWilliams & Siegel, 1997), which can be problematic, as discussed in Section 2.2.1. Dehning et al. (2003: p. 638) succinctly describe its usefulness:

> "Through the use of event study methodology and careful research design, it is possible to assess the extent to which attributes of IT investments, investing firms, and/or investment contexts influence shareholders' interpretation of the value relevance of such announcements and, as a consequence, produce abnormal movements in the investing firm's stock price."

2.7.1 IT Studies Using ESM

Many IT value studies have been conducted using ESM, and increasingly so in recent years. The first was a study by Dos Santos et al. (1993) who examined the market effects of innovative and non-innovative IT investments. Since then, other researchers have used it to examine a range of IS issues and various related factors.

Event studies looking specifically at IT investment value include: a comparison of infrastructural with application IT investments (Chatterjee et al., 2002), IT investments moderated by a range of contextual factors (Im et al., 2001; Oh & Kim, 2001), innovative IT investments (Dos Santos et al., 1993); explorative versus exploitative investments (Hunter, 2003); knowledge management strategies (Choi & Jong, 2005) and transformational IT investments (Dehning et al., 2003). Most of these studies have found some positive results: innovative investments resulted in positive abnormal returns (Dos Santos et al., 1993); Chatterjee et al. (2002) found both infrastructure and application investment events exhibited positive abnormal returns – infrastructure more so; and firm size and time lag effects help explain the market's reaction (Im et al. (2001).

Dehning et al. (2003), the study which this thesis is replicating, more specifically find positive returns to firms investing in IT with a transform strategic role and making IT investments in industries undergoing IT driven transformation. They also do not find negative returns for firms lagging the dominant industry role; for example, an automate investment in a transform industry. Furthermore, they show that the IT strategic role construct is able to explain the factor effects of the event study by Im et al. (2001) – firm size and time period – as, in fact, being manifestations of positive returns experienced from transformative IT investments.

Other ESM studies in the IS field examine more particular events, and include: e-commerce initiatives (Dardan & Stylianou, 2001; Dehning et al., 2002; Subramani & Walden, 2001), outsourcing agreements (Farag & Krishnan, 2003; Hayes, Hunton & Reck, 2000), ERP implementations (Hayes, Hunton & Reck, 2001), denial-of-service attacks (Ettredge & Richardson, 2001, 2003; Hovav & D'Arcy, 2003), security breaches (Campbell, Gordon, Loeb & Zhou 2003; Cavusogla, Mishra & Raghunathan,

2002), merger and acquisitions for Internet firms (Ma & Ranganathan, 2001; Ranganathan & Dadalt, 2001), newly created CIO positions (Chatterjee et al., 2001) and nominations to the board-of-directors of Internet companies (Richardson & Zmud, 2002).

2.8 Contextual Factors

A number of contextual, or control, variables have also been used in previous IT event studies to account for variations in abnormal returns. For comparison purposes, a number of these variables are included in this thesis; therefore, the literature supporting these factors is discussed here.

The list below shows variables examined by past IT investment event studies as well as the studies which have included them. Where a significant result was obtained for the variable (positive or negative), the study is italicised:

- firm size (*Hayes et al., 2000*; *Im et al., 2001*; Hayes et al., 2001; Oh & Kim, 2001; Chatterjee et al., 2002; Dehning et al., 2003; Hunter, 2003; Hart & Webber, 2005)
- financial sector member or not (Chatterjee et al., 2002; *Im et al., 2001*; Dehning et al., 2003; Hart & Webber, 2005; Choi & Jong, 2005)
- manufacturing sector member or not (Dos Santos et al., 1993; Choi & Jong, 2005)
- service sector member or not (*Hayes et al., 2000*; Hayes et al., 2001; Chatterjee et al., 2002; *Farag & Krishnan, 2003;* Choi & Jong, 2005)
- IT producer or user (Chatterjee et al., 2002; *Farag & Krishnan, 2003*; Hart & Webber, 2005)
- explorative versus exploitative (*Hunter, 2003*)
- strategic versus cost cutting (*Farag & Krishnan, 2003*)
- industry IT strategic role (*Chatterjee et al., 2001*; *Dehning et al., 2003*)
- IT investment strategic role (*Dehning et al., 2003*)
- firm growth (*Oh & Kim, 2001*; Chatterjee et al., 2002; Hart & Webber, 2005)
- free cash flow (*Oh & Kim, 2001*)

- variability of future cash flow (*Oh & Kim, 2001*)
- variability of daily stock returns (Oh & Kim, 2001)
- liquidity (Hunter, 2003)
- number of lines of business (Chatterjee et al., 2002)
- financial health (Hayes et al., 2001)
- time period (*Im et al., 2001*; *Chatterjee et al., 2001*; Dehning et al., 2003; Hunter, 2003)

As is evident, most studies of contextual factors do not show significant results. Two variables stand out: *industry IT strategic role* and *IT investment strategic role*. Other variables with both significant results and insignificant results include *firm size*, *financial sector*, *service sector*, *IT producer or user*, *explorative versus exploitative*, *strategic versus cost-cutting*, *firm growth*, *free cash flow*, *variability of future cash flow*, and *time period.* The most popular variables examined are firm size, the sector memberships, and time period even though they, generally, do not show significant empirical support.

Because a number of variables are tested in this thesis, theoretical support for their inclusion and expected results is discussed here. The variables are: firm size; the three sectors of financial, manufacturing and services; IT producer or technology sector; and time period.

Regarding firm size, it has been argued that smaller firms should have greater abnormal returns from investment announcements. Small firms, as theorised by Brynjolfsson (1994), are more likely to have certain advantages when information is considered an asset and complete contracting is not possible; this is also supported by Im et al. (2001). Atiase (1985) mentions that the information available about smaller firms is far less than for larger firms; so announcements by small firms should contain more news to investors. Relating the issue back to the FVF, Dehning et al. (2005) discuss that the duration of competitive advantage should be longer for small firms because they are scrutinised less and are seen as less of a threat by larger firms, but on the other hand, smaller firms are generally more risky. Although much has been argued for small size having superior results, recent research indicates numerous

possible effects of size, making interpretation problematic. Although it was expected that firm size would not have any effect on the results for this thesis, it is, nevertheless, included for comparison purposes.

The reasons for including sector memberships as contextual factors are often not justified in many of the event studies. Where justification is given, it usually concerns the hypothesised level of information or IT use in the sector. Farag and Krishnan (2003) mention that the service industries use information heavily and Gordon et al. (1993) show that service firms invest more heavily in IT, compared to manufacturing firms. A higher use, and consequently, greater IT investment, suggests that IT investments in this sector would be better received. Gilchrist et al. (2001), however, state that IT has a substantial impact on productivity growth for manufacturing firms, exceeding the impact that would be predicted by its factor share. This lends support to the idea that IT investments in manufacturing would be interpreted positively. Chatterjee et al. (2002) mention that little research has been conducted on the differences between service and manufacturing firms, justifying the inclusion of both as contextual factors.

Most of the authors agree on the reasons for including financial firms – financial firms are more information intensive (Im et al., 2001; Jarvenpaa & Ives, 1990; Porter & Millar, 1985) and so invest heavily in IT (Dos Santos et al., 1993). The only reason cited for including the IT industry variable is provided by Farag and Krishnan (2003) – because IT producers use information heavily.

Information or IT intensity is the justification for including industry variables, and as Dehning et al. (2003) conclude, this is dominated by the IT strategic role construct. Hence, in this thesis, the industry variables will only be seen to be significant if they correlate with the industry IT strategic role variable, and not simply by the nature of the industry itself.

Regarding the time lag variable, Im et al. (2001) provide a theoretical argument for its inclusion. They argue that an adjustment time, or long learning curve (Ives, 1994), was needed for firms to make complementary investments in order to make their IT

investments productive (Brynjolfsson & Hitt, 1998). Therefore, they made a distinction of two time periods – pre-1991 and post-1991 – the point at which the "the productivity paradox disappeared" (Brynjolfsson & Hitt, 1993, 1996). Chatterjee et al. (2001) divided their sample into two parts: as pre- and post 1994. Their reasoning was "the emergence of the Internet as a recognized and viable business platform". Dehning et al. (2003) simply tested two time variable methods: a binary variable as Chatterjee et al. (2001) did, and a continuous time variable looking at the number of days between each announcement and the first announcement.

Owing to the partial empirical support of previous studies, and to allow comparison with other IS event studies, time period is also tested in this thesis. The distinction used by Im et al. (2001) is not possible in thesis, due to the testing of later data and lack of evidence regarding a productivity paradox in South Africa. Following Chatterjee et al. (2001), an "event" was chosen for a binary test in this thesis as well, although, once again owing to later data, Chatterjee et al. (2001)'s event could not be used. The event chosen was the coinciding peak of the NASDAQ composite index and the Johannesburg Stock Exchange's (JSE's), IT index – both on March 10, 2000 – right before the dot com crash.

2.8.1 South African Research

Little South African research has been done on the value of IT. Van Aswegan (1993) investigated the effects of IT investment by South African banks on firm, industry and national performance. Lubbe (1994, 1998) studied the financial performance effects of IT investments by Namibian firms and IT investment processes of South African firms. And Lubbe, Parker and Hoarde (1995) conducted a study of large insurance companies, finding a positive relationship between IT investment levels and profitability.

Regarding event studies in general, there is a small history. Knight and Affleck-Graves (1988) looked at the market reaction to LIFO accounting adoptions, with Bhana conducting a range of studies: increased capital requirements for banks (1995), special dividends (1998), new share issues (1999a), potential takeovers (1999b), research and development announcements (2001), key executive dismissals (2003)

and management buyouts (2005). To the author's knowledge, the only South African IT value study using ESM is one investigating IT infrastructure and application announcements, by Hart and Webber (2005).

2.9 Conceptual Framework

A conceptual framework has been developed (Figure 2) to frame this thesis in the study of the business value of IT. It draws from:

- the IT business value model of Melville et al. (2004),
- the framework for IT and economic performance used by Dedrick et al. (2003), and
- the framework for evaluating research on the benefits of IT investments used by Dehning and Richardson (2002).

Melville et al. (2004) themselves draw from the RBV and so this is represented to a degree in the conceptual model as well. The categorisation of resources does not follow the role based typology of Day (1994), but is a melding of classifications by Barney (1991), Bharadwaj (2000), and Ross et al. (1996) into technology IT resources, human IT resources and complementary organisational resources. "Resource" is still taken to mean assets and capabilities.

The framework illustrates the overall body of knowledge of IT business value research. It can be viewed as a relationship between various factors in three domains: macro environment (economy and national factors), competitive environment (structures, regulations and competitiveness of an industry) and the firm. The factors interacting with the firm include: country characteristics (macro environment) and industry and trading partner characteristics (competitive environment). The firm itself is broken down into the business value generation process which includes the firm's resources, as mentioned above.

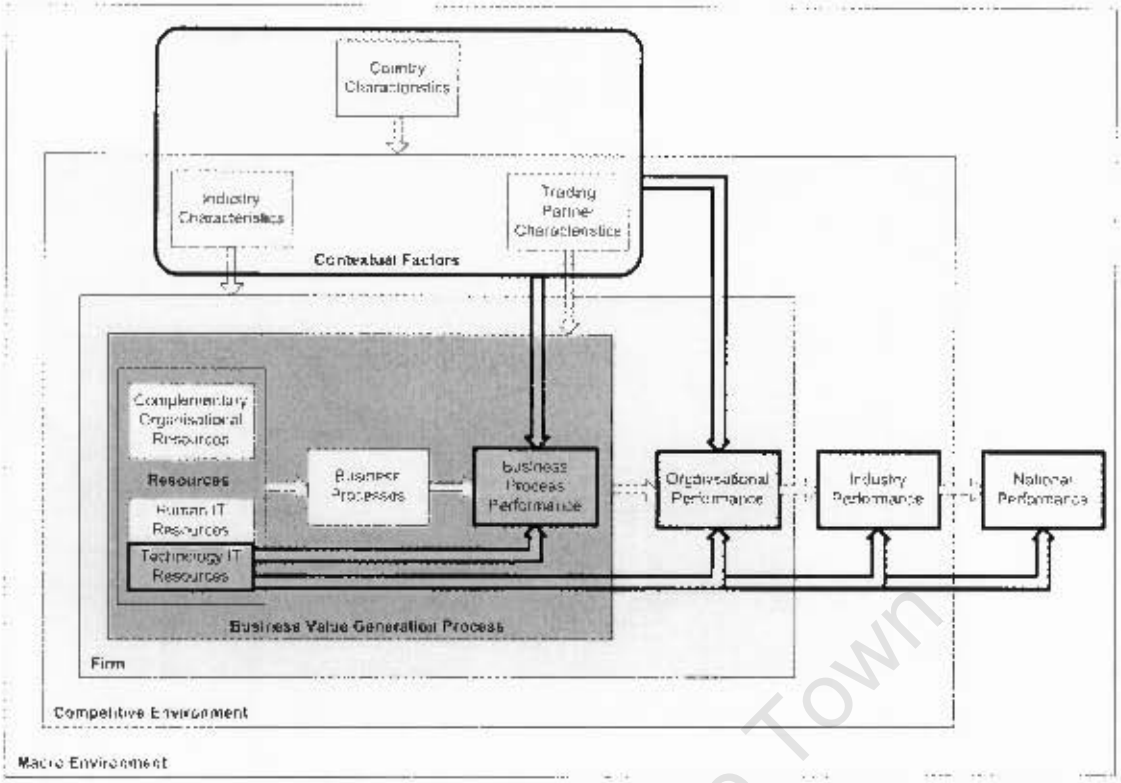


Figure 2 – Business Value of IT Research Framework

Business value generation follows the use of (and interaction between) the firm's resources and the firm's business processes to produce an economic rent for those resources. This impacts on business process performance, and when including firm characteristics outside of its business value generation and the effect of competitive and macro environment factors, is measured by organisational performance. This then contributes to industry performance, and when aggregated across all firms, is measured as industry performance. Lastly, when aggregating industries, this can be measured at a national level.

The framework also illustrates how the relationship between IT investments and performance has been empirically measured and tested in previous studies (following Dehning & Richardson, 2002). This is shown by the thick-lined blocks in Figure 2.

The proposed thesis is located within the framework as illustrated in Figure 3 below. Its scope is limited as follows:

- IT investment announcements – as the IT spending measure,

- industry IT strategic role, IT investment strategic role, firm size, and industry sectors – as the contextual factors, and
- firm market measures – as the measure for organisational performance.

These variables follow from the study by Dehning et al. (2003) and the theoretical development in this literature review.

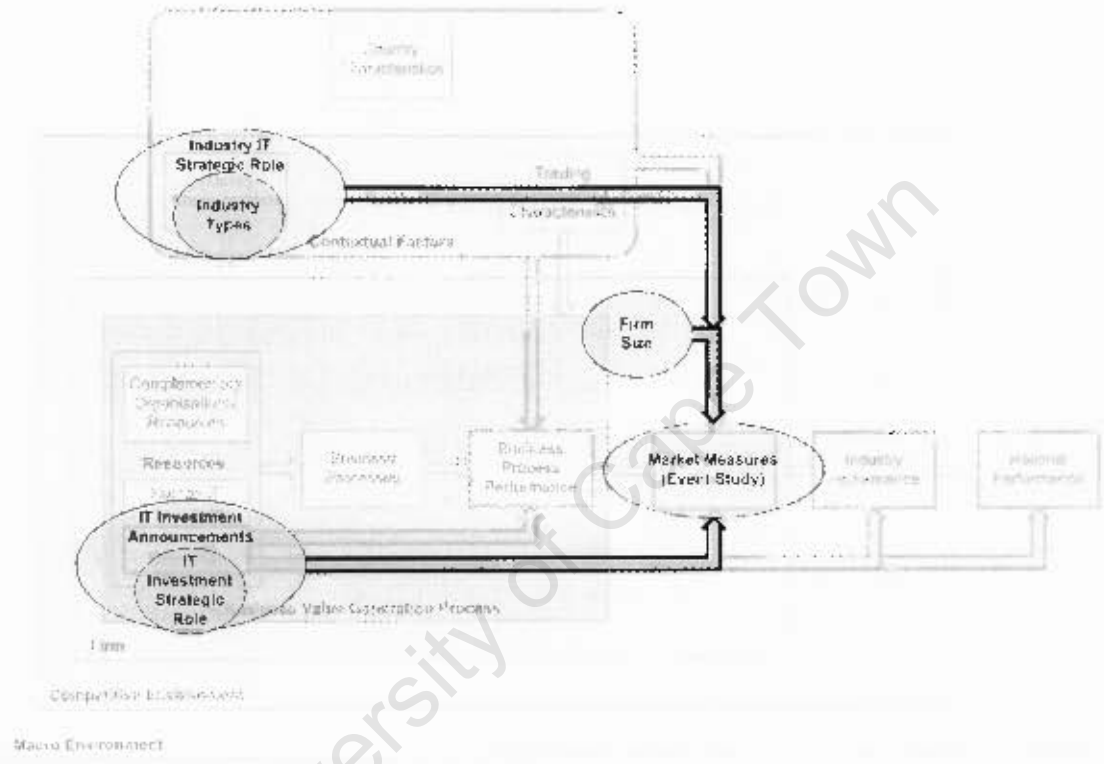


Figure 3 – Scope of Proposed Research

2.10 Summary

This literature review has discussed the context for the proposed thesis. Based on what has been covered, one can summarise the state of research in IT value, the problems encountered with empirical IT value research, and the value of the resource-based view and the IT strategic role construct in explaining how IT can add value.

It is clear that IT is an important resource to business in today's environment. The value that IT can offer has been an important management issue for many years and remains an important issue today. Research has shown that IT improves productivity

at the country level, industry level and firm level. Regarding the question of increased profitability, it has been identified that a sustained competitive advantage is required. However, exactly how IT can be used to create this is still not resolved and further research is required.

The methodologies used up to this point have made use of accounting measures and market value measures. Although the accounting-measure studies have presented relevant, constructive research over the last 20 years, there are questions that they have not been able to answer. This is due to many reasons, including modelling and measuring difficulties, and non-existent or, otherwise, poor data.

A relatively new methodology in the IS field – event study methodology – has emerged as a valuable new way to measure an IT investment's perceived value. In the last five years, event studies have been used to examine a range of different IS questions, including the question of IT investment value. Numerous opportunities exist for event studies to explore IT value more fully.

Research into IT value is now focussing more and more on reasons why and how firms get value from IT investments. What has been identified is that there are intangible assets which firms require in order to convert IT investments into returns. These intangible assets are created by complementary investments which are driven, themselves, by an IT strategy and innovative managerial practice. This process is the key to IT investments eventually yielding value.

The resource-based view is a well-developed and well-researched theory, and allows for a deeper understanding of a firm's resources and their role in creating firm value. Consequently, it can aid management in its IT and business strategies, and in planning for IT investments which are more likely to produce sustainable competitive advantages. The firm-value framework is a more recent addition to the IT value body of knowledge, and can be used, in consultation with the RBV, to examine the dynamic of IT investments and the influence of the various other factors affecting firm value. By focussing on mitigating risks and the characteristics of the industry environment, by scrutinising the available resources, the resources of competitors and

their possible responses, and the durability and possible delays of benefits from an IT investment, the FVF provides a well-rounded framework in understanding what goes into an IT investment increasing firm value.

IT strategic role has emerged as a useful construct in determining what it is about an IT investment which allows it to produce a sustainable competitive advantage. This construct has been successfully applied in prior research, specifically the empirical study by Dehning et al. (2003). The targeted IT strategic role of an investment, the industry IT strategic role of firms announcing IT investments, as well as the interaction of transform investments in a transform industry, were found to be significant factors of positive abnormal returns. Furthermore, the construct was found to subsume the findings of previous research.

At present, the body of knowledge concerning the relationship between IT, strategy and firm performance, although still in a developing state, is present on a conceptual and theoretical basis. To further the understanding of why and how IT adds value, what is required is more empirical research into this relationship. South Africa is a country with very limited research in IT value and so offers a great opportunity for IS research, especially research into the value of IT investments in a developing country.

3 Methodology

3.1 Introduction

Event studies essentially measure how stock markets react to new information. This reaction is measured and tested as an abnormal return to an, otherwise, normal market return. In order to assess abnormal returns, an event study uses a sample of stock price reactions to a specific type of new information entering the market, across a group of firms. This forms the event under investigation.

In order to carry out such a study, it is important to understand what assumptions this type of study makes. It is also important that the right methods are used for measuring and testing the effects of the event and that all considerations for the validity of these methods are addressed.

What follows is an outline of these possible concerns, how these concerns are handled, and the process and methods that are used in conducting this event study.

3.2 Event Study Concerns

In order to conduct a valid event study, there are certain design concerns that need to be addressed. Event studies can only be carried out under certain assumptions. Furthermore, there are specific issues regarding data and testing which can cause an event study to be poorly specified. McWilliams and Siegel (1997) conducted research into the effect of these event study issues – these issues are discussed below.

3.2.1 Event Study Assumptions

It is well established that the usefulness of event study methodology depends heavily on a set of rather strong assumptions (Brown & Warner, 1980, 1985). If the assumptions are violated, the empirical results may be biased and imprecise, and therefore basing conclusions on them may be problematic (McWilliams & Siegel,

1997). The three assumptions of event studies are: (1) markets are efficient, (2) the event was unanticipated, and (3) there are no confounding events in the event window.

The first assumption is the basis for event studies and makes use of the *efficient market hypothesis* (Fama, Fischer, Jensen & Roll, 1969). The hypothesis posits that stock prices represent all available information, and any new information should almost immediately be incorporated into stock prices. The stocks used in an event study should, therefore, originate from an efficient stock market. Also, since event studies assume an efficient market, it follows that the *event window* – the defined period of days over which the impact of the event is measured – should be fairly narrow. The use of a long event window is difficult to reconcile with the assumption of market efficiency.

The second assumption – that the event was unanticipated – is important because if leakages of information occurred, the effect of the event in question could not be uncovered or measured.

The third assumption is that there are no other material events confounding the effects of the event in question. If other events are occurring in the event window, the effect cannot be isolated. And the longer the event window, the greater the chance of confounding effects.

This thesis meets the required event study assumptions. Regarding the first assumption, the efficient market hypothesis recognises three forms of market efficiency: weak, semi-strong and strong. Both semi-strong and strong are considered efficient markets. Research by Okeahalam and Jefferis (1999) and Magnusson and Wydick (2002) found the JSE to be efficient at the semi-strong level, thus supporting the first assumption.

The event being unanticipated (the second assumption) is a potentially tenuous assumption. Although the JSE and the Financial Services Board of South Africa have attempted to eliminate "insider trading" (New Insider Trading Act, 1998), it is

possible that information of an upcoming event is traded on or escapes into the market before it is announced. However, a proof to the contrary is beyond the scope of this thesis, and it is argued that the stock prices are less likely to be impacted for this type of event than for those events conventionally seen to be directly related to increases or decreases in firm earnings or profitability. Nevertheless, efforts have been made to identify leakage and are discussed below in the Implementation Section 3.2.2.3.

Confounding effects are addressed in the implementation of this event study. This is discussed in Section 3.2.2.4.

3.2.2 Event Study Implementation Issues

Potential implementation issues of an event study could affect its validity and legitimacy, violate ESM assumptions, or present statistical problems during analysis. McWilliams and Siegel (1997) identify these concerns as: sample size, outliers, length of the event window, confounding effects, and the explanation of abnormal returns.

3.2.2.1 Sample Size

Small sample sizes can present problems because test statistics used in the event study framework are based on normality assumptions associated with large samples. When samples are small, Barclay and Litzenberger (1988) say that researchers would be prudent to use "bootstrap" methods, although this is disputed by McWilliams and McWilliams (2000).

In this thesis, however, sample size is not a problem on the whole. The study includes 8 years of data totalling 323 announcements. Most of the 17 sub-samples which are tested in this thesis are also sufficiently sizeable. However, there are occasions where this is not the case (see Table 8 for these numbers) and this is taken into consideration when reviewing the results. However, the only main effect tested in this thesis which is strongly influenced by sample size is the lead effect: where investment role leads industry role. Here, out of three lead sub-samples, only one is of sufficient size. This does not, however, severely limit this study and so, consequently, the scope of this thesis does not extend to including bootstrapping techniques.

3.2.2.2 Outliers

Outliers can be a problem to the typical event study methods which are very sensitive to them. Methods such as nonparametric tests can be used to address this potential problem, and are used in this study in conjunction with the typical parametric tests. The nonparametric tests which will be used are discussed below in Section 4.1.3.

However to limit the effects of outliers on results many event studies have taken the approach of removing extreme outliers from the sample (McWilliams & Siegel, 1997). McWilliams and Siegel (1997) point out, though, that simply removing all outliers is a drastic approach to control for them. In this study, four announcements containing very large outlying data points were removed from the sample in order to reduce the sensitivity of the statistical tests to these outliers. Although some of the other announcements showed other, less significant, outlying points, these were not removed. However, to gauge the results' sensitivity to them, all tests were conducted again after removing the 25 announcements with the highest kurtosis and skewness. This is discussed in Section 4.6.

3.2.2.3 Event Window Length

The issue of the length of the event window is related to, and can easily undermine, the assumption of efficient markets. It is described by McWilliams and Siegel (1997) as "the most crucial research design issue". Empirical testing has shown that a short event window will usually capture the significant effect of an event (Ryngaert and Netter, 1990). Studies such as Dann, Mayers and Raab (1977), Mitchell and Netter (1989) and Brooks, Patel and Su (2003) have shown evidence of stock prices adjusting within 15 to 90 minutes of an event. Therefore, it would be prudent to use a short event window in assessing abnormal returns.

The primary event window that is used is a 1-day window – looking at the day of the announcement, or day 0. In terms of identifying any abnormal returns which are present, this is the most suitable (Dyckman, Philbrick & Stephan, 1984; Glascock, Henderson, Officer & Shah, 1991), and, in terms of the efficient market hypothesis, is the most theoretically sound (Ball & Torous, 1988). Three other event windows are

also employed, and these follow what most IS event studies, including Dehning et al. (2003), have used: a 2-day (-1, 0), a 3-day (-1, +1) and a 5-day (-2, +2) window. These are suitable for comparison purposes.

As discussed earlier, a consideration in deciding on event window length is that of leakage and insider trading. It can be argued that a long event window would more fully capture insider reactions to an event; however, as McWilliams and Siegel (1997) state "if a window exceeds the standard 2-day length, it should be justified". The benefits of detecting any insider trading using a longer event window would not justify the cost of controlling for confounding effects which would most certainly reduce a sample dramatically. In an investigation of three studies using long event windows, McWilliams and Siegel (1997) found that after controlling for confounding effects of a 41-day event window, the sample size was reduced to 0, and for a 21-day window, the sample was reduced to 5. Furthermore, a long event window could not be reconciled with the efficient market hypothesis – an important tenet of ESM. This thesis, therefore, will limit its window size to a maximum of five days. Following Chatterjee et al. (2002) and Hart and Webber (2005), a (-10, +10) plot of cumulative average abnormal returns (CAARs) will be presented as a visual inspection for insider trading.

3.2.2.4 Confounding Events

Merely identifying confounding events is not sufficient; how they are dealt with is the important concern. Foster (1980) discusses several methods to control for them: (1) eliminate firms that have confounding events, (2) eliminate a firm from the sample on the day that it experiences a confounding event, (3) partition a sample by grouping firms that have experienced the same confounding events, and (4) subtract the financial impact of the confounding event when calculating the abnormal return.

Where confounding effects were discovered in this study's sample, the method that was used is (2) to eliminate firms with confounding effects on the days that they are present. The approach taken to identify confounding events was to search the Lexis-Nexis database, specifically in the Business Day and Financial Mail archives, in the 3-day window around the event date. It was not seen as necessary to search in the

largest 5-day window because this window was only included for comparison purposes, and owing to it not conforming to the efficient market hypothesis no significant results were predicted under this window (this did prove to be true). Removing announcements with confounding events is consistent with previous research and is the standard approach for event studies (Armitage, 1995).

The confounding events which were searched for included: firm restructuring, changes in prices, announcements of new products, dividends or earnings announcements, joint venture agreements, acquisitions, litigations, labour unrest, executive changes, changes in forecasted earnings, contract awards, layoffs, debt or equity related announcements, results releases, and specific to South Africa – black economic empowerment (BEE) deals.

3.2.2.5 Explaining Abnormal Returns

The last implementation issue is how abnormal returns are explained. Abnormal returns are seen as the returns above expected returns which are due to the event in question. Where abnormal returns are identified, they need to be explained by showing that the cross-sectional variation of returns across the firms is consistent with a given theory. This is accomplished by running a regression of the abnormal returns on measures predicted by the theory, and reporting on the parameter estimates. The regression method that is used is discussed in Section 3.3.1.5.

3.3 Event Study Process

As the number of event studies has increased, a process for effectively and correctly carrying out an event study has been formulated. MacKinlay (1997) outlines the event study process as consisting of three stages:

1. The devising of an econometric design.
2. The calculation and presentation of the test results.
3. The presentation of insights relating to understanding the effects of the event.

In designing the econometric model (1.) the process is broadly described as follows:

a. Defining the event of interest.
b. Identifying the event window.
c. Identifying the firm selection criteria.
d. Selecting the abnormal return appraisal method.
e. Designing the testing framework.

The **event of interest** (a) is the type of new information into the market which will be investigated. In this study, the event of interest can be formally stated as:

> Announcements of IT investments by listed South African firms.

As mentioned earlier, the **event window** (b) is the window over which the effect of the new information from the event is measured and, in this thesis, is a 1-day window around the announcement date (0), a 2-day window (-1, 0), a 3-day (-1, +1) and a 5-day window (-2, +2).

Certain firms or types of firms are not usable in an event study for validity reasons. For example, firms which lack sufficient financial data and firms which are in a particular industry may not be able to be included. Therefore, certain **selection criteria** are needed in selecting the firms which form part of the event study (c). The criteria to be used for selecting firms to be included in the sample can be stated as:

> South African firms which have been listed for more than three hundred business days before the event, which have no missing required data, and which have made an announcement of a new IT investment between the dates 1 January 1998 to 31 December 2005.

The time period specified gives a total length of eight years of possible data and was chosen because data prior to 1998 would have been difficult to obtain, and because the years post-1998 cover a period of high investor sensitivity to IT events, due to the year 2000 and e-commerce build up.

The sample of announcing firms needs to be summarised by its various characteristics. These include industry representation, firm market capitalisation, and distribution of events through time. Furthermore, the distribution of announcements across firms and the proximity of announcements (clustering) must also be noted. (This appears in Section 4.1.2).

The two other steps of the econometric model (d and e) concern how the abnormal returns are measured and how they are tested for significance. Abnormal returns, as mentioned previously, are computed as the difference between an actual return and the expected return. How expected returns are arrived at depends on the model used. Test statistics for the abnormal returns vary in design and both parametric and nonparametric tests can be used. Certain test statistics also favour certain circumstances and data characteristics.

The following sub-sections discuss the various modelling and return appraisal methods, and the reasons for choosing the ones which will be used in this thesis.

3.3.1 Abnormal Return Appraisal and Testing Framework

There are a number of possible procedures for estimating abnormal returns and testing their significance. Looking at event studies as a whole, Armitage (1995) describes studies as being far from homogenous in their use of these methods. In appraising abnormal returns and testing their significance, there are two areas to examine: choice of model and choice of significance test.

3.3.1.1 Choice of Model

Armitage (1995) identifies six primary models of expected returns:

1. Index model
2. Average return model
3. Market model
4. CAPM
5. Fama-MacBeth model
6. Control portfolio model

The simplest of these models is the *index model.* This model is based on the assumption that over a period of time, a share will earn the market rate of return. Therefore, the expected return for a share is substituted by a market index. Another simple model is the *average return model.* Here, the expected return is computed as a share's average return over an estimation period.

A more advanced model and the most commonly used one is the *market model.* This model uses a one factor ordinary least squares (OLS) regression of a shares return on the market's return (proxied for by a market index) over an estimation period. The estimation period may include the event period or not. If the event period is a subset of the estimation period, the abnormal returns are given by the relevant subset of regression error terms or residuals. If the two periods are separate, the market model abnormal returns are prediction errors. Described as "the earliest and most influential event study" (Armitage, 1995), Fama et al's (1969) examination of stock split announcements is an early example of the use of the market model. This model has been used almost exclusively in the information systems field.

The *capital asset pricing model* (CAPM) is unlike the above three models in that it is a true theoretical model developed by Sharpe (1964), Lintner (1965) and Mossin (1966). The model equates the expected return of a stock to the stock's sensitivity to the market risk premium added to a risk-free rate of investment. The market risk premium is the return above a risk-free investment that can be expected for investing in a portfolio which mimics the return of an efficient portfolio of all assets in the market. An example of a risk-free investment is a government bond, where the risk of default, in most circumstances, is considered to be zero. Essentially, CAPM puts a stock's rate of return equal to the market rate of return moderated by the stock's risk (β) in terms of the market.

The foundations of CAPM can be used to provide theoretical support to the market model. According to Armitage (1995), this is possible if the intercept term of the market model regression is interpreted as one of the terms in the CAPM equation (the formal derivation of this is illustrated further on). This interpretation of CAPM makes the market model a simple and well-specified model to use.

The other two models are the *Fama-MacBeth model*, developed by Fama and MacBeth (1973) and the *control portfolio model*. The former is a variant of CAPM. It uses cross-sectional regression coefficients for a specific length of time t for the β of a stock over t to calculate its expected return. The control portfolio model looks at the returns of a portfolio of stocks and compares it with a control portfolio that has the same risk or β.

A number of simulation experiments have been carried out which have tested these different models using a variety of circumstances and tests of significance (Brenner, 1979; Collins & Dent, 1984; Dyckman, Philbrick & Stephan, 1984; Brown & Warner, 1980, 1985; Seyhun, 1986; Klein & Rosenfeld, 1987; Brick, Statman & Weaver, 1989). Brown and Warner (1980), testing all the models except CAPM, report that "beyond a simple, one-factor market model, there is no evidence that more complicated methodologies convey any benefit." From these studies, the conclusions about event study modelling are that the index model can be less powerful than the market model, that the average return model is weak for events with the same dates and in bear and bull markets, that the control portfolio can be less powerful than the market model, and that contradictory results exist for the CAPM and Fama-MacBeth models.

On the whole, Armitage (1995) concludes that the different models produce similar but not identical results and that the market model is always at least as powerful as the best alternative. This, therefore, will be the modelling technique used in this event study.

Derivation of the Market Model

The market model is specified as follows:

$$R_{it} = \alpha_i + \beta_i R_{mt} + \varepsilon_{it} \quad (1)$$

where,

R_{it} = the rate of return on the shares of firm i on day t

R_{mt} = the rate of return on the market portfolio on day t

α_i = the intercept term of firm i

β_i = the systematic risk of firm i

ε_{it} = the error term, with $E(\varepsilon_{it}) = 0$

As discussed, this model uses a one factor OLS regression of a share's return on the market's return over an estimation period (T) preceding the event. Estimates of daily abnormal returns (AR) for firm i on day t are, therefore, obtained from the following equation:

$$AR_{it} = R_{it} - (a_i + b_i R_{mt}) \quad (2)$$

where a_i and b_i are the OLS parameter estimates of α_i and β_i respectively, obtained from the regression of R_{it} on R_{mt} over the estimation period.

As mentioned, the foundations of CAPM can be used to provide theoretical support to the market model. The model of CAPM is denoted as such:

$$E(R_{it}) = R_{ft} + \beta_i [E(R_{mt}) - R_{ft}] \quad (3)$$

Where

$E(R_{it})$ = the expected or normal rate of return on the shares of firm i on day t

R_{ft} = a measure of the risk-free rate of interest

β_i = the covariance of R_{it} with R_{mt} divided by the variance of R_{mt}

$E(R_{mt})$ = the expected return on the stock market

By interpreting the intercept term of the market model, α_i, as an estimate of $R_{ft}(1 - \beta_i)$, the market model can be seen as a version of CAPM, making it a simple and well-specified model to use (the formula for β_i is exactly the same as that of CAPM).

For the market model in this study, R_{it} is computed as the daily percentage change in closing share prices. Daily percentage change in stock returns is calculated as follows:

$$r_{it} = \frac{p_t - p_{t-1}}{p_{t-1}} \quad (4)$$

where p is the closing share price at time t.

R_{mt} is proxied for using the daily percentage change in the closing value of the FTSE/JSE All Share Index (J203). The FTSE Group, which is an independent company owned by The Financial Times and the London Stock Exchange, and the JSE Limited formed a partnership in 2002 to produce various indices for the JSE stocks. The J203 proxy is the index of all listed shares on the JSE. A study by Bradfield (2003) recommends the use of this index for market model estimations in South Africa. The stock return and index data were obtained from the McGregor BFA database. McGregor BFA, held by Naspers and MWeb, is a South African provider of real-time and historical fundamental information on South African listed companies, top unlisted South African companies, local and international economic data as well as international financial indicators and currency exchange data.

Estimation periods typically range from 100 to 300 days (Peterson, 1989). In looking at the IS event studies that have been conducted, estimation periods have ranged from 255 to 100, with most periods ending before the event date but some ending days after the event date.

Deciding the length of the event window involves a trade-off between greater precision of estimation of a_i and b_i and these coefficients becoming out of date (Armitage, 1995). Simulation results by Corrado and Zivney (1992) show that regression results are virtually unaffected by an estimation period of 89 days compared to 239 days, with 39 days producing a slight deterioration of performance. Considering these factors, this thesis makes use of four estimation periods, shown in Table 2.

Table 2 – Estimation Periods

	Period Start	Period End	Period Length
1.	-300	-45	255
2.	-260	-60	200
3.	-202	-2	200
4.	-102	-2	100

Some event studies, including certain IS studies, have used estimation periods which include the event period. In this case, the abnormal returns are not prediction errors but regression residuals. Because theory better supports the use of prediction errors for significance testing, and because residuals would require different significance

tests to the ones that will be used (discussed further on), all estimation periods end before the event period begins.

By using the market model, this event study will have a theoretically well-founded method of modelling expected returns, which compares favourably against all other possible models, and which will allow for direct comparisons with other information systems event studies.

3.3.1.2 Choice of Parametric Significance Test

In testing the significance of abnormal returns, it is almost always the case that a *t*-test is used (Armitage, 1995). The question is how to arrive at the test statistic. As with the choice of model, there is a range of methods for acquiring a parametric test statistic and testing significance. The methods below are discussed with the assumption that the market model is the model used. These methods follow those identified by Armitage (1995). Some of these tests are known by other names (Boehmer et al., 1991; Seiler, 2000), listed in brackets:

1. Share time series (traditional test or market model residual test)
2. Portfolio time series
3. Cross-sectional
4. Prediction error (standardised residual test)
5. Standardised cross-sectional
6. Generalised Least Squares – GLS

The first approach, the *share time series* method, is the most simple appraisal method. Here the computed abnormal returns of each share (AR_{it}) are standardised by the share's estimation period standard error of regression (s_i). Each standardised abnormal return has an expected mean of zero and standard deviation of nearly one. This makes the calculation of the test statistic fairly simplistic: it being merely a factor of the number of shares and the average abnormal return across the sample.

The *portfolio time series* method uses an unweighted average of the shares' abnormal returns ($\overline{AR_t}$) as the observations themselves. These observations are divided by a

time series standard deviation ($s_{\overline{AR}}$), which is based on the variance between $\overline{AR_t}$ and the mean of the residuals over the estimation period, to make up the test statistic.

The third approach, the *cross-sectional* method of Charest (1978), ignores estimation period estimates of variance. This method uses $\overline{AR_t}$ as the sample mean which is divided by the variance between each AR_{it} and $\overline{AR_t}$ to form the test statistic.

For the above three methods, if the event window is greater than one day (the event day), cumulative average abnormal returns ($\overline{CAAR}$) can be used. This can be calculated as either the sum of each $\overline{AR_t}$ for each day (t) in the event period, or the average of each share's $CAAR$ which is the sum of each AR_{it}.

In comparing the three methods, it is apparent that each one controls for a specific data issue. The first method, share time series, is concerned with estimation period errors. Because the market model will be used for estimation, errors will vary considerably from share to share. The share time series method, therefore, standardises estimation period errors, controlling for error variances. The portfolio time series method does not adjust for different error variances, but caters for share returns and errors being cross-correlated (and so not independently distributed). The cross-sectional method does not adjust for either estimation regression error variances or cross-correlation, but does allow for the variance of returns being greater in the test period than in the estimation period. This is often referred to as event-induced variance.

Up to this point, the event period may have been included in the estimation period, making the event period regression errors a subset of the estimation period errors. As Armitage (1995) points out, it is more correct to explicitly treat event period errors as prediction errors (and so have the two periods distinct). Three methods which do this are the *prediction error* method, the *standardised cross-sectional* method and the method of *generalised least squares* (GLS). These methods adopt a procedure for standardising observations in the event period, contrasting with the procedures of the first three methods (Armitage, 1995).

The three methods make use of standardised abnormal returns (SAR_{it}). These are calculated by standardising each prediction error in the event period by the error's standard deviation (the formula for this is shown in Equation 5). For the test statistic of Patell's (1976) prediction error method, these SPEs are normalised and averaged across the shares resulting in an *ASPE*. If the event period is greater than one day, *CAARs* are calculated and then formed into the *ASPE*. The normalising of errors adjusts for the fact that the event-period error is an out-of-sample prediction and hence will have a higher standard deviation than estimation period residuals. Furthermore, it allows for heteroskedastistic event-day errors and prevents shares with large variances from dominating the test (Boehmer, Musumeci & Poulsen, 1991).

The standardised cross-sectional method, as proposed by Boehmer et al. (1991), is a hybrid of the prediction error and cross-sectional methods. First, the abnormal returns are standardised by the estimation period standard deviation. If the event period is greater than one day, *CAARs* are calculated, normalised and averaged across the shares into an *ASPE* (following the standardised residual method). These average standardised cumulative abnormal returns are then standardised by the contemporaneous cross-sectional standard error (as in the cross-sectional method) to arrive at the test statistic. The standardised cross-sectional method caters for both a change in error variance in the estimation period and a shift of variance from the estimation period to the event period.

The last method, GLS, is described by Armitage (1995) as the most complete statistical procedure. Each share's prediction error is standardised by dividing it by a factor which reflects both the variance of its market model residual and the covariance of the residual with the residuals of the other shares. The problem with GLS is that the estimation of the variance-covariance matrix requires there to be more observations for each share than there are shares in the sample. Furthermore, many times more than these minima are required to obtain accurate estimates which are not biased downwards (Bernard, 1987). Although GLS is particularly powerful, this requirement for data makes the GLS method an extremely difficult and impractical method to use.

In summary, each of the various significance tests is well-specified for certain characteristics of market model errors but possibly poorly specified for other characteristics. This means that for a particular characteristic the test may reject the null hypothesis too often (Type 1 error) or is too weak to reject the null hypothesis (Type 2 error). These potential market model errors are that:

- there are differences of error variance across the estimation period for a share,
- there is a cross-correlation between the returns of certain shares and their errors, and
- there is a shift in error variance from the estimation period to the event period.

How the various tests compare in catering for these concerns appears in Table 3 below.

Table 3 – Accommodation of Market Model Concerns by Method

	Differing Variances	**Cross-Correlation**	**Shift in Variance**
Share Time Series	Yes	No (*Type 1*)	No (*Type 1*)
Portfolio Time Series	No (*Type 2*)	Yes	No (*Type 1*)
Cross-Sectional	No (*Type 2*)	No (*Type 1*)	Yes
Prediction Error	Yes	No (*Type 1*)	No (*Type 1*)
Standardised Cross-Sectional	Yes	No (*Type 1*)	Yes
GLS	Yes	Yes	Yes

It is clear from Table 3 that the two most capable methods are the standardised cross-sectional method and the GLS method. Although the GLS method caters for all three possible errors, in practice it is a particularly difficult method to use because of its heavy data requirements. The next best is the standardised cross-sectional method, which caters for differing variances and a shift in variance but not cross-correlation. Cross-correlation is possible when shares have the same event date and estimation periods (clustering) and likely when they are in the same industry. However, clustering is almost non-existent in the sample, and regarding correlation from being in the same industry, evidence from Brown and Warner (1980, 1985) shows that if shares are randomly chosen across industries, the impact is very small even when event dates are shared.

In comparing the use of the various methods across the IS event studies mentioned in the literature review, almost all do not mention what method is being used.

Furthermore, it is often unclear as to how test statistics are obtained, making it difficult to ascertain if the event study results and conclusions are truly valid. Despite the lack of labelling of method used, and taking into account the often subtle variations of test statistic derivation, one can ascertain to some degree which method a study was attempting to apply. In almost all cases, it appears that the share time series method or (more likely) the prediction error method served as the basis of the test.

It can be noted at this point that the majority of information systems studies have been at risk of rejecting the null hypothesis too often (Type 1 error) because of the possible presence of cross-correlation and a shift in error variance. In fact, as Cowan and Sergeant (1996) report, when the return variance increases on the event date, the prediction error test is severely misspecified. To the author's knowledge, this is the first information systems event study which will make use of the standardised cross-sectional method as derived by Boehmer et al. (1991) effectively controlling for two of the three possible market model errors in theory, and all three in practice.

Derivation of the Standardised Cross-Sectional Method

The abnormal returns are first calculated and then standardised by each one's standard deviation, resulting in a standardised abnormal return:

$$SAR_{it} = \frac{AR_{it}}{SD_{it}} \tag{5}$$

with

$$SD_{it} = \sqrt{S_i^2 \times \left[1 + \frac{1}{T} + \frac{\left(R_{mt} - \overline{R}_m\right)^2}{\sum_{\tau=1}^{T}\left(R_{m\tau} - \overline{R}_m\right)^2}\right]} \tag{6}$$

Where

S_i^2 = the residual variance from the market model as computed for firm i

$\overline{R}_m$ = the mean return on the market proxy calculated during the estimation period

$R_{m\tau}$ = the return on the market proxy for time τ during the estimation period

T = the number of days in the estimation period.

The individual abnormal returns are assumed to be cross-sectionally independent and distributed normally, so each standardized prediction error has a Student *t* distribution. By the Central Limit Theorem, the distribution of the sample average standardized prediction error is normal (Cowan & Sergeant, 1996).

The standardised abnormal returns can then be cumulated over a number of days, *k* (the event window), to derive a measure of the cumulative standardised abnormal return (*CSAR*) for each firm:

$$CSAR_i = \frac{1}{\sqrt{k}} \times \sum_{t=1}^{k} SAR_{it} \tag{7}$$

The test statistic used to assess whether the *CSARs* are significantly different from zero (its expected value) is:

$$Z = \frac{\frac{1}{n}\sum_{i=1}^{n} CSAR_i}{\sqrt{\frac{1}{n(n-1)}\sum_{i=1}^{n}\left(CSAR_i - \sum_{i=1}^{n}\frac{CSAR_i}{n}\right)^2}} \tag{8}$$

If the *CSARs* are assumed to be independent, which is the typical assumption in studies involving firm-specific rather than common event dates, then *Z* has approximately a standard normal distribution under the null hypothesis of no stock price effect (McWilliams & McWilliams, 2000). The *Z*-statistic is tested for significance against the standard normal distribution. If significant, the average cumulative abnormal return is assumed to measure the average effect of the event on the value of the *n* firms (McWilliams & Siegel, 1997).

3.3.1.3 Choice of Nonparametric Significance Test

Although parametric tests are used in almost all event studies, they are often vulnerable to misspecification. Previous studies have shown that abnormal returns distributions show fat tails and are right skewed (Serra, 2004). More specifically, research has shown that stock returns on markets such as the New York Stock Exchange (NYSE) and NASDAQ show a strong departure from normality (Campbell & Wasley, 1993; Dombrow et al., 2000). In South Africa, Bowie and Bradfield (1998) also found evidence of non-normality for stock returns on the JSE. When the assumption of normality of abnormal returns is violated, parametric tests are sensitive to outliers and are not well specified (Dielman & Pfaffenberger, 1982). Nonparametric methods offer another approach to event studies; they depend on fewer assumptions, while retaining, or even exceeding, the power of parametric tests in detecting abnormal performance (Cowan, 1992; Corrado & Zivney, 1992).

As with parametric tests, there are number of possible nonparametric tests that can be used in event studies. The four most common tests that will be discussed are those discussed by Armitage (1995), Corrado (1989), Corrado and Zivney (1992) and Cowan and Sergeant (1996):

- The generalised sign test
- Corrado and Zivney's adjusted sign test
- Wilcoxon signed rank test
- Corrado's rank test

The usual sign test is a simple binomial test of whether the frequency of positive abnormal residuals equals 50%. The generalised test is a refined version of this test by allowing the proportion of the null hypothesis to be different from 0.5. In this way, the generalised sign test can test for a difference in proportion of abnormal returns in the event period to the abnormal returns in the estimation period.

Corrado and Zivney (1992) present a version of the sign test in which the sign allocated to an abnormal return is determined by its difference from the share's time series median abnormal return, rather than from zero.

The Wilcoxon signed rank test is used by assigning a sign and magnitude to abnormal returns and testing them as usual.

Finally, Corrado's (1989) rank test is a nonparametric test created specifically to test for abnormal stock price performance. It ranks the errors (abnormal returns and estimation residuals) from the estimation and event periods for each share, and the average rank of all errors is subtracted from the rank of the event day error. The test statistic is then formed by dividing the average difference by the standard deviation of average differences over the estimation and event periods.

Various simulation studies have been conducted to test the performance of these nonparametric tests and to compare them with parametric tests. The least powerful of the tests in an event study is the Wilcoxon signed rank test. Armitage (1995) points out that it is not well-specified because it makes the assumption of a zero mean and median which is often not the case in event studies, and according to Brown and Warner (1980, 1985) and Berry et al. (1990) it causes under-rejection of the null hypothesis in event studies.

Two of the other tests are better specified: the generalised sign test and Corrado and Zivney's (1992) adjusted sign test. Simulation research by Cowan (1992) shows that, under a variety of conditions, the generalised sign test is well specified and powerful. The advantage of the generalised sign test is that it takes into account the evidence of skewness in security returns and it is relatively robust to variance increases on the event date. Regarding the adjusted sign test, research by Corrado (1989), Corrado and Zivney (1992) and Maynes and Rumsey (1993) show the test to be of similar power to the share time series and portfolio time series methods.

However, it is Corrado's rank test which is found to be the most suitable; the simulation studies of Corrado (1989), Corrado and Zivney (1992) and Maynes and Rumsey (1993) report Corrado's rank test to be slightly more powerful than both the generalised sign and the adjusted sign test. According to Armitage (1995), this superior specification is seen as a consequence of non-normality in the distribution of daily share returns and market model errors. Campbell and Wasley (1993) further

describe Corrado's rank test as being robust to a non-normal distribution, cross-sectional dependence, increases in the variance of abnormal returns during the event period, thinly traded stocks (infrequent trading of the firm's shares), clustering and serial dependence in abnormal returns.

In reviewing the event studies in the information systems field, only two studies were found to use a nonparametric method (Corrado's rank test): Chatterjee et al. (2002) and Hart and Webber (2005). This is very surprising considering the implications of non-normal error distributions and the violation of other assumptions. In this study, Corrado's rank test will be made use of in conjunction with the standardised cross-sectional parametric test.

Derivation of Corrado's Rank Test

The derivation follows that of Corrado and Zivney (1992) and Cowan (1992). The rank test procedure treats the estimation period and the event period as a single time series and assigns a rank to each daily abnormal return for each firm. Let K_{it} represent the rank of abnormal return AR_{it} in the time series of $T+k$ daily abnormal returns of firm i. Rank one signifies the smallest abnormal return; rank $T+k$, the largest. The mean rank for all firms for the entire time series is:

$$\overline{K} = \frac{1}{2} + \frac{T+k}{2} \tag{9}$$

The mean rank for n firms for k days of the event period is:

$$\overline{K_k} = \frac{\sum_{t=1}^{k}\sum_{i=1}^{n} K_{it}}{kn} \tag{10}$$

The mean rank for n firms on day t of the combined estimation and event period is:

$$\overline{K_t} = \frac{\sum_{i=1}^{n} K_{it}}{n} \tag{11}$$

The rank test statistic is:

$$z = \sqrt{k} \times \frac{\overline{K_k} - \overline{K}}{\sqrt{\frac{\sum_{t=1}^{T+k} \left(\overline{K_t} - \overline{K}\right)^2}{T+k}}} \tag{12}$$

Under the assumption of no cross-sectional correlation, the rank test statistic has a standard normal distribution (Corrado & Zivney, 1992) and is tested for significance against the standard normal distribution.

3.3.1.4 A Complete Nonparametric Approach

As mentioned earlier, nonparametric techniques were introduced into event study methodology because of concerns about the lack of normality in stock return distributions. However, the majority of past studies which made use of nonparametric test statistics have simultaneously used parametric procedures to estimate their expected returns (Corrado, 1989; Cowan, 1992; Campbell & Wasley, 1993). Dombrow et al. (2000) point out that OLS is only the best linear unbiased estimator and under conditions of non-normality, other non-linear estimators may be preferred:

> *"A good robust estimator is fairly efficient regardless of the true error function and only slightly inefficient versus least squares if the true error distribution is normally distributed. Under non-normality, the performance of a robust estimator should be superior to OLS."* (Dombrow et al., 2000, p. 363)

There are numerous alternative estimators which can be used, but following a review of these estimators by Andrews (1972) and research by Hussain and Sprent (1983), Talwar (1993) and Dombrow et al. (2000), the nonparametric estimator chosen for this thesis is *Theil's nonparametric regression* (Theil, 1950).

Various non-normal return distributions have been identified in the finance literature, and in tests done by Talwar (1993) on four of these, Theil estimators were found to

perform better than OLS. Under normality, Hussain and Sprent (1983) found Theil estimators to be slightly inefficient to OLS, but markedly superior under alternative distributions with heavy tails. Dombrow et al. (2000) provide the most significant evidence, however, by employing a simulation approach to test event study techniques. Their simulation looks at combinations of market model (OLS) and Theil estimations, with a parametric test – the prediction error method – and two nonparametric tests – the generalised sign test and Corrado's rank test.

Overall, in non-normal samples, the results of Dombrow et al. show that Corrado's rank test, using Theil estimators, exhibit greater power in detection of abnormal performance, especially in tests at lower levels of induced abnormal returns. In small non-normal samples, this test combination was found to be substantially more powerful. For example, at a 1% significance level, the ability to detect a 0.5% abnormal return in samples of 25 or more is more than doubled with Theil estimations; and in a sample of size 10 with a 0.25% abnormal performance, is tripled. And furthermore, in samples which are more normally distributed, the rank test using Theil estimators was found to provide no less than the same power as the rank test based on OLS.

Because robust statistics should be applied when uncertainty exists as to the true underlying distribution (MacKinlay, 1997; Dombrow et al., 2000), and because JSE security returns have been found to be non-normal, this thesis makes use of Theil estimators in conjunction with Corrado's rank test statistic as an extra estimation technique. To the author's knowledge, this is also the first use of a complete nonparametric approach to event studies, in the IS field.

Derivation of Theil Estimators

This derivation follows Theil's incomplete method (Theil, 1950). The incomplete method is more simplistic in computation and implementation (requiring *N/2* calculations as opposed to *N(N-1)/2*) and was found by Hussain and Sprent (1983) to be almost as efficient as the complete method. The calculation of the Theil estimators is algorithmic in nature, and so no specific equations for the estimators are provided.

The relationship between stock return and market return is assumed to be described by the equation:

$$R_{it} = \alpha_i + \beta_i R_{mt} \tag{13}$$

Step 1: The data consisting of n points of stock returns (R_{it}) and market returns (R_{mt}), for each firm i, for estimation window T, is ranked in ascending order of market return.

Step 2: The ranked data points are separated into two equal size groups of size g based upon the median – the low group (L) and the high group (H). If n is odd, the middle point is ignored.

Step 3: Slope parameters, b_{ij} of a line connecting each point of group L with group H is calculated for all points of each group. Let j represent each point in the two groups, L and H.

$$\begin{aligned} b_{i1} &= \frac{R_{iH,1} - R_{iL,1}}{R_{mH,1} - R_{mL,1}} \\ b_{i2} &= \frac{R_{iH,2} - R_{iL,2}}{R_{mH,2} - R_{mL,2}} \\ &\vdots \\ b_{ig} &= \frac{R_{iH,g} - R_{iL,g}}{R_{mH,g} - R_{mL,g}} \end{aligned} \tag{14}$$

Step 4: The median of slope parameters $b_{ij} \ldots b_{ig}$ is calculated and taken as the best estimate of β_i.

Step 5: For each data point, intercept terms a_{it} are calculated using the previously calculated b_i:

$$\begin{aligned} a_{i1} &= R_{i1} - b_i R_{m1} \\ a_{i2} &= R_{i1} - b_i R_{m1} \\ &\vdots \\ a_{iT} &= R_{iT} - b_i R_{m1} \end{aligned} \tag{15}$$

Step 6: The median of the intercept terms $a_{i1} \ldots a_{iT}$ is calculated and taken as the best estimate of α_i.

3.3.2 Other ESM Considerations

Other statistical considerations have been noted by researchers who have analysed ESM (Brown & Warner, 1980; 1985; Morse, 1984; Jain, 1986; Ball & Torous, 1988; Corrado, 1989; Corrado & Zivney, 1992; Armitage, 1995; MacKinlay, 1997; Dombrow et al., 2000; Seiler, 2000). These include the sampling interval, event date uncertainty, robustness and thin trading.

The sampling interval used in this study is a daily interval which provides the most power (Morse, 1984; MacKinlay, 1997) and so is not an issue. Event date uncertainty can be a problem if a publication used as an event source does not report the event on the day the market was informed. Ball and Torous (1988) found that the informal procedure of using a 2-day event window (-1, 0) works well enough – no more elaborate method is required. Robustness concerns the issue of non-normality in sample returns. This is investigated using descriptive statistics and normality tests, and catered for using the two nonparametric techniques discussed earlier. Regarding thinly traded stocks, Jain (1986) investigated the effect on the distribution of abnormal returns and suggested that, in general, adjustments for thin trading are not important. In Dombrow et al.'s (2000) simulation study, they mention that for their 240-day estimation windows, each stock was required to have a minimum of 40 returns. In this thesis, stocks were generally very actively traded with the odd thinly traded stock sitting well within the requirement of Dombrow et al.; so thin trading was not seen to be a concern.

3.3.3 Data Acquisition Process

The primary set of data required for this thesis was announcements of IT investments, which correspond to the event of interest and the firm selection criteria (discussed in Section 3.3). To obtain this data, a South African internet site which specialises in local IT news, and which hosts virtual press rooms for most of South Africa's IT companies, was used – *ITWeb*.

Because ITWeb has an online archive of IT related announcements, the initial search was conducted using simply the names of listed companies. This was made up of all companies listed over the eight year period, including all currently listed (387), delisted (745) and renamed (217) companies – obtained from the online share site *ShareData.co.za*. This initial search resulted in 521 announcements.

These were then screened to ensure a fit with the event of interest – this mainly excluded announcements which were not concerned, specifically, with a new IT investment. These included announcements of successes of previous investments, training contracts, consulting contracts, contract extensions, and announcements by listed IT companies involving other non-listed companies. This screening brought the total down to 383 announcements.

Each announcement was then examined to see if the trading history was at least 300 days in length. This excluded 16 announcements. The confounding events were then searched for and resulted in the exclusion of 40 further announcements (for a list of search terms, see Section 3.2.2.4). Lastly, announcements with extreme outliers were also removed. The final total came to 323 announcements, shown in Table 4. All the announcement data including the announcing company, announcement title, date, company sector and role ratings can be seen in Appendix D.

Table 4 – Breakdown of Final Sample

Initial Announcement Sample Size		521
Less: Announcements not meeting the selection criteria or event of interest		(138)
Less: Announcements of companies with an insufficient trading history		(16)
Less: Announcements with confounding events		(40)
Less: Announcements with extreme outliers		(4)
Final Sample Size		**323**
Automate Investments	*187*	
Informate Investments	*107*	
Transform Investments	*29*	
Investments in Automate Industries	*187*	
Investments in Informate Industries	*126*	
Investments in Transform Industries	*10*	

3.3.4 IT Strategic Role

The IT strategic role construct is used in this thesis at the investment level – IT investment strategic role – and at the industry level – industry IT strategic role. Therefore, two coding methods were required. The coding practices of Chatterjee et al. (2001) and Dehning et al. (2003) were used in this thesis to obtain both ratings.

In coding the industry role, a questionnaire (see Appendix A) was sent to senior members of the Department of Information Systems at the University of Cape Town, who both research and teach in the field of Information Systems. Each was asked to indicate whether the role that IT served within an industry in a specific time period would best be represented as automate, informate (up or down), or transform. Five responses were received.

A modal value for the level of IT-driven transformation was computed and assigned to each industry for the two periods to get the strategic role score (see Table 7 in Section 4.1.2 for the scores). Inter-rater reliability was also calculated. Each rating by the judges was given a score of 1, 2, or 3 according to the three possible ratings, and Spearman correlations were calculated. The inter-rater reliability score was calculated by concordance as follows:

$$\overline{S} = \frac{(k \times concordance) - 1}{k - 1} \tag{16}$$

where,

$\overline{S}$ = the average Spearman rank

k = the number of judges

The resultant concordance scores were 0.61 for the time period 1998 through 2000 and 0.69 for the time period 2000 through 2005. Relatively strong Cronbach alpha scores of 0.878 and 0.836 support these scores.

For the IT investment strategic role scores, the author of this thesis followed the process of Dehning et al. (2003) and read and categorised each announcement

according to the coding rules given by Dehning et al. – see Appendix B. Two complete passes across the sample of 327 announcements was made to ensure consistent ratings. An example of each role type is given in Appendix D.

3.3.5 Testing the Hypotheses

The first hypothesis states that firms making IT investment announcements characterized as a transform IT strategic role will realize an abnormal increase in value. This is captured by the IT investment strategic role main effect. Therefore, the sample of abnormal returns is grouped by the IT investment strategic role and tested.

The second hypothesis states that firms making IT investment announcements within an industry characterized as having a transform dominant IT strategic role will realize an abnormal increase in value. This is captured by the industry IT strategic role main effect. Therefore, the sample of abnormal returns is grouped by the industry IT strategic role and tested.

To provide further support to hypotheses one and two, the interactive effects of the investment and industry IT strategic role is also tested. This specifies whether the abnormal returns are different from zero for specific levels of IT investment strategic role (automate, informate, or transform) at specific levels of industry strategic role (automate, informate, or transform). Therefore, sub-samples were created from the nine different interactions of investment and industry strategic role, and tested.

In order to directly examine the lead and lag effects - hypothesis three and four respectively – as well as to explicitly contrast the effects of the IT strategic role variables relative to the effects of firm size, industry type and time period, multiple regression analysis is performed. This process is outlined in the next section.

3.3.6 Regression Analysis

McWilliams and Siegel (1997) say that demonstrating that the pattern of abnormal returns is consistent with established theory, a standard practice in other disciplines, lends considerable credibility to the empirical findings of the study. MacKinlay

(1997) also mentions how theoretical insights can result from examining the association between the magnitude of the abnormal return and characteristics specific to the event observation. Examining this relationship can be done using cross-sectional regression on the measures predicted by theory.

Following Dehning et al. (2003), three separate models were constructed for the regression analysis. These are used to test each of the four hypotheses as well as other contextual factors identified from the review of IT event study literature. Model 1 examines the industry-level and investment-level IT strategic role as main effects only. In model 2, the industry-level main effect is examined as well as the effect of a lead or lag of the IT investment strategic role. Model 3 looks at the interaction effect of industry-level and investment level IT strategic role. For each of the models, the following control variables are also tested: firm size; membership in the financial sector, manufacturing sector, service sector or IT sector, and time period. However, because of the partial correlation between industry variables, they are tested for in separate runs of each model. Their theoretical support was discussed in the Literature Review – Section 2.8.

Using the calculated *CSAR* for each announcement for each firm as the dependent variable, the full regression models for Model 1, Model 2 and Model 3 are respectively:

$$CSAR_i = b_0 + b_1 INVSR_i + b_2 INDSR_i + b_3 TIME_i + b_4 SIZE + b_5 IND + e_i \quad (17)$$

$$CSAR_i = b_0 + b_1 INDSR_i + b_2 LEAD_i + b_3 LAG_i + b_4 TIME_i + b_5 SIZE + b_6 IND + e_i \quad (18)$$

$$CSAR_i = b_0 + b_1 INVSR_i + b_2 INDSR_i + b_3 INTER_i + b_4 TIME_i + b_5 SIZE + b_6 IND + e_i \quad (19)$$

where

$CSAR_i$ = the cumulative standardised abnormal return for firm *i*

b_0 = the intercept term

$INVSR_i$ = a dummy variable set to 1 if the investment is judged to be of a transform IT investment strategic role; 0 otherwise

$INDSR_i$ = a dummy variable set to 1 if firm i is in an industry characterised as having a transform industry IT strategic role; 0 otherwise

$INTER_i$ = a dummy variable set to 1 if there is a transform investment strategic role and a transform industry IT strategic role interaction; 0 otherwise

$LEAD_i$ = a dummy variable set to 1 if the investment strategic role transforms or leads the industry IT strategic role; 0 otherwise

LAG_i = a dummy variable set to 1 if the investment strategic role lags the industry IT strategic role; 0 otherwise

$TIME_i$ = a dummy variable set to 0 if the announcement for firm i is in the period Jan 1998 – Mar 2000; 1 for the period Mar 2000 – Dec 2005

$SIZE_i$ = the size of firm i

IND_i = a dummy variable set to 1 if firm i is part of the tested industry, 0 otherwise; industries tested are financial, services, manufacturing and IT

e_i = the error term with $E(e_i) = 0$

The variables *INDSR, INVSR, LEAD, LAG* and *INTER* are all determined through the ratings of the investments and the industries as discussed earlier. Following Fama and French (1992), *SIZE* is proxied for by the firm's market value in the year of the announcement. As mentioned, *TIME*, is based on the date of the announcement relative to 10 March 2000 and was also tested using the number of days between each announcement and the first.

The four industry variables are determined by whether the firm is classified as a constituent of a particular JSE industry. Note that from the beginning of 2006, the sector classification system at the JSE changed from Global Classification Codes (GCS) to the Industry Classification Benchmark (ICB). The ICB follows an Industry – Supersector – Sector – Subsector breakdown. It is important to also note that in this thesis the term *industry* relates conceptually to the *sector* level of ICB classification. When the ICB notion of industry is specifically referred to in this thesis, the term,

ICB-industry, is used. Furthermore, the regression *industry variables* used in this thesis are called that to allow for comparison with previous studies. The *industry variables* do not correlate with any level of ICB classification but refer simply to a generic, high level aggregation of ICB-industries. The mapping of industry variables to ICB-industries is as follows:

- financial industry – Financial Industry
- manufacturing industry – Oil and Gas Industry; Basic Materials Industry; Industrials Industry (excluding Industrial Transportation and Support Services Sectors); Consumer Goods Industry; and Health Care Industry
- services industry – Consumer Services Industry; Telecommunications Industry; and the Industrial Transportation and Support Services Sectors of the Industrials Industry
- IT industry – Technology Industry

3.3.7 Understanding the Event Study Results

The last stage for the overall event study process is presentation of insights relating to understanding the effects of the event. These insights are considered in the Discussion section of this thesis, Chapter 5, and based on the association, or lack of, between the theory and the results of the testing. A comparison is also be made with the results of Dehning et al. (2003) and Hart and Webber (2005).

3.4 Summary

This research study is conducted using well-specified and valid parametric and nonparametric tests, according to a proven and theoretically valid event study process. It also sufficiently addresses all the accepted assumptions and potential implementation issues of an event study. This thesis also makes use of a complete nonparametric event study approach, to fully address all underlying assumptions, and is the first application of this approach in the IS field. The methods used in this thesis will allow a direct comparison with Dehning et al. (2003) and Hart and Webber (2005) and accommodate more of the possible data issues that have not been addressed by many other IS event studies.

4 Results

4.1 Introduction

In this chapter, the results of the various tests are presented. First, statistics are given which describe the data used in the event study tests. Next, the findings from the parametric and nonparametric tests are shown, both for market model and Theil estimations, looking at the full sample and sub-samples. The results of the multiple regression are then presented. Last to follow is an outlier analysis and graphs of the cumulative average abnormal returns over time.

4.2 Sample Descriptive Statistics

In this section, various statistics are mentioned which describe the distribution of announcements by time period, company, sector, and IT strategic role.

4.2.1 Announcements by Time Period

As shown earlier in Table 4, the full sample used totalled 323 announcements, made up of 187 automate investments, 107 informate investments and 29 transform investments. Table 5 below indicates the sample breakdown by the year of the announcement, shown visually in Figure 4. The comparatively small number in the first three years can be attributed to the availability of data from ITWeb during those years. Consequently, the distribution is biased towards the last five years of the eight year sample. Clustering of announcements was insignificant.

Table 5 – Announcements By Date

Date	Number of Announcements
1998	4 (1%)
1999	17 (5%)
2000	38 (12%)
2001	62 (19%)
2002	49 (15%)
2003	55 (17%)
2004	45 (14%)
2005	53 (16%)
Total	**323 (100%)**

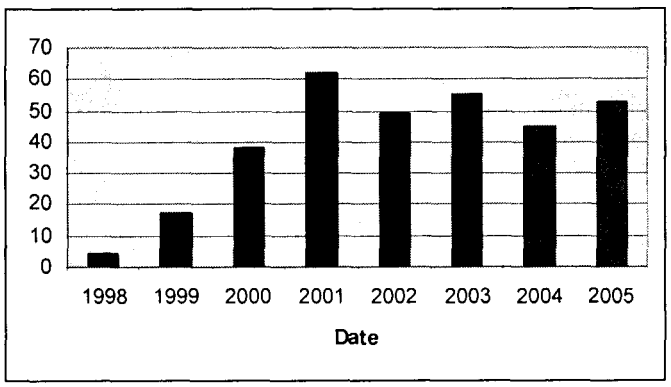


Figure 4 – Announcements By Date

4.2.2 Announcements by Company

Table 6 and Figure 5 illustrate the announcement distribution by company. As is expected, the majority of companies had relatively few announcements, with nearly half making only one or two announcements. Owing to the size of the sample and its distribution, no company or set of companies significantly dominates the sample.

Table 6 – Announcements by Company

Announcements per Company	Number of Companies	Announcements
1	29	29 (9%)
2	17	34 (11%)
3	15	45 (14%)
4	10	40 (12%)
5	7	35 (11%)
6	7	42 (13%)
7	5	35 (11%)
8	1	8 (2%)
11	1	11 (3%)
13	1	13 (4%)
14	1	14 (4%)
17	1	17 (5%)
Total	**95**	**323 (100%)**

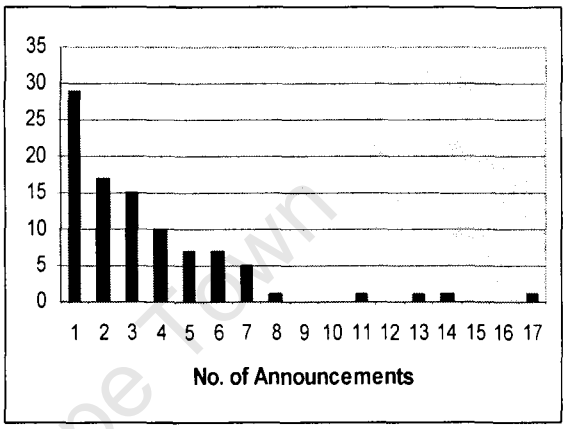


Figure 5 – Announcements By Company

4.2.3 Announcements by Industry and Sector

Figure 6 illustrates the sample breakdown according to each industry variable as specified in Section 3.3.5. The industry with the most announcements is the Financial industry, with the distribution of companies relatively similar across the Financial, Manufacturing and Services industries. The IT industry shows the smallest contribution to the sample of companies and announcements.

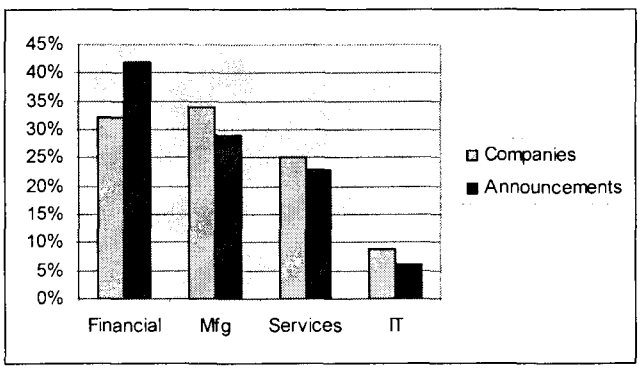


Figure 6 – Company and Announcement Distribution by Industry

At actual sector level, the distribution is generally flat, with the highest company and announcement numbers originating from Banks, General Financial Services, Life and Non-life Insurance, Mining, General Retail and Software and Computer Services. Table 7 shows the industries and sectors from which the announcements were drawn, as well as the number of companies and announcements in each industry and sector, including the strategic role rating from the questionnaires.

Table 7 – Sector Breakdown

Supersector - Sector	Number of Companies	Number of Announcements	Rating Pre-2000	Rating Post-2000
Financial				
Banks - Banks	8	42 (13%)	T	T
Financial Services - General Financial	8	22 (7%)	T	T
Financial Services - Real Estate	1	1 (1%)	T	T
Insurance - Life Insurance	8	48 (15%)	T	T
Insurance - Nonlife Insurance	5	22 (7%)	I	T
Total	*30*	*135 (42%)*		
Manufacturing				
Basic Resources – Forestry & Paper	1	2 (1%)	A	A
Basic Resources – Industrial Metals	2	3 (1%)	-	I
Basic Resources – Mining	11	32 (10%)	A	I
Chemicals-Chemicals	1	1 (1%)	I	-
Construction & Materials – Construction & Materials	2	4 (1%)	A	A
Food & Beverage – Beverages	3	10 (3%)	-	I
Food & Beverage – Food Producers	2	9 (3%)	I	I
Healthcare – Health Care Equipment & Services	2	9 (3%)	T	T
Industrial Goods & Services – Electronic & Electrical Equipment	2	4 (1%)	-	I
Industrial Goods & Services – General Industrials	3	9 (3%)	I	I
Oil & Gas – Oil & Gas Producers	2	9 (3%)	I	I
Personal & Household Goods – Personal Goods	1	1 (1%)	I	I
Total	*32*	*93 (29%)*		
Services				
Industrial Goods & Services - Industrial Transportation	5	8 (2%)	-	I
Industrial Goods & Services - Support Services	3	6 (2%)	I	I
Media - Media	3	8 (2%)	T	T
Retail - Food & Drug Retailers	2	9 (3%)	-	I
Retail - General Retailers	6	26 (8%)	I	I
Telecommunications - Mobile Telecommunications	1	7 (2%)	-	T
Travel & Leisure - Travel & Leisure	4	11 (3%)	I	T
Total	*24*	*75 (23%)*		
IT				
Technology - Software & Computer Services	8	17 (6%)	T	T
Technology - Technology Hardware & Equipment	1	3 (1%)	T	T
Total	*9*	*20 (6%)*		
Grand Total	**95**	**323 (100%)**		

4.2.4 Announcements by IT Strategic Role

The distribution of announcements for the IT strategic role at both the industry and investment level classification is shown in Table 8. The announcement totals in each of the investment–industry interactions are also shown. What is evident is that very few industries are classified as automate, with most being rated as fitting a transform role. However, for investment strategic role there is a higher proportion of automate and informate role ratings.

Table 8 – Cross-tabulation of Announcements by IT Strategic Role

Industry IT Strategic Role	IT Investment Strategic Role			Totals
	Automate	*Informate*	*Transform*	
Automate	$n = 3$	$n = 7$	$n = 0$	**$n = 10$**
Informate	$n = 75$	$n = 40$	$n = 11$	**$n = 126$**
Transform	$n = 109$	$n = 60$	$n = 18$	**$n = 187$**
Totals	**$n = 187$**	**$n = 107$**	**$n = 29$**	**$n = 323$**

4.2.5 Raw Return Descriptive Statistics

Descriptive statistics for the full sample of announcement raw returns data are shown in Table 9. The window chosen for these statistics is the longest – 255 day – estimation window: (-300, -45). These statistics illustrate to some degree a non-normal distribution for the returns data. This is examined further in the normality section below.

Table 9 – Descriptive Statistics of the Raw Returns Data

	Raw Returns Descriptive Statistics ($n = 323$)						
	Mean[1]	**Median**	**Min**	**Max**	**Std.Dev.**	**Skewness**	**Kurtosis**
Mean[2]	0.070	0.004	-10.424	10.015	2.565	-0.040	7.834
Min	-0.473	-1.235	-69.830	3.325	1.049	-12.462	-0.276
Max	0.584	0.320	-2.573	49.180	6.927	4.679	113.563
Std. Dev.	0.153	0.114	9.200	5.786	2.384	1.683	19.866

[1] These measures represent statistics across the raw returns
[2] These measures represent statistics across the statistics in [1].

4.2.6 Normality Summary

A key assumption of the parametric tests is that the abnormal returns follow a normal distribution (McWilliams & Siegel, 1997), where the data would have a skewness of 0 (perfectly symmetrical) and a kurtosis of 3 (Corrado & Zivney, 1992). The Kolmogorov-Smirnov goodness of fit test is a standard test of normality for abnormal returns (Cowan, 1992) and was used, along with two other well-known tests, Lilliefors and Shapiro-Wilk, to test each announcement's standardised abnormal returns. Again, the 255-day estimation window was used for these tests. Table 10 contains a summary of the results, showing the percentage of announcements which were significantly non-normal for each sample and sub-sample. These results show clearly the non-normal nature of the data used in this study. Even though tests can be fairly robust to departures from normality, the leptokurtic nature of the distributions, and the heavy prevalence of non-normality suggests that the nonparametric and the Theil tests would be most appropriate for interpreting results.

Table 10 – Normality Tests for the Standardised Abnormal Returns

Normality Test	Significance	Announcements (n = 323)						
		All	Investment Role			Industry Role		
			A	I	T	A	I	T
Kolmogorov-Smirnov	$p < 0.05$	53%	47%	55%	79%	80%	48%	54%
	$p < 0.01$	38%	31%	45%	62%	80%	32%	41%
Lilliefors	$p < 0.05$	83%	79%	87%	97%	100%	85%	81%
	$p < 0.01$	72%	68%	75%	90%	90%	71%	73%
Shapiro-Wilk	$p < 0.05$	87%	85%	90%	90%	100%	90%	84%
	$p < 0.01$	81%	78%	85%	86%	100%	80%	81%

4.2.7 CSAR Descriptive Statistics

Table 11 and Table 12 give an indication of the nature of the calculated CSARs for the 255-day estimation window, for each event window used in this study. It is evident that only transform IT investments and IT investments originating from automate industries exhibit positive average abnormal returns, having median CSARs greater than expected. There is also a very slight positive abnormal return for the transform industry (0) window. What is also apparent is that there are often differences across the various event windows, with opposite relationships being reported in some cases. This difference across event window is also noted further on

in the results. As mentioned in the methodology chapter, though, the shorter windows should generally be the more reliable.

Table 11 – CSAR Sample Descriptive Statistics

(sample mid point)		**Positive CSARs**	**Median CSAR**
Entire Sample *(162)*	(-2,+2)	143	-0.09
	(-1,+1)	144	-0.08
	(-1, 0)	151	-0.04
	(0)	158	-0.01

The sample mid point calculation is calculated as shown earlier in Equation 9, and is the mean rank for all firms for the entire time series. This is noted as it is the expected value for no event reaction for nonparametric statistics, just as the expected value for parametric statistics is zero.

Table 12 – CSAR Sub-Sample Descriptive Statistics

Investment Sub-Samples				**Industry Sub-Samples**			
(sample mid point)		**Positive CSARs**	**Median CSAR**	*(sample mid point)*		**Positive CSARs**	**Median CSAR**
Automate *(94)*	(-2,+2)	84	-0.06	**Automate** *(5.5)*	(-2,+2)	6	0.21
	(-1,+1)	82	-0.08		(-1,+1)	5	0.09
	(-1, 0)	84	-0.04		(-1, 0)	4	-0.03
	(0)	91	0.00		(0)	4	-0.07
Informate *(54)*	(-2,+2)	45	-0.13	**Informate** *(63.5)*	(-2,+2)	54	-0.14
	(-1,+1)	44	-0.14		(-1,+1)	59	-0.06
	(-1, 0)	46	-0.11		(-1, 0)	57	-0.08
	(0)	45	-0.06		(0)	56	-0.04
Transform *(15)*	(-2,+2)	14	-0.08	**Transform** *(94)*	(-2,+2)	83	-0.07
	(-1,+1)	18	0.22		(-1,+1)	80	-0.08
	(-1, 0)	21	0.18		(-1, 0)	90	-0.02
	(0)	20	0.13		(0)	96	0.01

With regards to the distribution of the sample across time, company, sector and industry, trends and biases are present but no one area ever influences the sample considerably. IT strategic role statistics show a fairly wide range in terms of sub-sample sizes; however, that is to be expected, and is taken into account in examining the results. A rather relevant observation though, is that the various returns data point to a violation of the normal distribution. This is notable in that the robustness of parametric tests is weakened when calculating statistics from a non-normal sample. Also, the CSAR statistics generally show a slight negative trend, with notable positive data originating only from transform investments.

4.3 Abnormal Return Statistics

In this section, the statistics calculated from the parametric and nonparametric tests are presented. In order to refer to the different combinations of estimation and statistical test, the term "parametric" is used to describe the market model–parametric test combination, "nonparametric" for the market model–rank test combination, and "Theil" for the Theil estimation–rank test combination. The sub-sections here examine the full sample of announcements and the breakdowns by IT investment strategic role, by industry IT strategic role, by the interaction of these two roles, and by period of announcement. All results are shown for all of the combinations of estimation and event window.

The tabled results show the average cumulative standardised abnormal returns (ACSARs) for the parametric tests; and the mean rank of the abnormal returns during the event period for the nonparametric tests. For the parametric tests, the expected ACSAR for no effect during the event is 0%. For the nonparametric tests, the expected rank is the sample average which varies according to the sample size; this, therefore, is shown in square brackets below the nonparametric rank statistics. The z-statistic is shown in parentheses below each of the above statistics, and will include a single star (*) if significant at a 5% level, and a double star (**) if significant at a 1% level.

4.3.1 Full Sample

Table 13 shows the results for the full sample of announcements. Two-tailed tests were conducted for the full sample as the market expectations for IT investments in general is uncertain. The parametric ACSARs are generally only marginally off the expected 0%, as are the rank tests to their expected values, with all figures showing no significance. This indicates that there is no value relevance for South African IT investments in general.

Table 13 – Analysis of Abnormal Returns for the Full Sample

Event Window	Test	Estimation Period (-300, -45)	(-260, -60)	(-202, -2)	(-102, -2)
(-2, +2)	*Parametric*	-0.08 [a] (-1.58) [b]	-0.09 (-1.74)	-0.08 (-1.54)	-0.08 (-1.32)
	Nonparametric	127.39 [c] (-1.49) [b]	100.71 (-1.34)	101.13 (-1.14)	52.32 (-0.83)
	Theil	133.24 [c] (0.85) [b]	104.75 (0.71)	105.08 (0.83)	54.11 (0.89)
	Expected Rank	[130.0]	[102.5]	[102.5]	[52.5]
(-1, +1)	*Parametric*	-0.07 (-1.19)	-0.08 (-1.35)	-0.07 (-1.20)	-0.06 (-1.05)
	Nonparametric	126.10 (-1.27)	99.38 (-1.20)	99.94 (-0.98)	51.46 (-0.51)
	Theil	131.98 (0.60)	103.56 (0.49)	104.06 (0.64)	53.08 (0.69)
	Expected Rank	[129.0]	[101.5]	[101.5]	[51.5]
(-1, 0)	*Parametric*	0.01 (0.14)	0.00 (0.08)	0.01 (0.10)	0.02 (0.29)
	Nonparametric	126.71 (-0.70)	99.88 (-0.61)	100.35 (-0.45)	51.48 (-0.02)
	Theil	133.12 (0.82)	104.07 (0.66)	104.75 (0.83)	53.24 (0.91)
	Expected Rank	[128.5]	[101.0]	[101.0]	[51.0]
(0)	*Parametric*	0.04 (0.86)	0.04 (0.78)	0.03 (0.64)	0.03 (0.58)
	Nonparametric	129.37 (0.19)	101.73 (0.19)	102.07 (0.30)	52.02 (0.57)
	Theil	135.72 (1.01)	106.19 (0.95)	105.93 (0.90)	53.40 (0.90)
	Expected Rank	[128.0]	[100.5]	[100.5]	[50.5]

* Significant at the 0.05 level; ** Significant at the 0.01 level (2-tailed tests)
[a] ACSAR; [b] z-statistic; [c] average event period rank; (n = 323)

4.3.2 Investment Strategic Role Sub-Samples

The results from the automate sub-sample, shown in Table 14, also indicate no real change from 0% or the average rank, and are highly insignificant. South African investors do not appear to regard automate investments as having a negative or positive value to companies.

Table 14 – Analysis of Abnormal Returns for the Automate Investment Sample

Event Window	Test	Estimation Period (-300, -45)	(-260, -60)	(-202, -2)	(-102, -2)
(-2, +2)	*Parametric*	-0.06 (-0.88)	-0.06 (-0.89)	-0.06 (-0.87)	-0.06 (-0.77)
	Nonparametric	126.84 (-1.45)	100.76 (-1.11)	100.80 (-1.11)	52.15 (-0.86)
	Theil	131.69 (0.37)	104.07 (0.42)	104.30 (0.51)	53.64 (0.51)
	Expected Rank	[130.0]	[102.5]	[102.5]	[52.5]
(-1, +1)	*Parametric*	-0.07 (-0.96)	-0.08 (-1.03)	-0.07 (-0.88)	-0.07 (-0.89)
	Nonparametric	125.30 (-1.29)	99.20 (-1.08)	99.16 (-1.12)	51.05 (-0.75)
	Theil	130.15 (0.16)	102.51 (0.16)	103.06 (0.32)	52.44 (0.27)
	Expected Rank	[129.0]	[101.5]	[101.5]	[51.5]
(-1, 0)	*Parametric*	0.02 (0.33)	0.02 (0.35)	0.03 (0.38)	0.04 (0.50)
	Nonparametric	127.43 (-0.40)	100.97 (-0.17)	101.21 (-0.09)	51.77 (0.18)
	Theil	133.11 (0.81)	104.48 (0.75)	105.26 (0.94)	53.38 (0.96)
	Expected Rank	[128.5]	[101.0]	[101.0]	[51.0]
(0)	*Parametric*	0.04 (0.62)	0.04 (0.59)	0.03 (0.43)	0.02 (0.22)
	Nonparametric	128.05 (-0.08)	101.23 (0.05)	101.95 (0.22)	51.62 (0.29)
	Theil	134.13 (0.79)	105.16 (0.74)	105.19 (0.75)	52.88 (0.69)
	Expected Rank	[128.0]	[100.5]	[100.5]	[50.5]

* Significant at the 0.05 level; ** Significant at the 0.01 level (2-tailed tests); (n = 187)

Looking at the informate sub-sample in Table 15, all the statistics, except some under Theil estimation, indicate a negative relationship. For a 2-tail test at the 5% level, one significant figure is found. For the earlier 200-day event window (-260, -60) and for the 2-day event window (-1, 0), the nonparametric test shows a negative relationship. Considering that it is only this one combination that yields significant results, and that the 3-day and 1-day event windows have highly insignificant statistics, it is perhaps prudent not to generalise this result with the true value relevance of informate IT investments.

Table 15 – Analysis of Abnormal Returns for the Informate Investment Sample

Event Window	Test	Estimation Period (-300, -45)	(-260, -60)	(-202, -2)	(-102, -2)
(-2, +2)	*Parametric*	-0.12 (-1.33)	-0.14 (-1.51)	-0.12 (-1.26)	-0.10 (-1.07)
	Nonparametric	128.06 (-0.75)	100.63 (-0.90)	101.61 (-0.53)	52.37 (-0.49)
	Theil	135.23 (1.01)	105.63 (0.75)	106.15 (0.86)	54.47 (0.83)
	Expected Rank	[130.0]	[102.5]	[102.5]	[52.5]
(-1, +1)	*Parametric*	-0.13 (-1.23)	-0.14 (-1.34)	-0.13 (-1.22)	-0.11 (-0.98)
	Nonparametric	124.52 (-1.19)	97.56 (-1.32)	99.16 (-0.85)	50.99 (-0.61)
	Theil	131.79 (0.38)	102.93 (0.21)	103.62 (0.34)	52.72 (0.32)
	Expected Rank	[129.0]	[101.5]	[101.5]	[51.5]
(-1, 0)	*Parametric*	-0.12 (-1.39)	-0.13 (-1.50)	-0.12 (-1.46)	-0.11 (-1.22)
	Nonparametric	119.17 (-1.93)	93.29 (-2.00)*	94.50 (-1.72)	48.72 (-1.39)
	Theil	126.68 (-0.32)	98.47 (-0.55)	99.18 (-0.40)	50.28 (-0.45)
	Expected Rank	[128.5]	[101.0]	[101.0]	[51.0]
(0)	*Parametric*	-0.03 (-0.41)	-0.04 (-0.49)	-0.04 (-0.50)	-0.02 (-0.24)
	Nonparametric	123.61 (-0.68)	96.50 (-0.79)	96.79 (-0.74)	49.81 (-0.43)
	Theil	130.29 (0.17)	101.47 (0.06)	101.30 (0.04)	50.90 (-0.03)
	Expected Rank	[128.0]	[100.5]	[100.5]	[50.5]

* Significant at the 0.05 level; ** Significant at the 0.01 level (2-tailed tests); (n = 107)

The results of the transform IT investment sub-sample in Table 16, on the other hand, indicate a wide and general support of a positive relationship under a number of different combinations. Following ESM theory, the significant results occur in the short event windows: the 1- and 2-day windows. Under 1-tail tests, and at a 5% level, support is provided by all three tests under all four estimation windows. At a 1% level, the parametric and Theil methods show positive results under most combinations. Overall, it is very clear that a significant, positive relationship was found for transform IT investments. A 1-tailed test is used for this sub-sample following the approach of Dehning et al. (2003) and the corresponding hypothesis. Many of the significant results would also have been significant at a 5% level if a 2-tailed test had been used.

Table 16 – Analysis of Abnormal Returns for the Transform Investment Sample

Event Window	Test	Estimation Period (-300, -45)	(-260, -60)	(-202, -2)	(-102, -2)
(-2, +2)	*Parametric*	-0.08	-0.10	-0.09	-0.07
		(-0.47)	(-0.62)	(-0.53)	(-0.44)
	Nonparametric	128.50	100.72	101.41	53.21
		(-0.29)	(-0.42)	(-0.29)	(0.07)
	Theil	135.88	105.96	106.13	55.74
		(0.74)	(0.52)	(0.56)	(0.89)
	Expected Rank	[130.0]	[102.5]	[102.5]	[52.5]
(-1, +1)	*Parametric*	0.18	0.16	0.14	0.15
		(1.09)	(0.93)	(0.85)	(0.97)
	Nonparametric	137.11	107.22	107.80	55.87
		(0.85)	(0.75)	(0.83)	(1.04)
	Theil	144.52	112.57	112.13	58.56
		(1.62)	(1.46)	(1.40)	(1.69)*
	Expected Rank	[129.0]	[101.5]	[101.5]	[51.5]
(-1, 0)	*Parametric*	0.38	0.37	0.34	0.34
		(2.39)**	(2.20)*	(2.10)*	(2.11)*
	Nonparametric	149.97	117.19	116.34	59.74
		(1.93)*	(1.86)*	(1.74)*	(1.83)*
	Theil	156.93	122.10	122.00	63.28
		(2.47)**	(2.34)**	(2.34)**	(2.50)**
	Expected Rank	[128.5]	[101.0]	[101.0]	[51.0]
(0)	*Parametric*	0.33	0.32	0.32	0.31
		(2.91)**	(2.81)**	(2.71)**	(2.62)**
	Nonparametric	159.17	124.24	122.34	62.76
		(2.00)*	(1.95)*	(1.78)*	(1.86)*
	Theil	165.93	130.24	127.79	65.93
		(2.35)**	(2.36)**	(2.17)*	(2.26)*
	Expected Rank	[128.0]	[100.5]	[100.5]	[50.5]

* Significant at the 0.05 level; ** Significant at the 0.01 level (1-tailed tests); (n = 29)

Another finding from this sub-sample is the change in results as the event window widens. Besides one slightly significant figure in the 3-day event window, the results quite suddenly indicate no event reaction. Furthermore, under the longest event window (-2, +2), some slight negative ACSARs and average rank figures occur, which is markedly different from the highly positive results in the shorter event windows.

4.3.3 Industry Strategic Role Sub-Samples

Table 17, Table 18 and Table 19 present the results of each of the industry sub-sample tests. For all the sub-samples, no significant results are present, and all the ACSARs and mean event ranks are, generally, only marginally different from their expected values. It is apparent that industry strategic role is not a relevant factor for investors considering new IT investments.

Table 17 – Analysis of Abnormal Returns for the Automate Industry Sample

Event Window	Estimation Period				
	Test	**(-300, -45)**	**(-260, -60)**	**(-202, -2)**	**(-102, -2)**
(-2, +2)	*Parametric*	-0.10 (-0.30)	-0.08 (-0.25)	-0.13 (-0.41)	-0.24 (-0.64)
	Nonparametric	133.80 (0.32)	105.38 (0.29)	102.08 (-0.11)	50.74 (-0.51)
	Theil	142.94 (1.03)	110.98 (0.87)	107.74 (0.53)	54.68 (0.35)
	Expected Rank	[130.0]	[102.5]	[102.5]	[52.5]
(-1, +1)	*Parametric*	0.00 (-0.02)	0.01 (0.06)	-0.03 (-0.10)	-0.08 (-0.31)
	Nonparametric	132.63 (0.24)	104.17 (0.21)	103.50 (0.14)	50.70 (-0.23)
	Theil	145.57 (1.04)	113.33 (0.97)	110.03 (0.70)	55.43 (0.55)
	Expected Rank	[129.0]	[101.5]	[101.5]	[51.5]
(-1, 0)	*Parametric*	-0.10 (-0.56)	-0.09 (-0.50)	-0.13 (-0.72)	-0.20 (-1.03)
	Nonparametric	118.25 (-0.66)	92.80 (-0.69)	88.95 (-0.94)	44.55 (-1.01)
	Theil	130.90 (0.10)	101.20 (-0.02)	98.00 (-0.25)	49.15 (-0.31)
	Expected Rank	[128.5]	[101.0]	[101.0]	[51.0]
(0)	*Parametric*	0.17 (0.58)	0.16 (0.52)	0.16 (0.51)	0.19 (0.49)
	Nonparametric	128.30 (-0.01)	100.70 (-0.02)	101.30 (0.02)	50.20 (-0.08)
	Theil	151.60 (0.87)	116.10 (0.75)	110.90 (0.50)	54.80 (0.36)
	Expected Rank	[128.0]	[100.5]	[100.5]	[50.5]

* Significant at the 0.05 level; ** Significant at the 0.01 level (2-tailed tests); (n = 10)

Table 18 – Analysis of Abnormal Returns for the Informate Industry Sample

Event Window	Test	Estimation Period (-300, -45)	(-260, -60)	(-202, -2)	(-102, -2)
(-2, +2)	*Parametric*	-0.05	-0.06	-0.03	-0.03
		(-0.68)	(-0.73)	(-0.41)	(-0.39)
	Nonparametric	126.28	99.76	100.86	52.25
		(-1.26)	(-1.21)	(-0.82)	(-0.60)
	Theil	132.88	104.38	105.06	54.23
		(0.55)	(0.42)	(0.61)	(0.75)
	Expected Rank	[130.0]	[102.5]	[102.5]	[52.5]
(-1, +1)	*Parametric*	-0.05	-0.05	-0.04	-0.04
		(-0.61)	(-0.63)	(-0.44)	(-0.50)
	Nonparametric	125.24	98.63	100.06	51.56
		(-0.99)	(-0.98)	(-0.58)	(-0.28)
	Theil	131.70	102.92	104.06	53.01
		(0.40)	(0.22)	(0.48)	(0.49)
	Expected Rank	[129.0]	[101.5]	[101.5]	[51.5]
(-1, 0)	*Parametric*	0.00	0.00	0.01	0.02
		(0.02)	(0.02)	(0.17)	(0.21)
	Nonparametric	124.67	98.06	99.86	51.44
		(-0.83)	(-0.82)	(-0.40)	(-0.03)
	Theil	132.48	103.08	104.64	52.97
		(0.52)	(0.31)	(0.60)	(0.58)
	Expected Rank	[128.5]	[101.0]	[101.0]	[51.0]
(0)	*Parametric*	0.07	0.07	0.07	0.07
		(0.71)	(0.72)	(0.78)	(0.83)
	Nonparametric	126.67	100.00	101.90	52.06
		(-0.25)	(-0.17)	(0.16)	(0.39)
	Theil	134.65	105.56	105.56	53.14
		(0.65)	(0.63)	(0.62)	(0.60)
	Expected Rank	[128.0]	[100.5]	[100.5]	[50.5]

* Significant at the 0.05 level; ** Significant at the 0.01 level (2-tailed tests); (n = 126)

Table 19 – Analysis of Abnormal Returns for the Transform Industry Sample

Event Window	Test	Estimation Period (-300, -45)	(-260, -60)	(-202, -2)	(-102, -2)
(-2, +2)	*Parametric*	-0.10	-0.12	-0.11	-0.10
		(-1.43)	(-1.59)	(-1.54)	(-1.21)
	Nonparametric	127.80	101.11	101.25	52.44
		(-0.99)	(-0.84)	(-0.86)	(-0.54)
	Theil	132.96	104.67	104.95	53.99
		(0.72)	(0.61)	(0.74)	(0.76)
	Expected Rank	[130.0]	[102.5]	[102.5]	[52.5]
(-1, +1)	*Parametric*	-0.08	-0.10	-0.09	-0.08
		(-1.04)	(-1.23)	(-1.14)	(-0.88)
	Nonparametric	126.34	99.62	99.66	51.44
		(-0.91)	(-0.83)	(-0.90)	(-0.43)
	Theil	131.45	103.46	103.73	53.01
		(0.44)	(0.42)	(0.52)	(0.61)
	Expected Rank	[129.0]	[101.5]	[101.5]	[51.5]
(-1, 0)	*Parametric*	0.02	0.01	0.01	0.03
		(0.26)	(0.16)	(0.09)	(0.35)
	Nonparametric	128.55	101.48	101.28	51.87
		(-0.11)	(-0.01)	(-0.07)	(0.24)
	Theil	133.67	104.89	105.18	53.64
		(0.87)	(0.80)	(0.90)	(1.08)
	Expected Rank	[128.5]	[101.0]	[101.0]	[51.0]
(0)	*Parametric*	0.02	0.02	0.00	-0.01
		(0.37)	(0.25)	(0.00)	(-0.11)
	Nonparametric	131.26	102.95	102.23	52.09
		(0.46)	(0.40)	(0.28)	(0.49)
	Theil	135.58	106.07	105.92	53.49
		(0.94)	(0.85)	(0.86)	(0.90)
	Expected Rank	[128.0]	[100.5]	[100.5]	[50.5]

* Significant at the 0.05 level; ** Significant at the 0.01 level (2-tailed tests); (n = 187)

4.3.4 Industry-Investment Interactions

For the nine investment–industry combinations, only three show significant results: automate–automate, transform–informate and transform–transform. The results from the other combinations are highly insignificant, with the ACSAR and rank figures straying only slightly from their expected values. Owing to this, these results are not shown here but can seen in Appendix C.

The results of the interaction between automate investments in an automate industry are also not shown here, even though it does present some significant results: the Theil method shows positive figures at a 5% significance level under the 3-day and 5-day event window, and the parametric method has a 5% significantly positive figure in one estimation window under the 5-day event window. The results are quite varied

though and sometimes even slightly negative (in the more theoretically sound 1-day event window). These findings may be initially surprising, but when considering that the size of this particular sub-sample is only three, one can assume that these results are unreliable, and are therefore excluded from this section. To ascertain the true value relevance, a much larger sample would be required.

The sub-sample size is also very small in four of the other investment–industry combinations: informate–automate (five), transform–automate (zero), transform–informate (eleven) and transform–transform (seventeen). The last two transformation investment combinations do, however, show significant results (for 1-tailed tests) and so are presented in Table 20 and Table 21 below.

Table 20 – Analysis of Abnormal Returns for Transform Investments in Informate Industries

Event Window	Test	Estimation Period (-300, -45)	(-260, -60)	(-202, -2)	(-102, -2)
(-2, +2)	*Parametric*	0.11 (0.58)	0.10 (0.50)	0.15 (0.79)	0.23 (1.16)
	Nonparametric	133.64 (0.31)	105.49 (0.31)	108.55 (0.70)	56.40 (0.85)
	Theil	147.47 (1.57)	115.44 (1.46)	116.65 (1.63)	61.71 (2.01)*
	Expected Rank	[130.0]	[102.5]	[102.5]	[52.5]
(-1, +1)	*Parametric*	0.36 (2.32)*	0.34 (2.05)*	0.37 (2.52)**	0.41 (3.34)**
	Nonparametric	146.21 (1.27)	115.58 (1.33)	118.79 (1.65)*	60.52 (1.69)*
	Theil	159.24 (2.15)*	124.64 (2.08)*	125.45 (2.18)*	65.64 (2.48)**
	Expected Rank	[129.0]	[101.5]	[101.5]	[51.5]
(-1, 0)	*Parametric*	0.55 (2.68)**	0.53 (2.47)**	0.54 (2.65)**	0.57 (2.99)**
	Nonparametric	161.64 (2.03)*	125.73 (1.95)*	128.86 (2.20)*	65.73 (2.32)*
	Theil	172.36 (2.57)**	134.18 (2.46)**	135.55 (2.60)**	70.45 (2.84)**
	Expected Rank	[128.5]	[101.0]	[101.0]	[51.0]
(0)	*Parametric*	0.26 (1.86)*	0.24 (1.70)*	0.28 (1.87)*	0.31 (2.09)*
	Nonparametric	151.64 (1.03)	117.09 (0.93)	120.82 (1.14)	62.09 (1.31)
	Theil	161.00 (1.38)	125.82 (1.34)	125.18 (1.32)	65.55 (1.59)
	Expected Rank	[128.0]	[100.5]	[100.5]	[50.5]

* Significant at the 0.05 level; ** Significant at the 0.01 level (2-tailed tests); (n = 11)

Firstly, for the sub-sample of transform investments in informate industries, significant (5% level), positive results are apparent. These occur for all the tests in the 2-day and 3-day event windows, and for the parametric tests on the event day. There is even one significant result under the 5-day event window. At a 1% level, the Theil and parametric methods show positive results in the 2-day and 3-day windows.

Table 21 – Analysis of Abnormal Returns for Transform Investments in Transform Industries

Event Window	Test	Estimation Period (-300, -45)	(-260, -60)	(-202, -2)	(-102, -2)
(-2, +2)	*Parametric*	-0.19 (-0.82)	-0.22 (-0.94)	-0.24 (-0.99)	-0.26 (-1.08)
	Nonparametric	125.36 (-0.60)	97.80 (-0.77)	97.06 (-0.89)	51.26 (-0.50)
	Theil	128.80 (-0.20)	100.17 (-0.42)	99.70 (-0.49)	52.10 (-0.26)
	Expected Rank	[130.0]	[102.5]	[102.5]	[52.5]
(-1, +1)	*Parametric*	0.07 (0.28)	0.05 (0.20)	0.00 (0.01)	-0.01 (-0.04)
	Nonparametric	131.56 (0.19)	102.11 (0.01)	101.09 (-0.11)	53.04 (0.23)
	Theil	135.52 (0.54)	105.20 (0.37)	103.98 (0.23)	54.24 (0.50)
	Expected Rank	[129.0]	[101.5]	[101.5]	[51.5]
(-1, 0)	*Parametric*	0.28 (1.24)	0.28 (1.16)	0.22 (0.96)	0.19 (0.86)
	Nonparametric	142.83 (1.04)	111.97 (1.00)	108.69 (0.69)	56.08 (0.84)
	Theil	147.50 (1.37)	114.72 (1.26)	113.72 (1.17)	58.89 (1.37)
	Expected Rank	[128.5]	[101.0]	[101.0]	[51.0]
(0)	*Parametric*	0.37 (2.28)*	0.37 (2.26)*	0.34 (2.02)*	0.32 (1.82)*
	Nonparametric	163.78 (1.87)*	128.61 (1.87)*	123.28 (1.51)	63.17 (1.59)
	Theil	168.94 (2.12)*	132.94 (2.16)*	129.39 (1.92)*	66.17 (2.00)*
	Expected Rank	[128.0]	[100.5]	[100.5]	[50.5]

* Significant at the 0.05 level; ** Significant at the 0.01 level (1-tailed tests); (n = 18)

Interestingly, for the transform–transform interaction, positive results are also found, again under all three testing methods, but only significantly on the event day, and only at a 5% level.

Based on the above, it does appear that transform investments in an informate industry are more significant than in a transform industry, possibly providing

evidence for a "lead" effect being value relevant. However, when considering the following: that transform investments alone showed highly significant results; that there is no transform–automate sub-sample leaving the transform investments to be split across only informate and transform industries; and, that the sizes of the two sub-samples are quite small, one can infer that what is being represented in the above results is merely the value relevance of transform investments themselves.

4.3.5 Sub-Samples by Time Period

As mentioned earlier, time period is distinguished in this thesis by the date, 10 March 2000. Table 22 and Table 23 show the pre-10 March and post-10 March sub-samples, respectively. The size of the earlier sample is 26, and the later, 297.

Table 22 – Analysis of Abnormal Returns for the Time Period Pre-March 2000

Event Window	Estimation Period				
	Test	(-300, -45)	(-260, -60)	(-202, -2)	(-102, -2)
(-2, +2)	*Parametric*	-0.11 (-0.75)	-0.11 (-0.73)	-0.13 (-0.88)	-0.16 (-0.79)
	Nonparametric	127.37 (-0.44)	100.66 (-0.41)	100.08 (-0.51)	52.84 (-0.06)
	Theil	133.20 (0.35)	104.11 (0.19)	105.71 (0.44)	55.80 (0.88)
	Expected Rank	[130.0]	[102.5]	[102.5]	[52.5]
(-1, +1)	*Parametric*	-0.26 (-1.38)	-0.25 (-1.38)	-0.27 (-1.43)	-0.30 (-1.21)
	Nonparametric	119.38 (-1.10)	93.96 (-1.11)	92.79 (-1.26)	49.24 (-0.76)
	Theil	125.59 (-0.40)	97.54 (-0.58)	99.47 (-0.32)	52.87 (0.22)
	Expected Rank	[129.0]	[101.5]	[101.5]	[51.5]
(-1, 0)	*Parametric*	-0.09 (-0.58)	-0.09 (-0.60)	-0.10 (-0.65)	-0.06 (-0.28)
	Nonparametric	121.25 (-0.69)	95.40 (-0.69)	91.96 (-1.07)	48.60 (-0.66)
	Theil	127.13 (-0.15)	98.67 (-0.30)	100.33 (-0.12)	52.87 (0.28)
	Expected Rank	[128.5]	[101.0]	[101.0]	[51.0]
(0)	*Parametric*	0.00 (-0.02)	-0.01 (-0.05)	-0.05 (-0.36)	-0.02 (-0.11)
	Nonparametric	125.65 (-0.18)	98.19 (-0.22)	96.54 (-0.35)	50.23 (-0.12)
	Theil	132.54 (0.24)	102.31 (0.10)	103.23 (0.16)	54.00 (0.43)
	Expected Rank	[128.0]	[100.5]	[100.5]	[50.5]

* Significant at the 0.05 level; ** Significant at the 0.01 level (2-tailed tests); (n = 26)

Two-tailed tests on the data result in no significant figures, and no trends are apparent across the data. This indicates that in South Africa there was no change in investors' perception of IT investment value pre– and post–dot com crash.

Table 23 – Analysis of Abnormal Returns for the Time Period Post-March 2000

Event Window	Test	Estimation Period (-300, -45)	(-260, -60)	(-202, -2)	(-102, -2)
(-2, +2)	*Parametric*	-0.08 (-1.45)	-0.09 (-1.61)	-0.08 (-1.38)	-0.07 (-1.14)
	Nonparametric	127.40 (-1.42)	100.72 (-1.28)	101.22 (-1.04)	52.27 (-0.89)
	Theil	133.24 (0.84)	104.81 (0.72)	105.02 (0.80)	53.96 (0.79)
	Expected Rank	[130.0]	[102.5]	[102.5]	[52.5]
(-1, +1)	*Parametric*	-0.05 (-0.85)	-0.06 (-1.04)	-0.05 (-0.85)	-0.04 (-0.70)
	Nonparametric	126.69 (-1.00)	99.85 (-0.94)	100.56 (-0.66)	51.66 (-0.33)
	Theil	132.54 (0.73)	104.08 (0.64)	104.46 (0.76)	53.10 (0.71)
	Expected Rank	[129.0]	[101.5]	[101.5]	[51.5]
(-1, 0)	*Parametric*	0.02 (0.29)	0.01 (0.22)	0.01 (0.27)	0.02 (0.39)
	Nonparametric	127.19 (-0.53)	100.27 (-0.44)	101.08 (-0.16)	51.73 (0.18)
	Theil	133.64 (0.91)	104.54 (0.77)	105.14 (0.92)	53.27 (0.95)
	Expected Rank	[128.5]	[101.0]	[101.0]	[51.0]
(0)	*Parametric*	0.05 (0.89)	0.04 (0.81)	0.04 (0.73)	0.03 (0.62)
	Nonparametric	129.70 (0.25)	102.04 (0.26)	102.56 (0.41)	52.18 (0.66)
	Theil	135.99 (1.04)	106.53 (1.00)	106.17 (0.93)	53.34 (0.90)
	Expected Rank	[128.0]	[100.5]	[100.5]	[50.5]

* Significant at the 0.05 level; ** Significant at the 0.01 level (2-tailed tests); (n = 297)

4.4 Multiple Regression Results

Multiple regression analysis was conducted on the announcement CSARs and was controlled for, using the IT strategic role of the investment and industry, the lead and lag effects of these roles, the transform–transform interaction of these roles, the time of announcement, and the four industry variables. Note that for the time variable, the approach of Dehning et al. (2003) was used, where a binary time variable was used and contrasted with a continuous time variable equalling the number of days from the

earliest announcement to each subsequent announcement. The multiple regression was tested using three separate models (as explained in the Methodology chapter) and under all the combinations of event window, estimation window, industry variable and time variable. Because the results were so similar for each combination (with virtually no difference between the two time variables) only the models from the 255-day estimation window (-300, -45), the 1-day event window (0), and the binary time variable are shown. These appear, under each industry variation of the models in Table 24 below.

Table 24 – Multiple Regression Models

Var.	Model 1				Model 2				Model 3			
	Serv.	Mfg.	Fin.	IT	Serv.	Mfg.	Fin.	IT	Serv.	Mfg.	Fin.	IT
Interc.	-0.008	-0.025	-0.021	0.008	0.019	0.014	0.018	0.048	-0.002	-0.010	-0.010	0.022
	(0.967)	(0.909)	(0.913)	(0.968)	(0.929)	(0.953)	(0.933)	(0.828)	(0.992)	(0.964)	(0.955)	(0.905)
INVSR	0.105	0.103	0.112	0.119	-	-	-	-	0.070	0.065	0.066	0.064
	(0.065)	(0.07)	(0.048)*	(0.039)*					(0.445)	(0.478)	(0.468)	(0.476)
INDSR	0.040	-0.030	-0.100	-0.010	0.001	0.003	-0.050	0.020	-0.040	-0.040	-0.110	-0.030
	(0.54)	(0.719)	(0.223)	(0.819)	(0.991)	(0.965)	(0.56)	(0.755)	(0.477)	(0.617)	(0.175)	(0.673)
INTER	-	-	-	-	-	-	-	-	0.044	0.048	0.061	0.074
									(0.634)	(0.608)	(0.509)	(0.433)
LEAD	-	-	-	-	0.047	0.047	0.045	0.041	-	-	-	-
					(0.46)	(0.464)	(0.483)	(0.518)				
LAG	-	-	-	-	-0.050	-0.050	-0.050	-0.060	-	-	-	-
					(0.471)	(0.494)	(0.428)	(0.397)				
TIME	0.019	0.015	0.015	0.007	0.027	0.023	0.024	0.018	0.019	0.016	0.016	0.007
	(0.741)	(0.786)	(0.783)	(0.899)	(0.643)	(0.686)	(0.672)	(0.757)	(0.742)	(0.785)	(0.772)	(0.899)
SIZE	0.022	0.026	0.022	0.019	0.025	0.029	0.025	0.023	0.022	0.026	0.021	0.018
	(0.703)	(0.657)	(0.697)	(0.732)	(0.671)	(0.62)	(0.668)	(0.688)	(0.7)	(0.652)	(0.709)	(0.753)
IND.	0.020	0.005	0.095	-0.080	-0.020	0.000	0.079	-0.060	-0.020	0.001	0.101	-0.090
	(0.697)	(0.941)	(0.227)	(0.192)	(0.758)	(0.969)	(0.317)	(0.341)	(0.743)	(0.993)	(0.203)	(0.153)
R^2	0.012	0.012	0.016	0.017	0.007	0.006	0.009	0.009	0.013	0.013	0.018	0.019
F-Stat	0.787	0.758	1.052	1.102	0.350	0.335	0.503	0.487	0.692	0.674	0.949	1.020
N	323	323	323	323	323	323	323	323	323	323	323	323

* Significant at the 0.05 level; ** Significant at the 0.01 level; [a] standardised coefficient; [b] p-value
Serv. = Services; Mfg. = Manufacturing; Fin. = Financial; IT = Information Technology; (n = 323)

The statistics of the multiple regression analysis are distinctly insignificant. An insignificant F-statistic provides support that neither of the controlling variables explains the change in the announcement CSARs. Furthermore, the R^2 statistic shows that the controlling variables account for virtually none of the variation in CSARs –

although this is characteristic of many previous accounting and finance event studies (Chatterjee et al., 2002).

However, one significant figure is present – the transform IT investment strategic role variable in Model 1 (for the financial and IT industry variable) – and is significant at a 5% level. This provides further support for the positive relationship between transform IT investments and firm-level abnormal returns. Because this was the only significant variable found, Table 25 shows the coefficients and p-values for all combinations of model, estimation window and event window for this variable, using the financial industry variable and the binary time variable. Only Model 1 and Model 3 are shown in Table 25, since these two include the transform IT investment variable.

Table 25 – Multiple Regression Results for the Transform IT Investment Variable

Model	Estimation Window	Event Window			
		(-2, +2)	*(-1, +1)*	*(-1, 0)*	*(0)*
Model 1	*(-300, -45)*	0.012 (0.830)	0.085 (0.133)	0.144 (0.011)*	0.112 (0.048)*
	(-260, -60)	0.008 (0.885)	0.082 (0.150)	0.141 (0.013)*	0.111 (0.049)*
	(-202, -2)	0.008 (0.890)	0.072 (0.203)	0.130 (0.021)*	0.111 (0.05)*
	(-102, -2)	0.012 (0.829)	0.069 (0.221)	0.122 (0.030)*	0.109 (0.055)
Model 3	*(-300, -45)*	0.053 (0.559)	0.122 (0.177)	0.185 (0.040)*	0.066 (0.468)
	(-260, -60)	0.047 (0.604)	0.113 (0.212)	0.176 (0.051)	0.059 (0.512)
	(-202, -2)	0.059 (0.515)	0.120 (0.187)	0.180 (0.046)*	0.072 (0.426)
	(-102, -2)	0.080 (0.375)	0.128 (0.158)	0.180 (0.045)*	0.078 (0.389)

* Significant at the 0.05 level; ** Significant at the 0.01 level; (n = 323)

What is apparent is the high significance for the transform investment variable for and 1- and 2-day event windows in Model 1, and a slight significance for the 2-day window in Model 3. Consistent with previous results is the lack of significance in wider event windows.

Under no tests are any of the other variables even slightly significant.

4.5 CAAR Analysis

It is typical in event studies to show a cumulative average abnormal return (CAAR) graph over time (Bodie et al., 2002). The length of the CAAR graph is dependent on the nature of the event, but in two IS event studies which have presented a CAAR graph (Chatterjee et al., 2002; Hart & Webber, 2005) the length used was 10 days before and 10 days after the event. In this study, therefore, a CAAR graph of the same length is presented (Figure 7 and Figure 8 below). Longer CAAR graphs were also constructed, but no other relevant trends or relationships were revealed.

In Figure 7, the CAARs of the whole sample and each of the investment role sub-samples are shown over the 20-day period. In Figure 8, the CAARs of the whole sample are also shown, along with the industry strategic role sub-samples. CAAR graphs were constructed for all four estimation windows. Because the trends were almost identical across them all, only the graphs constructed from the 255-day estimation window are shown.

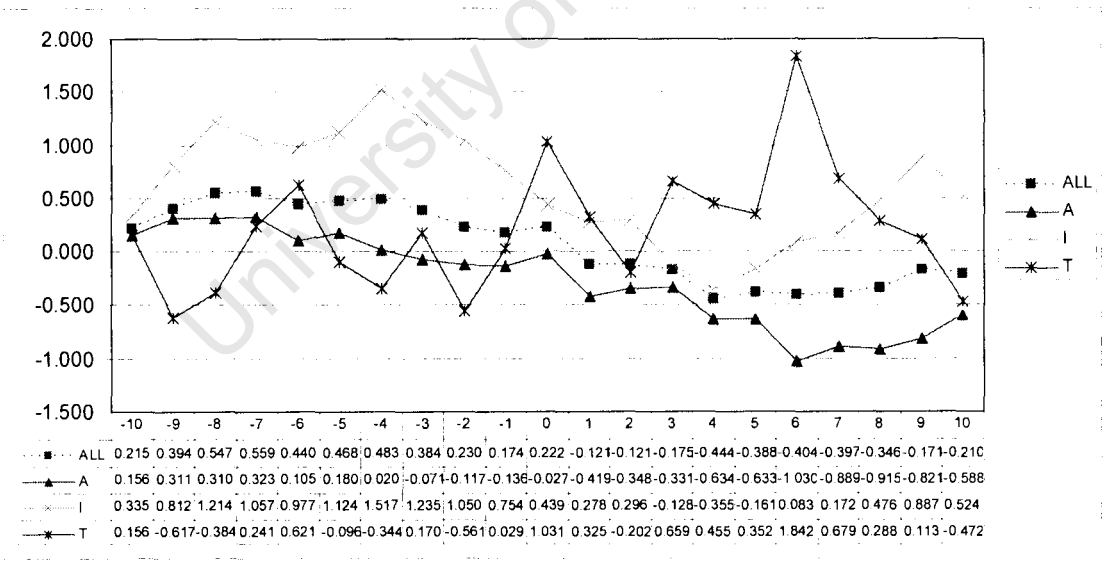
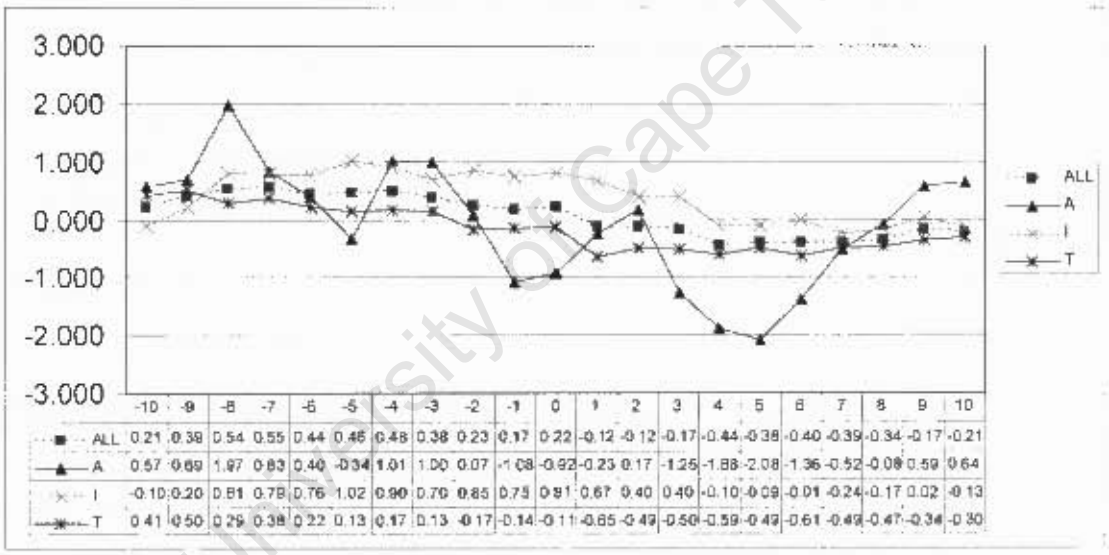


Figure 7 – CAAR versus Time Graph for the Whole Sample by IT Investment Strategic Role

The investment role CAAR graph shows a mixed reaction over time and for the different samples. Overall, all samples (except transform) exhibit a clear decreasing trend over the twenty day time period, with informate showing a recovery in the last 6 days, and transform showing a very mixed pattern At the time of the event, however,

there is a noticeable upwards movement for all sub-samples except for informate. Over the whole 20-day period, the return on shares of firms making IT investments at time 0 is negligible. What one could expect for a positive market reaction at time 0 with many firms is a new, higher level of stable cumulative returns from which there is little drift (Bodie et al., 2002). In the case of transform investment announcements, however, the varied pattern of drift after the event date can be explained by the small sample size (of twenty-nine) and by not controlling for confounding effects in the later days. For example, the sudden jump in the transform sample seen on day 6 was found to be driven to a large degree by two particular announcements (by Pick 'n Pay and Sun International). Although the reasons for the jump were not identified for these two announcements, it is most likely the result of other events, and it illustrates the greater effect of these events in smaller samples.



	-10	-9	-8	-7	-6	-5	-4	-3	-2	-1	0	1	2	3	4	5	6	7	8	9	10
ALL	0.21	0.38	0.54	0.55	0.44	0.46	0.48	0.38	0.23	0.17	0.22	-0.12	-0.12	-0.17	-0.44	-0.38	-0.40	-0.39	-0.34	-0.17	-0.21
A	0.57	0.69	1.97	0.83	0.40	-0.34	1.01	1.00	0.07	-1.08	-0.92	-0.23	0.17	-1.25	-1.88	-2.08	-1.36	-0.52	-0.08	0.59	0.64
I	-0.10	0.20	0.81	0.78	0.76	1.02	0.90	0.70	0.85	0.75	0.91	0.67	0.40	0.40	-0.10	-0.09	-0.01	-0.24	-0.17	0.02	-0.13
T	0.41	0.50	0.29	0.38	0.22	0.13	0.17	0.13	-0.17	-0.14	-0.11	-0.65	-0.49	-0.50	-0.59	-0.49	-0.61	-0.49	-0.47	-0.34	-0.30

Figure 8 – CAAR versus Time Graph for the Whole Sample by Industry IT Strategic Role

The industry IT strategic role CAAR graphs in Figure 8 show a generally muted, but slightly negative pattern over the 20-day period, for the whole sample and for the informate and transform sub-samples. Cumulative average abnormal returns to automate industries show a more irregular pattern. Once again, this can be explained by the small sample size (of ten); and, furthermore, again illustrates the mixed pattern of small samples. CAAR graphs are also used to ascertain the level of information leakage or insider trading before an event. The above graphs indicate that this is not significant.

4.6 Outlier Analysis

As mentioned in the Methodology chapter, it is possible that outliers drive the results of an event study. For this study, four very strong outliers were removed to limit this effect. However, it was noted that the returns of the announcements making up the sample are not normally distributed, and often leptokurtic and skewed. To test the effect of outliers on the results, 25 announcements were identified which exhibited a high kurtosis or skewness. To obtain these 25, announcements with a kurtosis higher than 35, skewness higher than 3.6 or skewness lower than -3.6, under any of the estimation windows, were identified. These were then removed from the sample and all the above tests conducted again. Note, the 25 outliers were very evenly distributed across investment role and industry role samples.

No new significant results were identified after removing these announcements, and all of the findings from the original sample were generally unchanged. To illustrate the unchanged results, comparisons of CAAR graphs from the original sample and the sample without the 25 outliers are shown in Figure 9 and Figure 10 below.

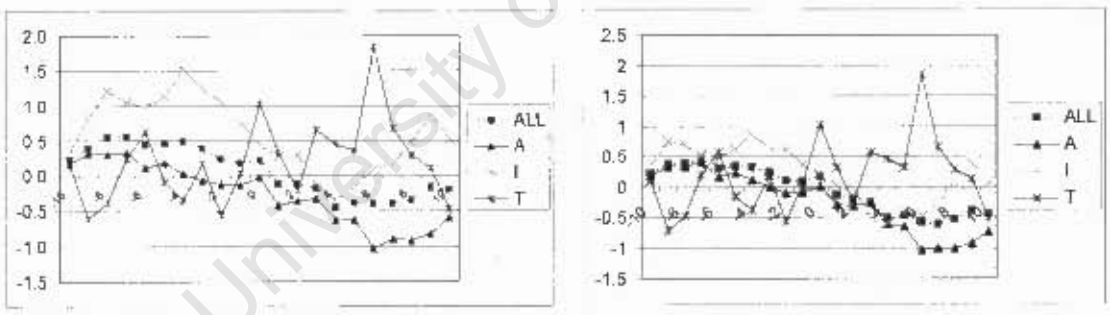


Figure 9 – CAAR Graph Comparison by IT Investment Strategic Role

(Original sample on left, reduced sample on right)

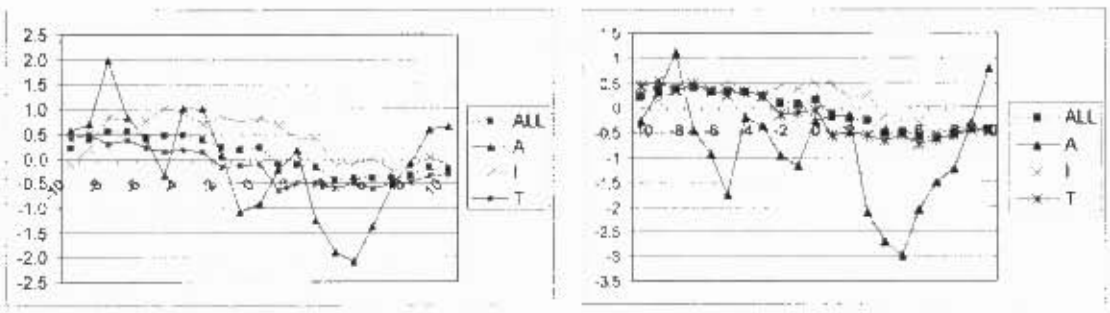


Figure 10 – CAAR Graph Comparison by Industry IT Strategic Role

(Original sample on left, reduced sample on right)

4.7 Summary

This chapter has presented the results of this thesis. The main areas reported on included: descriptive statistics of the sample, sub-samples and calculated CSARs; a normality summary; results from parametric and nonparametric tests of the full sample and various sub-samples using both market model and Theil estimations; results from a multiple regression analysis; the presentation of CAAR-time graphs; and an outlier analysis.

The descriptive statistics for the announcement data show no one particular area dominating the sample. Although sub-sample sizes are small for some combinations of industry and investment, this was expected and does not limit the testing of the hypotheses or other moderating factors. The various returns data and normality tests points to a violation of the normal distribution which is notable, especially concerning the interpretation of parametric tests. And CSAR statistics show a slight negative trend.

The abnormal returns analysis found that there was little reaction to automate and informate investments. Transform IT investments, though, found very strong and significant support for a positive relationship, especially around the 1-day and 2-day event windows. No value relevance was found for the industry IT strategic role sub-samples, nor for the time sub-samples. Regarding the interaction of investment and industry roles, the only robust, significant statistics were found for the two transform investment–industry interactions.

The multiple regression analysis found no significance for any contextual factors, not for lead and lag effects nor transform–transform interactions, but did provide further support for the positive effect of transform IT investments. The CAAR graph analysis revealed mixed reactions over time, but again showed the positive trend for transform investments over the event period, and in most cases, a slight negative trend for the other sub-samples. The more varied pattern of small samples was also seen.

Lastly, no indication of insider trading was discovered, and outliers were not found to drive the results.

5 Discussion

5.1 Introduction

In this chapter, the results reported in Chapter 4 are discussed. The discussion first considers the support that has been provided for the hypotheses. Following this, the results are compared with the results of IS event studies from the United States, and then with the only other South African IS event study. An interpretation of the findings is then presented, followed by a discussion of this study's limitations.

5.2 Support for Hypotheses

To aid the discussion, the hypotheses are restated here:

> ***H1: Firms announcing IT investments characterised as reflecting a transform IT strategic role will experience positive, abnormal changes in market value.***
>
> ***H2: Firms announcing IT investments in industries in which the transform IT strategic role dominates will experience positive, abnormal changes in market value.***
>
> ***H3: Firms announcing IT investments that lead their industry IT strategic role will experience positive, abnormal changes in market value.***
>
> ***H4: Firms announcing IT investments that lag their industry IT strategic role will experience negative, abnormal changes in market value.***

5.2.1 Hypothesis 1

Support for the first hypothesis was provided by all areas of the study. The testing of abnormal returns as estimated using the market model and Theil method, and both parametric and nonparametric tests showed strong, positive support for this hypothesis. The results were often significant at a 1% level, across all four estimation methods and the two shortest, most theoretically correct event windows. Further support was provided by the multiple regression analysis which showed that transform investments increase raw abnormal returns by standardised coefficients of around 0.37 on the event day, and 0.41 over the 2-day period (-1, 0). The CAAR graphs over time also showed a positive reaction for these two event periods.

Overall, the results provide strong support for rejecting the null hypothesis in favour of the alternative: that firms announcing IT investments characterised as reflecting a transform IT strategic role will experience positive, abnormal changes in market value.

5.2.2 Hypothesis 2

This study found no support for the second hypothesis. Although the abnormal returns analysis showed generally positive figures for transform industries, these were not at all significant, and were very similar to the results from the other two industry sub-samples. Furthermore, when considering the interaction sub-samples of transform investments in informate industries, and transform investments in transform industries, more significant results were found in the informate sub-sample. Although this does not, in itself, indicate a stronger reaction to investments in informate industries, it certainly shows no more of a positive reaction for investments in transform industries over informate industries. This observation could, however, indicate a lead effect – the third hypothesis investigated in this thesis.

5.2.3 Hypothesis 3

As mentioned in the Methodology chapter, this hypothesis could not be properly tested because of small sample sizes. The three lead investment–industry interactions are informate–automate, transform–automate and transform–informate. These had

sizes of 7, 0 and 11, respectively. The only sub-sample, therefore, of a reasonable, although still limited, size is the transform–informate interaction. As mentioned above, this interaction showed a slightly more significant response compared to transform–transform. However, the transform–informate sub-sample showed most of its significant results in the 2-day event window, whereas the transform–transform sub-sample showed all of its significant results in the 1-day event window, making interpretation and comparison difficult. Furthermore, both of these sub-samples are small (transform–transform being only slightly bigger at 18) and so the discrepancies discussed could easily be accounted for by small sample size. Therefore, the null hypothesis could not be rejected, but owing to the sample characteristics, it is also not clear that a lead effect does not exist.

5.2.4 Hypothesis 4

In contrast to the testing of a lead effect, a lag effect could be sufficiently tested with the sample sizes available. The three lag investment–industry interactions are automate–informate, automate–transform and informate–transform. Their sample sizes are 75, 109 and 60, respectively.

The results for the above interactions showed no significant deviation, negative or positive, from what was expected for no reaction. Therefore, for this hypothesis as well, the null hypothesis could not be rejected. However, this in itself is a relevant finding in that it shows that firms making IT investments which have strategic roles lagging the industry's are not penalised. There is apparently no perception from investors that lagging investments negatively affect firm value.

5.3 Comparison with United States IS Event Studies

Only two US information systems event studies have tested the concept of IT strategic role, with the other event studies examining IT investments in general, certain specific types of IT investments, and a range of contextual factors. In this section, the results of the two IT strategic role studies are looked at first, followed by contextual factors across all the IS event studies, and then some other specific event studies.

Firstly, industry IT strategic role was looked at by both Chatterjee et al. (2001) and Dehning et al. (2003). Both studies found that, over a 3-day event window, the only industry IT strategic role with significant results was transform, with a positive mean cumulative abnormal return (CAR). This was supported in both studies by multiple regression. In this study, industry IT strategic role was found to be quite insignificant.

Besides industry IT strategic role, Dehning et al. also found significant positive results for transform IT investments. Furthermore, they found that the investment–industry interactions of informate–transform and transform–transform also showed significant positive results. In this area of this thesis, the results are not much different. Transform IT investments were also found to be significantly positive, as was the transform–transform sub-sample. This thesis' results also included positive results for transform–informate investments though, but not for informate–transform. This is most likely driven by the insignificance of industry strategic role for this study though. The positive transform–informate interaction is most likely as a result of the positive transform investment role (as was noted, transform investments were only grouped into informate and transform industry roles as the automate interaction sub-sample was of size 0, making it difficult to distinguish which industry group for the transform investments is more relevant).

The multiple regression models were also the same as those conducted by Dehning et al. (2003) and the results were much in line. IT investment strategic role was again found to be significantly positive in both studies; the transform–transform interaction effect was not significant in both studies; both studies also found no negative lag effect; and all controlling factors were insignificant for both studies. Two differences between the findings were noted though: Dehning et al. found further positive results for industry strategic role, and a significant, positive lead effect was also found. Although a lead effect was not statistically present in this thesis, some level of support was seen and it was still identified as a possibility as the sub-sample sizes required to adequately test it were not available.

Altogether, the main differences in findings between the two studies were that an industry effect was not identified in this thesis, and the lead effect found by Dehning et al. (2003) could not be supported.

As discussed in Section 2.8, a range of contextual factors have been investigated by other IS event studies, and the most theoretically sound and popular were tested by this thesis as well. A widely cited event study by Im et al. (2001) tested some of these factors and found firm size and time period to be value relevant, with financial firms being value relevant in the later of two time periods. Firm size, which is the most investigated contextual factor, has been found by later studies (Hayes et al., 2001; Oh & Kim, 2001; Chatterjee et al., 2002; Dehning et al., 2003; Hunter, 2003) to have no value relevance though, and this thesis' findings agree with these later studies (this is discussed further in the Interpretation section below). Similarly, industry variables, although significant in Im et al.'s (2001) study, were not found to be at all significant in this study, which is consistent with Chatterjee et al. (2002), Dehning et al. (2003), Choi and Jong (2005) for "financial"; Dos Santos et al. (1993), Choi and Jong (2005) for "manufacturing"; Hayes et al. (2001), Chatterjee et al. (2002) and Choi and Jong (2005) for "services"; and Chatterjee et al. (2002) for "IT producer".

Time period has been investigated using particular "events" (Im et al., 2001; Chatterjee et al., 2001; Dehning et al., 2003) or as a continuous variable across the sample (Dehning et al., 2003; Hunter, 2003). Although the same events do not apply to this thesis, Chatterjee et al. (2001) and Dehning et al. (2003) found that industry IT strategic role dominated the positive time variable findings of Im et al. (2001). Consistent with these findings and with the tests of a continuous time variable by Dehning et al. (2003) and Hunter (2003), this thesis finds no value relevance for time as a contextual factor.

Lastly, two specific IS event studies have investigated IT investments in general and by grouping: Dos Santos et al. (1993) and Hunter (2003). Both Dos Santos et al. (1993) and Hunter (2003) found that as a whole, their samples had no significant excess returns, with Hunter (2003) even showing evidence of negative returns. These findings are consistent with this study's finding of no general reaction to IT

investments. Dos Santos et al. (1993), however, made a distinction between innovative and non-innovative IT investments and did find positive, significant results for the innovative investments. The "innovative" concept can be looked at in terms of the IT strategic role concept investigated by this thesis, and so places the findings of transform investments by this thesis in line with Dos Santos et al.'s (1993) findings as well. This is discussed further in the Interpretation section of this chapter.

5.4 Comparison with South African IS Event Studies

As mentioned in the Literature Review, there is currently only one other South African IS event study, that of Hart and Webber (2005). This study investigated South African IT investments in general and also, specifically, infrastructure and application investments. Hart and Webber found a neutral reaction to South African IT investments as a whole and no significant support for the value relevance of infrastructure or application investments. Hart and Webber (2005) also tested the contextual factors of firm size, and the manufacturing, financial and technology sectors, finding no significance for any of them.

The results of Hart and Webber (2005) are consistent with the findings of this thesis; an overall neutral reaction to South African IT investments was also found by this study, and all contextual factors were found to be insignificant as well. However, where no support was provided for the infrastructure–application distinction of Hart and Webber (2005), strong support was found for the strategic role construct of this thesis.

5.5 Interpretation of Results

In this section, the results of this thesis are interpreted in relation to the current understanding of IT value, the theoretical support of the IT strategic role construct, the two frameworks – the FVF, and the RBV – and the conceptual framework as formulated in Section 2.9.

Firstly, as a whole, the sample of South African IT investments found no overall significant reaction. As research has shown South Africa to have an efficient (semi-strong) stock market, new information should be quickly and effectively interpreted by the market, resulting in appropriate share price movements. Because a neutral reaction was observed for IT investments as a whole, this must be interpreted that in South Africa, IT investments generally add no firm value, and are essentially only worth as much as they cost.

Secondly, and more importantly, a positive, significant reaction was identified for a particular type of IT investment: transform investments. This, similarly, must imply that in South Africa, IT investments which have this strategic role add value to the investing firm and are, therefore, worth far more than the costs they incur. As discussed in the Literature Review, transformational IT investments can be seen to be disruptive in nature – changing industry practices and market structures, and redefining the existing complementarities. In the RBV sense, they would affect those resources most likely to provide a sustainable competitive advantage – the externally oriented (outside-in) and spanning resources. Although IT projects which try to respond to new market requirements, create more durable and specialised customer relationships, enhance business partnerships and integrate the firm's capabilities, are generally riskier, investors seem to believe that this risk is managed well by South African companies. By their nature, transformational investments can also often be plagued by delays in realising returns, reducing the potential firm value gains. In the South African case, it is apparent that stock market investors believe firms can also manage this sufficiently.

The evidence of this thesis' results indicate that IT investments are being successfully implemented in South Africa, that they allow firms to create new niches for themselves, to position themselves more favourably within an industry, and that they, ultimately, have business value.

The third interpretation which can be made of the results, is that automate and informate investments do not add business value. Although these types of investments are not seen to negatively affect a firm's value, they are seen, as IT investments are

seen generally, to be zero net present value investments. These types of investments make use of resources which can be quickly imitated, easily acquired, or simply substituted, such that competitors can respond swiftly enough to limit any competitive advantage gained by the initial firm. Although this should apply less to informate investments, the results suggest no distinction between automate and informate investment roles. The net result of both types of investments is a negligible impact on firm value.

The next set of results concerns industry IT strategic role. Although the transform role was found to be significant and positive in the Unites States studies of Chatterjee et al. (2001) and Dehning et al. (2003), it was not found to be regarded similarly in South Africa. In South Africa, where transforming was seen to dominate an industry, structural changes in the value chains and the creation of market niches or sub-industries either was not expected to take place or South African investors do not find industries in this state as value relevant.

In trying to understand this, it is important to note that what is being measured by these results is the market reaction concerning new IT investments, of any strategic role, in transform industries. The theory suggests that industries in a transform stage should have sub-groups which operate at higher industry abnormal earnings, owing to the weaker competitive forces. Furthermore, firms making IT investments should be declaring membership in one of the sub-industries, with the likelihood that they too will transform, if not doing so already. However, the results suggest that this implicit declaration of sub-industry membership, or increased likelihood to transform, is not recognised by South African investors. So even if the industry as a whole is seen as being transformational, unless firms make transformational IT investments, their IT investments will not be viewed positively.

Although this explains the result, it is not clear then why it is different to the two US studies. As mentioned above, South African IT investors could be interpreting the situation differently; however, another possibility exists. When looking at how industries have been rated in the US studies and this study, it is evident that in the more technologically advanced United States, far fewer industries were rated as

transform than in South Africa. The proportions of IT investments originating from automate, informate and transform industries in Chatterjee et al.'s (2001) sample (of 96) is 24%, 45% and 31%, respectively. In Dehning et al.'s (2003) study (with a larger sample of 353) these proportions were respectively: 59%, 27% and 16%, whereas in this sample, these same proportions are 3%, 39%, and 58%.

Although inter-rater reliability was calculated as being 0.61, and 0.69 for the two time periods, it is possible that the panel of judges as a whole did not fully understand the industry IT strategic role construct. Though 58% of JSE sectors might contain strong, well-known examples of transformational *companies*, it is unlikely that this many industries, as a whole, are actually in a transformational phase. So even if the contrary industry result can be explained, it is the opinion of the author that it is more likely that the judges of the industry role for this thesis overestimated, or misunderstood to some degree, the industry IT strategic role construct, causing the result of a neutral reaction to transformational industries.

The results of this thesis can be interpreted further, in looking at the IT investment–industry strategic role interaction, and the possibility of lead or lag effects. Here again, the suggested bias in industry strategic role rating would influence results, positively favouring the testing of the lead effect and negatively favouring the testing of the lag effect. Unfortunately, the samples were such that there was only one sub-sample out of a possible three which was of sufficient size to test the lead effect, which meant that no conclusions could be made. And for the lag effect, samples were certainly of sufficient size, but as mentioned, could have suffered from a negative bias caused by the industry role ratings. Nevertheless, the lag effect was found to be completely insignificant, as in the US studies, providing evidence that firms making automate and informate investments are not penalised by investors when these investments lag the industry role. Although Chatterjee et al. (2001) and Dehning et al. (2003) found that investments which lead their industry roles were rewarded by investors, this could not be disputed or supported by this study.

The last set of results to interpret are those brought into prominence by Im et al.'s (2001) study – contextual factors. Im et al. found significant support for firm size, the

financial industry and time period being value relevant factors. Despite this, the general consensus across IS event studies in the US has shown the typical contextual factors to be insignificant. Dehning et al. (2003) found, using much of the same data as Im et al. (2001), that the firm value predictors that they identified (contextual factors) were dominated by the IT investment role construct. Although no South African studies have found the Im et al. factors to be significant, the results of this study for transform investments follow those of Dehning et al., and with the general lack of significance of the tested contextual factors, this thesis finds that the effect of these contextual factors can be explained by the IT investment strategic role construct. This can be further clarified.

It is most likely that where positive results have been found for contextual factors, the same underlying concepts of IT strategic role were actually being measured. Firm size is a case in point, and its ambiguous effects can be shown. When information is an important asset, small firms can benefit as they are scrutinised less. This implies, further, that competitive advantages would go unnoticed for longer, allowing them to be sustained for longer. When trying to induce structural change, smaller firms also have less to lose if current business practices become non-competitive (Dehning et al., 2003). However, larger firms benefit from economies of scale and scope, have more advanced partnerships, and can better afford the rare, immobile, inimitable resources which provide sustainable competitive advantage. The strategic effects of size are clearly ambiguous, and are better explained by IT strategic role.

The industry variables can also be explained in terms of IT strategic role. Manufacturing industries might have, in the early days of IT, become competitive by automating their processes and becoming more efficient. As IT has become more commoditised, its use in an informating role would allow more information intensive industries, such as the services or financial industries, to compete more effectively. In the present time, where it is seen that IT can only be used competitively through transformational roles, members of particular industries can no longer simply invest in IT to add firm value (as found in Im et al., 2001), unless their members are making transformational investments. It is evident how IT strategic role can explain the

theoretical benefits of information technology to industry, and any past positive findings.

One other factor to consider is time. Firstly, in a similar way to industry variables, a time factor could indicate increasing IT enabled change, more widely available IT applications, and a greater understanding of how to correctly utilise IT, and so could also be closely tied to IT strategic role. This explains the lack of positive findings over time in this thesis (using the continuous time variable). However, the binary time variable was also tested – the rationale being that investor perceptions had become more irrational as the dot com bubble grew and then, with its bursting, had realigned to normal levels. This was also found to be insignificant, but is an important finding in that it strengthens the support for investor shrewdness in being able to evaluate the prospects of IT investments, and also points to the salience of IT investment strategic role as the main, or primary, determining factor for IT investment value relevance.

A specific finding noted in the US event study comparison was the positive value to innovative investments by Dos Santos et al. (1993). Innovativeness implies the introduction of a new technology or technology-enabled product or service, and in terms of IT strategic role, could be interpreted as taking either an informate or transform role. Although innovativeness can be understood to be a significant factor in the late eighties and early nineties, when IT itself could act as a strategic resource, today this is no longer the case. Today, it is more the actual strategic role of an IT investment which determines its value, and so, although innovativeness could find support in a modern event study, IT strategic role would be a more relevant factor.

Methodological interpretations can be made as well. This study made use of a number of estimation and event windows, abnormal return estimation models, and statistical tests. As a first point, it is apparent that the short event windows captured the main effects of this event study. This illustrates the theoretical soundness of the ESM and the application of it in this study and in South Africa. Secondly, it is clear that IS event studies have not been particularly rigorous in their application of ESM. This thesis noted that many of the IS event studies did not specify what statistical test they were using, or consider the implications of their chosen tests. Nonparametric tests

were seen to be rarely used in other IS event studies, and the implication of outliers or non-normal samples was almost never considered. The nonparametric test and the Theil method were used in this thesis to mitigate these effects and to avoid the known problem of over-rejecting a null hypothesis. Although these methods showed no extra ability to uncover other significant effects in this study, they lend much support to the validity of the findings, especially in relation to the findings of other event studies, where the possibilities of over-rejection and low test robustness are likely.

Lastly, one important factor which must be considered by an ESM study is the possibility of insider trading. In South Africa, insider-trading participants can have criminal and civil actions taken against them under the new Insider Trading Act of 1998, which should serve to limit the degree of insider trading. Nevertheless, it is still believed to occur in South Africa. CAAR versus time graphs can be used to measure illicit gains captured by insider trading (Bodie et al, 2002) and the pattern shown in the CAAR graphs produced for this study indicate that insider-trading was not present. This can, therefore, be excluded as a driver of the results of this study.

5.6 Limitations

The main limitation of this study is its sample size. Although the sample size as a whole was quite large, it was not sufficient to allow testing of all the sub-samples. This limited the study's ability to adequately test for a lead effect.

Another limitation is that the targeted IT strategic role variable does not capture the announcing firm's IT-related capabilities. Investors would certainly take these capabilities into consideration when evaluating an investment's potential to add firm value, and this consideration in conjunction with IT strategic role was not able to be tested in this thesis.

Lastly, the CAAR graph over time did not take confounding events into consideration. Where samples are large enough this is not a problem, but in some of the sub-samples of this thesis, samples sizes were small and so could have been influenced by confounding events.

6 Conclusion

6.1 Review of Thesis

The research question posed in the introduction was: Is IT strategic role a significant factor in predicting the perception of IT investment value by investors in the South African stock market? Event study methodology has been used in the past to allow research to get beyond the problems of other approaches, as was used here to examine a research question which is both relevant for business practice and the IS discipline. This thesis found significant positive results for IT investment strategic role, which was in line with the expected results and with US research. However, where industry strategic role and lead effects were found to also be positive factors in the US, they were not found to be so in South Africa.

One possible reason for the alternative perception in South Africa is that the transforming likelihood of firms making IT investments in a transform industry is not recognised by South African investors. Another more likely explanation is that the judges' industry role ratings were too positively biased towards a transformational role. This second explanation also then explains the lack of a lead effect found by this thesis, although sample size was also an issue here.

6.2 Implications for Theory

Berthon et al. (2002), Rosenthal (1991), and Tsang and Kwan (1999), among others, state that a theory development and knowledge creation process must consist of replications, extensions, and generalizations that provide new insights and add to the existing stock of knowledge. This thesis replicates the study of Dehning et al. (2003) in the South African context, and supports the findings of the IT strategic role construct as being value relevant in general, but also value relevant in a developing country.

This thesis uncovered some promising areas of future research as well. In future studies which look to analyse the effect of IT-related events on stock prices, variables which incorporate the transformational nature of investments should be included. Furthermore, this thesis indicates that a focus on sustained competitive advantage must be considered and investigated when trying to understand the situations under which IT investments add value. Also, concerning industry IT strategic role, this study highlighted that further research could be done on the transformational nature of South African industry sectors and their effect on investment value relevance. Both this study and Dehning et al. (2003) looked at IT strategic role as it applies to investments and industries. Future research could also examine *firm* IT strategic role.

Lastly, this thesis introduces the Theil method to IS event studies. Although no further significant findings were discovered using this method, it proved to support the findings of the conventional methods. This thesis recommends that in South Africa, where research is limited, and where insignificant findings have been found in previous research, that the Theil method be used in future, to ensure statistically valid research in a market showing non-normal returns, and to, possibly, better detect the value relevance of other factors.

6.3 Implications for Practitioners

From a practice perspective, this study recommends that firms announcing major IT investments, especially those of a transformational nature, be sure to clearly articulate the firm-specific and industry implications. Also, since a negative lag effect was not found, firms should also not be hesitant to announce IT investments which are not intended to be transformational.

Most importantly, firms who wish to impact on their future performance should look to use information technology to add business value, utilising it in a role which can transform its business and move it into an industry niche where competition is weak, and where high profits can be more easily earned.

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Appendix A

Please indicate which of the following categories best reflects the role of IT in the specified list of industries during the periods Jan 1998 – Feb 2000 and March 2000 –Dec 2005. The construct for the categories – IT strategic role – is conceptualised by Schein (1992) and Zuboff (1988) as follows:

Automate: Replace human labour by automating business processes. Goals are to improve, apply and refine firm capabilities; substitute labour with computers.

Informate Up/Down: Provide data/information to empower management, employees or customers.
Goals are better decision making, better coordination and collaboration.

Transform: Fundamentally alter traditional ways of doing business by redefining (internal or external) business processes and relationships.
Involves using IT to dramatically change how tasks are carried out – is the move recognized as being important in enabling firm to operate in different markets, serve different customers, or gain considerable competitive advantage by doing things differently?

Rating Scale: Automate (A); Information Up/Down (I); Transform (T)

Industry Sectors	IT Role
1998-2000	
Banks - Banks	
Basic Resources - Forestry & Paper	
Basic Resources - Mining	
Chemicals-Chemicals	
Financial Services - General Financial	
Financial Services - Real Estate	
Food & Beverage - Food Producers	
Insurance - Life Insurance	
Insurance - Nonlife Insurance	
Media - Media	
Oil & Gas - Oil & Gas Producers	
Personal & Household Goods - Personal Goods	
Retail - General Retailers	
Technology - Software & Computer Services	
Travel & Leisure - Travel & Leisure	

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2000-2005	
Banks – Banks	
Basic Resources - Forestry & Paper	
Basic Resources - Industrial Metals	
Basic Resources - Mining	
Construction & Materials - Construction & Materials	
Financial Services - General Financial	
Financial Services - Real Estate	
Food & Beverage - Beverages	
Food & Beverage - Food Producers	
Healthcare - Health Care Equipment & Services	
Industrial Goods & Services - Electronic & Electrical Equipment	
Industrial Goods & Services - General Industrials	
Industrial Goods & Services - Industrial Transportation	
Industrial Goods & Services - Support Services	
Insurance - Life Insurance	
Insurance - Nonlife Insurance	
Media - Media	
Oil & Gas - Oil & Gas Producers	
Personal & Household Goods - Personal Goods	
Retail - Food & Drug Retailers	
Retail - General Retailers	
Technology - Software & Computer Services	
Technology - Technology Hardware & Equipment	
Telecommunications - Mobile Telecommunications	
Travel & Leisure - Travel & Leisure	

Appendix B

Assessing the IT Investment Strategic Role of IT Investment Announcements

Coding Rules

- Do not code information about IT that is embedded in industrial technology.

Automate Rules

- Replace human labour by automating business processes.
- Virtually no IT-driven transformation efforts.
- Goals: Improving, applying and refining firm capabilities, substitute labour with computers.
- Outcomes: Clearly definable benefits, e.g. cost reduction, process consistency, process efficiency.

Automate Examples

- IT providing enhancements to existing processes or practices.
- IT providing a new channel for old information (i.e., using technology to provide traditional services to the deaf, etc.).
- Choosing a long distance carrier without adding new services.

Informate Up/Down Rules

- Provide new data/information to empower management, employees, or customers.
- An intermediate level of IT-driven transformation efforts.
- Goals: Better decision making, better coordination and collaboration.
- Outcomes: 'Soft' benefits, difficult to evaluate in advance e.g. better decisions shared understanding, clearer picture of cause-effect relationships, greater understanding of operating environment.

Information Up/Down Examples

- IT providing new information to customers.
- IT creating new information flows.
- Choosing a long distance carrier to provide new services such as a new network.

Transform Rules

- Fundamentally alter traditional ways of doing business by redefining business capabilities and/or (internal or external) business processes and relationships.
- Strategic acquisition to acquire new capabilities or to enter a new marketspace.

- Use of IT to dramatically change how tasks are carried out…is the move recognized as being important in enabling firm to operate in different markets, serve different customers…gain considerable competitive advantage by doing things differently.

Transform Examples

- IT changing the way a marketplace operates.
- IT providing new ability, new services, restructuring the market.
- New IT-based products typically transform.
- Strategic alliances or purchases are typically transform.

Appendix C

The following tables show the investment–industry combinations not mentioned in the Results chapter.

Automate–Automate

Event Window	Test	Estimation Period (-300, -45)	(-260, -60)	(-202, -2)	(-102, -2)
(-2, +2)	*Parametric*	0.57 (1.66)	0.62 (1.69)	0.51 (1.42)	0.47 (2.38)*
	Nonparametric	165.47 (1.77)	130.67 (1.83)	119.73 (1.12)	59.40 (0.82)
	Theil	171.13 (2.02)*	134.40 (2.07)*	129.73 (1.76)	64.40 (1.43)
	Expected Rank	[130.0]	[102.5]	[102.5]	[52.5]
(-1, +1)	*Parametric*	0.74 (1.48)	0.76 (1.51)	0.69 (1.34)	0.73 (1.68)
	Nonparametric	175.44 (1.82)	137.78 (1.85)	132.44 (1.59)	66.33 (1.44)
	Theil	184.67 (2.14)*	145.67 (2.25)*	140.67 (1.98)*	70.56 (1.83)
	Expected Rank	[129.0]	[101.5]	[101.5]	[51.5]
(-1, 0)	*Parametric*	0.36 (1.27)	0.37 (1.24)	0.30 (1.02)	0.31 (1.31)
	Nonparametric	157.33 (0.92)	124.50 (0.98)	118.67 (0.74)	58.83 (0.61)
	Theil	172.83 (1.40)	136.67 (1.49)	131.50 (1.27)	64.50 (1.07)
	Expected Rank	[128.5]	[101.0]	[101.0]	[51.0]
(0)	*Parametric*	-0.05 (-0.19)	-0.07 (-0.25)	-0.12 (-0.41)	-0.16 (-0.72)
	Nonparametric	111.00 (-0.41)	87.00 (-0.43)	99.33 (-0.05)	47.67 (-0.20)
	Theil	139.67 (0.25)	108.33 (0.22)	102.67 (0.05)	48.33 (-0.16)
	Expected Rank	[128.0]	[100.5]	[100.5]	[50.5]

* Significant at the 0.05 level; ** Significant at the 0.01 level (2-tailed tests); (n = 3)

Automate–Informate

Event Window	Test	Estimation Period (-300, -45)	(-260, -60)	(-202, -2)	(-102, -2)
(-2, +2)	*Parametric*	-0.12	-0.11	-0.12	-0.17
		(-1.12)	(-1.01)	(-1.09)	(-1.46)
	Nonparametric	123.14	97.81	98.07	50.75
		(-1.83)	(-1.59)	(-1.57)	(-1.62)
	Theil	126.54	100.10	100.13	51.39
		(-0.92)	(-0.84)	(-0.83)	(-0.97)
	Expected Rank	[130.0]	[102.5]	[102.5]	[52.5]
(-1, +1)	*Parametric*	-0.12	-0.11	-0.12	-0.19
		(-1.04)	(-0.95)	(-1.06)	(-1.53)
	Nonparametric	122.42	96.96	96.72	49.67
		(-1.38)	(-1.21)	(-1.31)	(-1.34)
	Theil	125.40	98.68	98.90	49.89
		(-0.74)	(-0.75)	(-0.70)	(-1.01)
	Expected Rank	[129.0]	[101.5]	[101.5]	[51.5]
(-1, 0)	*Parametric*	0.00	0.02	0.01	-0.02
		(0.03)	(0.14)	(0.04)	(-0.19)
	Nonparametric	123.72	98.25	98.81	50.62
		(-0.85)	(-0.64)	(-0.55)	(-0.42)
	Theil	129.40	101.55	102.29	51.36
		(0.06)	(0.01)	(0.15)	(-0.06)
	Expected Rank	[128.5]	[101.0]	[101.0]	[51.0]
(0)	*Parametric*	0.08	0.08	0.07	0.03
		(0.57)	(0.60)	(0.50)	(0.25)
	Nonparametric	124.00	98.65	100.27	50.81
		(-0.51)	(-0.33)	(-0.11)	(-0.06)
	Theil	131.21	103.13	102.29	51.28
		(0.29)	(0.28)	(0.17)	(0.08)
	Expected Rank	[128.0]	[100.5]	[100.5]	[50.5]

* Significant at the 0.05 level; ** Significant at the 0.01 level (2-tailed tests); (n = 75)

Automate–Transform

Event Window	Test	Estimation Period (-300, -45)	(-260, -60)	(-202, -2)	(-102, -2)
(-2, +2)	*Parametric*	-0.04	-0.05	-0.04	0.00
		(-0.40)	(-0.53)	(-0.41)	(-0.01)
	Nonparametric	128.32	101.96	102.16	52.91
		(-0.64)	(-0.38)	(-0.33)	(-0.07)
	Theil	134.15	105.96	106.48	54.90
		(0.91)	(0.94)	(1.15)	(1.27)
	Expected Rank	[130.0]	[102.5]	[102.5]	[52.5]
(-1, +1)	*Parametric*	-0.05	-0.08	-0.05	-0.01
		(-0.59)	(-0.79)	(-0.48)	(-0.13)
	Nonparametric	125.90	99.69	99.93	51.58
		(-0.83)	(-0.67)	(-0.64)	(-0.26)
	Theil	131.91	103.96	104.88	53.70
		(0.47)	(0.48)	(0.75)	(0.92)
	Expected Rank	[129.0]	[101.5]	[101.5]	[51.5]
(-1, 0)	*Parametric*	0.03	0.02	0.03	0.07
		(0.33)	(0.24)	(0.41)	(0.73)
	Nonparametric	129.15	102.18	102.38	52.36
		(0.03)	(0.16)	(0.22)	(0.44)
	Theil	134.57	105.60	106.58	54.46
		(0.89)	(0.83)	(1.08)	(1.32)
	Expected Rank	[128.5]	[101.0]	[101.0]	[51.0]
(0)	*Parametric*	0.02	0.02	0.01	0.01
		(0.29)	(0.22)	(0.11)	(0.12)
	Nonparametric	131.31	103.39	103.18	52.28
		(0.38)	(0.40)	(0.39)	(0.46)
	Theil	135.99	106.46	107.26	54.11
		(0.85)	(0.79)	(0.94)	(0.99)
	Expected Rank	[128.0]	[100.5]	[100.5]	[50.5]

* Significant at the 0.05 level; ** Significant at the 0.01 level (2-tailed tests); (n = 109)

Informate–Automate

Event Window	Test	Estimation Period (-300, -45)	(-260, -60)	(-202, -2)	(-102, -2)
(-2, +2)	*Parametric*	-0.38	-0.38	-0.41	-0.54
		(-0.99)	(-1.04)	(-0.99)	(-1.10)
	Nonparametric	120.23	94.54	94.51	47.03
		(-0.89)	(-0.93)	(-0.86)	(-1.16)
	Theil	130.86	100.94	98.31	50.51
		(0.03)	(-0.20)	(-0.45)	(-0.44)
	Expected Rank	[130.0]	[102.5]	[102.5]	[52.5]
(-1, +1)	*Parametric*	-0.32	-0.30	-0.34	-0.43
		(-1.48)	(-1.51)	(-1.48)	(-1.80)
	Nonparametric	114.29	89.76	91.10	44.00
		(-1.02)	(-1.04)	(-0.86)	(-1.22)
	Theil	128.81	99.48	96.90	48.95
		(-0.04)	(-0.19)	(-0.38)	(-0.42)
	Expected Rank	[129.0]	[101.5]	[101.5]	[51.5]
(-1, 0)	*Parametric*	-0.30	-0.29	-0.32	-0.41
		(-1.49)	(-1.47)	(-1.56)	(-1.94)
	Nonparametric	101.50	79.21	76.21	38.43
		(-1.51)	(-1.55)	(-1.63)	(-1.64)
	Theil	112.93	86.00	83.64	42.57
		(-0.75)	(-0.96)	(-1.10)	(-1.01)
	Expected Rank	[128.5]	[101.0]	[101.0]	[51.0]
(0)	*Parametric*	0.27	0.25	0.29	0.34
		(0.64)	(0.62)	(0.64)	(0.61)
	Nonparametric	135.71	106.57	102.14	51.29
		(0.28)	(0.28)	(0.05)	(0.03)
	Theil	156.71	119.43	114.43	57.57
		(0.95)	(0.82)	(0.60)	(0.54)
	Expected Rank	[128.0]	[100.5]	[100.5]	[50.5]

* Significant at the 0.05 level; ** Significant at the 0.01 level (2-tailed tests); (n = 7)

Informate–Informate

Event Window	Test	Estimation Period (-300, -45)	(-260, -60)	(-202, -2)	(-102, -2)
(-2, +2)	*Parametric*	0.02	0.00	0.07	0.15
		(0.18)	(-0.03)	(0.55)	(1.18)
	Nonparametric	130.14	101.84	103.98	53.93
		(-0.06)	(-0.27)	(0.22)	(0.40)
	Theil	140.77	109.37	111.12	57.50
		(1.40)	(1.18)	(1.43)	(1.62)
	Expected Rank	[130.0]	[102.5]	[102.5]	[52.5]
(-1, +1)	*Parametric*	-0.04	-0.06	0.01	0.10
		(-0.24)	(-0.37)	(0.08)	(0.63)
	Nonparametric	124.74	97.13	101.17	52.65
		(-0.66)	(-0.89)	(-0.14)	(0.22)
	Theil	135.93	104.89	107.85	55.38
		(0.68)	(0.42)	(0.81)	(0.96)
	Expected Rank	[129.0]	[101.5]	[101.5]	[51.5]
(-1, 0)	*Parametric*	-0.15	-0.17	-0.11	-0.05
		(-1.16)	(-1.31)	(-0.88)	(-0.42)
	Nonparametric	116.28	90.10	93.85	49.04
		(-1.44)	(-1.71)	(-1.08)	(-0.68)
	Theil	127.29	97.38	100.55	51.18
		(-0.15)	(-0.49)	(-0.11)	(-0.08)
	Expected Rank	[128.5]	[101.0]	[101.0]	[51.0]
(0)	*Parametric*	-0.01	-0.01	0.02	0.09
		(-0.08)	(-0.08)	(0.14)	(0.64)
	Nonparametric	124.80	97.83	99.78	51.65
		(-0.30)	(-0.34)	(-0.12)	(0.13)
	Theil	133.85	104.55	106.28	53.23
		(0.33)	(0.30)	(0.42)	(0.37)
	Expected Rank	[128.0]	[100.5]	[100.5]	[50.5]

* Significant at the 0.05 level; ** Significant at the 0.01 level (2-tailed tests); (n = 40)

Informate–Transform

Event Window	Test	Estimation Period (-300, -45)	(-260, -60)	(-202, -2)	(-102, -2)
(-2, +2)	*Parametric*	-0.19	-0.20	-0.21	-0.22
		(-1.48)	(-1.56)	(-1.63)	(-1.63)
	Nonparametric	127.59	100.54	100.86	51.96
		(-0.66)	(-0.67)	(-0.62)	(-0.66)
	Theil	132.04	103.68	103.76	52.91
		(0.32)	(0.17)	(0.19)	(-0.05)
	Expected Rank	[130.0]	[102.5]	[102.5]	[52.5]
(-1, +1)	*Parametric*	-0.17	-0.19	-0.20	-0.21
		(-1.07)	(-1.13)	(-1.23)	(-1.22)
	Nonparametric	125.57	98.76	98.76	50.69
		(-0.69)	(-0.69)	(-0.74)	(-0.65)
	Theil	129.38	102.03	101.58	51.38
		(-0.02)	(0.01)	(-0.08)	(-0.26)
	Expected Rank	[129.0]	[101.5]	[101.5]	[51.5]
(-1, 0)	*Parametric*	-0.08	-0.09	-0.11	-0.11
		(-0.62)	(-0.67)	(-0.88)	(-0.84)
	Nonparametric	123.16	97.05	97.08	49.72
		(-0.84)	(-0.78)	(-0.82)	(-0.73)
	Theil	127.88	100.66	100.08	50.58
		(-0.15)	(-0.14)	(-0.23)	(-0.32)
	Expected Rank	[128.5]	[101.0]	[101.0]	[51.0]
(0)	*Parametric*	-0.08	-0.10	-0.12	-0.14
		(-0.78)	(-0.87)	(-1.08)	(-1.16)
	Nonparametric	121.40	94.43	94.18	48.42
		(-0.72)	(-0.81)	(-0.90)	(-0.75)
	Theil	124.83	97.32	96.45	48.57
		(-0.34)	(-0.43)	(-0.52)	(-0.60)
	Expected Rank	[128.0]	[100.5]	[100.5]	[50.5]

* Significant at the 0.05 level; ** Significant at the 0.01 level (2-tailed tests); (n = 60)

Transform–Automate

The sample size is zero and so no statistics could be calculated.

Appendix D

Note that, as mentioned in the Methodology chapter, delisted and renamed companies were also searched for. Some announcements, therefore, originate from companies which may now, or at one time, had a different name. For that reason, the *Company Name* column below indicates the original company name, whereas the *Company Code* column indicates the code of the current company from which the data was obtained.

Company Name	Company Code	Announcement Title	Date Announced	Sector - Subsector	IT Role	Sector Role
African Bank Investments Limited	ABIL	African Bank and Datacentrix complete upgrade in record time	04/12/2001	Financial Services - General Financial	A	T
African Bank Investments Limited	ABIL	African Bank selects PIC for risk management solutions	06/03/2000	Financial Services - General Financial	A	T
African Bank Investments Limited	ABIL	African Bank standardises servers, PCs with Datacentrix	19/02/2004	Financial Services - General Financial	A	T
African Bank Investments Limited	ABIL	African Bank streamlines internal maintenance with CA solution	15/07/2004	Financial Services - General Financial	A	T
African Bank Investments Limited	ABIL	EnABILed' by Borland	14/12/2000	Financial Services - General Financial	A	T
African Bank Investments Limited	ABIL	Spescom DataFusion delivers fast solution for African Bank	27/05/2004	Financial Services - General Financial	A	T
ABSA Group Limited	ABSA	Absa awards PQ Networks and Nortel R220 m Unified Networks contract	21/02/2002	Banks - Banks	A	T
ABSA Group Limited	ABSA	Absa banks on SafeGuard iT's disaster recovery services	21/05/2003	Banks - Banks	A	T
ABSA Group Limited	ABSA	Absa expands TRIAD consulting support from PIC Solutions	12/08/2003	Banks - Banks	I	T
ABSA Group Limited	ABSA	Absa Merchants Services automates processes with Pastel Evolution	02/12/2003	Banks - Banks	I	T
ABSA Group Limited	ABSA	Absa selects Microsoft Exchange as its communication infrastructure	27/09/2001	Banks - Banks	A	T
ABSA Group Limited	ABSA	ABSA strengthens customer relations with USKO and Prime Response	05/11/2003	Banks - Banks	I	T
ABSA Group Limited	ABSA	ADC KRONE wins CopperTen contract with Absa Bank for large data centre in SA	29/03/2000	Banks - Banks	A	T
ABSA Group Limited	ABSA	AST enabling Absa today, tomorrow, together	11/06/2002	Banks - Banks	A	T
ABSA Group Limited	ABSA	AST-A, ABSA create R1b company.htm	26/05/2005	Banks - Banks	T	T
ABSA Group Limited	ABSA	First all-electronic home loan application process for Absa	17/08/2005	Banks - Banks	A	T
ABSA Group Limited	ABSA	Gendac develops virus incident management system for Absa	24/05/2005	Banks - Banks	A	T
ABSA Group Limited	ABSA	Technology takes ABSA global	23/08/2000	Banks - Banks	A	T
ABSA Group Limited	ABSA	Telkom, Vodacom and Absa enter strategic alliance	22/03/2005	Banks - Banks	T	T
Adcorp Limited	ADCORP	Johnnic, DiData and Adcorp form Internet recruitment portal	04/06/2000	Industrial Goods & Services - Support Services	T	I
Advtech Limited	ADVTECH	E-learning focus sees ADvTECH Training emerge as ADvTECH Skills	06/03/2000	Industrial Goods & Services - Support Services	T	I
Advtech Limited	ADVTECH	E-learning with instructor base	03/10/2000	Industrial Goods & Services - Support Services	I	I
AECI Limited	AECI	AECI brings document explosion under control	26/05/1999	Chemicals-Chemicals	A	I
Afgri Limited	AFGRI	Cargo Carriers breaks new ground with PRAGMA's On Key	06/09/2005	Food & Beverage - Food Producers	I	I
Afgri Limited	AFGRI	Datacentrix implements new IT solution for improved flexibility at Afgri	06/07/2004	Food & Beverage - Food Producers	A	I
Afgri Limited	AFGRI	Sowing the seeds for agricultural financial service efficiency	15/07/2004	Food & Beverage - Food Producers	A	I
OTK Holdings Limited	AFGRI	OTK awards multimillion-rand deal to the AST Group	25/01/2002	Food & Beverage - Food Producers	A	I
OTK Holdings Limited	AFGRI	Stonewall to play an integral role in OTK Holdings' online strategy	15/09/2001	Food & Beverage - Food Producers	A	I
African Life Assurance Company Limited	AFLIFE	African Life outsources to EDS	29/04/1999	Insurance - Life Insurance	A	T
African Life Assurance Company Limited	AFLIFE	Faritec launches ASP offering for South African healthcare administration sector	24/04/2003	Insurance - Life Insurance	I	T

Alexander Forbes Limited	ALEXFBS	Alexander Forbes leads the way with high-tech office	10/03/2004	Insurance - Nonlife Insurance	A	T
Alexander Forbes Limited	ALEXFBS	Alexander Forbes Risk Services adopts e-learning using people-centric approach.htm	28/08/2003	Insurance - Nonlife Insurance	I	T
Alexander Forbes Limited	ALEXFBS	Alexander Forbes signs R2m deal with DiData	23/06/2004	Insurance - Nonlife Insurance	A	T
Alexander Forbes Limited	ALEXFBS	Alexander Forbes takes MTN pensions online.htm	08/05/2000	Insurance - Nonlife Insurance	I	T
Alexander Forbes Limited	ALEXFBS	Bespoke IT at Alexander Forbes' delivers rapid ROI throughout African operations.htm	28/10/2003	Insurance - Nonlife Insurance	A	T
Alexander Forbes Limited	ALEXFBS	Quintus to drive Alexander Forbes Contact Centre	14/02/2001	Insurance - Nonlife Insurance	I	T
Anglogold Ashanti Limited	ANGGOLD	AngloGold Ashanti reaffirms GijimaAst as its strategic outsourcing partner	18/08/2005	Basic Resources - Mining	A	I
Anglogold Ashanti Limited	ANGGOLD	GMSI, AngloGold lead mineral resource management to new levels	12/11/2003	Basic Resources - Mining	I	I
Anglogold Ashanti Limited	ANGGOLD	USKO chosen as AngloGold's Microsoft licensing partner	07/07/2000	Basic Resources - Mining	A	I
Anglo American plc	ANGLO	Anglo's e-learning is launched.htm	21/06/2003	Basic Resources - Mining	A	I
Anglo American plc	ANGLO	Spescom signs deal in excess of R20m with Anglo American.htm	18/10/2000	Basic Resources - Mining	A	I
Anglo Platinum Limited	ANGLOPLAT	Anglo Platinum opts for more flexible Group Provident Fund system.htm	04/10/2000	Basic Resources - Mining	A	I
Anglo Platinum Limited	ANGLOPLAT	Anglo Platinum streamlines employee benefits administration	19/06/2001	Basic Resources - Mining	A	I
Anglo Platinum Limited	ANGLOPLAT	CS Holdings wins R1_5m Anglo Platinum contract.htm	25/03/2002	Basic Resources - Mining	A	I
Anglo Platinum Limited	ANGLOPLAT	Local pilot takes Anglo American procurement to new level.htm	30/07/2001	Basic Resources - Mining	T	I
African Rainbow Minerals Limited	ARI	CS Holdings develops R1m data warehouse for African Rainbow Minerals.htm	20/06/2001	Basic Resources - Mining	I	I
Avgold Limited	AVGOLD	Avgold awards contract to AST-A	06/12/1999	Basic Resources - Mining	I	A
Avgold Limited	AVGOLD	Anglovaal Mining, Avgold explore the future with Oracle.htm	01/11/2001	Basic Resources - Mining	A	I
Avgold Limited	AVGOLD	AST-A receives Avgold contract.htm	29/11/1999	Basic Resources - Mining	I	A
Barloworld Limited	BARWORLD	Barloworld Robor first SA company to choose Cognos ReportNet as enterprise reporting standard	10/12/2003	Industrial Goods & Services - General Industrials	I	I
Barloworld Limited	BARWORLD	Barloworld takes lead in supply chain management with first South African mySAP SCM implementation	24/05/2005	Industrial Goods & Services - General Industrials	I	I
Barloworld Limited	BARWORLD	Datacentrix supplies Barloworld Logistics with scanning solution	29/03/2005	Industrial Goods & Services - General Industrials	A	I
Barloworld Limited	BARWORLD	Fulcrum completes EPM project at Barloworld	12/08/2005	Industrial Goods & Services - General Industrials	I	I
Barloworld Limited	BARWORLD	ProcureTrade signs agreement with Barloworld	07/11/2000	Industrial Goods & Services - General Industrials	A	I
Barloworld Limited	BARWORLD	Unisys boosts Barloworld Plascon national network in R3m deal	11/02/2003	Industrial Goods & Services - General Industrials	T	I
BHP Billiton plc	BHPBILL	AST MSI upgrades BHP Billiton's control systems	29/08/2002	Basic Resources - Mining	A	I
BHP Billiton plc	BHPBILL	CSC wins 2nd LAN contract for BHP Billiton	18/11/2002	Basic Resources - Mining	A	I
Bidvest Group Limited, The	BIDVEST	Bidvest chooses Commerce One to power electronic marketplace solution, mymarket.com	16/04/2002	Industrial Goods & Services - Support Services	I	I
Bidvest Group Limited, The	BIDVEST	BIDvest's mymarket.com trades on Microsoft technologies	07/02/2001	Industrial Goods & Services - Support Services	T	I
Bidvest Group Limited, The	BIDVEST	Rennies finds its missing link	10/10/2002	Industrial Goods & Services - Support Services	I	I
Barnard Jacobs Mellet Holdings Limited	BJM	Grintek Telecom installs flexible trading system for local stock broking firm	26/01/2001	Financial Services - General Financial	I	T
BoE Limited	BOE	Bank partners with Compuware for mission-critical software development	04/06/2002	Banks - Banks	A	T
BoE Limited	BOE	BoE backs Data Pro management buyout	16/07/2001	Banks - Banks	T	T
BoE Limited	BOE	BoE buys iLAB's iREQUIRE to align software development with business goals	02/05/2002	Banks - Banks	A	T
BoE Limited	BOE	BoE Merchant Bank signs up for Microsoft compliance with Unisys	05/09/2001	Banks - Banks	A	T
BoE Limited	BOE	BoE to implement IP telephony	10/07/2001	Banks - Banks	A	T
BoE Limited	BOE	NoE Life takes broker to the web with Unisys	28/09/2001	Banks - Banks	T	T
Brandcorp Holdings Limited	BRANDCO	Matus gets better budgeting, forecasting with local software solution	30/05/2005	Retail - General Retailers	I	I
Bytes Technology Group Limited	BTG	Bytes Business Solutions, Spatial Technologies announce business alliance	06/09/2004	Technology - Software & Computer Services	I	T
Bytes Technology Group Limited	BTG	Bytes Technology Group acquires storage company Optitek	31/07/2003	Technology - Software & Computer Services	T	T
Bytes Technology Group Limited	BTG	Bytes Technology Networks selects Solutional's Radical as workflow management software solution	20/02/2004	Technology - Software & Computer Services	I	T
Bytes Technology Group Limited	BTG	Bytes to grow storage skills after acquisition	15/08/2003	Technology - Software & Computer Services	T	T
Bytes Technology Group Limited	BTG	Maseco, Bytes Technology Networks merge Cape operations	11/04/2002	Technology - Software & Computer Services	T	T
Bytes Technology Group Limited	BTG	Online share trading facility launched	09/02/2000	Technology - Software & Computer Services	T	T
Business Connexion Group Limited	BUSCONNEX	Spescom supplies proprietary technology to Business Connexion	21/09/2005	Technology - Software & Computer Services	A	T
Cadiz Holdings Limited	CADIZ	Cadiz boosts reporting functionality with new financial software implementation	13/05/2003	Financial Services - General Financial	I	T
Capitec Bank Holdings Limited	CAPITEC	NamITech assists Capitec to reach the underbanked	13/10/2004	Banks - Banks	T	T
Capital Alliance Holdings Limited	CAPTALL	Capital Alliance Life achieves business continuity	05/02/2004	Insurance - Life Insurance	A	T
Capital Alliance Holdings Limited	CAPTALL	Global Technology helps develop Caliber system for Capital Alliance Life.htm	02/02/2001	Insurance - Life Insurance	I	T
City Lodge Hotels Limited	CITYLDG	From office to airport, to hotel, stay Connected, wherever you are	30/03/2005	Travel & Leisure - Travel & Leisure	T	T

City Lodge Hotels Limited	CITYLDG	Lorge wins City Lodge accounting software contract	06/07/2005	Travel & Leisure - Travel & Leisure	I	T
Comparex Holdings Limited	COMPAREX	Comparex signs R3.5m deal with MTN Network Solutions	08/04/2003	Technology - Software & Computer Services	A	T
Concor Limited	CONCOR	Strive Software International, Unlimited Consulting collaborate on providing training solution for Concor	13/02/2003	Construction & Materials - Construction & Materials	I	A
Datacentrix Holdings Limited	DCENTRIX	New call centre installation enhances operations	16/10/2000	Personal & Household Goods - Personal Goods	I	T
De Beers / Centenary Linked Unit	DEBEERS	Two De Beers divisions reduce reporting process with Impact and Analyst Financials	29/04/1999	Basic Resources - Mining	A	A
Decillion Limited	DECILLION	KPMG Consulting and Decillion redefine the boundaries of forex trade	22/08/2000	Financial Services - General Financial	T	T
Delta Electrical Industries Limited	DELTA	Delta Electrical Industries upgrades	01/12/2000	Industrial Goods & Services - Electronic & Electrical Equipment	A	I
Delta Electrical Industries Limited	DELTA	Mission Critical Server room upgrade	13/06/2004	Industrial Goods & Services - Electronic & Electrical Equipment	A	I
Dimension Data Holdings plc	DIDATA	Dimension Data reshapes service offering	26/07/2005	Technology - Software & Computer Services	I	T
Dimension Data Holdings plc	DIDATA	Goods in TransIT: Dimension Data improves supply chain efficacy with Oakwell Solutions' custom tracking solution	29/03/2005	Technology - Software & Computer Services	I	T
Dimension Data Holdings plc	DIDATA	Johnnic, DiData and Adcorp form Internet recruitment portal	04/06/2000	Technology - Software & Computer Services	T	T
Distell Group Limited	DISTELL	Comparex Africa secures R17.5m Distell managed services deal	29/10/2002	Food & Beverage - Beverages	A	I
Distell Group Limited	DISTELL	Distell - e-business spirit ignites	31/05/2002	Food & Beverage - Beverages	I	I
Distell Group Limited	DISTELL	Distell brews up a storm with Quartet Solutions	24/02/2004	Food & Beverage - Beverages	I	I
Distell Group Limited	DISTELL	Distell improves accessibility with Datacentrix	14/09/2005	Food & Beverage - Beverages	A	I
Famous Brands Limited	FAMBRANDS	Famous Brands outsources customer care line to Solutional	31/05/2004	Travel & Leisure - Travel & Leisure	I	T
Fedsure Holdings Limited	FEDSURE	Business Edge Systems develops web-based system for Fedsure Life's products	21/06/2000	Insurance - Life Insurance	A	T
Fedsure Holdings Limited	FEDSURE	CCH enables Fedsure call centre to generate single view of clients	24/08/2000	Insurance - Life Insurance	I	T
Fedsure Holdings Limited	FEDSURE	CS Holdings secures R5-million Fedsure outsource deal	10/09/1999	Insurance - Life Insurance	A	T
Fedsure Holdings Limited	FEDSURE	Datacentrix, Financial IQ implement large data storage, archive solution for Fedsure	11/09/2001	Insurance - Life Insurance	A	T
Fedsure Holdings Limited	FEDSURE	USKO Provides On-Line Claim Payments For Fedsure Health With MediSwitch	15/06/1999	Insurance - Life Insurance	A	T
Firstrand Limited	FIRSTRAND	DiData rolls out CRM solution at FNB Corporate	18/10/2001	Banks - Banks	I	T
Firstrand Limited	FIRSTRAND	First National Bank takes Internet security to a new level	26/02/2004	Banks - Banks	A	T
Firstrand Limited	FIRSTRAND	FirstRand Bank successfully implements SAS Campaign Manager	08/09/2003	Banks - Banks	A	T
Firstrand Limited	FIRSTRAND	FNB applies sophisticated technology to offer banking throughout rural SA	10/06/2005	Banks - Banks	T	T
Firstrand Limited	FIRSTRAND	Momentum Life goes live with Apropos contact centre from CCH	23/11/2000	Banks - Banks	A	T
Foschini Limited	FOSCHINI	Foschini implements Realyst Premises Manager	01/09/2001	Retail - General Retailers	A	I
Foschini Limited	FOSCHINI	Foschini selects Contactor Service from PIC Solutions	12/08/2003	Retail - General Retailers	A	I
Foschini Limited	FOSCHINI	Foschini upgrades TRIAD account management system	05/07/2005	Retail - General Retailers	A	I
Foschini Limited	FOSCHINI	Global Vision buttons down Foschini contract	12/10/2004	Retail - General Retailers	A	I
Foschini Limited	FOSCHINI	RCS Personal Finance selects PIC Solutions Collections System	21/06/2005	Retail - General Retailers	A	I
Gold Fields Limited	GFIELDS	Gold Fields signs R20m-plus HR/payroll deal with Solit	23/05/2001	Basic Resources - Mining	I	I
Gold Fields Limited	GFIELDS	GMSI implements CADSMine for Gold Fields	10/09/2001	Basic Resources - Mining	I	I
Gold Fields Limited	GFIELDS	GMSI implements resource management solution for Gold Fields	11/02/2004	Basic Resources - Mining	A	I
Glenrand M.I.B. Limited	GLENMIB	Bytes Technology Networks upgrades Glenrand MIB's Microsoft licence requirements	28/01/2003	Insurance - Nonlife Insurance	A	T
Glenrand M.I.B. Limited	GLENMIB	Customised Policy Holders' Protection Bill solutions	13/08/2001	Insurance - Nonlife Insurance	A	T
Glenrand M.I.B. Limited	GLENMIB	New WebSoft insurance claims management system a world beater	01/03/2001	Insurance - Nonlife Insurance	I	T
Glenrand M.I.B. Limited	GLENMIB	WebSoft implements CRM solution at Glenrand MIB	22/07/2002	Insurance - Nonlife Insurance	I	T
Grindrod Limited	GRINDROD	Grindrod upgrades to HEAT 8 for enhanced efficiencies	31/01/2005	Industrial Goods & Services - Industrial Transportation	A	I
Grindrod Limited	GRINDROD	Röhlig-Grindrod boosts revenue with ProClarity	07/09/2004	Industrial Goods & Services - Industrial Transportation	I	I
Grintek Limited	GRINTEK	Datacentrix heads large-scale Grintek software inventory	11/11/2002	Industrial Goods & Services - Electronic & Electrical Equipment	A	I
Grintek Limited	GRINTEK	Grintek adds value with Electrodynamics	21/06/2001	Industrial Goods & Services - Electronic & Electrical Equipment	T	I
Group Five Limited	GROUP-5	Centricity gives Group Five's information architecture a reVAMP	27/11/2001	Construction & Materials - Construction & Materials	I	A
Group Five Limited	GROUP-5	Group Five implements impact in three months	13/01/2000	Construction & Materials - Construction & Materials	I	A
Group Five Limited	GROUP-5	JD Edwards builds foundation with major construction group	23/07/2001	Construction & Materials - Construction & Materials	A	A
Harmony Gold Mining Company Limited	HARMONY	Harmony Gold opts for Unicenter	11/10/2005	Basic Resources - Mining	A	I
Illovo Sugar Limited	ILLOVO	Illovo Sugar in R2m payroll upgrade to UniQue 3	18/04/2001	Food & Beverage - Food Producers	A	I

Illovo Sugar Limited	ILLOVO	Illovo Sugar realises IT investment protection with PM Tech, InfoWave	17/09/2003	Food & Beverage - Food Producers	A	I
Illovo Sugar Limited	ILLOVO	Sweet deal for Bytes Technology Networks as Illovo Sugar renews R175m IT infrastructure agreement	30/10/2003	Food & Beverage - Food Producers	A	I
Illovo Sugar Limited	ILLOVO	USKO wins Illovo project worth more than R100 million	14/10/1998	Food & Beverage - Food Producers	A	I
Imperial Holdings Limited	IMPERIAL	AccTech Systems implements CRM at Imperial Fleet Services	09/03/2005	Industrial Goods & Services - Industrial Transportation	I	I
Impala Platinum Holdings Limited	IMPLATS	AST GMSI implements resource management solution for Impala Platinum	04/05/2004	Basic Resources - Mining	I	I
Impala Platinum Holdings Limited	IMPLATS	Implats implements Solit system for real-time production reports	08/11/2001	Basic Resources - Mining	I	I
Impala Platinum Holdings Limited	IMPLATS	Implats revamps maintenance system	07/02/2001	Basic Resources - Mining	A	I
Impala Platinum Holdings Limited	IMPLATS	Implats signs R240m business performance deal with EDS	06/08/1998	Basic Resources - Mining	I	A
Impala Platinum Holdings Limited	IMPLATS	mplats changes to SAP enterprise resource management solution	10/05/2005	Basic Resources - Mining	I	I
Investec plc	INVPLC	Datacentrix provides enterprise storage solution at Investec Asset Management	27/07/2005	Financial Services - General Financial	A	T
Investec plc	INVPLC	More success for NetTrace cost centre management	08/09/2005	Financial Services - General Financial	A	T
JD Group Limited	JDGROUP	JD Group tunes up reporting performance with ProClarity	12/07/2005	Retail - General Retailers	I	I
JD Group Limited	JDGROUP	Octagon deploys 'Frontier' in JD Group	25/03/2004	Retail - General Retailers	I	I
JD Group Limited	JDGROUP	UCS rolls out new business-to-business solution at JD Group	22/11/2001	Retail - General Retailers	I	I
Johnnic Communications Limited	JOHNCOM	Johnnic implements new backup, storage solution	22/02/2002	Media - Media	A	T
Johnnic Communications Limited	JOHNCOM	Johnnic, DiData and Adcorp form Internet recruitment portal	04/06/2000	Media - Media	T	T
Kumba Resources Limited	KUMBA	AST maximises business efficiency for Kumba Resources	05/08/2003	Basic Resources - Mining	A	I
Kumba Resources Limited	KUMBA	AST provides Kumba with solution for change, configuration management	04/02/2004	Basic Resources - Mining	A	I
Kumba Resources Limited	KUMBA	AST provides one-stop network service to Kumba	03/09/2003	Basic Resources - Mining	A	I
Kumba Resources Limited	KUMBA	AST wins LAN upgrade for Kumba Resources	20/08/2003	Basic Resources - Mining	A	I
Kumba Resources Limited	KUMBA	Kumba automates KRAMIT with K2.net 2003	18/01/2005	Basic Resources - Mining	A	I
Kumba Resources Limited	KUMBA	Kumba renews contract with Datacentrix	09/12/2003	Basic Resources - Mining	A	I
Kumba Resources Limited	KUMBA	Minolta South Africa wins Kumba Resources tender	04/02/2005	Basic Resources - Mining	A	I
KWV Beleggings Beperk	KWV BEL	KWV gets latest 'plug-and-play' technology	22/10/2005	Food & Beverage - Beverages	A	I
KWV Beleggings Beperk	KWV BEL	KWV says cheers to world-class production with improved asset management	15/10/2004	Food & Beverage - Beverages	I	I
The Laser Group Limited	LASER	Laser plugs into the Integr8 connective pipeline	07/01/2002	Industrial Goods & Services - Industrial Transportation	T	I
Liberty Group Limited	LIBERTY	Amvia business partner QuartzIT implements RightFax solution at the Liberty Group	28/06/2002	Insurance - Life Insurance	A	T
Liberty Group Limited	LIBERTY	Datacentrix awarded Liberty Group account	24/03/2004	Insurance - Life Insurance	A	T
Liberty Group Limited	LIBERTY	DiData in e-learning project at Liberty Group	07/03/2001	Insurance - Life Insurance	I	T
Liberty Group Limited	LIBERTY	Insurance giant awards large contract to Software Futures	07/08/2001	Insurance - Life Insurance	A	T
Liberty Group Limited	LIBERTY	IQ Business Group implements FileNet's Magnetic Storage Array technology at Liberty Group	07/05/2003	Insurance - Life Insurance	A	T
Liberty Group Limited	LIBERTY	Liberty Collective Investments implements new workflow system	01/03/2002	Insurance - Life Insurance	A	T
Liberty Group Limited	LIBERTY	Liberty Group enhances security with RSA solution	02/10/2001	Insurance - Life Insurance	A	T
Liberty Group Limited	LIBERTY	Liberty Group invests in online learning	10/10/2002	Insurance - Life Insurance	I	T
Liberty Group Limited	LIBERTY	Liberty Group relies on Iocore's e-learning solution to train agents	16/05/2001	Insurance - Life Insurance	I	T
Liberty Group Limited	LIBERTY	Liberty Group selects Shoden Data Systems as storage partner	07/11/2001	Insurance - Life Insurance	A	T
Liberty Group Limited	LIBERTY	Liberty Group takes IT capacity planning to new levels	02/09/2003	Insurance - Life Insurance	I	T
Liberty Group Limited	LIBERTY	Liberty implements Silica for unit trust management	27/07/2001	Insurance - Life Insurance	A	T
Liberty Group Limited	LIBERTY	Liberty in voice response investment	11/08/1999	Insurance - Life Insurance	A	T
Liberty Group Limited	LIBERTY	Liberty invests in storage technology and DiData	20/06/2001	Insurance - Life Insurance	A	T
Liberty Group Limited	LIBERTY	Liberty Life in R3m disaster recovery upgrade	18/05/1999	Insurance - Life Insurance	A	T
Liberty Group Limited	LIBERTY	Liberty Life opts for SA-developed software solution	27/06/2001	Insurance - Life Insurance	A	T
Liberty Group Limited	LIBERTY	The Liberty Group purchases WebLOAD testing tool from Atio	27/09/2001	Insurance - Life Insurance	A	T
Mutual & Federal Insurance Company Limited	M-&-F	Mutual & Federal migrates to Novell	25/05/2001	Insurance - Nonlife Insurance	A	T
Mutual & Federal Insurance Company Limited	M-&-F	Mutual & Federal pioneers CSC's product development tool	16/07/2003	Insurance - Nonlife Insurance	I	T
Mutual & Federal Insurance Company Limited	M-&-F	SafeGuard iT ensures Mutual & Federal keeps on delivering	14/10/2003	Insurance - Nonlife Insurance	A	T
Medi-Clinic Corporation Limited	MEDCLIN	Centennial helps Medi-Clinic to monitor, control assets	25/10/2002	Healthcare - Health Care Equipment & Services	I	T
Medi-Clinic Corporation Limited	MEDCLIN	Integr8 IT boosts Medi-Clinic's WAN efficiency	05/07/2004	Healthcare - Health Care Equipment & Services	A	T
Medi-Clinic Corporation Limited	MEDCLIN	Medi-Clinic improves output through Integr8 IT	31/03/2003	Healthcare - Health Care Equipment & Services	A	T
Medi-Clinic Corporation Limited	MEDCLIN	Tracking Web usage: NetTracker helps Medi-Clinic better understand client needs	03/08/2005	Healthcare - Health Care Equipment & Services	I	T

Metropolitan Holdings Limited	MET LTD	Exposing hidden information in data: MHG uses BI for improved risk management	07/06/2005	Insurance - Life Insurance	I	T
Metropolitan Holdings Limited	MET LTD	Metropolitan boosts infrastructure efficiency above 99%	06/06/2003	Insurance - Life Insurance	I	T
Metropolitan Holdings Limited	MET LTD	Metropolitan Employee Benefits seeks a differentiation that customers value	02/02/2004	Insurance - Life Insurance	I	T
Metrofile Holdings Limited	METROFILE	Metrofile brings content management to heel with new strategy	05/12/2002	Technology - Software & Computer Services	T	T
Metrofile Holdings Limited	METROFILE	Metrofile selects Dell for secure storage management	26/02/2002	Technology - Software & Computer Services	A	T
MGX Limited	METROFILE	MGX Disaster Recovery Centre employs Avaya contact centre solution from Spescom Datafusion	27/09/2000	Technology - Software & Computer Services	A	T
Ispat Iscor Limited	MITTAL	Ispat Iscor awards AST outsourcing contract	04/11/2004	Basic Resources - Industrial Metals	A	I
Ispat Iscor Limited	MITTAL	Ispat Iscor signs multimillion-rand outsourcing deal with Dimension Data	12/10/2004	Basic Resources - Industrial Metals	A	I
Mercantile Bank Holdings Limited	MRCANTIL	CCI gives Mercantile a new voice	10/08/2000	Banks - Banks	A	T
MTN Group Limited	MTN GROUP	MTN connects with Dell	03/07/2001	Telecommunications - Mobile Telecommunications	A	T
MTN Group Limited	MTN GROUP	MTN expands relationship with Intelsat to provide additional high-speed services to maritime customers	07/06/2004	Telecommunications - Mobile Telecommunications	I	T
MTN Group Limited	MTN GROUP	MTN goes for SAS campaign management tool	26/07/2001	Telecommunications - Mobile Telecommunications	I	T
MTN Group Limited	MTN GROUP	MTN Network Solutions spends R40m on fibre	14/02/2003	Telecommunications - Mobile Telecommunications	A	T
MTN Group Limited	MTN GROUP	MTN SP signs two-year deal with Adcheck Mobile	17/03/2005	Telecommunications - Mobile Telecommunications	I	T
MTN Group Limited	MTN GROUP	MTN uses SAS Institutes technology to implement new CRM focus	12/04/2000	Telecommunications - Mobile Telecommunications	I	T
MTN Group Limited	MTN GROUP	MTN's prepaid value added services now running faster and more reliably	08/02/2005	Telecommunications - Mobile Telecommunications	A	T
Mustek Limited	MUSTEK	Grintek Telecom helps Mustek rejuvenate call centre	14/05/2002	Technology - Technology Hardware & Equipment	I	T
Mustek Limited	MUSTEK	Mustek online with Usko Communications	08/02/1999	Technology - Technology Hardware & Equipment	I	T
Mustek Limited	MUSTEK	PQ Africa sells QDD to Mustek	08/02/1999	Technology - Technology Hardware & Equipment	T	T
Nampak Limited	NAMPAK	Nampak launches project to implement ERP software from JD Edwards	09/04/2002	Industrial Goods & Services - General Industrials	I	I
Nampak Limited	NAMPAK	Nampak signs multimillion-rand outsourcing deal with Comparex Africa	24/04/2003	Industrial Goods & Services - General Industrials	A	I
Nando's Group Holdings Limited	NANDOS	Nando's reaps rewards of data warehouse implementation	21/01/2003	Travel & Leisure - Travel & Leisure	I	T
Naspers Limited	NASPERS	Cointel wins Naspers tender	02/11/2004	Media - Media	A	T
Naspers Limited	NASPERS	Naspers Medical Fund chooses MIP's MedStar	26/03/2002	Media - Media	I	T
Naspers Limited	NASPERS	Naspers, MIH improve compliance and planning in R3 mil deal with Intellient	01/02/2005	Media - Media	I	T
Naspers Limited	NASPERS	Software Futures in R17.5m strategic sourcing deal with N-Direct	01/04/2003	Media - Media	A	T
Nedbank Group Limited	NEDBANK	Aligning employees with company strategy is imperative for business	24/05/2005	Banks - Banks	I	T
Nedbank Group Limited	NEDBANK	BoE Bank commences Profiler Service with PIC Solutions	12/03/2003	Banks - Banks	I	T
Nedbank Group Limited	NEDBANK	Nedbank adopts Intel Itanium 2-based Unisys ES7000 servers to enhance efficiency, drive new revenue streams	02/09/2004	Banks - Banks	A	T
Nedbank Group Limited	NEDBANK	Nedbank banks on STT for simulation-based training	17/07/2002	Banks - Banks	I	T
Nedbank Group Limited	NEDBANK	Nedbank selects Debt Manager for improved collections results	10/11/2005	Banks - Banks	A	T
Nedbank Group Limited	NEDBANK	Nedcor Retail Division of Nedbank implements R11m SAS BI, data warehouse solution	18/02/2004	Banks - Banks	I	T
Nedbank Group Limited	NEDBANK	Spescom supplies recording technology to Nedbank	20/10/2005	Banks - Banks	A	T
Network Healthcare Holdings Limited	NETCARE	CS Holdings announces R10 million technology contract with Netcare.htm	06/07/2001	Healthcare - Health Care Equipment & Services	A	T
Network Healthcare Holdings Limited	NETCARE	iLAB manages R3.5m Netcare 911 project.htm	15/01/2002	Healthcare - Health Care Equipment & Services	I	T
Network Healthcare Holdings Limited	NETCARE	Netcare looks to Cognos to enable it to respond quickly to rapid changes in the medical industry	24/01/2000	Healthcare - Health Care Equipment & Services	I	T
Network Healthcare Holdings Limited	NETCARE	Netcare uses SAP to create world's largest healthcare system of its kind.htm	01/06/2005	Healthcare - Health Care Equipment & Services	I	T
Network Healthcare Holdings Limited	NETCARE	USKO launches healthcare VPN	22/11/1999	Healthcare - Health Care Equipment & Services	A	T
Nedcor Investment Bank Holdings Limited	NIBH	Nedcor Bank and Dimension Data sign R20m trading room deal	06/12/2000	Financial Services - General Financial	T	T
Nedcor Investment Bank Holdings Limited	NIBH	Nedcor enhances customer service with R3m maintenance contract with CS Holdings	28/03/2002	Financial Services - General Financial	A	T
Nedcor Investment Bank Holdings Limited	NIBH	Staffware and Dimension Data win R10 million workflow implementation for Nedcor Loans Processes	08/11/2000	Financial Services - General Financial	A	T
New Clicks Holdings Limited	NUCLICKS	New Clicks, Bytes optimise information delivery with BI	30/03/2004	Retail - General Retailers	I	I
Old Mutual plc	OLDMUTUAL	Old Mutual and Nedbank sign $275 million network outsourcing agreement with CSC and Telkom South Africa	19/08/2005	Insurance - Life Insurance	A	T
Old Mutual plc	OLDMUTUAL	Old Mutual banks on backup with MGX	03/04/2002	Insurance - Life Insurance	A	T
Old Mutual plc	OLDMUTUAL	Old Mutual chooses AST's Brio	20/03/2001	Insurance - Life Insurance	I	T
Old Mutual plc	OLDMUTUAL	Old Mutual chooses SDT solution for African operations	03/09/2003	Insurance - Life Insurance	A	T
Old Mutual plc	OLDMUTUAL	Old Mutual division opts for idu-Concept as budgeting tool of choice	28/04/2005	Insurance - Life Insurance	A	T
Old Mutual plc	OLDMUTUAL	Old Mutual enhances IT productivity with CA	07/07/2004	Insurance - Life Insurance	A	T
Old Mutual plc	OLDMUTUAL	Old Mutual gains strategic advantage using IBM technology to get single view of each of several million clients	10/02/2003	Insurance - Life Insurance	I	T
Old Mutual plc	OLDMUTUAL	Old Mutual maintains leadership with strategic customer segmentation solution	12/08/2003	Insurance - Life Insurance	I	T

Old Mutual plc	OLDMUTUAL	Old Mutual opts for Oblix	27/05/2002	Insurance - Life Insurance	A	T
Old Mutual plc	OLDMUTUAL	Old Mutual utilises CA in new initiative to improve legacy systems	01/07/2003	Insurance - Life Insurance	A	T
Old Mutual plc	OLDMUTUAL	Siemens plays major role in Old Mutual,Nedbank network	19/10/2005	Insurance - Life Insurance	A	T
Palabora Mining Company Limited	PALAMIN	AST implements mining template for Palabora Mining Company	10/09/2002	Basic Resources - Industrial Metals	A	I
Pick n Pay Stores Limited	PICKNPAY	3fifteen uses MS technology to build IT solution for Pick 'n Pay's retail pharmacy initiative	29/10/2001	Retail - Food & Drug Retailers	T	I
Pick n Pay Stores Limited	PICKNPAY	Backup power solution for Pick 'n Pay security and data centre	01/06/2004	Retail - Food & Drug Retailers	A	I
Pick n Pay Stores Limited	PICKNPAY	Pick 'n Pay broadens corporate reporting with Sybase	05/05/2004	Retail - Food & Drug Retailers	A	I
Pick n Pay Stores Limited	PICKNPAY	Pick 'n Pay fulfils online shopping with RangeGate wireless solution	11/12/2001	Retail - Food & Drug Retailers	T	I
Pick n Pay Stores Limited	PICKNPAY	Pick 'n Pay implements new system for prepaid airtime	20/11/2001	Retail - Food & Drug Retailers	A	I
Pick n Pay Stores Limited	PICKNPAY	Pick 'n Pay switches from building its own IT systems to acquiring full mySAP ERP solution	07/06/2005	Retail - Food & Drug Retailers	I	I
BillCad Holdings Limited	PLANIT	Billcad chooses StorageTek for tape storage	07/07/1999	Technology - Software & Computer Services	A	T
Primedia Limited	PRIME	ComutaNet chooses Realyst	27/09/2004	Media - Media	A	T
Primedia Limited	PRIME	Ster-Kinekor launches SA's first speech-powered booking service with Intelleca	21/11/2002	Media - Media	I	T
Primegro Properties Limited	PRIMEGRO	Primegro goes with Artec	16/08/2002	Financial Services - Real Estate	A	T
PSG Group Limited	PSG	Infovu installs complete IT solution at PSG Channel Group	21/01/1999	Financial Services - General Financial	A	T
PSG Group Limited	PSG	PSG Investment Bank partners with Dimension Data	05/01/2000	Financial Services - General Financial	A	T
PSG Group Limited	PSG	PSG invests in Maximizer Enterprise	14/08/2002	Financial Services - General Financial	A	T
PSG Group Limited	PSG	PSG Online extends trading hours and reach with voice portal	26/09/2001	Financial Services - General Financial	I	T
Relyant Retail Limited	RELYANT	Relyant Retail live with TRIAD Marketing Communications	04/06/2003	Retail - General Retailers	I	I
Relyant Retail Limited	RELYANT	Relyant teams up with PIC for TRIAD implementation	11/04/2002	Retail - General Retailers	I	I
Richemont Securities AG	RICHEMONT	DiData's SA-developed market intelligence system for Richemont's European operations	04/09/2002	Personal & Household Goods - Personal Goods	I	I
Saambou Holdings Limited	SAAMBOU	Saambou implements Mobius to integrate diverse application environment	25/07/2001	Banks - Banks	I	T
Saambou Holdings Limited	SAAMBOU	Saambou invests in more power from PQ Africa's Persetel	08/12/2000	Banks - Banks	A	T
Saambou Holdings Limited	SAAMBOU	Saambou opts for DiData's TCO Integrators and Microsoft	13/06/2000	Banks - Banks	A	T
SABMiller Plc	SAB	AST MSI completes project at SAB	27/02/2002	Food & Beverage - Beverages	A	I
SABMiller Plc	SAB	Datacentrix sets SAB Project Lightyear on road to success	14/11/2003	Food & Beverage - Beverages	A	I
SABMiller Plc	SAB	Mobile computers put extra fizz into SA Breweries	08/12/2004	Food & Beverage - Beverages	A	I
SABMiller Plc	SAB	Partner success, Harvey Jones Systems, South African Breweries Miller Africa & Asia	06/09/2004	Food & Beverage - Beverages	I	I
South African Eagle Insurance Company Limited	SA-EAGLE	Bytes Technology Networks wins SA Eagle contract	24/04/2002	Insurance - Nonlife Insurance	A	T
South African Eagle Insurance Company Limited	SA-EAGLE	SA Eagle signs further three-year outsource contract with BTN	17/09/2004	Insurance - Nonlife Insurance	A	T
South African Eagle Insurance Company Limited	SA-EAGLE	SA Eagle soars with SAP training from CS Holdings	05/12/2001	Insurance - Nonlife Insurance	A	T
South African Eagle Insurance Company Limited	SA-EAGLE	SAS provides datawarehousing solution on AS 400 platform to SA Eagle	02/10/1998	Insurance - Nonlife Insurance	I	I
South African Eagle Insurance Company Limited	SA-EAGLE	USKO Enterprise Networks wins SA Eagle business	06/05/1999	Insurance - Nonlife Insurance	A	I
Safmarine and Rennies Holdings Limited	SAFREN	Safmarine sails ahead with Control-O-PC	06/05/1998	Industrial Goods & Services - General Industrials	A	I
Sage Limited	SAGEGRP	Sage Life selects ATIO as its contact centre partner	23/07/2002	Insurance - Life Insurance	A	T
Sanlam Limited	SANLAM	Lorge implements financial software solution for Sanlam Properties	12/05/2005	Insurance - Life Insurance	A	T
Sanlam Limited	SANLAM	Nashua Western Cape wins Sanlam contract	28/11/2000	Insurance - Life Insurance	A	T
Sanlam Limited	SANLAM	Sanlam exceeds business requirements with e-2 Financials	27/01/2003	Insurance - Life Insurance	I	T
Sanlam Limited	SANLAM	Sanlam heads to the forefront of e-payments	21/04/2004	Insurance - Life Insurance	A	T
Sanlam Limited	SANLAM	Sanlam outsources IT training to CS Holdings	21/02/2000	Insurance - Life Insurance	A	T
Sanlam Limited	SANLAM	Sanlam proves why software testing is critical	14/08/2001	Insurance - Life Insurance	A	T
Sanlam Limited	SANLAM	Sanlam upgrades HR system	18/06/2004	Insurance - Life Insurance	A	T
Santam Limited	SANTAM	Market leader in short-term insurance, Santam, selects FlowCentric for stolen vehicle management	10/01/2005	Insurance - Nonlife Insurance	A	T
Santam Limited	SANTAM	Santam awards R50m, three-year networking services contract to Dimension Data	06/08/2002	Insurance - Nonlife Insurance	A	T
Santam Limited	SANTAM	Santam outsources data centre to PQ Africa in multimillion-rand contract	08/08/2001	Insurance - Nonlife Insurance	A	T
Santam Limited	SANTAM	Santam renews training contract with CS Holdings	10/09/2002	Insurance - Nonlife Insurance	A	T
Sappi Limited	SAPPI	Sappi unites 330 000 accounts worldwide with Hyperion	13/09/2001	Basic Resources - Forestry & Paper	I	A
Sappi Limited	SAPPI	USKO's Spearhead successfully completes Sappi SAP R-3 project and is awarded 'Certificate Of Appreciation'	17/11/1999	Basic Resources - Forestry & Paper	A	A
Sasfin Holdings Limited	SASFIN	Sasfin gears up to grow its business with locally-developed CRM solution	01/04/2003	Financial Services - General Financial	I	T
Sasfin Holdings Limited	SASFIN	Sasfin set to reinvigorate ABF market with CreditEase	26/07/2004	Financial Services - General Financial	I	T

Sasfin Holdings Limited	SASFIN	Sasfin sets the standard with CommCIS	09/02/2004	Financial Services - General Financial	A	T
Sasfin Holdings Limited	SASFIN	Sasfin signs R2.7m contract with MTNNS	07/05/2003	Financial Services - General Financial	A	T
Sasol Limited	SASOL	Advanced technology for Sasol Synthetic Fuels from AST Networks	21/02/2002	Oil & Gas - Oil & Gas Producers	A	I
Sasol Limited	SASOL	AST implements electronic faxing delivery solution for Sasol Polymers	11/09/2002	Oil & Gas - Oil & Gas Producers	A	I
Sasol Limited	SASOL	Oakwell forges paperless, mobile inspection solution for Sasol	01/10/2002	Oil & Gas - Oil & Gas Producers	A	I
Sasol Limited	SASOL	Ovations to equip Sasol Synfuels with Enterprise Web Reporting from Crystal Decisions	17/01/2003	Oil & Gas - Oil & Gas Producers	I	I
Sasol Limited	SASOL	Philips in major telecom deal with Sasol	31/05/2001	Oil & Gas - Oil & Gas Producers	A	I
Sasol Limited	SASOL	Sasol Polymers in broad SAP roll-out	21/11/2001	Oil & Gas - Oil & Gas Producers	A	I
Sasol Limited	SASOL	Sasol project rolls out nationwide	12/11/2004	Oil & Gas - Oil & Gas Producers	A	I
Sasol Limited	SASOL	Yet Another First for Interconnect Systems	18/11/2005	Oil & Gas - Oil & Gas Producers	A	I
Shoprite Holdings Limited	SHOPRIT	EasyPay now at Shoprite Checkers Money Market	01/06/2001	Retail - Food & Drug Retailers	I	I
Shoprite Holdings Limited	SHOPRIT	Prism helps Shoprite ready for EMV smart cards	06/05/2003	Retail - Food & Drug Retailers	A	I
Shoprite Holdings Limited	SHOPRIT	Shoprite readies for smart card transactions	23/11/2001	Retail - Food & Drug Retailers	A	I
Sondor Industries Limited	SONDOR	Sondor Industries poised to increase competitive edge with IMPACT Encore	25/04/2000	Oil & Gas - Oil & Gas Producers	I	I
Standard Bank Group Limited	STANBANK	HTML Transit simplifies management of Standard Bank intranet	05/06/2003	Banks - Banks	A	T
Standard Bank Group Limited	STANBANK	Standard Bank selects SunGard for global Basel II compliance, capital management	15/06/2005	Banks - Banks	I	T
Standard Bank Group Limited	STANBANK	Standard Bank selects SunGard's Adaptiv Credit Risk	10/02/2005	Banks - Banks	I	T
Standard Bank Group Limited	STANBANK	Standard Bank South Africa goes live with DSTI's HiPortfolio	19/05/2005	Banks - Banks	A	T
Standard Bank Group Limited	STANBANK	Standard Corporate invests in Rational from Software Futures	27/09/2002	Banks - Banks	A	T
Standard Bank Group Limited	STANBANK	The E-mail Corporation secures Standard Bank's statements	26/11/2001	Banks - Banks	A	T
Sun International Limited	SUNINT	Internet Solutions supplies WiFi hotspots to Sun International	19/10/2005	Travel & Leisure - Travel & Leisure	I	T
Sun International Limited	SUNINT	Power Controls, Minotaur in world first with Sun International's Carnival City Casino	05/11/1999	Travel & Leisure - Travel & Leisure	T	I
Sun International Limited	SUNINT	Sun International calls on Novell, Compaq to keep the heart of its casino beating	08/08/2001	Travel & Leisure - Travel & Leisure	A	T
Sun International Limited	SUNINT	Sun International chooses a collaborative enterprise architecture strategy	28/10/2003	Travel & Leisure - Travel & Leisure	I	T
Sun International Limited	SUNINT	Sun International opts for Nortel Networks	08/05/2000	Travel & Leisure - Travel & Leisure	A	T
Sun International Limited	SUNINT	Sun International standardises on Nortel Network Campus Switching technology	08/05/2001	Travel & Leisure - Travel & Leisure	A	T
Sun International Limited	SUNINT	Sun International, Unisys and TPI partner on R50m outsourcing contract	18/11/2003	Travel & Leisure - Travel & Leisure	T	T
Super Group Limited	SUPRGRP	Auto Parts improves reporting, advances business with BI	13/10/2004	Industrial Goods & Services - Industrial Transportation	I	I
UCS Group Limited	UCS	UCS Solutions implements FrontRange Contact Centre	14/06/2005	Technology - Software & Computer Services	A	T
Unitrans Limited	UNITRAN	Comparex and Unitrans create B2B household goods electronic marketplace	06/07/2000	Industrial Goods & Services - Industrial Transportation	T	I
Unitrans Limited	UNITRAN	Nashua Mobile drives effective customer communication solution Unitrans	05/12/2003	Industrial Goods & Services - Industrial Transportation	I	I
Unitrans Limited	UNITRAN	PQ Africa moves Unitrans to Oracle to boost data access	15/08/2001	Industrial Goods & Services - Industrial Transportation	A	I
Woolworths Holdings Limited	WOOLIES	AST ESM implements ESM initiative for Woolworths	02/05/2000	Retail - General Retailers	A	I
Woolworths Holdings Limited	WOOLIES	CCH and Woolworths ensure business continuity in the Western Cape	11/05/2000	Retail - General Retailers	A	I
Woolworths Holdings Limited	WOOLIES	CSC wins Woolworths IT outsourcing account	17/10/2002	Retail - General Retailers	A	I
Woolworths Holdings Limited	WOOLIES	PIC Solutions assists with Woolworths industry first	30/10/2002	Retail - General Retailers	A	I
Woolworths Holdings Limited	WOOLIES	PIC Solutions develops scoring solution for Woolworths Financial Services	07/06/2005	Retail - General Retailers	A	I
Woolworths Holdings Limited	WOOLIES	PIC Solutions wins Woolworths Financial Services VisionPLUS project	10/04/2003	Retail - General Retailers	A	I
Woolworths Holdings Limited	WOOLIES	Internet Solutions supplies WiFi hotspots to Sun International	23/02/2001	Retail - General Retailers	I	I
Woolworths Holdings Limited	WOOLIES	Synergy Computing takes BI to next level with Cognos 8; achieves African first	27/09/2005	Retail - General Retailers	I	I
Woolworths Holdings Limited	WOOLIES	Woolworths awards managed services contract to Unisys	30/07/2002	Retail - General Retailers	A	I
Woolworths Holdings Limited	WOOLIES	Woolworths hones workflow environment with Metrofile	19/03/2003	Retail - General Retailers	A	I
Woolworths Holdings Limited	WOOLIES	Woolworths partners with SAS to nurture lifetime customer relationships	18/11/2003	Retail - General Retailers	I	I
Woolworths Holdings Limited	WOOLIES	Woolworths SA invests in Qpasa IBM WebSphere MQ management solution	14/03/2003	Retail - General Retailers	A	I
Woolworths Holdings Limited	WOOLIES	Internet Solutions supplies WiFi hotspots to Sun International	23/04/2001	Retail - General Retailers	I	I
Woolworths Holdings Limited	WOOLIES	Woolworths signs CredITMentor contract with PIC Solutions	16/08/2005	Retail - General Retailers	A	I