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## **The Impact of Information System and Technology (IST) Investment Announcements on the Market Value of Australian Companies: An Event Study**

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### **Abstract**

*The research presented in this paper studied the impact selected Information System and Technology (IST) investment announcements had on the market value of firms. It applies the event study method, a method to measure how a company's share price reacts to new information, to a list of publicly traded Australian firms. It uses and explicitly describes its approach to the selection of a reliable sample and the calculation of share return, which is well-known in financial research, but not established in IS research. On this background a total of 62 announcements related to the launching of new IST products or initiatives were selected over 1996 to 2003. On a whole the research showed that these announcements yielded positive abnormal returns only on -1 to +2 days from the announcement dates, the other days in the event window -15 to +15 yielded negative abnormal returns. The results indicate a possible market reaction, but they were not found to be statistically significant. This, in line with previous studies, supports and extends the claim that IST investments have not resulted in increased market value for publicly traded firms not only in the United States, but also in other developed, western countries such as Australia.*

### **Keywords**

IS/IT investment, Market Value, Event Study, IS/IT Impacts, Share Price Reaction

### **INTRODUCTION**

Since the advent of Information Systems and Technology (IST) in the workplace, the question has lingered in the minds of most investors and users of this technology, exactly what value does IST provide?. A large portion of the literature focuses on the area of the 'value' and 'pay off' of IST. However as Im *et al.* (2001) point out, "...because many factors influence firm performance, it is difficult to establish causality between IST investments and firm level output performance" (pg. 104). To this effect there is growing interest in the relationship between IST and the value of companies (Kamssu *et al.* 2003). Perhaps this interest is growing because of the rapid rise in technological innovation over the years, and its importance to the smooth operation of organisations (Dos Santos *et al.* 1993). Research has shown however, that IST has no imperative impact on company performance (Dos Santos *et al.* 1993). Nevertheless the area remains of interest to both industry and academia.

A robust, proven and interesting way in which one may be able to study the relationship between IST investments and company performance is through event studies. It is defined as being "A methodology used to measure how a firm's share price reacts to new information" (Seiler 2004, pg. 424). In short, this is achieved by analysing a number of company announcements to determine how the market reacts to such news. This is based on an understanding that if an investment yields a positive Net Present Value<sup>1</sup> (NPV) resulting from net discounted cash flows, the market value of a company should increase (Dos Santos *et al.* 1993). If the company is listed on an exchange and trading in an efficient market, the change in market value should be reflected in its share price soon after such investment announcement is made (Dos Santos *et al.* 1993; Hunter 2003). Furthermore, such changes to share price returns allows it according to Dos Santos *et al.* (1993) to be observed and measured.

If the market re-values a company's share price based on an IST investment announcement, then it is reasonable to assume that there is an impact on the market value of a company (Dos Santos *et al.* 1993). The examination of share

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<sup>1</sup> A measure of the benefits expected to generate a return greater than the required rate of return.

price reactions to IST investment announcements is used to measure "...the market's assessment of the expected impact of IST investments on total firm value..." (Dos Santos *et al.* 1993, pg. 3). Subramani & Walden (2001) argue that if investors can foresee future benefits to company performance from IST investment announcements, this would lead to positive returns. There is however little research in the field and most existing studies have been conducted in the United States. To find out whether their results are also valid in other regions, research in other countries is needed. The main question which this paper seeks to answer therefore is, what impact do IST investment announcements have if any on the market value of Australian companies?

The expected outcomes and contribution to knowledge from this research are; firstly further application of the event study method in examining the correlation between IST investments and company value. Secondly, an examination of the impact IST investment announcements have if any on a selection of publicly traded Australian companies in determining whether results obtained are consistent with previous studies, and thirdly a greater understanding of the value IST investment announcements have on market value and an opportunity to make valuable suggestions to guide further research in this domain.

The remainder of the paper is structured as follows: The next section provides a brief overview of the research performed in the field and introduces our research hypothesis. We then describe our research design and method with a special emphasis on the selection of our sample and the calculation of the share return. The paper concludes with the presentation and discussion of our findings.

## LITERATURE REVIEW AND RESEARCH HYPOTHESIS

Despite the importance of the topic an extensive search for literature only uncovered six studies in the area. These are here briefly discussed in chronological order as the background for our study.

Dos Santos *et al.* (1993) provide the first such study which used the event study method and aimed at evaluating IST investments making it the seminal paper for which all future work has referenced. The focus of this study was to address the question 'Do IST investments affect the market value of the company?' The study looked at a sample of 97 IST investments over the period of 1981 – 1988, and found that "...share price reactions to proposed IST investments are not significantly different from zero, either for the whole sample or for sub-samples in financial services and manufacturing" (Dos Santos *et al.* 1993, pg. 4). Im *et al.* (2001) comment that the results from the pioneering study did not show a significant effect of all IST investments on excess returns. In addition to this, industry classification has no effect on the value of IST investments. However an interesting discovery was that the IST investments that were classified as 'innovative' result in positive changes in company value. The effect of other types of IST investments including follow-up investments has been shown to be negative. These results indicate more than anything that the market during the period of 1981 to 1988 expected future foreseeable positive returns higher than the required rate of return from companies who chose to invest in 'innovative' IST. A key limitation of their study was that it was based on an assumption that the announcements which were observed were disclosed voluntarily (Dos Santos *et al.* 1993). As a result sample bias might be present given that only announcements which companies wanted to release were included (Dos Santos *et al.* 1993).

Eight years after the first study by Dos Santos *et al.* (1993), the second known study was performed by Im *et al.* (2001). This study builds up on the previous in three ways, the sample size is larger and more recent. The examination of volume reactions is the first such study of its kind for this specific problem domain, and confounding factors such as time lag effect, company size (not tested by Dos Santos *et al.* 1993) and industry are controlled for to enhance the internal validity of the findings. The study found that on average "...IT investment does not increase the market value of the firm. Similarly, trading volume was not higher than the expected trading volume over the event period" (Im *et al.* 2001, pg. 109). The results also indicate that "...IT investments do not seem to exhibit the industry effect in the overall time period" (Im *et al.*, 2001, pg. 110). Also consistent with the Dos Santos *et al.* (1993) study, financial companies did not have a larger impact of IST Investments on their market value than non-financial companies. Overall, there was no price reaction by larger companies but surprisingly, positive price returns were present for smaller companies. In terms of price and volume reaction, the study has been able to show an increase over time. In addition, the effects of both the industry and size of the company strengthen over time. It was also discovered that the bigger the company size the greater the dissemination of information (Im *et al.* 2001).

Subramani & Walden (2001) focused on e-commerce announcements and the subsequent impact on the market value of companies. The focus on e-commerce announcements is quite interesting because these particular initiatives have been a way in which a company projects an image of forward-looking management ready and not frightened to capitalise on technological advances to strengthen the business and adapt to a changing and competitive environment (Subramani & Walden 2001). The findings of the study were significant in that for the first time it was shown that "...e-commerce announcements are associated with significant increases in market valuation in firms and, at least temporarily, create value for the firm's shareholders" (Subramani & Walden 2001, pg 148). This shows that the market believes such announcements would yield future benefit streams for the company. These results were found to hold true for a broad set of companies and product types. The obvious limitation of this study as with other similar event studies is that it was based on a short interval being the last

quarter of 1998. This raises generalisability issues to other periods, and what is worse is that there may be cyclical and seasonal influences which have not been explicitly controlled for in the study.

Chatterjee *et al.*'s (2002) study was slightly different in that IT 'infrastructure' investment announcements were analysed to determine whether they had a significant impact on the market value of companies. It found evidence that IT infrastructure investment announcements had a significant impact on price returns. Another finding showed significant increases in trading volumes associated with IT infrastructure investment announcements, and interestingly, the authors also found evidence to suggest that IT infrastructure investments are more closely associated with increases in market value than investments in IST applications. These results provide a strong foundation and justification for making substantial investments in IT infrastructure. However given the limited period of 1992 – 1995, does not allow for generalisability to other periods.

Dehning *et al.* (2003) took a step forward in studying the problem by including all the announcements from the previous three major studies (Dos Santos *et al.* 1993; Im *et al.* 2001; Chatterjee *et al.* 2002). A total number of 350 announcements covered a period between 1981 and 1996. The focus was on the impact that an investment's strategic role has on the market value of a firm. The IST strategic role construct was conceptualised by Shein (1992) and Zuboff (1988) as being: (1) Automate, (2) Informate-up, (3) Informate-down, and (4) Transform. This construct is an important one because an IST investment's strategic role may be "...distinct from the firm's overall IT strategy role". (Dehning *et al.* 2003, pg. 639). The study demonstrated that the IST strategic role can explain how IST investments in each of the IST strategic roles might affect the company's competitive position and ultimately company value. These results provide support for the value of capturing the IST strategic role of a company's IST-related competitive manoeuvring in studies striving to understand the conditions under which IST investments are likely to produce out-of-the-ordinary, positive returns. The two limitations of the study are that it was possible that the results were driven by other 'contemporaneous' events, and that there could have been leakage for these announcements.

Hunter (2003) compares the mean and variance of share price returns of two types of IST investment announcements: (1) Investments that utilise existing organisational capabilities; and (2) Investments that are made exploratory in acquiring new capabilities. In studying this area Hunter (2003) examined 150 announcements of IST investments between 1990 – 1997. The results indicate that as expected exploitative IST investments have the same mean as, yet lower variance than, abnormal returns associated with exploratory IST investments. The unexpected finding was that the two types of IST investments yielded a significantly negative impact to the market value of the firms under consideration. This is important because these findings according to Hunter (2003) suggest that "...the characteristics of IST investments themselves, as well as the industry and strategic context within which they were made, are important determinants of the market value of the firm" (pg. 1).

All the previous research to date about this specific domain has been insightful and has indeed produced mixed results. Perhaps this could be attributed to the different periods of time being examined, or the different types of announcements under examination. Either way it is evident that a gap exists in the literature in that there is no precedent to studying this area in the Australian market. This has potential to uncover some interesting results, which could shed further light on the overall question of whether IST investments are value positive for companies. A question which has plagued IS academics and practitioners alike. The literature shows that on a whole IST investment announcements have not consistently resulted in significant positive abnormal returns. However these studies have been conducted primarily in the United States and a look at other developed countries is needed to determine whether these results are occurring exclusively in the US market or whether they apply in other developed, western countries such as Australia.

Therefore, the main hypothesis which was tested by our research is:

*IST investment announcements (specifically the launch of new IST products and initiatives) made by listed Australian firms will not result in significant positive abnormal returns, consistent with other US based studies and will not therefore be value adding.*

Such a hypothesis is crucial not only because it have never been tested in this context but because it could help support a future 'general' claim that IST investment announcements in developed countries do not consistently lead to statistically significant positive abnormal returns. The testing goal therefore focuses on how important the average announcement is, and as a result equal weights will be given to all announcements.

Being central to this research the notion 'IST Investments' is defined as being, an intent to or actual investment either by commitment to develop a technology internally, acquire the technology from a provider either by an alliance, outsourcing, or partnership deal or by acquiring the IST provider's company through partial or full acquisition. This definition is imperative as it influences the criteria used to filter announcements when deciding which announcements are excluded and which are included in this study. This will be discussed further in the sampling strategies and data collection areas of the paper, along with the specific type of IST investment announcements captured within the scope of the research.

## RESEARCH DESIGN AND METHOD

The research follows the positivist methodology primarily because the intent is to answer questions about the causal relationship between IST investment announcements and market value of companies. It is also selected given the objective, value-free nature of the study. The approach taken is quantitative because the data used to answer the research question and the hypothesis are value-free, historical, objective and numerical in its raw state (being share price/returns) and transformed state in the form of calculated Abnormal Returns.

### The Event Study Method

The underlying method governing the research is Event Studies. Event Studies in short allow a researcher to determine whether unanticipated announcements have a significant impact, whether positive or negative to a collection of publicly traded companies. An examination of the literature has revealed that the main method which is used to investigate the impact IST investment announcements have on the market value of a company is 'Event Studies'. In fact from the six studies reviewed all of them have used Event Studies to carry out their research (Chatterjee *et al.* 2002; Dehning *et al.* 2003; Dos Santos *et al.* 1993; Hunter 2003; Im *et al.* 2001; Subramani & Walden 2001). The event study method features prominently in financial research as a valuable analytical tool to detect the wealth effect of an event (Binder 1998; MacKinlay 1997; McWilliams & Siegel 1997; Peterson 1989; Subramani & Walden 2001). In fact the event study method has become the "...standard method of measuring security price reaction to some announcement or event" (Binder 1998, pg. 111). This has been supported by Seiler (2004) who states that "In order to measure how a firm's share price reacts to new information, an event study methodology is used" (pg. 217).

The event study method has been used extensively because it precludes the need to analyse and rely on "...accounting-based measures of profit, which have been criticised because they are often not very good indicators of the true performance of firms" (McWilliams & Siegel 1997, pg. 626). The main benefit of an Event Study is that it is "...relatively easy to implement because the only data necessary are the publicly traded firm's name, event dates, share prices and volume" (Im *et al.* 2001, pg. 105). The other strength comes from its reliance on data which cannot easily be manipulated from inside the organisation (Mc Williams & Siegel 1997).

Event Studies in short aim to determine the abnormal returns in share prices resulting from an unanticipated event (Peterson 1989; Mc Williams & Siegel 1997, Wells 2004). The underlying basis here is that prices of shares are determined by investors' reaction to new information of these unanticipated events (Fama *et al.* 1969). This new information is what investors believe they can attain in company announcements. In other words event studies allow researchers to determine the nature of the share market's reaction to strategic moves (Chatterjee *et al.* 2002; Im *et al.* 2001), among other types of announcements. This 'reaction' is important because it is based on whether investors believe an announcement will bring future expected cash flows (McWilliams & Siegel 1997; Wells, 2004). If the release of this information is perceived to be good news, an increase in abnormal returns should be expected (Im *et al.* 2001), because of the positive impact brought about by the good sentiment of such good news.

The theoretical foundation of Event Studies comes from the notion of efficient markets (Brown & Warner 1985; Fama *et al.* 1969) that is, given the rationality of investors the effects of an event (announcement for example) should be 'priced in' to the share immediately after such an event (MacKinlay 1997; Seiler 2004). In an efficient capital market "...investors are assumed to collectively recognise future benefit streams accruing from initiatives announced by firms, a judgment subsequently reflected in the share price of the firm" (Subramani & Walden 2001, pg. 136). The efficient market hypothesis (EMH) dictates that "...capital markets are efficient mechanisms to process information on firms" (Subramani & Walden 2001, pg. 140-141), and that share prices incorporate all relevant information about the value-creation and growth prospects of a firm (Chatterjee *et al.* 2002; Subramani & Walden 2001), and as MacKinlay (1997) states "...a measure of the event's economic impact can be constructed using security prices observed over a relatively short time period" (pg. 13).

### The Sampling Technique

The sampling technique is based on a pre-defined set of criteria and is therefore selective rather than being random. This set of criteria was formed to control for a number of key confounding factors that impose limitations on Event Studies if not adequately addressed. It also seeks to strengthen the validity and integrity of the study and prevent selective bias and other validity threats.

The SIRCA database was interrogated to identify relevant announcements using a number of key words including System, Software, Technology and others. This resulted in 4,325 announcements, and for further refinement of data the following factors were excluded from the original list. Similar Announcements – Same Company, Other Announcements – Same Company, Duplicate Announcements, Irrelevant Announcements – by Criteria, Irrelevant Announcements – by Research Topic, Announcements with Insufficient data – Historical Share Data, Announcements with Insufficient Data – Historical (corresponding) Index Data.

The focus of this study is primarily on the investments relating to the launch of a new Information System or Technology product internally or externally to the market. Essentially this type of announcement represents the fruit

of any IST investment and may be of particular interest to investors which is why it was chosen. From a market perspective particularly, the bottom line is whether the IST event is a value increasing or decreasing investment. This resulted in a total of 62 announcements covering the years 1996 to 2003 over 13 industries across Australia.

### **Data Collection and Analysis**

The daily company and index prices, and announcements data were collected from three databases held by SIRCA: The first being, ASX Daily Data Database which holds the daily price and volume data for each share listed on the ASX. The second database called All Ordinaries Accumulation Index<sup>2</sup> Database holds the daily price and volume data for the All Ordinaries Accumulation Index. Finally the Company Announcements (Signal G) Database which holds the details of all company announcements lodged with the ASX.

The data collection phase is very important in Event Studies and should be carried out carefully. The following steps were taken: Access to these databases was organised through SIRCA who provided the required data in the form of a series of files. These files were imported into a database to allow for centralised querying. This improved efficiency and validity because of the level of data integrity, and reduction in human error.

The final sample was analysed using Microsoft Excel based on the text by Seiler (2004) to determine the Company Share Returns, Predicted Returns, Abnormal Returns (positive or negative from predicted returns), and the statistical significance of results through z-statistic and p-value test. Other data analysis tools such as Eventus were not compatible with the non-US data being used for this study.

The theoretical part of the statistical method governing this study was based on MacKinlay (1997), whereas the application part was based on Seiler (2004). Announcements detailing a new launch of an Information System or Technology product internally or externally to the market were selected because of their suitability to the topic.

There are a few different frequencies of data which can be used in Event Studies the two most common being Daily and Month. The Daily data frequency was selected for more observation points (Seiler 2004), great accessibility of data, improve and reliability of results (Peterson 1989), and that it is commonly used in event studies (Seiler 2004).

Seiler (2004) defines the Event Window as being "...the number of trading periods examined preceding and following the event date" (pg. 424). He states that an event window of -15 to +15 days from the event date should be selected predominately because the event date can be identified with a high degree of certainty, and therefore an excessively large event window is not necessary. He continues by arguing that this makes the measurement of the event's significance on the company's share prices more powerful. An event window of -15 to +15 days from the event date is also consistent with recommendations in the literature (Peterson 1989).

The estimation period of 115 days to -16 days before the event date (0), was chosen for this study and is consistent with recommendations in the literature (Peterson 1989). It is defined as being "...the period of time over which no event has occurred. It is used to establish how the returns on the share should behave in the absence of the event" (Seiler 2004, pg. 424). Care has to be taken with this estimation because as Peterson (1989) states "The greater the precision in determining the event date the more powerful the test" (pg. 54).

It is interesting to note that the estimation period is not standard for all studies (Seiler 2004). A general recommendation by Seiler (2004) on defining estimation periods is that one should try to "...make the interval wide enough to capture the relationship between the share and the market, but not so wide that the estimated relationship no longer applies to the firm today" (pg. 219).

Following Seiler (2004), who puts forward that it is imperative that the criteria used to screen the final sample are defined and documented thoroughly to support the reliability of a study the sample selection and analysis strategies are discussed further. Seiler (2004) underlines the importance of identifying the event date: The event date is defined as "...the time when the market first learns of the relevant new information (the event)" (Seiler 2004, pg. 217). He points out that "Studies have shown that discrepancies and reporting delays exist among providers. The less accurate you are in identifying the event date, the less powerful the test, and therefore, the less able you are to accurately measure the impact of the event on the firm" (pg. 218). The event date is captured as a field within each announcement record provided by SIRCA.

### **Calculating Returns**

To perform a reliable event study a number of items have to be computed; first, the share and index returns are determined as the movement in price from one day to the next as opposed to using just the average or raw price. If the raw price was used it would be very difficult to compare and use them together in calculations seeing that each company has different prices.

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<sup>2</sup> An index which measures movements in the value of the major shares listed on the Australian Share Exchange, (factors in reinvestment of dividends), and generally provides a better measure of investment performance than a straight price index like the All Ordinaries index (<http://www.superannuation.asn.au/dictionary/a/All%20Ordinaries%20accumulation%20index.htm>)

Then, the normal and abnormal returns are calculated using the risk-adjusted return approach. According to Gallagher & Looi (2005) the risk-adjusted return "...for a particular share 's' is, therefore, the return on share 's' less the value-weighted benchmark return on the characteristics-matched portfolio for which share 's' belongs" (pg. 131). Abnormal returns are the difference between the estimated and actual share returns, hence the word abnormal because it is anything above or below the normal return.

Subsequently, the abnormal returns are standardised (called standardised abnormal returns) by the standard deviation of the risk, these are then totalled for each day in the event window to get the total standardised abnormal returns. The total standardised abnormal returns are then collected for all events to determine the total cumulative standardised abnormal returns, which is needed to represent all the abnormal returns in the data set.

Finally the statistical significance of the results has to be tested. For this purpose the z-statistic is used to calculate the number of standard deviations from the actual mean (zero) to the value of importance, following a standard deviation of 1.0. The p-value is a measure of the probability of observing a value that is radically different from the actual value observed where there is a null hypothesis. The smaller the p-value the greater is the confidence level of the results.

For a better understanding of the computations used in the study, the following mathematical formulae are explained in some more detail. Share and Index Returns are significant for our study; share returns are known to follow a log normal distribution (Seiler 2004) and are therefore calculated as:

$$\text{Share Return} = \text{Log} \left( \frac{P_t}{P_{t-1}} \right) \quad \text{Where } P = \text{Daily Share Price, } t = \text{Price at time (t)}$$

This formula returns the natural logarithm of each day's share price. Natural logarithms are based on the constant 2.71828182845904. This was repeated for the share prices of all companies including the estimation period (-115 to -16 days) and the Event Window (-15 to + 15 days). It is also repeated for all the daily closing prices of the All Ordinaries Accumulation Index including both the estimation period and the event window.

In order to determine whether IST investment announcements have had an impact on their company's share price it is important to estimate what the share price would have been had there been no announcement (Peterson 1989). This is called normal returns and "...can be calculated by four different methods: mean return, market return, proxy (or control) portfolio return and risk-adjusted return" (Seiler 2004, pg. 220).

For this study the risk-adjusted return approach was used, predominately because it is the most commonly used method to generate expected returns over the event window. Seiler (2004) states that with this method Abnormal Returns "...defined as the difference between the actual return and the expected return, where the expected return for each of the days in the event window is predicted using a regression" (pg. 221). More specifically he states that the return on the share is regressed against the return on the market. He continues by stating that the next step required is to subtract the predicted value for each day from the actual return in the event window to determine the abnormal return (Seiler 2004).

The regression was determined using the All Ordinaries Accumulation Index as opposed to the All Ordinaries Index primarily because it allows for reinvestment of dividends which is in line with the set of prices being used for individual company share prices which also factors into account dividends and splits among other items.

The Capital Assets Pricing Model<sup>3</sup> (CAPM) is the most frequently used way to determine a company's share return (Dos Santos *et al.* 1993; Kamssu *et al.* 2003), and has been used by the following related studies (Dos Santos *et al.* 1993; Im *et al.* 2001; Subramani & Weldon 2001). It was calculated as follows:

$$R_{jt} = \alpha_j + \beta_j R_{mt} \quad \text{Where } R_{jt} = \text{rate of return for firm } j \text{ on day } t, R_{mt} = \text{rate of return on the market,}$$
$$\alpha_j \beta_j = \text{market model intercept}^1 \text{ and slope parameters for firm } j$$

The relationship between the share return and market return in the absence of an event was measured by performing a regression between the two series within the estimation period. This regression is done by calculating the intercept or alpha (regression intercept) and slope.

The abnormal return is derived by calculating the difference between the estimated and actual returns for each share with the sample for each event day in the event window (Peterson 1989, Seiler 2004). Abnormal returns according to Subramani & Walden (2001) are "...created by the consensual estimates of the large number of investors in the capital markets of the expected future benefit streams associated with firm initiatives" (pg. 140).

If investors feel the event will be of value to the company they will react favourably and this "...will be reflected in a positive abnormal return for the firm's share – a risk adjusted return in excess of the average share market return" around the date of the IST investment announcement (Subramani & Walden 2001, pg. 140). In other words, share

<sup>3</sup> A valuation model meant to describe the relationship between risk and return ([www.kayne.com/glossary.shtml](http://www.kayne.com/glossary.shtml)).

returns are subject to some degree of 'noise' or random statistical fluctuation, but the event study is looking for returns that exceed this normal level of variation. This was calculated as follows:

$AR_{jt} = R_{jt} - (\alpha_j + \beta_j R_{mt})$  Where  $AR_{jt}$  = Abnormal Return on share  $j$  for each day in the event window,  
 $R_{jt}$  = return on share  $j$  for each day in the event window,  $\alpha_j$  = intercept slope for share  $j$  measure over the estimation period,  $\beta_j$  = slope term for share  $j$  measured over the estimation period,  
 $R_{mt}$  = return on the market for each day in the event window

The Standardised Abnormal Return (SAR) is then calculated. The AR is divided by the standard deviation of the risk. The SAR must be calculated for all companies ( $j$ ) over all days in the event window ( $t$ ). The Standardised Abnormal Returns were calculated as follows:

$SAR_{jt} = \frac{AR_{jt}}{\sqrt{s^2 AR_{jt}}}$  Where  $SAR_{jt}$  = standardised abnormal return for firm  $j$  at time  $t$ ,  $AR_{jt}$  = abnormal return for firm  $j$  at time  $t$ ,  $\sqrt{s^2 AR_{jt}}$  = square root of the variance of the abnormal return for firm  $j$  at time  $t$

The next step is to aggregate the SARs for each separate day in the event window and determine if the results are significant as a Total Standardised Abnormal Return (TSAR). To determine the statistical significance of the TSAR Results, the Z-statistic is calculated. It is used as a pre-cursor to calculating the p-value in order to determine the statistical significance of each TSAR for each day in event window. The Z-statistic follows a standard normal distribution which means it has a mean of zero and a standard deviation of 1.0, it was calculated for each event window day's TSAR as follows:

Z-statistic =  $\frac{AR}{\sqrt{\sum_{j=1}^N \frac{D_j - 2}{D_j - 4}}}$  The p-value was computed in Excel using the NORMSDIST function as recommended by Seiler (2004) to return the standard normal cumulative distribution function with a mean of zero and a standard deviation of one. The formula looks as follows, p-value = 2 x (1-NORMDIST(ABS({z-statistic}))).

This is a standard normal distribution, and since the p-value is calculated using the cross-sectional standard deviation of abnormal returns it would be expected to correlate with the mean abnormal returns.

The cumulative total standardised abnormal returns (Cumulative TSAR) to be computed next are the sum of the abnormal returns according to Seiler (2004) and are calculated as follows:

$CumulativeTSAR_{T_1, T_2} = \sum_{t=T_1}^{T_2} TSAR_t$  Where Cumulative  $TSAR_{T_1, T_2}$  = cumulative TSAR for each day in the event window,  $TSAR_t$  = TSAR for each day in the event window,  $T_1$  = earliest date in the event window (-15),  $T_2$  = later date in the event window (ranges from -15 through +15)

Finally the statistical significance of the Cumulative TSAR Results is calculated as follows: The Z-statistic was used as a pre-cursor to calculating the p-value in order to determine the statistical significance of each Cumulative TSAR for each day in event window. The Z-statistic follows a standard normal distribution which means it has a mean of zero and a standard deviation of 1.0, it was calculated for each event window day's Cumulative TSAR as follows:

Z-statistic =  $Z_t = \left( \frac{1}{\sqrt{N}} \right) \left( \frac{\sum_{T_1}^{T_2} SAR_{jt}}{\sqrt{(T_2 - T_1 + 1) \left( \frac{D_j - 2}{D_j - 4} \right)}} \right)$  Where  $Z_t$  = Cumulative TSAR Z-Statistic for each day in the event window,  $N$  = number of firms in the sample (62),  $SAR_{jt}$  = SAR for firm  $j$  for each day in the event window,  
 $T_1$  = earliest date in the event window (-15),  $T_2$  = later date in the event window (ranges from -15 through +15),  
 $D_j$  = number of observed trading day returns for firm  $j$  over the estimation period

The p-value was computed in exactly the same manner as previously discussed.

### Validity and Reliability Issues

The threat to face validity is one which focuses on whether the measure appears to be measuring what it is supposed to measure on the face value (Neumann 2003). It is rather significant and does not rely on previous established theories. This threat was mitigated by having three senior academics in three universities with extensive experience in carrying out Event Studies review the research design thoroughly. The accuracy of the Event Study method has been discussed in various areas of the paper including but not limited to the sampling, data collection and analysis sections.



Internal validity is perhaps the most important item, because of the nature of the study and need for accuracy in the design of the research. Internal validity refers to the level of rigor taken to perform measurements, the research design, the inclusion of alternative views, and explanations for the causal relationships between factors (independent and dependant) being examined (Neumann 2003). This threat was mitigated through careful research design and rigor in measurement. This has been discussed where appropriate in the data collection, sampling, data analysis and other sections of the paper.

External validity refers to the extent to which the results of the research can be generalised (Neumann 2003). This is a positivist, quantitative based study and one of the aims is to be able to generalise findings if possible. This form of validity is imperative because of the need for the study to be repeatable in order for the results to be reliable, accurate and accepted. In a normal sense, random sampling strengthens the ability to generalise, however where it is not practical to draw a random sample – generalisation must then be done on a theoretical basis (Hoyle, Harris & Judd 2002). Therefore replicating research in other settings and with other samples strengthens external validity. The ability to generalise is improved given that a relatively lengthy period of study was taken over years 1996 to 2003. There was clear delineation marking those investment types within and outside the scope of the study. The search and statistical method utilised was based on precedent clearly substantiated in the literature review.

The results of this research are limited by the following points; firstly the study focused on IST investment announcements between the years 1996 and 2003. This means the results are only applicable to this period and may not be generalised over other periods of time being before 1996 and after 2003. Secondly, the research is only based on announcements which companies chose to disclose. This is somewhat problematic because companies undergo a larger number of IST investments (perhaps on a smaller scale) internally which investors are not privy to but may or may not end up being significant in terms of influencing either directly or indirectly the company's ability to generate future cash flows. It is assumed that no leakages occurred prior to the announcement date. Finally, the research was not able to extend passed 2004 because SIRCA does not publish the All Ordinaries Accumulation Index prices beyond 2004. This led to a reduction in the sample size.

The research was conducted based on a number of assumptions. Firstly the information contained in the IST investment announcements is not anticipated by the market forces before the first public announcements. Secondly markets are efficient in that shares reflect all relevant information (Fama *et al.* 1969; McWilliams & Siegel 1997). It is also assumed that any new information relevant to pricing those shares is impounded in an unbiased manner into the market price. In addition events are unanticipated in that Abnormal Returns are a result of investor reaction (Dos Santos *et al.* 1993; McWilliams & Siegel 1997). It is also assumed that individual share returns over time can be predicted to some degree, based on historical share returns. Events are not confounded by eliminating other factors (McWilliams & Siegel 1997). Lastly, it is assumed that share prices reflect expected future earnings, and deviations from that will be arbitrated away.

## FINDINGS AND DISCUSSION

The research has revealed the cumulative total standardised abnormal returns for all 62 announcements in this study as presented in Figure 1. The results indicate that where Australian companies have made IST investment announcements to the market from 1996 to 2003, there has been substantial negative abnormal returns from -15 to -2 days prior to the announcement and +3 to +15 days after the announcement. The interesting finding is that there seems to be an unprecedented positive abnormal return around the days of the actual announcement itself. This clearly shows that the announcements have yielded a positive return in excess of what was predicted given historical price returns. However merely returning a positive or negative return is not enough, because the amount needs to be statistically significant to be accepted academically as providing empirical support for the relevant hypothesis.

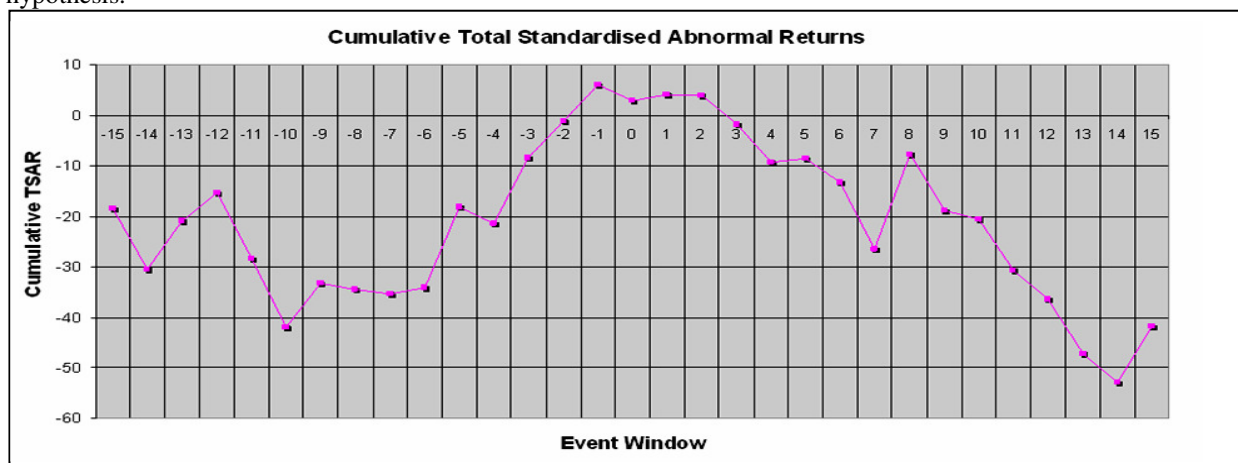


Figure 1: Cumulative Total Standardised Abnormal Returns

The statistical significance of the abnormal returns was determined using the p-statistic. The p-values for each of the event dates have been calculated. p-values that fall below .05 were deemed to be statistically significant at a 95 % level. If the p-value is .01 the results are significant at the 99% level. The only statistically significant days were 15, 14 and 10 days prior to the event dates for all announcements studied with the following confidence levels:

Event Days	Cumulative TSAR p-value	Confidence levels
-15	0.018812107	95%
-14	0.006365646	99%
-10	0.029797733	95%

Table 1: Statistically Significant Results

Since they are not relatively close to the event date they do not reveal anything interesting. The results for the crucial period within and around the announcement are captured below:

Event Days	Cumulative TSAR	Cumulative TSAR Z-Stat	Cumulative TSAR p-value
-1	6.01500465	0.19681038	0.843975928
0	2.843371806	0.090080611	0.928223157
1	4.105978786	0.126197253	0.899575786
2	3.853988681	0.11511498	0.908353986

Table 2: Positive Abnormal Returns

As can be seen in the Table 2 as well as in Figure 1, while there was clearly an abnormal return for the period just before (-1) to just after (+2) the announcement date, the results were not statistically significant as shown by the p-values being greater than 0.05. These results are interesting firstly because they show that there was an unprecedented positive abnormal return around the event dates however not large enough to merit their statistical significance. The results are also in line with previous findings in the literature and more work is required perhaps in analysing other IST investment types to determine whether there is any discrepancy or consistency in the findings so far.

This data and subsequent analysis show that the hypothesis made in this paper is supported. The results further support previous studies in their findings that IST investments on a whole do not result in positive significant abnormal returns (Dos Santos *et al.* 1993; Hunter 2003; Im *et al.* 2001).

Ultimately it is very difficult to assess the NPV of an IST investment and even harder to expect capital markets to do a better job, perhaps that is why we do not observe significant positive abnormal returns with IST investment related announcements. Certainly more work is required to reach some consensus on the value IST investments have on companies. Share market investors consider the trade-off of both risk and return in assessing the viability of company investments and their ability to contribute to growth opportunities to the company going forward (Chatterjee *et al.* 2002). For this reason the Event Study method was used to look into the problem of whether IST investments impact the market value of companies.

The study showed clearly that for the sample companies in Australia, over the time period 1996 to 2003 investors did see future income potential greater than the rate of return for IST investments and therefore when they were announced all resulted in positive abnormal returns until 2 days after the announcement, despite the fact that they were statistically insignificant. It still showed that the market is yet to be sure of companies making IST investments. In the past the Dos Santos *et al.* (1993) study showed that a particular type of IST investment that is, investments in innovative Information Technologies result in positive abnormal returns. Either way the results of this study were consistent with previous studies, which is interesting because it will contribute considerably towards supporting the claim in future that IST investments have not resulted in increased market value for publicly traded companies in the United States, the United Kingdom and now Australia.

The above mentioned limitations are in fact opportunities for further research on this problem area in Australia. The results are the first of its kind focusing on Australian companies. Other possible research questions could focus on the other types of IST investment announcements discussed previously in determining whether there is a difference in the Abnormal Returns of those announcements compared with the ones which have been studied in this paper. Another interesting piece of research would be to conduct a series of interviews with Equity Analysts, Brokers and Fund Managers across Australia to gauge what importance they have placed on IST Announcements in making their judgments and technical reports on companies. The insight gained from such study should assist researchers in future, whether academic or practitioner, to shed some more light on this problem.

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