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Requirements on IT business value measures for mobile-integrated business processes

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STOCK MARKET REACTION TO INFORMATION TECHNOLOGY INVESTMENTS: TOWARDS AN EXPLANATORY MODEL

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Abstract

Investments in information technology (IT) do not always result in the expected tangible payoffs, and the factors which influence the effect of IT investments on organizational performance are not well understood. Stock market reaction is one approach to appraising IT investments. In this paper we propose a conceptual model describing the factors that impact IT investments based on market reaction findings of major event studies on IT implementation announcements. This preliminary model may serve as a starting point to better understand the complex issue of stock movements related to IT investments.

1   INTRODUCTION

In light of the apparent importance of IT to organizational performance, combined with the lack of clarity as to what makes IT investments successful (Oz, 2005), it is not surprising that much research has been dedicated to identifying and understanding the factors that lead to improved payoffs from IT. IT productivity has implications not only for the firm and its stakeholders, but also for the economy at large. Much current research is dedicated to the impact of IT on global competiveness and development, particularly in emerging and developing countries (Roztocki & Weistroffer, 2008b).

In addition to the more traditional approaches to investigate IT productivity, such as case studies, surveys, and research databases, event studies are also increasingly being used (Roztocki & Weistroffer, 2008a; Roztocki & Weistroffer, 2009). According to the efficient market theory (Fama, 1970; Fama, 1991), which provides the foundation for the event studies methodology, all available information to investors is reflected in the stock prices. When unanticipated news reach the financial markets, investors assess their relevance and potential effects on particular firms, industries, and economic regions. Stock prices of a company will move up when the news are perceived to be favorable, and bad news, i.e. news indicating the possibility of diminishing future cash flows for a company, will result in decreasing stock prices. In the event studies approach, the reaction of stock markets to reported events is used to explore the perceived relevance and implications of these events (McWilliams & Siegel, 1997).

Event studies are now widely-used in business research areas such as accounting, finance, and strategic management. More recently event studies have become quite popular in IT research to identify specific factors which impact the outcomes of IT investments. Most of these studies, however, have taken an oversimplified approach, looking at particular factors in isolation – the interaction among the influential factors has hardly been considered at all (Oh et al., 2006). Frequently, this simplistic approach may lead to a perceived absence of market reaction to IT investments in a large sample of announcements, as the interaction of various factors can have a nullifying effect. Despite the fact that interaction among factors seems apparent and has been observed by several authors (Hayes et al., 2001; Oh et al., 2006), according to our knowledge, no attempts have been made to construct a model to explain the interaction among multiple factors.

In this paper we try to close or at least narrow this gap and propose a model which encompasses a variety of factors and possible interactions between these factors. The proposed model is based on a systematic literature review and backed by experiences from conducting our own event studies.

2 METHODOLOGY AND DATA COLLECTION

Our conceptual model is constructed from a systematic review of previous event studies investigating stock price reactions to IT investments. To identify appropriate published studies, we checked several literature databases, such as ABI/Inform (Proquest), Business Source Premier (EBSCO), JASTOR, and Science Direct. To find papers relevant to our proposed model, search queries including keywords such as "event study", "stock market reaction", "market value", "announcement", "information technology" and "information system" were used. This literature review was first conducted in spring 2007, with several up-dates, the last one in fall 2008.

The selection of research papers describing relevant event studies was topic driven and not particularly focused on specific publication outlets. However, to be included for the construction of our model, an article needed to satisfy the following three criteria: First, the article needed to be published in an academic, peer-reviewed journal, or in refereed proceedings of a major IT conference. Second, the article needed to use an event studies approach as the primary research method. Third, the topic of investigation presented in the paper had to be some kind of investment in IT, where investment in IT is defined as any large, non-routine expense for implementing new technology or aimed at making better use out of existing technology. This definition basically follows that proposed by Bacon (1992), though we broaden it slightly beyond hardware and software to also include human resources. Thus, implementing a new enterprise information system qualifies, but so does creating a new executive position dedicated to the administration and management of existing technology.

After assembling the appropriate papers, we conducted a systematic review of the reported studies, following the steps suggested by Rosenthal and DiMatteo (2001). Consequently, each paper was examined for independent, dependent, and control variables, and the reported results across the different studies were compared and analyzed for possible explanations when the outcomes differed or seemed to contradict each other.

Overall, our final sample includes at total of twenty-three studies.

3 REVIEW OF EVENT STUDIES ON IT INVESTMENTS

3.1 General Overview of the Event Studies

Twenty-two of the twenty-three papers included in our sample were published in the time period 2001-2008; one paper was published in 1993. The twenty-three papers in our sample represent a combined authorship of forty-eight authors, most (thirty-four) affiliated with US universities; the remaining fourteen authors were from Australia (three), Canada (two), China (two), Netherlands (three), South Korea (one) and Taiwan (three). The main focus of the investigations was stocks of US based companies.

The majority (nine) of the twenty-three papers investigated the stock market reaction to IT investments in general, while most of the others focused on investment in a particular technology, such as e-commerce initiatives (six), *enterprise resource planning* (ERP) systems (two), *enterprise application integration* (EAI) applications (one), supply chain managements systems (one) and customer-related systems (one). One paper examined both integration solutions (ERP and EAI) and two investigated IT related investments in human resources, specifically the creation of a CIO position. Table 1 summarizes the event studies in chronological order.

Authors	Type of IT Investments	Specific Factors Investigated
Dos Santos et al. (1993)	general IT investments 97 announcements for 1981-1988	• manufacturing vs. financial industry • innovative vs. non-innovative IT
Chatterjee et al. (2001)	CIO position 96 announcements for 1978-1998	• 1987-1994 vs. 1995-1998 time periods • IT driven vs. not IT driven industry • external vs. internal CIO hires
Hayes et al. (2001)	ERP implementation 91 announcements for 1990-1998	• small vs. large company • financially healthy vs. unhealthy • large vs. small vendor
Im et al. (2001)	general IT investments 238 announcements for 1981-1996	• manufacturing vs. financial industry • small vs. large company size • 1981-1990 vs. 1991-1996 time periods
Subramani and Walden (2001)	e-commerce investments 251 announcements for Oct.-Dec. 1998	• traditional vs. Internet firm • B2B vs. B2C • tangible vs. digital goods
Chatterjee et al. (2002)	general IT investments 112 announcements for 1992-1995	• IT infrastructure vs. IT applications
Geyskens et al. (2002)	e-commerce investments 93 announcements	• channel power and experience • time of entry
Dehning et al. (2003)	general IT investments 353 announcements for 1981-1996	• transformational vs. non-transformational • industries with substantial structural changes vs. industries with modest changes • leaders vs. laggards
Hunter (2003)	general IT investments 150 announcements for 1990-1997	• exploitative vs. exploratory
Dehning et al. (2004)	e-commerce investments 244 announcements for Oct.-Dec. 1998 538 announcements for Oct.-Dec. 2000	• 4th quarter of 1998 vs. 4th quarter of 2000
Ferguson et al. (2005)	e-commerce investments in Australia 232 announcements for Jan. 1988-Jun. 2001	• innovative vs. non-innovative
Filbeck et al. (2005)	supply chain management IT 247 announcements for 1995-2000	• general only
Dardan et al. (2006)	customer-related IT investments 57 announcements for 1996-2001	• general only
Oh et al. (2006)	general IT investments 340 announcements for 1981-1999	• high growth vs. slow growth firm • strategic vs. non-strategic investment • asset specific vs. non- asset specific
Ranganathan and Brown (2006)	ERP implementations 116 announcements for 1997-2001	• full suites vs. small number of modules • leading vs. non leading ERP vendors
Roztocki and Weistroffer (2006)	IT investments by companies using ABC 81 announcements	• automate vs. transform
Dewan and Ren (2007)	e-commerce investments 67, 152, 215, 206 announcements for 1996, 1998, 2000, 2002 respectively	• new vs. expansion • tangible vs. digital goods and services • B2B vs. B2C
Khallaf and Skantz (2007)	CIO position 443 announcements for 1987-2002	• CIO hires: new vs. existing position
Lin et al. (2007)	e-commerce investments 179 announcements for 1999-2002	• large vs. small firms • early entrants vs. late entrants
Meng and Lee (2007)	general IT investments 128 announcements for 1999-2002	• company location in China vs. USA
Roztocki and Weistroffer (2007a)	EAI investments 81 announcements for 1998-2005	• 1998-2001 vs. 2002-2005 time period • companies with low beta vs. high beta • bull vs. bear market condition
Roztocki and Weistroffer (2007b)	general IT investments 179 announcements for 1989-2005	• companies using ABC vs. not using ABC • companies with low beta vs. high beta • bull vs. bear market conditions
Roztocki and Weistroffer (2008c)	EAI and ERP investments 129 announcements for 1994-2005	• 1998-2001 vs. 2002-2005 time period • companies with low beta vs. high beta • bull vs. bear market conditions

Table 1. Summary of Event Studies Reviewed

3.2 Variables Used in the Studies

Following the meta-analysis approach of Rosenthal and DiMatteo (2001) we examined the independent and dependent variables in the studies of our sample. Almost all studies used changes in stock price as dependent variable. One study used changes of systematic and unsystematic company risk as consequence of investments in IT (Dewan & Ren, 2007). Additionally, a few studies used changes in trading volume as dependent variable. We also identified the control variables reported in the studies. Overall, the independent and control variables used in the studies fall into five major categories: company characteristics, type of IT investments, vendor characteristics, economic conditions, and characteristics of the announcements. Tables 2 and 3 summarize the independent and control variables.

Variables		Studies	Comments
Company Characteristics	Industry	(Dos Santos et al., 1993)	1: manufacturing; 0: otherwise
		(Im et al., 2001)	finance versus non-finance
		(Chatterjee et al., 2001)	1: high level of IT driven transformation; 0: otherwise
		(Dehning et al., 2003)	1: financial (SIC code 6000-6299); 0: otherwise
		(Meng & Lee, 2007)	manufacturing versus finance
		(Meng & Lee, 2007)	IT-using versus IT-producing companies
	Company Size	(Hayes et al., 2001)	small and large companies, based on total assets
		(Im et al., 2001)	small, middle, and large companies, based on total assets
		(Dehning et al., 2003)	estimated by total assets
		(Meng & Lee, 2007)	estimated by assets
	Company Location	(Meng & Lee, 2007)	companies located in China versus companies located in the USA
	Financial Health	(Hayes et al., 2001)	estimated by Altman's Z score
	Company Growth	(Oh et al., 2006)	estimated by market-to-book ratio
	Systematic Company Risk	(Roztocki & Weistroffer, 2007a; Roztocki & Weistroffer, 2007b; Roztocki & Weistroffer, 2008c)	estimated by beta factor
	Variance of Daily Stock Returns	(Oh et al., 2006)	
	Costing Systems	(Roztocki & Weistroffer, 2007b)	companies using activity-based costing versus not using activity-based costing
Type of IT Investments	Innovation Content	(Dos Santos et al., 1993)	two dummy variables: 1: innovative investment; 0: otherwise 1: non-innovative investment; 0: otherwise
		(Ferguson et al., 2005)	innovative and non-innovative e-commerce initiatives
	Benefit to IT Infrastructure	(Chatterjee et al., 2002)	1: infrastructure investment; 0: otherwise
	CIO Position	(Chatterjee et al., 2001)	1: external candidate; 0: otherwise
	Strategic Role	(Oh et al., 2006)	1: transformative investments; 0: otherwise
	Tangible/Digital Goods	(Dewan & Ren, 2007)	1: for tangible goods electronic commerce initiatives; 0: for digital goods or services initiatives
		(Dewan & Ren, 2007)	1: for a B2B type of electronic commerce initiative; 0: for B2C
	Asset Specificity	(Oh et al., 2006)	1: specific purpose investment; 0: high flexibility investment
	Time of Announcement	(Im et al., 2001)	two sub-samples: 1981-1990 and 1991-1996
		(Dehning et al., 2003)	number of days passed from the first announcement
		(Ferguson et al., 2005)	pre-10 March 2000 versus post-10 March 2000 electronic commerce initiatives
		(Dewan & Ren, 2007)	1: 1998 or 2000; 0: 1996 or 2002

Variables		Studies	Comments
		(Roztocki & Weistroffer, 2007a; Roztocki & Weistroffer, 2008c)	1998-2001 versus 2002-2005
	Scope of Investment	(Dewan & Ren, 2007)	1: new electronic commerce initiative; 0: expansion of existing ecommerce capability
Vendors Characteristics	ERP Vendor Size	(Hayes et al., 2001)	two sub-samples: large (SAP and PeopleSoft) and small (all others)
	ERP Vendor Leadership	(Ranganathan & Brown, 2006)	1: leading vendor (SAP, People Soft, Baan, Oracle and J.D. Edwards); 0: otherwise
Economics Conditions	Stock Market Conditions	(Roztocki & Weistroffer, 2007a; Roztocki & Weistroffer, 2007b; Roztocki & Weistroffer, 2008c)	bull versus bear market

Table 2. List of Independent Variables

Variables		Studies	Comments
Company Characteristics	Industry	(Oh et al., 2006)	1: financial industry; 0: otherwise
		(Chatterjee et al., 2002)	1: service industry (SIC code>=5000); 0: otherwise
			1: financial industry; 0: otherwise
			1: IT-producing companies; 0:otherwise
		(Ranganathan & Brown, 2006)	1: service industry (two digit SIC code between 40 and 89); 0 otherwise
	Company Size	(Chatterjee et al., 2002)	market value of company
		(Hunter, 2003)	estimated by natural log of total sales
		(Oh et al., 2006)	logarithm of total assets
		(Ranganathan & Brown, 2006)	estimated by logarithm of company's revenue and by logarithm of number of employees
		(Dewan & Ren, 2007)	estimated by logarithm of market value
	Company Growth	(Chatterjee et al., 2002)	estimated by market-to-book ratio
	Organizational Slack	(Hunter, 2003)	estimated by quick ratio; portion of liquid resources in a company
	Firm Performance	(Dewan & Ren, 2007)	estimated by stock return over the period of two years prior to the announcement
	Systematic Company Risk	(Dewan & Ren, 2007)	estimated by beta factor
	Unsystematic Company Risk	(Dewan & Ren, 2007)	
Type of IT Investment	Time of Announcement	(Hunter, 2003)	year of the investment
Announcement Characteristics	Source of Announcement	(Oh et al., 2006)	1: investing firm; 0: otherwise

Table3. List of Control Variables

3.3 Comparison of Reported Stock Market Reactions

Typically, the stock market reaction to IT investments is assessed by calculating abnormal returns (AR) around the time of the announcement (Roztocki & Weistroffer, 2008c). The day of the announcement is denoted as day 0. The period around the announcement day is called event window and may include several days before and/or after. The most commonly used event window includes one day before (day -1), the day of announcement (day 0), and the day after the announcement (day 1). The AR for the days included in the event window are added up to get the cumulative abnormal returns (CAR). Frequently, the AR are standardized and the stock market reaction for particular event windows is measured by cumulative standardized abnormal returns (CSAR). (The formula for

calculating the CSAR can be found in, for example, Roztocki & Weistroffer (2008c)) Table 4 shows the stock market reactions reported by the studies included in our sample.

	Reaction (%)	Measured by	Sample Size	Study
General IT Investments				
	0.09	CSAR (-1,0)	97	(Dos Santos et al., 1993)
	0.02	CSAR (-1,0)	238	(Im et al., 2001)
	1.224	CAR(-1,1)	112	(Chatterjee et al., 2002)
	-0.85	CAR(-1,1)	150	(Hunter, 2003)
	0.35	CAR(-1,1)	340	(Oh et al., 2006)
	0.0037	CAR(0,2)	63	(Meng & Lee, 2007)
	1.0778	CAR(0,2)	65	(Meng & Lee, 2007)
	-0.09	CSAR (-1,1)	179	(Roztocki & Weistroffer, 2007b)
Specific Types of Investments				
Innovative	1.03	CSAR (-1,0)	25	(Dos Santos et al., 1993)
Not Innovative	-0.09	CSAR (-1,0)	43	(Dos Santos et al., 1993)
CIO Position	1.16	CAR(-1,1)	96	(Chatterjee et al., 2001)
Customer Related	0.366	CSAR(-1,1)	57	(Dardan et al., 2006)
EAI	-0.084	CSAR(-1,1)	81	(Roztocki & Weistroffer, 2007a)
Electronic Commerce	4.2	CAR (-1,1)	251	(Subramani & Walden, 2001)
	-1.9	CAR (-1,1)	542	(Dehning et al., 2004)
	0.48	CAR (-1,1)	232	(Ferguson et al., 2005)
ERP	0.6	CAR(0,1)	91	(Hayes et al., 2001)
	1.49	CAR (-1,1)	116	(Ranganathan & Brown, 2006)
	-0.113	CSAR(-1,1)	48	(Roztocki & Weistroffer, 2008c)
Specific Company Characteristics				
Manufacturing	0.40	CSAR (-1,0)	33	(Dos Santos et al., 1993)
Finance	-0.08	CSAR (-1,0)	64	(Dos Santos et al., 1993)
	-0.03	CSAR (-1,0)	115	(Im et al., 2001)
No-Finance	0.066	CSAR (-1,0)	123	(Im et al., 2001)
Companies Using ABC	-0.097	CSAR(-1,1)	81	(Roztocki & Weistroffer, 2006)

Table 4. Stock Market Reaction

4   SUMMARY OF FINDINGS

A comparison across different studies suggests that there are a large number of factors, which may influence stock market reaction with varying contributions. Company size and timing of the investments appear to be highly influential, whereas industry type seems to have a more moderate effect. As stated earlier, the variables examined in the reviewed event studies can be grouped into five major categories: company characteristics, type of IT investments, vendor characteristics, economic conditions, and announcement characteristics. The market reactions observed in the twenty-three studies reviewed are summarized in Table 5.

Category	Factor	Stock Reaction	Comments
Company Characteristics	Industry type	Indifferent	Industry effects tend to be insignificant
	Size	Negative	The magnitude of stock market reactions seems to be negatively related to the company's size; larger for small companies; smaller for large companies. Stock reactions seem to be more positive for smaller companies.
	Financial health	Indifferent	For ERP investments, when the financial health of a company worsens, the stock price reaction seems to become more positive for large firms and become more negative for smaller firms
	Costing system used	Indifferent	ABC implementation seem to benefit investments to automate business processes
	Industry leadership	Indifferent	Stock market seems to react more positively when the announcing company that lead its industry sector, but this reaction is statistically insignificant
IT Investment Type	Innovation content	Positive	Highly innovative announcement are better received
	Category	Indifferent	ERP implementation seem to be received positively Infrastructure investments also positively There seems to be large variation in stock respond to e-commerce initiatives.
	Strategic importance	Positive	Transformative IT investments seem to be received more positively
	Focus	Indifferent	Asset specific IT investments seem to result in insignificantly negative stock reaction
Vendor Characteristics	Size	Positive	Large, leading vendors with established reputation seem to benefit investment in IT
Economic Conditions	Bear/Bull stock market	Bull: Positive Bear: Negative	Conditions of the stock market seem to be important factor
Announcement Characteristics	Source of announcements		Stocks seem to respond more favorably when the announcement is released by the investing company as opposed to the vendor.

Table 5. Observed Market Reaction

4.1 Company Characteristics

Several event studies looked at a number of different company characteristics as potentially influential factors to explain stock market reaction. The industry of the investing company was most often used as a variable, with the idea that companies in certain industries, such as finance, will benefit more from IT investments. This assumption was derived from the fact that banking is an information intensive industry. Most event studies, however, fail to provide evidence that industry is an influential factor.

Firm size effect was also examined by several studies. Overall, it appears that the magnitude of stock reactions diminish with company size. This makes sense, as the same size investment will have larger impact on a small firm than a large firm, i.e. the size of the investment relative to the size of the company or its capital assets is important.

4.2 Type of IT Investments

Type of IT investments investigated includes those with innovative content, transformative IT investments (as opposed to investments for operational efficiency only), investments in specific types of IT such as ERP or e-commerce, and asset specific focused investments. Only innovative IT investments and investments of strategic significance (transformative IT investments) resulted in positive stock market reactions. Innovative and transformative IT investments may result in competitive advantages for the investing company, and seem to be rewarded by the stock market.

4.3 Vendor Characteristics

Large, established vendors seem to instill trust, and investments in IT from large vendors are more likely to result in positive market reactions. In other words, it seems that stock market investors believe that large vendors are more likely to posses the technical expertise and resources to make IT investments successful.

4.4 Economic Conditions

Investments in IT in times of bull market conditions are more likely to result in positive stock market reactions than investments during bear market conditions. It appears that stock market investors are more doubtful about investments in IT and their effects on financial performance during bear markets.

4.5 Announcement Characteristics

Relatively few event studies looked at the characteristics of the announcement itself. However, it may reasonably be expected that the way the investments are communicated to the investors is of some relevance. The study by Oh et al. (2006) compared the stock market reaction to announcements made by the investing companies and announcements made by the vendors, and found a significant difference in the reaction. Financial markets appear to respond more positively to announcements made by the investing company. Interestingly, a large number of companies (approximately 60 percent) as reported by Oh et al. (2006) do seem to prefer that the announcements are made by vendors or service providers.

In addition to the source of announcements, there may also be influential factors related to the wording used in the announcements themselves. For example, investors may interpret specific language used in the announcements as an indication of presence or absence of clear objectives, technical competence, or support by management. No published studies have investigated this aspect, to the knowledge of the authors.

5 PROPOSED MODEL

The results from the literature review also suggest that there may be complex interactions between the factors that impact abnormal stock price returns. For example, the study by Hayes et al. (2001) implies that there is an interaction between the financial health and the size of a company. The most positive reactions to ERP investments were observed for small, financially healthy companies. As a company's size increases while the financial health remains strong, the magnitude of the stock market reaction diminishes. When the financial health of a company worsens, the stock price reaction seems to become more positive for large firms and become more negative for smaller firms.

While the study by Hayes et al. (2001) looked at the interaction of two factors related to company characteristics, a comparison across different studies provides evidence of more complex interaction between factors. For example, while most studies were unable to find positive stock price reactions to non-innovative, automate IT investments (Dos Santos et al., 1993), Roztocki and Weistroffer (2006) reported positive reaction to automate investments when a company is using activity-based costing (ABC).

5.1 General Model

Overall, the reviewed studies confirm that there are a large number of influential factors that may affect investments in IT, and that these factors seem to be subject to complex interactions. As stated earlier, the identified factors can be categorized into five major groups: company characteristics, IT investment type, vendor characteristics, economic conditions, and announcement characteristics, thus suggesting the general model as depicted in Figure 1.
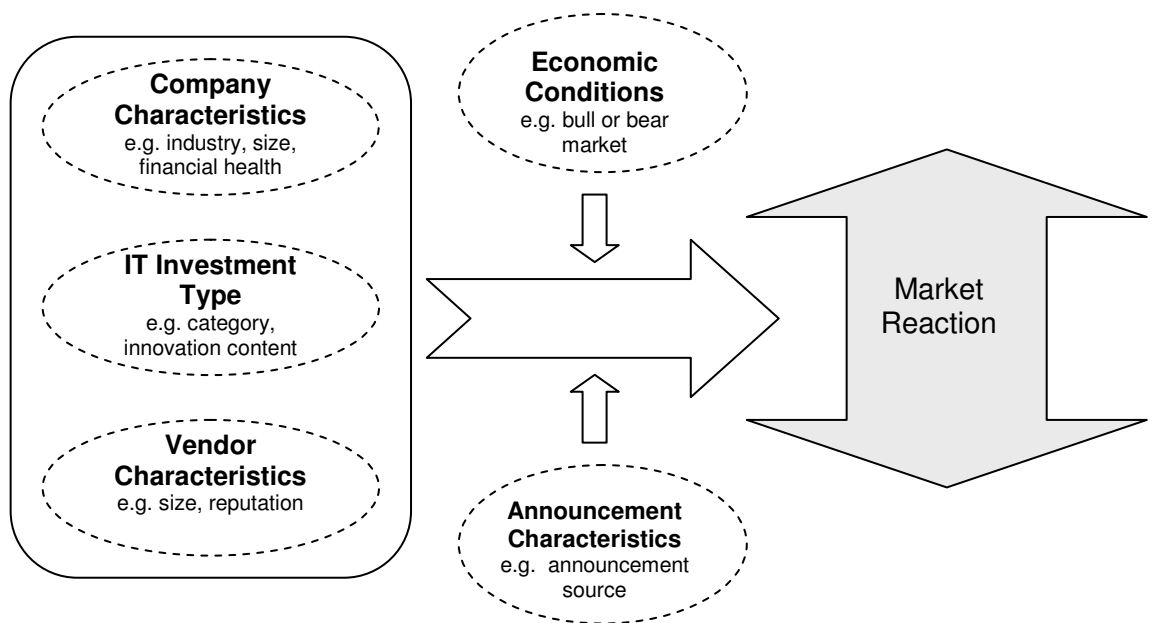
Figure 1. General Model

5.2 Application of the model

For the purpose of illustrating the use of the model and complexity of multiple factors interacting, we look at innovation content for a possible investment type. For vendor characteristics we look at size and for economic conditions we use the conditions of the stock market (i.e. bear or bull market), as shown in Figure 2.
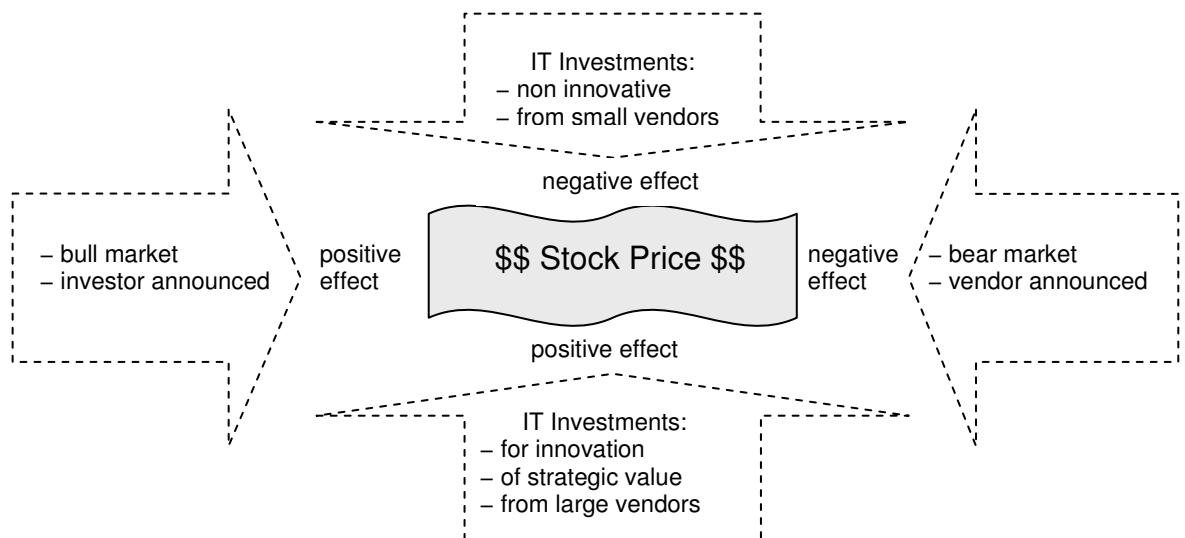

Figure 2. Observed Negative and Positive Effects on Stock Market Reaction

Regarding the innovation content of IT investments, the stock prices seem to react more favorably when the investments are innovative and move the company ahead of its competitors. Therefore we show a positive effect for IT investments for innovation. Regarding vendor characteristics, a positive stock market reaction is more likely for large established vendors than for smaller and less established ones. Therefore again, we show a positive effect in our model. Regarding economic conditions, a bull market seems to benefit a positive stock market reaction. While declining stock markets, i.e. bear

markets, are more likely to result in less favorable stock price reactions. Again these are shown as positive and negative effects respectively in our model.

Our model, at least to some extent, explains the inconclusive findings of previous productivity studies (Oz, 2005). It is for example possible, for exactly the same type of IT investment to obtain significantly positive or negative stock price reactions when not controlling for other influential factors. A significantly positive stock price reaction is likely for a sample including mostly smaller companies buying from large established leading vendors during bull markets. For the same type of IT investment, the stock market reaction could be significantly negative when the companies in the sample are buying from small, non-leading vendors during bear market conditions. In both situations, investments from smaller companies seem to result in heftier stock market reactions.

5.3   Possible Business Implications

The model and the observed effects as shown in Figure 2 may have some important implications for businesses that are considering new investments in IT. Companies, particularly large companies, should not expect a positive reaction by the stock market to new IT investments, unless it is clearly communicated that the IT investment will likely result in innovation and provide strategic value to the investing firm. Furthermore, IT investments realized through small, less established vendors, are perceived as particularly risky and likely to result in negative market reactions. Using large, established vendors seems to be a safer way to go, if negative market reactions are to be avoided. If possible, IT investments are better done during bull market conditions; thus if market conditions are unfavourable, it may be wise to hold off with any non-critical new investments. Finally, the investing company should take the initiative in communicating the news to its shareholder and make the initial announcement of the new IT investment itself, rather than let the vendor make the announcement.

6   CONCLUSIONS

6.1   Contribution

We believe that our systematic review of event studies related to IT investments and our model presented in this paper make a substantial contribution to the body of knowledge in that this is perhaps the first meta analysis of event studies in the field of IT investments and the first attempt to construct a model to explain the impact and interactions of various factors on market reaction to IT investments. This model and the results of our review of twenty-three papers should greatly benefit other scholars, as it may serve as a foundation for further research on IT productivity. Future research building on our model need not be limited to event studies, as the compiled list of potentially influential factors may impact other measures of IT productivity, besides stock market reaction, and thus serve as a foundation for other types of research as well. Furthermore, as mentioned earlier, our model may help explain some of the inconclusiveness and inconsistency in the results of earlier IT productivity studies.

We believe that our model is also useful to business executives, as stock performance is often seen by stakeholders as a crucial indicator of firm performance. It is difficult for executives to ignore unfavorable stock movements of their companies, as such movements may lead to loss of confidence by employees, customers, suppliers, creditors, etc. In this regard, our model may help managers better understand favorable or unfavorable conditions for making IT investments.

Moreover, since the ideas presented in this paper are based on a comprehensive literature review, the proposed model may also lead to increased and improved usage of event studies in IT research.

6.2   Limitations

Although event studies in the field of IT have become more common, as compared to other disciplines, the absolute number of such studies is still small, which constitutes our first limitation.

Basically, our conclusions are drawn from event studies published in twenty-three academic papers. It is likely that as more studies are conducted and published, more influential factors will emerge.

A second limitation is related to the methods of estimating the stock market reaction. There is variation in estimation periods and event windows used by the different studies. Therefore the comparison of the findings from different studies may be limited. In addition, there is always a chance that the particular data set is contaminated. For example, Dehning et al. (2003) reported finding two outliers in their earlier event studies. Some outliers may go undetected and lead to faulty conclusions.

A further limitation of this study is that our model was constructed mostly based on findings derived from US companies and stock data. It is possible that for international companies some factors could vary in importance and the model would need further refinement to accommodate country characteristic.

6.3 Future Research

The results presented in this paper are not final but provide a more complete picture and new ideas for possible research avenues. Overall, it seems that previous event studies in the field of IT call for substantial revalidation. Future research may validate and enhance or improve our model by looking at additional factors that influence market returns. It is quite possible that other economic factors, such as interest rates, inflation level, and exchange rates substantially influence the stock market reaction. Also, with respect to announcement characteristics, there may be influential factors related to the communication of the investments. For example, the wording used in the announcements themselves could impact the investors' reactions to IT investment announcements. Thus, investors may interpret overly use of some words as a sign of lacking decisiveness, lacking technical competence, or lacking support by management.

7 REFERENCES

Bacon, J. C. (1992) The Use of Decision Criteria in Selecting Information Systems/Technology Investments. *MIS Quarterly* 16 (3), 335-353.

Chatterjee, D., Pacini, C. and Sambamurthy, V. (2002) The Shareholder-Wealth and Trading-Volume Effects of Information-Technology Infrastructure Investments. *Journal of Management Information Systems* 19 (2), 7-42.

Chatterjee, D., Richardson, V. J. and Zmud, R. W. (2001) Examining the Shareholder Wealth Effects of Announcements of Newly Created CIO Position. *MIS Quarterly* 25 (1), 43-70.

Dardan, S., Stylianou, A. and Kumar, R. (2006) The Impact of Customer-Related IT Investments on Customer Satisfaction and Shareholder Returns. *Journal of Computer Information Systems* 47 (2), 100-111.

Dehning, B., Richardson, V. J., Urbaczewski, A. and Wells, J. D. (2004) Reexamining the Value Relevance of E-Commerce Initiatives. *Journal of Management Information Systems* 21 (1), 55-82.

Dehning, B., Richardson, V. J. and Zmud, R. W. (2003) The Value Relevance of Announcements of Transformational Information Technology Investments. *MIS Quarterly* 27 (4), 637-656.

Dewan, S. and Ren, F. (2007) Risk and Return of Information Technology Initiatives: Evidence from Electronic Commerce Announcements. *Information Systems Research* 18 (4), 370-394.

Dos Santos, B. L., Peffers, K. and Mauer, D. (1993) The Impact of Information Technology Investment Announcements on the Market Value of the Firm. *Information Systems Research* 4 (1), 1-23.

Fama, E. F. (1970) Efficient Capital Markets: A Review of Theory and Empirical Work. *The Journal of Finance* 25 (2), 383-417.

Fama, E. F. (1991) Efficient Capital Markets: II. *The Journal of Finance* 46 (5), 1575-1617.

Ferguson, C., Finn, F. and Hall, J. (2005) Electronic commerce investments, the resource-based view of the firm, and firm market value. *International Journal of Accounting Information Systems* 6 (1), 5-29.

Filbeck, G., Gorman, R., Greenlee, T. and Speh, T. (2005) The stock price reaction to supply chain management advertisements and company value. *Journal of Business Logistics* 26 (1), 199-216.

Geyskens, I., Gielens, K. and Dekimpe, M. G. (2002) The Market Valuation of Internet Channel Additions. *Journal of Marketing* 66 (2), 102-119.

Hayes, D. C., Hunton, J. E. and Reck, J. L. (2001) Market Reaction to ERP Implementation Announcements. *Journal of Information Systems* 15 (1), 3-18.

Hunter, S. D. (2003) Information Technology, Organizational Learning, and the Market Value of the Firm. *The Journal of Information Theory and Application* 5 (1), 1-28.

Im, K. S., Dow, K. E. and Grover, V. (2001) Research Report: A Reexamination of IT Investment and the Market Value of the Firm - An Event Study Methodology. *Information Systems Research* 12 (1), 103-117.

Khallaf, A. and Skantz, T. R. (2007) The Effects of Information Technology Expertise on the Market Value of a Firm. *Journal of Information Systems* 21 (1), 83-105.

Lin, J.-S. C., Jang, W.-Y. and Chen, K.-J. (2007) Assessing the market valuation of e-service initiatives. *International Journal of Service Industry Management* 18 (3), 224-245.

McWilliams, A. and Siegel, D. (1997) Event Studies in Management Research: Theoretical and Empirical Issues. *Academy of Management Journal* 40 (3), 626-657.

Meng, Z. and Lee, S.-Y. T. (2007) The value of IT to firms in a developing country in the catch-up process: An empirical comparison of China and the United States. *Decision Support Systems* 43 (3), 737-745.

Oh, W., Kim, J. W. and Richardson, V. J. (2006) The Moderating Effect of Context on the Market Reaction to IT Investments. *Journal of Information Systems* 20 (1), 19-44.

Oz, E. (2005) Information technology productivity: in search of a definite observation. *Information & Management* 42 (6), 789-798.

Ranganathan, C. and Brown, C. V. (2006) ERP Investments and the Market Value of Firms: Toward an Understanding of Influential ERP Project Variables. *Information Systems Research* 17 (2), 145-161.

Rosenthal, R. and DiMatteo, M. R. (2001) Meta-Analysis: Recent Developments in Quantitative Methods for Literature Review. *Annual Review of Psychology* 52, 59-82.

Roztocki, N. and Weistroffer, H. R. (2006) Stock Price Reaction to the Investments in IT: Relevance of Cost Management Systems. *Electronic Journal of Information Systems Evaluation* 9 (1), 27-30.

Roztocki, N. and Weistroffer, H. R. (2007a) How Do Investments in Enterprise Application Integration Drive Stock Prices? In *Proceedings of the 40th Hawaii International Conference on System Sciences (HICSS 2007)*.

Roztocki, N. and Weistroffer, H. R. (2007b) Identifying Success Factors for Information Technology Investments: Contribution of Activity Based Costing. In *15th European Conference on Information Systems (ECIS 2007)*, pp 1031-1040.

Roztocki, N. and Weistroffer, H. R. (2008a) Event Studies in Information Systems Research: A Review. In *Proceedings of the Fourteenth Americas Conference on Information Systems (AMCIS 2008)*, Toronto, Ontario, Canada

Roztocki, N. and Weistroffer, H. R. (2008b) Information Technology Investments in Emerging Economies. *Information Technology for Development* 14 (1), 1-10.

Roztocki, N. and Weistroffer, H. R. (2008c) Stock Price Reaction to Investments in EAI and ERP: A Comparative Event Study. In *Proceedings of the 41st Hawaii International Conference on System Sciences (HICSS 2008)*.

Roztocki, N. and Weistroffer, H. R. (2009) Event Studies in Information Systems Research: An Updated Review. In *Proceedings of the Fifteenth Americas Conference on Information Systems (AMCIS 2009)*, San Francisco, California.

Subramani, M. and Walden, E. (2001) The Impact of E-Commerce Announcements on the Market Value of Firms. *Information Systems Research* 12 (2), 135-154.