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Effects of firm and IT characteristics on the value of e-commerce initiatives: An inductive theoretical framework

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Abstract We explore the theoretical foundations on how firm and IT characteristics explain the market value variations in e-commerce initiatives by examining the announcements of 946 e-commerce initiatives in the public media. Our approach combines the Event study methodology and Decision tree induction to examine the main and interaction effects of IT and firm characteristics on Cumulative Abnormal Returns (CAR). In particular, we generate complex interaction models that can guide e-commerce investment decisions so managers can know, for example, which combination of IT and firm characteristics are more likely to be viewed positively by investors. The selected study variables as well as explanation of the proposed framework are informed by innovation, resource-based view, transaction cost economics and complementarity theories. We have inductively developed a set of propositions that can be deductively tested to assess the validity of our proposed theoretical framework. Hence our study provides an initial roadmap for theory development on e-commerce and CAR.

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1 Introduction

Several researchers have sought to measure the market value of e-commerce investments using the event study methodology to measure abnormal returns (Dardan and Stylianou 2001; Dehning et al. 2002, 2003, 2004; Subramani and Walden 1999, 2000, 2001). In addition, other researchers have identified explanatory variables that influence the observed abnormal returns in e-commerce investments (e.g., Dehning et al. 2004; Subramani and Walden 2001). However, the results of the research on market reaction to the announcement of IT investments in general and e-commerce in particular are mixed (Meng et al. 2007; Reck 2006). For instance, while Subramani and Walden's (2000) study did not find Product Type variable to be a determinant for abnormal returns in e-commerce investments, a later work found higher returns for Tangible products than Digital products (Subramani and Walden 2001). At the same time, it was noted that the returns for Digital products were higher for initiatives that occurred in 2000 but not for those in 1998 (Dehning et al. 2004). Also while Meng et al. (2007) found that announcements of IT investments for firms in China led to the attainment of abnormal returns, no such impact was found for firms in the United States. A possible explanation for the mixed results is that while researchers have paid attention to how individual firm and IT characteristics separately influence market returns (main effects), the interaction effects of these variables on market returns have not received the same level of consideration (Oh et al. 2006). The mixed findings point out the need for more research so

as to enhance the understanding and build the body of evidence that informs researchers and decision makers.

We extend research on e-commerce and *Cumulative Abnormal Returns* (CAR) by combining two methodological approaches to develop a theoretical framework that might help explain the impact of announcements of e-commerce initiatives in the public media on the market value of the firms making the announcements and to further understand the interaction effects of study variables on the market value.

It has been suggested elsewhere that the market value of e-commerce investments can be better explained by the interaction among the predictor variables (Hayes et al. 2001; Oh et al. 2006). Additionally, it has been argued that examining interaction effects is a useful mechanism for IS theory development research (Chin et al. 2003). Unfortunately, prior research on e-commerce and market value has ignored the interaction effects. Further, Kleist (2003) laments on lack of studies on IT payoff that focus on e-commerce. In fact it has been argued that investments in e-commerce are different from traditional IT investments (Kohli et al. 2003). The goal of this research is to use the event study methodology and decision tree induction to examine how firm and IT characteristics interact and provide possible explanation of the impact of e-commerce initiatives on abnormal returns (i.e. excess returns).

Although the specific variables used in prior research to examine the abnormal return associated with the announcement of e-commerce initiatives vary, the factors used in IT investments in general can be classified as either firm or IT characteristics (Oh et al. 2006). In this paper, we use both firm and IT characteristics to examine the market value creation of e-commerce initiatives. We use decision tree induction to study both the main and interaction effects of the firm and IT characteristics on cumulative abnormal returns. The application of decision tree induction enables the development of inductive theory from the data. Grounding an emerging theory on the data has been found in the literature to engender new perspectives on previously researched topics (Granados et al. 2006; Hitt et al. 1998). It has been argued that the inductive approach is very useful for e-commerce theory development (Amit and Zott 2001).

Consistent with other studies that have examined the market value of e-commerce initiatives, we use event study methodology in our study (Dehning et al. 2004; Subramani and Walden 1999, 2000, 2001, 2002). The methodology is used to measure excess returns (abnormal returns) observed when an announcement of an event such as an e-commerce initiative is made in the public media over normal returns that are expected in absence of the event. An abnormal return measured over the event window is the cumulative abnormal return (CAR). The CAR associated with the announcement of an e-commerce initiative is used as a measure of investors' confidence in how the initiative promises future benefits in terms of market returns.

Decision tree induction is used to generate rules involving the likelihood of observing an abnormal return from the announcement of an e-commerce initiative in the public media based on the presence of a predictor or independent variable or the interaction of those variables. Hence, decision tree induction enables the examination of both the main and interaction effects of the study variables.

The rest of the paper is organized as follows. In section 2, we present a literature review on the theoretical foundations for the firm and IT characteristics variables. In section 3, we discuss the research methodology, present our results, and discuss the resultant theoretical framework and propositions that can influence future research on e-commerce and firm market value. In section 4 we conclude the paper by discussing theoretical, methodological and practical implications of the research as well as possible future research.

2 Theory and literature

This research uses an inductive approach. Unlike the deductive approach, the inductive method does not require initial propositions or hypotheses involving the independent and dependent variables. Rather, through data collection and analysis, models, explanations, and theories are proposed. However, the use of the inductive approach does not preclude an identification of previous variables or constructs that might inform the underlying data analysis. The approach used in this paper is consistent with other inductive studies (Amit and Zott 2001; Granados et al. 2006). Thus, in this section, we discuss the theoretical foundations upon which the potential predictor variables were selected.

It has been suggested that the theoretical models on the source of e-commerce value creation have limitations and that a combination of the strengths of the different theories may be the most effective way to explain the value creation of e-commerce investments (Amit and Zott 2001; Barringer and Harrison 2000; Merchant and Schendel 2000). In fact, it has been argued that the use of complementary theories to explain a phenomenon improves the soundness of the resulting theory (Barringer and Harrison 2000). The specific theories of interest in this study are: (1) innovation and e-commerce (Barua and Mukhopadhyay 2000; Dehning et al. 2002, 2003, 2004; Dos Santos et al. 1993; Schein 1992; Schumpeter 1934), (2) resource-based view of the firm (Barney 1991), (3) complementarity (Barua et al. 1996; Bharadwaj 2000; Brynjolfsson and Hitt 1996; Brynjolfsson et al. 1998; Subramani and Walden 2002; Zhu and Xu 2004), and (4) transaction cost economics (Williamson 1975, 1979, 1983). These theories will also

inform our explanation of the relationships identified in our study.

We discuss briefly in the next subsections the underlying theoretical arguments that led to the identification of the study variables. These variables are grouped into three categories: IT characteristics, Firm characteristics, and Time.

2.1 IT characteristics

2.1.1 Innovativeness

Schumpeter's (1934) theory views innovation as a source of value creation. Schumpeter's list of sources of innovation or value creation includes introducing new goods or new production methods, discovering new supply sources, creating new markets, and reorganizing industries. Schumpeter's innovation theory stresses the importance of technology and looks at the novel combinations of resources as well as the services they provide as the basis for new products and production methods. Thus, innovative information technology investments can be considered as sources of value creation for firms (Dos Santos et al. 1993; Mascarenhas 1992). Innovative and non-innovative e-commerce investments can also be referred to as Transformational and Executional/incremental initiatives respectively (Subramani and Walden 2002). An initiative is Transformational if it allows the firm to leverage e-commerce technologies to radically change its strategy through changes in processes, practices and business models (Venkatraman 2000). On the other hand, with Executional initiatives, which are incremental in nature, firms employ e-commerce technologies only to extend current strategy.

The need for information technology investments to have strategic appeal has been noted elsewhere (Barua and Mukhopadhyay 2000; Dehning et al. 2003; Dos Santos et al. 1993; Subramani and Walden 2002; Venkatraman 2000). It has been suggested that the particular technology chosen to support an organization's business strategy influences the firm's stock performance (Kamssu et al. 2003). The Innovativeness of an IT investment influences a firm's competitive capabilities and subsequent ability to create value. Therefore, Innovativeness is a relevant factor for examining how firms create value through e-commerce initiatives.

2.1.2 Product type

Advanced technologies have enabled firms to develop Digital products (intangible) in addition to traditional Tangible products. Digital products are digital representations of products that are enabled by IT artifacts (Granados et al. 2006). In e-commerce markets, Digital products can instantly be delivered by immediate download from the company's web site or some other source. Prior research identified Product Type as a potential predictor of market return of e-commerce although the results from the different studies are mixed (Dehning et al. 2004; Subramani and Walden 2000, 2001). Transaction cost economics theory considers the cost reduction resulting from transaction efficiencies as a major source of value creation for the firm (Amit and Zott 2001; Granados et al. 2006). The Internet, as a network economy, creates opportunities for transaction efficiencies, as cost reductions are easily attainable through reduction in intermediaries (Granados et al. 2006). Thus, a transaction cost approach critically informs the understanding of value creation in e-commerce investments (Amit and Zott 2001). The IT capabilities that enable instant delivery of Digital products may be a source of value creation as the transaction cost benefits from the different products may be different (Kiang et al. 2000). We therefore expect that Product Type would be a relevant factor in the study of e-commerce and CAR.

2.2 Firm characteristics

We describe and provide below the rationale for three firm characteristics that might be important in the discussion of the relationships between CAR and ecommerce initiatives.

2.2.1 Governance

Governance refers to the governing structure of the initiative, i.e. whether the initiative is unilateral by a single firm or a joint alliance or partnership of multiple firms (Osborn and Baughn 1990; Subramani and Walden 2002). The complementarity theory asserts that an IT initiative has more value when it is coupled with complementary investments in intangible assets resulting in changes in organizational design (Brynjolfsson et al. 1998; Kauffman and Walden 2001; Subramani and Walden 2002). Sherer et al. (2003) show that complementary investment in change management leads to payoff from IT investments. The resource-based view of the firm considers a combination of a firm's unique set of complementary and specialized set of capabilities and resources as a source of value creation (Amit and Zott 2001). Alliance formation may be an appropriate avenue for a firm to leverage its resource capabilities and to develop complementary assets to create market value for its e-commerce investments (Amit and Zott 2001; Merchant and Schendel 2000). Hence, Governance may be a relevant predictor in e-commerce and market value study.

2.2.2 Firm type

The e-commerce literature identifies different type of firms, Net and Non-Net firms. Net firms rely solely on the Internet

for market transactions whereas Non-Net firms, also called brick-and-mortar, use both the Internet and traditional markets to generate sales (Cavusoglu et al. 2004; Subramani and Walden 2000). As these different Firm Types use the Internet for different strategic purposes, the transaction cost benefits may be different for these firms (Kiang et al. 2000). Hence, Firm Type may be a relevant variable in studying e-commerce and firm value. Our focus here is on Net versus Non-Net firms. However we note that other studies have looked at other differences such as between manufacturing and financial firms (Meng et al. 2007).

2.2.3 Customer type

The e-commerce market is classified into two main types: business-to-business (B2B) and business-to-consumer (B2C) (Chen and Siems 2001; Kauffman and Walden 2001; Subramani and Walden 2001). B2B relationships are those where the e-commerce initiative promises benefits to business customers whereas B2C e-commerce seeks to generate benefits for the individual consumer or customer (Subramani and Walden 2002). B2B initiatives tend to focus on improvement in the processes and systems that enable flow of information between organizations (Gebauer and Shaw 2002).

The kinds of complementary investments that are possible through B2B relationships are different from those for B2C. For instance, more technical expertise is required for B2B than B2C initiatives (Subramani and Walden 2002). Thus, Customer Type is a potential relevant predictor of CAR.

2.3 Time

The Internet bubble that occurred in March 2000 had a tremendous effect on how organizations looked at e-commerce investments. For instance, it has been suggested that the market reactions to e-commerce initiatives were quite different for the period before and after the Internet bubble (Dehning et al. 2004). It is possible that prior to 2000, investors greeted e-commerce initiative announcements with a lot of enthusiasm and rewarded companies making those announcements. It is also possible post 2000, investors have become more cautious and are more likely to examine critically any initiative announcements. This is because there was a general concern that internet stocks for instance were overvalued during the internet bubble era (Higson and Briginshaw 2000). Hence, Time is a potential important variable in examining the relationship between e-commerce initiatives and market value creation.

2.4 Prior research on e-commerce and CAR

In sections 2.1–2.3, we presented theoretical bases for selecting the variables used in our study. Table 1 is a brief summary of some of the prior research on CAR and examples of research on e-commerce and CAR where those variables have been used.

3 Research method & results

One of the main objectives of our study is to develop a theoretical framework that can help explain the impact of e-commerce initiative announcements on firms' market value. Whetten (1989) suggested that a theory involved: WHATs (i.e. *Factors* that could logically be considered to be part of the explanation of the phenomenon of interest), HOWs (i.e. *Relationships* between the *Factors*), WHYs (i.e. the underlying dynamics that justify the selection of the *Factors* & *Proposed Relationships*), and WHO-WHERE-WHEN (i.e. Temporal & Contextual factors that indicate the range of the theory). Our research approach that includes Whetten's (1989) theoretical constituents consists of the following major steps each of which is described in more detail later in this section:

1. Identification of Potential Predictor Variables (WHAT):
2. Data Collection & Coding:
3. Application of the Event Study methodology to compute the cumulative abnormal returns observed when e-commerce initiatives are announced in the public media
4. Data Analysis (HOW):
    a. Application of Decision Tree (DT) Induction to generate multiple DTs that represent rulesets where the variables perform *discriminating* functions
    b. Hypotheses Generation & Evaluation based on the results of DT Generation
5. Creation of Model/Theoretical Framework & Justification
    a. Creation of Model/Theoretical Framework (HOW): This involves integrating the set of links associated with the hypotheses that were supported by statistical analysis resulting in a set of propositions
    b. Explanation of the Model/Theoretical Framework (WHY): This involves using existing theory to justify/explain the observed relationships associated with the propositions of the model

3.1 Selection of potential predictor variables

This step involves the use of existing theory to identify variables that could reasonably be considered potential predictors of *cumulative abnormal return* (*CAR*). The discussion on the theoretical models that support the selection of the variables (i.e. Innovativeness, Governance, Firm Type, Customer Type, Product Type, and Time) was presented in the previous section. In Table 2 we reference the sources of the variables.

Table 1 Event studies on e-commerce Initiatives

Author (s)	Period of analysis	Main focus	Variables	Some major findings
Subramani and Walden (1999)	10/1998–12/1998	E-commerce initiatives	*Firm Type*	○ Firms reported CAR of 3–11% within event window
			Customer Type	○ There was no difference in CAR between *Net* and *Non-Net* firms
				○ CAR was higher for *B2C* than *B2B*
Subramani and Walden (2000)	10/1998–12/1998	Empirically test the incomplete contract theory on *B2B* firms	*Product Type* (*Digital* v. *Tangible*)	○ CAR for *Net* firms was significant and that of *Non-Net* firms was not
			Firm Type	○ There was no significant difference in CAR for *Tangible* v. *Digital* goods
				○ CAR for *Net* firms was significant and that of *Non-Net* firms was not
				○ There was no significant difference in CAR for *Tangible* v. *Digital* goods
				○ CAR for *Net* firms was significant and that of *Non-Net* firms was not
Subramani and Walden (2001)	10/1998–12/1998	Ecommerce initiatives	*Firm Type*	○ CAR was higher for *Tangible* goods than *Digital* goods
		Sample size less than previous study	*Customer Type*	○ *Firm Type* results were similar to 1999 study
Dehning et al. (2004)	1/1998–6/2002	Reexamine Subramani and Walden (2001) for 1998 and 2000	*Firm Type*	○ Positive and significant CAR in 1998 but not in 2000
		Time lag effect	*Customer Type Time* (2000 v. 1998)	○ CAR was higher for *Digital* goods than *Tangible* goods in 2000 but not in 1998
			Product Type	○ Initiatives involving *B2B*, *Tangible* products and *Net* firms had higher CAR in 1998 than in 2000
Subramani and Walden (2002)	1/1998–12/2000	Develop comprehensive ecommerce theory	*Firm Type*	○ CAR for *Net* firms was 11.38%
			Customer Type	○ CAR for *B2B* initiatives was 20.55%
			Product Type	○ CAR for *Tangible* goods was 13.39%
			Governance Innovativeness	○ CAR for *Transformational* initiatives was 11.43%.

Table 2 Short description of the six potential predictor variables (content guide for coding e-commerce announcements)

Variable	Description and coding categories	Source and prior use of variable
Innovativeness	The innovativeness variable was coded as Transformational or Executional. ➢ An announcement that portrays a firm or alliance making strategic investments such as moving into new lines of business or adopting new business models was coded as *Transformational.* ➢ Announcements that show some minor changes or modifications were coded as *Executional* (Non-Transformational).	The innovativeness variable was classified as Transformational and Non-transformational (Venkatraman 2000). Later it was classified as Transformational and Executional (Subramani and Walden 2002).
Governance	*Governance* variable deals with whether a firm intends to implement an e-commerce initiative unilaterally or via strategic alliance or via a partnership. ➢ If the announcement involved one business entity, we coded it as *Unilateral.* ➢ We coded an announcement as *Joint* if two or more firms were involved through some kind of partnership or alliance.	Osborn and Baughn (1990) suggested that contractual agreement or joint venture can be used as a form of governance. Subramani and Walden (2002) used this variable in prior e-commerce initiative research.
Firm Type	The *Firm Type* predictor variable was coded as *Net* and *Non-Net*. The Internet Stock Listing™ and Morgan Stanley Dean Witter's Internet Company list were used to identify "Net" and "Non-Net" firms. ➢ Net firms, also called pure-plays, rely solely on the Internet to perform transactions. ➢ Conventional firms also referred to as *Non-Net* firms, can generate sales from both traditional markets and the Internet.	The Firm type variable has been used in many event studies including those examining e-commerce initiatives (e.g., Cavusoglu et al. 2004; Dehning et al. 2004; Subramani and Walden 2002).
Customer Type	➢ *B2B* initiatives tend to focus on improvement in the processes and systems that enable flow of information between organizations (Gebauer and Shaw 2002). If the value creation is primarily for a business entity, we coded that initiative as *B2B*. ➢ *B2C* e-commerce involves at least one-business entity and individual consumers. An initiative that focuses on value creation for the individual consumer is coded as *B2C*.	The e-commerce market is classified into two main types: business-to-business (*B2B*) and business-to-consumer (*B2C*) (Chen and Siems 2001; Kauffman and Walden 2001; Subramani and Walden 2001).
Product Type	➢ *Digital* goods include products generated by computers and can be downloaded from the Internet. ➢ Products that are not available for downloads and are not available for use on the Internet are coded as *Tangible*.	*Tangible* and *Digital* are two *broad Product Types* that are offered by e-commerce firms (Jones 2003; Negroponte 1995; Shapiro and Varian 1999; Subramani and Walden 2002). This variable was used in prior e-commerce research (Dehning et al. 2004; Subramani and Walden 2001, 2002)
Time	➢ Announcements that were made prior to March 2000 were classified as Pre 2000 ➢ Announcement made after March 2000 were classified as Post 2000.	Market fluctuations pre and post the Internet bubble make time a potential predictor of market returns of e-commerce transactions (Higson and Briginshaw 2000). Time variable was used in prior research (Dehning et al. 2004).

3.2 Data collection and coding

In this research, we define an event as the announcement of an e-commerce initiative in the public media. We collected data on the announcements of e-commerce initiatives for the period 1998 through 2003. Our sources of data were PR Newswire and Business Wire using the online search features of Lexis–Nexis. We use the search terms launch or announce which appear in the same sentence as the words online or e-commerce and ".com." and NYSE, NASDAQ or AMEX. About 1,405 events were generated from the query. However, the final number of events was 946 as some of the events were eliminated for the following reasons (Meng et al. 2007). If the same announcement was repeated in the same medium or multiple media, we kept only the first announcement. Only publicly traded firms with data in the Center for Research in Security Prices (CRSP) database and with prices listed in the periods used for estimating market returns were included. We also eliminated announcements that were confounded by other events such as a firm making earnings and/or dividend payout announcement or any major announcement within the event window.

Table 2 is used as a form of content analysis to guide the coding of the announcements. Content analysis has been used in the IS literature for similar studies (Agrawal et al. 2006). Using content analysis, one coder read each of the 946 announcements and assigned a category for each IT and firm characteristic as well as Time variable. Although there is no ambiguity because it is easy to classify each announcement based on the content analysis, another coder cross-checked a sample of the announcements. In a few cases where the specific category was not explicit in the announcement, we used other news sources to confirm our coding. We provide two samples of how we coded announcements as Appendix A1 and A2. Together they provide an example of each category of the study's variables.

3.3 Application of the event study methodology

The event study methodology is a common approach that has been used in Finance, Accounting, and Information Systems (IS) disciplines to study several events (e.g., Ball and Brown 1968; Binder 1998; Dos Santos et al. 1993; Fama et al. 1969; Meng et al. 2007). It has been accepted in the information systems discipline as a useful approach for examining the market value of firms (e.g. Meng et al. 2007). The market value of the firm's equity can be effectively used to measure information technology (IT) investments and such a measure can help mitigate the problems with measuring tangible and intangible benefits of e-commerce. The current market value of the firm depicts investors' perception of the present value of all future benefits (both long term and short term) to the firm. Measuring an event's economic impact can be computed easily using stock prices observed over a relatively short period using the event study approach. The use of market value can minimize the time lag between e-commerce implementation and when productivity and or profitability improvements are realized, which may require observations of several months or years (Mackinlay, 1997), a situation that intensifies the productivity paradox (Brynjolfsson and Hitt 1996; Brynolfsson 1993; Hitt and Brynjolfsson 1996).

Using the Market Model (Sharpe 1963), the return of a specific stock can be represented as:

$$R_{it} = \alpha_i + \beta_i R_{mt} + \varepsilon_{it} \tag{1}$$

Where R_{it} = return of stock i on day t; R_{mt} is the return of the market portfolio on day t, α_i, β_i are the intercept and slope parameters respectively for firm i, and ε_{it} is the disturbance term for stock i on day t.

The Efficient Market Hypothesis (Fama et al. 1969), can be used to examine whether a firm that announces an e-commerce initiative observes a positive abnormal return. This reflects the market's reaction to the announcement, which is quickly absorbed into the firm's stock. The abnormal return for firm i on day t of the event window can be estimated as:

$$AR_{it} = R_{it} - \left(\hat{\alpha}_i + \hat{\beta}_i R_{mt}\right) \tag{2}$$

Where $\hat{\alpha}$ and $\hat{\beta}$ are the ordinary least square estimates of α and β. These parameters are estimated using the market model over 120 day period ending with the day immediately preceding the first day of the event window, i.e. day (−2).

The summation of the daily abnormal returns over the event window is the cumulative abnormal return (CAR). The CAR for stock i over the event window $(_{T1,\ T2})$ is computed as:

$$CAR_{i(T1,T2)} = \sum_{t=T1}^{T2} ARit \tag{3}$$

For a sample of n stocks the average cumulative abnormal return over the event window is

$$CAR_{(T1,T2)} = \frac{1}{n}\sum_{i=1}^{n} CAR_{i_{(T1,T2)}} \tag{4}$$

While the CAR for the entire data set (all events) is used to determine whether the announcements in general create value for firms (positive CAR), the CAR for the individual events is used as the dependent variable for the DT Generation.

3.4 Results of the event study

Table 3 shows the results of the average cumulative abnormal returns obtained over a 3-day window. CAR is

Table 3 Average cumulative abnormal return for 3-day window

Days	Cumulative average abnormal return	*Z*	Positive: negative	Generalized sign *Z*
(−1, +1)	1.83%	5.844***	497:449	4.085***

***significant at .001

computed for each event by summing abnormal returns over the event window. The generalized sign test is a comparison of the proportion of events with positive abnormal returns around the event to proportion from a period that is not affected by the event (Cowan 1992). Hence, the generalized sign test takes into account potential asymmetric return distribution under the null hypothesis that the observed abnormal return is due to chance. For the 3-day event window, the ratio of number of events with Positive CAR to those with Negative CAR is greater than 1 (497:449) with a corresponding Z value that indicates that the CAR for the 3-day event window (−1, 1) is positive and significant at the 1% level. The results indicate that the announcements of e-commerce initiatives in the public media lead to positive CAR (See Table 3).

We use short event windows because others have demonstrated that when the event window is increased beyond three days, the power of the model decreases and that shorter windows help to control for confounding effects of other events that can affect a firm's market value (Agrawal et al. 2006; Dehning et al. 2004; McWilliams and Siegel 1997). One problem with a long term event window is that some firms make several announcements within this period. Since the motives for each announcement and the initiatives are different and can be influenced by prior initiatives, using long term event window could confound prior announcements or initiatives. For instance, if an announcement is made involving Executional initiative, and another announcement involving Transformational initiative is made within the event window, the second announcement would confound the previous announcement. In such a situation, the second announcement needs to be dropped.

In general, our results were in contrast to other works, where it was reported that a short event window did not produce consistent CAR (e.g., Subramani & Walden, 2002). Our work shows that within 3 days of the event window, the announcement of e-commerce initiative leads to positive CAR and that the abnormal return is attributable to the announcement, and does not occur by chance. For a 3-day event window, the average CAR for the 946 events is about 1.83% and is significant. Table 4 provides the average abnormal returns for each of the days within the event window. The average abnormal returns for the day before and day after the announcement were not significant indicating that those abnormal returns cannot be attributed to the e-commerce announcements. However, for the day of the announcement, the efficient market hypothesis suggests that the announcement creates value because the information was not expected and is quickly absorbed into the market value of the firm.

Table 5 provides descriptive statistics depicting the number of events and the average CAR for the different categories within each study variable.

3.5 Data analysis

3.5.1 Application of decision tree induction

A decision tree (DT) is a representation of a given decision problem in tree structure where every non-leaf node is associated with one of the decision variables, and every branch from a non-leaf node is associated with a subset of the values of the corresponding decision variable, and each leaf node is associated with a value of the target (or dependent) variable. Decision Tree induction (or generation) is the process of generating a DT from a given dataset. DT induction was applied on 946 event data each having CAR value as the target variable and six input values representing one category of each firm and IT characteristics as well as Time variable. For each node the DT generation algorithm generates the relative frequencies (probabilities) for the classes of the target variable. At every leaf a class is assigned, with the winning class being the one that provides the largest class probability (even if the probability is less than 50%). Associated with each leaf of a DT is a set of IF–THEN rules or rule-set. For a given rule (e.g. IF *Innovativeness* is *Transformational* & *Governance* is *Unilateral* THEN *CAR* is *Positive* with probability 74.7% and *N* (i.e. Number of Cases)=115)), the condition component of the rule is described by the relevant internal nodes and branches from the root to the given leaf. The action part of the rule is described by the class distribution of the relevant leaf.

An essential component of a DT Generation algorithm is the splitting method, as it is this component that determines

Table 4 Abnormal return for each of the 3-days in the event window

Days	Average abnormal return	*Z*	Positive: negative	Generalized sign *Z*
−1	0.37	1.115	452:494	1.149
0	1.60	7.699***	505:441	4.607***
1	−.14	1.309$	447:499	0.823

$ Significant at .10; * significant at .05; ** significant at .01; *** significant at .001

Table 5 Descriptive statistics of study variables

	Innovativeness		Governance		Firm Type		Customer Type		Product Type		Time	
	Transform	Exec	Joint	Unilateral	Net	Non-net	B2B	B2C	Digital	Tangible	Pre 2000	Post 2000
N	321	625	348	598	204	742	502	444	538	408	499	447
Avg. CAR	8.28	−2.95	0.96	2.19	0.52	2.07	2.15	1.27	1.12	2.53	−2.95	7.03

the partitioning of the dataset. Multiple DTs are generated using different splitting methods (i.e. Chi-square, Gini, and Entropy) since it is known that for some datasets, different splitting methods can give different rulesets (Breiman et al. 1984; Osei-Bryson and Giles 2002, 2006). In order to ensure some variation in our experimentation we varied the Splitting Criterion (i.e. Chi-Square, Entropy and Gini). The DT algorithm partitioned the dataset into subsets based on input variables selected by the relevant splitting method. Given that our purpose for doing DT generation is to partition the original dataset into subsets, and to subject sibling subsets to traditional statistical analysis based on the relevant parent node (i.e. predictor variable), we used the entire dataset for training. Were we interested in finding the 'best' DT then the use of a validation dataset would be appropriate, but given our objective of generating multiple rulesets in order to generate hypotheses then it is appropriate to use only the training dataset. In other words, our objective is to use this technology to recursively partition our dataset into subsets based on the potential predictor variables so that we can generate hypotheses that can be subjected to traditional statistical hypotheses testing techniques. For each predictor variable, we present the ruleset that depicts the variable as a discriminating variable, where all conditions for a pair of rules is the same except for the discriminating variable. Associated with each rule is the relative frequency of there being an abnormal event (i.e. positive CAR) or a normal event (i.e. 0 or negative CAR).

3.6 Hypotheses generation & evaluation

In this study, our purpose for applying DT induction is to generate rulesets that allow us to formulate hypotheses, each of which will be subjected to traditional statistical analysis. From the DT results, we identify situations where each of the potential predictors serves as a discriminating predictor, and develop the conditions and number of events involved from which a hypothesis is statistically tested. We refer to nodes that have the same non-root parent node (i.e. input variable) as *sibling nodes* (see Appendix B), where each sibling is associated with a mutually exclusive subset of the values of the relevant input variable, and the relevant value of any higher ancestor node.

3.6.1 Results of decision tree induction and the creation & evaluation of hypotheses

For a given ruleset, each rule has at least one sibling. Since for our dataset all our variables are binary, each rule has exactly one sibling, and so sibling rules are in pairs (see Table 6) where both rules have the same Moderating Condition but have different values for the Discriminating Variable(s). Our hypotheses are created in one of two ways: 1) from a single pair of sibling rules, which results in the first-order sibling rules hypothesis; or 2) from two pairs of sibling rules, which results in the second-order sibling rules hypothesis. The relative frequency shown in Table 6 represents the number of cases in which a cumulative

Table 6 Examples of first-order sibling rules hypothesis

	Moderating condition	Discriminating condition	CAR relative frequency	*N*
Pair of sibling rules	None	*Innovativeness* = 'TRANSFORMATIONAL'	0.77	379
		Innovativeness = 'EXECUTIONAL'	0.36	567
Hypothesis	Transformational *Innovativeness* is more favorable than Executional *Innovativeness*			
	*** Accepted (*p*-value<0.001) ***			
Pair of sibling rules	*Innovativeness* = 'TRANSFORMATIONAL'	*Governance* = 'UNILATERAL'	0.747	115
		Governance = 'JOINT'	0.843	97
Hypothesis	If *Innovativeness* is 'TRANSFORMATIONAL', JOINT *Governance* is more favorable than UNILATERAL *Governance*.			
	*** Accepted (*p*-value=0.04) ***			

abnormal return was observed under the given discriminating condition. For example, for the discriminating condition where Innovativeness is Transformational, a cumulative abnormal return was observed for 77% of 379 cases, while in the situation where innovativeness is Executional, a cumulative abnormal return was observed in 36% of 567 cases. Appendix B presents details on the approach used to create and test each hypothesis. We present sample calculations on the difference of proportion test used to test the first order and second order sibling hypotheses as well as details on the test for each hypothesis.

Table 7 displays the sets of sibling rules where the associated hypotheses are statistically tested at the 5% level. The "Accept?" column indicates whether the associated hypothesis was supported, and as such, whether the corresponding Discriminating Variable should be accepted as being a predictor of CAR.

$H_{I.1}$, $H_{G.1}$, $H_{F.1}$, $H_{C.1}$, $H_{P.1}$, and $H_{T.1}$ are the hypotheses for the main effect of the Innovativeness, Governance, Firm Type, Customer Type, Product Type and Time variables respectively on CAR. It is noted from Table 7 that only $H_{I.1}$ was accepted which means that Innovativeness is the only variable that has main effect on CAR. We also provide in Appendix B details and sample calculations on how the second-order sibling hypotheses were generated and tested. It is important to note that the purpose of the statistical test is to examine whether the difference in the relative frequencies (proportions) of observing Abnormal CAR in each hypothesis is statistically significant, hence the difference of proportion test is an appropriate method to use (Groebner et al. 2008). The results are summarized in Table 8.

In traditional confirmatory studies, the researcher might end his/her analysis here and perhaps conclude that the other variables have no effect on CAR. However, the DT induction technique allows us to apply a clever way to quickly examine if these variables play moderating roles in the presence of other variables. While the dominant approach in confirmatory data analysis involves the formulation of global hypotheses that test main effects only, in many published studies well researched main-effect hypotheses may not be supported by traditional data analysis methods. In that case the researcher may not obtain interesting findings even though there may be valid, meaningful conditional hypotheses that would be supported by traditional statistical analysis. Thus, in many situations local hypotheses may be appropriate for explaining a given phenomenon and exploratory data analysis techniques

Table 7 First order sibling rules hypotheses

ID	Discriminating variable	Hypothesis	Accept?
$H_{I.1}$	Innovativeness	Transformational *Innovativeness* is more favorable than Executional *Innovativeness*	Yes *p*-value<0.001
$H_{G.1}$	Governance	Joint *Governance* is more favorable than Unilateral *Governance*	No *p*-value=0.275
$H_{G.2}$	Governance	If *Innovativeness* is 'TRANSFORMATIONAL', JOINT *Governance* is more favorable than UNILATERAL *Governance*.	Yes *p*-value=0.04
$H_{F.1}$	Firm Type	Non-Net firm is more favorable than Net Firm	No *p*-value=0.306
$H_{F.2}$	Firm Type	If *Innovativeness* is 'EXECUTIONAL' & *Product Type* is 'Digital' & *Customer Type* is 'B2B', a Non-Net Firm is more favorable than Net firm.	Yes *p*-value=0.025
$H_{C.1}$	Customer Type	B2B *Customer Type* is more favorable than B2C *Customer Type*	No *p*-value=0.178
$H_{C.2}$	Customer Type	If *Innovativeness* is 'TRANSFORMATIONAL' & *Time* is 'PRE 2000', B2B *Customer Type* is more favorable than B2C *Customer Type*	Yes *p*-value=0.0027
$H_{C.3}$	Customer Type	If *Innovativeness* is 'EXECUTIONAL' & *Time* is 'PRE 2000', B2C *Customer Type* is more favorable than B2B *Customer Type*	Yes *p*-value=0.016
$H_{P.1}$	Product Type	Tangible *Product Type* is more favorable than Digital *Product Type*	No *p*-value=0.11
$H_{P.2}$	Product Type	If *Innovativeness* is 'EXECUTIONAL' & *Time* is 'POST 2000', Digital *Product Type* is more favorable than Tangible *Product Type*	Yes *p*-value=0.0027
$H_{T.1}$	Time	PRE 2000 is more favorable than POST 2000	No *p*-value=0.178
$H_{T.2}$	Time	If INNOVATIVENESS is 'TRANSFORMATIONAL', POST 2000 is more favorable than PRE 2000	Yes *p*-value<0.001

Table 8 Second-order sibling rules hypotheses

HID	Discriminating Variable 1	Discriminating Variable 2	Hypothesis	Accept?
$H_{2.1}$	Customer Type	Innovativeness	The increase in the relative occurrence of Abnormal CAR between Transformational & Executional Innovativeness is greater for B2B initiatives than B2C initiatives.	Yes p-value<0.001
$H_{2.2}$	Customer Type	Time	For Transformational *Innovativeness*, the increase in relative occurrence of Abnormal CAR before & after March 2000 crash is greater for B2C initiatives thanB2B initiatives.	Yes p-value=0.003
$H_{2.3}$	Customer Type	Time	For Executional *Innovativeness*, the increase in relative occurrence of Abnormal CAR before & after March 2000 crash is greater for B2B initiatives than B2C initiatives.	No p-value=0.128
$H_{2.4}$	Product Type	Innovativeness	The increase in relative occurrence of Abnormal CAR between Transformational & Executional *Innovativeness* is greater for *Digital* products than for Tangible products.	Yes p-value<0.001
$H_{2.5}$	Product Type	Time	For Transformational *Innovativeness*, the increase in relative occurrence of Abnormal CAR before & after the March 2000 crash is greater for *Tangible* products than for *Digital* products.	Yes p-value=0.034
$H_{2.6}$	Product Type	Time	For Executional *Innovativeness*, the decrease in relative occurrence of Abnormal CAR before & after the March 2000 crash is greater for *Digital* products than for *Tangible* products.	No p-value=0.065

could be used to expose and statistically validate such hypotheses. So in this paper we intentionally took an exploratory data analysis approach that involved taking advantage of existing data mining technology to automatically recursively partition the dataset into subsets that were associated with values of our potential predictor variables. This allowed us to develop both global and local hypotheses. Our approach then involved us doing traditional statistical hypothesis testing.

3.7 Theoretical framework

Our framework involves integrating the set of links associated with the abducted hypotheses that were supported by statistical analysis. It describes the independent and dependent variables and the newly hypothesized relationships that were supported (see Tables 7 and 8). This resulting framework can be presented in terms of interactions between the predictor variables in the determination of CAR (see Table 9) and corresponding propositions (see Table 10).

Table 9 shows the framework of the n-way interaction of independent variables that were statistically supported from Tables 7 and 8 with HID referencing the specific hypotheses from those tables. A one-way model involves only one independent variable or a main effect model. An n-way model represents the effect of the interaction of n-independent variables on CAR, in other words, how n-1 independent variables moderate the effect of one independent (discriminating predictor) variable on CAR.

The results of our inductive and abductive approaches presented above allow us to make propositions (see Table 10) about CAR and firm and IT characteristics that can be deductively tested using different data sets to provide additional insights on e-commerce initiatives and cumulative abnormal returns.

The research method is consistent with the inductive/abductive nature of our approach. In an inductive study, empirical phenomena are observed first and then inferences are drawn from them. The inductive approach allows us to draw generalizations from the observed data. An abductive approach bears similarity to induction in that the starting point is not a priori hypotheses. However, the abductive approach moves beyond generalizations to articulation of specific rules or hypotheses that one believes provide consistent explanations of the observed data. Thus, rather than focusing on generalizations the abductive approach focuses on specific situations that deviate from the general structure, providing a possible explanation of some puzzling phenomena.

3.8 Explanation/justification of the framework

Although a proposition may involve the interaction of several independent variables, we have organized the propositions and discussions according to the variable that plays a discriminating role, i.e., the variables whose two categories have different likelihood of CAR in the presence of additional interaction variables. Each of the propositions 3.8.1–3.8.7, and 3.8.11 includes only one discriminating variable while each of the Propositions 3.8.8–3.8.10 includes two discriminating variables. In the following subsections, we state each proposition and provide a justification by drawing from the theories that formed the basis for selecting the predictor variables.

Table 9 Main and interaction (multi-way) effects of IT and firm characteristics on CAR

N-way Interaction	HID	Discriminating predictor (s)	Moderating variables	Findings
1-way (main effect)	$H_{I.1}$	Innovativeness	None	Transformational Innovativeness is more favorable than Executional Innovativeness.
2 way	$H_{T.2}$	Time	Innovativeness	For Transformational Innovativeness, Post 2000 initiatives are more likely to create value than Pre 2000 initiatives.
	$H_{G.2}$	Governance	Innovativeness	For Transformational Innovativeness, Joint initiatives are more favorable than Unilateral initiatives.
	$H_{2.1}$	Customer Type Innovativeness	None	The increase in the relative occurrence of Abnormal CAR between Transformational & Executional Innovativeness is greater for B2B initiatives than B2C initiatives.
	$H_{2.4}$	Product Type Innovativeness	None	The increase in relative occurrence of Abnormal CAR between Transformational & Executional *Innovativeness* is greater for *Digital* products than for Tangible products.
3-way	$H_{C.2}$	Customer Type	Innovativeness Time	For Transformational Innovativeness, Pre 2000 initiatives, B2B is favored over B2C.
	$H_{C.3}$	Customer Type	Innovativeness Time	For Executional Innovativeness, Pre 2000 initiatives, B2C is favored over B2B.
	$H_{P.2}$	Product Type	Innovativeness Time	For Post 2000 Executional Initiatives, Digital products are favored over Tangible products.
	$H_{2.2}$	Customer Type Time	Innovativeness	For Transformational *Innovativeness*, the increase in relative Abnormal CAR before & after March 2000 crash is greater for B2C initiatives than B2B initiatives.
	$H_{2.5}$	Product Type Time	Innovativeness	For Transformational *Innovativeness*, the increase in relative occurrence of Abnormal CAR before & after the March 2000 crash is greater for Tangible products than for Digital products.
4-way	$H_{F.2}$	Firm Type	Innovativeness Customer Type Product Type	For Executional Innovativeness, B2B and Digital products, Non-net firms are favored over Net firms.

3.8.1 Innovativeness

Proposition P1 Firms are more likely to experience positive abnormal returns for e-commerce announcements involving Transformational than Executional Innovativeness.

Justification This finding is consistent with the Schumpeterian innovation theory (Schumpeter 1934) as well as other theoretical models on innovation and e-commerce investments (Barua and Mukhopadhyay 2000; Dehning et al. 2003; Subramani and Walden 2002; Venkatraman 2000). The market value creation of Transformational e-commerce investments results from the potential changes that the initiative may bring such as introducing new products and/or services, discovering new supply services, or reorganizing industries and markets or creating new markets (Aral and Weill 2007; Schumpeter 1934). Investors recognize the market value of Transformational investments and respond accordingly leading to the positive CAR.

The findings on the Innovativeness variable also corroborate those studies that discuss intangible assets and complementarity theory where the investments in complementary assets, here the intangible assets such as business processes and new sets of supplier relationships, influence the business value of a firm's IT initiatives (Brynjolfsson et al. 1998). Investors appear to reward firms for Transformational initiative announcements because they expect those initiatives to have future market promise. Firms that make Transformational e-commerce investments are motivated to make complementary investments in intangible assets such as improvement in buyer–supplier relationships, business process enhancements and human resource management improvements that seek to support the e-commerce investments. In addition, it is shown that firm performance is enhanced through the complementarity of IT and business strategy (Shin 2006).

3.8.2 Governance

Proposition P2 Firms that make e-commerce announcements are more likely to experience positive abnormal returns for Joint Governance structure than Unilateral Governance structure if the initiative is Transformational.

Justification For Transformational e-commerce investments, those based on Joint rather than Unilateral Governance structure are more likely to create value for the firm.

Table 10 Propositions on the Predictors of CAR

Variable		Proposition	
	HID	ID	Description
Innovativeness	$H_{I.1}$	P1	Firms are more likely to experience positive abnormal returns for e-commerce announcements involving Transformational than Executional Innovativeness.
Governance	$H_{G.2}$	P2	Firms that make e-commerce announcements are more likely to experience positive abnormal returns for Joint Governance structure than Unilateral Governance structure if the initiative is Transformational.
Product Type	$H_{P.2}$	P3	Firms that make e-commerce announcements are more likely to experience positive abnormal returns for Digital products than Tangible products if the initiative is Post Internet bubble era and the innovation is Executional.
Customer Type	$H_{C.2}$	P4	For e-commerce initiative announcements that are Transformational and occurred in the Pre Internet bubble era, firms are more likely to experience positive abnormal returns if the initiative were targeted for the B2B market rather than the B2C market.
	$H_{C.3}$	P5	For e-commerce initiative that are Executional and occurred in the Pre Internet bubble era, firms were more likely to experience positive abnormal returns if the initiative were targeted for the B2C market rather than the B2B market.
Firm Type	$H_{F.2}$	P6	Non-net firms are more likely than Net firms to experience positive abnormal returns for e-commerce announcements if the initiative is Executional, is for a Digital product, is Joint and targeted at the B2B market.
Time	$H_{T.2}$	P7	Firms that make e-commerce announcements are more likely to experience positive abnormal returns for Post Internet bubble era than Pre Internet bubble era if the initiative is Transformational.
Customer Type Innovativeness	$H_{2.1}$	P8	The increase in CAR between Transformational and Executional *Innovativeness* is greater for B2B than B2C.
Product Type Innovativeness	$H_{2.4}$	P9	The increase in CAR between Transformational and Executional *Innovativeness* is greater for *Digital* products than for *Tangible* products.
Customer Type Time	$H_{2.2}$	P10	For Transformational *Innovativeness*, the increase in CAR before and after March 2000 crash is greater for B2C than for B2B.
Product Type Time	$H_{2.5}$	P11	For Transformational *Innovativeness*, the increase in CAR before and after the March 2000 crash is greater for *Tangible* products than for *Digital* products.

We suggest some possible explanations for why investors reward firms when such announcements are made. A firm can create value from strategic partnerships or alliances. Based on the resource-based view of the firm, we argue that the value creation is a result of a firm's ability to combine its own competencies with those of partners to build complementary assets that actually lead to value creation. We contend that the motivation for partners to participate in the relationship depends on the strategic intent of the initiative. The potential market value creation of the initiative is a source of motivation for all partners to make the necessary required level of initial investments that would ensure that complementary investments are made as well. Also, transaction cost economics suggests alliances might serve to mitigate market inefficiencies and provide superior monitoring mechanisms that lead to improved profitability (Osborn and Baughn 1990). However, according to the incomplete contract theory, organizations may doubt the market potential of Executional initiatives and subsequent ex post bargaining power of the partnership (Subramani and Walden 2000). Thus in partnership or alliance relationships, partners may not commit to providing the requisite initial investments to enable investments in complementary assets that are the "real" source of value creation if the initiative is Executional.

We show from the data that for Transformational e-commerce investments alliances are more likely to create value for the firm than unilateral. While prior research shows that alliances can create value (Chan et al. 1997; McConnell and Nantel 1985), here we specifically show that Transformational e-commerce investments are more likely to create value and that non-Transformational e-commerce investments are less likely to create value for the firm in joint or alliance relationships. This is a significant contribution of this research. Whereas one might expect all matched alliances to be important in e-commerce initiatives, we have demonstrated that pursuing alliances in non-transformational initiatives might not be so beneficial.

3.8.3 Product type

Proposition P3 Firms that make e-commerce announcements are more likely to experience positive abnormal returns for Digital products than Tangible products if the initiative is Post Internet bubble era and the innovation is Executional.

Justification Firms stand to benefit more from the Internet if they create Digital products rather than traditional tangible products and or services if the initiative is Executional. Investors reward firms that use the Internet to create value through the minimization of transaction costs. The reward for digital products therefore might result from the transaction costs benefits that Digital products promise as Digital products can instantly be delivered to the customer at relatively lower cost than Tangible products. We contend that organizations are more likely to create value in delivering Digital rather than Tangible products through e-commerce investments. For instance, they can build digitized capabilities such as digital logistics, digital customer service, and digital analytics (Kohli and Grover 2008) to create value. It is also possible that following the Internet bubble, and with increase in ecommerce activities investors have become more savvy about the Internet and its capabilities and have developed a greater understanding of which initiatives related to product offerings are likely to generate value for firms. Thus investors' expectation for firms to take advantage of transaction cost benefits of digital products is higher post internet bubble than pre internet bubble era.

3.8.4 Customer type

Proposition P4 For e-commerce initiative announcements that are Transformational and occurred in the Pre Internet bubble era, firms are more likely to experience positive abnormal returns if the initiative was targeted for the B2B market rather than the B2C market.

Justification In P1, we established that Transformational initiatives are perceived as being beneficial. Although the main effect of time was not significant, our results demonstrated that time could play a moderating role as discussed in P3. The possible explanation for P4 is that B2B firms may benefit from investment from trading with B2B partners such that those investments may help the organizations develop capabilities and complementary assets that enable the firms to create market value. As suggested by Kauffman and Walden (2001), B2B electronic commerce originates from electronic data interchange where firms are expected to make complementary investments to enable effective implementation of electronic commerce strategies. There may be high initial investments in IT capabilities and complementary investments that promise value for the participants. Investors recognize the current and future value potential of such investments and therefore reward those initiatives resulting in the positive abnormal returns. The importance of the findings related to time lies in the fact that the pre 2000 era refers to the Internet bubble where there were concerns that internet stocks were overvalued. Thus our findings provide useful guide for both investors and researchers when dealing with situations that are similar to the market bubble era in 2000.

Proposition P5 For e-commerce initiatives that are Executional and occurred in the Pre Internet bubble era, firms were more likely to experience positive abnormal returns if the initiative were targeted for the B2C market rather than the B2B market.

Justification From our discussions from Proposition 4, we note that investors reward firms for Transformational e-commerce initiatives targeting the B2B market. However, investors do not expect all firms to have the necessary capabilities to indulge in Transformational initiatives and therefore rewarded firms that announced Executional investments probably because of benefits expected from transaction cost efficiencies. Thus, although Transformational investments are more likely to create value in general, Executional initiatives are more likely to create value when they target B2C than B2B markets. We note that the time element is common in both instances.

It has been suggested that, in general, e-commerce initiatives create value if they target B2C market rather than B2B market because the public is more aware of B2C than B2B e-commerce (Subramani and Walden 2000). Herein lies another significant contribution of our study. We have shown that the market value creation for B2B vs. B2C depends on the Innovativeness of the initiative.

3.8.5 Firm type

Proposition P6 Non-net firms are more likely than Net firms to experience positive abnormal returns for e-commerce announcements if the initiative is Executional, is for a Digital product, is Joint and targeted at the B2B market.

Justification The plausible explanation for this observation is that Net firms are expected to enhance their web sites regularly for operational reasons and so announcement of Executional investments would not be rewarded by investors. However, Executional investments by Non-net firms may be interpreted by investors as the use of the Internet to enable transaction cost benefits.

3.8.6 Time

Proposition P7 Firms that make e-commerce announcements are more likely to experience positive abnormal returns for Post Internet bubble era than Pre Internet bubble era if the initiative is Transformational.

Justification Due to the general concern that firms were overvalued during the internet bubble era, investors'

reaction to e-commerce announcements will be influenced by the type of initiatives. Thus, while investors may not have differentiated between Transformational and Executional when responding to e-commerce initiatives during the pre internet bubble era, now investors' reaction to Transformational initiatives are more favorable than Executional initiatives. Our finding supports the innovation and e-commerce theories that suggest that an initiative creates value if it has strategic intent and the Innovativeness is Transformational. Thus, firms can continue to benefit from Transformational initiatives even after the market crash. More specifically, because of the internet bubble, investors expect firms to engage in more transformational initiatives.

3.8.7 Innovativeness and customer type

Proposition P8 The increase in CAR between Transformational and Executional Innovativeness is greater for B2B than B2C.

Justification This proposition supports and extends propositions 4 and 5. It emphasizes the need for targeting B2B market with Transformational initiatives rather than Executional initiatives, as the difference in market value from both types of initiatives is large.

Firms that indulge in B2B transactions can take advantage of strategic partnerships to develop complementary assets. This can create market value as observed by investors' response to the corporate action. However, involvement in Executional investments may not be appreciated by the market since organizational resources could be considered underutilized or "wrongly" invested. This is plausible explanation for the large difference between CAR for investments involving B2B transactions for Transformational and Executional. However, since B2C transactions involve relatively less number of partners, according to the incomplete contract theory (Subramani and Walden 2000), the potential benefits from joint ventures is not as much as in B2B.

3.8.8 Innovativeness and product type

Proposition P9 The increase in CAR between Transformational and Executional Innovativeness is greater for Digital products than for Tangible products.

Justification This proposition adds to the others by suggesting that firms are more likely to create market value from e-commerce initiatives by delivering Digital products rather than Tangible products if the Innovativeness of their initiative is Transformational.

3.8.9 Time and product type

Proposition P10 For Transformational Innovativeness, the increase in CAR before and after March 2000 crash is greater for B2C than for B2B.

Justification Although there is increase in CAR before and after the Internet market crash, the difference is larger for B2C than B2B because in pre market crash, most B2B were involved in Transformational initiatives while B2C focused on Executional. However, after the internet bubble, firms recognize investors' expectation of much broader involvement in initiatives that drive strategic and innovative products and services whether the target is B2B or B2C. Investors reward firms that indulge in Transformational initiatives because of the potential market value of such initiatives.

3.8.10 Time and product type

Proposition P11 For Transformational Innovativeness, the increase in CAR before and after the March 2000 crash is greater for Tangible products than for Digital products.

Justification Similar to Proposition 10, investors expect firms to use strategic, Transformational approaches to deliver both Digital, and Tangible products since Transformational investments promise higher market value than Executional investments. Hence, firms are rewarded in post market crash than they were in pre market crash if they employ Transformational Innovativeness to deliver Tangible products.

4 Conclusion

Several researchers have sought to measure the market value of e-commerce investments and identify explanatory variables that influence the observed abnormal returns. However, the results of these studies are mixed. In this paper, we combined two methodological approaches—event study methodology and decision tree induction to explore both the main and interaction effects of IT and firm characteristics on abnormal returns. Within the 3-day event window, firms on the average gained 1.83% market value above normal returns. Although on the surface a 1.8% increase might not represent a lot, it is very significant given that, in general, annual stock market returns average less than 10%.

Through the methodology used in this study, we have identified specific conditions when combinations of IT and firm characteristics are likely to provide market value for e-commerce initiatives. The Innovativeness of an e-

commerce initiative plays a dual role in helping understand the relationships between IT/Firm characteristics and the attainment of abnormal returns. Innovativeness has a direct impact on CAR. It also moderates the relationship between CAR and other IT/firm characteristics. Our results indicate that while firm and IT characteristics by themselves might have no effect on CAR, they interact to produce an effect on the cumulative abnormal returns that result from e-commerce announcements in the public media. For example, while whether a firm engages in an e-commerce initiative unilaterally or in a strategic alliance does not have an effect on the attainment of abnormal returns, we have shown that abnormal returns are possible if the effort is specifically targeted at a Transformational initiative. Time also explains the relationship as investors' reactions have been influenced by the concern of overpriced stocks during the internet bubble era. Our methodology has enabled us to provide such many insights on the relationships between CAR and firm/IT characteristics.

5 Implications for research and practice

This study makes theoretical, methodological and practical contributions. The research makes a novel methodological contribution in that it is the first time the Event study methodology and Decision tree induction approach have been combined to develop interaction models to help explain the abnormal returns that result from e-commerce announcements in the public media. The theoretical contribution lies in the fact that our findings suggest that examining interaction models might be a useful way of explaining and predicting how e-commerce initiatives influence firm performance. We also present a set of propositions from our empirical analysis that can further be deductively validated by other researchers to gain more understanding to the e-commerce and CAR phenomenon. As suggested by Whetten (1989), we have used existing theories to explain the propositions.

For practitioners, the theoretical models can be used to refine their understanding and thinking about how Firm and IT characteristics influence the market value creation from e-commerce initiatives. In particular, we generate several interaction models of the IT and firm characteristics that can guide e-commerce investment decisions so managers can know, for example, which combination of IT and firm characteristics are more likely to be viewed positively by investors. Firms can continue to create market value from strategic Transformational e-commerce investments. The market value creation for transformational investments can be enhanced through strategic alliances. The increase in CAR between Transformational and Executional Innovativeness is greater for B2B than B2C. For Transformational Innovativeness, the increase in CAR before and after the Internet bubble is greater for B2C than B2B. The increase in CAR between Transformational and Executional Innovativeness is greater for Digital products than Tangible products. Finally, for Transformational Innovativeness, the increase in CAR before and after the Internet bubble is greater for Tangible products than Digital products. We believe the exposition provided by our results can be used by decision makers in e-commerce investments decisions. This is very critical because management choices influence payoff from IT investments (Santos 2003).

6 Future research

The data collected did not provide enough information to distinguish between different kinds of alliances. It would be interesting for future work to capture the different kinds of alliances such as those involving joint ventures and licensing. Other important variables will be firms' prior experience in managing alliances, and any existing persistent firm-specific differences in their ability to create value through alliances (Anand and Khanna 2000). In this paper, we demonstrate that the selected firm and IT characteristics have interaction effect on market value of e-commerce initiatives and subsequently on firm performance. However, other studies may identify and use other classes or a modification of the firm and IT variables that was used in our study to gain further insight on CAR and e-commerce. Researchers may use the findings of this work to develop additional deductive theoretical models of e-commerce and market value creation. Also, our methodology was applied to e-commerce initiatives. However, we can anticipate many other initiative announcements such as in supply chain, manufacturing technology and healthcare investments where the method could be applied to elicit useful insights on how such initiatives impact a firm's market value.

Appendix A1: Sample e-commerce announcement and classification

Business Wire
January 4, 1999, Monday

DISTRIBUTION: Business Editors

LENGTH: 346 words
HEADLINE: Sterling Vision, Inc. to Launch Interactive E-Commerce Website
DATELINE: EAST MEADOW, N.Y.

BODY:
January 4, 1999--Sterling Vision, Inc. (ISEE-NASDAQ), one of the largest retail optical chains in the United States today announced plans to launch a fully interactive, optical goods web-site. The Company has formed a special task force to create what it believes will be the most advanced E-commerce site marketing optical products and services online. Dr. Robert Cohen, Chairman, said "We will use Sterling's 85 years of professionalism, retail experience, product and technical knowledge to enter the 21st century as the country's first true optical E-tailer". The site is currently under construction and is anticipated to be operational by the end of the first quarter of 1999. Cohen added, "The U. S. Optical market is a 15 billion dollar industry, making the potential for optical sales on the Internet virtually unlimited. Sterling is confident that it will be in the forefront of this technology, enabling the Company to increase its existing multi-million customer base of eyeglass and contact lens wearers throughout the country." All statements contained herein (other than historical facts) are based upon current expectations. These statements are forward looking in nature and involve a number of risks and uncertainties. Actual results may differ materially from the anticipated results or other expectations expressed in the Company's forward looking statements. Generally, the words "anticipate", "believe", "estimate", "expects" and similar expressions as they relate to the Company and/or its management, are intended to identify forward looking statements.

CONTACT: Sterling Vision, Inc.
Joseph Silver, Esq.
Executive Vice President &
General Counsel
(516) 390-2144

Today's News On The Net - Business Wire's full file on the Internet

with Hyperlinks to your home page.

URL: http://www.businesswire.com

LOAD-DATE: January 5, 1999

This announcement was coded as *B2C* because the benefits are promised for the end consumer and not the business entity. It was coded *Unilateral* because it was an initiative by a single business entity. This is *Executional* as the firm continues to sell the same products except that they use the Internet to support their operations. The firm is not a *Net* firm because most of the sales are not from the Internet operations but from the traditional markets. Finally the products are *Tangible* and not *Digital*.

Appendix A2: Sample e-commerce announcement and classification

Copyright 1998 **Business Wire,** Inc.
Business Wire
March 25, 1998,Wednesday

DISTRIBUTION: Business Editors

LENGTH: 1206 words
HEADLINE: Getty Targets SOHO Market
DATELINE: LONDON.

BODY:
March 25, 1998—Getty Images, Inc. (NASDAQ:GETTY), one of the leading international providers of visual content, today announces the launch of PowerPics™, (Www.powerpics.com), the company's first important step in its strategy to target the expanding corporate and small office/home office (SOHO) market sector. Getty's subsidiary PhotoDisc, a leading provider of royalty-free digital stock photography and believed to be the largest provider of imagery on the internet, collaborated with Hewlett-Packard Company to produce PowerPics, an electronic commerce enabled website which provides high quality, affordable imagery to business users. Getty's PhotoDisc is the first company to use Hewlett-Packard's OpenPix Server software suite to provide access to imagery in a fully electronic commerce enabled environment. PowerPics offers a focused selection of imagery in a digitized, ready-to-use format. A simple search system allows selection from a variety of common business themes and images are subsequently purchased and downloaded directly from the website. The image license allows used in a variety of business documents, from presentations and proposals to brochures and newsletters, and is delivered in JPEG-compressed format which is easily read by current versions of most desktop applications. The images are available in two file sizes: 400K for onscreen use or for printing to a maximum size of 3"X5", and 5MB for printing to a maximum size of 8"X10". Getty's customers include advertising and design agencies, magazines, news papers, broadcasters, productions companies and traditional and new media publishers, and the company believes that there is additional potential for building image use in everyday business documents by providing the business community with a relevant product. Getty also intends to launch PowerPics ImagePacks(TM) later this year. ImagePacks will include five images, pre-selected or user-selected, which are value priced as a group, depending on file size. Getty believes that ImagePacks will play an important role in further persuading the SOHO and corporate market to take advantage of high quality, relevant and affordable imagery in order to increase the impact of their business communication. Getty's Chief Executive Officer, Jonathan Klein, said "There is a growing awareness of the influencing power of imagery and we believe that this has created a demand for affordable imagery for use in internal documents and presentations within corporations and for use in marketing materials and client briefings within SOHO sector. We are delighted to have worked with Hewlett-Packard to meet the demand and we are confident that PowerPics will prove to be a very convenient and valuable service for many." In addition to PhotoDisc, a leading world-royal-free digital stock provider, Getty's high quality visual content portfolio also includes Tony Stone Images, one of the world's leaders in contemporary stock photography; Allsport, a leading global sports picture agency; Hulton Getty, one of the two largest privately owned archival photograph collections in the world; Gamma Liaison, a leading North American news and photojournalism business; and Energy Film Library, one of the world's leading stock footage companies. Getty's strategy has been to be a consolidator, in the visual content industry, of businesses that are among the leaders in all sectors of the market and to make the content available for digital search, selection and delivery.

CONTACT: Getty Communications, London
Jonathan Klein, 011-44/171-544-3456
Or
Taylor Rafferty Associates, New York
Jim Prout, 212/889-4350

Today's News On The Net - Business Wire's full file on the Internet
with Hyperlinks to your home page.
URL: http://www.businesswire.com
LOAD-DATE: March 26, 1998

This announcement was coded as *B2B* because the benefits are promised for the business consumer and not the end consumer. It was coded *Joint* because it was an initiative that was a collaboration between Getty images and Hewlett-Packard. This is *Transformational* as it was a strategy to target corporate and small office/home office businesses. The firm is a *Net* firm according to data provided on The Internet Stock Listing™ and Morgan Stanley Dean Witter's Internet Company list. Finally the products are *Digital* as they can be downloaded directly from the website.

Appendix B. Hypothesis abduction and evaluation

First-order sibling rules hypothesis

Consider a pair of sibling rules presented in Table 6 (generated from the DT induction) where all conditions are the same (Innovativeness is Transformational) except for the one involving the given discriminating variable (e.g. Governance):

- IF *Innovativeness* is *Transformational* & *Governance* is *Unilateral* THEN *CAR* is *Positive* with probability 74.7% and *N* (i.e. Number of Cases)=115;
- IF *Innovativeness* is *Transformational* & *Governance* is *Joint* THEN *CAR* is *Positive* with probability 84.3% and *N*=97.

The existence of this pair of sibling rules leads to the creation of the hypothesis: "IF *Innovativeness* is *Transformational* THEN *Governance* is a predictor of CAR." Governance is a discriminating predictor in this case.

For the given target event (e.g. CAR is Positive), the posterior probabilities for each sibling node are compared. If for any pair of sibling nodes, the relevant posterior probabilities are very different, then this would suggest that the given variable is a predictor for the target event (Osei-Bryson and Ngwenyama 2004). In this manner, a given set of sibling rules can be used to generate and test hypotheses that involve conjecturing that the given variable is a predictor of CAR. If the number of cases associated with a given set of sibling nodes is sufficiently large, then the hypothesis may be subjected to statistical analysis. The statistical test used here is difference of proportion test to confirm that the difference in posterior probabilities (proportions or relative frequencies of the abnormal events) for the sibling nodes of the discriminating variable did not occur by chance. The difference is between two proportions (p1 and p2) based on two independent samples of size n_1 and n_2 with sample proportions $\hat{P}_1$ and $\hat{P}_2$.

According to (Groebner et al., 2008), the test statistic for the difference of proportion test is given by:

$$Z = \frac{\hat{P}_1 - \hat{P}_2}{\sqrt{\frac{\hat{P}_1(1-\hat{P}_1)}{n_1} + \frac{\hat{P}_2(1-\hat{P}_2)}{n_2}}}$$

From the sample pair of sibling rules,

$$\hat{P}_1 = 0.843,\ \hat{P}_2 = 0.747,\ n_1 = 115 \text{ and } n_2 = 97$$

$$\text{Thus } Z = \frac{0.843 - 0.747}{\sqrt{\frac{0.843(0.157)}{115} + \frac{0.747(0.253)}{97}}}$$

$$\text{Thus } Z = \frac{0.096}{\sqrt{0.001364 + 0.001643}}$$

$$Z = 0.096/0.05484 = 1.750425.$$

$$P(Z) = 0.04.$$

Similarly, for the other sibling rule in Table 6,

- IF *Innovativeness* is *Transformational* THEN *CAR* is *Positive* with probability 77% and N (i.e. Number of Cases)=379;
- IF *Innovativeness* is *Executional* THEN *CAR* is *Positive* with probability 36% and *N*=567.

$$\hat{P}_1 = 0.77,\ \hat{P}_2 = 0.36,\ n_1 = 379 \text{ and } n_2 = 567$$

$$\text{Thus } Z = \frac{0.77 - 0.36}{\sqrt{\frac{0.77(0.23)}{379} + \frac{0.36(0.64)}{567}}}$$

$$\text{Thus } Z = \frac{0.41}{\sqrt{0.000467 + 0.000406}}$$

$$Z = 0.41/0.029557 = 13.87138$$

$$P(z) = 0.0.$$

Details of the difference of proportion tests performed at the 5% level are presented in Table 11 below.

Table 11 Difference of proportions tests for first-order sibling rules hypotheses

ID	Variable	P_1	n_1	P_2	n_2	Z	Cum Prob (1 tail)	Prob=1-Cum Prob	Significant?
$H_{I.1}$	Innovativeness	0.77	379	0.36	567	13.87138	1.00000	0.00000	Yes
$H_{G.1}$	Governance	0.54	353	0.52	593	0.59639	0.72454	0.27546	No
$H_{G.2}$	Governance	0.843	97	0.747	115	1.75043	0.95998	0.04002	Yes
$H_{F.1}$	Firm Type	0.53	742	0.51	204	0.50625	0.69366	0.30634	No
$H_{F.2}$	Firm Type	0.228	127	0.111	45	1.95576	0.97475	0.02525	Yes
$H_{c.1}$	Customer Type	0.54	497	0.51	449	0.92302	0.82200	0.17800	No
$H_{C.2}$	Customer Type	0.709	79	0.484	64	2.78781	0.99735	0.00265	Yes
$H_{C.3}$	Customer Type	0.508	59	0.324	71	2.15046	0.98424	0.01576	Yes
$H_{p.1}$	Product Type	0.55	411	0.51	535	1.22324	0.88938	0.11062	No
$H_{P.2}$	Product	0.354	99	0.143	147	3.76329	0.99735	0.00265	Yes
$H_{T.1}$	Time	0.54	482	0.51	464	0.92409	0.82228	0.17772	No
$H_{T.2}$	Time	0.873	236	0.608	143	5.73319	0.99997	0.00003	Yes

Table 12 Format of second-order sibling rules hypotheses

Set	Rule	Moderating condition	Discriminating conditions		Relative frequency of CAR	N	Diff
			Variable 1	Variable 2			
S_1	R_{11}	** Same for all Rules **	DC_{11}	DC_{21}	$\rho_{11,21}$	$n_{11,21}$	$\rho_{11,21}-\rho_{11,22}$
	R_{12}		DC_{11}	DC_{22}	$\rho_{11,22}$	$n_{11,22}$	
S_2	R_{21}		DC_{12}	DC_{21}	$\rho_{12,21}$	$n_{12,21}$	$\rho_{12,21}-\rho_{12,22}$
	R_{22}		DC_{12}	DC_{22}	$\rho_{12,22}$	$n_{12,22}$	
Hypothesis		Given {Moderating Condition}, the difference in CAR between DC_{21} and DC_{22} is greater for DC_{11} than for DC_{12}.					

DC_{11} condition 1 of discriminating variable 1; DC_{12} condition 2 of discriminating variable 1

DC_{21} condition 1 of discriminating variable 2; DC_{22} condition 2 of discriminating variable 2

Second-order sibling rules hypotheses

A first-order sibling rules hypothesis is based on a set of sibling rules. A second-order sibling rules hypothesis is based on two sets of sibling rules (say S_1, S_2) that have the following conditions: (Tables 12, 13, and 14, Fig. 1)

Similar to the First Order Sibling Rules (Groebner et al. 2008), the difference of proportion testing for the Second-Order Sibling Rules Hypothesis involves computing Z which is given by:

$$Z = \left(\left(\rho_{11,21} - \rho_{11,22}\right) - \left(\rho_{12,21} - \rho_{12,22}\right)\right)/s_p^{1/2}$$

where $s_p = \left(\rho_{11,21}\left(1-\rho_{11,21}\right)/n_{11,21} + \rho_{11,22}\left(1-\rho_{11,22}\right)/n_{11,22} + \rho_{12,21}\left(1-\rho_{12,21}\right)/n_{12,21} + \rho_{12,22}\left(1-\rho_{12,22}\right)/n_{12,22}\right)$.

Using example in Table 12 which is also the rule for $H_{2.1}$ (Table 8),

$$\rho_{11,21} = 0.69, \rho_{11,22} = 0.43, \rho_{12,21} = 0.82 \text{ and } \rho_{12,22} = 0.27$$
$$n_{11,21} = 134, n_{11,22} = 315, n_{12,21} = 245, \text{and } n_{12,22} = 252$$

$$\left(\rho_{11,21} - \rho_{11,22}\right) - \left(\rho_{12,21} - \rho_{12,22}\right) = 0.55 - 0.26 = 0.29$$

(See Table 13, B2B has higher difference than B2C).

$$Sp = (0.001596 + 0.000778 + 0.000602 + 0.000782) = 0.003759$$
$$Sp^{1/2} = 0.06131$$
Thus $Z = 0.29/0.06131 = 4.73004$.
$P(Z) = 0.000001$.

Details of difference of proportion tests performed at the 5% significant level for the Second-Order Rules Hypotheses are presented in Table 15 below.

Table 13 Example of second-order sibling rules hypotheses without moderator

Set	Rule	Moderating condition	Discriminating conditions		Relative frequency of CAR	N	Diff
			Customer Type	Innovativeness			
S_1	R_{11}	None	B2C	Transformational	0.69	134	+0.26
	R_{12}		B2C	Executional	0.43	315	
S_2	R_{21}	None	B2B	Transformational	0.82	245	+0.55
	R_{22}		B2B	Executional	0.27	252	
Hypothesis		The increase in CAR between Transformational & Executional *Innovativeness* is greater for B2B than B2C.					

Table 14 Example of second-order sibling rules hypothesis with moderator

Set	Rule	Moderating condition	Discriminating conditions		Relative frequency of CAR	*N*	Diff
			Customer Type	Time			
S_1	R_{11}	Innovativeness = 'Transformational'	B2C	<March 2000	0.89	70	+0.41
	R_{12}		B2C	≥March 2000	0.48	64	
S_2	R_{21}	Innovativeness = 'Transformational'	B2B	<March 2000	0.87	166	+0.16
	R_{22}		B2B	≥March 2000	0.71	79	
Hypothesis		For Transformational *Innovativeness*, the increase in CAR before & after March 2000 crash is greater for B2C than for B2B.					

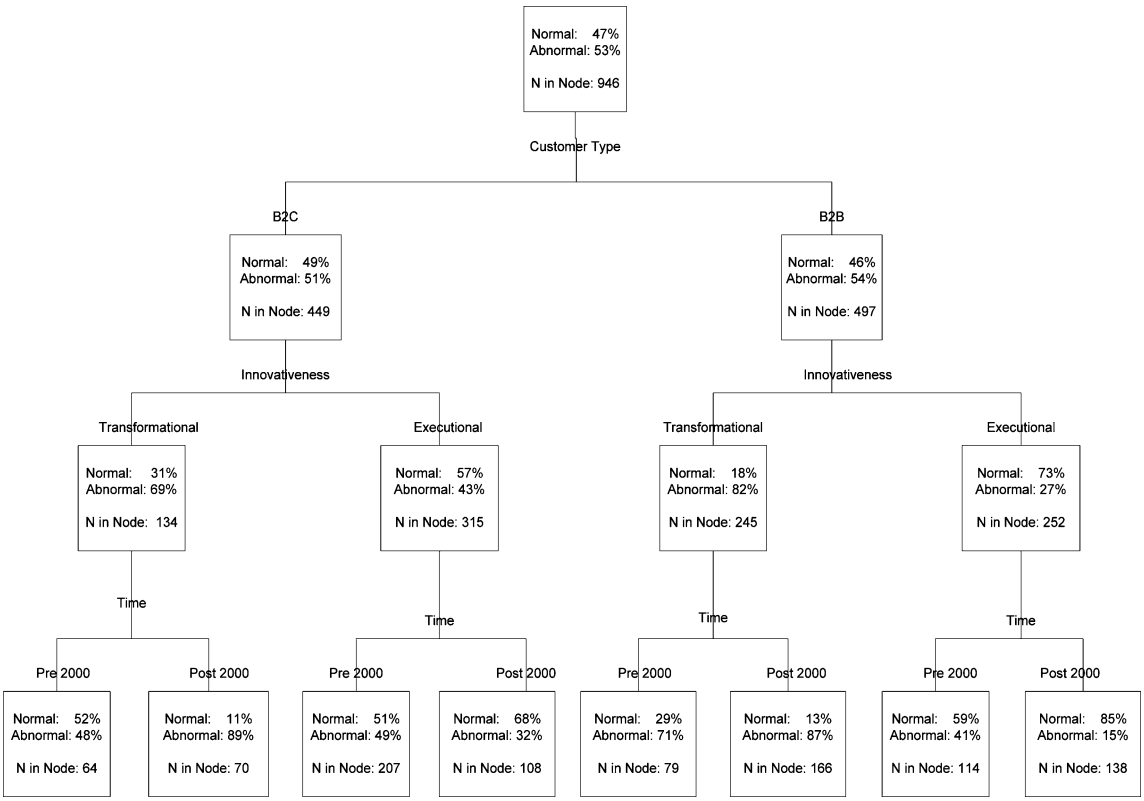

Fig. 1 Decision tree example

Table 15 Difference of proportion tests for second-order rules hypotheses

ID	$\rho_{11,21}$	$n_{11,21}$	$\rho_{11,22}$	$n_{11,22}$	$\rho_{12,21}$	$n_{12,21}$	$\rho_{12,22}$	$n_{12,22}$	A	Sp	Z	CumProb (1-tail)	Prob = 1-CumProb	Significant
$H_{2.1}$	0.82	245	0.27	252	0.69	134	0.43	315	0.29	0.00376	4.73004	0.99999	0.00000	Yes
$H_{2.2}$	0.89	70	0.48	64	0.87	166	0.71	79	0.25	0.00859	2.69798	0.99651	0.00349	Yes
$H_{2.3}$	0.41	114	0.15	138	0.49	207	0.32	108	0.09	0.00627	1.13679	0.87219	0.12781	No
$H_{2.4}$	0.78	258	0.27	277	0.77	121	0.45	290	0.19	0.00369	3.12622	0.99911	0.00089	Yes
$H_{2.5}$	0.91	77	0.52	44	0.86	159	0.65	99	0.18	0.00979	1.81906	0.96555	0.03445	Yes
$H_{2.6}$	0.41	130	0.14	147	0.5	191	0.35	99	0.12	0.00629	1.51346	0.93492	0.06508	No

$A = (r_{11,21} - r_{11,22}) - (r_{12,21} - r_{12,22})$

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