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Systematic Differences in Firm's Information Technology Signaling: Implications for Research Design*

Robert W. Zmud
University of Oklahoma
rzmud@ou.edu

Henry Croes
ITT Technical Institute, Kansas City
hcroes@itt-tech.edu

Teresa Shaft
University of Oklahoma
tshaft@ou.edu

Weijun Zheng
University of Wisconsin, Parkside
zheng@uwp.edu

Abstract

Because research programs investigating IT-related phenomena are hindered by limitations in the availability of archival data, researchers have used a variety of data collection strategies including the gathering of firms' IT signaling via press releases to the media. Little is known, however, about firms' IT signaling propensities. Here, contents of firms' press releases and annual reports are coded to test a model explaining a firm's propensity to signal stakeholders about its IT-related activities. Results demonstrate that firms transmitting greater numbers of IT signals tend to be low performers in their industries, tend to reside in industries characterized by a transform industry IT strategic role and tend to be larger. Implications of these findings for research design are provided.

***Keywords**: IT signal, strategic signaling, research design*

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1. Introduction

Strategic signaling, as defined by scholars from a variety of organization science disciplines, refers to actions taken by individuals or organizations to influence the views – and ultimately the behaviors – of stakeholders, e.g., investors, investment analysts, customers, suppliers, partners, employees, competitors, etc. (Moore, 1992; Porter, 1980; Prabhu and Stewart, 2001). Strategic signals take many forms, but most often involve either verbalized/written messages or observable behaviors. Of the two, observable behaviors are generally more convincing because of their evidence content (Moore, 1992; Schelling, 1960). Still, verbalized/written strategic signals are regularly used, as they are inexpensive to produce, though not costless, relative to behaviors (Soberman and Gatignon, 2005) and have the potential to reveal information that could only be inferred from behaviors (Moore, 1992). Verbalized/written strategic signals generally take the form of announcements of intended actions or explanations regarding the outcomes of completed actions, and can involve a variety of transmittal mechanisms, i.e., press releases, annual reports, trade shows, press briefings, mass media advertising, trade journal advertisements, intra-company newsletters, customer newsletters, write-ups in industry publications, executive interviews, executive speeches, etc. (Herbig and Milewicz, 1996).

The construct *strategic signal* is consistent with this prior literature, perhaps best expressed by Porter (1980) as "… any action by a [firm] that provides a direct or indirect indication of its intentions, motives, goals, or internal situation… " (p. 75). In other words, a strategic signal carries an instrumentally-composed message from a signaler that stakeholders who gain access to te message then interpret. In this literature, referring to a transmitted message as a *strategic* signal reflects the instrumental nature of a signal rather than indicates that these signals only reference organizational strategies. In order to emphasize this instrumental character of transmitted messages, we will refer to them as signals rather than as strategic signals.

Information systems scholars have frequently used information technology (IT) signals, typically transmitted in the form of press releases, as proxies for firms' IT-related behaviors. For example, studies have used the content of press releases to examine firms' IT investment behaviors (Chatterjee et al., 2002; Dehning et al., 2003; Dos Santos et al., 1993; Im et al., 2001), B2B and B2C business initiatives (Subramani and Walden, 2001); ERP deployments (Hayes et al., 2001; Ranganathan and Brown, 2006), IT outsourcing initiatives (Hayes et al., 2000), establishment of the CIO position (Chatterjee et al., 2001), etc. Given this tradition of using IT signals to proxy for firms' IT-related behaviors, we found it surprising that little research had been directed toward examining firms' propensities to engage in IT signaling. Instead, scholars using press releases as proxies for firms' IT-related behaviors seem to implicitly assume that firms persist equally in transmitting IT signals. However, if systematic variation is found to characterize firms' propensities to engage in IT signaling, then research designs not accounting for such variation are likely to produce biased results. *The primary objective of this study is to determine if systematic variation exists regarding firms' IT signaling propensities.*

As noted, most information systems research utilizing IT signals has collected data through the use of organizations' press releases. Other organization science disciplines, however, have used organizations' annual reports to good effect in examining firms' communications with stakeholders (Arndt and Bigelow, 2000; Bettman and Weitz, 1983; Elsbach, 1994; Elsbach and Sutton, 1992; Fiol, 1995). With a few exceptions (Jarvenpaa and Ives, 1990, 1991; Broadbent and Weill, 1993; Chang, Jackson and Grover, 2003), information systems scholars have opted not to utilize annual reports as a data collection source – despite evidence (Arndt and Bigelow, 2000; Elsbach, 1994) from organization science research indicating that discussions of technology-related phenomena can prove especially effective in firms' efforts to influence stakeholders through annual reports. *A secondary objective of the study is to contrast the use of press releases and annual reports as vehicles for IT signaling.*

We begin by reviewing what is known about firms' choices to engage in strategic signaling and about the use of press releases and annual reports as signaling mechanisms. Then, we develop a set of research hypotheses explaining firms' propensities to engage in IT signaling. Next, we describe the data collection and analysis methods used in examining these research hypotheses, leading to a discussion of the study's findings and their implications.

2. Strategic Signaling

While marketing and management theorists have both expressed interest in firms' strategic signaling behaviors, their respective focus has been somewhat distinct. Within marketing, interest has predominately centered on the use of strategic signals in preannouncing intended actions. Within management, the focus has predominately been on the use of strategic signals to explain, justify or legitimize outcomes.

2.1. Signals as Instruments of Intended Actions

Preannouncements are appealing tools for marketing communications, as they represent a relatively fast and low cost means by which firms can signal intended actions to stakeholders (Calantone and Schatzel, 2000; Eliashberg and Robertson, 1988). Such signals provide firms with a number of potential benefits (Calantone and Schatzel, 2000; Eliasberg and Robertson, 1988; Heil and Robertson, 1991; Robertson et al., 1995):

- Preempt competitors by discouraging them from either following the firm's action or from engaging in a similar action.
- Develop opinion leadership and favorable word of mouth regarding the intended action and, in general, enhance the firm's image by building brand equity.
- Induce others to undertake actions that complement a firm's intended action, e.g., develop complementary products or services, assure ready supplies of materials or components, etc.
- Promote a consistent set of practices across an industry, e.g., regarding the conduct of pricing, advertising, discounting, etc.

Signals about intended actions are also subject to potential risks (Eliashberg and Robertson, 1988; Heil and Robertson, 1991): competitive queuing, where a signal stimulates retaliatory responses; product cannibalization; reputational damage, when the signal is unfulfilled; and anti-trust action.

Press releases are a popular signaling device to gain the attention of customers, inform suppliers, warn competitors, and deliberately leak information (Calantone and Schatzel, 2000; Herbig and Milwicz, 1996). Additionally, signals issued via press releases can be used to document behaviors undertaken in response to governmental, regulatory, and legal requirements. As press releases are subject to public and legal scrutiny, motivations for firms to bluff – which are real (Heil and Robertson, 1991) – are somewhat attenuated, thus, press releases maintain some sense of perceived accuracy and believability (Calantone and Schatzel, 2000).

2.2. Signals as Instruments of Explanation

Another communication tactic applied by managers to shape stakeholder perceptions involves providing "… explanations, rationalizations, and legitimation for activities undertaken in the organization…" (Pfeffer, 1981, p. 4). Early studies (Bettman and Weitz, 1983; Staw et al., 1983) examined the positive and negative causality associated with such events, finding internal attributions tended to be associated with positive events and external attributions tended to be associated with negative events. More recently, investigations of organizational responses to controversial events have gained insight into how organizations are able to shift attention away from an undesirable event toward more socially desirable goals or more widely accepted practices (Elsbach, 1994; Elsbach and Sutton, 1992). For example, Arndt and Bigelow (2000) examined how organizations structure accounts of potentially negatively-interpreted courses of action after they had occurred but before the reactions of important stakeholders were known. Of particular interest to the present study, both Elsbach (1994) and Arndt and Beigelow (2000) found that arguments based on technological grounds proved particularly effective in influencing stakeholders' willingness to accept a communicated message.

In this body of research, firms' *annual reports* have served as the primary source of data for their instrumental communications. The annual report provides not only an account of events but also the opportunity to shape stakeholders' perceptions of these events (Segars and Kohut, 2001). Examinations of firms' annual reporting practices indicate that the contents of annual reports are determined by two independently operating forces (Adams, 1997; Gibbins et al., 1990): ritualism, i.e., adhering to prescribed norms in disclosure practices; and opportunism, i.e., seeking firm-specific advantages from disclosure practices. Ritualism is primarily felt as constraints on annual report contents imposed through (Adams, 1997; Gibbins et al., 1990; Lev, 1992): regulatory and legal requirements along with public scrutiny; industry, peer group and competitor accounting and reporting practices; and firms' evolved and entrenched corporate reporting practices. Opportunism, as one might expect, can take many forms.

Further research suggests that the contents of annual reports are perceived as communicating reliable accounts of a firm's behaviors. Bowman (1978) found that a sample of firms characterized as "outstandingly responsible" appeared to accurately communicate current activities. Bettman and Weitz (1983) claimed that annual reports provide fairly comparable sets of data over time. Further, the amount of information voluntarily disclosed in the annual report is unlikely to vary substantially over time because of institutional forces and the observation that management's perceived credibility is largely a function of analysts and investors interpreting and assessing an organization's performance over the long term (Lev, 1992). In other words, managers are prone to exhibit disclosure practices that minimize surprises and mitigate adverse long-term effects on the firm's ability to raise market capital and generate new business (Adams, 1997).

3. Explaining a Firm's Propensity to Engage in IT signaling

Much has been written in both scholarly articles and the business press about the positive effects of IT-enablement on organizations, with a growing body of empirical evidence confirming positive effects when IT-enablement is well-targeted, well-configured, and well-implemented (Banker, Bardhan, Chang, and Lin 2006; Bharadwaj, Bharadwaj, and Bendoly 2007). As a consequence, opportunities are likely to exist for a firm's leadership to gain (or regain) favor with external stakeholders by communicating the firm's intentions to deploy IT in pursuing opportunities or overcoming challenges or by communicating successful outcomes associated with such deployments. It is for these reasons that a firm's leadership may be motivated to engage in IT signaling. Our research model explaining a firm's propensity to engage in IT signaling builds upon and extends prior work on firms' propensities to engage in signaling of all types.

Calantone and Schatzel (2000) and Heil and Robertson (1991) developed conceptual models that identify industry, firm-specific, and signal-specific drivers of firms' signaling behaviors. Subsequent empirical testing (Calantone and Schatzel, 2000) found that firms exhibiting higher levels of signaling tended to: be exposed to more dynamic industry structures/practices, be larger in size, display greater propensities for risk, and be seen by stakeholders as leaders within their industries. We expect the drivers of IT signaling to be similar. Accordingly, as depicted in Figure 1, we develop hypotheses associated with variables accounting for industry dynamics (industry IT strategic role), firms' risk propensities, and firms' relative performance within their industries (industry leadership), and we control for organization size. Additionally, we develop hypotheses regarding the nature of the IT-enablement being signaled (recognizing that different uses of IT may vary in their meaningfulness to stakeholders), and we control for firms' overall propensity to engage in signaling (information interactivity).

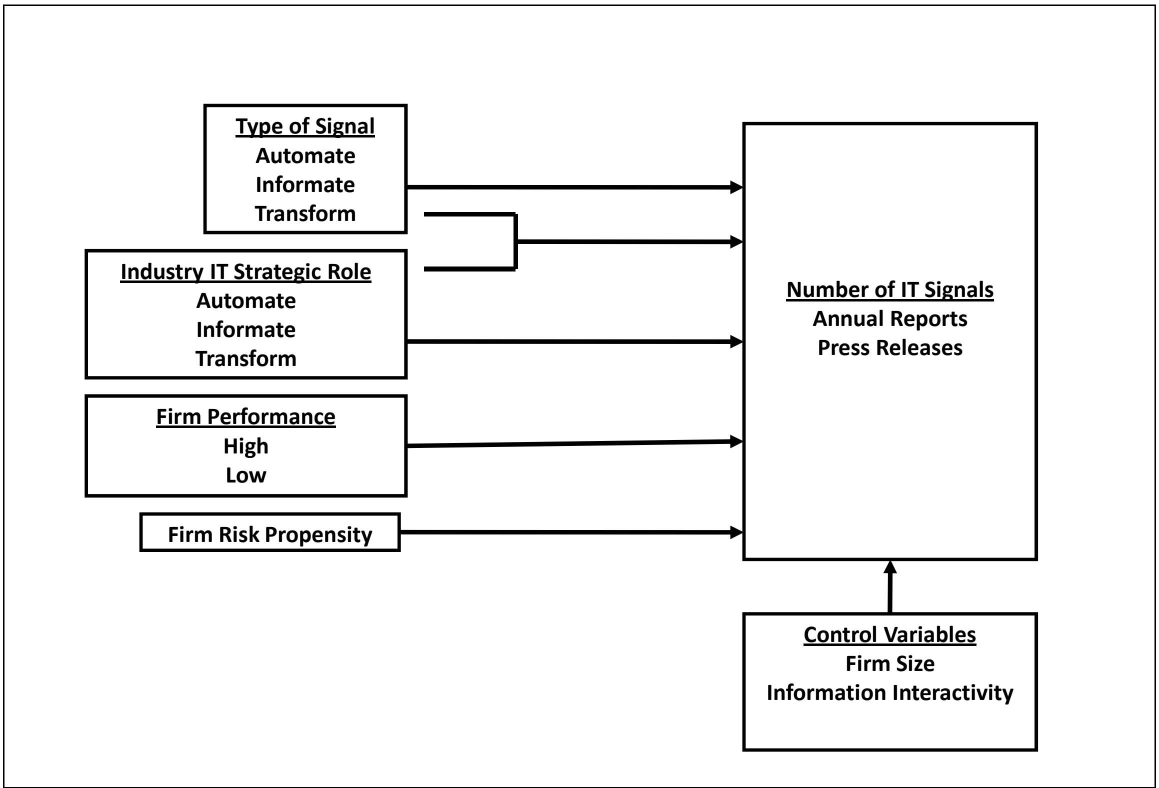

Figure 1. Research Model

3.1. Propensity to Engage in IT signaling

Our research model is intended to explain variation in firms' IT signaling behaviors. The dependent variable, thus, is the number of IT signals contained within transmitted press releases and within produced annual reports.

Type of Signal (Nature of the IT Deployment Being Signaled)

Firms engage in IT signaling as a means of influencing stakeholders' perceptions of the firms' current and future business capabilities and performance outcomes. It is clear from prior information systems research, however, that stakeholders' interpretations of IT deployments are influenced by the nature of these deployments (Kaarst-Brown, 2005; Tallon, Kraemer, and Gurbaxani, 2000).

Schein (1992) and Zuboff (1988) conceptualize the purposes that underlie a firm's IT use as: automate (using IT to reduce the role served by humans in carrying out work processes and otherwise improving work efficiency, speed, and productivity), informate-up (using IT to provide relevant, timely data and information to managers for analysis purposes, for control purposes, and for vertical coordination purposes), informate-down (using IT to provide relevant, timely data and information to employees for analysis purposes, for horizontal coordination purposes, and for empowerment purposes), and transform (using IT to significantly restructure business and/or industry practices, processes, and relationships for revenue growth and profitability purposes). Following earlier information systems research (Armstrong and Sambamurthy, 1999; Dehning et al., 2003), we combine the informate-up and informate-down categories in creating three categories of IT deployments: automate, informate and transform. Weill (1991) and Aral and Weill (2007) apply a very similar scheme for categorizing business-focused IT investment in their analyses of the relationships between IT investment and firm performance.

We expect the number of automate IT signals to exceed the number of informate or transform IT signals. As argued by Dao, Shaft, and Zmud (2009), most firms engage in limited IT innovation given associated risks (Dewan et al., 2007; Tanriverdi and Ruefli, 2004) and the ease by which successful IT innovations are often imitated by competitors (Dehning et al., 2003; Piccoli and Ives, 2005). Instead, most firms prefer to adopt technologies already proven effective by others, and most of these proven technologies when adopted have automate-like characteristics: pre-configured procedures and decisions rules are invoked with minimal human involvement through the use of digitized work processes. In other words, an IT innovation proven feasible and valuable by an industry technology leader is relatively quickly embedded within the product and service offerings of IT vendors and service providers and diffused to other industry participants. For example, a firm with industry-leading, IT-enabled logistics practices may use informate IT functionality to devise innovative IT-enabled logistical processes. Typically, however, such functionality is relatively quickly embedded within packaged logistical solutions and operationally applied by package adopters via these digitized business processes enabled through installed software packages. Thus, an IT deployment that initially surfaced as an informate-like logistics IT deployment diffuses to most firms as an automate-like logistics IT deployment. Another example of this phenomenon involves banking ATMs. When first introduced, ATMs were transformational in nature, as these technologies redefined the relationship between a bank and its customers and dramatically lowered the cost structure of many customer-focused business processes. But, as ATMs diffused throughout the banking industry, they relatively quickly came to be seen as a competitive necessity associated with the automation of customer transactions.

We also expect the number of transform IT signals to be less than the number of automate or the number of informate IT signals. Transform IT deployments are least likely to be undertaken due to their heightened risk (Henderson and Venkatraman, 1993; Hughes and Scott Morton, 2006), financial burden (Kobelsky et al., 2008; Kumar and Van Hillegersberg, 2000) and proclivity for implementation abandonment (Galliers and Baets, 1998).

Considered together, the above arguments lead to our first set of hypotheses:

> *Hypothesis 1a Greater numbers of IT signals will be observed for automate IT deployments than for informate IT deployments.*

> *Hypothesis 1b Greater numbers of IT signals will be observed for informate IT deployments than for transform IT deployments.*

Industry IT Strategic Role (Industry Dynamics)

Among the important forces determining a firm's beliefs/values regarding both its IT deployment and its external communication practices are institutional forces such as the actions and expectations of bodies such as regulatory agencies, industry consortiums, and market analysts as well as the ingrained business practices conditioned by dominant industry participants (Chiasson and Davidson, 2005; DiMaggio and Powell 1983). Here, we use the industry IT strategic role construct to represent distinctive industry-level contexts within which IT deployments occur.

The automate, informate, and transform categorization scheme has also been used in information system research to reflect the reality that the differing industry contexts present differential competitive opportunities and pressures that influence firms' IT deployment decisions (Andersom et al., 2006; Chatterjee et al., 2001; Dehning et al., 2003; Kobelsky et al., 2008). Generally, the more digitizable and the more dynamic are an industry's business processes, products, and services, the greater are the opportunities and pressures for firms in the industry to engage in a greater number of more innovative and ever-evolving IT deployments (Sambamurthy et al., 2003). As initially discovered by Chatterjee et al. (2001), firms in very dynamic industries whose business processes and product/service offerings are highly digitizable are likely to engage in seemingly continuous streams of IT deployments. Not infrequently, such IT deployments are integral to firm's efforts to introduce innovative, even transformative, changes in firm and industry structures, processes and practices. In such industries, IT is seen as serving a *transform industry IT strategic role*. At the other extreme, firms in relatively stable industries whose business processes and product/service offerings are either difficult to digitize or for whom digitization is difficult to justify are likely to engage in less frequent IT deployments, most of which are associated with incremental changes to firm and industry structures, processes, and practices. With these industries, IT is seen as serving an *automate industry IT strategic role*. Between these two extremes are firms in moderately dynamic industries with increasingly-digitizable business processes and product/service offerings. In addition to automation IT deployments, opportunities in these industries regularly arise to exploit IT functionality in archiving, analyzing, disseminating, and applying digitized data to inform employees' (as well as customers' or suppliers') actions. With these industries, IT is seen as serving an *informate industry IT strategic role*.

As noted from prior research on signaling, firms facing more turbulent competitive arenas (i.e., transform industries) are more likely to signal than firms facing less turbulent environments (i.e., informate and automate industries). While we know of no prior research examining firm propensities to engage in IT signaling, Dehning et al. (2003) have empirically observed that the business value implications of IT signaling are significantly greater for transform industries than for informate or automate industries. Dehning et al. (2003) attribute such a finding regarding transform industries to a greater incidence of opportunities about which to signal as well as a heightened meaningfulness of IT-enablement (and, hence, of signals indicative of IT-enablement) for stakeholders. Taken together, these prior research outcomes lead to a second set of hypotheses:

> *Hypothesis 2a Greater numbers of IT signals will be observed in transform industries than in automate industries.*

> *Hypothesis 2b Greater numbers of IT signals will be observed in transform industries than in informate industries.*

Interaction of Signal Type and Industry IT Strategic Role

In their study of the value relevance of IT investments, Dehning et al. (2003) observed that only transform IT investments produced significant investor reactions and that significant investor reactions occurred only for IT investments made by firms in transform industries. Applying the aforementioned arguments regarding more opportunities to signal (i.e., the likelihood of a greater number of transformative IT deployments about which to signal) and a greater likelihood that these signals (about transformative IT deployments) will prove meaningful to stakeholders of firms in transform industries, we anticipate that the propensity to transmit IT signals about transform IT deployments will be greatest for firms in transform industries:

> *Hypothesis 3a Greater numbers of signals about transform IT deployments will be observed for firms in transform industries than for firms in automate industries.*

> *Hypothesis 3b Greater numbers of signals about transform IT deployments will be observed for firms in transform industries than for firms in informate industries.*

Firm Performance

Most typically, information systems research utilizing IT signals as proxies for firms' IT-related actions has focused on examining the relationship between IT investment and firm performance (e.g., Chatterjee et al., 2002; Dehning et al., 2003; Dos Santo et al., 1993; Jarvenpaa & Ives, 1990). However, the relationship between IT investment and firm performance is anything but straightforward. It is increasingly evident that well-targeted, appropriately designed and complemented, and well-managed IT investments are associated with positive financial returns. However, what remains unclear is whether this association reflects the influence of IT investments on firm performance or the influence of firm performance on the availability of the resources needed for IT investments as well as to fund the building of the capabilities necessary to appropriate value from these investments (Dedrick, Gurbaxani, and Kraemer, 2003). Regardless of how such arguments play out in practice, high-performing firms are likely to possess more resources than low-performing firms -- resources that may enable both a greater incidence of IT deployments (and, hence, more opportunities for IT signaling) and a greater overall incidence of signaling.

High-performing firms, on the other hand, are less motivated to signal (Bannister and Higgins, 1991; Eliashberg and Robertson, 1988; Herbig and Milewicz, 1996) as the risks (e.g., information leaks, reputation loss, etc.) associated with exposing intentions and rationales are considerable for such firms. As low–performing firms have much less to lose and much more to gain (e.g., in terms of heightened customer, investor, and partner confidence) from IT signaling, we hold that this motivational argument will trump the opportunities argument. This produces a fourth hypothesis:

> *Hypothesis 4 Greater numbers of IT signals will be observed for low-performing firms than for high-performing firms.*

Risk Propensity

As reported earlier, Calantone and Schatzel (2000) found that firms with higher risk propensities signaled more than firms with lower risk propensities. A firm's risk propensity is conceptualized as the collective manifestation of senior managers' tendencies to take, rather than avoid, risk as reflected in the firm's decision cultures, structures, and behaviors (Grabowski and Roberts, 1999; Sitkin and Pablo, 1992). Firms whose management teams are characterized as having higher risk propensities are likely to mitigate the risks (Sitkin and Pablo, 1992) inherent in signaling appropriately (Eliashberg and Robertson, 1988; Heil and Robertson, 1991) and, consequently, likely to engage in greater signaling. This leads to the study's final hypothesis:

> *Hypothesis 5 Greater numbers of IT signals will be observed for firms holding higher risk propensities than for firms holding lower risk propensities.*

3.2. Control Variables

We include two control variables in the research model: firm size and firm information interactivity.

As discussed earlier, prior literature has noted the influence of firm size (Eliashberg and Robertson, 1988; Heil and Robertson, 1991) on firms' propensities to signal due to the slack and specialization advantages held by larger firms. However, an opposing perspective has also surfaced. Recognizing the more limited activity scope of smaller firms, theorists have argued that a signal might possess greater meaning for a smaller firm's stakeholders, as the intention or action being communicated may represent a more pervasive event for the smaller firm than might be expected for a larger firm (Eliashberg and Robertson, 1988). As we have no basis to compellingly argue for either a positive or negative size effect, we have chosen to account for size as a control variable rather than a predictor variable.

Our second control variable arises from the recognition that IT signaling is but one aspect of a firm's portfolio of signaling behaviors. Calantone and Schatzel (2000) have used the term information interactivity to refer to a firm's overall propensity to exchange information with its external environment. Firms characterized as exhibiting greater information interactivity would be expected to expend more resources in developing communication capabilities than would firms characterized as exhibiting less information interactivity – communication capabilities that could then be leveraged with regard to IT signaling. Thus, we account for a firm's overall tendencies to communicate with stakeholders by including information interactivity as the second control variable.

4. Research Methodology

To test our model, we used a theoretical sampling approach (Denzin, 1989) to select the firms included within the research design. The advantage of a theoretical sampling approach is that it ensures that theoretical constructs are adequately represented in the sample. A well-designed theoretical sampling procedure maximizes the chances of detecting the hypothesized relationships while ruling out an alternative explanation that any findings are due to either random noise or systematic bias in the data.

We examined the IT signaling propensities of high- and low-performing firms in three industries, each of which was selected to represent a distinct industry IT strategic role. To create measures of the IT signaling behaviors of these firms, we content analyzed communications (press releases and annual reports) associated with each firm's IT deployments over the 1996 -2000 time period. We selected this time period for four reasons. First, it represented the height of the "dot-com boom" – an era we expected firms in general would have been actively engaged in IT signaling. Second, this was also a time period in which most firms invested heavily in Internet-related technologies and in enterprise systems in order to build critical technology and business platforms (McAfee and Brynjolfsson, 2008); such investments would likely have been of interest to these firms' stakeholders. Third, the time period concludes prior to the technology bust of 2001, thereby excluding disruptive changes in firms' IT deployment patterns. Finally, an industry IT strategic role classification structure is available (Chatterjee et al., 2001; Dehning et al., 2003) for this time period.

4.1. Industry IT Strategic Role

We selected each of our three industries to represent a distinct industry IT strategic role using the classifications provided in Chatterjee et al. (2001), a categorization structure used successfully in a number of subsequent studies (Anderson et al., 2006; Dehning et al., 2003; Kobelsky et al., 2008). These classifications were based upon assessments made by four IT scholars, with an inter-rater reliability of .82, for the years 1995-1998. We constrained our selections by considering only industries with a sufficiently large number of participants (at least 30 firms within the COMPUSTAT database) in order to have confidence in our distinguishing of high- and low-performing firms within an industry. We selected primary metal manufacturing (METALS: NAICS code 331); specialty retailing (SPECRETAIL: NAICS codes 442 {Furniture and Home Furnishing Stores}, 448 {Clothing and Clothing Accessories Stores} and 4511 {Sporting Goods, Hobby, and Musical Instruments}); and financial services (FINANCE: NAICS code 523) to represent industries characterized, respectively, by the automate, informate, and transform industry IT strategic roles consistent with the Chatterjee et al. (2001) classifications.

4.2. Firm Performance

In order to identifying the high- and low-performing firms in each of the three industries, we considered only those firms in each industry that reported financial measures for at least four of the five years of data collection. For these firms, we computed performance metrics (using COMPUSTAT data) recommended by Standard and Poor's for each industry. We averaged these performance metrics over the data collection time period to emphasize sustained performance. We then used exploratory factor analysis (EFA) to reduce the number of indicators to an internally-consistent set. The factors were extracted using the principal factor method followed by a Promax (oblique) rotation retaining factors with an eigenvalue of at least 1. EFA yielded an immediate single-factor solution in the FINANCE and METAL industries. The EFA for the SPECRETAIL industry initially yielded a two-factor solution with one item (operating margin) cross-loaded on both factors; deletion of this variable resulted in a single-factor solution for the SPECRETAIL dataset.

We retained variables in the single-factor solutions for further analysis if they loaded on the factor at greater than 0.4 (Gorsuch, 1983). Using this criterion, four financial ratios loaded on a single performance factor for the metal production industry, and three each for specialty retail and financial services (Table 1). Using these factor loadings, we created a composite performance score for all firms in each industry. We then selected as our sample those firms in each industry with the five highest and the five lowest performance scores (listed alphabetically in Table 2). This sample size balances the need for a sample that is large enough to detect differences due to performance against the labor intensive nature of the content analysis undertaken to identify and classify IT signals in all firms' annual reports and press releases. Ranking the firms and classifying them as high- or low-performers was conducted by the fourth author and was blind to the other co-authors to limit possible bias during the IT signal coding process. Since our sample selection process eliminated the mid-range of firm financial performance for each industry, the firms in our sample represent only the extreme performers in each industry. Further, as our measures of firm performance were unique to each industry, it would have been inappropriate to include firm performance as a continuous variable across the three industries. Therefore, we model firm financial performance as a categorical (classification) variable in subsequent analyses.

Table 1. Single-Factor Items for Each Industry

Industry	Factor items	Loadings	Correlations	Cronbach's alpha
Automate (METAL)	Operating margin - before taxes	.96	.92	.90
	ROA	.79	.74	
	Gross margin	.79	.71	
	EPS	.78	.74	
Informate (SPECRETAIL)	ROI	.98	.91	.91
	ROA	.97	.89	
	Inventory turnover	.70	.69	
Transform (FINANCE)	Operating margin – before taxes	.97	.77	.82
	Operating margin	.94	.86	
	EPS	.47	.44	

Table 2. Firms For Each Industry

Automate (METALS)	Informate (SPECRETAIL)	Transform (FINANCE)
Alcoa	Bed Bath & Beyond	Atalanta Sosnoff Capital
Cold Metal Products	Charming Shoppes	Bear Stearns Companies
IPSCO	Chicos FAS	Capstead Mortgage Corp
Mueller Industries	Gap	Friedman, Billings & Ramsey R
NS Group	Harolds Stores	Lehman Brothers Holdings
Rouge Industries	Intimate Brands	Morgan Stanley Dean Witter
Texas Industries	Reeds Jewelers	Olympic Cascade Financial
Tredegar	Syms	Schwab (Charles)
Weirton Steel	TJX Companies	Stifel Financial
WHX Corp	Venator Group	Ziegler Company

4.3. Risk Propensity

A variety of measures have been used in prior research as indicators of organizational risk propensity including, but not limited to, debt-to-equity, long-term debt-to-equity, debt-to-assets, long-term debt-to-assets, and standard deviation of operating income (e.g., Waddock and Graves, 1997). From these, we selected debt-to-equity as our proxy for risk propensity for two reasons. First, of the measures we were able to identify in our literature review related to organization risk metrics, it was one of only two used in more than one study. Second, the only other measure that has been used multiple times was long-term debt-to-assets, which we deemed inappropriate for our cross-industry study, as asset levels are industry-dependent: Assets are a function not only of the underlying industry technology base (e.g ., asset investment is necessarily higher in the metals processing industry as compared to specialty re tailers) but also firms' depreciation strategies. Data regarding firms' debt-to-equity ratio were drawn fr om the COMPUSTAT database.

4.4. IT Signals

Variables that represent IT signals show up in two places in our research model: type of IT signal (automate, informate, or transform) serves as a predictor variable, and number of IT signals (for press releases and for annual reports) serves as the dependent variable. The automate-informate-transform IT signal categorization structure has been successfully used in prior research (Armstrong and Sambamurthy, 1999; Dehning et al., 2003) and is essentially the same as that used by Weill (1991) and Aral and Weill (2007).

Utilizing textual descriptions (as provided in press releases and annual reports) of our sampled firms' IT deployments is especially advantageous in coding type of signal, as these descriptions provide the contextual basis for understanding the "what, where, why and how" (e.g., the business objective being sought, complementary investments, use of legacy assets/capabilities, etc.) of specific IT deployments. Two examples demonstrate the importance of these contextual descriptions. First, a signal about an IT deployment applying Internet technology enabling customers to order products could be coded, as transform if this was a first-in-the-industry initiative aimed at growing new markets, as informate if the initiative provided customers with valuable but previously unavailable information about products prior to placing an order, or as automate if the objective of the initiative was primarily to make an existing ordering process more convenient and more efficient. Second, a signal about a new IT outsourcing arrangement could be coded as automate if the objective being sought through the arrangement was positioned as lowering costs, as informate if the objective being sought through the arrangement was an infusion of expertise from the IT services provider, or as transform if the objective being sought through the arrangement was to reorient the internal IT organization from an operational focus to a focus on facilitating value-creating business initiatives. As a result, we are confident that our coding process reflects inherent differences in the instrumental purposes of automate, informate, and transform IT deployments – differences crucial to message creation and interpretation. We summarize this coding process below; Appendix A contains the complete set of coding rules.

Press Releases

We employed a two-step coding process for press releases. In the first step, coders determined if the press release mentioned an IT deployment. We then examined only those press releases identified as pertaining to IT deployments in a second step to ascertain the type of IT deployment (automate, informate, or transform) being communicated. The full press release served as the coding frame, consistent with earlier studies of IT announcements (Chatterjee et al., 2001; Chatterjee et al., 2002; Dos Santos et al.,1993; Hayes et al. 2000; Hayes et al. 2001; Im et al. 2001). We coded press releases as a single type of IT signal, i.e., whether the description was interpreted as representative of an automate, an informate, or a transform IT deployment. Then, for each firm, we created a count of the total number of press releases reflecting each type of IT signal.

Annual Reports

We coded the contents of the firms' annual reports – specifically, the letter to shareholders and other materials prior to management's discussion and analysis of financial data. We excluded management's discussion and analysis of financial data because the IT issues discussed therein appeared to be "boilerplate," not changing much (if at all) from year to year. Further, we did not code statements related to Year 2000 preparedness, because we expected and observed little variance across firms: As annual report Year 2000 preparedness materials conformed to regulatory requirements, these statements were not indicative of IT deployments unique to a firm. Annual report paragraphs served as the coding frame. Thus, coders identified those paragraphs in the annual reports that contained statements about IT deployments and typed each identified paragraph as representing an automate, an informate, or a transform IT deployment. For each firm, we created a count of the number of paragraphs, or IT signals, associated with each type of IT deployment.

Coding Inter-Rater Reliabilities

Coding one firm at a time, the four coders independently assigned codes and then met to reach consensus and finalize the codes for a firm. We assessed inter-rater reliabilities using Cohen's Kappa (Table 3) by comparing each coder's initial code with the agreed upon final code. With one exception, the reliabilities reflect "substantial" (0.61-0.80) or "almost perfect (0.81-1.0) agreement (Landis and Koch, 1977). Coder 3's reliability for the Phase II coding of press releases reflects "moderate" agreement, due to a tendency to code IT deployments conservatively, i.e., 40 instances where coder 3 rated a press release as automate, when the consensus final code was either informate or transform.

Control Variables

Our initial research design specified the use of two control variables: firm size and information interactivity. As described below, these two variables proved highly correlated. Therefore, we created a single indicator, which we termed communication intensity.

Table 3. Inter-Rater Reliabilities			
	Press Releases Phase I (code/no code)	**Press Releases Phase II (IT Strategic role)**	**Annual Reports**
Coder 1	0.90	0.76	0.83
Coder 2	0.86	0.75	0.70
Coder 3	0.86	0.47	0.79
Coder 4	0.87	0.70	0.74

Numerous measures are used in information systems research to operationalize the firm size construct; and, due to its multidimensional nature, Goode and Gregor (2009) suggest the value of using multiple indicators. We chose to use number of employees and total sales because both are readily available,[1] and they encompass two of the three categories of indicators identified by Goode and Gregor (2009): sales/revenue and resource.[2] Further, both have been regularly used by organization science scholars in measuring firm size (Kimberly, 1976). We averaged the values of each indicator for each firm over the five years in our study. As these size measures tend to be positively skewed, we applied a log transformation.

To capture information interactivity, we measured each firm's overall intensity of signaling via press releases and via annual reports. For press releases, we counted the total number of press releases (over all topics: IT-related and non-IT) for each of the five years in our study and created an average for each firm. These data include all announcements included in the Business Wire and PR Newswire databases for which a firm was the source or was listed as a contact. For annual reports, we measured the size of the annual report by counting the number of lines contained in a firm's annual reports. We then created an average for the five years of data collection. Included in these counts was the CEO's letter to shareholders as well as the other materials prior to management's discussion and analysis of financial data, consistent with the content coded for statements related to strategic IT signals. Initially, both measures were distributed in a non-normal fashion. After conducting a log transformation on each measure, each conformed to a normal distribution.

Initial examination of the firm size and information interactivity variables revealed high inter-item correlations (.26 to .87). These relationships are not surprising, as larger firms are likely to have more business activities to describe and more resources to devote to communication activities. Therefore, we summed the standardized values of these four variables to create a new metric, termed communication intensity, to serve as a single control variable (Cronbach's $\alpha = 0.79$).

5. Analysis and Results

Descriptive statistics and correlations for the control, continuous independent, and dependent variables (per nature of the IT deployments) are provided in Table 4a and 4b.[3] Because we are interested in the overall relationship between firm performance and industry with propensity to signal, we aggregated the five years of data to create counts of the number of automate, informate, and transform IT signals. We present the counts, means, and standard deviations for the dependent variable organized by firm performance category and IT signaling channel (press release and annual report) in Tables 5a and 5b. Recall that there are 10 firms (five high-performing and five low-performing) for each of the three Industries.

We estimated two distinct models, one each for the press releases and the annual reports data sets, using the same design for both. Our dependent variable is the number of a particular type of IT signal (automate, informate, or transform), aggregated over the five years for which we collected data.

[1] Several of Goode and Gregor's (2009) measures require collecting primary data from organizational representatives.
[2] A third category was identified as "other," which includes more industry-specific indicators such as "patient days."
[3] Correlation tables for these variables segmented by the values of industry and firm performance category are available from the second author upon request.

Therefore, we have multiple observations per firm. Hence, type of IT signal (automate, informate, or transform) is included as an independent classification (categorical) variable and is modeled as a within-firm, repeated measure. Using this repeated design from 30 firms yields 90 observations for each signal channel (press release or annual report), with the overall study utilizing a total of 180 observations.

Table 4a. Press Releases: Descriptive Statistics and Correlations

	Mean (st. dev)	Comm Intensity	Risk Propensity	Automate Signal Count	Informate Signal Count	Transform Signal Count
Comm. Intensity	0 (3.12)	1.00				
Risk Propensity	5.37 (8.53)	0.31†	1.00			
Automate Signal Count	4.60 (18.93)	0.26	0.18	1.00		
Informate Signal Count	1.63 (6.18)	0.30	0.18	0.99****	1.00	
Transform Signal Count	1.33 (3.63)	0.37*	0.39*	0.95****	0.94****	1.00

† p < .1, *p<0.05, **p<0.01, ***p<0.001, ****p<0.0001

Table 4b. Annual Reports: Descriptive Statistics and Correlations

	Mean (st. dev)	Comm. Intensity	Risk Propensity	Automate Signal Count	Informate Signal Count	Transform Signal Count
Comm. Intensity	0 (3.12)	1.00				
Risk Propensity	5.37 (8.53)	0.31†	1.00			
Automate Signal Count	17.83 (32.09)	0.35†	0.34†	1.00		
Informate Signal Count	4.57 (6.69)	0.45*	0.43*	0.76****	1.00	
Transform Signal Count	2.20 (4.45)	0.54**	0.56**	0.77****	0.60***	1.00

† p < .1, *p<0.05, **p<0.01, ***p<0.001, ****p<0.0001

The model includes two additional independent, classification variables: firm financial performance (high or low) and industry IT strategic role (automate - metals, informate - specialty retail, or transform - financial services) for each firm. The final independent variables, communication intensity and risk propensity, are modeled as random variables because they are continuous. This design leverages our theoretical sampling approach and uses multiple observations per firm, which provides us with greater power than a study utilizing a single observation per firm.

As the dependent variable in our study is a count of number of IT signals for each category, we needed a technique that would account for the deviation from normality and discrete nature of these data. Therefore, we used generalized linear modeling, which models the log of the expected count as a linear function of the independent variables. Generalized linear modeling extends the traditional linear model, making it applicable to a wider range of data analysis problems, such as counts consistent with our data (McCullagh and Nelder, 1989). We fit our data using SAS PROC GENMOD. We specified a negative binomial regression because our dependent variable (number of signals) is over-dispersed (i.e., the variance is greater than the mean) (Littell et al., 2002). Due to the repeated

Table 5a. Press Releases: Signal Counts, Means and (Standard Deviations)

	High Performers				Low Performers				All Firms			
Industry	Automate	Informate	Transform	All Signals	Automate	Informate	Transform	All Signals	Automate	Informate	Transform	All Signals
Automate (Metal)	1 0.2 (.45)	2 0.4 (.55)	0 0 (0)	3 0.6 (.89)	0 0 (0)	0 0 (0)	1 0.2 (.45)	1 0.2 (.45)	1 0.1 (.32)	2 0.2 (.42)	1 0.1 (.32)	4 0.4 (.70)
Informate (Retail)	4 0.8 (.84)	7 1.4 (1.34)	1 0.2 (.45)	12 2.4 (2.07)	3 0.6 (.89)	1 0.2 (.45)	3 0.6 (1.34)	7 1.4 (2.61)	7 0.7 (.82)	8 0.8 (1.14)	4 0.4 (.97)	19 1.9 (2.28)
Transform (Financial)	15 3 (4.12)	5 1 (1.22)	12 2.4 (2.61)	32 6.4 (7.7)	115 23 (45.42)	34 6.8 (15.21)	23 4.6 (8.11)	172 34.1 (68.67)	130 13 (32.19)	39 3.9 (10.62)	35 3.5 (5.80)	204 20.4 (48.37)
All Industries	20 1.33 (2.58)	14 0.93 (1.10)	13 0.87 (1.81)	47 3.13 (4.97)	118 7.87 (26.70)	35 2.33 (8.76)	27 1.8 (4.86)	180 12 (40.23)	138 4.6 (18.93)	49 1.63 (6.18)	40 1.33 (3.63)	227 7.57 (28.52)

Table 5b. Annual Reports: Signal Counts, Means and (Standard Deviations)

	High Performers				Low Performers				All Firms			
Industry	Automate	Informate	Transform	All Signals	Automate	Informate	Transform	All Signals	Automate	Informate	Transform	All Signals
Automate (Metal)	14 2.8 (4.09)	22 4.4 (4.93)	4 0.8 (1.30)	40 8 (9.3)	10 2 (2.92)	7 1.4 (.89)	5 1 (2.24)	22 4.4 (3.36)	24 2.4 (3.37)	29 2.9 (3.70)	9 0.9 (1.73)	62 6.2 (6.86)
Informate (Retail)	70 14 (11.07)	5 1 (1.22)	1 0.2 (.45)	76 15.2 (11.78)	55 15.24 (2.13)	25 5 (5.24)	6 1.2 (1.79)	86 17.2 (18.61)	125 12.5 (12.66)	30 3 (4.16)	7 0.7 (1.34)	162 16.2 (14.72)
Transform (Financial)	119 23.8 (26.07)	36 7.2 (8.81)	29 5.8 (7.56)	184 36.8 (38.94)	267 53.4 (64.07)	42 8.4 (11.72)	21 4.2 (6.69)	330 66 (81.75)	386 38.6 (48.68)	78 7.8 (9.80)	50 5 (6.78)	514 51.4 (62.3)
All Industries	203 13.53 (17.69)	63 4.2 (6.04)	34 2.27 (4.86)	300 20 (25.65)	332 22.13 (42.19)	74 4.93 (7.49)	32 2.13 (4.17)	438 29.2 (52.60)	535 17.83 (32.09)	137 4.57 (6.69)	66 2.2 (4.45)	738 24.6 (40.92)

measure nature of our data (type of IT signal), we utilized generalized estimating equations (GEE) to estimate the specific effects. When using GEE, a working correlation matrix can be computed using one of several structures to account for the composition of the data. We specified an exchangeable (compound symmetry) structure for the working correlation matrix due to the repeated measures nature of our data.

Table 6a. Statistics for Type 3 GEE Analysis for Press Releases Signals

	Model 1			Model 2			Model 3		
	df	Chi-Square	Pr > Chi-Square	df	Chi-Square	Pr > Chi-Square	df	Chi-Square	Pr > Chi-Square
Communication Intensity	1	1.91	.17	1	3.64	*.06*	1	6.36	*.07*
Signal Type				2	2.02	.36	2	.52	.75
Industry Strategic IT Role				2	6.20	**.05**	*2*	6.22	**.05**
Firm Performance				1	2.79	*.09*	1	1.20	*.09*
Firm Risk Propensity				1	6.48	**.01**	1	.69	**.02**
Signal Type*Industry IT Role							4	6.22	.17
Criteria for Assessing Goodness of Fit									
Pearson Chi-square	154.88			78.44			66.94		
df	88			82			78		
Pearson/df	1.76			.96			.86		
Log likelihood	445.67			472.75			474.78		

We present results in Table 6a (parameter significance levels and fit statistics) and Table 6b (parameter estimates) for press release signals and, correspondingly, in Tables 7a and 7b for annual report signals. For both sets of signals, Model 1 presents the results for the control variable. Model 2 includes the control variable and main effects. The Pearson Chi-square provides an assessment of how well a model fits the data. However, it does not consider the degrees of freedom (number of parameters) included in the model. Therefore, we rely upon the Pearson Chi-square/df as an indicator of model fit; a Pearson/df close to 1.0 indicates good fit (McCullagh and Nelder, 1989). The decrease in Pearson/df observed for Model 2 compared to Model 1 indicates that the model fit improves, even when the additional degrees of freedom are considered. Finally, in Model 3 we add the interaction terms consistent with our theoretical model. For Press Release signals, model fit improves slightly when the interaction terms are added. Model fit does not improve for the annual reports signals, but the fit value, although above one, does not provide evidence of a lack of fit (Littell et al., 2002).

To interpret the parameter estimates presented in Tables 6b and 7b, as generalized linear modeling is used, the parameter estimates reflect the link function (in this case cumulative logit, the default when the negative binomial is the specified distribution of the dependent variable) used to estimate the transformed dependent variable. The direction of the parameter estimate and magnitude of the influence of the parameter relative to other parameters can be interpreted consistent with the more familiar linear regression. However, one cannot directly interpret the magnitude of influence on the actual counts (i.e., a parameter estimate of "2" does not indicate that each unit increase in the independent variable doubles the number of counts reflected in the dependent variables).

Table 6b. Parameter Estimates for Press Release Signals

Parameter	Estimate	Standard Error	P > | Z |
Intercept	-1.15	0.60	.05
Communication Intensity	0.67	0.10	<.0001
Automate	0.86	0.66	.19
Informate	0.86	0.70	.20
Transform	0.00	0.00	.
Finance	2.50	0.73	<.001
Metals	-1.40	1.17	.23
Specialty Retail	0.00	0.00	.
High Performers	-1.34	0.53	.01
Low Performers	0.00	0.00	.
Firm Risk Propensity	-0.05	0.02	.02
Automate* Finance	-0.20	0.82	.81
Informate* Metals	-1.04	1.56	.5
Transform* Specialty Retail	0.00	0.00	.
Automate* Finance	-1.41	0.83	.09
Informate* Metals	-0.26	1.43	.85
Transform* Specialty Retail	0.00	0.00	.
Automate* Finance	0.00	0.00	.
Informate* Metals	0.00	0.00	.
Transform* Specialty Retail	0.00	0.00	.

Table 7a. Statistics for Type 3 GEE Analysis for Annual Reports Signals

	Model 1			Model 2			Model 3		
	df	Chi-Square	Pr > Chi-Square	df	Chi-Square	Pr > Chi-Square	df	Chi-Square	Pr > Chi-Square
Communication Intensity	1	3.55	*.06*	1	6.05	**.01**	1	5.37	**.02**
Signal Type				2	14.54	**.01**	2	-	[4]-
Industry Strategic IT Role				2	5.94	**.05**	*2*	6.03	**.05**
Firm Performance				1	4.15	**.04**	1	3.63	*.06*
Firm Risk Propensity				1	.04	.84	1	.00	.98
Signal Type*Industry IT Role							4	8.38	*.08*
Criteria for Assessing Goodness of Fit									
Pearson Chi-square	135.42			92.25			98.78		
df	88			82			78		
Pearson/df	1.54			1.13			1.27		
Log likelihood	1615.58			1649.83			1653.72		

[4] The GEE Type 3 test failed to converge on an estimate for this effect. Therefore, we repeated the analysis using the more computationally efficient Wald statistic, which indicates that type of signal is statistically significant ($\chi^2_2 = 60.87$, $p < 0.0001$). Because the significance level for Wald statistics may be less accurate than those computed for Type 3 tests, we report the GEE Type 3 results for the other effects. All effects found to be significant via the Type 3 estimates also are significant using the Wald statistic.

Table 7b. Parameter Estimates for Annual Report Signals			
Parameter	Estimate	Standard Error	P > | Z |
Intercept	-0.33	0.49	.50
Communication Intensity	0.28	0.04	< .0001
Automate	3.11	0.45	<.0001
Informate	1.51	0.44	<.001
Transform	0.00	0.00	.
Finance	1.77	0.58	.002
Metals	0.19	0.66	.77
Specialty Retail	0.00	0.00	.
High Performers	-0.78	0.36	.03
Low Performers	0.00	0.00	.
Firm Risk Propensity	-0.00	0.02	.97
Automate*Finance	-0.87	0.58	.13
Informate*Metals	-1.69	0.87	.05
Transform*Specialty Retail	0.00	0.00	.
Automate*Finance	-0.78	0.65	.23
Informate*Metals	-0.10	0.78	.90
Transform*Specialty Retail	0.00	0.00	.
Automate*Finance	0.00	0.00	.
Informate* Metals	0.00	0.00	.
Transform*Specialty Retail	0.00	0.00	.

Because three levels of type of signal and of industry IT strategic role occur in our model, we test Hypotheses 1-3 using planned (*a priori*) comparisons via contrast coding. Contrast coding is particularly useful when more than two levels of a factor are present in a research design and also facilitates investigation of interaction effects because it allows researchers to test specific predictions (Winer et al., 1991). Essentially, contrast coding allows the researcher to conduct a test that includes only those levels of factors that are relevant to the hypothesis. Buckless and Ravenscroft (1990) provide a discussion of contrast coding in behavioral analyses, and examples of contrast coding are found in Irwin's (2002) study of reuse in object-oriented system development.[5] We tested each hypothesis for each signal channel (press releases and annual reports) using the contrast coding presented in Appendix B. A summary of the results obtained for the contrast analyses is presented in Table 8.

Hypothesis 1a argues that automate IT signals will be more prevalent than informate IT signals, while Hypotheses 1b argues that informate IT signals will be more prevalent than transform IT signals. Hypothesis 1a and 1b are not supported for press release signals: The number of automate IT signals did not differ significantly from informate signals (H1a) nor did the number of informate signals exceed transform signals (H1b) ($p > .1$ for both). Examining Table 5a suggests a possible explanation: The very low levels of signaling via press releases by automate and informate firms reduce the likelihood of detecting differences. Hypothesis 1, however, is supported for annual report signals: Automate IT signals exceed informate signals (H1a: $p < 0.01$), and informate IT signals exceed transform IT signals (H1b: $p < 0.01$). Overall for press releases, automate IT signals accounted for 61 percent of the signals, informate for 21 percent, and transform for 18 percent. Overall for annual reports, automate IT signals accounted for 72 percent of the signals, informate for 19 percent and transform for 9 percent.

The second set of hypotheses argues that a greater number of signals will be observed for firms in the transform *industry* as compared to automate or informate industries. Similar to Hypotheses 1a and 1b, we specified two contrasts and tested this specification for each signal channel. For press release signals, both tests are statistically significant: There were more transform industry signals compared to the automate industry (H2a: $p < .02$) and to the informate industry (H2b: $p < .02$). For

[5] See Blomquist (1995) for an explanation on writing contrasts in SAS or SPSS.

annual report signals, both tests were statistically significant and showed the same pattern: more transform *industry* signals compared to the automate industry (H2a: $p < 0.02$) and to the informate industry (H2b: $p < 0.03$). Thus, Hypotheses 2a and 2b are supported for both signal channels. Overall, the transform industry firms accounted for 90 percent of the press release IT signals and 70 percent of the annual report IT signals.

Table 8. Results For Contrast Analyses

Contrast		***Press Releases***		***Annual Reports***	
	DF	*Chi-Square*	*P > Chi-Square*	*Chi-Square*	*P > Chi-square*
H1a: Greater numbers of IT signals will be observed for automate IT deployments than for informate IT deployments.	1	.10	.753	8.40	.004
H1b: Greater numbers of IT signals will be observed for informate IT deployments than for transform IT deployments.	1	.43	.517	8.18	.004
H2a: Greater numbers of IT signals will be observed in transform industries than in automate industries.	1	5.53	.019	6.12	.013
H2b: Greater numbers of IT signals will be observed in transform industries than in informate industries.	1	5.53	.019	5.27	.022
H3a: Greater numbers of signals about transform IT deployments will be observed for firms in transform industries than for firms in automate industries.	1	9.19	.002	6.45	.011
H3b: Greater numbers of signals about transform IT deployments will be observed for firms in transform industries than for firms in informate industries.	1	8.95	.003	7.43	.006

Hypotheses 3a and 3b argue that the number of transform IT signals will be greater for *firms* in the transform industry compared to automate or informate industries. We coded two contrasts for each signal channel, similar to the process used for the previous hypotheses, and all are supported. For press release signals, the number of transform IT signals is greater for *firms* in the transform industry than in the automate industry (H3a: $p < 0.01$) or informate industry (H3b: $p < 0.01$). For annual report signals, the number of transform IT signals is greater for *firms* in the transform industry than in the automate industry (H3a: $p < 0.02$) or informate industry (H3b: $p < 0.01$). Thus, Hypotheses 3a and 3b are strongly supported for both annual reports and press releases. Overall, transform industry firms accounted for 87 percent of the transform IT signals contained in press releases and 76 percent of the transform IT signals contained in annual reports.

The fourth hypothesis argues that low-performing firms will transmit more IT signals than will high-performing firms. The results reported in Tables 6a and 7a assume a two-sided test. However, as Hypothesis 4 specifies direction, a single-sided test is appropriate. Hence, to test this hypothesis, the p-values reported by SAS should be halved. Therefore, the results indicate that the relationship between firm performance and number of signals is significant for both press releases ($p < .05$) and annual report signals ($p = .03$). Examination of the parameter estimates confirms that the relationship directions are as expected. Overall, the low-performing firms accounted for 79 percent of the press release IT signals and 59 percent of the annual report IT signals.

Hypothesis 5 argues that the higher a firm's risk propensity, the greater the number of IT signals that will be transmitted. Risk propensity is found to be a significant factor with regard to press releases.

However, the relationship is not in the direction we anticipated (Table 6b). Lower levels of risk propensity were associated with greater levels of IT signaling. Risk propensity does not appear to have a relationship with the amount of annual report IT signals. Hence, Hypothesis 5 is not supported.

6. Limitations

As with any study, there are limitations to be noted. First, we selected a single industry to represent each industry IT strategic role. However, because our sample was selected using a theoretical sampling approach (Denzin,1989), we ensured each industry IT strategic role was represented. Second, while we sampled only 10 firms from each industry, these were selected so as to maximize the distinction between high- and low-firm performance – a key issue in the research design and regarding which our analyses revealed having a significant influence in the likelihood of a firm engaging in IT signaling. Third, while the collected data spans only a five-year period, this time period was carefully established and produced 965 IT signals for coding – a very large sample for any study applying content analysis. Fourth, while our research design is ignorant of managers' *a priori* intentions regarding each of the IT deployments described in these firms' press releases and annual reports, we have relied on a rigorous coding procedure and multiple coders to increase the validity of the classifications.[6] Fifth, in the coding procedure (see Appendix A), when statements about an IT deployment might be interpreted as inferring multiple types (e.g., automate and informate), we chose to be conservative and coded only the higher type (e.g., informate). Typically, in such instances the "lower" type was described (explicitly or implicitly) as enabling the "higher" type, with the primary message communicated focused on the "higher" type. Thus, this coding procedure eliminated a few automate and informate signals. Finally, a reader might consider the correlations among the counts of the number of IT signals of each type (automate, informate, and transform) as a limitation. However, by modeling these as a within-firm variable and using the working correlation matrix as described earlier, the analysis accounts for the correlation among these measures.

7. Discussion and Implications

The results of our study's hypotheses testing are summarized in Table 9. The discussion that follows begins by addressing the two questions that motivated the study: does systematic variation exist across firms' IT signaling behaviors, and does systematic variation exist in firms' use of press releases and annual reports as the signaling medium? For each of these issues, we discuss the implications of our findings for research design. Next, we discuss what we have learned about explaining firms' propensities to engage in IT signaling. Finally, we discuss the implications of our findings to practice.

7.1. Does Systematic Variation Exist Across Firms' IT Signaling Behaviors?

Through a very rigorous research design, we constructed a sample that distinguished firms regarding their industry IT strategic role and relative performance within the industry, controlling for a firm's size and overall propensity to communicate with external stakeholders. Given our findings, it seems clear that firms are *not* equally likely to engage in IT signaling.

Industry IT Strategic Role

As hypothesized, firms in the transform industry engaged in significantly more IT signaling than firms in the automate or informate industries. Further, again as hypothesized, firms in the transform industry transmitted a greater number of signals about transform IT deployments than firms in automate or informate industries. These findings are important given that prior research has observed that the value relevance of IT signals is greatest with signals describing transform IT deployments and when the signals come from firms in a transform industry (Dehning et al., 2003). If

[6] Evidence supporting the validity of our signal coding is found in the results of a companion study (available from the authors on request) that finds significant relationships – consistent with those observed by Aral and Weill (2007) – between automate, informate and transform (annual report) signals and pre-specified firm performance metrics.

firms in transform industries signal more about their IT-related activities and signal more especially about (potentially) transformative activities, then collected samples of IT signals are prone to be overrepresented by firms in transform industries – that is, in more dynamic, information-intensive industry contexts where both the opportunity to signal about IT activities and the value-relevance of these activities are highest. *Unless industry IT strategic role (or, an associated construct) is accounted for in research designs, it is likely that a bias will be present that inflates relationships between the IT activities being signaled and organizational outcomes.*

Table 9. Summary of Results

Hypothesis	***Press Releases***	***Annual Reports***
H1: Greater numbers of IT signals will be observed for automate IT deployments than for informate IT deployments, which in turn will be associated with a greater number of IT signals than will transform IT deployments.	*Not Supported*	*Supported*
H2: Greater numbers of IT signals will be observed in transf orm industries than in automate or informate industries.	*Supported*	*Supported*
H3: Greater numbers of signals about transform IT deploym ents will be observed for firms in transform industries than fo r firms in automate or informate industries.	*Supported*	*Supported*
H4: Greater numbers of IT signals will be observed for low-performing firms than for high-performing firms.	*Supported*	*Supported*
H5: Greater numbers of IT signals will be observed for firms holding high risk propensities than for firms holding low risk propensities.	*Not Supported*	*Not Supported*

Firm Performance

As hypothesized, low-performing firms engage in more IT signaling than do high-performing firms. It can be argued, in general, that low-performing firms are less endowed with capabilities, including IT capabilities, than are high-performing firms. Correspondingly, firms with greater IT capabilities are likely to be more effective in targeting IT activities and in realizing the anticipated outcomes from these activities. If high-performing firms signal less often about their IT activities, then the firms most likely to realize anticipated benefits from these activities are prone to be underrepresented in collected samples of IT signals. *Unless firm relative industry performance is accounted for in research designs, it is likely that a bias will be present that deflates relationships between the IT activities being signaled and organizational outcomes.*

Post-Hoc Analyses

If a particular industry context was driving our results, it could be regarded as a limitation of our research design that might limit the generalizability of our findings. While our examinations of Hypotheses 2 and 3 explicitly examined industry effects, our examinations of Hypotheses 1 (type of signal), 4 (firm performance), and 5 (risk propensity) did not. Therefore, we conducted post-hoc analyses to further investigate this possibility.

With regard to Hypothesis 1, if a particular industry context was exerting a dominating influence on the nature of the IT signals being transmitted, we should have observed a statistically significant interaction between signal type and industry IT strategic role. Recall that for press releases this interaction is not statistically significant ($p = .17$), and for this data we can rule out the possibility that a specific industry is driving the findings related to Hypothesis 1. For annual reports, the interaction between IT signal type and industry is marginally statistically significant (p=.08). Therefore, we graphed the cell means for this interaction (as reported in Table 5b) and tested for differences between cell means (Table 10).

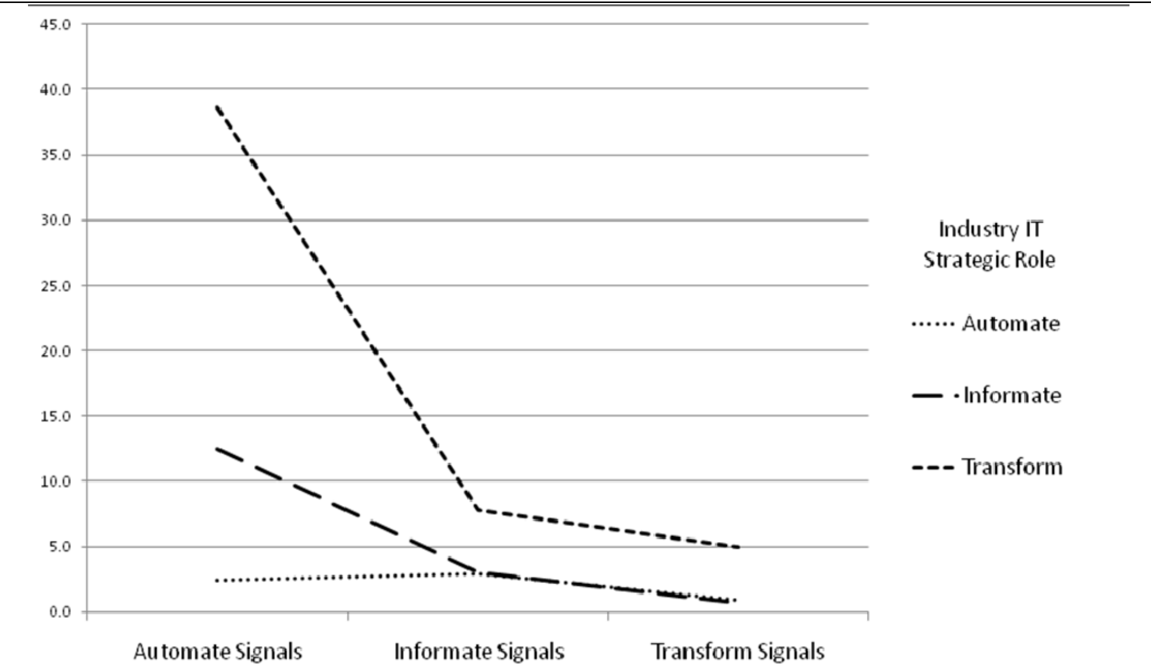

Figure 2. Interaction between Type of Signal and industry IT Strategic Role (Annual Report)

Table 10. Test for Differences Between Type of Signal and Industry IT Strategic Role (Annual Reports)

Industry	Automate Signals	Informate Signals	Transform Signals
Automate	2.4	2.9	.9
Informate	12.5	3.0	.7
Transform	38.6	7.8	5.0

To understand Table 10, note that the endpoints of each line join cells with statistically significant differences between means (solid lines signify differences a p < .05; dotted lines p < .01).[7] We considered only "meaningful" comparisons (i.e., within industry or across a particular type of signal – so, for instance, we were not concerned with differences between automate signals in the informate industry vs. informate signals in the transform industry). Recall that Hypothesis 1 argued that more automate signals would be observed than informate signals and more informate than transform. The post-hoc analyses revealed that the informate industry's signaling behaviors are fully consistent with Hypothesis 1, and the other industries' signaling behaviors are partially consistent. When one

[7] Although the absolute difference between the cell means for informate signals in the automate and transform industries exceeds that of the informate and transform industries, because each pairwise comparison relies upon a unique estimate of standard error, only the difference between the informate and transform industries is statistically significant. A similar circumstance occurs in the automate industry.

considers these results and recalls that the interaction between Type of Signal and Industry IT Strategic role was not statistically significantly for press release data, it does not appear that a single industry is driving the results with regard to Hypothesis 1.

To further investigate our findings with regard to Hypothesis 4, we conducted a *post hoc* examination for a relationship between Industry IT strategic role and firm performance to investigate if an interaction between these variables influenced signaling behavior. To do so, we included an interaction term for Industry IT strategic role and firm performance in our models. For annual report signals, the interaction term was not significant ($p = .31$); however, the interaction term was significant for press release signals ($p<.0001$). (It should be noted that in order to achieve model convergence for the press release data, we used Wald parameters as estimates, which are considered permissive. Hence, the following results should be regarded as exploratory.) We present a graph of the interaction below.

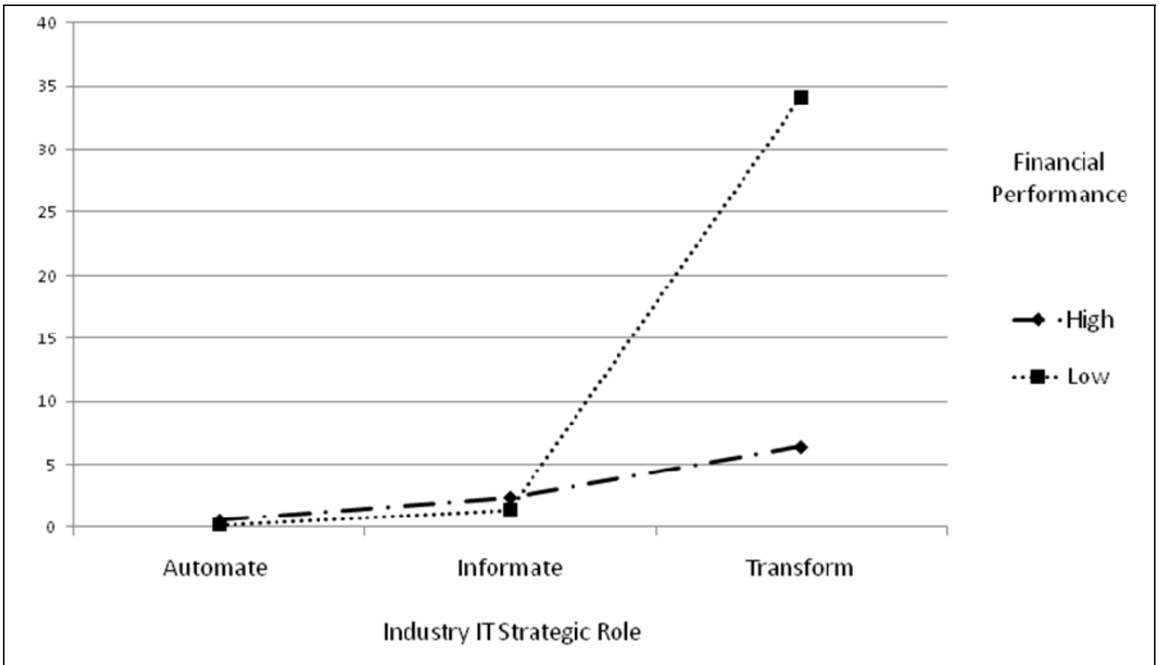

Figure 3. Interaction between Financial Performance and Industry IT Strategic Role (Press Release)

Our data clearly reveals that low-performing firms in the transform industry signaled more frequently than other firms. Given that press releases have been the dominant source of IT signaling data in previous information systems research examining the relationship between IT investment and firm performance, this exploratory finding suggests that industry IT strategic role and firm performance should *both* be accounted for in research designs examining the relationships between signals of IT activities and anticipated organizational outcomes.

Finally, the fifth research hypothesis positing that firms characterized by higher risk propensity would transmit a greater number of IT signals than firms characterized by lower risk propensity was not supported. Instead, our findings indicate that firms with *higher* levels of risk propensity transmit fewer strategic IT signals via press releases (the findings with respect to annual report IT signals were not significant). Recall, however, that the zero-order correlation between risk propensity and the number of each type of IT signal was positive for press release signals (refer to Table 4a), though significance occurred only with transform signals. Given this anomaly, we suspected that an unhypothesized – and therefore unaccounted for – effect was influencing the relationship between risk propensity and number of signals.

To isolate the factor(s) that might be contributing to our unexpected finding regarding press release signals, we next ran our estimation model with risk propensity and only one of the other independent variables. With these *post hoc* analyses, the only variable that led to a negative parameter estimate for risk propensity was industry IT strategic role – isolating this variable as the factor most likely producing the unexpected direction of the parameter estimate for risk propensity. We then re-ran the full estimation model with the addition of an interaction between risk propensity and industry IT strategic role. While this interaction was statistically significant (p = .02) and the parameter estimate for risk propensity was positive (as originally hypothesized), the main effect for risk propensity was not statistically significant. To aid in interpreting this finding, the correlations between risk propensity and the number of each type of signal within the industry IT strategic roles are displayed in Table 11. Note that these correlations are positive for the specialty retail industry, negative for the metals industry and mixed for the financial services industry. Industry effects are clearly present, indicating that the relationship between risk propensity and IT signaling propensity is far more complex than initially conceptualized. We strongly encourage future research that focuses specifically on examining how risk propensities vary across industries and subsequent relationships between these industry-specific risk contexts, various IT-related behaviors, and the outcomes associated with these behaviors.

Table 11. Correlations between Risk Propensity and Number of Signals (Press Releases)

	Automate Signals	Informate Signals	Transform Signals	All Signals
Financial:				
Risk Propensity	-0.03	0.02	0.19	0.01
p-value	0.94	0.95	0.61	0.98
Metals:				
Risk Propensity	-0.06	-0.22	-0.20	-0.25
p-value	0.86	0.55	0.58	0.49
Specialty Retail:				
Risk Propensity	0.61	0.50	0.35	0.62
p-value	0.06	0.14	0.32	0.06

7.2. Does Systematic Variation Exist Across Firms in their Use of Annual Reports and Press Releases as Vehicles for IT Signaling?

As mentioned earlier, most studies examining firms' IT signaling behaviors have used press releases as the primary data source. As seen in Tables 5a and 5b, the sampled firms transmitted a much larger number of IT signals through annual reports than through press releases (738 vs. 227). This is not entirely surprising given, as noted earlier, that annual reporting practices are likely to be less idiosyncratic (i.e., annual reports are mandated, but press releases are not, and annual reporting practices are more likely influenced by institutional forces (Adams, 1997; Gibbins et al., 1990; Lev, 1992)) and that technically-oriented arguments have been shown to be particularly effective in annual reports (Arndt and Bigelow, 2000; Elsbach, 1994).

Examinations of firms' annual reports are, thus, likely to produce more IT signals than observed with press releases. In addition, the finding that Hypothesis 1 was not supported with press releases but was supported with annual reports suggests that IT signaling via press releases may be biased toward the transmittal of signals perceived by senders as likely to have a greater effect on receivers (i.e., greater proportions of informate and transform IT signals and a greater proportion of IT signaling by the transform industry firms), and hence, less representative of firms' actual IT deployment portfolios. Thus, we encourage information systems scholars to consider the use of annual reports as a source of data for IT-related activities, especially if the sampling intent is to capture realistic portrayals of firms' IT activities.

7.3. Explaining Firms' Propensities to Engage in IT signaling

For the most part, the results are supportive of the research model developed to explain variation in firms' IT signaling propensities. Certain of the observed significant predictor variables were similar to those Calantone and Schatzel (2000) found to explain signaling propensities in a marketing context: industry dynamics and organization size. Interestingly, we observed two predictor variables to behave differently within an IT-related context than in a marketing context: we observed an organization's industry leadership (relative firm industry performance) to be negatively related to IT signaling propensity; and observed an organization's risk propensity to have a non-significant relationship with IT signaling propensity. We interpreted the finding regarding relative firm industry performance in terms of high-performing firms having less motivation than low-performing firms to inform stakeholders (especially competitors) of their IT activities. We explained the finding regarding risk propensity on what appear to be much nuanced industry differences regarding how risk preferences influence executive behaviors as evidenced by the patterns of correlations displayed in Table 11. We hope these results prove useful to scholars interested in understanding why and when organizations engage in IT signaling.

7.4. Implications for Practice

Our findings are also meaningful for practice regarding both the decision to signal about IT activities and the interpretation of other firms' transmitted signals.

Regarding the decision to signal, we observed what appears to be a hesitancy of high-performing firms to signal about their IT-related activities. External communications with stakeholders can serve a variety of important roles: informing customers and suppliers of forthcoming, consequential initiatives; dispelling inaccurate views of an organization's technical capabilities and plans; and setting the stage for and affirming an organization's support for industry-wide initiatives. While the possibility of unintended information leakages does exist, careful execution of external communications activities can mitigate these risks. We consequently encourage high-performing (and other) firms to examine their biases and capabilities with regard to external communication so as to ensure that valuable opportunities are not being lost.

Regarding the interpretation of other firms' signals, we observed what appears to be a proclivity for low-performing firms to actively signal about their IT-related activities. While It was beyond our research objective to distill the motives behind such signaling, we expect that some of this signaling occurred as a means for low-performing firms to regain the confidence of stakeholders unsure about the firm's strategic and operational capabilities, and we also expect that some of these messages may promise far more than is actually delivered. Consequently, we encourage individuals attending to other firms' IT signals to carefully examine such messages and to take steps to validate content prior to taking action based on this content.

8. Conclusions

This study's findings contribute to information systems research in both theoretical and methodological ways. Theoretically, we have demonstrated the existence of a number of factors that influence firms' propensities to engage in IT signaling. Methodologically, we have demonstrated the possibility of systematic biases in opportunistically-captured samples of IT signals. Firms transmitting greater numbers of IT signals tend to be lower performers in their industries, tend to reside in industries characterized by a transform industry IT strategic role and tend to be larger. We strongly advise researchers studying firms' IT signaling behaviors to account for these factors in their research models and designs. Our analyses also indicated that firms communicate a greater number of IT signals through annual reports than through press release and that more realistic portrayals of firms' IT deployment portfolios may be provided by annual reports. Finally, in carrying out this study, we developed a rich set of coding rules for identifying and distinguishing amongst a firm's IT signals. We anticipate this methodological advance, in particular, will prove useful for scholars considering the use of IT signals as a proxy for firms' IT activities.

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Appendix A: Coding Procedures

We coded IT signals by alternating sessions where first each author independently coded the press releases and annual reports for a particular firm, then all authors met to assess agreement between the codes. During the meetings, any disagreements in code assignments were discussed and resolved before coding another firm. The frequent meetings to discuss coding rules and procedures helped maintain consistency throughout the coding process. An initial set of coding rules was developed using data from two firms not included in the study. When necessary, additional rules were developed during the meetings. We were careful to revisit previous code assignments whenever changes were made to our coding rules. The complete set of coding rules follows our discussion of the coding process for signals from each channel.

Press Releases

We searched the Lexus/Nexus, Business Wire and PR Newswire databases to identify all press releases for each firm. We considered only press releases that included the firm as a source (either by explicitly stating the firm as the source or by including the contact information for a firm representative). In the rare situation that multiple releases were made of the same statement, we coded only the first release. Further, any quarterly or annual earnings statements released to the press were not coded, even if it happened to include statements about IT; the motivation for the signal was to address the earnings rather than IT (see Press Release coding rule #2). Then we employed a two-phase coding process. During the first phase, we determined if the contents of the press release related to IT by having all authors independently review the press releases for a firm and decide if the press release should be coded or not. The authors then met to compare the results of this review. If there was disagreement among the authors, they discussed the contents of the press release until agreement was reached. Hence, we excluded press releases not related to IT from the construction of the dependent variables but used the count for information interactivity as described previously. The press releases with statements relevant to IT were included in the second phase of coding, during which each author independently assigned a code to indicate the nature of the IT discussed: automate, informate, or transform. Similar to the first phase, the authors then met to compare codes. If there was a disagreement between the codes, the authors discussed the reasons for assigning a particular code until agreement was reached.

Annual Reports

We coded the contents of annual reports including the letter to shareholders and other materials prior to management's discussion and analysis of the financial data. The annual reports for a firm were coded in a single phase such that each coder reviewed a firm's annual reports and assigned a code (transform, informate, or automate) to each paragraph that discussed IT. Paragraphs that did not discuss IT were not coded. Consistent with the coding process for press releases, the authors then met to compare codes and discuss any disagreements to determine the correct code.

Coding Rules

Definitions

Automate	Replace human labor by automating business processes.
Informate Up/Down	Provide data/information to empower management, employees, or customers.
Transform	Fundamentally alter traditional ways of doing business by redefining business processes and relationships.

Press Releases

1. Do not code general statements about IT, must report a specific IT use.
2. Do not code earnings statements.

3. Assign one code to the entire newswire, where the appropriate code is the highest level (i.e., transform > informate > automate) usage of IT in the newswire[8].
4. Ignore boilerplate about the nature of an organization, including the use of IT, when assigning a code.

Annual Reports

1. Code at the level of the paragraph, the appropriate code is the highest level (automate, informate, transform) usage of IT indicated in the paragraph.
2. Code multiple instances of the same issue, but only if each instance includes enough detail about the IT issue to assign a code (in other words, do not assign a code based on information provided in other statements, assign the code based on the information in that particular instance).
3. Do not code anything related to Y2K issues.

Press Releases & Annual Reports

1. Do not code information about information technology that is embedded in industrial technology.
2. Providing a new channel for old information is automate (i.e., using technology to provide traditional services to the deaf, providing an on-line chat with the organization, etc.).
3. IT providing new information to customers: informate.
4. IT creating new information flow: informate.
5. IT changing the way a marketplace operates: transform.
6. IT providing new ability, new services, restructuring the market: transform.
7. New IT-based products typically transform[9].
8. IT-related alliances:
    a. Strategic alliances or strategic acquisitions are typically transform;
    b. Marketing alliances are typically automate (e.g., joining Yahoo!);
    c. Global alliances (i.e., partnering to gain access to a new geographic market) should not be coded unless the alliance was driven by a specific IT-related objective;
    d. Outsourcing is generally not a strategic alliance; thus, it would typically be coded as automate.
9. Adding a new product, even through an IT channel, would not be coded. For instance, selling a new mutual fund electronically would not be coded. However, the new ability to sell mutual funds electronically would be coded as automate.
10. If there is not enough detail to determine if an information system is involved (i.e., the discussion could be based on altering a manual system) no code is assigned. If there is enough detail to determine that an information system is involved, but not enough to distinguish automate, informate, or transform, assign a code of automate.

Examples of IT Signals and Rationale

Transform Strategic IT Role (METAL Industry)

Wierton Steel Corporation, Annual Report, 1998, pg. 2-3.

In 1998 we made significant strides in this direction: Introduction of MetalSite L.P. (www.metalsite.net), a revolutionary partnership with LTV Steel and Steel Dynamics to establish an Internet-based

[8] In determining the correct code, we focused on the nature of the IT capability as discussed in the press release – that is our code was meant to best reflect the firm's view of the IT capability. In the rare instance when a single initiative was discussed in terms of multiple levels of capabilities we assigned the higher level code as we believe this best reflected the firm's comprehensive view of the IT investment.

[9] Note that the full contents of an announcement (press release or annual report paragraph) were considered when determining the correct code. Hence, although some rules refer to "typically" assigning a particular code, if the context of an announcement indicated that the "typical" code would be incorrect the code that best reflected the description in the announcement was assigned.

marketplace for the secure online purchase of metals.

Rationale: Both sources rules 5 and 8a. The introduction of this web site is a partnership, hence a strategic alliance (rule 8a) and also is referred to as "revolutionary" and impacts the marketplace (rule 5). For both rules, transform is the appropriate IT signal code.

Informate Strategic IT Role (RETAIL Industry)

Charming Shoppes, Inc. Annual Report, 1999, pg. 18
Through our proprietary credit card, third part credit cards and cash customers, we have compiled and maintain a database of more than 18 million names. This data helps us to micro-merchandise, develop product assortments, and respond to customer preferences in each mark. We also micro-market to specific customers based on their shopping habits, products they like, and sizes they wear. Our card program includes cards for Fashion Bug, Catherine's Plus Sizes, and The Answer customers, and ranks as the 17th largest proprietary credit card program in the nation.

Rationale: Press releases rule 3 and both sources rule 4. While this initiative may have also required automate technology, the focus is on providing a new information flow (rule 4), thus informate, the higher level of IT usage (wires rule 3), is the appropriate IT signal code.

Automate IT Strategic Role (FINANCE Industry)

Bear Sterns & Co. Inc. Press Release.

Copyright 1999 Business Wire, Inc.
February 12, 1999, Friday
DISTRIBUTION: Business/Technology Editors
LENGTH: 494 words
HEADLINE: Bear Stearns Opens Technology Development Center in Tampa
DATELINE: NEW YORK
BODY:
Feb. 12, 1999--Bear, Stearns & Co. Inc. announced today the grand opening of its Tampa Development Center, a facility where software application development and systems administration will be conducted for the firm. The center commenced operations on September 1, 1998. The development center will be under the direction of Phil Stern, senior managing director and co-CIO of information technology in New York, and managed by Larry Gioia, a managing director in Tampa. The center is currently staffed with approximately 65 systems professionals with plans in place to hire another 100 programmers locally. Phil Stern said, "In order to process and manage data in an efficient, timely and seamless manner, the firm's technology requirements are continually being elevated. We are delighted that our new development center, which will support all facets of Bear Stearns' business activity, is located in Tampa, where we can tap into a highly educated technical populous." The firm also announced a relationship with the University of South Florida involving the creation and funding of the Bear Stearns Information Technology Research Center in the Department of Information Systems & Decision Sciences at the College of Business Administration. This research center will house faculty and department projects, which currently include computer skills assessment, community database and data warehousing development, data communications research, computer facial expression imaging research, business multi-media applications research, and community public health research. Bear, Stearns & Co. In., a leading worldwide investment banking and securities trading and brokerage firm, is the major subsidiary of The Bear Stearns Companies Inc. (NYSE: BSC). With approximately $ 18.9 billion of total capital, Bear Stearns serves governments, corporations, institutions and private investors worldwide. The company's business includes corporate finance and mergers and acquisitions, institutional equities and fixed income sales and trading, private client services, derivatives, foreign exchange and futures sales and trading, asset management and custody services. Through Bear, Stearns Securities Corp., it offers professional and correspondent clearing, including securities lending. Headquartered in New York City, the company has over 9,500 employees located in domestic offices in Atlanta, Boston, Chicago, Dallas, Los

Angeles and San Francisco; and an international presence in Beijing, Buenos Aires, Dublin, Hong Kong, London, Lugano, Sao Paulo, Shanghai, Singapore and Tokyo. For additional information about Bear Stearns please visit our website at www.bearstearns.com.

Rationale: Press release rules 1 and 4. Boiler plate about the firm and its general IT activities are not enough to assign a code. Both sources rule 10. Clearly, new IT has been implemented but the discussion focuses on processing and managing data, there is not enough information to distinguish automate, informate and transform. Consequently, no IT signal code was assigned (and counted) for this press release.

Appendix B: Contrast Coding For Hypotheses 1, 2, And 3

	Hypothesis	Signals	Automate	Informate	Transform						
1a	Greater numbers of IT signals will be observed for automate IT activities than for informate IT activities.	Comparison H1a	1	-1	0						
1b	Greater numbers of IT signals will be observed for informate IT activities than for transform IT activities.	Comparison H1b	0	1	-1						
		Industry	**Automate**	**Informate**	**Transform**						
2a	Greater numbers of IT signals will be observed in transform industries than in automate industries.	Comparison H2a	-1	0	1						
2b	Greater numbers of IT signals will be observed in transform industries than in informate industries.	Comparison H2b	0	-1	1						
		Industry	**Automate**	**Informate**	**Transform**						
3a	Greater numbers of signals about transform IT activities will be observed for firms in transform industries than for firms in automate industries.	Comparison H3a	-1	0	1						
		Variable	**Automate Signal / Automate Industry**	**Automate Signal / Informate Industry**	**Automate Signal / Transform Industry**	**Informate Signal / Automate Industry**	**Informate Signal / Informate Industry**	**Informate Signal / Transform Industry**	**Transform Signal / Automate Industry**	**Transform Signal / Informate Industry**	**Transform Signal / Transform Industry**
		Comparison 3a (cont.)	0	0	0	0	0	0	-1	0	1
		Industry	**Automate**	**Informate**	**Transform**						
3b	Greater numbers of signals about transform IT activities will be observed for firms in transform industries than for firms in informate industries.	Comparison H3b	0	-1	1						
		Variable	**Automate Signal / Automate Industry**	**Automate Signal / Informate Industry**	**Automate Signal / Transform Industry**	**Informate Signal / Automate Industry**	**Informate Signal / Informate Industry**	**Informate Signal / Transform Industry**	**Transform Signal / Automate Industry**	**Transform Signal / Informate Industry**	**Transform Signal / Transform Industry**
		Comparison H3b (cont.)	0	0	0	0	0	0	0	-1	1

About the Authors

Robert Zmud is Professor, Michael F. Price Chair in MIS and George Lynn Cross Research Professor in the Michael F. Price College of Business at the University of Oklahoma. He is a recipient of the AIS *LEO* Award and has been recognized as a *fellow* of DSI, of AIS and of INFORMS Information Systems Society. His teaching and research interests focus on the business value of information technology, on technology adoption and use, and on the management of information technology. He has and continues to serve in editorial roles at major scholarly journals in the information system and management areas, has served numerous leadership roles in professional societies and conferences, and has consulted for a number of corporations and government agencies. He holds a Ph.D. in Business Administration from the University of Arizona, a M.S. in Management from MIT, and a Bachelors of Aerospace Engineering from the University of Virginia.

Teresa Shaft is an Associate Professor of MIS at the University of Oklahoma. She teaches systems analysis and design and project management. Her research interests include the cognitive processes used by IS professionals during system development and maintenance, the role of IS in environmental management and obtaining value from IT investments. Her work has been published in *Information Systems Research, Management Information Systems Quarterly, Journal of Management Information Systems, Business and Society,* and *Journal of Industrial Ecology*. She holds a Ph.D. from the Pennsylvania State University. She is a co-founder of IS-CORE, a special interest group of AIS. Her research has been supported by grants from the National Science Foundation.

Weijun Zheng is an assistant professor of MIS in the School of Business and Technology at the University of Wisconsin-Parkside. His recent research interests have included the strategy and design of electronic markets, offshore outsourcing and online reputation systems. He has published in *MIS Quarterly*, *MISQ Executive*, *Information System* and *e-Business Management*, and *Communications of International Information Management Association*. He holds a Ph.D. from the University of Oklahoma and a Ph.D. from Shanghai Jiaotong University.

Henry Croes is an instructor for ITT Technical Institute, Kansas City. His teaching assignments for the School of Information Systems include operating systems, networking, systems security and data communications. He holds an AS and BS in Computer Information Systems, and an "ABD" in Management information Systems.

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