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Communications of the Association for Information Systems



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Abstract:

While Information Technology (IT) has been identified by researchers as a source of strategic advantage for businesses, commentators have argued that this reality may not endure. These commentators argue that the growing ubiquity of IT makes it a commodity input rather than a scarce and valuable resource. We examine CEOs' Letters to Shareholders, one of the primary statements of corporate strategy, using both content analysis and latent semantic analysis, a text mining technique. Examining these letters allows us to investigate whether IT may be declining in strategic importance over time. We examine 160 annual reports from firms in the healthcare industry, covering a ten-year span of time, from 1997 through 2006. Our results indicate that the strategic emphasis placed on IT may be increasing, but its association with firm performance is declining. Our findings imply that as markets become more competitive, IT management capabilities and the strategic use of IT take on increasing importance. Our findings also imply that CEOs' perception of the importance of IT is a necessary but not a sufficient condition for improved firm performance. This article makes two primary contributions. First, we present an empirical examination of the issue of IT commoditization as a complement to existing anecdotal discussions. Second, we demonstrate the use of latent semantic analysis (LSA), a relatively new methodology for analyzing textual data, one that is evolving into an alternative to the well-known content analysis technique.

Keywords: CEOs, senior management, annual reports, text mining, IT commoditization, longitudinal data, firm performance

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I. INTRODUCTION

The importance of Information Technology (IT) as a component of corporate strategy has been of interest to business researchers for decades [Cash and Konsynski, 1985; Chang et al., 2003; Jarvenpaa and Ives, 1990; Porter, 2001; Porter and Millar, 1985]. Because IT can improve customer service, change distribution channels, help develop new products, create new business models, and change industry dynamics [Jarvenpaa and Ives, 1990], there is general agreement that IT is a key component of corporate strategy. Nevertheless, some have argued that the growing ubiquity of IT means that its strategic importance is diminishing and that IT is, in fact, becoming merely a commodity [Carr, 2003, 2005; Rappa, 2004]. As IT becomes an integral component of all business processes, these commentators argue, its strategic importance as a source of competitive advantage will diminish. Changes in the way IT is sold to and used by organizations have been highlighted as reasons why IT's place of importance in overall corporate strategy may be eroding [Carr, 2005; Rappa, 2004]. These assertions are controversial and stand in stark contrast to the dominant position that IT has been and remains an important element of corporate strategy. If IT is indeed becoming less important over time, the implications for IS researchers and business leaders could be far-reaching. This study is an effort to empirically measure whether IT is still viewed by business leaders as a strategic tool to gain competitive advantage, or if IT is becoming commoditized and diminishing in importance.

Papers that address the general question, "Is IT becoming commoditized?" have, to this point, been largely anecdotal and conceptual (e.g., Carr, 2003, 2005; Rappa, 2004). This study offers a step toward an empirical and theoretical understanding of this question. To investigate whether or not the importance of IT is diminishing, we examine CEOs' letters to shareholders from corporate annual reports from *Fortune 500* companies in the healthcare industry over a ten-year period from 1997 to 2006. These "Letters to Shareholders" have been described as standardized components of the annual report that may provide more objective data on an organization than would interviews; furthermore, this standardized data provides a way to compare organizations to one another [Bettman and Weitz, 1983; Chang et al., 2003; Jarvenpaa and Ives, 1990]. By examining the prominence of IT in these letters, an indication of CEOs' perspectives on the strategic importance of IT can be gleaned. We believe the time period from 1997 to 2006 is an ideal time period to examine because it includes not only the "tech bubble" of the late 1990s, but also the subsequent "bust." Changes in IT strategy should be clearly observable over this period of time.

In this research, we explore (1) CEOs' perspectives about the strategic importance of IT across time, and (2) the effect of CEOs' perspectives about IT on their firms' performance. Our findings provide evidence that may be used in the debate about the commoditization of IT. We not only update the findings of authors who have investigated similar questions in earlier eras of the information age (e.g. Jarvenpaa and Ives, 1990), but more importantly, we demonstrate the use of a new type of data analysis, text mining, to analyze CEO Letters to Shareholders. In text mining, computer software is used to discover themes and concepts in a large collection of documents [SAS, 2004]. The type of analysis we conduct, Latent Semantic Analysis (LSA), is evolving into a modern, highly automated variant of the well-known content analysis technique [Krippendorff, 2004]. Developing a way to use text mining rather than human coders may represent a novel alternative to qualitative techniques. We have incorporated our data from CEO letters with panel data on the performance of the firms we examine. This longitudinal analysis provides a way for us to explore changes in CEOs' perceptions and changes in organizational performance over time.

Our article proceeds as follows. We first review literature relevant to our study. We note how CEOs' perspectives on strategy have been gleaned from letters to shareholders in the past, how IT has been used as a strategic tool for organizations, and how IT provides value to businesses. We then describe our research method, including a discussion of our sample, our variables, our measurement of those variables, and the design of our research. It is in the methodology section that we describe our use of the text mining methodology. Next, we present the results of our analysis. We then discuss our results, highlighting the implications of our research for both researchers and practitioners. Limitations and directions for future research are noted before we conclude our article.

II. LITERATURE REVIEW

CEO Perspectives on Strategy

The CEO is "the principal architect of corporate strategy" [Harrison, 1992] and manages technology based on his or her perceptions of the external environment [Lefebvre et al., 1997]. In IS research, CEOs have frequently been used as the point of data collection for studies examining the link between IT and corporate strategy. CEOs have been

interviewed [Bourgeois III and Eisenhardt, 1988; Jarvenpaa and Ives, 1991; Lefebvre et al., 1997], surveyed [Weill, 1992], or both [Floyd and Wooldridge, 1990] for such studies. To conduct study on CEOs, researchers have two options for a data source: interviews or publicly available information such as press releases, news articles, and corporate annual reports.

While interviews offer advantages, such as the depth of data gathered and the opportunity to collect information not publicly available, a research plan to interview each of the CEOs of the top healthcare firms from the *Fortune 500* list once per year over the past ten years is clearly not possible. Similarly, a ten-year research plan to interview CEOs over the next ten years fails to provide valuable insights today. Additionally, some have argued that CEOs' letters may provide even more objective information than interviews with CEOs [Bettman and Weitz, 1983; Chang et al., 2003; Jarvenpaa and Ives, 1990]. For these reasons, we have not chosen to conduct interviews, and have instead opted to focus on publicly available information.

Of the sources of publicly available information, including press releases, news articles, and corporate annual reports, only corporate annual reports offer a standard format across firms. This standard format provides a good basis on which companies can be compared [Bettman and Weitz, 1983]. In addition, corporate annual reports are subject to intense scrutiny from shareholders, financial analysts, and other stakeholders. Historical data can be quantified by analyzing this letter [Ginsberg, 1988]. Thus, it is reasonable to assume that the information contained there is accurate and unbiased [Bettman and Weitz, 1983]. Finally, the use of annual reports rather than news articles or press releases ensures that better-known firms will not be over-represented in the corpus of data. Given these benefits, the use of these letters to study organizations has been encouraged [Ginsberg, 1988; Pfeffer, 1981]. "Content analysis of annual reports can be of real usefulness for understanding some issues of corporate strategy" [Bowman, 1984, p. 70]. In sum, the CEO's letter to shareholders provides a unique window on corporate strategy.

The Diminishing Perspectives of CEOs on Strategic Importance of IT

Empirical work points to the historical importance of IT in firm strategy. This has been clearly highlighted in books and reviews of MIS literature that focus on IT and business strategy [Brynjolfsson and Saunders, 2010; Sambamurthy, 2000; Sampler, 2000; Segars and Dean, 2000]. Continuing research points to the emphasis placed on IT as a strategic tool [Chang et al., 2003] as do special issues of leading journals that are devoted to strategy, economics, and Information Systems [Clemons et al., 2004]. Practitioners have also noted the continuing influence of IT as a component of firm strategy [Gentle, 2007; McCormack, 2007; Porter, 2001; Tam, 2007]. Thus, it is generally accepted that IT has dramatically reshaped modern business and continues to be a focus of firms' strategy.

The rationale for the strategic importance of IT was built largely on the Resource-Based View of the Firm (RBV). The earliest formulation of the RBV was presented by Penrose [1959], but the application of the RBV lay largely dormant until research into this theory was reinvigorated by Wernerfelt [1984, 1995] and elaborated on by Barney [1991]. The RBV explains that competing firms possess heterogeneous sets of resources [Wernerfelt, 1984, 1995]; those that are valuable and rare are a potential source of competitive advantage. Differences in the sets of resources and capabilities each firm possesses may be long-lasting [Barney, 1991]. To the extent that these assets are not easily imitated, substituted, or transferred, sustained long-term strategic advantage can be achieved [Barney, 1991]. In research on the strategic importance of IT, the RBV was used to explain that IT was a valuable, rare, inimitable, and non-substitutable asset upon which competitive advantage could be built.

Few argued with this position until the publication of "IT Doesn't Matter," a controversial piece published in *Harvard Business Review* and written by Nicholas Carr [2003]. In his article, Carr argues that while IT is changing business, and while the strategic use of IT does provide competitive advantage for firms, competitive advantage may be short-lived [Carr, 2003]. By making analogies to the electrification of manufacturing facilities and the growth of railroads in the twentieth century, Carr argues that massive investment (in IT, electric generators, or railroads) increases capacity, decreases prices, and leads to the commoditization of the resource. While it was once a source of strategic advantage for firms to have their own electric generators and proprietary rail links, it is no longer so. The same is said of IT. IT has become a commodity that can now be reliably purchased from third-party providers. IT no longer meets RBV criteria of being valuable, rare, inimitable, and non-substitutable, and thus is no longer a source of competitive advantage. With more and more off-the-shelf software, Internet service providers, website hosting, off-site data storage, e-commerce website management, and other cloud computing services, the need for a firm to have a strategic emphasis on IT is not as great as it once was. Subsequent papers opine that the business world is moving toward a model where IT will be purchased from an "IT Utility Company" in the same way that electricity and water are purchased from utility companies [Carr, 2005; Rappa, 2004].

A theoretical argument for the diminishing value of IT has been provided in the discussion of the lifecycle of new IT products [Oz, 2005], an argument that aligns with the aforementioned ideas of Carr [2003, 2005]. It has been

suggested that a new useful technology follows five phases of a product lifecycle: (1) adoption of new IT, (2) increased profit, (3) standardization of IT, (4) lower price, and (5) decreased productivity. In Phase 1, a firm adopts a new IT that supplants existing technology to produce products and services efficiently. Early adopters often experience substantial benefits. In Phase 2, some followers imitate the actions of the first mover, but some of them fail to achieve the productivity gains of the first mover because of difficulties incorporating and adapting the new IT for their firms. In Phase 3, all firms in an industry use the technology, and the IT gradually becomes standard. The IT becomes a commodity and the strategic value of the IT recedes. In Phase 4, firms often begin to compete with each other by decreasing prices. Finally, in Phase 5, the strategic advantage of IT disappears. Thus, through each of these phases, the logic of the RBV holds, with novel technologies providing competitive advantage for early adopters (when the technology is rare and without substitute), but then no longer providing that advantage in later stages, after those technologies become widely available or commoditized. In the lifecycle of a IT product, only Phases 1 and 2 have a strategic value of IT, and in other phrases IT becomes a commodity. Indeed, research indicates that only IT investment in growth-oriented applications has positive relationship to firm revenue [Oh and Pinsonneault, 2007].

Personal computers, for instance, are presently in Phase 3 where they are standardized and the adoption of them no longer produces strategic advantage. This is one of the reasons why IBM has left the computer hardware manufacturing industry to concentrate on providing IT services. Carr's arguments [2003, 2005] indicate that he believes that most if not all types of IT are in Phase 3 or later, where firms can no longer exploit the strategic advantages of the technology. Based on this assessment, Carr advises practitioners to focus on optimizing the cost effectiveness and minimizing IT risks, ideas which align with Phases 4 and 5 of the IT product lifecycle.

The conjecture that most or all IT is becoming commoditized and is no longer a strategic tool to enhance firm performance [Carr, 2003, 2005; Rappa, 2004] is a conjecture that can be investigated empirically. To date, only conceptual and anecdotal evidence of the trend toward IT commoditization has been given. If IT is indeed becoming commoditized, the importance of IT in the firm should be on the decline. One surrogate or proxy for the strategic value of IT is the attention that IT is given by a firm's CEO [Chang et al., 2003; Tallon and Kraemer, 2007; Yadav et al., 2007]. We argue that if IT does not play a key role in business and becomes a utility [Hopper, 1990], CEOs in firms will gradually reduce the strategic emphasis that they place on IT. If IT is becoming commoditized, it seems likely that IT will appear less frequently in CEO Letters to Shareholders than it has the past.

Thus, by integrating the RBV with ideas about the lifecycle of technologies, we hypothesize that:

Hypothesis 1: The emphasis placed on IT by the CEO will decrease over time.

CEO Perspectives of IT Business Value

IT business value has been defined as "the organizational performance impacts of information technology at both the intermediate process level and the organization-wide level, and comprising both efficiency impacts and competitive impacts" [Melville et al., 2004, p. 287]. Early studies of IT business value identified the so-called "productivity paradox," a phenomenon where investments in IT failed to produce expected payoffs in terms of increased productivity or profitability [Brynjolfsson, 1993; Strassmann, 1990; Strassmann, 1997; Weill, 1992]. Numerous explanations were advanced as to why expected performance benefits failed to materialize. Explanations included methodological shortcomings [Brynjolfsson, 1993; Robey and Boudreau, 1999], the existence of time lags in observing payoff [Devaraj and Kohli, 2000], and the presence of intermediate variables [Barua et al., 1996]. By the late 1990s, positive effects from IT investment were identified and it was acknowledged that IT investments did indeed benefit organizations [Brynjolfsson and Hitt, 1996; Mahmood et al., 1999; Sircar et al., 1998; Stratopoulos and Dehning, 2000]. Several reviews of this phase of IT payoff research summarize the key findings [Brynjolfsson and Hitt, 1996; Mahmood et al., 1999; Sircar et al., 1998].

IT has not only been demonstrated to be a tool to improve organizational performance, but it has also been shown that the effect of IT on firm performance depends in some degree on the strategic importance the CEO places on IT [Chang et al., 2003; Jarvenpaa and Ives, 1990; Jarvenpaa and Ives, 1991]. Strategic leadership theory posits that the specific knowledge, experience, values, and preferences of top managers affect their assessment of competitive situations, their decision-making, and thereby have an impact on organizational outcomes [Cannella and Monroe, 1997; Hambrick and Mason, 1984]. CEOs must assess strategic issues and consider a range of potential solutions by considering the resources that are within their organization, or available to it. When a firm confronts technical and environmental change, top leaders play a crucial role setting a firm's course of action [Tichy and Cohen, 2002]. As CEOs at different firms interpret strategic issues differently, they may choose different strategic actions to respond to the same external challenges, leading to different outcomes [Thomas and McDaniel, 1990]. Because CEOs are in a unique position, one where they influence virtually all operational and strategic decisions, they have a substantial impact on firm performance, explaining as much as 29.2 percent of the variance [Mackey, 2008].

Executive support is often described as a critical factor for exploiting the benefits of IT. CEOs have perceived IT as a competitive weapon [Ives and Learmonth, 1984], an innovation driver [Sambamurthy et al., 2003; Swanson, 1994], and an efficient means of inter-organizational cooperation [Bensaou, 1997]. It has been shown that the degree of importance placed on IT by CEOs is associated with the firm's progressive use of IT [Jarvenpaa and Ives, 1991]. Others have found that CEOs in firms with more focused goals for IT obtain greater payoffs from IT than CEOs in firms with less focused goals for IT [Tallon et al., 2000]. Furthermore, CEOs' perceptions on IT are shaped by the experience of IT uses as well as the interactions with CIOs. If both CEOs and CIOs have shared visions on the role of IT, IT will be used as a tool to attain the strategic goals of the firm [Feeny et al., 1992].

Thus, the CEO's perspective of IT is very important if the firm wishes to utilize IT as a strategic resource and capture the competitive advantage that may exist through IT. Based on this rationale, we hypothesize that:

Hypothesis 2: The CEO's perspective on the strategic importance of IT will be positively associated with a firm's performance.

III. SAMPLE

Letters to Shareholders

The Letter to Shareholders is a basic component of the annual report that a firm issues at the end of each fiscal year when it reports its performance and business to shareholders. The Letter to Shareholders is one of the best opportunities for the CEO to communicate directly with individual as well as institutional investors. The letter is often only one or two pages; thus CEOs have to present business activities succinctly and specifically [Lebar, 1982]. Although CEOs utilize the assistance of their public relations department or other internal experts, the topics in Letters to Shareholders are determined by CEOs themselves.

Although it seems that CEOs play a key role regarding the coverage and contents of the letters, the letters are not an arbitrary collection of topics, but are developed from careful reflection by the CEO on the firm's priorities. Many researchers have demonstrated that the contents of Letters to Shareholders are objective, accurately reflect firms' priorities, and provide a qualitative measure that supports and supplements the quantitative statements made in the annual report and 10-K filing. Indeed, Yadav et al. [2007] examines the relationship between the contents of CEOs' letters and boardroom agendas of two firms in *Fortune* 500, and finds that the letters directly reflect the discussion of boardroom agendas. Thomas [1997] finds that although the letters are not wholly the work of one person, they embody the agenda and priorities of top management. Fiol [1995, p. 534] compares the cognitions expressed in the letters with the contents expressed in internal planning documents and finds that the letters faithfully incorporate the content of planning documents. Thus, although the coverage and content of the letters are determined by CEOs, they are also a result of continuous interaction with internal stakeholders (including employees and the board of directors) and external stakeholders (creditors and the government).

One may argue that firms might consider strategic uses of IT but do not want to disclose plans that are still in the early stages. Or perhaps CEOs do not want to share strategic IT plans because competitors could learn the firm's strategy. We admit these possibilities, but we also point out that strategies on IT expressed in CEOs letters might be published in newspapers or other media outlets. Furthermore, the contents of strategic plans are often abstract and broad, without sufficient detail for others to duplicate.

In any case, the key value of the letters comes from the fact that CEOs are able to make all important decisions. CEOs allocate resources, including IT resources, in order to attain their firms' goals and improve the firms' strategic position. When CEOs write about their key strategic initiatives in their Letters to Shareholders, they will focus on the most important items. Furthermore, if it is possible to observe the CEOs' thoughts on strategy over a period of time, the letter will be a unique window into the perceptions of CEOs [Abrahamson and Hambrick, 1997; Kabanoff, 1997]. Seagars and Kohut [2001, p. 535] note that "the CEO's Letter to Shareholders is perhaps the most strategic in conveying the well-being and future direction of the enterprise." Thus, Letters to Shareholders provide an excellent vantage point from which to study the perceptions of CEOs on various firm strategies.

In our sample of Letters to Shareholders, we find that *strategy* is used at least one time by each firm, and the total number of the uses of this term in the letters is 252. Also, the words *information* and *technology*, are used 210 and 390 times respectively. For example, in the Letters to Shareholders of Express Scripts in 2000, the CEO explains his perception about the value of IT by stating, "From the beginning, we recognized that information technology and automation would support every business process in our organization. Each year, we invest in technology to enhance accuracy and productivity, and to enable us to make the drug benefit more accessible and convenient for plan sponsors and their members." Because such statements are common across our sample of letters, we are confident that our sample reveals the perceptions of CEOs on IT strategies within their organizations.

Healthcare Industry

The healthcare industry is presently using IT to transform itself. New strategies and tactics to increase efficiency and quality through the use of IT are being developed and implemented [Anderson et al., 2006]. We have selected the healthcare industry as our focus for four reasons. First, the healthcare industry has implemented IT relatively slowly compared to other industries [Khoumbati et al., 2006; Menachemi et al., 2006]. However, increasing competition and national focus on this industry has led to significant investment in IT in the past few years [Anderson et al., 2006; McGee, 2004]. Thus, the expectations that IT will improve productivity in this industry are high [Menon et al., 2000]. Second, we have chosen to investigate the healthcare industry because this industry has shown equivocal results with regard to the business value of IT. Some studies indicate a negative relationship between IT investment and performance [Brynjolfsson, 1993; Strassmann, 1997], while others indicate a positive relationship [Baker et al., 2008; Menon et al., 2000]. Third, the use of data from one industry increases the accuracy of measurement of CEOs' perceptions on IT because CEOs are most influenced by their peers in the same industry [Watson, 1990]. Fourth and finally, there is a great need to improve organizational performance in the healthcare industry because it has been observed that the healthcare costs in developed countries have begun to threaten those countries' competitive advantage in the global marketplace [Pralhad, 1999]. IT may be one such way to improve performance and reduce costs.

Sample Selection

The *Fortune 500* does not list a specific "healthcare" industry, but lists numerous firms in categories such as medical facilities, managed care, medical products and equipment, and also pharmacy and other services. We have selected three categories of firms whose names begin with "Health Care" in the *Fortune 500*, including "Health Care: Medical Facilities," "Health Care: Pharmacy and Other Services," and "Health Care: Insurance & Managed Care." We have also included "Medical Product & Equipment." All four industries rank among the top fifty industries in *Fortune 500* with respect to Return on Revenue criteria. Medical Product & Equipment ranks in the top 6, and Insurance and Managed care, Medical Facilities, and Pharmacy and Other Services rank 21, 32, and 39 respectively. Thus, the comparison among health-related industries can be meaningful in that we compare the high performing firms in each category. We control for potential industry effects with a industry dummy variable. We have excluded two categories that could possibly be considered, "Pharmaceuticals" and "Insurance (Stocks and Mutual Funds)". We have excluded "Pharmaceuticals" from our sample because it is classified as an independent industry in the *Fortune 500*. We also have excluded the "Insurance (Stocks and Mutual Funds)" because it is more closely related to financial firms than to healthcare firms. The following table shows healthcare-related firms in the *Fortune 500* as well as the number of companies that we have selected from each category.

Table 1: Healthcare Industries in the *Fortune 500*

Industry	Total Firms	Sample Firms
Health Care: Medical Facilities 1. Health Management Associates (HMA ¹) 2. Renal Care Group (RCI) 3. Universal Health Service (UHS)	17	3
Health Care: Pharmacy and Other Services 1. Express Scripts (ESRX) 2. Quest Diagnostics (DGX) 3. Omnicare (OCR) 4. Laboratory Corp. of America (LH) 5. Apria Healthcare Group (AHG)	8	5
Health Care: Insurance & Managed Care 1. Cigna (CI) 2. Health Net (HNT) 3. Humana (HUM)	16	4
Medical Product & Equipment 1. Baxter International (BAX) 2. Becton Dickison (BDX) 3. Boston Scientific (BSX) 4. Medtronic (MDT)	12	4
Industry: Pharmaceuticals	19	0

¹ HMA denotes stock ticker symbol for Health Management Associates. Ticker symbols are shown for other firms as well.

After selecting the firms for our sample, we collected Letters to Shareholders from these firms for the period of time from 1997 to 2006. We choose this time period because many new information technologies such as the Internet

and E-Commerce emerged during this period. We were able to collect letters from sixteen firms that have full Letters to Shareholders over ten years. Letters were not available for all firms for the time period selected because some firms merged with other firms and also because some firms did not develop an annual report for every year, instead simply filing a 10-K form. In total, we collected 160 letters from sixteen firms over our ten-year period. The total number of words in documents that form our sample is 274,278, and the average number of words per page is 1,716.

IV. METHODOLOGY

Dependent Measures

Many researchers have developed and used various measures to gauge firms' performance [Abrahamson and Amir, 1996; Bettman and Weitz, 1983; Bharadwaj et al., 1999; Chang et al., 2003; Jarvenpaa and Ives, 1990; Mackey, 2008; Ravichandran et al., 2009; Weill, 1992]. In general, measures can be divided into two types of measurements: *accounting-centric measures* and *stock market-centric measures*. For the accounting centric measures, Return on Assets (ROA), Return on Sales (ROS), Return on Investment (ROI), and Return on Equity (ROE) are the most common. Because of the ease of calculation and the straightforward understanding of these ratios, the measures have been commonly used in studies of firms' performance [Mackey, 2008; Weill, 1992]. Stock market-centric measures include market-adjusted return and Tobin's *q*.

In this study, we use Tobin's *q* as one measure of a firm's performance because it considers not only a firm's long-term performance, but also the value of intangible assets a firm possesses, both of which are likely to be affected by IT strategies [Bharadwaj et al., 1999; Ravichandran et al., 2009]. The effects of IT strategies can appear over a long period of time as returns or profits, and can also appear in the form of intangible assets such as intellectual property and patents [Bharadwaj et al., 1999].

Table 2: Performance Measures of Previous Studies and Their Rationale

Performance	Explanation	Studies
Firm profitability (ROA, ROS)	A class of financial metrics that are used to assess a business's ability to generate earnings as compared to its expenses and other relevant costs incurred during a specific period of time.	Weill, 1992 Mackey, 2008
Sales growth	Sales growth is the most visible and interpretable variable with little influence of accounting principles.	Bettman and Weitz, 1983 Jarvenpaa and Ives, 1990
Company profit growth	In the knowledge economy, strategy must focus on expanding existing markets or creating new ones. Growth without profitability is not sustainable.	Chang et al., 2003
Growth profit margin		
Market-adjusted return	Ultimately, strategies need to increase stock return.	Abrahamson and Amir, 1996 O'Sullivan and Abela, 2007
Tobin's <i>q</i>	Tobin's <i>q</i> , as a market-based measure for performance, is forward-looking and risk-adjusted. The measure considers not only a firm's long-term performance but also the value of intangible assets a firm possesses, both of which are likely to be affected by IT strategies.	Ravichandran et al., 2009 Bharadwaj et al., 1999

We also use ROA as a measure of firm performance. Because ROA, ROS, ROI, and ROE have high correlations with each other, it is unnecessary to use multiple accounting-centric measures of performance. Table 2 summarizes key performance measures and their rationale.

We calculate Tobin's *q* using the following method,

$$\text{Tobin's } q = (\text{Market Value of Equity} + \text{Preferred Stock Value} + \text{Debt}) / \text{Total Assets},$$

where Market Value of Equity = (Closing price of share at the end of the financial year) x (Number of common stock shares outstanding), Preferred Stock Value = Liquidation value of the firm's outstanding preferred stock, Debt = (Current liabilities – Current Assets) + (Book value of inventories) + (Long term debt), and Total Assets = Book value of total assets. To supplement Tobin's *q*, we calculate ROA as (net income/total assets). All values for calculating Tobin's *q* and ROA are taken from the COMPUSTAT database.

When matching performance measures with CEO's perceptions on IT, we follow the fiscal year criteria of the COMPUSTAT database where a company's fiscal year corresponds to the calendar year in which it has the most overlap in months. If the fiscal year ends between June and December, then the data year is the year in which the fiscal year ends. For example, if the data year in an annual report is about from April 1, 1995, to March 31, 1996,

and the end of fiscal year is March, the accounting data of the firm is classified as fiscal 1995 data. Thus, the data from Letters to Shareholders have to be classified as the same fiscal year, 1995 [Standard & Poors, 2007].

Independent Measures

We measure CEOs' perceptions of IT using three dimensions: *frequency of IT terms*, *initiative type*, and *expected effects*. We define perception as the "reciprocal interaction of information seeking, meaning ascription and action" [Thomas et al., 1993, p. 240]. Our categorization allows us to first count the *frequency of IT terms*, then note the *initiative type*, to see whether the term indicates a new use of IT, a redevelopment of some organizational capability using IT, the enhancement of some organizational capability using IT, or the use of a (previously unavailable) IT. Then, we are able to assess the *expected effects* of the IT, which may be improved operating efficiency, increased customer satisfaction, cost savings, internal growth, or external growth. Table 3 summarizes each of these measures.

Table 3: The Three Dimensions of CEO's Perception

Frequency of IT terms	Initiative Type	Expected Effects ¹
IT terms	New Redevelopment Enhancement Use	Operating Efficiency Customer Satisfaction Cost Savings Internal Growth External Growth

¹ Each effect is defined by the following;

- Operating Efficiency: the improvement of efficiency in internal organizations (i.e., billing systems, system maintenance, decision makings, administrative efficiency, productivity, and strategic alignments)
- Customer Satisfaction: the improvement of customer relationship (i.e., user satisfaction, better services, and connectivity to users)
- Cost Savings (i.e., the decline of healthcare cost)
- Internal Growth: Information Systems to get economic benefits (i.e., financial performance, profits, and revenue)
- External Growth: Information Systems to procure new markets (i.e., expansion of services, new customers, new markets, and new patients)

When quantifying the CEO's perception of IT, we first identify the number of IT-related terms in the Letters to Shareholders. Then, we can examine the initiative type as well as the expected effects. For instance, when the CEO mentions a newly developed Customer Relationship Management system (CRM) and expresses the effects of the deployment of this system in terms of customer satisfaction and internal growth, we can quantify the CEO's perception in terms of the initiative type (new), as well as in terms of effects (customer satisfaction and internal growth). Thus, we have three measures of the CEO's perception on IT including the number of IT-related words, the number of Information Systems, and the number of expected effects.

Three Complementary Methods for Counting IT Terms

A CEO's perceptions are measured by the number of IT terms that the CEO uses in the Letters to Shareholders. In order to count the frequency of IT terms automatically, we use three complementary methods: *healthcare dictionary*, *text mining*, and *manual identification*. IT-related terms are defined as those that "discuss the management, application, investment, and organization of computer, communications, or office technology for improving or modifying operations, establishing linkage with customers, suppliers, competitors, channel partners, or the development of new products" [Jarvenpaa and Ives, 1990, pp. 357–358].

Healthcare Dictionary

For healthcare IT terms, we use the glossaries from *Dictionary of Health Information Technology and Security* [Marcinko and Hetico, 2007]. We exclude prominent names of people, and obtain 3,703 terms. Although we have many healthcare IT-terms, these terms may not constitute an exhaustive list. CEOs are likely to use other terms that are not contained in the dictionary, such as newly-coined terms like *e-prescribing*. Thus, we need to also consider firm-specific healthcare IT-terms. Although it is possible for researchers to read all letters and find firm-specific IT-terms, the work requires great patience and might lead to inaccurate records because of human mistakes. We overcome this limitation using a text mining method, latent semantic analysis.

Text Mining

The analysis of text by researchers within the positivist tradition has most often been accomplished by using the content analysis technique [Krippendorff, 1980]. Attempts to employ information technology to assist in the application of this technique have often been limited to having software count the number of words in documents [Sidorova et al., 2007]. More advanced approaches to analyzing text exist in the fields of information retrieval and text mining, however. The vector space model [Salton et al., 1975] was introduced to aid with information search by representing documents as multidimensional vectors where each term in the group of documents is considered to be a vector. In this way, a mathematical representation can be created of every document in a corpus of text and similarity between documents (vectors) can be assessed.

Latent Semantic Analysis (LSA) is an approach to text analysis that was developed to look beyond the simple occurrences of words [Deerwester et al., 1990; Dumais, 2004; Landauer et al., 1998]. LSA is one of several text-mining dimension reduction methods. LSA projects a term-document matrix into a small factor space. For instance, 3,000 terms contained in a total of 500 documents can be reduced into a matrix of thirty factors by 500 documents using LSA. In other words, LSA represents an original term-document matrix into the smaller dimensions of a factor-document matrix. This factor-document matrix is thus an approximation of the original term-document matrix.

In LSA, this dimension reduction is possible with little loss of information because a document uses very few terms. For example, suppose that document 1 contains *information technology* and document 2 contains *technology leadership*. Because both document 1 and 2 use *technology* in each document, *information*, *technology*, and *leadership* are classified into one factor to which we can name as "IT leadership." Thus, we can consider that a factor in LSA is a synonym set having similar meanings. Because of this feature, if a factor can be regarded as "information technology," then we are able to consider the terms in the factor as terms with similar meanings. (For more details about LSA, refer to the examples of Deerwester [1990] and Landauer [1998]. Also, for a tutorial on LSA, refer to the appendix of Sidorova et al.'s study [2008]).

Table 4: Additional IT Terms Obtained from LSA analysis

algorithm	e-commerce	Internet	signature	tools
communication	elearning	Mail	software	ware house
cost	electronic	Mining	support	warehouse
data	electronic business	Mis	technological	Web
data mining	e-mail	Online	technologies	Web-based
data warehouse	e-prescribing	Platform	technologists	website
decision	e-procurement	Portal	tele	
e-business	e-signatures	Prescribing	telephone	
e-clinical	information	Sap	telephone calls	
e-cmns	intelligence	sap-based	tool	

However, LSA cannot identify the *polysemy* of a term, where a single term has multiple meanings. For instance, *technology* can be used as different meanings. If *technology* is used as *information technology*, we can regard *technology* as an IT term. However, if *technology* is used as *medical technology*, we cannot regard *technology* as an IT term but as a medical term. In order to get homogeneous meanings of IT terms, we exclude non-IT-related-paragraphs from Letters to Shareholders, extract IT-related paragraphs, and assemble new letters with the extracted paragraphs. Because the new letters contain only IT-related contents, factors now include only IT-related terms. To identify IT-related paragraphs, we use the healthcare dictionary of Marcinko and Heticco [2007]. If a paragraph contains at least one term in the dictionary, we extract the paragraph and make a new letter with other IT-related paragraphs. We manually examined 10 percent of a random sample of Letters to Shareholders to identify IT-related paragraphs. Then, we compared the results with the dictionary identification method to verify that all paragraphs are actually related to IT.

Then, using the newly created letters, we conduct LSA by increasing the number of factors from two to fifty. At the setting of twelve factors, we have one IT factor that contains IT terms such as e-clinical, e-signature, e-learning, SAP, and so on. As we progress to higher-factor solutions, we obtain forty-six additional IT terms, and add the terms to healthcare dictionary terms, totaling 3,749 IT terms. Table 4 shows additional IT terms obtained from LSA analyses and Figure 1 shows LSA analysis procedures we have performed in this study.

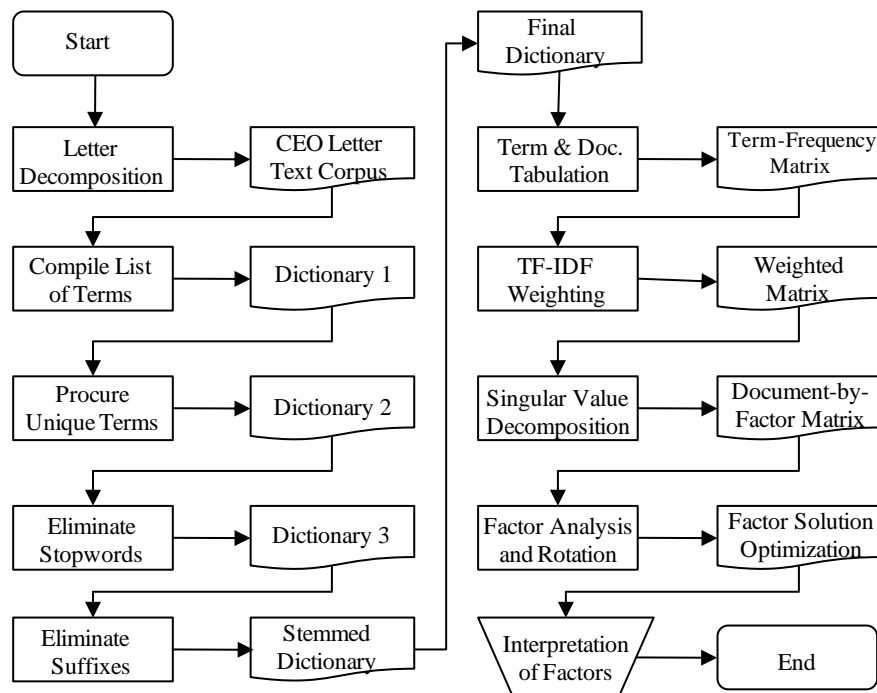


Figure 1. Text Mining Methodology

After this process, we extract all paragraphs from each letter that contains at least one of the 3,749 IT terms, and make a new letter with other paragraphs. Two authors checked independently whether each paragraph really is related to IT. If two authors disagreed for the classification of a paragraph, one author in the study determines the relevance of the paragraph. On the most paragraphs (225 out of 234 paragraphs), the two coders agreed on the IT relevance. Of the nine remaining paragraphs, where there was disagreement, one coder classified only five paragraphs as IT relevant paragraphs, yielding a total of 230 paragraphs. We also check the negative or positive meanings of paragraphs because those positive and negative terms impact on firm's performance differently. We identified one negative paragraph and excluded the paragraph. By combining the 229 paragraphs, we obtained ninety-five final letters. Then, we counted the number of IT terms from the ninety-five letters using the total of 3,749 terms from our dictionary. We also then calculated the frequency of term usage as CEO's perception of IT. Also, using the ninety-five letters, we code initiative type and expected effects with criteria in Table 3 following the general principles put forth by Krippendorff [1980].

Manual Identification

We checked sixty-five non-IT letters manually that were excluded from the analysis, and found that all sixty-five letters do not discuss IT. On the basis of our analysis and our manual checks, we believe that the CEOs' perceptions of IT have been accurately identified.

Control Variables

Because firm performance can be influenced by firm size [Bharadwaj et al., 1999; Chang et al., 2003; Ravichandran et al., 2009] and capital intensity [Bharadwaj et al., 1999; Ravichandran et al., 2009], we consider these variables as control variables in our models. We measure firm size as the natural log of the number of employees, and capital intensity as long-term debt divided by total capital.

Models

In order to test Hypothesis 1 (the emphasis placed on IT by the CEO will decrease over time), we use robust regression analysis to alleviate the effects of outliers and heteroskedasticity [Andersen, 2008]. We set the following model to trace the pattern of CEO perception.

$$CEOPerception = \beta_0 + \beta_1 Time + \beta_2 FirmSize + \beta_3 CapitalIntensity + u,$$

where CEOPerception is one of Initiative, Effects, and ITterm measures. CEO perception is measured with three different measures; the number of systems (Initiative), the number of expected effects from systems (Effects), and the number of IT terms in letters (ITterm). In the model u is a error term. We conduct robust regression over three measures of CEO perceptions with un-centered FirmSize and CapitalIntensity control variables. Through this model, if β_1 is negative and significant, we have evidence that supports Hypothesis 1.

Linear Growth Models with Firms Covariates

In order to test Hypothesis 2, we use a two-level mixed model, within a firm and between firms, in which the level-1 model is a firm's growth model, and the level-2 model expresses variation in parameters from the growth model as random effects. The underlying premise of the mixed model is that "some subset of the regression parameters vary randomly from one individual to another, thereby accounting for sources of natural heterogeneity in the population" [Fitzmaurice et al., 2004, p. 187]. We use the following model with different covariance structures including compound symmetry (CS), Heterogeneous CS (CSH), autoregressive (1) (AR(1)), and heterogeneous autoregressive (1) (ARH(1)) [Fitzmaurice et al., 2004; SAS, 2009, p. 3959; Singer, 1998; Sullivan et al., 1999].

Tobin's $q_{ij} = \pi_{0j} + \pi_{1j}(\text{Time})_{ij} + r_{ij}$, where $r_{ij} \sim N(0, \Sigma)$

$$\pi_{0j} = \beta_{00} + \beta_{01}(\text{CEOPerception})_j + \beta_{02}(\text{FirmSize})_j + \beta_{03}(\text{CapitalIntensity})_j + u_{0j},$$

$$\pi_{1j} = \beta_{10} + \beta_{11}(\text{CEOPerception})_j + \beta_{12}(\text{FirmSize})_j + \beta_{13}(\text{CapitalIntensity})_j + u_{1j},$$

$$\text{, where } \begin{pmatrix} u_{0j} \\ u_{1j} \end{pmatrix} \sim N \left[\begin{pmatrix} 0 \\ 0 \end{pmatrix}, \begin{pmatrix} \tau_{00} & \tau_{01} \\ \tau_{10} & \tau_{11} \end{pmatrix} \right], \quad i = \text{time}, j = \text{firm}.$$

In these models, the CEOPerception, FirmSize, and CapitalIntensity variables are adjusted to their grand means for interpretation of analysis. We change the behavior of assumption r_{ij} which is within-firm residuals *over time*, with CS, CSH, AR(1), and ARH(1), and choose the best fit model in terms of AIC and BIC criteria. The residual observations within firms are correlated through the within-firm error covariance matrix Σ . By considering CS, CSH, AR(1), and ARH(1) and by comparing the goodness of fit of the models, we are able to determine the appropriate model for the data. Then, we check two coefficients of CEOPerception, β_{01} and β_{11} . β_{01} indicates the degree of association of CEO perception with the variation of intercepts in the firm growth model. β_{11} indicates the degree of association of CEO perception with the variation of slopes in the firm growth model.

The logic behind this model is that we first remove a spurious association in a firm's growth model by using a time variable [Wei, 2006]. Time series data often tend to move in the same direction because of a trend that is common to all firms. After removing the time effect, the residuals in a firm's growth model contain variance of Tobin's q that is not explained by time. Furthermore, we consider individual firm growth by specifying Σ structure with CS, CSH, AR(1), or ARH(1). For example, if there is a AR(1) pattern in Tobin's q , we can have better fit model incorporating the AR(1) structure to Σ . By comparing AIC and BIC from the models with various covariance structures, we are able to determine a best fit model.

Each firm's growth model has intercept and slope, which are vary among firms. Now, the variation of intercepts is explained with CEOPerception, FirmSize, and CapitalIntensity, and the variation of slopes is explained with the same three variables. Thus, we measure two associations: initial performance (in 1997) and CEO perception, and growth of performance and CEO perception according to Time (the coefficient of Time x CEOPerception). Finally, the coefficients of CEOPerception and CEOPerception x TIME will be used to test the Hypothesis 2.

V. RESULTS

We examine our data to look for significant differences in CEO perceptions of IT over ten years. We also examine whether CEO perception of IT is positively associated with firm performance. Similar work using text mining has analyzed qualitative data from corporate annual reports and compared it to the quantitative data from those same reports [Back et al., 2001; Back and Vanharanta, 1999; Kloptchenko, 2003; Kloptchenko and Eklund, 2002].

For Hypothesis 1 (the emphasis placed on IT by the CEOs will decrease over time), we first check the pattern of CEOs' perceptions of IT during the ten years of our sample as well as the distributions of CEOs' perceptions for each year. We perform this analysis with the graphics shown in Figures 2 and 3. Figure 2 shows changes and distributions of CEOs' perceptions that are measured with (a) frequency of IT terms, (b) initiative type, and (c) expected effects. From this figure, we are able to identify three distinct regions. The first region is from 1997 to 2000. For all three measures, CEO perception increases steeply and reaches a peak in 2000. The second region is from 2001 to 2005. During this period, CEO perception decreases steadily and arrives at a trough in 2005. After 2005,

CEO perception increases again steeply. The evidence from the healthcare industry is partially corroborated by related work in the commercial bank industry that indicates that the prominence of IT and Internet-enhanced IT in CEO Letters to Shareholders has declined in the years from 1997 to 2005 [Baker et al., 2007]. Alternative explanations for these finding may exist; we will address these subsequently in the Discussion section of the article.

The results of our robust regression for IT terms are shown in Table 5. CEOs' perception of IT increases 0.37 point every year. However, for the cases of Initiative and Effect, we fail to reject the null hypothesis that the coefficient is zero. One possible explanation is that as Information Systems become integrated into many business functions into single, unified Information Systems such as ERP systems, CEOs can express the strategic importance of IT although the number of systems that firms introduce is few. For instance, the "Genesis" Information System in the Becton Dickison firm covers real-time business information, provides a single point of contract, facilitates inventory management, procurement, manufacturing, finance, human resources, and data storage and retrieval. The CEO in Becton Dickison boasts of the system in the Letter to Shareholders with many IT terms. Thus, in the case of Becton Dickison, the number of IT terms per system will be large. In 1998, the company introduced the Genesis Information System, expecting internal growth, cost savings, and operating efficiency as benefits. Thus, the number of initiatives is one and the number of effects for the system is three. Because the number of IT terms for 1998 is 6, the average number of IT terms for the system is 6 (6/1) and the average number of IT terms for effects is 2 (6/3).

Table 5: The Result of Robust Regression for CEO Perception

CEO perception measure	Intercept	Time	Firm Size	Capital Intensity
IT term	4.12 (0.01)	0.37 (0.04)	-0.25 (0.21)	0.59 (0.29)
Initiative	2.36 (0.00)	0.05 (0.18)	-0.29 (0.06)	0.14 (0.18)
Effects	2.63 (0.00)	0.04 (0.28)	-0.31 (0.10)	0.24 (0.06)

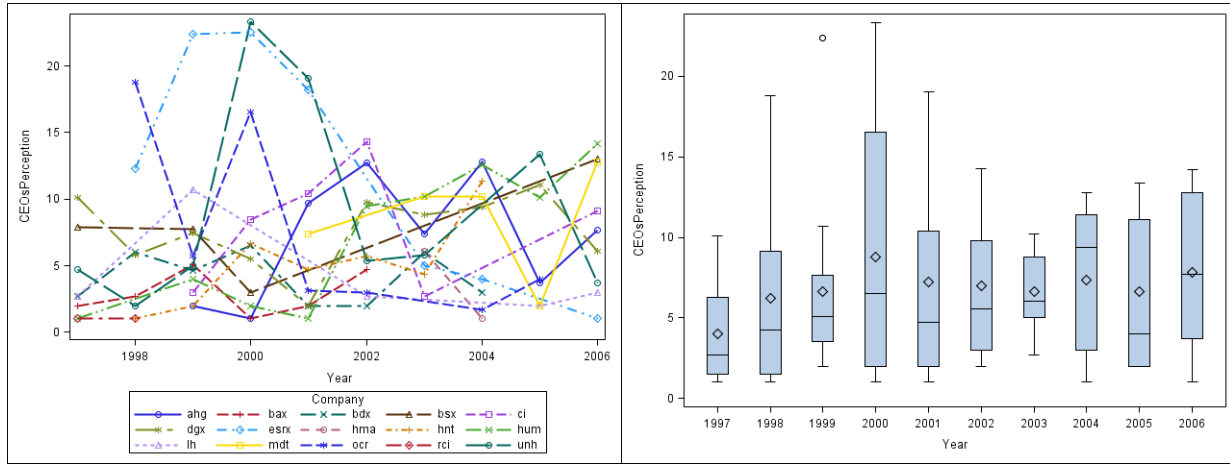
The value of parenthesis is *p*-value.

In this article, CEO perception of IT is measured with the number of IT terms. However, if a firm adopts many Information Systems in a certain year, the number of IT terms increases. If instead, a firm adopts few Information Systems, the number of IT terms decreases. For instance, if a firm introduces four Information Systems in 1997, and the number of IT terms is 12, the CEO's perception will be measured as 3 (12/4). Now, if the company introduces 1 Information System in 1998, and the number of IT terms is 3, the perception will be measured as 3 (3/1). If we compare the perception between 1997 and 1998 in terms of the number of IT terms, the perception for two years will be different. Therefore, in order to compare CEOs' perception, we normalize the measure by dividing by the number of adopted systems and the number of expected effects. The implicit assumption is that the more a firm adopts Information Systems and expects benefits from them, the more CEOs will use IT terms.

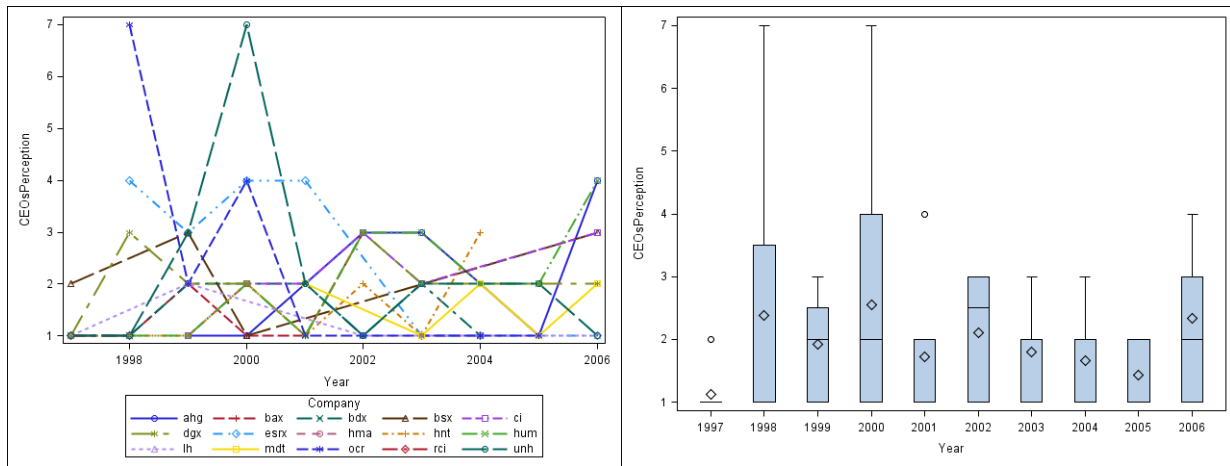
We, therefore, calculate two ratios, ITterm/Initiative, and ITterm/Effects, and show their trends in Figure 3. Examination of this graphic confirms that the two ratios increase over time. However, when regressing the two ratios on time, we have a 0.102 ($p < 0.10$) estimate for ITterm/Initiative and an 0.07 ($p < 0.12$) estimate for ITterm/Effects. At the 10 percent significance level, we are able to reject the coefficient of ITterm/Initiative is zero but to fail reject the null hypothesis of the coefficient of ITterm/Effects. This means that for one information system, CEOs expect multiple effects, and thus ITterm/Effects is not significant at the 10 percent significance level but ITterm/Initiative is significant, although the difference of significances are only 0.01 (0.12 – 0.10). Therefore, by considering a positive sign and significance, we are able to reject Hypothesis 1 that there is a significant drop in the CEOs' perception of the importance of IT over the last ten years.

We further test which years are highly associated with CEOs' perception by dummy variable regression with two control variables. Table 6 shows the year effect on CEOs' perception. In these results, y1997 is the intercept and the effects of y1998 can be calculated by adding its value with the value of y1997. Thus, the estimate of y1998 is 9.47 (7.58 + 1.86). For all three measures of CEO perception, we notice that the estimates of years from 1998 to 2006 increase compared to y1997. In particular, years 1997, 1998, 2000, 2002, and 2006 have a positive association with CEO perception. Thus, throughout the dummy regression, we also confirm that CEO perception increases over the last ten years, although CEO perception appears high in some years but low in other years. When we regress CEO perception on year, we have perception = 8.976 + 0.286year where the *p*-value for the slope is 0.04.

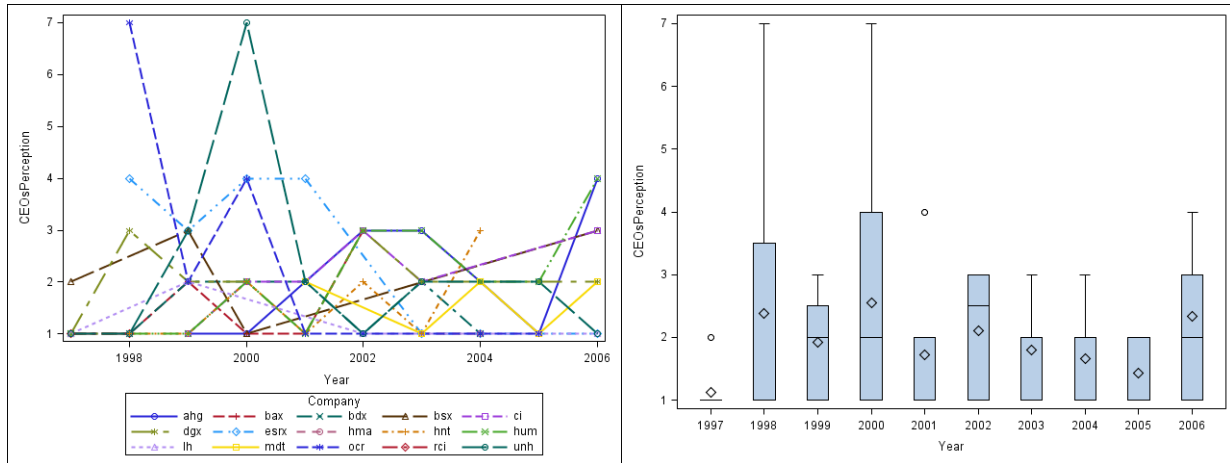
We test Hypothesis 2 with longitudinal analysis. We center CEO perception measures as well as each control variable on its grand mean for interpretation. Also, we select an appropriate model in terms of AIC and BIC criteria from several possible covariance structures including Unstructured (UN), Compound Symmetry (CS), Heterogeneous CS (CSH), Autoregressive (1) (AR(1)), and Heterogeneous AR(1) (ARH(1)) [Fitzmaurice et al., 2004; Wooldridge, 2002]. Table 7 shows fit statistics of models using five different covariance structures. For the all measures, UN does not converge. We use two firm performance measure, Tobin's *q* and ROA. For each dependent variable and independent variable, we select a model with the lowest AIC and BIC values as an appropriate model.



(a) The Trend of CEO Perception Measured with Frequency of IT Terms

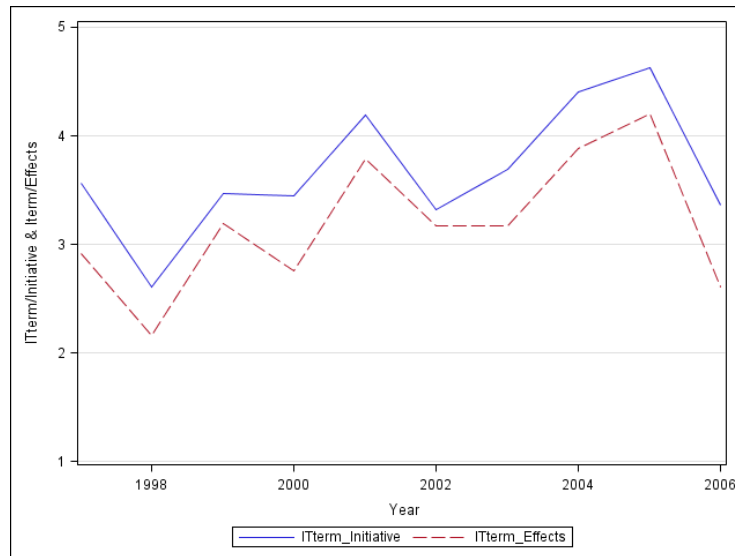


(b) The Trend of CEO Perception Measured with Initiative Type



(c) The Trend of CEO Perception Measured with Expected Effects

Figure 2. The Trend and Distribution of CEO Perception over Ten Years



Note

1. ITTerm/Initiative denotes the average number of IT terms per system that is calculated with IT terms divided by the number of systems.
2. ITTerm/Effects denotes the average number of IT terms per expected effects. For instance, if a systems is introduced for cost savings, operating efficiency, and internal growth, and 6 IT terms are used, the average number of IT terms per expected effects will be 2 with 6/3.

Figure 3. The Changes in Two Ratios, ITTerm/Initiative and ITTerm/Effects, Over Ten Years

Table 6: The Year Effect on CEO Perception

Year	y1997	y1998	y1999	y2000	y2001	y2002	y2003	y2004	y2005	y2006
IT perception	7.58*** ¹	1.89	2.60	4.76**	3.32	3.23**	2.81	3.50	3.22	4.37*
Initiative	1.86**	1.18**	0.78	1.42**	0.62	1.03**	0.71	0.57	0.43	1.32**
Effects	2.15***	1.43**	0.67	1.78***	0.53	0.86	0.74	0.56	0.33	1.72**

1. * p < 0.1, ** p < 0.5, and *** p < 0.01

Table 7: AIC and BIC for Three Models with Five Covariance Structures

Type	#Param	Tobin's q						ROA					
		IT term		Initiative		Effects		IT term		Initiative		Effects	
		AIC	BIC	AIC	BIC	AIC	BIC	AIC	BIC	AIC	BIC	AIC	BIC
UN	t(t+1)/2	-	-	-	-	-	-	-	-	-	-	-	-
CS	2	202.9	206.5	202.9	206.5	192.7	200.7	-253.1	-249.6	-258.4	-254.8	-260.7	-257.2
CSH	t+1	168.1¹	196.1	188.1	198.1	-	-	-	-	-246.0	-244.5	-286.9	-277.7
AR(1)	2	193.3	196.8	193.0	196.8	185.7	189.3	-253.5	-249.9	-258.7	-255.2	-260.7	-277.7
ARH(1)	t+1	-	-	173.0	181.5	-	-	-	-	-	-	-	-

1. In the linear growth model with dependent variable is Tobin's q and independent variable is IT term, CSH model show the lowest AIC and BIC value. Then, we choose CSH model as an appropriate model.
2. #Param denotes the number of parameters, and t denotes the number of years. For instance, in CS, two parameters (variance of year and covariance with neighbor year) are required.

Table 8 shows estimates of variables from each model. In these results, we are particularly interested in the CEO perception and CEO perception x Time variables. The CEO perception variable indicates the association between CEO perception and firm performance in 1997. In other words, the variable explains the variation of intercepts of the firm growth model. The other term of interest, CEO perception x Time, indicates that how well CEO perception is associated with firm performance over time. This variable explains variation of slopes of firm growth model. CEO perception x time is more meaningful for testing Hypothesis 2 because it explains the relationship between CEO perception and performance over ten years.

Table 8: The Coefficients of Selected Models

	Tobin's q			ROA		
	IT term	Initiative	Effects	IT term	Initiative	Effects
Intercept	1.848 (0.002) ¹	1.430 (0.017)	2.162 (0.001)	0.052 (0.021)	0.050 (0.034)	0.044 (0.002)
Time	-0.051 (0.341)	0.052 (0.321)	-0.063 (0.154)	0.002 (0.003)	0.002 (0.432)	0.003 (0.007)
CEO perception	0.105 (0.246)	0.123 (0.019)	0.244 (0.001)	0.001 (0.001)	0.006 (0.282)	0.007 (0.073)
CEO perception x Time	-0.034 (0.036)	-0.015 (0.107)	-0.051 (0.001)	-0.008 (0.000)	-0.001 (0.154)	-0.002 (0.020)
Firm Size	0.701 (0.078)	-0.326 (0.471)	0.557 (0.186)	-0.007 (0.761)	-0.009 (0.726)	-0.005 (0.746)
Firm Size x Time	0.014 (0.757)	0.100 (0.055)	0.013 (0.786)	0.004 (0.298)	0.003 (0.342)	0.006 (0.005)
Capital Intensity	-0.852 (0.029)	-0.706 (0.017)	-0.787 (0.028)	0.007 (0.735)	0.007 (0.721)	-0.001 (0.914)
Capital Intensity x Time	0.038 (0.390)	0.036 (0.291)	0.006 (0.886)	-0.006 (0.078)	-0.006 (0.083)	-0.004 (0.051)

1. The value in the parenthesis denotes p -value ($pr > |t|$)

2. Table 8 shows estimates of variables from each model. From the result, we are particularly interested in CEO perception and CEO perception x Time variables. The CEO perception variable indicates the association between CEO perception and firm performance in 1997. In other words, the variable explains variation of intercepts of firm growth model. On the other hand, CEO perception x Time indicates that how well CEO perception is associated with firm performance over time. This variable explains variation of slopes of firm growth model. Thus, CEO perception x time has more meaningful for testing the Hypothesis 2 because it explains the relationship between CEO perception and performance over ten years.

Firm performance (the dependent variable) is measured using Tobin's q as well as ROA. In the case of Tobin's q , CEO perception (the independent variable) as measured by initiative type and expected effects has a positive association with firm performance. These coefficients are significant at the 5 percent level. This means that at the beginning year (1997), CEO perception using initiative type and expected effects is positively associated with Tobin's q . In the case of initiative type, CEO perception is associated with Tobin's q by 1.553 (1.430 + 0.123), and for the case of expected effects, it is associated with Tobin's q by 2.406 (2.162 + 0.244). Thus, at the beginning of year 1997, CEO perception using the expected effects measure has a higher association with Tobin's q than CEO perception using initiative type.

Also, we test the relationship between CEO perception and firm performance over ten years by controlling for firm size and capital intensity. The coefficient of CEO perception x time shows that the marginal effect of CEO perception on Tobin's q decreases slightly with time. For instance, the effect of CEO perception decreases by 0.051 for the expected effects measure. Then, in the second year (in 1999), the total effect of CEO perception on Tobin's q using Effects measure becomes 0.142 (0.244 + -0.051x2), and in the fifth year, the effect of CEO perception will have -0.011 (0.244 x -0.051x5). The negative coefficients of CEO perception x Time are significant for both the number of IT terms and the expected effects measure, but not for initiative type measure at the 5 percent significance level. At the 10 percent significance level, the coefficient of CEO perception x Time is almost significant. Given the negative signs for IT terms, initiative type, and expected effects, and the significance of the estimates, we have evidence that the marginal effect of CEO perception on firm performance slightly decreases over time. In the case of ROA, we reach the same result. In this case, the negative coefficients of CEO perception x Time are also significant for both IT terms and expected effects, but not for initiative type at the 5 percent significance level.

Therefore, given the negative marginal effect of CEO perception x Time variable over time, we reject Hypothesis 2, that the CEO's perception on the strategic importance of IT will be positively associated with a firm's performance.

VI. DISCUSSION

In this study, we present evidence that although CEOs' perceptions of IT are increasing, the association of IT perception with firm performance is decreasing, an evidence of IT commoditization. One possible explanation for the increasing prominence of IT as a theme in these CEOs' letters is the existence of the technology boom of the late 1990s. It seems conceivable that CEOs mentioned IT at this point in time because rapid investment was being made in technology across a broad spectrum of industries. Because IT was of broad importance to all firms worldwide, we would expect to see the peak in 2000, and find the support from Figure 2. Another explanation for the increasing

CEOs perceptions of IT is the trend toward multi-functioned Information Systems. As IT investment in the healthcare industry is increasing, Information Systems are beginning to embrace many business functions. Thus, it seems likely that CEOs expect more benefits in later years than in the early years. Large investments in IT began to be made in the middle of the first decade of the twenty-first century, not before [Khoumbati et al., 2006; McGee, 2004, 2005; Menachemi et al., 2006]. In light of this fact, it seems more likely that IT will be mentioned prominently toward the end of our ten-year data window, not toward the front.

However, despite CEOs' increasing emphasis on IT, IT's association with firm performance is decreasing. One possible reason is that as competition in the industry is increasing and many CEOs are paying attention to IT, the strategic value of IT has been declining. If firms attain their strategic goals such as increased productivity and additional value provided to customers, any potential benefits using IT might be competed away [Chang et al., 2003]. Firms may have increased productivity but that is not connected with performance proportionally in such competitive environments. Oz [2005] proposes that once technology has matured, IT investment may not result in economic gain, and rather IT becomes a disadvantage if firms do not use the matured technology properly. Another reason is that IT influences can be varying according to right use [Feld and Stoddard, 2004]. Even though two firms adopt the same technology, its effects can be different because of variation in IT management capabilities and IT governance [Neirotti and Paolucci, 2007].

Additionally, we have tested the effects of IT initiative types by classifying IT systems as new, redevelopment, enhancement, or use, and find that systems that are new or redevelopments have a positive association with Tobin's q at the 5 percent significance level. This implies that new systems and redevelopments that require intensive investment have a higher association with firm performance than continuous use systems and enhancements of existing systems. Thus, we contend that our explanation of the commoditization of the IT resource is plausible.

Theoretical Implications

It seems conceivable that IT may be viewed as a priority by CEOs since they are mentioning it more in their letters at the end of our observation period, but as we have noted, the relationship between IT and firm performance becomes weaker. IT is certainly becoming more common and more embedded in business processes, but this in and of itself does not mean that IT is, in fact, commoditized or that competitive advantage cannot be built from it. Instead, findings from our first and second hypotheses show that as markets become more competitive, IT management capabilities and strategic use become more important. These management capabilities and strategic applications can continue to be valuable, rare, inimitable, and non-substitutable even if the technology itself is commoditized.

CEOs' perceptions of IT are a necessary but not sufficient condition for improved firm performance. In order to obtain competitive advantage in the use of IT, CEOs need elaborate, contextually appropriate strategies for IT and management. CEOs who understand IT and value its strategic importance can reap benefits for their organization. Thus, instead of accepting the arguments of commentators who argue that the strategic importance of IT is waning, researchers should examine firms where IT is being used to benefit customers and shareholders. It seems plausible that CEOs who are knowledgeable about IT and its novel application to business problems will continue to be able to benefit financially and strategically from it. Future studies will certainly provide additional insights for researchers.

Methodological Implications

This study investigates CEOs perspectives on IT and how those perspectives are associated with firm performance. The analysis presented here demonstrates how text mining may be used in theory-driven IS research. Research questions that lead to testable hypotheses can be investigated using text mining and evaluated with established methods of analysis, including regression, and the inspection of descriptive statistics. Additional analysis using t-tests, ANOVAs, and a host of time-series techniques can be used in the future. We have argued that text mining may evolve into a modern, highly automated variant of content analysis [Krippendorff, 1980]. Such a development would represent a valuable tool for researchers, one with which they could undertake multi-methodology studies to triangulate their results.

Furthermore, our study affirms that CEOs' Letters to Shareholders can be used as a tool to investigate their perspectives on firm strategy. The continued use of this letter should be encouraged within the IS research community as a source of information on the strategy of a firm. Future work may utilize these letters as a data source for investigating a number of research questions. For instance, CEO involvement in IT could be assessed using these letters. Alternately, the frequency with which IT strategy and corporate strategy are mentioned could be examined. Advances in semantic analysis may provide an avenue to investigate alignment between the two.

Managerial Implications

The findings of our study provide useful information to practitioners. The first finding of this study is that IT is becoming a less-prominent component of corporate strategy than it has been in the past. This suggests that CIOs, IT Directors, and others within the IT function of an organization may need to educate their CEOs about the strategic importance and financial benefits of IT. The second finding of this study provides support for IT leaders when they approach CEOs with proposals for IT investment. The insight that companies that feature IT as a component of their corporate strategy see better returns on assets and better shared values allows IT leaders to present a compelling case for supporting IT. In sum, CEOs should educate themselves—or IT leaders should educate them—about the benefits of IT to their organization and its bottom line.

Limitations and Future Research

First, we have investigated only the healthcare industry. The role of IT may vary across industries, and, therefore, our findings may have limited generalizability. However, as we noted earlier, similar results have been found in the commercial banking industry [Baker et al., 2007] and may hold in other industries as well. Second, we have conducted only very fundamental quantifications of CEOs' perspectives on IT. Future work should examine whether these perspectives can be categorized as positive or negative. Then, the impact of a CEO's positive perspective on the use of IT could be compared with the impact of a CEO's negative perspective on IT. This would allow a comparison of text mining results with content analysis results, to assess whether the text mining may one day be a substitute for content analysis. Third, other levels of analysis could be examined. Here, we have looked only at the firm level, but, clearly, differences across industries may provide valuable information as well. Fourth and finally, other dependent variables for measuring firm performance could be incorporated into this analysis. In sum, the extension and further development of this study will shed further light on the role of IT in corporate strategy.

VII. CONCLUSION

IT has been, and remains, an important component of corporate strategy. Its mention in CEOs' Letters to Shareholders indicates that it is among the most important information that executives want to communicate to analysts, shareholders, employees, and other stakeholders. And rather than seeing the growing ubiquity of IT but the diminishing impacts on performance as evidence of its declining importance, researchers and practitioners should realize that the embeddedness of IT in business processes reveals a host of ways in which IT can continue to be leveraged to gain competitive advantage.

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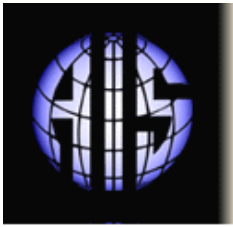
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