

DOES CEO'S IT KNOWLEDGE MATTER? AN EMPIRICAL ANALYSIS OF EARNINGS CONFERENCE CALLS

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Abstract

We study the impact of Chief Executive Officer (CEO)'s IT knowledge on firm performance by leveraging the knowledge-based view and the influence of top management. We take an innovative approach by examining CEO's conversation with financial analysts and investors in the earnings conference calls, which are considered as the biggest information event for listed companies. We measure CEO's IT knowledge by counting the amount of IT discussions in the CEO's answers to IT-related questions at the conference calls. The results show a positive relationship between CEO's IT knowledge and firm performance. The findings will have clear and high contributions to the core IS literature of business value of IT by explicitly studying the role of top executives in IT success.

Keywords: Chief Executive Officer, CEO, IT Knowledge, Knowledge-Based View, the Influence of Top Management, Firm Performance, Business Value of IT.

1 Introduction

The Chief Executive Officer (CEO), who is responsible for key business areas of the firm, is critical to firm performance. The CEO has been characterized as a firm's chief cognizer and decision maker (Calori et al., 1994), and its importance in driving strategic changes in firms has been highlighted by literature (Rajagopalan and Spreitzer, 1997). Empirical evidence has suggested that characteristics of CEOs affect strategic decision processes (Peterson et al., 2003) and strategic actions (Carpenter et al., 2001) that have implications for firm performance. Other studies find direct evidence that characteristics of CEOs (e.g., CEO personality) influence firm performance (Nadkarni and Herrmann, 2010).

In IS literature, the role of the CEO in IT success has received attention for a long time. More than twenty years earlier, IS scholars have pointed out that as applications of IT become a necessary element of organizational strategy, the CEO's views and leadership about investments in IT will considerably become more relevant and more instrumental in corporate success or failure (Clemons and Row, 1988; Jarvenpaa and Ives, 1990). Jarvenpaa and Ives (1991) show that a CEO's perceptions and attitudes concerning IT are strongly associated with the firm's progressive use of IT. It is also found that CEOs with more IT knowledge are more likely to implement IT adoption (Ettlie, 1990; Thong, 1999). Participation of the CEO in IT planning helps to secure top management support, and it is critical in producing managerial knowledge of information assets and IT opportunities (Boynton et al., 1994; Kearns and Lederer, 2003; Lederer and Mendelow, 1989).

Despite the enthusiastic calls for the CEO's support for IT, little is known about its impact on firm performance. CEO's IT knowledge, one important characteristic of the CEO, remains largely unexplored. As IT has become a necessary element of organizational strategy, the question that how CEO's IT knowledge can affect the implementation of IT within organizations and to what extent it can influence firm performance, is important to our understanding of the business value of IT. In this paper, we

adopt the knowledge-based view and the influence of top management as our theoretical foundation to study the impact of CEO's IT knowledge on firm performance. Knowledge-based view, which is developed in management area, views a firm as an economic structure for integrating the knowledge from individual specialists. The influence of top management is considered important in IT success and is widely discussed in IS literature.

In this paper, we propose an innovative approach to get objective measures of CEO's IT knowledge from the earnings conference call transcript data. We believe that the earnings conference call transcript data can be used as an important complementary data source to self-reported surveys and interviews. The data are more objective and disclose important information about a firm. One reason that CEO's IT knowledge remains largely unexplored is the challenge in CEO data access. Almost all extant studies rely on interviews and surveys to measure CEO characteristics and behaviours. There is only one exception that use CEO's letters to observe CEO's IT perspectives and participation (Jarvenpaa and Ives, 1990; 1991). Compared with Jarvenpaa and Ives (1990, 1991), our approach is better in information richness, and could be generalized to measure other top executives besides CEOs.

This study have two major contributions. First, it contributes to the growing literature on management support for IT and the business value of IT by examining the impact of CEO's IT knowledge on firm performance. We propose that CEO's IT knowledge has positive influence on firm performance, and the empirical evidence provides support for our argument. Second, it contributes by introducing a new approach to measure CEO's IT knowledge. Given the difficulty in achieving CEO's data of prior studies that have relied exclusively on interviews and surveys, our approach provides objective and information-rich measures of CEO's IT knowledge. It is also possible to use the approach to study a large sample of CEOs.

The paper is organized as follows. The next section presents the theoretical arguments for our research hypothesis. In section 3, we present details of the data and the empirical analysis. Finally, we present the results and discuss the implications and limitations of the study.

2 CEO's IT Knowledge and Firm Performance

The foundation of our theoretical framework comprises of two elements: the knowledge-based view and the influence of top management.

2.1 Knowledge-based View

From the knowledge-based view, a firm is an economic structure for integrating the knowledge of different individuals in the superior production of value-added products and services (Grant, 1996a; 1996b). The knowledge-based view emphasizes the importance of common knowledge, as it permits individuals to share and integrate aspects of knowledge which are not common between them.

CEO's IT knowledge is important to the common knowledge of IT within organizations. CEO's IT knowledge encompasses the knowledge of an organization's IT infrastructure, IT strategy, and IT actions. While there are five different types of common knowledge, in our context IT knowledge is related to shared meaning and recognition of individual knowledge domains. Shared meaning and recognition refers to the establishment of shared understanding between individuals, and at the same time, each individual is aware of everyone else's knowledge repertoire. CEO's IT knowledge is beneficial for the establishment of shared understanding between the CEO and the other managers and employees, for example, the CIO. Furthermore, CEO's IT knowledge is important for the CEO to recognize the abilities of the other managers such as the CIO.

Later studies, which extend the knowledge-based view, argue that there are two distinct components of the structures for knowledge integration: objective knowledge and systems of knowing (Spender 1996; Armstrong and Sambamurthy 1999). Objective knowledge refers to the explicit knowledge processed

by individuals; while systems of knowing refer to structures of interaction among individuals for sharing the perspectives, pooling the knowledge, and developing the shared understanding.

CEO's IT knowledge are related to both objective knowledge and systems of knowing. On the one hand, CEO's IT knowledge is the CEO's objective knowledge, and it is critical to the firms' knowledge integration and IT use. CEOs with a high IT knowledge can better understand the IT issues, such as appropriate technologies to invest in, the timing of those investment choices, and the level of investments. Besides, the CEO with a high level of IT knowledge is more adept at effective use of IT applications in supporting, shaping, and enabling the firm's business strategies and value-chain activities. On the other hand, the CEO with a high level of IT knowledge is beneficial to the firm's systems of knowing for IT, especially for the convergence between IT and business executives. Johnson and Lederer (2005) find such convergence exists when business executives understand IT objectives. The knowledge of the senior leadership and the interactions among them are expected to have a significant influence on firms' IT assimilation, which is important for firm performance (Armstrong and Sambamurthy, 1999). In addition, the CEO-CIO relationship has been viewed as a factor of IT success. The closer the CEO-CIO relationship, the greater the IS influence on top-level decision making in the organization (Jones et al., 1995). Banker et al. (2011) also summarizes that, in IS literature, IT success is more likely if the CIO is closer to the CEO. The CEO with a high level of IT knowledge can have better communications with the CIO. It is found that successful CEO-CIO relationships are linked to a shared vision of the role of IT (Feeny et al. 1992).

According to the knowledge-based view, CEO's IT knowledge is beneficial for IT knowledge integration within the firm, and it is beneficial for IT use and IT success. As both knowledge integration and IT use can exhibit significant business value, we argue that CEO's IT knowledge will significantly enhance firm performance.

2.2 The Influence of Top Management

The importance of top management in IT success within organizations has long been recognized by IS practitioners and academics. A broad base of literature provides theoretical support for the role of top management in driving IT usage (Reich and Benbasat 1990). For example, it is found that the efforts to convince top management of the strategic impact of information systems impede IT planning (Lederer and Mendelow, 1986; 1988). Byrd et al. (1995) later show that management support and attitudes toward IT planning are important determinants of planning success. For large scale systems, top management is especially critical for forging partnerships among functional area executives (Doll and Vonderembse 1987). Prior studies also find that top management affects progressive usage of IT in companies (Jarvenpaa and Ives 1991), increases the assimilation of web technologies (Chatterjee et al. 2002), and can even reverse failing implementations (Akkermans and van Helden 2002).

The CEO, who positions at the top level of the management hierarchy, is important in IT success. Previous studies indicate the importance of the hierarchical level of the executive in influencing the importance given to IT in the organization. Ein-Dor and Segev (1981) propose that any significant effect due to rank would decline rapidly the lower the rank of the IS executive, and would be "virtually negligible" when it is more than two ranks below the CEO. In other words, the CEO plays the most critical role in management support. The influence of the CEO is revealed in a tale of two IS projects (Emery 1990). Two different companies, both in the financial services industry, set about to develop an important mainline system to provide online support of their principal transaction processing activities. The implementation tools and methodology were essentially identical in the two cases. Even the technical teams were very similar. The only thing that differed in any substantial way was the support of the CEOs of the two companies. One company achieved an outstanding success, while the other failed completely. In the successful company, both the president and the chairman (play similar role of the CEO) actively participated in the IT project. In contrast, the CEO in the failed company largely delegated supervision of the project to the head of the information systems group, who himself displayed no great

enthusiasm for the whole affair. This tale reveals just how important the CEO is to the success of an IT project.

CEO's IT knowledge is important to the CEO's attitude to IT. Keen (1991) argues that when top management teams do not possess a high strategic IT knowledge, they could abdicate key IT initiatives to their CIO or the IS department, and such conditions are likely to impair the organization's effective use of IT. Empirical test shows that such impact may decline significantly even when the IS head is more than one level below the CEO (Raghunathan and Raghunathan, 1989). Accordingly, if the CEO has more IT knowledge, it is more possible that the CEO will actively participate in the IT project. Otherwise, he might delegate supervision of the project to the CIO or the IS department.

IS literature has long suggest that information technologies can exhibit significant business value when firms are able to apply IT effectively in their business activities (Armstrong and Sambamurthy, 1999; Boynton et al., 1994; Brynjolfsson and Hitt, 1996; Cooper and Zmud, 1990; Trice and Treacy, 1986). As CEO's IT knowledge have great influence in the success of IT projects, we argue that CEO's IT knowledge has great impact on firm performance.

3 Research Data and Variables

Our study uses a sample of Standard & Poor's 500 (S&P 500) firms of ten years from 2003 to 2012. We exclude information technology firms for a concern that many of the CEOs in the IT firms are IT experts, and the importance of their IT knowledge is obvious. Our interest focuses on the impact of CEO's IT knowledge in non-IT firms. We obtain the Global Industry Classification Standard (GICS) code for each firm, and exclude the firms whose GICS code begins with 45, which are industries of *Software & Services*, *Technology Hardware & Equipment*, and *Semiconductors & Semiconductor Equipment*. We end up with 518 firms after this step.

Our data are from five sources. We obtain earnings conference call data from transcripts compiled by *TomsonReuters*, IT capability rank data from the Annual *InformationWeek 500*, firm financial data from *Compustat*, CEO compensation data from *ExecuComp*, stock price and shares outstanding data from *CRSP*.

In the following part, we present our measures. The description of all the variables used in our analyses are shown in Table 1.

3.1 CEO's IT Knowledge

We adopt a similar approach in Jarvenpaa and Ives (1990). Jarvenpaa and Ives (1990) use the number of IT-related phrases in the CEO's letters to observe CEO's perspectives on IT and strategy. Our measure of CEO's IT knowledge is the extent to which a CEO communicates with the audience about IT at the earnings conference calls. We obtained 14,858 earnings conference calls in total. For each conference call, we identify the date of the call, the name and ticker symbol of the firm, and the names, titles, speak contents, and the speak order of the participants.

The earnings conference call is a way for companies to relay information to all interested parties, including investors and analysts. Companies usually conduct these calls immediately following the release of financial results, typically at the end of each quarter. Conference call participants usually include the CEO, the CFO and various other executives, depending on situations. There are two sessions of the conference calls. In the first session, the executives provide an overview of all the major issues that affected the company's performance during the last quarter. The second session is question and answer (Q&A), during which analysts and investors can ask questions regarding the company. Conference calls are a great way for top management keeping the investors and analysts informed about the company.

We construct two measures for CEO's IT knowledge. We focus on the Q&A session, because it is more representative of CEO's knowledge. In contrast to the speech session, which could be prepared by others

before the conference call, CEOs give answers based on their own knowledge in the Q&A session. We measure how much the CEO has talked about IT in the Q&A session. The basic logic is that the more IT is talked about, the more IT knowledge is the CEO. We identify CEO IT-related answers and count the number of words. The first measure, *CEOwords_toITQ*, focuses on the CEO's responses to the IT-related questions. *CEOwords_toITQ* is the total number of words of a CEO responding to IT questions in the Q&A session of a conference call. The second measure, *CEOwords_ITAns*, focuses on the CEO's responses that are IT-related, but the questions he respond to may not be IT-related. *CEOwords_ITAns* is the total number of words in the CEO's responses that are IT-related. We use the logarithms of these variables.

To identify IT-related questions and IT-related answers, we compile a list of IT words. We search these IT words in the questions and CEOs' answers. If one or more of the IT words are included, then the question or the answer is identified as IT-related. To compile the word list, we first review IS studies that have searched for IT investment news, and obtained the following IT words (Im et al., 2001; Ranganathan and Brown, 2006; Subramani and Walden, 2001): *computer, hardware, software, Internet, Intranet, Client/Server Systems, DSS, EIS, ES, ERP, enterprise resource planning, enterprise systems, decision support systems, executive information system, e-commerce, e commerce, and electronic commerce*. Second, we review the IT word lists on Wikipedia and other websites, and add the IT words that are important in our opinion but not included in previous studies: *laptop, notebook, PC, information systems, information technology, information services, operating system, file system, database, data base, data warehouse, data mart, ETL, business intelligence, cloud computing, cloud*. We include all these words and their variations in our search.

The conference calls are typically quarterly events, however, most other variables that we use in this study are measured at annual basis. We therefore aggregate the conference call data to annual observations by averaging the numbers across all conference calls for a firm within a fiscal year. After this procedure, there are 3,837 firm-year observations.

3.2 Firm Performance

We use *Tobin's q* to measure firm performance. Financial market measures such as Tobin's *q* are considered as better indicators of future growth options associated with intangible assets such as IT investment and IT knowledge (Bardhan et al., 2013; Bharadwaj et al., 1999; Kohli et al., 2012). Tobin's *q* represents the market-to-book ratio of the firm, and is a forward-looking measure of firm value that accounts for the lag effects between intangible assets and the payoff.

Multiple approaches have been adopted for calculating Tobin's *q*, but the different approaches tend to yield very similar values (Chung and Pruitt, 1994). Here we adopt the approach used in Bharadwaj et al. (1999) and Bardhan et al. (2013). In our approach, Tobin's *q* is the sum of market value of common equity, liquidating value of preferred stock and book value of debt, scaled by total assets.

3.3 IT Capability

To distinguish the measure of CEO's IT knowledge from firm's IT capability, and to demonstrate that the impact of CEO's IT knowledge on firm performance is not because of its correlation with IT capability, we include IT capability in our analysis. To measure firm's IT capability, the rankings provided by InformationWeek (IW) in their annual special issue are used. Since 1989, InformationWeek (IW) has selected and ranked 500 companies as IT leaders of technology in their respective industries for each year. The selection criteria have evolved with changing business and technological developments.

In general, the IT leaders and their rankings are determined by a select group of industry analysts, IT executives, IS researchers, and other practitioners, who are asked to vote for the firms they consider to be most effective and efficient in use of IT. The IW Rank is used as a measure of a firm's overall IT capability in IS studies (Bharadwaj, 2000; Chae et al., 2014; Santhanam and Hartono, 2003; Stoel and

Muhanna, 2009). Therefore, we create a dummy variable *IW500* as a measure of IT capability. *IW500* is 1 if the firm is ranked as IW500 IT leaders in that year, otherwise *IW500* is 0.

Variable	Description
Tobin's q_{it}	The sum of market value of common equity ($CSHO*PRCC_F$ from Compustat), liquidating value of preferred stock ($PSTKL$ or $PSTKR$ if $PSTKL$ is missing from Compustat) and book value of debt scaled by total assets (AT from Compustat) measured at the fiscal year end of year t . Book value of debt is computed as the difference between current liabilities (LCT from Compustat) and current assets (ACT from Compustat) plus inventory ($INVT$ from Compustat) plus long-term debt ($DLTT$ from Compustat).
$IW500_{it}$	Dummy variable, 1 for firm i ranked as InformationWeek 500 IT leaders in year t ; 0 for otherwise.
$CEOwords_toITQ_{it}$	The total number of words of a CEO responding to IT questions in the Q&A session of a conference call, averaged across all the conference calls of firm i in year t ; taken the natural logarithm.
$CEOwords_ITAns_{it}$	The total number of words in the CEO's responses that are IT-related in the Q&A session of a conference call, averaged across all the conference calls of firm i in year t ; taken the natural logarithm.
$CEOwords_{it}$	The total number of words of a CEO in the Q&A session of a conference call, averaged across all the conference calls of firm i in year t ; taken the natural logarithm.
$CIOParticipate_{it}$	The ratio that the CIO participates an earnings conference call of firm i in year t .
$CEOCompensation_{it}$	CEO's total compensation from firm i in year t , used as a proxy of a CEO's overall capability; taken the natural logarithm.
$CEOTenure_{it}$	CEO's number of years in office of firm i until year t , used as a proxy of a CEO's knowledge about the firm in general; taken the natural logarithm.
$ADVT_{it}$	Advertising expense (XAD from Compustat) divided by sales revenue of firm i in year t .
$R\&D_{it}$	R&D expense (XRD from Compustat) divided by sales revenue of firm i in year t .
$Growth_{it}$	The year-over-year percentage sales growth using the firm's net sales ($SALE$ from Compustat), equals $100 * (\text{sales revenue in year } t - \text{sales revenue in year } t-1) / \text{sales revenue in year } t-1$.
$Asset_{it}$	Total company assets (AT from Compustat) of firm i in year t , used as a proxy for firm size; taken the natural logarithm.

Table 1. Variable Description

3.4 Control Variables

We review IS studies that have used firm performance as the output, especially those use Tobin's q as the dependent variable, and find that there are two common controls: industry level controls and firm level controls. In this study we use industry dummies to control for industry factors, and use advertising expenditure, R&D expenditure, sales growth, and firm size as our firm-specific controls (Bardhan et al., 2013; Bharadwaj, 1999; Hitt and Brynjolfsson, 1996).

Variables	Mean	Std. dev.	[1]	[2]	[3]	[4]	[5]	[6]	[7]	[8]	[9]	[10]	[11]	[12]
[1]Tobin's q	1.37	1.11	1											
[2] IW500	0.17	0.38	-0.11	1										
[3] CEOwords_toITQ	0.77	1.59	0.11	0.01	1									
[4] CEOwords_ITAns	1.45	2.15	0.09	0.04	0.38	1								
[5]CEOwords	6.99	1.82	0.01	-0.05	0.02	0.25	1							
[6]CEOCompensation	8.90	0.74	-0.02	0.04	0.05	0.04	-0.04	1						
[7]CEOTenure	1.59	0.78	0.08	-0.02	0.012	-0.02	-0.04	0.07	1					
[8]CIOParticipate	0.02	0.09	-0.03	0.05	-0.03	0.00	0.03	0.01	0.03	1				
[9]ADVT	0.01	0.03	0.21	-0.03	0.06	0.02	0.05	0.07	-0.03	-0.04	1			
[10]R&D	0.02	0.06	0.20	-0.05	0.00	0.01	-0.03	0.03	0.01	0.05	0.01	1		
[11]Asset	9.71	1.36	-0.51	0.16	-0.12	-0.15	-0.16	0.32	-0.06	0.04	-0.12	-0.10	1	
[12]Growth	7.43	28.49	0.09	-0.02	0.02	0.028	-0.03	0.03	0.01	-0.00	-0.03	0.07	0.03	1

Table 2. Descriptive Statistics and Spearman/Pearson Correlation Matrix of Variables

(Notes: Bold values indicate correlations that are significant at $p < 0.01$; Bold Italics indicate correlations that are significant at $p < 0.05$)

We control for the general talkative level of a CEO using *CEOwords*, which is the total number of words spoken by the CEO in the Q&A session of a conference call. This variable is also aggregated to the annual level. We also control for *CIOParticipate*, which is the ratio that the firm's CIO participates an earnings conference call in a fiscal year.

We also control for some basic CEO characteristics. We use *CEOCompensation*, which is the total income of a CEO from the company in a year, to proxy for the CEO's overall capability; and use *CEOTenure*, which is the number of years that the CEO has been in office of the firm, to proxy for the CEO's knowledge about the firm in general.

4 Models and Results

4.1 Descriptive Statistics

Exclude observations with missing values, we have a final sample of 2,778 observations, which is an unbalanced panel of 473 firms for 10 years from 2003 to 2012. We present the descriptive statistics and the correlation matrix of our data set in Table 2. The correlation coefficients between the CEO's IT knowledge variables and Tobin's q are generally around 0.1 and significant. This indicates initial support for our hypothesis. In addition, it does not indicate the presence of multicollinearity in our estimation models.

4.2 Econometric Estimation

Fixed-effect models are used to estimate the association between CEO's IT knowledge and Tobin's q, controlling for other characteristics of the CEO, as well as the firm and industry specific explanatory variables. We test the following two regression equations in a hierarchical manner:

$$\text{Tobin's } q_{it} = \alpha + \beta \text{ IT Capability}_{it} + \gamma \text{ Controls}_{it} + \rho_i + \omega_t + \varepsilon_{it} \quad (1)$$

$$\text{Tobin's } q_{it} = \alpha + \beta \text{ IT Capability}_{it} + \delta \text{ CEO's IT Knowledge}_{it} + \gamma \text{ Controls}_{it} + \rho_i + \omega_t + \varepsilon_{it} \quad (2)$$

Where:

ρ_i is the fixed effect of a firm;

ω_t is the fixed effect of a fiscal year;

ε_{it} is an i.i.d error term with zero mean.

The basic model, *model (1)*, tests the association between IT capability and firm performance. In *model (2)*, we include CEO's IT knowledge to test our hypothesis. We estimate both models by separately running the fixed-effect regression.

4.3 Main Results

The estimation results are presented in Table 3. Column 1 shows result of *model (1)*, and columns 2 and 3 show results of *model (2)*. We use two variables of CEO's IT knowledge, and run the estimation for *model (2)* for twice. The results indicate that *IW500* is not significant, neither in *model (1)* or in *model (2)*. This is consistent with the results of Chae et al. (2014). One explanation is that using the *IW500* to measure IT capability introduces some important limitations. For example, the selection criteria and procedure are not scientific and rigorous enough to provide consistent data for research.

The results show that CEO's IT knowledge is positive and significant. *CEOwords_toITQ*, which count CEO's responses to IT-related questions, are positive and significant at 0.01 level. *CEOwords_ITAns*,

which counts CEO's IT-related responses, is positive and significant at 0.1 level. The VIFs are small, which suggest that there is a small possibility for the multicollinearity problem.

VARIABLES	(1)		(2)		(3)	
	Tobin's q	VIF	Tobin's q	VIF	Tobin's q	VIF
IW500	-0.023 (-0.644)	1.05	-0.028 (0.036)	1.05	-0.025 (0.036)	1.06
CEOwords_toITQ			0.034*** (0.008)	1.03		
CEOwords_ITAns					0.011* (0.006)	1.1
CEOwords	-0.004 (-0.357)	1.05	-0.006 (0.011)	1.05	-0.007 (0.011)	1.11
CIOParticipate	0.143*** (6.337)	1.17	0.292* (0.171)	1.17	0.267 (0.172)	1.18
CEOCompensation	0.008 (0.390)	1.02	0.141*** (0.022)	1.02	0.141*** (0.023)	1.02
CEOTenure	0.202 (1.514)	1.01	0.008 (0.021)	1.01	0.010 (0.021)	1.01
ADVT	4.748*** (3.189)	1.03	4.914*** (1.484)	1.04	4.815*** (1.489)	1.03
R&D	0.103 (0.327)	1.03	0.116 (0.314)	1.03	0.123 (0.315)	1.03
Asset	-0.741*** (-16.779)	1.23	-0.742*** (0.044)	1.25	-0.743*** (0.044)	1.25
Growth	0.002*** (4.387)	1.04	0.002*** (0.000)	1.04	0.002*** (0.000)	1.04
Year Dummies	Yes		Yes		Yes	
Constant	7.272***		7.288***		7.311***	
Observations	2,778		2,778		2,778	
Number of firms	473		473		473	
R-squared	0.226		0.232		0.227	
F test	37.01		36.29		35.29	

Table 3. Fixed Effects Estimation Results

(Notes: Standard errors in parentheses; *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$)

The general talkative level of a CEO (*CEOwords*) is not significant, which exclude the alternative explanation that the number of IT words is just a proxy for the general length of CEO's response. As we have expected, CEO compensation (*CEOCompensation*) is positively associated with Tobin's q. The ratio of CIO participation has a weak positive association with Tobin's q as well.

The results for other control variables are almost consistent with prior results in extant research. Advertising expenses (*ADVT*) and sales growth (*Growth*) are positively associated with Tobin's q. However, *R&D* is not significant in our model. Firm size measured by total assets (*Asset*) is negatively associated with Tobin's q. Although surprising, it is consistent with the result in Bharadwaj et al. (1999).

4.4 Robustness Check

Our first robustness check use an alternative measure for CEO's IT knowledge. Rather than counting all the words in responses to IT-related questions, we count IT words instead. It is aimed to address the

concern that our previous measures might be blurred by words in the non-IT part in CEO's responses. Therefore we construct alternative measures that count IT words only. *CEOITwords_toITQ* is the total number of IT words in the CEO's responses to IT questions. *CEOITwords_ITAns* is the total number of IT words in the CEO's IT-related responses. These variables are aggregated to annual level. Table 4 shows the estimation results using these alternative measures. The results are qualitatively consistent with our main results. Both variables of CEO's IT knowledge remain positive and significant.

VARIABLES	(1)		(2)	
	Tobin's q	VIF	Tobin's q	VIF
IW500	-0.024 (0.036)	1.05	-0.025 (0.036)	1.06
CEOITwords_toITQ	0.180** (0.074)	1.02		
CEOITwords_ITAns			0.131*** (0.045)	1.07
CEOwords	-0.005 (0.011)	1.05	-0.009 (0.011)	1.09
CIOParticipate	0.284* (0.172)	1.18	0.268 (0.172)	1.18
CEOCompensation	0.140*** (0.023)	1.02	0.140*** (0.023)	1.02
CEOTenure	0.009 (0.021)	1.01	0.011 (0.021)	1.01
ADVT	4.758*** (1.487)	1.04	4.879*** (1.487)	1.04
R&D	0.101 (0.314)	1.03	0.124 (0.314)	1.03
Asset	-0.740*** (0.044)	1.25	-0.743*** (0.044)	1.26
Growth	0.002*** (0.000)	1.04	0.002*** (0.000)	1.04
Year Dummies	Yes		Yes	
Constant	7.284***		7.322***	
Observations	2,778		2,778	
Number of firms	473		473	
R-squared	0.228		0.228	
F test	35.47		35.63	

Table 4. Fixed Effects Estimation Results (Only count IT words)
(Notes: Standard errors in parentheses; *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$)

In our second robustness check, we use a subsample for analysis. It is possible that the CEO did not talk about IT in the Q&A session not because of their lack of knowledge in IT, but because they were not asked about IT. Our measures have counted for this issue in some extent. Now we further address this issue by using a subsample analysis. We exclude the observations for which the CEO's IT knowledge is zero. In other words, we only include observations that the CEO have talked about IT at least once in the conference calls in a fiscal year. The results are presented in Table 5. Both variables of CEO's IT knowledge are positive and significant at 0.01 or 0.05 level. These results are qualitatively consistent with our main results.

VARIABLES	(1)		(2)		(3)	
	Tobin's q		Tobin's q	VIF	Tobin's q	VIF
IW500	-0.046 (-0.322)	1.12	-0.065 (0.142)	1.12	0.057 (0.098)	1.09
CEOwords_toITQ			0.096** (0.037)	1.13		
CEOwords_ITAns					0.105*** (0.032)	
CEOwords	0.028 (0.671)	1.06	0.027 (0.042)	1.06	0.080 (0.078)	1.1
CIOParticipate	0.234*** (2.896)	1.23	0.226*** (0.080)	1.26	0.171*** (0.052)	1.1
CEOCompensation	0.015 (0.175)	1.08	0.049 (0.086)	1.12	0.039 (0.057)	1.22
CEOTenure	0.815 (1.360)	1.04	1.299* (0.753)	1.05	0.387 (0.487)	1.06
ADVT	10.020** (2.446)	1.03	10.394** (4.062)	1.03	12.015*** (3.506)	1.03
R&D	-8.618 (-1.283)	1.06	-9.862 (6.671)	1.06	0.327 (2.626)	1.03
Asset	-0.872*** (-4.733)	1.31	-0.842*** (0.183)	1.32	-0.772*** (0.103)	1.07
Growth	0.008*** (2.775)	1.12	0.007*** (0.003)	1.12	0.005*** (0.001)	1.25
Year Dummies	Yes		Yes		Yes	
Constant	7.555***		7.025***		5.956***	
Observations	580		580		901	
Number of firms	238		238		307	
R-squared	0.282		0.298		0.281	
F test	7.081		7.202		11.85	

Table 5. Fixed Effects Estimation Results (Use a subsample)
(Notes: Standard errors in parentheses; *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$)

5 Conclusions and Discussion

This study has two major contributions. First, it contributes to the growing literature on management support for IT and the business value of IT by examining the impact of CEO's IT knowledge on firm performance. We propose that CEO's IT knowledge has positive influence on firm performance, and the empirical evidence demonstrates the positive association between CEO's IT knowledge and Tobin's q. The effect remains significant after controlling for industry variables, firm-specific factors, and the other CEO characteristics. The results are robust using alternative measures and subsample analysis. Our findings are consistent with the notion that IT support from top management is important for IT success and firm performance. While previous studies mainly focus on CIO's business knowledge and CIO's interaction with the CEO, we empirically show that CEO's IT knowledge also plays a critical role in knowledge integration between business executives and IT executives and supporting IT projects, which are important for firm performance.

Second, this paper contributes by introducing a new approach to evaluate CEO's IT knowledge. Given the difficulty in achieving CEO's data of prior studies that have relied exclusively on interviews and self-reported surveys, our approach provides objective and information-rich measures of CEO's IT knowledge. Additionally, this approach could be generalized to other top executives including CIOs, CFOs, etc., and it also provides opportunities to study a large sample of firms. We empirically validate that our measure of CEO's IT knowledge is distinct from firms' IT capability, CEO's general ability, and CEO's general talkativeness.

One limitation of the paper is that we did not categorise different types of IT knowledge of CEOs. This could be a future direction to further explore CEO's IT knowledge. The second limitation is that we focus on CEOs, while other top management team members are also important in IT success. The impact of the synergy of IT knowledge between top management team members on firm performance will be an interesting research question for future studies.

References

- Akkermans, H., and K. van Helden (2002). "Vicious and Virtuous Cycles in ERP Implementation: A Case Study of Interrelations between Critical Success Factors." *European Journal of Information Systems* 11(1), 35-46.
- Armstrong, C. P. and V. Sambamurthy (1999). "Information Technology Assimilation in Firms: The Influence of Senior Leadership and IT Infrastructures." *Information Systems Research* 10(4), 304-327.
- Banker, R. D., N. Hu, P. A. Pavlou, and J. Luftman (2011). "CIO Reporting Structure, Strategic Positioning, and Firm Performance." *MIS Quarterly* 35 (2), 487-504.
- Bardhan, I., V. Krishnan, and S. Lin (2013). "Research Note—Business Value of Information Technology: Testing the Interaction Effect of IT and R&D on Tobin's Q." *Information Systems Research* 24 (4), 1147-1161.
- Bharadwaj, A. S., S. G. Bharadwaj and B. R. Konsynski (1999). "Information Technology Effects on Firm Performance as Measured by Tobin's q." *Management Science* 45 (7), 1008-1024
- Bharadwaj A. S (2000). "A Resource-Based Perspective on Information Technology Capability and Firm Performance: An Empirical Investigation." *MIS Quarterly* 24 (1), 169-196
- Boynton, A. C., R. W. Zmud, and G. Jacobs (1994). "The Influence of IT Management Practices on IT Use in Large Organizations." *MIS Quarterly* 18, 299-318.
- Brynjolfsson, E. and L. Hitt. 1996a. *The Customer Counts*. Information Week.
- Byrd, T. A., V. Sambamurthy, and R. W. Zmud (1995). "An Examination of IT Planning in a Large, Diversified Public Organization." *Decision Sciences* 26 (1), 49-73.
- Calori, R., G. Johnson, and P. Sarnin (1994). "CEO's Cognitive Maps and the Scope of the Organization." *Strategic Management Journal* 15, 437-457.
- Carpenter, M. A., Sanders, W. G., & Gregersen, H. B. (2001). "Bundling Human Capital with Organizational Context: The Impact of International Assignment Experience on Multinational Firm Performance and CEO Pay." *Academy of Management Journal*, 44, 493-501.
- Chae, H. G., E. K. Chang and V. R. Prybutok (2014). "Information Technology Capability and Firm Performance: Contradictory Findings and Their Possible Causes." *MIS Quarterly* 38 (1), 305-326.
- Chatterjee, D., R. Grewal, and V. Sambamurthy (2002). "Shaping Up for E-Commerce: Institutional Enablers of the Organizational Assimilation of Web Technologies." *MIS Quarterly* 26(2), 65-89.
- Chung, K. H. and S. W. Pruitt (1994). "A Simple Approximation of Tobin's q." *Financial Management* 23, 70-74.
- Clemons, E. K. and M. Row (1988). "McKesson Drug Company: A Case Study of Economost—a strategic information system." *Journal of Management Information Systems* 5 (1), 36-50.
- Cooper, R. B. and R. W. Zmud (1990). "Information Technology Implementation Research: A Technology Diffusion Approach." *Management Science* 36, 123-139.

- Doll, W. J., and M. A. Vonderembse (1987). "Forging a Partnership to Achieve a Competitive Advantage: The CIM Challenge." *MIS Quarterly* 11(2), 205-220.
- Ein-dor, P. and E. Segev (1981). *A Paradigm for Management Information Systems*. New York: Praeger.
- Emery, J. C. (1990). "Editor's Comments - The Management Difference: A Tale of Two IS Projects." *MIS Quarterly*, 14 (3), 11-12.
- Ettlie, J. E (1990). "What Makes a Manufacturing Firm Innovative?" *Academy of Management Executive* 4 (4), 7-20.
- Feeny, D. F., B. R. Edwards, and K. M. Simpson (1992). "Understanding the CEO/CIO Relationship." *MIS Quarterly* 16, 435-448.
- Grant, R. M. (1996a). "Toward a Knowledge-Based Theory of the Firm." *Strategic Management Journal* 17, 109-122.
- Grant, R. M. (1996b). "Prospering in Dynamically Competitive Environments: Organizational Capability as Knowledge Integration." *Organization Science* 7, 375-387.
- Hitt L. and E. Brynjolfsson (1996). "Productivity, Profit and Consumer Welfare: Three Different Measures of Information Technology's Value." *MIS Quarterly* 20 (2), 121-142.
- Jarvenpaa, S. L. and B. Ives (1990). "Information Technology and Corporate Strategy: A View from the Top." *Information Systems Research* 1 (4), 351-376.
- Jarvenpaa, S. L. and B. Ives (1991). "Executive Involvement and Participation in the Management of Information Technology." *MIS Quarterly* 15(2), 205-227.
- Jones, M. C., G. S. Taylor, and B. A. Spencer (1995). "The CEO/CIO Relationship Revisited: An Empirical Assessment of Satisfaction with IS." *Information and Management*, 29 (2), 123-130.
- Kearns, G. S. and A. L. Lederer (2003). "A Resource-Based View of Strategic IT Alignment: How Knowledge Sharing Creates Competitive Advantage." *Decision Sciences* 34 (1), 1-29.
- Keen, P. G. W (1991). *Shaping the Future*. Harvard Business School Press, Boston, MA.
- Kohli, R., S. Devaraj, and T. T. Ow (2012). "Does Information Technology Investment Influence a Firm's Market Value? A Case of Non-publicly Traded Healthcare Firms." *MIS Quarterly* 36(4), 1145-1163.
- Lederer, A. L. and A. L. Mendelow (1986). "Issues in Information Systems Planning". *Information and Management* 10 (5), 245-254.
- Lederer, A. L. and A. L. Mendelow (1988). "Information Systems Planning: Top Management Takes Control." *Business Horizons* 31 (3), 73-78.
- Lederer, A. L. and A. L. Mendelow (1989). "Coordination of Information Systems Plans with Business Plans." *Journal of Management Information System* 6 (2), 5-19.
- Nadkarni, S. and P. Herrmann (2010). "CEO Personality, Strategic Flexibility, and Firm Performance: The Case of the Indian Business Process Outsourcing Industry." *Academy of Management Journal* 53(5), 1050-1073.
- Peterson, R. S., D. B. Smith, P. V. Martorana, and P. D. Owens (2003). "The Impact of Chief Executive Officer Personality on Top Management Team Dynamics: One Mechanism by Which Leadership Affects Organizational Performance." *Journal of Applied Psychology*, 88, 795-808.
- Raghunathan, B. and T. S. Raghunathan (1989). "Relationship of the Rank of Information Systems Executives to the Organizational Role and Planning Dimensions of Information Systems." *Journal of Management Information Systems* 6 (1), 111-126.
- Rajagopalan, N., and G. M. Spreitzer (1997). "Toward A Theory of Strategic Change: A Multi-lens Perspective and Integrative Framework." *Academy of Management Review*, 2, 48-71.
- Reich, B. H., and I. Benbasat (1990). "An Empirical Investigation of Factors Influencing the Success of Customer-Oriented Strategic Systems." *Information Systems Research* 1(3), 325-347.
- Santhanam, R. and E. Hartono (2003). "Issues in Linking Information Technology Capability to Firm Performance." *MIS Quarterly* 27 (1), 125-153.
- Spender, J. C (1996). "Making Knowledge the Basis of a Dynamic Theory of the Firm." *Strategic Management Journal* 17, 45-62.

- Stoel, M. and W. Muhanna (2009). "IT Capabilities and Firm Performance: A Contingency Analysis of the Role of Industry and IT Capability Type." *Information and Management* 46(3), 181-189.
- Thong, J. Y. L (1999). "An Integrated Model of Information Systems Adoption in Small Businesses." *Journal of Management Information Systems* 15 (4), 187-214.
- Trice, A. W. and M. E. Treacy (1986). "Utilization as a Dependent Variable in MIS Research." *Proceedings of the 7th International Conference of Information Systems*. Indianapolis, IN.