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Knowledge Management Capability and Firm Performance: An Empirical Investigation

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ABSTRACT

It is with great interest for information systems researchers and practitioners regarding the contribution of information technology investment to firm performance. This study focuses on the impact of the implementation of knowledge management systems (KMS) on firm performance. Although many organizations have implemented KMS, there is little empirical evidence of KMS on firm performance. This research is an attempt to examine this issue among those firms of adopting KMS by using the data extracted from the COMPSTAT. With hypotheses developed from literature and our research design, we collected financial data of companies that adopted KMS since 1999. The results show that firms significantly reduce the ratios of costs of selling, general, and administrative (SG&A) to revenues and SG&A to sales in the second year after the adoption of KMS. The findings support some of our hypotheses. This study also discussed some limitations and future research possibilities.

Keywords

Knowledge management, Knowledge management system, IT investment, firm performance

INTRODUCTION

In the past few years, there has been a growing interest in treating knowledge as a significant organizational resource. Consistent with the interest in organizational knowledge and knowledge management (KM), IS researchers have begun promoting a class of information systems, referred to as knowledge management systems (KMS). The objective of KMS is to support creation, transfer, and application of knowledge in organizations (Alavi and Leidner, 2001). IS researchers and practitioners often debate on the contribution of IT investment to firm performance. Prior IS research has examined information technology and firm performance in different ways. This study focuses on KMS and its impact on firm performance. Resource-based perspective and transaction costs theories are used to investigate the specific IT investment on implementing KMS. KMS is expected to reduce costs by improving efficiencies and effectiveness through computerization; and to enhance decision making by providing accurate and timely enterprise-wide knowledge from knowledge repository. These effects of utilizing KMS in firms may be associated with improved firm performance. A review of the literature suggests that there is very little empirical research on how to successfully develop and implement KM solutions to enhance firm performance, particularly in core business processes (Massey et al., 2001; 2002). Rather, much of the current KM research has either focused on the use of various technologies to acquire or store knowledge resources (Alavi and Leidner, 2001) or it has been conceptual in nature (Becerra-Fernandez and Sabherwal, 2001; 2003).

We find many descriptions of such knowledge management systems in research literature, but most of them cover technical issues. Few are dealing with how these systems actually improve the bottom line in the organizations. Whether adopting KMS can improve organization performance is remained to be investigated. Hence, this study is an attempt to examine the firms of adopting KMS and to analyze what is the impact of such systems on work in a firm. To identify firms that adopted KMS, we carefully selected the qualified KMS vendors from the KM World magazine. It published the KM World’s 100 companies which provide different kind of knowledge management applications in March 2003 issue. From KM vendors, we identify their client companies who have acquired their KM solutions. We then extracted their financial data from the
The purpose of this paper is to employ the resource-based view and transaction cost theories to develop the research model and empirically examine the relationship between adopting KMS and firm performance. Since the resource-based theory and transaction cost theory explicitly recognize the importance of intangible capability such as organizational knowledge assets, they offer a significant opportunity to explore these theoretical complementarities in examining the relationship between KM capability and firm performance. The remainder of this paper is organized as follows. The coming section reviews the KMS and its capability with the resource-based theory and transaction cost theory. The literature review lays the theoretical foundation for this research from which we propose hypotheses in the following section. Then the next section presents the data collection and empirical analysis in the research method. Finally, the results are presented and the conclusions are drawn along with some implications and suggestions for future research.

LITERATURE REVIEW

Knowledge Management System

According to Nonaka and Takeuchi (1995), knowledge management requires a commitment to create new task-related knowledge, disseminate it throughout the organization, and embody it in products, services, and systems. IT is critical to knowledge management as technologies such as groupware and multimedia systems assist in clarifying assumptions, speeding up communications, eliciting tacit knowledge, and constructing histories of insights and cataloging them (Bharadwaj, 2000). Housel and Bell (2000) have pointed out knowledge services may be divided into three main types: infrastructure services, core services, and packaged services. These services build on one another such that packaged services make use of core services, which employ infrastructure services. Much knowledge management literature concentrates on these packaged services. This focus is attributable to the fact that these types of problems are clearly connected to end-user needs. The literature concentrates on three classes of packaged services, including customer relationship management (CRM) services, business intelligence services and enterprise information portals (Housel and Bell, 2000). Some technologies (e.g. video conferencing and collaborative work systems) are applied to capturing and sharing tacit knowledge. Others (e.g. knowledge acquisition, decision support, and expert systems) are applied to transforming tacit knowledge into explicit knowledge. And still others (e.g. search engines, databases, and document management systems) are used for acquiring, codifying, storing and disseminating explicit knowledge (Nemati et al., 2002; Massey et. al., 2002).

KMS are IT-based systems developed to support and enhance the organizational processes of knowledge creation, storage, retrieval, transfer, and application. While not all KM initiatives involve an implementation of IT, and admonitions against an emphasis on IT at the expense of the social and cultural facets of KM are not uncommon (Davenport and Prusak, 1998; Malhotra, 1999), many KM initiatives rely on IT as an important enabler (Lee and Choi, 2003). With the growing strategic importance of Knowledge Management (KM) and Knowledge Management Systems (KMS) in organizations, more businesses are implementing KMS. In a nutshell, KMS can be defined as “a class of information systems applied to managing organizational knowledge” (Alavi and Leidner, 2001; Kaplan, 2002). There are various types of knowledge to be supported by the KMS. The objective of KMS is to support creation, transfer, and application of knowledge in organizations (Alavi and Leidner, 2001). Therefore in this study knowledge management systems (KMS) refer to a class of information systems applied to managing organizational knowledge, including customer relationship management services, business intelligence services, and document management systems.

Resource-based Theory and KM Capability

Rooted in management strategy literature, the resource-based view of the business posits that businesses compete on the basis of “unique” corporate resources that are valuable, rare, difficult to imitate, and non-substitutable by other resources (Conner, 1991; Schulze, 1992). The resource-based theory operates under the assumptions that the resources needed to conceive, choose, and implement strategies are heterogeneously distributed across businesses and that these businesses differences remain stable over time (Barney, 1991). Although proponents of the resource-based view generally tend to define resources broadly, to include assets, knowledge, capabilities, and organizational processes, Grant (1995) distinguished between resources and capabilities and provided a classification of resources into tangible, intangible, and personnel-based resources. Tangible resources include the financial capital and the physical assets of the firm such as plant, equipment, and stocks of raw materials. Intangible resources encompass assets such as reputation, brand image, and product quality, while personnel-based resources include technical know-how and other knowledge assets including dimensions such as organizational culture,
employee training, loyalty, etc (Grant, 1995). The commodity like the technology components may be, the architecture that removes the barriers of system incompatibilities and makes it possible to build a corporate platform for launching business applications is clearly not a commodity (Bharadwaj, 2000).

Adopting a resource-based perspective, information systems researchers have identified various IT related resources that serve as potential sources of competitive advantage (Bharadwaj, 2000; Santhanam and Hartono, 2003). Extending the traditional notion of organizational capabilities to a firm’s IT function, a firm’s KM capability is defined in this study as its ability to adopt and deploy KMS in combination with other kinds of information system and resources. Specifically, the concept of KM capability was developed using the premise that while resources can be easily duplicated, a unique set of capabilities mobilized by a firm cannot be easily duplicated and will result in sustained competitive advantages and better firm performance. Viewed from resource-based perspective, the KMS provides the resources that make feasible innovation and continuous improvement KM capability of businesses. In summary, the resource-based view illustrated that businesses can differentiate themselves on the basis of their KMS. A firm’s KMS including its human IT skills and its ability to leverage IT for intangible benefits serve as firm specific resources, which in combination create a firm wide KM capability. While each of the individual knowledge assets is complex to acquire and difficult to imitate, firms that achieve competitive advantage through KMS have also learned to combine their knowledge assets to effectively create an overall KM capability.

Transaction Cost Theory and KM Capability

The transaction cost theory and resource-based theory are, to a certain extent, complementary. From the stance of theoretical pluralism, the two theories offer more comprehensive perspective by taking both costs and benefits into account (Osborn and Hagedoorn, 1997; Tsang, 2000). Resource-based theory compensates for the weakness of transaction cost theory by looking at the value-creating benefits of a transaction (Tsang, 2000). Thus, we next describe the relationship between transaction cost theory and KM capability. Transaction cost economics proposes that a firm is an economic entity created in an effort to economize on market transaction costs — searching and communicating market information, negotiating a deal, and preventing or dealing with contract default (Gurbaxani and Whang, 1991; Poston and Grabski, 2001). High market transaction costs are often associated with firm-specific assets, where long term contracting is required to prevent the other party from acting opportunistically (Williamson, 1981). External sourcing of an input factor may entail extra costs in obtaining market information, communicating with geographically separated vendors, transporting goods, and holding inventories (Gurbaxani and Whang, 1991). Accordingly, market transaction costs may be classified into two categories: one is due to the loss of operational efficiencies, while the other is establishing and maintaining contractual relationship with outside parties (Poston and Grabski, 2001).

For transaction cost theory, KMS is expected to maintain accurate knowledge repository more accessible which reduces administrative, search, and decision making costs. Because of the practical difficulties involved in allocating buying costs, storage costs, and handling costs, these items are not ordinarily included in valuing inventories or product costs but are period expenses (Kieso and Weygandt, 1989). These costs are also reflected in the general and administrative categories of the financial statement. Much empirical research has supported technology spending and operational improvements, such as lower growth in operating expenses (Bharadwaj, 2000; Santhanam et al., 2003), improved cost efficiency (Bender, 1986; Poston and Grabski, 2001), and higher return on assets, return on investment, and total asset turnover (Hunton et al., 2003; Weill, 1992).

RESEARCH HYPOTHESES

The fundamental premise is that a KMS that can improve firm performance and may produce long-term sustainable competitive advantage for the organization (Spender and Grant, 1996; Teece, 1998; Alavi and Leidner, 2001). Organizations invest in knowledge management systems might as well for the same reason they invest in other information systems. They believe that the value derived from using the system will exceed its cost (Santhanam and Hartono, 2003). There have been many studies and much debate over the value derived from using information systems; the so-called “productivity paradox” has been a long-running research theme (Brynjolfsson and Yang, 1996; Brynjolfsson and Hitt, 1998; Chan, 2000). Researchers have examined the potential performance benefits from information systems at the level of the economy, industry, business, and individual (Chan 2000; Devaraj and Kohli, 2003). Although inconclusive, this body of research suggests that the use of an information system in some circumstances can provide significant individual and organizational benefits.
In the resource-based view research, firms can devise strategies to create and sustain advantages from investments in IT (Duliba et al., 2001). Researchers have shown that a firm’s ability to effectively leverage its IT investments by developing a strong IT capability can result in improved firm performance (Santhanam and Hartono, 2003). Their results also indicate that firms with superior KM capability indeed exhibit superior current and sustained firm performance when compared to average industry performance. In the other hand, the transaction cost perspective economics proposes that a firm is an economic entity created in an effort to economize on market transaction costs (Gurbaxani and Whang, 1991). As such, the firms of adopting KMS might reduce costs by automating process to accumulate knowledge assets in organization and by providing better document management to improve decision making and customer relationship management. Giving managers desirable access to the corporate knowledge repository, they can efficiently and effectively review and retrieve the timely knowledge in a timely manner. Thus, KMS should decrease the administrative costs, reduce defects and human errors, and eliminate the need for investigation and reduplicate work.

KMS is not production automation tools and is not expected to impact overall production costs. Selling, general, and administrative (SG&A) expenses are period costs, not directly related to the acquisition or production of goods. Selling expenses result from the company’s efforts to make sales, while general and administrative expenses result from the general administration of company operations. Cost of goods sold (COGS) reflects the direct costs and overhead associated with the physical production of products for sale. Typical product overhead costs include: power, heat, light, property taxes on factory, factory supervisory labor, depreciation of plant assets, and supplies (Kieso and Weygandt, 1989). Amir and Lev (1996) also find earnings and book value are not associated with firm value for firms in the intangibles rich wireless communications industry without adding the firms’ SG&A expenses divided by revenue to their costs. This indicates firms are expensing intangible assets appearing in aggregate SG&A expenses in the profit and loss statement. COGS and SG&A expenses are the generally accepted accounting measures for the production and overhead costs of a firm (Bharadwaj, 2000). While other variables have been examined (i.e., return on assets and Tobin’s q), this study focuses on specific ratios of costs and revenues that have been used in prior studies (Bharadwaj, 2000; Poston and Grabski, 2001; Santhanam and Hartono, 2003). Meanwhile, these ratios could also reflect the firm performance of adopting KMS. Based on the above discussion, the firms of adopting KMS might decrease COGS and SG&A expenses.

The benefits of superior KM capability must be sustainable over time. Barney (1991) states the sustained competitive advantage does not imply that the benefits will last forever. He indicates that it will not be competed away by the duplication efforts of other firms. He points out this can be an important research issue (Barney, 1991). Prior research has also indicated that a time lag is necessary for capturing the performance improvements from information technology (Brynjolfsson and Hitt, 1998). Therefore, this study follows the suggestions of prior research and does not count financial data of the firm in the following fiscal year when KMS was adopted. Though the sample size will be further reduced, this practice will allow us to examine the firm performance more objectively.

Based on the above discussion, we propose our research hypotheses. Firms adopted KMS should have better performance in subsequent years than prior to the adoption of KMS. Due to the nature of KMS and its predicted association with decreased administrative costs, information search costs, and operational costs, as well as improved decision-making and increasing revenues, the research hypotheses can then be tested based on the ratios of SG&A/R, SG&A/S, COGS/R, and COGS/S as stated below:

Hypothesis: The cost ratios of KMS adopters should be reduced after implementing KMS in subsequent years.

H1: SG&A/Revenues\textsubscript{Post} < SG&A/Revenues\textsubscript{Pre}
H2: SG&A/Sales\textsubscript{Post} < SG&A/Sales\textsubscript{Pre}
H3: COGS/Revenues\textsubscript{Post} < COGS/Revenues\textsubscript{Pre}
H4: COGS/Sales\textsubscript{Post} < COGS/Sales\textsubscript{Pre}

THE RESEARCH METHOD AND DATA COLLECTION

This study tests the proposed hypotheses using archival financial data from COMPSTAT on businesses that have adopted KMS. To identify firms with superior KM capability by adopting KMS, the vendor list published by KM World is selected to find the subject companies. 100 KMS companies were listed in KM World special issue in March 2003. We use the web site of Reuters.com (http://cnbc.investor.reuters.com) to search the key developments of KM vendors that have publicly disclosed
companies acquired their KMS. Since Reuters.com provides the public disclosed data after 1999, as the result of this constraint, the samples of adopting KMS firms are from the second quarter of 1999 to the fourth quarter of 2003. The firms have selected KMS vendors’ KM applications are considered as our research cases. Their financial data are extracted from COMPUSTAT for statistical analysis. The COMPUSTAT is a database published by the Standard & Poor. It includes the financial statements of almost all US-based publicly traded corporations. Firms have to satisfy the following criteria to be included in our sample:

1. They have to be listed on the COMPUSTAT database.
2. They have to be active as of the end of 2003 fiscal year (i.e. firms that were taken over, went private, became bankrupt, or otherwise inactive are excluded from the final sample).
3. Complete cost and revenue indicators are available through the COMPUSTAT database which are captured and calculated as continuous variables for annual ratios of costs and revenues.

The third restriction addresses the variables used in the study. They are calculated as each firm’s SG&A/Sales, SG&A/revenues, COGS/Sales, and COGS/revenues ratios. Firm performance is defined as the ratios of cost and revenues in order to measure both the cost-reduction and revenue-enhancing effects of KMS on the firm. The sample of events was constructed from search of announcements related to KM during the period from April 1999 to September 2003. The distribution of KMS adoption firms by announcement year is presented in Table 1. Of the sampled firms, 11.8% have just announced KMS adoption, 27% have implemented KMS for one years, 29.8% have implemented KMS for two years, 22.4% have implemented KMS for three years, and only 9% have adopted KMS for four years.

<table>
<thead>
<tr>
<th>Announced Implementation Time</th>
<th>Number of KMS Cases</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>2003 IV</td>
<td>3</td>
<td></td>
</tr>
<tr>
<td>2003 III</td>
<td>5</td>
<td></td>
</tr>
<tr>
<td>2003 II</td>
<td>12</td>
<td></td>
</tr>
<tr>
<td>2003 I</td>
<td>10</td>
<td>11.8%</td>
</tr>
<tr>
<td>2002 IV</td>
<td>17</td>
<td></td>
</tr>
<tr>
<td>2002 III</td>
<td>16</td>
<td></td>
</tr>
<tr>
<td>2002 II</td>
<td>15</td>
<td></td>
</tr>
<tr>
<td>2002 I</td>
<td>21</td>
<td>27.0%</td>
</tr>
<tr>
<td>2001 IV</td>
<td>20</td>
<td></td>
</tr>
<tr>
<td>2001 III</td>
<td>21</td>
<td></td>
</tr>
<tr>
<td>2001 II</td>
<td>20</td>
<td></td>
</tr>
<tr>
<td>2001 I</td>
<td>15</td>
<td>29.8%</td>
</tr>
<tr>
<td>2000 IV</td>
<td>15</td>
<td></td>
</tr>
<tr>
<td>2000 III</td>
<td>21</td>
<td></td>
</tr>
<tr>
<td>2000 II</td>
<td>11</td>
<td></td>
</tr>
<tr>
<td>2000 I</td>
<td>10</td>
<td>22.4%</td>
</tr>
<tr>
<td>1999 IV</td>
<td>11</td>
<td></td>
</tr>
<tr>
<td>1999 III</td>
<td>8</td>
<td></td>
</tr>
<tr>
<td>1999 II</td>
<td>4</td>
<td>9.0%</td>
</tr>
<tr>
<td>Total</td>
<td>255</td>
<td>100%</td>
</tr>
</tbody>
</table>

Table1: The Distribution of KMS Adoption Firms

RESULTS

Measured firms’ performance was divided into two time periods—pre-adoption and post-adoption. The fiscal year of the KMS announcement, identified as year zero (t0), served as the baseline year for aligning the KMS-adopting firms. The pre-
adoption period encompassed the first years ($t_{-1}$) before the adoption of KMS. The post-adoption periods are denoted by each year ($t_{+3}$, $t_{+2}$, $t_{+1}$) after adopting KMS for all ratios. Prior research suggests that a time lag should be factored in to estimate IT effects due to learning curve. Hence, we perform statistical tests only on those firms have announced their adoption of KMS with recent two-year financial data.

Small sample size may disrupt and confound findings. Paired samples t tests can be controlled for firm and industry effects by minimizing the variance within the individual firm (Poston and Grabski, 2001). Therefore, we apply the paired samples t tests to compare firm performance ratios post versus pre KMS adoption. The results of the tests are listed in Table 2.

**Table 2: Pairwise T-test Results for Adopting KMS Firms**

<table>
<thead>
<tr>
<th>Comparison of Ratio Post vs. Pre KMS implementation</th>
<th>COGS/Revenues</th>
<th>COGS/Sales</th>
<th>SG&amp;A/ Revenues</th>
<th>SGA&amp;R/Sales</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 year after vs. year before</td>
<td>-0.586</td>
<td>0.337</td>
<td>-0.474</td>
<td>-0.732</td>
</tr>
<tr>
<td></td>
<td>(0.561)</td>
<td>(0.738)</td>
<td>(0.638)</td>
<td>(0.469)</td>
</tr>
<tr>
<td>2 year after vs. year before</td>
<td>-0.342</td>
<td>0.129</td>
<td>-2.085</td>
<td>-1.770</td>
</tr>
<tr>
<td></td>
<td>(0.734)</td>
<td>(0.898)</td>
<td><em>(0.044)</em>*</td>
<td>*(0.085) *</td>
</tr>
</tbody>
</table>

[$t$ statistic (P value)], $t$ value significant at .05 level(**), and .10 level(*).

Results indicate that firms with KMS implementation do not show significant decrease on the cost of goods sold (COGS) divided by revenues and COGS divided by sales after first and second year. Thus, Hypotheses 3 and 4 are not supported. However, the results indicate that firms with KMS implementation significantly reduce the selling, general, and administrative costs (SG&A) divided by revenues and SG&A divided by sales after second year. Hypotheses 1 and 2 are supported.

**CONCLUSION**

Based on our statistic results, there are significant decreases in SG&A by revenue and SG&A by sales in the second year after implementation of KMS. These findings are exciting because KMS is aimed to reduce administrative costs by maximizing knowledge capability. Though hypotheses 3 and 4 are not supported by this study, KM research has shown that KMS has little to do with the reduction of production costs. Our research confirms the claims with insignificant COGS/Revenues and COGS/Sales. This study further confirms that KMS improve firm performance in decreasing SG&A expenses. SG&A expenses are period costs, not directly related to the acquisition or production of goods, but the COGS reflects the direct costs and overhead associated with the physical production of products for sale. The main purpose of KMS is to reduce the administrative expenses. Therefore, adopting KMS lessens the SG&A expenses.

The effects of reduced SG&A costs are not obvious on the first year after KMS implementation due to the learning curve. Those effects become significant on the second year after KMS implementation. It may contribute the maturity of IT in this case the maturity of KMS. Employees need time to co-invent through their own experimentation and discovery. The time lag allows them to find ways for the new system to support their work (Bresnahan and Greenstein, 1996). It seems like that end users of the adopted KMS overcome the learning curve and become productive. They understand more features of the KMS and apply effective know-how to reduce more work risk. Hence, the cost ratios related to SG&A are significantly reduced on the second year. The findings are aligned with former IS research.
However, cost reduction gains tend to be short-lived as competitors acquire the cost-saving technology and demand for the cheaper product plateaus (Payson, 1998) or savings are competed away to benefit consumers (Brynjolfsson and Hitt, 1996). The increased performance is expected due to the cost advantage provided by IT such as in the areas of supply chain management and reduced overhead. Wal-Mart, for example, a frequently cited case of a company with an IT-enabled competitive advantage, has overhead of around 15%, compared to 21% for Kmart and 30% for Sears (Laudon and Laudon, 2000). Implementing KMS in a firm could reduce costs by automating processes and by providing better document management and customer relationship management. Giving managers necessary access to knowledge repository, they can efficiently and effectively review and retrieve the timely information. At the same time, they can make better decisions from the knowledge provided by the KMS. KMS should decrease the need for additional monitoring activities, which in terms to reduce the administrative costs.

There are some limitations on this study. First, we use the web site of Reuters.com to search KM vendors who have publicly disclosed client companies that have selected their KM solutions after 1999. Though the search turned out 254 subject companies adopting KMS from 1999 to 2003, we won’t be able to analyze those firms adopted KMS before 1999. Cnnfn.com, Yahoo.com and MSN.com have the same cutoff date on 1999.

Second, COMPUSTAT publishes the financial data of publicly-trade companies. Private companies adopted KMS are excluded from this study. Third, to compensate the time lag of IT adoption, we only selected the firms adopted KMS in 1999 and 2000, which have at least 2-year longitudinal data for our data analysis. This time window may be insufficient to capture the effects of KMS on firm performance. Future research should be continued when new fiscal year data become available in order to see the longitudinal effects of KMS on firm performance.

Fourth, macroeconomic environment may influence the firm performance so the KMS effects could not be detected adequately. Given the down turn of economy for past three years, most firms suffered their performance and claimed that as the worst years. Our data were collected among those three years. The invisible hand has strong impact on the firm performance which may have dwarfed our findings. Future studies might employ a control sample of non-KMS adopting firms to compare with the KMS adopting firms.

**REFERENCE**