Does Knowledge Management Pay Off?

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Abstract

The resource-based theory of the firm attributes superior firm performance to organizational resources that are valuable, rare, irreplaceable, and not readily reproduced. Aligned with this theory, this study examines the widely expressed notion that knowledge management (KM) competencies form a critical organizational resource that contributes to firm performance. Specifically, the current study addresses the question: does KM pay off? Using the findings of an independent research company and the data from COMPUSTAT, this study empirically examines the relationship between KM performance and firm performance in terms of both profit and cost ratios. Matched Sample Comparison Group (MSCG) methodology is employed to test the research hypotheses. The results of this study suggest that firms with superior KM performance are likely to enjoy higher profitability ratios and lower cost ratios.

1. Introduction

It is widely accepted by practitioners and researchers that KM can bring important strategic consequences to organizations: KM improves organizations' competitive positions [14, 15]. However, empirical support for the link between well-designed KM and firm performance consists primarily of individual case studies [15], along with a few practitioner surveys [14]. Systematic empirical investigations of the link, based on actual rather than perceived performance, have yet to be done. As a result, it is unclear whether the identified link can be generalized from the individual cases to all organizations.

Researchers need to address a question that has yet to be definitively answered: Does KM pay off [17]? In an article introducing the knowledge chain theory, which identifies and characterizes critical KM activities, Holsapple and Singh [15] call for more research attention to the investigation of the connections between KM practices (including both methods and technologies) and organizational competitiveness.

This paper investigates business effects of successful KM initiatives. More specifically, this study contributes to a better understanding of the relationship between KM performance and firm performance by addressing the following research question at the organizational level of analysis:

Can KM be performed in ways that enhance a firm's financial performance?
This research question is investigated in the context of multi-market firms in various industries.

2. Theoretical Foundations and Hypotheses

2.1. Knowledge Management

Knowledge management is defined as "an entity's systematic and deliberate efforts to expand, cultivate, and apply available knowledge in ways that add value to the entity, in the sense of positive results in accomplishing its objectives or fulfilling its purpose" [11]. According to Holsapple and Joshi [10], one major objective of KM is to "ensure that the right knowledge is available to the right processors, in the right representations and at the right times, for performing their knowledge activities (and to accomplish this for the right cost)." KM is therefore scoped out very broadly as any process or practice of generating new knowledge, acquiring valuable knowledge from outside sources, selecting needed knowledge from internal sources, altering the state of knowledge resources, and embedding knowledge into organizational outputs [11].

2.2. A Resource-Based Theory of KM and Research Hypotheses

With its roots in management strategy literature, the resource-based theory of the firm is developed to understand reasons why firms are able to gain and sustain a competitive advantage [1]. The theory asserts that the main driver of firm performance is "unique" firm resources that are valuable, rare, difficult to imitate, and non-substitutable by other resources [4]. Moreover, an important assumption of

the theory is that the resources needed to conceive, choose, and implement strategies are heterogeneously distributed across firms, which in turn are posited to account for the differences in firm performance [9].

Stemming from the resource-based theory, one stream of research identifies knowledge as a basic source of competitive advantage and suggests that performance differences between firms can be attributed to asymmetries in knowledge, knowledge processors, and knowledge processes [7]. Knowledge processors are basically human beings and computer systems, while knowledge processes are patterns of knowledge manipulation actions intended to achieve KM objectives [10].

KM is of great importance to firm performance because it allows the firm to better leverage its knowledge through improved knowledge processes 1) involving knowledge generation, acquisition, selection, assimilation, and emission and 2) operating under managerial influences of leadership, coordination, control, and measurement [11]. Previous research on the resource-based theory of KM also suggests that firms can outperform their competitors by taking advantage of KM. A firm's product, customer, and managerial knowledge, and its ability to leverage this knowledge serve as firm-specific KM resources that differentiate the firm from its competitors. In other words, the valuable KM resources are likely to contribute to key aspects of firm performance, such as improved ability of innovation, enhanced coordination of efforts, effective process of decision making, and rapid commercialization of new products [8, 16]. And ultimately, the contribution of KM resources is captured by a firm's bottom line figures [8]. In light of this, it follows that firms that are successful in leveraging KM resources, in turn, enjoy superior financial performance in terms of higher payoff ratios and lower cost ratios. This logic directly leads us to the following two groups of hypotheses: the first group for payoff ratios and the second group for cost ratios.

H_{1a}: *Superior KM performance is positively related to higher Return on Assets (ROA) ratio.*
H_{1b}: *Superior KM performance is positively related to higher Return on Sales (ROS) ratio.*
H_{1c}: *Superior KM performance is positively related to higher Operating Income to Assets (OI/A) ratio.*
H_{1d}: *Superior KM performance is positively related to higher Operating Income to Sales (OI/S) ratio.*

H_{2a}: *Superior KM performance is positively related to lower Total Operating Expenses to Sales (OEXP/S) ratio.*
H_{2b}: *Superior KM performance is positively related to lower Cost of Goods Sold to Sales (COGS/S) ratio.*

The ROA ratio refers to return on assets and indicates how profitably a firm employs its assets. The ROS measure, which refers to return on sales, reflects how much profit a firm is able to generate for each dollar of product sold. The OI/A and OI/S ratios, which refer to operating-income-to-assets and operating-income-to-sales, respectively, focus on operating returns only and exclude income earned by the firm from other sources such as interest income and investment income [5].

The OEXP/S ratio refers to total operating expenses to sales and shows the relationship between the total expenditures necessary for the operation of a firm and the firm's total sales. The COGS/S ratio refers to cost of goods sold to sales. As one of the most popular accounting measures, COGS focuses on total production expenses of a firm.

3. Methodology

The Matched Sample Comparison Group (MSCG) methodology is employed to empirically test the research hypotheses. As a set of statistical techniques, MSCG methodology refers to statistical analysis that, over time, compares levels of variables-of-interest across two samples [20]. In this study, the two samples are the *treatment sample*, comprised of firms with superior KM performance, and a carefully selected *control sample* of firms matched to the treatment sample by size and type. The most important advantage of using MSCG methodology is that "the performance of the matched control sample of firms serves as a benchmark and helps remove the confounding effects of extraneous variables and market forces that could influence firm performance" [5].

3.1. Most Admired Knowledge Enterprise

To identify organizations with superior KM performance, we employ the winners provided by Teleos and its KNOW Network (http://www.knowledgebusiness.com) in their annual Most Admired Knowledge Enterprise (MAKE^{sm}) study. Teleos is an independent KM and intellectual capital research company based in the United Kingdom. Teleos also operates, an international Web-based professional knowledge sharing network.

Teleos and the KNOW Network aim to help practitioners create the best possible level of performance across their organizations by building on the most advanced know-how and skills.

Each year, since 1998, Teleos and KNOW Network have conducted the internationally recognized MAKE[sm] study which seeks to identify and learn from the leading organizations in the knowledge-based economy. The study uses a Delphi-oriented survey approach to identify organizations believed by experts to be at the forefront in the areas of generating, acquiring, selecting, assimilating, and emitting knowledge in pursuit of competitive advantage. The experts involve the chief executive officer, chief financial officer, and chief technology/information officer of Fortune Global 500 companies (by sales), plus nearly 300 chief knowledge officers and leading knowledge management practitioners.

Since 1998, Teleos and KNOW Network have identified 20 organizations each year as the winners of the global MAKE[sm] study. Firms are evaluated based on a framework of eight criteria that are considered as primary elements of KM performance: (1) success in establishing an enterprise knowledge culture, (2) top management support for managing knowledge, (3) ability to develop and deliver knowledge-based goods/services, (4) success in maximizing the value of the enterprise's intellectual capital, (5) effectiveness in creating an environment of knowledge sharing, (6) success in establishing a culture of continuous learning, (7) effectiveness of managing customer knowledge to increase loyalty and value, and (8) ability to manage knowledge to generate shareholder value.

The MAKE[sm] study survey questionnaire asks each expert to nominate up to three organizations with superior KM performance from all business sectors worldwide and then rate them against the eight key KM performance criteria. The nominated organizations' KM performance criteria are rated on a 1 (poor) to 10 (excellent) point Likert scale. To be recognized as a MAKE[sm] study finalist, an organization needs to receive nominations from at least 20% of the respondents. For each finalist, the scores are then summed with equal weights. Thus, the highest possible score for an organization against the eight criteria is 80. After iterative evaluation of the organizations, the 20 organizations with the highest totals are designated as the MAKE[sm] study winners of theyear (http://www.knowledgebusiness. com).

3.2. Sample Selection

Using the MAKE[sm] study results from 1998 to 2004, we first create a sample that includes all organizations recognized as winners in any of the seven years. This yields a list of 38 organizations. Of these organizations, 10 are excluded because their financial data is not available in the COMPUSTAT database due to various reasons: they are non-profit organizations; they are private organizations; they are foreign organizations whose stocks were not traded on a USA stock exchange. Thus, a total of 28 MAKE[sm] study winners is used for data analysis of this study.

To create a matching group of control firms drawn from the COMPUSTAT database, we apply the following steps that are widely accepted in the literature [3, 5]. First, based on their primary four-digit Standard Industrial Classification (SIC) code, the winners are grouped into industry categories. Second, for each firm in the MAKE[sm] study winner sample, its control firm is selected from the firms with the same primary four-digit SIC code. Third, from these potential control firms, the selection is further narrowed down to the firm(s) whose seven-year average sales are within 70% to 130% of the winner firm. According to Barber and Lyon [3], this is a fundamental specification for defining industry comparison groups because it enables researchers to empirically match a control sample to the treatment sample in firm size. Finally, if there is more than one such potential control firm, we chose the one whose seven-year average sales are closest to the winner firm. If there is no firm satisfying the 30%-range target, we identify a corresponding control firm at the two or three digit SIC code.[1] Appendix A presents the list of MAKE[sm] study winners and control firms.

The steps described above help us match pairs of firms on two dimensions: (1) the firms in each pair are drawn from the same industry, and (2) they are of similar size. Such steps have also been employed in studies of operating performance to match similar-size control firms to treatment firms in the same industry [18]. The underlying assumption is that operating performance varies with industry category and firm size, and that some of the cross-category and firm-size-based variation in operating performance can be explained by an appropriate industry benchmark [5].

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[1] For four firms (marked with asterisk (*) in Table 2 and 3), we are not able to identify a corresponding firm at two, three, or four digit SIC code, whose seven-year average sales lay within 70% to 130% of the winner firm. Therefore, these firms are not included in data analysis.

3.3. Comparability Test of the Two Groups

To ensure there is no significant difference between the two groups on firm size, we compare the two groups of firms by using general firm size measures: sales and total assets [5]. Non-parametric (Wilcoxon test) testing is employed to check whether a significant difference exists in these two measures. Table 1 shows the descriptive statistics and the comparability test results for the two groups of firms. The mean sales for the MAKE^{sm} study winners and the control firms are $39.74b and $40.19b, respectively. The mean total assets for the MAKE^{sm} study winners and the control firms are $44.46b and $42.44b, respectively. Thus, the latter is about 95.5% of the former. The two groups of firms appear to be well matched on firm size, because the non-parametric test reveals no significant differences between the two groups in sales and total assets.

3.4. Financial Performance Halo Test

A potential threat to the validity of this study is the financial performance halo effect, which here refers to a possible bias that the recognition of MAKE^{sm} study winners is influenced by their past financial performance. Prior research suggests that surveys like the one conducted by Teleos and KNOW Network may suffer from a halo effect [5]. If this is the case in the MAKE^{sm} study, then an alternative explanation for a firm being recognized as a winner is that the firm has outstanding past financial performance rather than superior KM performance. To assess this salient threat, we use the approach developed by Brown and Perry [6] to examine whether a financial performance halo effect exists in the MAKE^{sm} study data.

As a statistical method applicable to various contexts, the approach is a good fit for a data set derived from large-scale survey results that may be heavily influenced by factors extraneous to the constructs of interest. The approach employs five financial performance measures: average return on assets, relative market to book value, sales, growth, and risk [5]. Applying the approach to this study, we would expect significant correlations between MAKE^{sm} study winnings and these five measures if the recognition of the winners by the experts is in fact influenced by the past financial performance of the firms. More specifically, the approach here tests a logistic regression model with a binary variable (Y = 1 for winners and Y = 0 for control firms) as dependent variable and the five financial performance measures as independent variables. As with

Bharadwaj's [5] method, we use financial performance data, which are five years immediately preceding the first time recognition of each MAKE^{sm} study winner, to examine the halo effect. More specifically, if a firm is recognized as a MAKE^{sm} study winner for the first time in 1998, financial performance data from 1993 to 1997 are used for that firm; if a firm was recognized as a MAKE^{sm} study winner for the first time in 2002, then financial performance data from 1997 to 2001 are used for that firm to test the logistic regression model.

The results of the logistic regression analysis using five-year past data show that none of the p-values for the coefficients of the five financial performance variables are statistically significant. Moreover, the p-value for the model chi-square is not statistically significant. These results indicate that there is no evidence of the five financial performance measures influencing the selection of MAKE^{sm} study winners, either individually or collectively. The winners' group, therefore, does not appear to be tainted by halo effects due to past financial performance.

4. Hypotheses to Be Tested

4.1. Statistical Tests

To decide whether a winner firm should be included for data analysis for a specific year, a five-year window method is employed [21]. That is, if a firm is recognized as a winner in year t, then it will be included for data analysis for each of the five years from year t-1 to year t+3. This five-year window method has been widely used in accounting, finance, and management to study issues related to firm performance [19].

Given that profit and cost ratios are often not normally distributed [5], a non-parametric test – Wilcoxon Signed Ranks Test – is used to evaluate the research hypotheses. Consistent with the predictions, all of the cost ratios in each of the seven years are statistically significantly lower for the MAKE^{sm} study winners than for the control firms, thus supporting hypotheses H_{2a} and H_{2b}. In the case of profit ratios, operating income to sales (OI/S) is statistically significantly higher for the MAKE^{sm} study winners than for the control firms in all seven years, thus supporting hypothesis H_{1d}. The ratios of return on assets, return on sales, and operating income to assets are also higher for MAKE^{sm} study winners in all seven years, with statistical significance reported in four, four, and seven of the eight years, respectively. Thus,

hypothesis H_{1a}, H_{1b}, and H_{1c} are partially supported. Table 2 shows all the results.

5. Discussion

Drawing on the resource-based theory of the firm, the purpose of this study is to investigate the relationship of a firm's KM performance to the firm's financial performance. Through linking KM and the resource-based theory, the study provides a framework for suggesting that KM can be appropriately viewed as a key driver of firm performance.

As we hypothesize, the results of this study suggest that firms with superior KM performance are likely to enjoy higher profitability ratios and lower cost ratios. The positive results for the two cost ratios suggest that firms are likely to be able to achieve lower total costs (i.e., OEXP) and lower production costs (i.e., COGS) by virtue of superior KM performance, as measured by the eight MAKE^{sm} criteria. At the same time, the results for ROA and ROS indicate that firms successful in leveraging KM resources are likely to generate more profit for each dollar of assets they control and for each dollar of products they sell. Moreover, the results for OI/A and OI/S indicate that such firms tend to derive greater operating income from each dollar of their assets and output. However, the limitation of small sample size must be taken into account in interpreting these results.

5.1. Implications for Managers

By establishing the link between KM performance and firm performance, this study serves to inform business managers that firms should do much more than merely have some form of KM practice. They should develop a clear strategy to make their KM performance superior. Previous research and real-world examples suggest that achieving such a superior performance is complex and requires time and effort [5]. Although there is little well-developed guidance for managers on how to achieve superior KM performance, an increasing number of studies have begun to address this issue. For example, the knowledge chain theory identifies nine classes of activity that a firm can focus on as it strives for competitiveness via increased productivity, agility, innovation, and/or reputation [15]. Extensions to this theory find over sixty distinct types of knowledge management activity that belong to the nine basic classes [12, 13].

An important step toward achieving superior KM performance is self-assessment, which requires a firm to assess its own strengths and weaknesses. To effectively measure and appraise a firm's KM performance, managers must look broadly and deeply at its knowledge, knowledge processors, and knowledge processes. This study is based on external peer evaluations of KM performance and uses MAKE^{sm} study outcomes as a measure of a firm's KM performance. Managers can employ MAKE^{sm} study results for self-assessment by considering their own firm's performance on the eight MAKE^{sm} criteria and by comparing their firms with other firms in their industry that have been recognized as MAKE^{sm} study winners. Such a comparison is likely to help managers better understand the nature and scope of their KM opportunities and challenges.

5.2. Limitations

Although the data support most of the proposed hypotheses, readers need to be cautious about the limitations of this initial study. First, this study uses external MAKE^{sm} study winning as an indicator of superior KM performance. A critical concern with the MAKE^{sm} study is that identification of winners is not based on objective evaluations of a firm's KM performance, and thus the MAKE^{sm} study results may have some inherent biases. Another limitation is the selection of the control firms. For four firms, we cannot identify a corresponding firm satisfying the 30%-range target for two, three, or four digit SIC code matches. Therefore, these firms are excluded from data analysis. Finally, an additional limitation of this study is the small sample size. Although it is quite common for studies on firm performance to use small samples (e.g., [5]), the generalizability of the studies' findings may be impacted.

5.3. Future Research

This study suggests avenues for future research. Although the results indicate that superior KM performance is linked to superior firm performance, the underlying mechanisms whereby this is achieved are not fully clear. Additional research is needed to identify the full chain of variables connecting KM performance to firm performance. To effectively measure KM performance, researchers can develop a model that identifies and examines all important KM resources and a firm's ability to leverage these resources. Such a model can then be linked to measures of firm performance, and thus help understand the underlying mechanisms between superior KM performance and financial performance.

Future research can also investigate why some firms are better at converting their KM investments

into superior KM performance. Such studies will yield valuable insights into the effectiveness of a firm's KM strategy, how KM resources develop and evolve, and how the firm can enhance its ability to leverage these resources.

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Table 1: Descriptive Statistics and Comparability Test Results

Descriptive Variables	MAKE^{sm} Study Winners		Control Firms		Wilcoxon Signed Ranks Test for Paired Samples	
	Mean	Median	Mean	Median	Z-Value	P-Value
Sales (billion $)	39.74	25.99	40.19	21.28	-0.14	0.89
Assets (billion $)	44.46	28.62	42.44	27.87	0.00	1.00

Table 2: Results

The Profit and Cost Ratios													
Year	Firm	ROA		ROS		OI/A		OI/S		OEXP/S		COGS/S	
		Mean	Z Value	Mean	Z Value	Mean	Z Value	Mean	Z Value	Mean	Z Value	Mean	Z Value
1998 N=14	Winners	0.089	1.50	0.100	1.64[c]	0.211	1.99[b]	0.233	2.27[b]	0.767	-2.12[b]	0.473	-2.61[a]
	Control	0.056		0.058		0.157		0.149		0.847		0.631	
1999 N=15	Winners	0.110	2.27[b]	0.133	2.61[a]	0.215	2.56[a]	0.254	3.12[a]	0.746	-2.98[a]	0.460	-3.12[a]
	Control	0.049		0.053		0.141		0.144		0.853		0.659	
2000 N=18	Winners	0.095	2.07[b]	0.113	1.59	0.189	2.34[b]	0.227	3.05[a]	0.756	-2.84[a]	0.527	-2.68[a]
	Control	0.053		0.063		0.136		0.137		0.861		0.688	
2001 N=20	Winners	0.037	0.97	0.031	1.27	0.146	0.81	0.179	2.64[a]	0.812	-2.48[a]	0.582	-2.35[b]
	Control	0.029		0.028		0.131		0.125		0.877		0.693	
2002 N=20	Winners	0.019	1.53	-0.002	-1.23	0.145	2.46[a]	0.178	2.64[a]	0.811	-2.49[a]	0.595	-1.72[c]
	Control	0.008		-0.001		0.093		0.093		0.907		0.708	
2003 N=19	Winners	0.074	1.89[c]	0.086	1.93[b]	0.164	2.68[a]	0.194	2.96[a]	0.796	-2.79[a]	0.616	-1.62[c]
	Control	0.024		0.016		0.089		0.084		0.916		0.722	
2004 N=19	Winners	0.098	2.90[a]	0.113	3.26[a]	0.168	2.72[a]	0.196	3.24[a]	0.793	-3.10[a]	0.625	-1.69[c]
	Control	0.033		0.023		0.101		0.093		0.907		0.725	

[a]Significant at 0.01; [b]Significant at 0.05; [c]Significant at 0.10.
ROA—return on assets; ROS—return on sales; OI/A—operating income to assets; OI/S—operating income to sales; OEXP/S—operating expense to sales; COGS/S—cost of goods sold to sales; N—number of observations.

Appendix A: List of MAKE^{sm} Study Winners and Control Firms

MAKE^{sm} Study Winners			Control Firms		
Company Name	**SIC**	**Industry Description**	**Company Name**	**SIC**	**Industry Description**
3M CO	2670	Convert paper, paperboard	GEORGIA-PACIFIC CORP	2600	Paper and allied products
*ACCENTURE LTD	8742	Management consulting services			
BP PLC	2911	Petroleum refining	ROYAL DUTCH PETROLEUM -ADR	2911	Petroleum refining
CANON INC	3577	Computer peripheral equipment	CATERPILLAR INC	3531	Construction machinery and equipment
CHEVRONTEXACO CORP	2911	Petroleum refining	TOTAL SA -ADR	2911	Petroleum refining
CISCO SYSTEMS INC	3576	Computer communication equipment	SANYO ELECTRIC CO LTD	3579	Office Machines
DELL INC	3571	electronic computers	NEC CORP	3571	electronic computers
*GENERAL ELECTRIC CO-PRE FASB	3600	Electric, other electronic equipment			
GOOGLE INC-REDH	7370	Computer programming, data process	EQUANT N V -ADR	7370	Computer programming, data process
HEWLETT-PACKARD CO	3570	Computer & office equipment	TOSHIBA CORP	3570	Computer & office equipment
*INTL BUSINESS MACHINES CORP	7370	Computer programming, data process			
INFOSYS TECHNOLOGIES	7371	Computer programming services	ANALYSTS INTERNATIONAL CORP	7371	Computer programming services
INTEL CORP	3674	Semiconductor related device	ERICSSON (L M) TEL -ADR	3663	Radio, TV broadcast, Communication equipment
JOHNSON & JOHNSON	2834	Pharmaceutical preparations	MERCK & CO	2834	Pharmaceutical preparations
LUCENT TECHNOLOGIES INC	7373	Computer integrated system design	ADECCO SA -ADR	7363	Help supply services
MICROSOFT CORP	7372	Prepackaged software	ELECTRONIC DATA SYSTEMS CORP	7370	Computer programming, data process
MONSANTO CO	2870	Agricultural chemicals	SYNGENTA AG	2870	Agricultural chemicals
NOKIA CORP	3663	Radio, TV broadcast, Communication equipment	MOTOROLA INC	3663	Radio, TV broadcast, Communication equipment
PFIZER INC	2834	Pharmaceutical preparations	GLAXOSMITHKLINE PLC -ADR	2834	Pharmaceutical preparations
ROYAL DUTCH/SHELL GRP COMB	2911	Petroleum refining	EXXON MOBIL CORP	2911	Petroleum refining
SCHLUMBERGER LTD	1389	Oil and gas field exploration services	HALLIBURTON CO	1389	Oil and gas field exploration services
*SIEMENS AG	9997	Conglomerate			
SONY CORP	3651	Household audio & video equipment	MATSUSHITA ELECTRIC -ADR	3600	Electric, other electronic equipment
SUN LIFE FINANCIAL INC	6311	Life insurance	NORTHWESTERN MUTUAL LIFE INS	6311	Life insurance
SUN MICROSYSTEMS INC	3571	electronic computers	DEERE & CO	3523	Farm machinery and equipment
TOYOTA MOTOR CORP	3711	Motor vehicles & car bodies	GENERAL MOTORS CORP-PRE FASB	3711	Motor vehicles & car bodies
UNILEVER PLC	2000	Food and kindred products	GROUPE DANONE -ADR	2000	Food and kindred products
XEROX CORP	3577	Computer peripheral equipment	CATERPILLAR INC-PRE FASB	3531	Construction machinery and equipment