The effect of tacit knowledge on firm performance

Harold Harlow

Abstract

Purpose – The purpose of this paper is to propose the use of the tacit knowledge index (TKI) to assess the level of tacit knowledge within firms and its effect on firm performance.

Design/methodology/approach – A sample of 108 US and Canadian firms that are using knowledge management was surveyed to determine each firm’s TKI. This measure includes both the degree of usage and the tacitness of the knowledge management method. Regression and correlation were used to statistically analyze the innovation and financial outcomes.

Findings – Significant relationships were found between a firm’s level of TKI and the firm’s innovation performance. Less clear is the relationship between a higher TKI and financial measures.

Research limitations/implications – This research gives managers a way to structure their use of knowledge management methodology and use of resources in a way that may maximize performance, either as stand alone systems or as part of the Balanced Scorecard.

Practical implications – The use of this research could greatly reduce the uncomfortable gut feeling that many managers have in funding so-called soft tacit-based knowledge management systems rather than invest in easier to assess hardware systems.

Originality/value – This pioneering research develops tacit knowledge as a measurable quantity and links this metric to firm performance.

Keywords Tacit knowledge, Knowledge management, Knowledge management systems, Balanced scorecard, Innovation

Paper type Research paper

Introduction

The late Peter Drucker said that “knowledge has become the key economic resource and the dominant—and perhaps even the only-source of competitive advantage.” The firm specific concept of intellectual capital was introduced in the early 1990s which connected the idea of a firm’s knowledge to the concept of firm intellectual capital to address valuation of intangibles and to further explain the idea of value creation and its relationship to firm performance (Edvinsson and Malone, 1997; Roos and Roos, 1997; Stewart, 1997; Sveiby, 1997) Since this time, researchers have attempted to understand how intellectual capital is generated at firms and what effect this intellectual capital has on firm performance Understanding how intellectual capital can be converted into meaningful results and which knowledge management methods that produce those results is the main thrust of this research.

Several researchers have developed models of tacit knowledge transfer and effect on performance that support our observations. Somech and Bogler (1999) details how tacit knowledge is quantified in college freshmen and can be measured as the students gain more tacit knowledge as they progress to seniors. The term practical intelligence has been used as a proxy for tacit knowledge (Sternberg, 1997). Others have developed tools for measuring tacit knowledge as part of their work on quantifying managerial intelligence (Wagner and Sternberg, 1992). Measuring tacit knowledge is also seen as “risky business” (Nonaka and Takeuchi, 1995). O’Dell and Grayson (1998) detail ways that internal
knowledge can be transferred using “best practices” that supports this study’s measurement of both activities and outcomes. The Intellectual Capital Services’ IC-Index – originally developed in Scandinavia and Australia by Johan and Göran Roos (Roos and Roos, 1997) the index identifies four categories of intellectual capital: relationship, human, infrastructure and innovation; it then looks at the relative importance of each, and also at the impact of changes in intellectual capital.

This research develops an operational definition of a tacit knowledge index (TKI) that provides a measurement tool for managers to use in selecting appropriate knowledge management methods for desired innovation and financial outcomes. The development of this scale is significant because no current research exists that develops an operational definition of tacit knowledge that combines the degree of tacit knowledge content of various KM methods with usage of theses methods at the firm to measure firm performance. This measure will be useful as firms try to measure their ability to create both a core competence in KM and maintain or improve their capability to create and disseminate tacit knowledge.

This paper is divided into three sections. The first section is the theoretical review and refinement that connects the concepts of intellectual capital, knowledge, knowledge management and tacit knowledge. The second section presents the research hypotheses and relationships that are described. The final section is a presentation of the methodology and results of the research including how the TKI was developed and the statistical relationships of TKI to innovation and financial outcomes.

**Theoretical development**

The first step is to understand the concepts of knowledge and intellectual capital and how these relate to how we see knowledge generation and more specifically tacit knowledge creation. The first question was to answer what is knowledge? Ikujiro Nonaka and Noburu Konno (1998) think that knowledge is a “shared space for emerging relationships that can be either a physical space, virtual, mental or any combination of the above.” This concept is known as ‘ba’ – place – and originally was proposed by Japanese philosophers Kitaro Nishida and refined by Shimizu. ‘Ba’ provides a shared place that provides meaning. This intangible idea of knowledge differs markedly from tangible information that once separated from “ba” can be communicated via media or networks. What is important to recognize from this definition is what knowledge is not. Knowledge is not information nor is it tangible. Knowledge may be created and shared using “ba” but knowledge is constantly undergoing change and transformation to new levels of knowledge. This change is presented in the SECI (socialization, externalization, combination, internalization) model of spiral evolution of knowledge creation and the self transcending process (Nonaka and Konno, 1998) that uses the concept of an ever changing spiral evolution of knowledge from tacit to tacit through internalization and socialization and from tacit to explicit through externalization and combination. This is the definition used in this research because it succinctly presents that knowledge exists as a continuum and the interplay of tacit and explicit knowledge creates ever more knowledge.

There are a number of varying descriptions and definitions of intellectual capital such as: knowledge that can be converted into value (Edvinsson and Sullivan, 1996); it is about knowledge and knowing capability of a social collectivity (Nahapiet and Ghoshal, 1998); packaged useful knowledge (Stewart, 1997); and Intellectual capital = competence × commitment (Ulrich, 1998). This research includes specific inclusion of the use of knowledge to create customer value which in turn drives firm outcomes.

What is knowledge management (KM)? The definition of KM is that it is the formal process of determining what internally held information could be used to benefit a company and ensuring that this information is easily made available to those who need it (Roy, 2002). KM has also been defined as the effective use of systems to collect, use, and reuse knowledge within the firm (Davis, 2002). The use of KM systems (Castillo, 2002) has grown substantially in the past ten years (Teece, 2001). A firm’s overall economic, strategic, and innovation performance is dependent on the degree to which the firm can use all of the knowledge created by the firm and turn this knowledge into value-creating activities (Krogh, 1998). KM
is a strategic process, the desired goal of which is to harness the value of information by integrating it with processes that govern the manipulation of intellectual assets (Loshin, 2001). The use of KM enables firms to have more effective decision-making processes and enables firms both to create new knowledge and to apply this knowledge to generate more innovation in products, strategy, and processes (Probir and Tacit, 2002). Greater levels of innovation and improved processes in turn lead to enhanced market and financial performance. KM also enables better strategic moves that enable the firm to have greater-than-average long-term returns. Just as more knowledge in the stock market enables investors to gain greater-than-average returns, our argument is that knowledge that is shared widely within the firm and made available in a timely manner enables better strategic decision making.

A knowledge management system (KMS) is one that allows both tacit uncodified and explicit codified knowledge to be created, stored and shared using technology or other methods. A knowledge management system is not simply an information technology system since codified knowledge (explicit knowledge) is just one component of knowledge. Because explicit-based KM systems are easy to imitate, it is not clear that they form the basis for a core competitive advantage (Barney, 1991). A KMS includes the following eight major knowledge processes (Ruggles, 1998):

1. generation of new knowledge;
2. accessing valuable knowledge from outside sources;
3. using accessible knowledge in decision making;
4. embedding knowledge in processes, products and/or services;
5. representing knowledge in documents, databases, and software;
6. facilitating knowledge growth through culture and incentives;
7. transferring existing knowledge into other parts of the organization; and
8. measuring the value of knowledge assets and/or impact of knowledge management.

Measuring the value of knowledge assets and/or impact of knowledge management processes is the main thrust of this research and the aim is to enable knowledge creation that unlocks the mystery of tacit knowledge toward greater innovation within the firm (Von Krogh et al., 2000). Empirical studies have shown that 46 percent of executives believe that their firm’s KMS performance is good to excellent at creating new knowledge but only 4 percent rate their firm’s performance as good in measuring the value of knowledge assets and/or the impact of KM. In developing these processes, surveys have shown that the people side of the KMS, dealing mostly with sharing and creating tacit knowledge, is the most difficult area of KMS – 56 percent rate this as the most difficult area – and measuring knowledge assets and their value is the second most difficult process – 43 percent – (Ruggles, 1998).

This lack of empirical information on the impact of KMS that include both tacit and explicit methods has meant that firms often choose technology solutions that are designed to capture and disseminate mostly explicit knowledge (Almeida and Kogut, 1999). While these systems offer the advantage of ready usage metrics, their actual contribution to effective KM within the firm is less clear (Berman et al., 2002). The degree of explicit codification – more manuals or product plans do not presage success at firms – does not indicate that the knowledge encoded is valuable or unique. Firms may have extensive libraries of codified knowledge that is rarely accessed or is bypassed by unmapped tacit processes.

Current research has not validated which KM methods (either explicit or tacit or a combination of both) are more or less effective, and there has been little research that looks at the relationship of KMS to the firm’s outcomes (Grant, 1996). This research focuses on developing a measure of the value of knowledge assets and/or impact of knowledge management by having senior experienced executives rate knowledge management methods according to their degree of tacitness or explicitness. A firm can determine its
degree of usage and hence use the underlying tacitness to evaluate its relationship to the innovation and financial impact of knowledge management at the firm. Further, this research can help managers determine which knowledge management strategy is being used-either explicitly or implicitly-at the firm to allow managers to adjust their strategy to achieve better financial or innovation outcomes.

In order to use knowledge management, firms develop a firm-specific knowledge management system (KMS) and firms are able to develop a sustainable competitive advantage in KM by developing a mix of KM methods that complement and enable their core strategies (Hansen, 2002). However, despite large investments in KM technology, many of the performance outcomes are not clear and the causal relationship between what works and what does not work has not been established empirically (Liebeskind, 1996).

It is further argued that firms with greater degree of managing knowledge, and specifically tacit KM, will achieve higher than average returns. The measures of economic effectiveness of KM systems have frequently used the Return on Sales (ROS), share price, growth of sales, and other financial metrics as a test to the success of KM systems (Sveiby, 1997). These metrics provide useful information but may be hard to measure in large global firms that use KM in only part of their operations. A firm’s overall economic, strategic, and innovation performance is dependent on the degree to which the firm can use all of the knowledge created by the firm and turn this knowledge into value-creating activities (Krogh, 1998). These firms are able to use the tacit knowledge component of KM to create hard-to-duplicate core competence in managing, identifying, capturing, systemizing, and applying tacit knowledge to create customer value as measured by innovation and economic outcomes. In order to measure the innovation and economic outcomes of the firm, it is important to understand how and why tacit KM is both crucial and necessary in today’s firms.

Tacit knowledge is internal in nature and is relatively hard to code and extract. Not only does tacit knowledge need to be discovered, extracted, and captured; it has to be creatively disseminated so that this shared knowledge can be efficiently used to extend the KM base (Davis, 2002). Wagner and Sternberg (1985) defined tacit knowledge as “that work-related practical knowledge learned informally on the job”. This definition defines only one part of tacit knowledge, that is, the part that encompasses know-how. The other part of tacit knowledge is the cognitive dimension (Beamer and Varner, 2001) which consists of beliefs, values, attitudes, ideals, mental maps, and schemata which are related to the cultural shaping of the individual and the group. This cognitive dimension of tacit knowledge is a most important, yet most difficult, part of enabling knowledge creation and dissemination.

Within these two dimensions of tacit knowledge there are four categories: hard-to-pin-down skills; mental models; ways of approaching problems; and organizational routines (Lubit, 2001). Metalworkers frequently cannot explain how they know the right temperature and amount of pressure to apply to a metal deformation but, over time, they learn such tacit skills that cannot be described by a process chart or in words. These skills are transferable to apprentices only as they work for several years with the master metalworker.

Another way to understand tacit knowledge is that it is used in three ways: to find problems; to solve problems; and to predict and anticipate problems. In problem finding, the ability to develop a mental model and map of the problem is highly related to the internal store of tacit knowledge. These techniques of problem finding and problem solving are similar to the craftsman’s model in that tacit knowledge of how things go together and which way the
system acts leads to the identification and solution of problems. This process also allows one to anticipate problems just as one’s experience often creates an accurate way to predict and anticipate one’s store of tacit knowledge in the form of experience and skills creates the mental imagery needed for predicting how both similar and dissimilar events and processes will develop.

Perhaps tacit knowledge is the more important component of KM, to the extent that the collaboration that it encourages leads to quantum shifts in knowledge rather than the incremental linear enhancements that are typically associated with explicit KM. However, tacit knowledge extraction, dissemination, and collaboration are difficult to effect (Markus, 2001). Tacit knowledge may be best understood by the assertion that “we know more than we can tell” (Polanyi, 1966). This observation is quickly supported if people are asked to write out a certain process or workflow. Persons asked to explain how to drive a car cannot fully describe how to accomplish this common task of everyday life. Much of the process and workflow is contained in a mutual understanding of the work or process and it is not easily documented nor can it be easily communicated.

The identification of what is explicit knowledge is relatively straightforward. Drawings, e-mails, policy manuals, product manuals, and other forms of explicit knowledge lend themselves to the application of metrics. While tacit knowledge and explicit knowledge coexist in a continuum (or as a knowledge spiral) complementing each other, the explicit knowledge forms are more easily extracted and measured (Nonaka and Konno, 1998). The measurement of tacit knowledge is less clear. Tacit knowledge can be part of the group collective knowledge (Spender, 1996). This socio-cultural knowledge (Castillio, 2002) drives the organization, but it is difficult to measure.

Quantifying tacit knowledge by proxy measurements such as financial and human resource data on the penetration of new markets by Japanese and American firms was completed by Hennert (1992) and Kim and Hwang (1992). Nonaka and Takeuchi’s (1995) theory of knowledge creation depends on the idea that implicit (tacit) knowledge can be transferred. As examples of the successful transfer of tacit knowledge, they pointed to the success of Japanese multinationals NEC, Honda, and Matsushita. These theories of knowledge creation support this research and its measurement of tacit knowledge since they also point out that in order to transfer tacit knowledge successfully the firms must plan for that transfer by using tacit methods (people-centered) appropriate to tacit knowledge transfer.

It is not sufficient to have knowledge assets, patents, or other marketable intellectual property. The firm must also be capable of translating that knowledge into value for customers. In this research, customer value is measured through the analysis of the performance outcomes where the results of the firm, in both innovation and financial outcomes, are equated to customer value. That value-creating capability resides in the know-how or tacit knowledge of the engineers, managers and marketing staff and this dynamic tacit knowledge capability creates sustainable competitive advantage (Teece, 1998). These subject matter experts must be able to fit into an automated system that allows tacit knowledge dispersal and tacit knowledge use by both the experts and the rest of the firm’s staff and depends to a large degree on the KM systems that are employed (Maybury et al., 2000).

The two-stage approach and experts’ pretest used in this research to determine tacitness has been used previously to measure tacit knowledge levels between subjects (Somech and Bogler, 1999). This study uses an expert’s pretest to assign tacitness to KM methods. It also extends the prior studies and uses the proxies of innovation and financial outcomes as a means to quantify the tacit knowledge effects.

Prior research quantifying tacit knowledge by proxy measurements such as financial and human resource data on the penetration of new markets by Japanese and American firms was completed by Hennert (1992) and Kim and Hwang (1992) and led to the following hypothesis:

H1. There is a positive association between the Tacit Knowledge Index (TKI) and firm outcomes.
Both innovation and financial outcomes are enhanced by the high degree of tacit knowledge (Leonard and Sensiper, 1998) created by groups in an effective KMS. The use of KMS improves effective decision-making processes and allows firms both to create new knowledge and to apply this knowledge to generate more innovation in products, strategy, and processes (Probir and Tacit, 2002). Greater levels of innovation and improved processes in turn lead to enhanced market and financial performance. A firm’s overall economic and innovation performance is dependent on the degree to which the firm can use all of the knowledge created by the firm and turn this knowledge into value-creating activities (Krogh, 1998). These theories led to the following performance based hypothesis:

\[ H2. \] TKI has a positive relationship to innovation.

The research was based on the assumptions that the firm strategy deployed a system of both explicit and tacit knowledge management methods to positively affect firm innovation and financial performance. This includes various methods of KM that are tacit, not technology based, such as teaming, master craftsman, communities of practice, experting, and collaboration. The explicit methods in the research includes the use of technological methods such as e-mail data-mining, digital databases, capturing lessons learned digitally, use of groupware, technology for Computer Aided Design/Computer Aided Manufacturing/Computer Aided Engineering, content capture, expertise capture and written processes and procedures.

Methodology

Sample

The original Delphi stage of the research was a survey which was sent to six (6) recipients based on their senior level positions managing technology and knowledge systems at Fortune 500 companies in San Diego, California. The six included four (4) vice presidents, one (1) CEO and one (1) director. Industries represented included aerospace, health sciences, technology, transportation and manufacturing. After evaluating this approach, another six members were surveyed – one (1) Dutch consultant, one (1) French executive, two (2) Middle Eastern IT/KM, one (1) Scottish NGO technology executive and one (1) Swiss IT business CEO. This Delphi group was chosen from another geographic area (Europe and the Middle East) in order to understand if differences between geographies might affect the scoring and to confirm the universality of the Delphi tacitness scores. Both groups of Delphi experts were chosen based on their knowledge of the KM industry and their accessibility through personal contacts and eminence in industry. They completed an assessment of each knowledge management method and rated each as to its tacitness or explicitness. All 12 responded to all questions.

The primary research survey was a random survey sent to 1,128 knowledge management professionals who were selected based on their titles from a list of over 68,000 knowledge management industry professionals. Of these, 113 responded (10 percent response rate) and 108 were finally certified as usable based on their survey completeness. The respondents included a cross-section of industries and all management levels (see Table I). No respondent was from the same organization. Over half (57) of the respondents were managers or executives. A large minority (37) were in service industry firms, primarily consulting and software systems. Telecommunications (17), aerospace (14), energy (5) and manufacturing (14) were also industries represented.

Measures

Tacit knowledge. This was operationalized (Delphi Method) by asking this panel of 12 industry experts in two groups – USA and European/Middle East groups – first, to assess several definitions of tacit knowledge presented to them – the definition that tacit knowledge may be best understood by the assertion that “we know more than we can tell” (Polanyi, 1966) was the definition chosen by the groups as the definition of tacit knowledge; second, to determine a common understanding of tacit knowledge; and finally, to rate KM methods according to their tacitness or explicitness. The experts were given a number of scholarly
definitions of tacit knowledge to help them understand the tacit scale question as one concerned with the amount of codification and externalization of each method and this relationship to the tacitness. This information was then used to rate methods as to their tacitness and to use that assignment to determine whether a firm had a higher degree of tacit knowledge methods employed and a higher degree of tacit knowledge as measured by the index. The 15 KM methods used in this study were chosen based on their common use and understanding as the primary elements of a knowledge management system (Harlow, 2004). They are listed in Table II.

**Tacit Knowledge Index.** In stage two of this research, the expert’s individual method TK score was used as a multiplier for each method’s usage (usage measured on a scale of 1 to 5) at each firm in order to determine a TKI score per method. The TKI individual method scores were then summed for all methods employed at each company surveyed and the sum was the overall TKI score. The TKI independent variable was then regressed to the innovation and financial measures to explore the dependent relationships. For example, the TKI for communities of practice was 4.8. If the usage from the Likert scale 1-5 survey was 3, then the TKI for that element was 3 times 4.8 or 14.4. That summation was repeated for each of the fifteen methods and summed for a total firm TKI score. Each firm had a distinct score based on their usage of each KM method.

**Firm performance.** Innovation and financial measures (see Table III) were operationalized in the survey based on the research performance variables from the Profit Impact of Market

<table>
<thead>
<tr>
<th>KM method</th>
<th>Group 1</th>
<th>Group 2</th>
<th>Mean 1 and 2</th>
<th>Means difference</th>
<th>SD difference</th>
<th>SD Group 1</th>
<th>SD Group 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>Collaboration</td>
<td>4.83</td>
<td>4.67</td>
<td>4.75</td>
<td>−0.17</td>
<td>−0.07</td>
<td>0.52</td>
<td>0.44</td>
</tr>
<tr>
<td>Communities</td>
<td>4.83</td>
<td>4.67</td>
<td>4.75</td>
<td>−0.17</td>
<td>−0.07</td>
<td>0.52</td>
<td>0.44</td>
</tr>
<tr>
<td>Experting</td>
<td>4.67</td>
<td>4.33</td>
<td>4.50</td>
<td>−0.33</td>
<td>−0.15</td>
<td>0.82</td>
<td>0.67</td>
</tr>
<tr>
<td>Teaming</td>
<td>4.17</td>
<td>3.83</td>
<td>4.00</td>
<td>−0.33</td>
<td>−0.20</td>
<td>0.75</td>
<td>0.56</td>
</tr>
<tr>
<td>Master craftsman</td>
<td>4.33</td>
<td>4.67</td>
<td>4.50</td>
<td>0.33</td>
<td>−0.07</td>
<td>0.52</td>
<td>0.44</td>
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<tr>
<td>CRM</td>
<td>4.00</td>
<td>4.00</td>
<td>4.00</td>
<td>0.00</td>
<td>−0.23</td>
<td>0.89</td>
<td>0.67</td>
</tr>
<tr>
<td>Lessons</td>
<td>3.83</td>
<td>4.00</td>
<td>3.92</td>
<td>0.17</td>
<td>−0.23</td>
<td>0.89</td>
<td>0.67</td>
</tr>
<tr>
<td>Data-mining</td>
<td>2.00</td>
<td>2.00</td>
<td>2.00</td>
<td>0.00</td>
<td>−0.23</td>
<td>0.89</td>
<td>0.67</td>
</tr>
<tr>
<td>Digital databases</td>
<td>1.50</td>
<td>1.50</td>
<td>1.50</td>
<td>0.00</td>
<td>−0.05</td>
<td>0.55</td>
<td>0.50</td>
</tr>
<tr>
<td>Groupware</td>
<td>1.33</td>
<td>1.50</td>
<td>1.42</td>
<td>0.17</td>
<td>−0.05</td>
<td>0.55</td>
<td>0.50</td>
</tr>
<tr>
<td>Written procedures</td>
<td>1.83</td>
<td>1.83</td>
<td>1.83</td>
<td>0.00</td>
<td>−0.20</td>
<td>0.75</td>
<td>0.56</td>
</tr>
<tr>
<td>Technology use</td>
<td>1.67</td>
<td>1.67</td>
<td>1.67</td>
<td>0.00</td>
<td>−0.15</td>
<td>0.82</td>
<td>0.67</td>
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<tr>
<td>Content capture</td>
<td>1.50</td>
<td>2.17</td>
<td>1.83</td>
<td>0.67</td>
<td>−0.15</td>
<td>0.98</td>
<td>0.83</td>
</tr>
<tr>
<td>Written processes</td>
<td>2.83</td>
<td>3.17</td>
<td>3.00</td>
<td>0.33</td>
<td>−0.20</td>
<td>0.75</td>
<td>0.56</td>
</tr>
<tr>
<td>Capture expertise</td>
<td>4.00</td>
<td>4.17</td>
<td>4.08</td>
<td>0.17</td>
<td>−0.20</td>
<td>0.75</td>
<td>0.56</td>
</tr>
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</table>
Strategies (PIMS) database (Anderson and Paine, 1978). Scores from the Likert scale questions were summed to create an overall factor innovation or financial score. Higher additive scores indicated higher performance on each measure.

Results

TK was measured with strong correlation of the raters to each other. There was little variation between raters which indicated that the Delphi method was measuring that which it was intended to measure and the tacitness of each method had strong reliability based on the inter-rater scores. The two Delphi groups-USA and Europe/Middle East-also had very little difference in their rating of the tacitness of each method. Table II shows the KM methods and results of the industry experts’ pretest tacitness scoring.

A statistical comparison of the experts’ ratings of each method was performed. The means of the two groups was compared to determine if different Delphi groups in different locations differed in their scoring. There were small differences between the two groups in that the tendency for Group 2 (Europeans and Middle Easterners) was to rate all methods slightly lower in tacitness. No other significant differences between the two groups was found. A Cronbach Alpha statistic was performed on each group – Group 1 \(= 0.94\), Group 2 = 0.96 and Group’s 1&2 = 0.98 as one group with no significant differences. This shows a high degree of inter-rater reliability.

The highest tacit rated methods were collaboration (4.8), master craftsman (4.8) and communities of practice (4.7). Teaming was rated lower (4.3) which was unexpected. Table IV indicates a moderate correlation that is significant in all cases for all compared raters. Rater 2 and Rater 6 within Group 1 and Rater 10 and 12/9 in Group 2 showed the least correlation to each other, but both of these raters were moderately correlated to other raters. The resultant TKI variable was one that combined the reliable tacitness (TK) measurement with the survey usage to arrive at the TKI for the firm.

The measures of central tendency for TKI, innovation and financial variables show a distributed data set (see Table V). The maximum TKI for all companies is 219.4 with a minimum of 34. The Innovation max-min is 5 and 1 with a mean of 3.43 for all companies and the financial max-min is 5 and 1 with a mean of 3.21. The standard deviations for all three variables are; TKI = 35.43, Innovation = 1.10 and Financial = 1.23.

This research consisted of the entire sample of 108 firms. Predictor TKI variable had a \(R^2\) value of 0.389 and 0.237 when regressed against the firm performance variables, innovation and financial performance, respectively. The higher \(R^2\) effect on innovation of the firm indicates that TKI has the greatest influence on innovation with a more moderate relationship to financial performance (see Table VI).

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"Greater levels of innovation and improved processes in turn lead to enhanced market and financial performance."
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<table>
<thead>
<tr>
<th>Rater 1</th>
<th>Rater 2</th>
<th>Rater 3</th>
<th>Rater 4</th>
<th>Rater 5</th>
<th>Rater 6</th>
<th>Rater 7</th>
<th>Rater 8</th>
<th>Rater 9</th>
<th>Rater 10</th>
<th>Rater 11</th>
<th>Rater 12</th>
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<tr>
<td>Pearson correlation</td>
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<td>0.875</td>
<td>0.874</td>
<td>0.778</td>
<td>0.647</td>
<td>0.796</td>
<td>0.800</td>
<td>0.811</td>
<td>0.738</td>
<td>0.674</td>
<td>0.712</td>
</tr>
<tr>
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<td>–</td>
<td>0.000</td>
<td>0.000</td>
<td>0.001</td>
<td>0.009</td>
<td>0.000</td>
<td>0.000</td>
<td>0.000</td>
<td>0.002</td>
<td>0.006</td>
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<td>n</td>
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<td>15</td>
<td>15</td>
<td>15</td>
<td>15</td>
</tr>
<tr>
<td>Rater 2</td>
<td>Pearson correlation</td>
<td>0.875</td>
<td>1</td>
<td>0.838</td>
<td>0.660</td>
<td>0.526</td>
<td>0.666</td>
<td>0.821</td>
<td>0.807</td>
<td>0.732</td>
<td>0.607</td>
</tr>
<tr>
<td>Sig. (2-tailed)</td>
<td>0.000</td>
<td>–</td>
<td>0.000</td>
<td>0.007</td>
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<td>0.561</td>
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Research limitations

The small relationship of TKI to financial outcomes limits this study’s use in predicting financial performance. Also, new research is needed to determine how to develop and use TKI as a predictor of strategic performance. The research methodology of using managers to rate their usage of various methods at firms could differ systematically from actual usage of KM at the firms. Manager’s might reflect either more or less actual usage than is occurring and measurement use of actual occurrences over a long period of time might produce an entirely different result, either meaning less or more relationship to the TKI variable. This study also may raise questions as to which knowledge methods should be included and to the use of an overall scale to capture what is a tacit attribute of each method. The five-point Likert scale used in the study provides a limited measurement scale and may miss significant resolutions in the data set. Further research using a seven point scale might produce results that would be more clearly defined.

This study was conducted in the USA and Canada (initial Delphi in San Diego and sampling in the USA and Canada), Europe and the Middle East (second Delphi rating) and there are certain limitations that might apply to this research if conducted in other areas of the world. For instance some cultures, such as the Japanese, are highly contextual which gives them a more tacit-based group approach to sharing knowledge. Japanese are more contextually adept at sharing knowledge within groups and collaborating than westerners who tend to view knowledge as resident within the individual, not within the group. In addition, because group membership is often extended for years, much of the sharing of knowledge may take place between many staffers who are both expert and maintain organizational cultural tacit knowledge. In asking Japanese experts to rate the methods described in this study, we may get a less extreme rating of the tacit and explicit methods since the Japanese share context-based tacit knowledge within their organizational cultures on a continuous basis. Nonaka and Konno (1998) think that knowledge is a “shared space for emerging relationships that can be either a physical space, virtual, mental or any combination of the above”. This Japanese view that knowledge is a shared place (”ba”) that combines aspects of the contextual (physical space) virtual space or mental space demonstrates that ideas about what is knowledge and specifically tacit knowledge may vary according to cultural reference. In other collectivist cultures, this may mean that judgments about the differences between what is tacit and explicit knowledge may result in a very different scale and may not be universally applicable.

Two groups of Delphi experts (Group 1 – US, Group 2 – European and Middle Eastern members) were used in this study to compare how experts rate tacit and explicit knowledge methods in different geographies, cultures and organizations. While the two Delphi groups agreed closely, the Western cultural bias of which methods are more or less tacit or explicit
and the relative ratings reflect a Euro-American idea of tacit knowledge. That idea is grounded in the western belief that learning can occur second hand through books rather than through spiritual or learned experience (Beamer and Varner, 2001). Some cultures would value experience and spiritual learning as more valuable than book knowledge and thus rate experiential KM methods higher than westerners. This may affect the universal application of the results and limit initial deployments to western cultures. Further research is needed to develop a universally applicable scale.

Conclusions

The experts confirmed that what is being measured in each method is a measure of the medium of knowledge sharing or the method's throughput capability of tacit knowledge. When combined with usage at a firm, using a Likert scale measure, TK is positively associated with firm performance.

\( H_1 \). There is a positive association between the Tacit Knowledge Index (TKI) and firm outcomes.

This hypothesis was accepted and the null rejected because there was a positive relationship between TKI and Innovation and Financial outcomes.

\( H_2 \). Firms that have a high TKI will have a higher degree of innovation.

This hypothesis was accepted and the null rejected since TKI had a stronger relationship to innovation outcomes.

\( H_3 \). Firms with a low TKI will have stronger relationships to financial outcomes.

This hypothesis was accepted and the null rejected since there appeared to be a significantly lower relationship of financial outcomes to the TKI.

The results of this study provide empirical results that appear to indicate that use of tacit methods has a greater effect on innovation than on financial measures. The implication is that firms that want to innovate should employ a higher degree of tacit method usage than firms whose goals are financial. Further, firms whose environments require more innovation would be advised to use the methods that are highest in TK throughput such as experting, collaboration and master craftsman.

The ability to measure TK and the development of the TKI is the most important contribution of this study to the field of strategic KM. Armed with this tool, managers are now able to measure the TKI of their firm by determining the usage of the various KM methods and using our expert rating of the underlying tacit-ness of each method. This is a significant step because it sets the stage for more detailed studies with more definition of each of the variables and perhaps a look at how this tacit measure affects firm strategic choices.

Choices for new KM systems can now be made knowing that a more accurate measure of return on equity may be possible by measuring before and after TKI scores and relating those to the performance of the firm. While no study can account for all confounds and variables, this study makes an important first step in helping managers to quantify a largely unquantified area of management. The positive significant relationship between use of knowledge management tools, which is measured by the index, and innovation is not a new finding (Zahra and Nielsen, 2002). However, the development of a quantifiable approach to choosing a KMS mix as well as the counterintuitive findings that not all KM methods deliver results in each of the areas of innovation and financial outcomes-explicit methods are strongly related to financial outcomes and tacit methods to innovative outcomes-make this study a powerful KM selection management tool.

The present research further supports work on measuring TK and penetration of markets by Hennert (1992) and Kim and Hwang (1992). Nonaka and Takeuchi’s (1995) theory of knowledge creation depends on the idea that implicit (tacit) knowledge can be transferred. This work clearly shows that knowledge is highly transfer-able and useful as a measure of outcomes.
That socio-cultural knowledge can be part of the collective TK and the group collective knowledge (Spender, 1994) is highly important; however, before this study, this collective knowledge was very difficult to measure. The use of the overall TKI gives a proxy measure of the socio-cultural knowledge (Castillio, 2002) that drives the organization yet is difficult to measure.

The TKI measure developed within this study should allow firms to make better strategic decisions, since firms that identify TK as important make better decisions during the strategic decision-making process (Brock and Anthony, 2002). The study by Brock and Anthony provided an integration of the cognitive and strategic literatures to show that TK is accessible and how it plays an integral role in the context of strategic decision-making. Brock and Anthony proposed that better decisions would occur when TK is employed overtly during strategy sessions. This idea supports the findings of this study, since the use of tacit methods has been shown to have a high degree of impact on innovation and financial performance when these tacit methods are used.

**Practical application**

Many executives in the 1980s argued that financial measures alone did not allow them to manage effectively and wanted to replace those measures with operational measures. David Norton and Robert Kaplan (1992) proposed and championed the Balanced Scorecard (BSC) that included both operational and financial measures that would lead to a better understanding of whether or not the company was effectively achieving its long-term strategy (Kaplan and Norton, 1996a). The BSC uses four parameters (financial, customer, internal processes and learning and innovation) to develop metrics that directly link to the strategy of the firm (Kaplan and Norton, 1996b). By tying each of these parameters to the overall firm strategy (Kaplan and Norton, 2001), firms link the strategy to programs and actions (Kaplan and Norton, 1996c) and gain from the inter-relational effect of each parameter's metrics resulting in even better firm performance.

Straightforward measures for the financial, customer perspective and internal processes parameters have been developed. However, many companies implementing BSC have struggled to devise scorecard metrics for the learning and innovation parameter. Kaplan and Norton (1992) have found that companies draw from a common core of three outcome measurements—employee satisfaction, retention and productivity. Within this core, the employee satisfaction objective is considered the driver of the other two dimensions. They explain that staff competencies, technology infrastructure and a climate for action enable the core measurements. The drivers for staff competency are strategic skills, training levels and skill leverage. Drivers for technology infrastructure include strategic technologies, strategic databases, experience capture, proprietary software and intellectual property. The climate-for-action driver includes key decision cycle, strategic focus, staff empowerment, personal alignment, morale and teaming.

The TKI fits into the BSC innovation and learning framework by addressing all of three of these drivers that enable core measurements (Norton and Kaplan, 2005). Use of the TKI develops staff competencies by increasing the knowledge flows and knowledge networking within the firm between the knowledge holders and increasing strategic skills by developing collaborative skills, training the staff through experting and master craftsman approaches and leveraging the skill of experts. The use of the 15 KM methods coupled with the TKI methods enables the development and measurement (using TKI) of strategic database progression and use, degree of experience capture and the identification of proprietary software and intellectual property. Key decision cycles are measured indirectly using TKI in that innovation and financial results improve as a direct result of an increase in TKI capability. Use of methods to increase TKI has improves strategic focus by developing shared ideas and cooperation toward common goals. Since many of the KM methods are people-centric, the staff is further empowered which creates better personal alignment, morale and atmosphere for teaming. Again, the TKI metric allows managers to set targets and allocate resources toward these measures by increasing the usage and quality of both tacit and explicit KM methods.
TKI solves the BSC innovation and learning measurability problem by giving managers a way to increase the company's learning and innovation parameters through programs (such as experting, communities of practice and collaborative) that can be directly measured using the TKI. For example, BSC metrics for experting would be calculated by identifying the number of experts and multiplying that number times the reported usage of these experts by staff (another number) times the tacit rating of each method as provided by the this research (the last number). This can be repeated for each of the fifteen (15) factors (i.e. communities of practice, collaborative, teaming) to arrive at a final score for the base and improved TKI. Finally, these metrics can be related to improvements in financial and innovation outcomes by regressing the resultant TKI against those two variables. It would be of further research interest to measure the amount of tacit versus explicit knowledge versus the types of firm and country culture and the success of the firm relative to the market. The key issues remain how to diffuse and transfer the technology of managing knowledge (Martinez-Brawley, 1995). This means that developing KM systems that are measurable and can be improved using measures is the most important task facing managers and those responsible for KM in their firms. That knowledge and organizational knowing are not the same has been detailed (Cook and Brown, 1999). To address this gap, companies can develop KM strategies that measure organizational knowing using the TKI.

Contribution

This paper has made a significant contribution to management by addressing all three of the KM research issues: first, how can TK be tapped into and used, second, how to structure knowledge flow optimally between knowledge seekers and providers to maximize the impact of knowledge on the firm's outcomes, and finally, how to make knowledge that is usually, by its nature, fuzzy and intangible, visible and concrete (Holthouse, 1998). In addition, the use of TKI to implement the learning and innovation perspective of BSC provides managers with a ready tool to match their strategy to their innovation and learning perspective, measure and improve their businesses.

References


Polanyi, M. (1966), The Tacit Dimension, Doubleday Anchor, Garden City, NJ.


Further reading


About the author

Harold Harlow is Assistant Professor of Management at The American University in Cairo where he teaches Strategic Management, Technology and Innovation Management, International Business, Cross Cultural Communications and General Management. His business experience includes over 20 years as an executive at IBM, QUALCOMM, GE and Rockwell International. His research interests are innovation and technology knowledge development, entrepreneurial ventures in developing countries and strategic management of high technology firms. He has published several articles on tacit knowledge management and innovation, reengineering the firm, quality strategy and emotional intelligence. He is currently working on a book on technology and product innovation as well as consulting with the European Union in Egypt as managing director of MEI Consultants, a general consulting firm in Egypt. Harold Harlow can be contacted at: hharlow@aucegypt.edu

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