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ABSTRACT

This study assessed the use of knowledge management (KM), the process of generating, codifying, and transferring information assets for increased organizational performance, and the strategies that further its use in research universities. The study also examined relationships between use and efficiency of strategies and the effectiveness of KM, developed a classification model of KM effectiveness, and determined the critical success factors for KM effectiveness. A 43-item survey was adapted from an existing instrument. A field test concluded that the instrument was reliable (96%), and a panel of experts validated the content (72% agreement rate). The survey was distributed to 1,285 administrators at 257 public and private research universities, and 300 participants from 161 universities responded (62.6% response rate). Descriptive statistics and inferential analyses were used. Universities demonstrated an above moderate level use of strategies and a below moderate use of processes of KM. Technology was the most implemented strategy, measurement, the least. Notable differences were found between public and private universities regarding use of leadership strategy and transfer process. The proposed discriminant model for classifying institutions by KM effectiveness level was 76% accurate. Variance in KM effectiveness ranged from 46.6% (measurement) to 30.1% (culture). The most critical factors for effective KM centered around technology and measurement strategies. (Contains 14 figures, 10 tables, and 231 references.) (Author/SLD)

Knowledge Management in Research Universities:

The Processes and Strategies

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Abstract

In the fields of organizational studies and business management there has been a growing emphasis on the practice of knowledge management (KM)—the process of generating, codifying, and transferring information assets for increased organizational performance. This once-theoretical discipline is expanding into other sectors such as higher education institutions. The purpose of this study was to (a) assess the use of KM and the strategies which further its use in research universities, (b) examine relationships between use and efficiency of the strategies and the effectiveness of KM, (c) develop a classification model for KM effectiveness, and (d) determine the critical success factors for KM effectiveness.

A 43-item survey (rating strategies and processes on two dimensions—"use" and "importance") was adapted from a benchmarking tool created by Arthur Andersen Consulting and the American Productivity and Quality Center. The field test concluded that the instrument was reliable (96%) and a panel of experts validated the content (72% agreement rate). The survey was distributed to 1285 administrators at the 257 public and private United States research universities. Three hundred (300) participants from 161 universities responded. The response rate, calculated by number of organizations responding, was 62.6%. Descriptive statistics and inferential analyses (analysis of variance, correlational analysis, and discriminant analysis) were employed.

Five key findings were discovered. First, universities demonstrated an above moderate level (above 3 on a 5-point Likert scale) "use" of strategies and a below moderate level "use" of processes. Second, technology was the most implemented strategy, and measurement was the least. Third, notable differences between public and private universities were found regarding use of leadership strategy and transfer process. Fourth, the proposed discriminant model for classifying institutions by KM effectiveness level was 76% accurate. Variance in KM Effectiveness ranged from 46.6% (measurement) to 30.1% (culture). Finally, the most critical factors for effective KM centered around technology and measurement strategies. Tactics within each of these strategies were further identified to enable higher education leaders to increase KM effectiveness. Other considerations are highlighted for organizations wishing to implement a KM initiative, and recommendations are made for further research.

KNOWLEDGE MANAGEMENT IN RESEARCH UNIVERSITIES: THE PROCESSES AND STRATEGIES

Introduction

It was once observed that cave dwellers froze to death over beds of coal. Coal was directly under them, but they couldn't see it, mine it, or use it. This situation is a clear case of *what-you-don't-know-can-hurt-you*. It is happening all over again today, this time, though, it is not cavemen and coal, but, rather, organizations and "beds of knowledge"—or the hidden, untapped reservoirs of intelligence that exist in almost every organization. Few organizations, today, however, are not making this mistake. By using a business philosophy known as knowledge management (KM), they are tapping into hidden knowledge assets—getting the right information, to the right people, in the right place, at the right time.

In the fields of organizational studies and business management there has been a growing emphasis on the practice of KM for increased value and organizational performance (Bassi, 1997; Hope & Hope, 1997; Wah, 1999; Comeau-Kirschner, 2000; Gladstone, 2000; Gupta & Govndarajan, 2000). However, despite these ongoing research contributions and efforts of private organizations to adapt to the notion of the information organization and the knowledge society, researchers have paid little attention to higher education institutions, and non-profit, government, and community organizations. There is a long history of academic management mirroring the innovations, philosophies, strategies, and techniques originating in the private sector (Dill, 1982; Tierney, 1998; Katz, 1999; Birnbaum, 2000; Kezar, 2000; Allen, 2001). If KM follows previous attempts of universities to adopt business strategies (i.e., Total Quality Management, Business Process Engineering, etc.), then there should be some evidence of it in institutions of higher education.

Purpose of the Study

The purpose of this study was to (a) assess the use of KM and the strategies which further its use in research universities, (b) examine relationships between use and efficiency of the strategies and effectiveness of the KM process, (c) develop a classification model for KM effectiveness using the strategies as independent variables, and (d) determine the critical success factors that distinguished the research universities which use KM most effectively from those that use it least effectively.

This study assumes that universities would benefit from being able to manage knowledge in order to create the intellectual assets they need to achieve their potential as organizations and to remain competitive in a global society. It also assumes that: (a) KM is a process used by universities; (b) some universities manage knowledge more efficiently than other universities; (c) the effectiveness of the KM process is facilitated by the presence of enabling management strategies related to leadership, culture, technology, and measurement; and, (d) the effectiveness of the KM process is mediated by contextual factors such as Carnegie classification, state control (private or public), functional area, and institutional age.

Theoretical Framework

This study focuses on the penetration of KM into universities by investigating the use, importance, and current initiatives of KM in research universities in the United States. Among the central concepts framing this study are knowledge management, knowledge, knowledge management processes, knowledge management strategies, intellectual capital, and organizational performance. The relationship among these concepts is mirrored in the model in Figure 1.

[Figure 1 about here]

This model depicts knowledge management (KM) as the processes of generating, codifying, and transferring knowledge within an organization. It is a management discipline that treats knowledge as a managed asset. In the KM process, personal (tacit) knowledge is turned into organizational, or explicit, knowledge that can be widely shared and applied throughout an organization. The processes, enabled by cultural, leadership, technological, and measurement strategies, harness and leverage the knowledge necessary to develop intellectual capital needed by organizations to operate, grow, and remain competitive. The model suggests that organizations that manage knowledge should have a greater potential to increase their intellectual capital. Furthermore, the model assumes that as intellectual capital grows, organizational performance should also increase.

Knowledge Management

The importance of knowledge management (KM) has been emphasized recently and frequently by academics, practitioners, and consulting firms. They all agree that the total process harnesses and leverages the knowledge necessary to develop the intellectual capital needed by organizations to operate, grow, and remain competitive (Allee, 1996; Quinn, Anderson, & Finklestein, 1996a; Davenport, DeLong, & Beers, 1998; Koulopoulous & Frappaolo, 1999).

An examination of the KM literature reveals that a great deal of attention has been directed toward understanding (a) the preeminence of the knowledge worker (Drucker, 1956; Reich, 1991; Blackler, Reed, & Whitaker, 1993), (b) knowledge as the organization's most valuable asset (Brockmann & Simmonds, 1997; Klein, 1998; Torraco, 1999; Gore & Gore, 1999; Huseman & Goodman, 2000), (c) knowledge transfer and sharing in the organization (Mullin, 1996; Koulopoulos, Spinello, & Toms, 1997; Comeau-Kirschner, 2000), (d) the impact of technologies in managing knowledge (Demarest, 1997; Cropley, 1998; Carayannis, 1999; Giunipero, Dawley, & Anthony, 1999; Hansen, Nohria, & Tierney, 1999; Rossett & Marshall, 1999; Chapman, Coukos, & Pisapia, 2001), and (e) the management of intellectual assets (Bassi, 1997; Stewart, 1997; Svieby, 1998; Teece, 1998a; Gordon, 1999; Strassman, 1999).

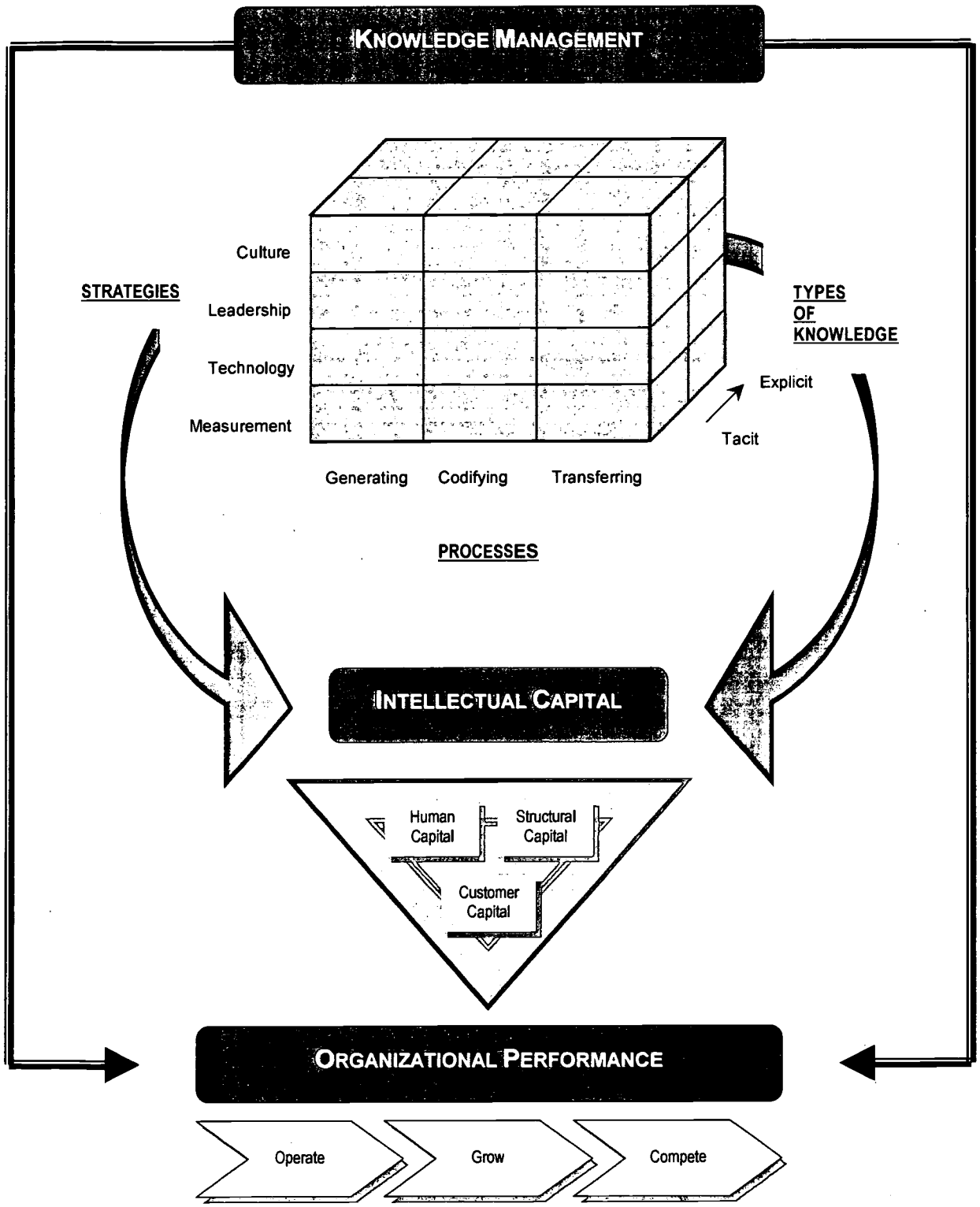


Figure 1. Conceptual Framework of the Relationships Among Knowledge Management, Intellectual Capital, and Organizational Performance

Little quantitative research exists on how the KM strategy impacts intellectual capital and organizational performance. However, common benefits of KM have emerged from case study research involving observations, interviews, and records analysis. The following benefits were found: (a) embedding knowledge into decision making and problem solving processes (Choo, 1998; Ruggles, 1998; Newman, 2000); (b) reducing the duplication of effort and "reinventing the wheel" (Davenport & Prusak, 1998); (c) keeping abreast of global competition and pace of change (Neef, 1998; Mascitelli, 1999); (d) making knowledge accessible and available to the right people at the right place and time (Horibe, 1999; O'Dell &; Grayson, 1999); (e) enhancing customer relations (Klein, 1998; Liebowitz & Beckman 1998); (f) converting tacit to explicit knowledge and human capital to structural capital (Nonaka & Takeuchi, 1995; Stewart, 1997; Strassman, 1998); and, (g) reducing the risk of losing valuable information if an employee leaves the organization (Huseman & Goodman, 2000).

Knowledge, information, and communication are crucial for effective performance and key to the ability of the organization to respond to change (Dhillon, 2001). Moreover, many observers feel that in a knowledge-based economy, KM is the critical element of a business strategy that allows an organization to improve its operational processes and accelerate the rate at which it handles new challenges and opportunities. It does so by leveraging its most precious resources—collective know-how, talent, and expertise.

Knowledge

In the business sector, knowledge is now being perceived as a valuable asset. It is not just another resource alongside the traditional factors of production, land, and labor; rather, some would claim that it is the only meaningful resource in today's workforce (Drucker, 1993; Stewart, 1997). Knowledge, broadly defined as information combined with experience, context, interpretation, and reflection, is a high-value form of information that is ready to apply to business processes, decisions, and actions. Knowledge refers to the sum of what is known: A familiarity, awareness, or understanding gained through experience, that, in a business context, guides operations and administrative processes.

Although producing and transmitting academic, or scholarly, knowledge is the primary purpose of higher education organizations, the focus of this study is on the management of the non-academic, organizational knowledge found in administrative units of organizations. Organizational knowledge refers to knowledge of the overall business the organization is in, the organization's strengths and weaknesses, the markets it serves, and the factors critical to organizational success. Universities also rely on faculty-generated knowledge and traditional means of discovery and transmission of knowledge which undergirds its academic programs. This study focused singularly on organizational knowledge applied to university operations.

Organizational knowledge, like all knowledge, exists in two forms—explicit and tacit—both of which are embedded in any organization (Polyani, 1966; Nonaka & Takeuchi, 1995). Explicit knowledge is formal and systematic; it is easily codified, communicated, and shared. Explicit knowledge is represented by an organization's policies and procedures, business plans, databases, directories, and accounting

procedures. It is the knowledge that remains in the organization after employees leave work.

Tacit knowledge, on the other hand, is highly personal. It is hard to formalize, very difficult to articulate, and therefore, extremely challenging to communicate. It can be described as experiences, know-how, competencies, or people skills—essentially, the personal knowledge residing in people's heads. In the words of Michael Polanyi (1966), "We can know more than we can tell." Tacit knowledge consists of technical "know-how" skills and has a cognitive dimension (i.e., mental models and conceptual frameworks). In organizations, the unpredictable nature of tacit knowledge tends to be a problem, for it can literally walk out the door when a knowledgeable employee leaves the organization.

Knowledge in the minds of organizational members is a valuable resource. However, unless managed efficiently, knowledge may not transfer into intellectual capital, or assets, that the organization can use to be more competitive and productive (Skyrme, 1994). Given the importance of such an asset, it is not surprising that organizations everywhere are paying attention to knowledge—exploring what it is and how to create, codify, transfer, and apply it more effectively. By identifying, harnessing, managing, and leveraging organizational knowledge, businesses have been able to advance and have a competitive edge (Skyrme, 1994; Marshall, Prusak, & Shpilberg, 1996; Stewart, 1997; Ruggles, 1997; Ulrich, 1998b; Drucker, 1994). Hence, success in an increasingly competitive society depends critically on the relevance and quality of knowledge which organizations apply to their key business processes.

Knowledge Management Processes

There is general agreement that the primary processes associated with the management of knowledge include generating, codifying, and transferring knowledge. See Figure 2.

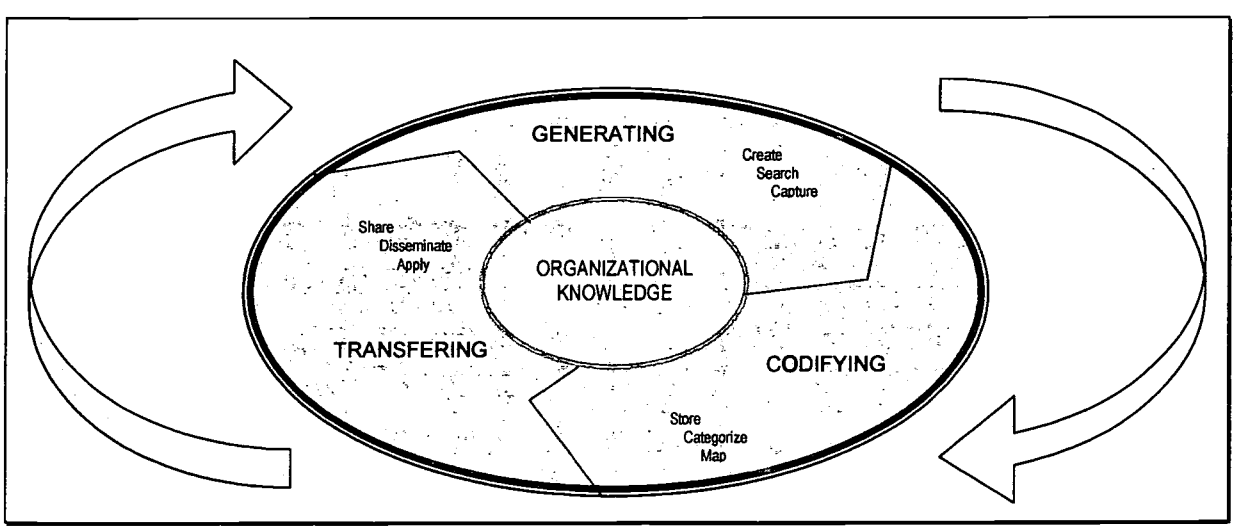


Figure 2. Knowledge Management Processes

As Figure 2 illustrates, generating knowledge refers to the sub-processes of searching, capturing, and creating knowledge. Basically, knowledge generation includes knowledge acquired by an organization as well as that knowledge developed within it. In universities, the use of outside consultants and borrowing from other divisions or organizations are examples of generating knowledge. Codifying refers to translating data and information into symbols that others can understand. Codification encompasses the sub-processes of storing, categorizing, and mapping of tacit knowledge, rendering it explicit. In universities, databases, directories, procedural handbooks, and email messages are examples of codifyed knowledge. Finally, transferring knowledge refers to the sub-processes of data-mining, distributing, and sharing organizational knowledge. The transfer of knowledge is key to organizational success, quality, and competitiveness. In universities, publications, presentations, websites, white papers, policies, and reports are examples of mechanisms used to transfer knowledge. The main challenge confronting organizations, however, is to shift the emphasis placed on key skills, business processes, and technologies in order to create systematic and well-integrated approaches to generating, codifying, and transferring knowledge throughout the organization.

Knowledge Management Strategies

Business leaders, organizational consultants, and management gurus tend to use four key management strategies that enable an organization to manage its knowledge. These management strategies are broadly identified as culture, leadership, technology, and measurement (The American Productivity and Quality Center and Arthur Andersen Consulting, 1997; Davenport & Prusak, 1998; O'Dell & Grayson, 1998; Davenport, 1999). It is thought that these enabling strategies work in concert to streamline and enhance the generation, codification, and transfer of an organization's data, information, and knowledge for the purpose of delivering it to individuals and groups accomplishing specific tasks. Each of the KM strategies can be defined by a set of behaviors, or tactics, promoting an integrated approach to managing—identifying, creating, gathering, organizing, storing, disseminating, using, sharing, exploiting, and leveraging—all of an organization's information and knowledge assets.

In this study, culture refers to the general knowledge-sharing climate of the organization as related to an integrated pattern of human behavior—including thoughts, speech, actions, and artifacts. In universities, examples of culture strategies include communities of practice, ad hoc and standing committees, and staff development and training opportunities. Leadership refers to the ability of the organization to align KM behaviors with organizational strategy, identify opportunities, promote the value of KM, communicate best strategies, facilitate the evolution of the learning organization, and provide metrics for assessing the impact of knowledge. Examples of KM leadership strategies in universities include strategic planning, hiring knowledgeable employees, and evaluating employees for knowledgeable contributions. Technology refers to the infrastructure of tools, systems, platforms, and automated solutions that centralize and enhance the development, application, and distribution of organizational knowledge. Intranets, web pages, and electronic repositories and databases are examples of technology strategies in universities.

Finally, measurement refers to the assessment methods of KM and their relationships to organizational performance. In universities, measurement strategies may include benchmarking against other universities, allocating resources toward efforts that measurably increase the knowledge base, and linking KM to the strategic plan.

Intellectual Capital

Intellectual Capital (IC) is related to knowledge but is a broader concept. It is generally defined as the possession of knowledge, applied experience, organizational technology, customer relationships, and professional skills that provide organizations with value and a competitive edge (Edvinson & Sullivan, 1996). While this variable is not examined in this study, knowledge of the concept is essential to understanding the importance of KM. Knowledge in the minds of organizational members is a valuable resource, but, unless it is managed, it may not transfer into the IC that the organization can use to be more competitive and productive. Intellectual capital manifests its value by how it is managed to enhance the performance and development of a company on the route to achieving its strategic intent (Zelany, 1989; Nasseri, 1996; Fruin, 1997). Moreover, Brennan and Connell (2000) report that IC management was found to be important for a company's long-term success.

Organizational Performance

In this knowledge era, it is thought that increased organizational performance (OP) requires new skills, new mind-sets and models, commitment throughout the organization, as well as new ways of thinking about what is meants by effective management. In this emerging economy, IC and the collective knowledge and experience of the workforce becomes an organization's greatest weapon. Intellectual capital is most likely one of a few appreciable assets, unlike other assets (i.e. buildings, equipment) that begin to depreciate the day they are acquired.

Like IC, this variable is not studied; however, it is necessary for understanding the importance KM. The key to enhancing OP is to continuously improve the efficiency and effectiveness of operational processes (Seymore, 1995). Proponents of KM believe that the management technique pays off in fewer mistakes, less redundancy, quicker problem solving, and better decision-making (Ruggles, 1998; Newman, 2000). Other benefits may include reduced research and development costs, increased worker independence, enhanced customer relations, and improved services. These benefits combined add up to keeping the organization a few steps ahead of its competitors. In universities, some examples of OP include increased full-time enrollment (FTE) and student retention, enhanced faculty publication rate, and an increase in grants and contracts.

Significance

The significance of this study is based on the uncontested pressure the global economy has placed on organizations to exploit the properties of their intangible intellectual assets (Marquardt & Reynolds, 1994; Mann, 1998; Neef, 1998). Unfortunately, although the literature is replete with anecdotes, little empirical research exists on the relationships among knowledge, knowledge management,

intellectual capital, and organizational performance. This lack of research is even more prevalent in university uses of knowledge management strategies.

This study begins filling the research void by (a) using the existing literature and industry strategies to conceive how the concepts are related, and (b) focusing the research lens on the strategies that enable organizations to employ KM more effectively. The study leaves the relationship between the effectiveness of KM and the growth of IC and OP to future research efforts. Specifically, by exploring and by further developing a better understanding of KM in higher education institutions, this paper addresses three major goals.

First, it examines, within the context of higher education, a relatively new area in the field of management and organizational studies at the forefront of scholarly attention. Various cultural, technical, and strategic forces are brought to bear on the management process. As such, there is a trend in current research discovering how these forces enable or constrain the management of knowledge in an organization (Leonard-Barton, 1995; Cropley, 1998; Davenport & Prusak, 1998; de Jager, 1999; Nijhol, 1999; Russett & Marshall, 1999). However, as previously stated, there is little reported research in institutions of higher education.

Second, this study not only furthers the existing state of knowledge in KM from a scholarly and academic standpoint, but also brings the practical issues, best strategies, and critical success factors to the surface. In that regard, this study can potentially serve as a reference guide for higher education research institutions involved in KM projects or considering employing a KM initiative.

Third, this study takes existing research on KM, which is currently limited to abstract concepts, ideas, frameworks, models, and anecdotes and adds significantly to both the theoretical and applied fronts of KM research. From a theoretical point of view, this research fills in the gaps by developing a conceptual framework based on the synthesis of existing literature and industry strategies to assess KM in the university setting. On the applied front, this study focuses on the operational aspects of the management of organizational knowledge by examining various relationships and generating a list of critical success factors to guide universities who wish to use KM.

Finally, KM has been widely touted and discussed; nevertheless, few empirical studies (Bohn, 1994; Nonaka & Takeuchi, 1995; American Productivity and Quality Center [APQC], 1999; APQC, 2000; APQC, 2001; Torraco, 1999; Quinn, 1992) have been done in the private sector and even fewer in higher education institutions. Some higher education institutions have come to face pressures increasingly similar to private sector organizations and have adopted a variety of management techniques, it seems reasonable to suppose that KM and related strategies might have something to offer higher education institutions.

Moreover, the present and future success of universities has come to be based less on the strategic allocation of physical and financial resources and more on the strategic management of organizational knowledge. Therefore, through addressing KM processes and strategies used by research universities and identifying critical success factors, higher education leaders will be better equipped to restructure organizational processes, thereby enhancing quality and performance.

Methodology

The multidimensional framework proposed in this paper places the management of higher education organizations within a dynamic conceptual system composed of KM processes and strategies (See Figure 1). Guided by the framework, this exploratory, organizational study assesses within research universities the current use, perceived importance, and efficiency of the KM processes (generation, codification, and transfer) and the KM strategies associated with culture, leadership, technology, and measurement. This section describes the research approach used to answer the study's research questions.

Research Questions

The following eight research questions were formulated to frame and guide the current study:

- Q1: Do research universities use knowledge management processes (KM)?
- Q2: Are the use, importance, and efficiency of KM affected by contextual factors?
- Q3: Do research universities use the knowledge management strategies of culture, leadership, technology, and measurement (strategies)?
- Q4: Are the use, importance, and efficiency of the strategies affected by contextual factors?
- Q5: Is there a relationship between the use of the strategies and KM effectiveness?
- Q6: Is the relationship between the use of the strategies and KM effectiveness affected by contextual factors?
- Q7: Is there a relationship between the efficiency of the strategies and KM effectiveness?
- Q8: Is there a difference in the use of strategies between the research universities who use KM most effectively and those that use KM least effectively?

Research Design

A descriptive design that is primarily quantitative and correlational in nature was used in this study. Figure 3 displays the overall research design of the study including relationships among the variables and research questions, as well as the general statistical procedures employed for data analysis.

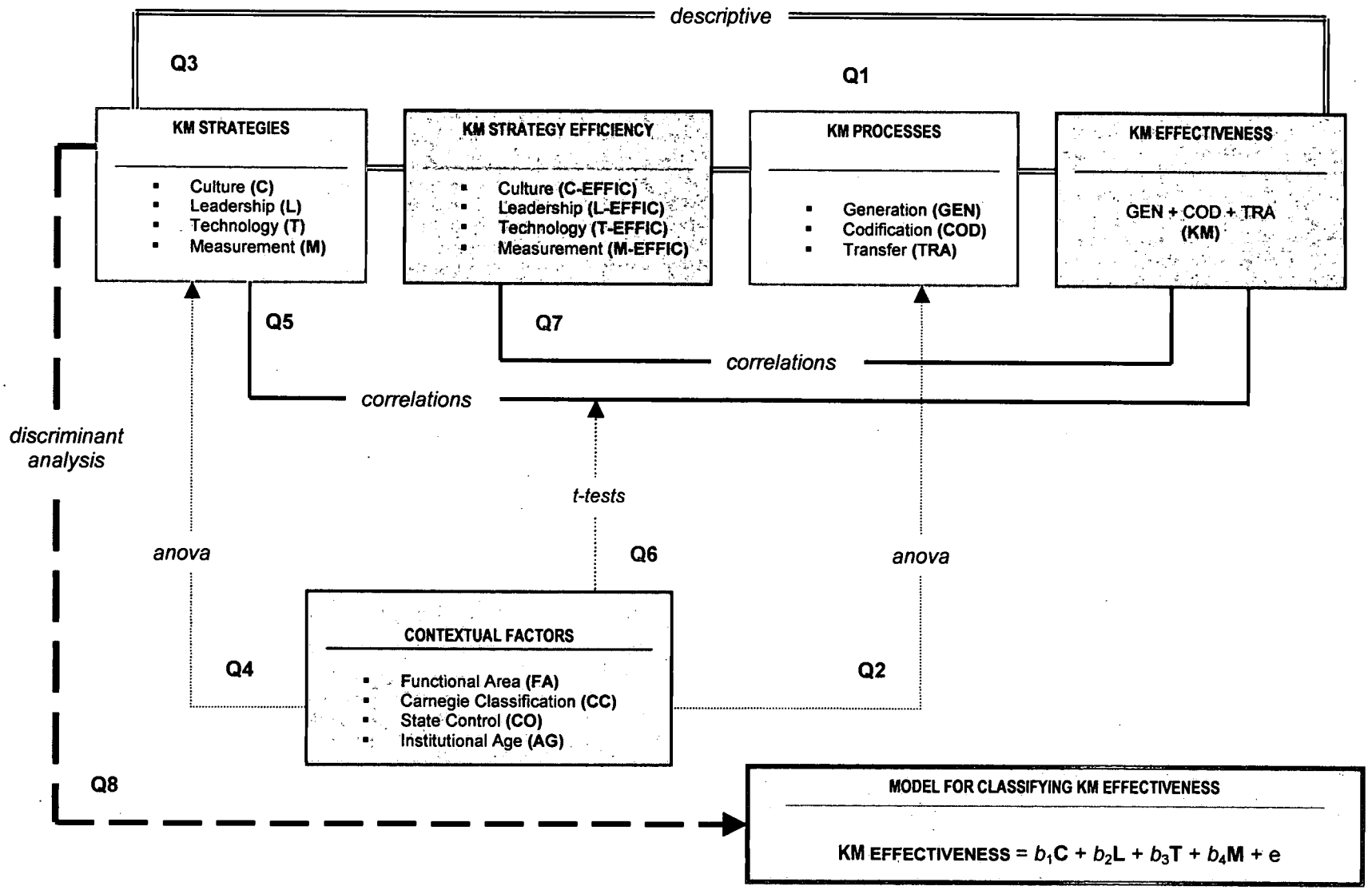


Figure 3. Research Design and Statistical Procedures

Data Collection

Instrumentation

A mail questionnaire-survey was designed in order to assess and investigate the concept of KM and the enabling strategies within the research university setting. A pre-existing instrument, the *Knowledge Management Assessment Tool (KMAT)* was used with permission in the construction of the survey. Many of the Tailored Design Method (TDM) recommendations suggested by Dillman (1998) were adopted in the administration. The TDM method includes five phases: pre-notice communication, questionnaire, thank you postcard, replacement questionnaire, and final contact.

The questionnaire, *A National Survey of Knowledge Management Processes and Strategies Used in Research Universities*, gathered information on the current use and perceived importance of KM and enabling strategies in higher education institutions. The survey was designed as an easy-to-read six-page booklet and was accompanied by a cover letter introducing the concept of knowledge management.

The personal demographic variables in this study related to functional area, gender, current position, years in position, previous position, years of administrative experience, nature of appointment, and future goals. Institutional, or contextual, variables included the institution's age, state control (public, private), and Carnegie Classification.

Study Population

Target participants in this study were administrators from various functional areas in United States research universities. The population institutions came from one of the following two groupings of Carnegie Classification of Institutions of Higher Education (2000)—Research-Intensive (formerly Doctoral Research II institutions) and Research-Extensive (formerly Doctoral Research I institutions). The study's sample is the total population of higher education public and private research institutions (n = 257).

In this study, it was necessary to survey the highest-ranking people in research universities who have administrative responsibilities for the conduct, coordination, and management of various functional areas in the university. This method is widely used since, as Hambrick and Mason (1984) suggest, organizations are a reflection of their top management. The functional areas examined in this study included academic affairs (ACA), business affairs (BUS), student affairs (STU), office of institutional effectiveness (IEA), and division of sponsored research (RES). Conversations with colleagues at several universities made it clear that these management tasks were assigned to people in similar positions, yet had different titles at different levels (e.g. chief officer, provost, associate provost, assistant provost, vice-president, assistant vice-president, dean, assistant dean, director, and coordinator). These individuals were targeted because (a) they are in the position to observe business strategy within their respective units, and (b) they have oversight of the organization. A total of 1285 surveys (257 institutions x 5 respondents per institution) were mailed directly to the participants.

Since this study concentrates on the organizational level of analysis, each respondent was required to answer the questionnaire as a representative of the functional unit for which they represent. In effect, each respondent acted as a proxy

for his or her area. Although, responses were analyzed at the institutional level, multiple participants from each institution provided diverse perspectives and a more realistic view of organizational KM behavior. Data received from each of the five functional areas for an institution were then collapsed to create organizational measures.

Data Analysis

Data were analyzed using the *Statistical Package for the Social Sciences* (SPSS) Version 10.5. Data analysis included descriptive statistics, t-tests, analysis of variance, correlational analysis, and discriminant analysis. Descriptive statistics were produced and displayed in tables. Indices were calculated and scales were derived for (a) "use" and "importance" of the processes, (b) "use" and "importance" of the strategies, (c) efficiency of the strategies, and (d) effectiveness of the overall knowledge management process. Inferential statistics included tests for difference, association, and prediction. An analysis for variance and t-tests were performed to examine differences among different groups. Correlations were run to detect relationships among variables. Finally, discriminant analysis was employed to create a model for classifying institutions by determining the relative contribution of each of the strategies on the effectiveness of the process.

Definition and Measurement of Variables

The variables in this study included (a) KM processes (generation, codification, and transfer), (b) effectiveness of the overall KM process, (c) KM strategies (culture, leadership, technology, and measurement), (d) efficiency of the strategies, and (e) various contextual factors associated with institutions of higher education (i.e., state control, Carnegie classification, institutional age, and functional area). Figure 4 outlines the operational definitions and measurement of these variables.

[Figure 4 about here]

DEFINITION AND MEASUREMENT OF VARIABLES

VARIABLE	DEFINITION	MEASUREMENT
	Processes	
Generation (GEN)	Acquiring and developing knowledge within an organization. Sub-processes include searching, capturing, creating.	Mean "use" scores (5=high; 1=low) collapsed across survey items #27-32. Same for "importance" scores.
Codification (COD)	Translating data and information into symbols that others can understand. Sub-processes include storing, categorizing, mapping.	Mean "use" scores (5=high; 1=low) collapsed across survey items #33-38. Same for "importance" scores.
Transfer (TRA)	Flows of artifacts from one agent to another. Sub-processes include distributing, sharing, data-mining.	Mean "use" scores (5=high; 1=low) collapsed across survey items #39-43. Same for "importance" scores.
TOTAL KM Process Index	Index of total use for combined processes—generating, codifying, and transferring.	Sum of GEN, COD, TRA divided by the maximum score of 15 for each use and importance scores.
	Effectiveness of Process	
KM Process Effectiveness	An organization's use of the knowledge management process.	Sum of GEN + COD + TRA (3=low; 15=high)
	Strategies	
Culture (C)	The general knowledge-sharing climate of the organization as related to patterns of human behavior.	Mean "use" scores (5=high; 1=low) collapsed across survey items #1-5. Same for "importance" scores.
Leadership (L)	The ability of the organization to align knowledge management behaviors to organizational strategy.	Mean "use" scores (5=high; 1=low) collapsed across survey items #6-13. Same for "importance" scores.
Technology (T)	The infrastructure of tools, systems, platforms, and automated solutions which enhance the development, application, and distribution of organizational knowledge.	Mean "use" scores (5=high; 1=low) collapsed across survey items #14-21. Same for "importance" scores.
Measurement (M)	The assessment methods of knowledge management and their relationship to organizational use.	Mean "use" scores (5=high; 1=low) collapsed across survey items #22-26. Same for "importance" scores.
TOTAL KM Strategy Index	The degree of use of all knowledge management strategies (C, L, T, and M)	Sum of C, L, T, and M divided by maximum score of 20 for each "use" and "importance"

Figure 4 : Definition and Measurement of Variables. (continues)

Figure 4 (continued).

VARIABLE	DEFINITION	MEASUREMENT
	Efficiency of Strategies	
Culture (C-EFFIC)	The relationship between an organization's perceived use and importance of knowledge management-related culture strategies.	Ratio of "use" score/"importance" score collapsed across survey items #1-5.
Leadership (L-EFFIC)	The relationship between an organization's perceived use and importance of knowledge management-related leadership strategies.	Ratio of "use" score/"importance" score collapsed across survey items #6-13.
Technology (T-EFFIC)	The relationship between an organization's perceived use and importance of knowledge management-related technology strategies.	Ratio of "use" score/"importance" score collapsed across survey items #14-21.
Measurement (M-EFFIC)	The relationship between an organization's perceived use and importance of knowledge management-related measurement strategies.	Ratio of "use" score/"importance" score collapsed across survey items #22-26.
KM Strategy Efficiency Metric (KM-EFFIC)	The relationship between an organization's perceived use and importance of knowledge management-related culture, leadership, technology, and measurement strategies.	Ratio of "use" score divided by "importance" score collapsed across all strategies (C-EFFIC + L-EFFIC + T-EFFIC + M-EFFIC / 4)
	Contextual Factors	
State Control (CO)	Governance and funding status of university	Qualitative nominal variable measured on dichotomous dimensions: Public Private
Carnegie Classification (CC)	National classification of universities dependent on the number of doctoral degrees conferred and amount of research dollars awarded per year.	Qualitative nominal variable measured on dichotomous dimensions: Doctoral Research-Extensive Doctoral Research-Intensive
Age Institution (AG)	Categorized by Historical Era in which institution was founded	Qualitative nominal variable measured on five levels as defined by Cohen (1995): Colonial Era (1636-1789) Emergent Nation (1790-1869) University Transformation (1870-1944) Mass Higher Education (1945-1975) Contemporary (1976-2000)

VARIABLE	DEFINITION	MEASUREMENT
Functional Area (FA)	Organizational divisions in the university.	Qualitative nominal variable measured on five levels: Academic Affairs Business Affairs Institutional Effectiveness Sponsored Research Student Affairs

Processes

For this study, knowledge management processes refer to the generation, codification, and transfer of knowledge. Generation encompasses the sub-processes of searching, capturing, and creating knowledge. Basically, knowledge generation is defined as the acquisition and development of new knowledge into the organization. Codification refers to translating data and information into symbols that other can understand, thus making knowledge available to those who need it. Sub-processes of codification may include categorizing, and mapping tacit knowledge, rendering it explicit. Transfer is defined by the sub-processes of data-mining, distributing, and sharing organizational knowledge. The ability to transfer knowledge tends to be the key to organizational success, quality, and competitiveness.
Survey responses were quantified by assigning numeric value to varying degrees of "use" (i.e., 5 = excellent; 4 = good; 3 = fair; 2 = poor; 1 = no) and "importance" (i.e., 5 = essential; 4 = important; 3 = fairly important; 2 = slightly important; 1 = not at all important). Survey items # 27-32 were collapsed to create a "use" score and an "importance" score for knowledge generation. Codification scores were derived from responses to survey items # 33-38, and transfer scores were measured by survey items # 39–43. Efficiency metrics ("use" score divided by "importance" score) were also computed for each of the processes.

Effectiveness of Process

For the purpose of this study, the effectiveness of the knowledge management process, or KM, is defined as the degree to which organizations are currently involved in the comprehensive process of generating, codifying, and transferring organizational knowledge. Process effectiveness was measured by an index calculated by totaling the generation "use" score, the codification "use" score, and the transfer "use" score. Process effectiveness scores ranged from a low of 3.0 to a high of 15.0.

Strategies

Knowledge management strategies refer to the organizational practices and tactics associated with enabling the KM process (i.e., identifying, creating, gathering, organizing, storing, disseminating, using, sharing, exploiting, and leveraging). These strategies include practices and behaviors categorized into four areas: culture (C), leadership (L), technology (T), and measurement (M). Each strategy is defined by a set of behaviors, or tactics, promoting an integrated approach to managing all of an organization's information and knowledge assets. Survey items # 1-27 related to the strategies and were rated on two dimensions: "use" and "importance." Similar to the

measurement of the processes, numeric value was assigned to the degree of "use" and "importance" for each survey item associated with the knowledge management strategies.

Culture refers to the general knowledge-sharing climate of the organization as related to an integrated pattern of human behavior—including thoughts, speech, action, and artifacts. Culture is measured collectively by responses to survey items # 1-5. Leadership refers to the ability of an organization to align knowledge management behaviors and tactics with organizational strategy and vision, identify opportunities, communicate best practices, and provide metrics for assessing the impact of knowledge. Leadership is measured collectively by responses to survey items # 6-13. Technology, the infrastructure of tools, systems, platforms, and automated solutions that centralize and enhance the development, application, and distribution of organizational knowledge, is measured collectively by responses to survey items # 14-22. And, measurement, the assessment methods of knowledge management strategies and processes and their relationship to organizational performance, is measured collectively by survey items # 23-27.

Efficiency of Strategies

"Efficiency" in this study refers to the relationship between the "use" ratings and the "importance" ratings. Basically, efficiency defines the level at which universities are performing the strategies relative to the degree with which they assign importance to those strategies. Represented as a percentage, the efficiency metric is determined by dividing the "use" rating by the "importance" rating for each survey item. Efficiency metrics for the strategy areas of culture (C-EFFIC), leadership (L-EFFIC), technology (T-EFFIC), and measurement (M-EFFIC) were then developed by computing the arithmetic mean of the efficiency metrics for the survey items in each section.

Contextual Factors

State control. The state control of higher education organizations refers to the governance status of a university. Institutions in this study were labeled as either public or private. Private universities, independent of state control, are generally considered more autonomous and have more flexibility in making decisions. Currently there are a total of 92 private research universities. Public universities, on the other hand, are more accountable to the general public and the state's legislative body. There are currently a total of 165 public research institutions.

Carnegie classification. Universities were classified according to the *Carnegie Classification of Institutions of Higher Education* (2000) as either Doctoral Research-Extensive or Doctoral Research-Intensive. Research-Intensive universities are identified by awarding at least ten doctoral degrees per year across three or more disciplines, or at least twenty doctoral degrees per year overall. Currently, there are 64 public institutions and 43 private institutions recognized as Research-Intensive. Research-Extensive universities are identified by awarding fifty or more doctoral degrees per year across at least fifteen disciplines. There are presently 101 public and 49 private higher education institutions recognized as Research-Extensive.

Institutional age. The age of the institution for this study was measured on five levels corresponding with historical eras in which the institution was founded (Cohen, 1995). These eras are identified as: (a) Colonial (1636-1789), (b) Emergent Nation (1790-1869), (c) University Transformation (1870-1944), (d) Mass Higher Education (1945-1975), and (e) Contemporary (1976-2000).

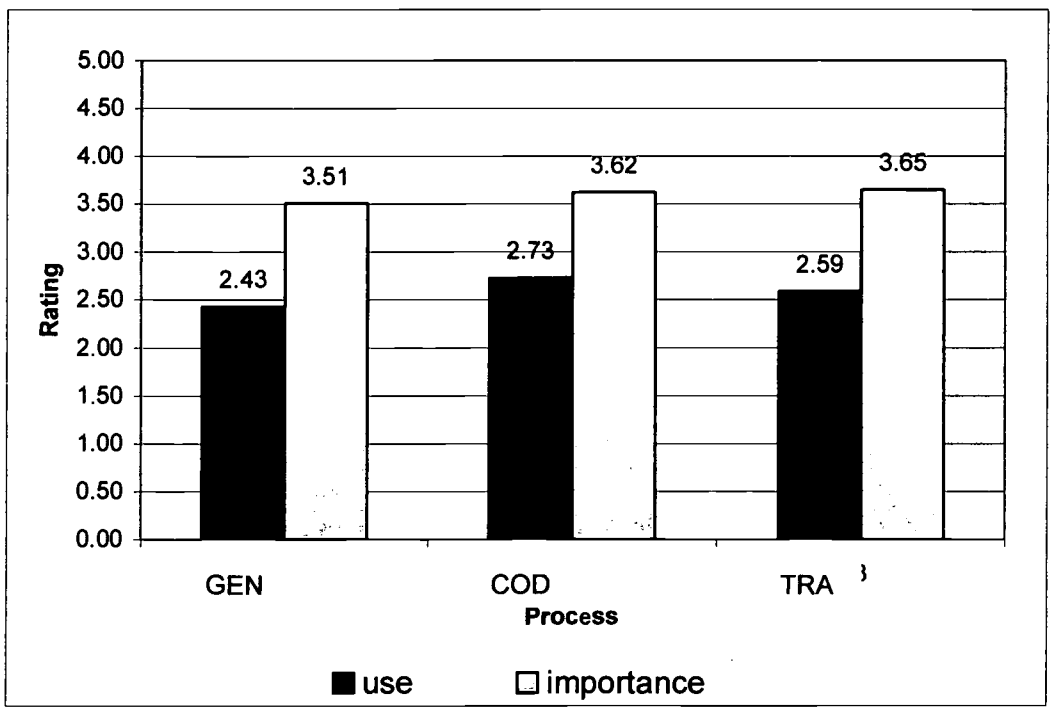
Summary of Findings and Discussion

KM Processes

Finding Number One

The overall use of KM was below the moderate level, and importance was above the moderate level.

Discussion. The dichotomy (seen in Figure 5) between the rankings makes a clear statement that "use" does not match "importance."



USE: 5=Excellent; 4=Good; 3=Fair; 2=Poor; 1=No
IMPORTANCE: 5=Essential; 4=Important; 3=Fairly Important; 2=Slightly Important; 1=Not at all Important

Figure 5. Overall Use and Importance of Processes

Ideally, KM initiatives would be designed to resolve the differences and decrease the gap between use and importance.

Codification, across all universities, was the most used process, although the transfer process was perceived as the most important. However, as seen in Table 1, the most notable differences between "use" and "importance", across all universities, existed primarily with the generation and transfer KM processes.

Table 1.
Most Notable Differences Between Use and Importance of Processes

Tactic	Use	Importance	Efficiency
COD 36: Past know-how is made explicit, making it easy to access.	2.41	3.53	72%
TRA 39: The university has a formalized process of transferring best practices, such as documentation and lessons learned.	2.57	3.81	71%
TRA 43: Process knowledge is rapidly communicated through the university, making it easy to transfer best strategies.	2.59	3.65	71%
GEN 30: Knowledge directories exist that list employees' skills, knowledge, location, and how to reach them.	2.17	3.28	70%
GEN 29: The university creates and maps all of its knowledge terrain, indicating where information is located and how to access it.	2.36	3.59	68%
GEN 31: Knowledge directories of other groups aligned with the university are also disseminated.	1.91	3.04	67%

Efficiency (represented as a percentage) measures how well a university efficiently performs a tactic with respect to the importance assigned to it. In other words, universities using a tactic at a level equivalent to the perceived importance of the tactic are performing at 100% efficiency.

Finding Number Two

There are significant differences in efficiency levels of the generation and transfer processes between Research-Extensive and Research-Intensive universities.

Discussion. Research-Extensive universities used the KM processes more than Research-Intensive universities. However, the Research-Intensive universities rated the KM processes at a higher importance level. As the efficiency metric is a representation of the difference between "use" and "importance", it is apparently clear that Research-Extensive universities are more efficient (Figure 6). They are performing closer to level of importance.

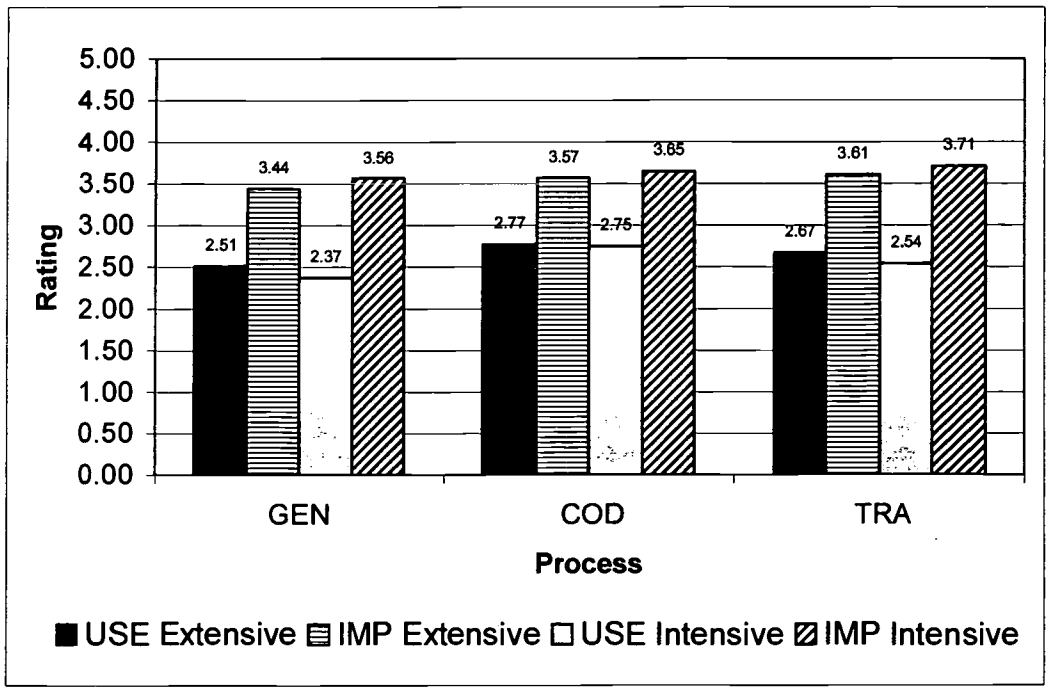


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Figure 6. Use and Importance of Processes for Research-Extensive and Research-Intensive Universities

The tactics which produced the most notable differences between Research-Extensive and Research-Intensive universities were related to the processes of generation and transfer. These tactics are reported in Table 2 with their effect sizes

Table 2.
Most Notable Differences in Process Tactics Between Research-Extensive and Research-Intensives Universities

Tactic	Research-Extensive	Research-Intensive	Effect Size
GEN 27: Knowledge gaps are systematically identified.	2.74	2.52	.25
GEN 29: The university creates a map of the knowledge terrain, indicating where information is located and how to access it.	2.77	2.59	.20
TRA 40: The university provides locations and occasions for employees to talk to and listen to one another and interact informally.	3.06	2.78	.28

Research-Extensive universities are more inclined to identify knowledge gaps, create a map of the knowledge terrain, and provide locations and occasions for interaction. These low effect sizes indicate low practical significance.

Finding Number Three

Public universities reported a significantly higher level of use of the KM transfer process. They also assigned greater degrees of importance to the generation and transfer processes.

Discussion. As seen in Figure 7, public universities appear to be further along the KM path as evidenced by consistently higher levels of use and greater degrees of importance across all process areas. These results are consistent with existing literature on comparisons of public and private sector perceptions and use of KM (McAdams & Reid, 2000). They reported that KM is more developed as a management philosophy in the public sector. This development is attributed to the continual pressure for increased efficiency, reduced resources, and improved quality within the public sector.

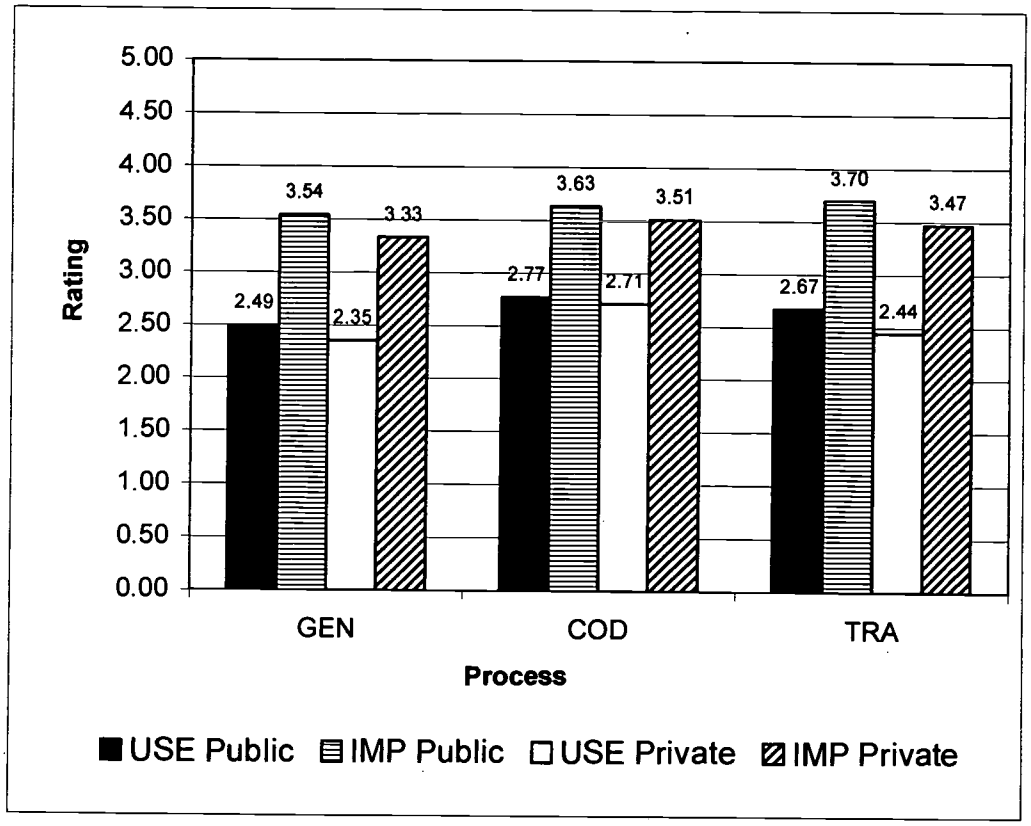

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Figure 7. Use and Importance of Processes for Public and Private Universities

A more in-depth investigation into the use of transfer tactics revealed that public universities are more likely to process knowledge and rapidly communicate it

through the university. The most notable differences in efficiency (seen in Table 3), determined by effect size (ES), were related to generation (i.e., knowledge directories exist that list employees' skills, knowledge, location, and how to reach them; and, knowledge directories of other groups aligned with the university are also disseminated) and transfer (i.e., success stories involving new tools or new approaches are widely communicated in the university; and, process knowledge is rapidly communicated through the university, making it easy to transfer).

Table 3.
Most Notable Differences in Process Efficiency Between Public and Private Universities

Tactic	Public	Private	ES
GEN 30: Knowledge directories exist that list employees' skills, knowledge, location, and how to reach them.	.70	.73	.14
TRA43: Process knowledge is rapidly communicated through the university, making it easy to transfer best practices.	.72	.71	.13
GEN 31: Knowledge directories of other groups aligned with the university are also disseminated.	.69	.67	.11
TRA 42: Success stories involving new tools or new approaches are widely communicated in the university.	.78	.79	.09

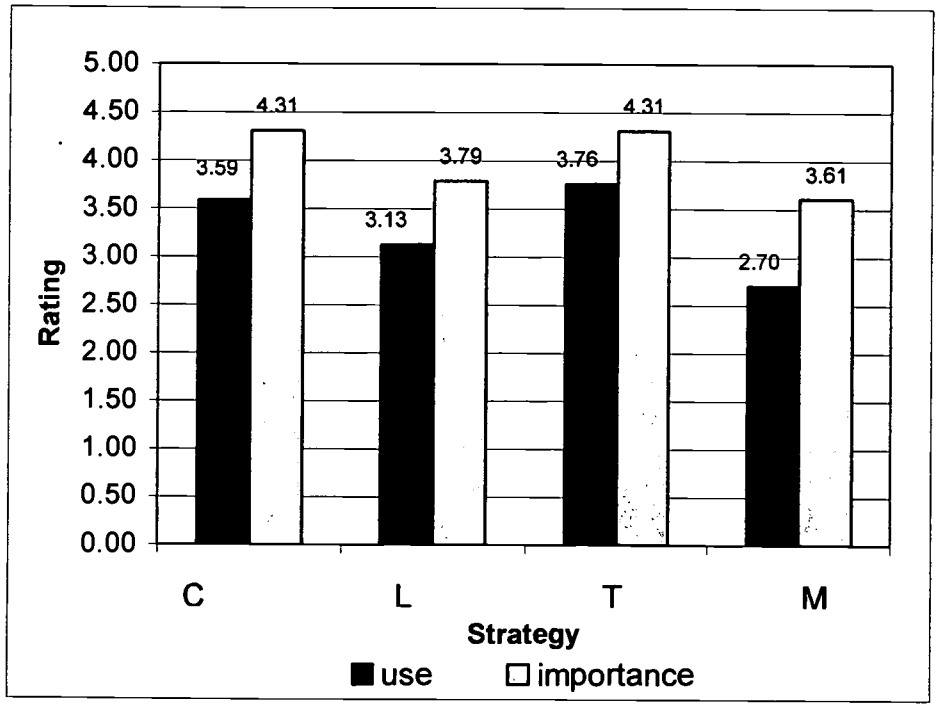
KM Strategies

Finding Number Four

Universities use the technology, culture, and leadership strategies at an above moderate level and the measurement strategy at a below moderate level. Nevertheless, "importance" ratings for all strategy areas exceeded the "use" ratings.

Discussion. The most commonly used strategy across all universities was technology. Figure 8 illustrates the degree of "use" and "importance" for each of the strategy areas across all universities. This finding is consistent with the literature. Warren (1999) emphasizes that the storage of information is the first and perhaps the easiest phase of KM. In organizations, technology and culture tend to be the most used strategies, especially at the start of a KM initiative (Bhatt, 2001). Technology organizes the data, transforming it into information, and people are endowed with

interpretive capabilities. Therefore, to manage knowledge effectively, an organization will need to coordinate the technology and culture strategies.



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IMPORTANCE: 5=Essential; 4=Important; 3=Fairly Important; 2=Slightly Important; 1=Not at all Important

Figure 8. Overall Use and Importance of KM Strategies

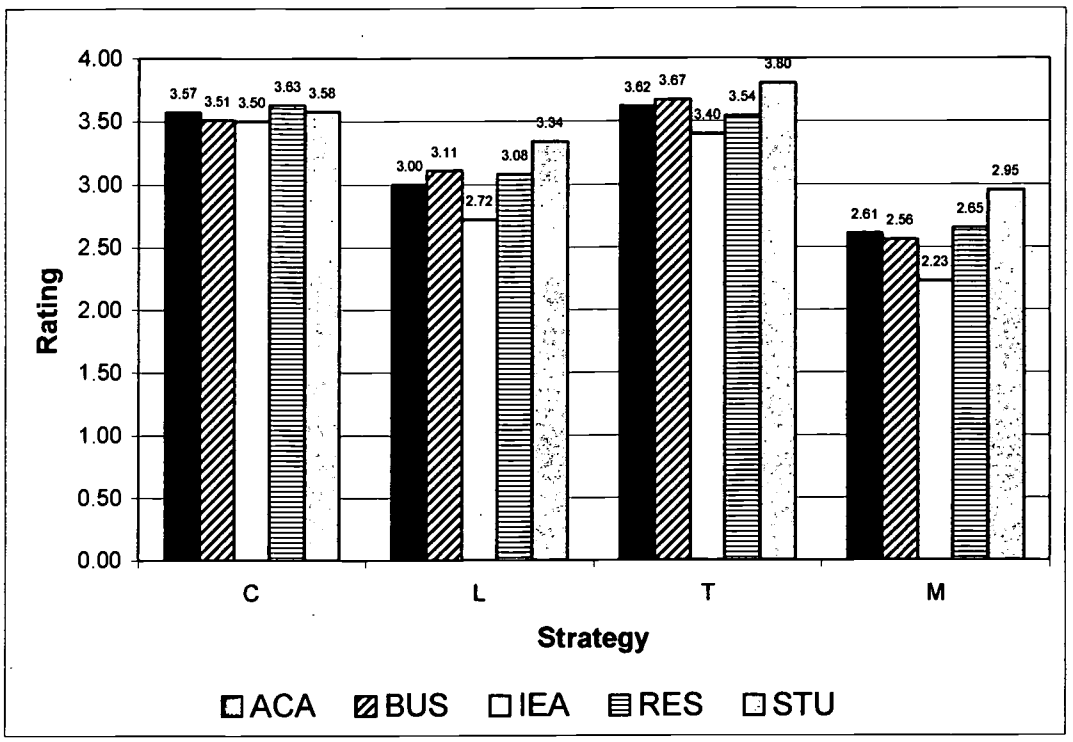
Although respondents seem fully aware of the implications of the measurement strategy (i.e., high importance rating), very few respondents' organizations have established or even implemented the strategy (i.e., low use rating). Consistent with the literature, formal measurement rarely takes place in the earliest stages of KM implementation (APQC, 2001). Rather, as KM becomes more structured and widespread and organizations move into the more-advanced stages, the need for measurement steadily increases.

The high "importance" ratings suggest a level of validation to the overall stream of research. The efficiency metric reports the gap between "use" and "importance". Simply speaking, the wider the gap, the lower the level of efficiency. In this case, the greatest gap appears to be related to measurement strategies, meaning that although the strategy is assigned high importance by universities, it is being used at a lesser degree.

Finding Number Five

The functional areas of student affairs and institutional effectiveness significantly differed in the levels of "use" of measurement, technology, and leadership strategies.

Discussion. Findings were consistent between the two functional areas, revealing perceived higher levels of usage by student affairs for each of the strategies. Figure 9 illustrates the degree of use of the strategies by functional area.



USE: 5=Excellent; 4=Good; 3=Fair; 2=Poor; 1=No

Figure 9. Use of Strategies by Functional Area

Although one might expect the results to have been reversed (i.e., higher levels of use by institutional effectiveness) one can argue that a lack of understanding of the KM concept on the student affairs part may have led to the higher ratings by the individuals representing student affairs. A closer examination of individual tactics within each strategy revealed that the most notable differences between the two functional areas, as reported by effect size (ES), were related to leadership (L), technology (T), and measurement (M) strategies. Table 5 displays the most notable differences in use of tactics between student affairs and institutional effectiveness.

Table 5.
Most Notable Differences In Use of Tactics Between Student Affairs and Institutional Effectiveness

Tactic	Strategy	ES
L13: The university has vision for managing knowledge.	L	.92
L8: The university develops strategies for selling knowledge assets.	L	.86
L7: The university understands the value and potential of its knowledge assets.	L	.86
L11: Individuals are compensated for contributions to development of organizational knowledge.	L	.72
T17: Technology brings the university closer to its students.	T	.67
M26: The university allocates resources toward efforts that measurably increase its knowledge base.	M	.64
M24: The university has developed a set of indicators to manage knowledge.	M	.61
M25: The measurement system incorporates measure of intangible assets such as intellectual capital.	M	.58
T21: Information reaches appropriate decision makers in a timely fashion to contribute to business decisions.	T	.56
T14: Technology links all members of the university to one another.	T	.56
T16: Technology creates an institutional memory that is accessible to the entire university.	T	.56
T18: Technology is designed to help employees work more efficiently.	T	.54
M23: The university's annual report to the governing body includes how knowledge capital has contributed to bottom-line use.	M	.53

Institutional Effectiveness tends to be more versed with measurement and more likely to use technology at a more advanced level. They are more in tune with the organization's strategic plan and vision, for its purpose is to measure and report progress toward meeting organizational goals. Student Affairs, on the other hand, may use technology for different, not as complex reasons. One might argue that individuals associated with Institutional Effectiveness may have a more advanced understanding of the concept of KM and the processes and strategies involved. Therefore, the tendency exists for a more critical report and lower ratings.

Finding Number Six

Research-Extensive universities reported higher use of all strategy areas. However, Research-Intensive universities reported higher importance ratings across all areas. As a result, the gap between "use" and "importance" (efficiency) was much greater for Research-Intensive universities.

Discussion. The statistically significant differences with efficiency of leadership and measurement strategies between Research-Extensive and Research-Intensive universities suggest that Research-Extensive universities do what they believe is important more so than Research-Intensive universities. Figure 10 illustrates the levels of "use" and "importance" for each strategy by Carnegie classification.

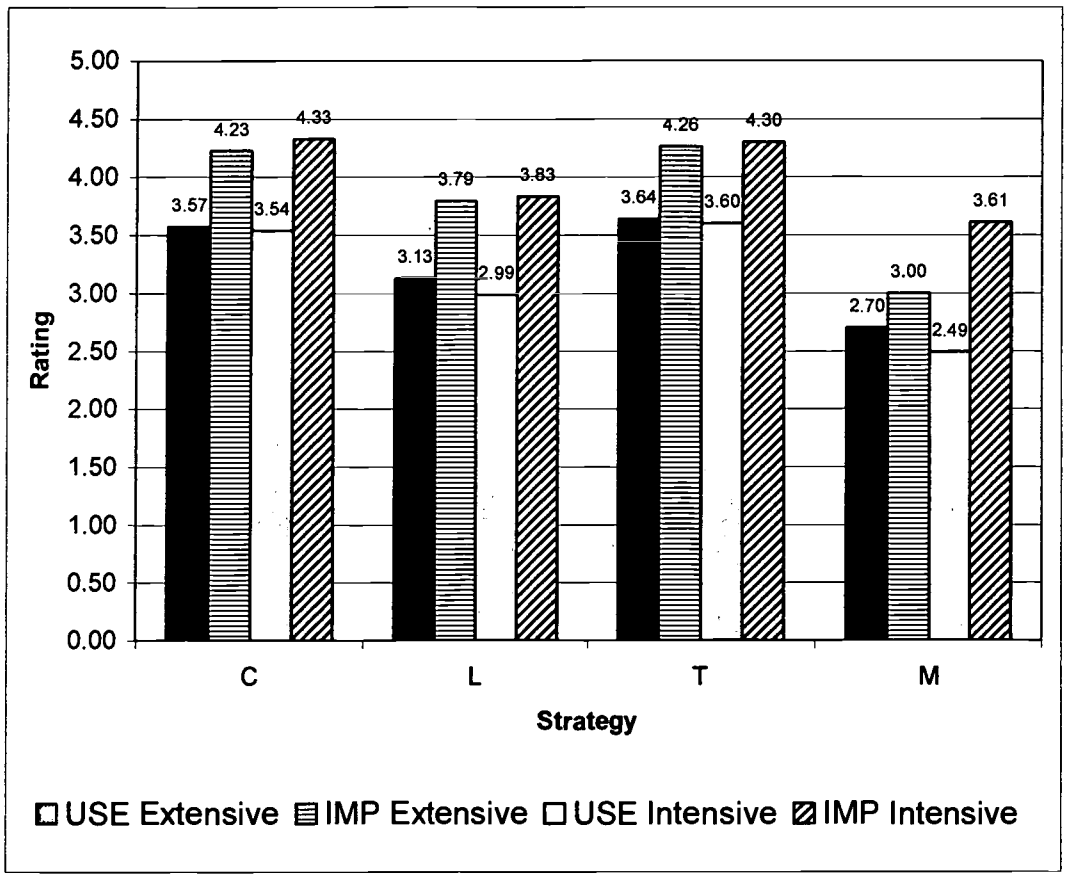


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Figure 10. Use and Importance of Strategies for Research-Extensive and Research-Intensive Universities

A closer examination into the tactics within each strategy area revealed that the differences between Research-Extensive and Research-Intensive universities were strongest in all tactics across all strategy areas in "use" except one specific tactic related to the culture strategy: "employees take responsibility for their own learning". Research-Intensive universities view this one practice as more important than Research-Extensive universities do. One could argue that Research-Extensive universities may not have the freedoms that the Intensive universities have.

Additionally, Research-Extensive universities are significantly more efficient than Research-Intensive universities in both leadership (Extensive = 88%; Intensive = 79%) and measurement strategies (Extensive = 78%; Intensive = 71%). This means that there is a smaller gap between what they believe to be worthwhile and important, and what they are actually doing. A review of efficiency metrics of specific tactics revealed two prominent differences between the two groups. One difference was related to the leadership strategy: "individuals are compensated for contributions to development of organizational knowledge" (ES=.42). The second major difference was related to the measurement strategy: "the measurement system incorporates measures of intangible assets such as intellectual capital" (ES=.32).

Finding Number Seven

Public universities consistently rated the use of strategies higher than private universities, but both types of universities placed almost equal value on the importance of each strategy.

Discussion. Although no statistically significant differences were discovered between the two types of universities with respect to use, importance, or efficiency of strategies, it can easily be seen, in Figure 11, that public universities employed the strategies at a slightly higher level. Culture and leadership importance ratings were higher for both public and private universities. This finding is consistent with the fact that most organizations begin with culture strategies first.

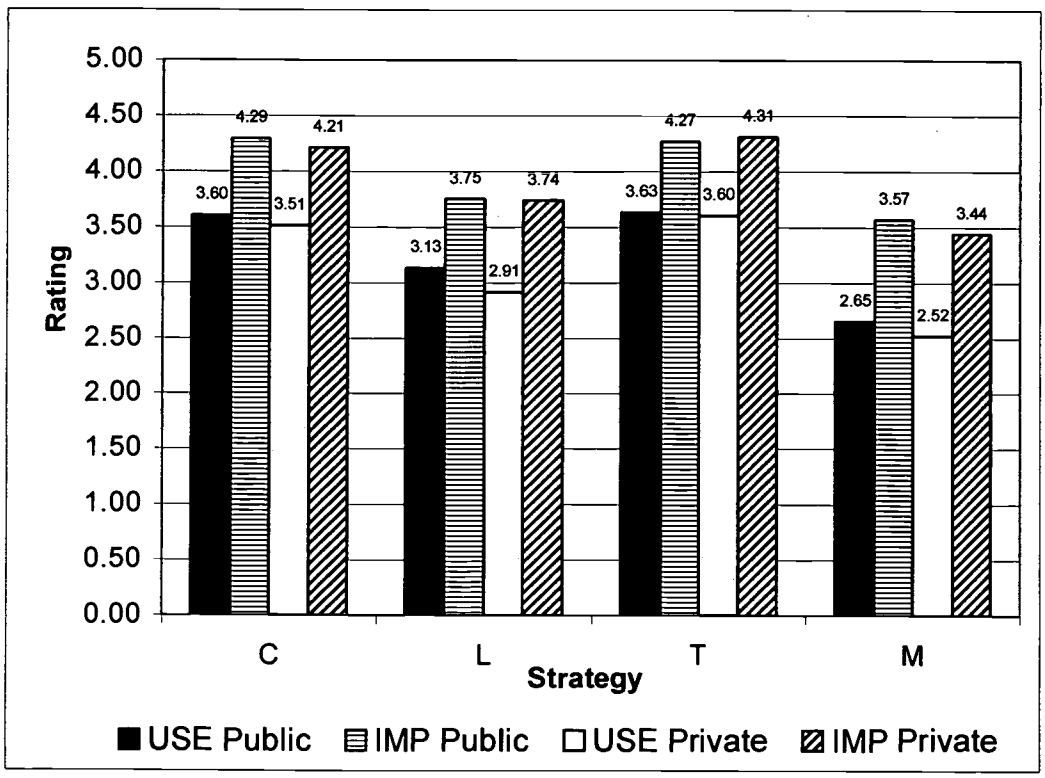

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Figure 11. Use and Importance of Strategies for Public and Private Universities

A closer examination of the strategies revealed that public universities practiced all the tactics of the strategies at a higher level, with the exception of four specific factors across three strategy areas reported in Table 6.

Table 6.
Tactics Rated Higher By Private Universities

Culture	Leadership	Technology
C4 : Student (customer) value creation is acknowledged as a major objective of knowledge management.	L7: Universities understand the value and potential of its knowledge assets.	T14: Technology links members of the university to one another. T17: Technology brings the university closer to the students.

Moreover, the most notable differences in tactics between public and private universities were related to the leadership strategy. Research-Extensive universities reported at a higher level that the university has a vision for managing knowledge (ES=.42); and, a position has been created to promote development of knowledge relating to university's core competencies (ES=.37). These findings are consistent with the literature where organizations that have achieved the greatest success are those that (a) have a strong vision (Van Buren, 1999), and (b) have appointed a senior-level executive to assume the position of chief knowledge officer (CKO) (Gopal and Gagnon, 1995; Goh, 1998).

Relationships

Finding Number Eight

The amount of variance in KM Effectiveness was accounted for by the use of the measurement (46.6%), leadership (36.8%), technology (35.2%), and culture (30.1%) strategies.

Discussion. This finding implies that across all universities, the measurement strategy appears to be the most influential factor determining KM effectiveness. Furthermore, all of the tactical behaviors related to the measurement strategy contributed to the level of effectiveness. One could infer that the measurement strategy should be considered first when implementing KM in universities. According to the results of this study, other strategies to consider, in descending order of importance, would be leadership, technology, and then culture.

Finding Number Nine

The amount of variance in KM attributed to each of the strategies, indicating relative importance, differed significantly for public and private universities (i.e., public universities: 49.4% measurement, 38.4% leadership, 35.3% technology, and 25.6% culture; private universities: 46.9% culture, 36.1% measurement, 36.0% technology, and 29.7% leadership.)

Discussion. Organizations pursue different KM strategies aligned to their business strategies. Hansen, et al (1999) reported two separate strategies which they call codification (or technology) strategy and personalization (or culture) strategy. Others discuss a third strategy—the organizational effectiveness (or measurement)

strategy (Edvinson & Malone, 1997; Stewart, 1997; Sveiby, 1997; Klein, 1998). Figure 12 shows the differences between the public and private universities.

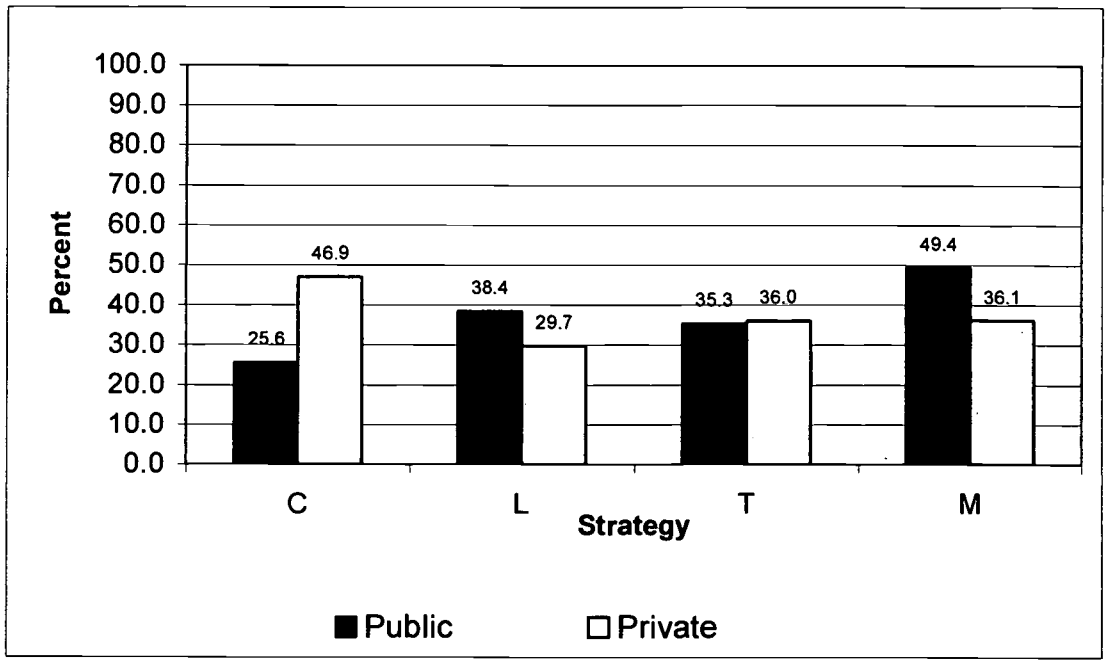

Figure 12. Amount of Variance in KM Effectiveness Accounted for by Each Strategy for Public and Private Universities

Additionally, as illustrated in Figure 12, relationships between strategies and KM effectiveness are influenced by state control. Furthermore, the results of this study infer that public and private universities should focus on different strategies. For example, public universities should place more emphasis on measurement strategy, whereas private universities should focus more on culture. One might argue the case that, as a public university, more governing control and accountability measures are present. Therefore, there is a greater need for a strong measurement system. Private universities, on the other hand, focus more on the cultural, or behavioristic, approach. As Rowley (2000) reports, governments and other policy making bodies have pushed institutions towards the KM revolution.

Finding Number Ten

The proposed classification model was proved 76% accurate. More specifically, 75.9% (most effective) and 76.1% (least effective) of the cross-validated grouped cases were correctly classified. Z-scores for each group and for the total sample group were significant at the .01 level for the cross-validated hit-rates. The model takes the following form:

$$.073\ (C) + .080\ (L) + .680\ (T) + .834\ (M) - 5.152$$

Discussion. A four-variable equation to predict effectiveness of knowledge management in research universities was derived. By discriminating between most

effective and least effective groups, administrators could then give special attention to these strategies, and tactics, as organizations prepare to implement a KM initiative.

The most effective and least effective universities differed in the use, importance, and efficiency of the strategies. Table 7 illustrates the mean scores of processes for each group, and Table 8 shows how each group rank-ordered (1 = high) the strategies by use, importance, and efficiency.

Table 7.
Mean Scores of KM Processes and Strategies by Effectiveness Group

	Most Effective	Least Effective
Process		
Generation	3.06	1.90
Codification	3.34	2.21
Transfer	3.28	2.03
All Processes	3.22	2.01
Strategy		
Culture	3.91	3.41
Leadership	3.87	3.32
Technology	3.46	2.74
Measurement	3.15	2.15
All Strategies	3.59	2.90

Table 8
Rank Ordering of Use, Importance, and Efficiency of Strategies by KM Effectiveness Level

	Culture	Leadership	Technology	Measurement
Most Effective				
Use	2	3	1	4
Importance	1	3	2	4
Efficiency	1	3	2	4
Least Effective				
Use	1	3	2	4
Importance	2	3	1	4
Efficiency	1	2	3	4

Table 9 displays the rank-ordering of all tactics by degree of use (1 = most used for the most-effective (ME) and least-effective (LE) universities.

Table 9.
Rank-Order of Tactics by Most-Effective (ME) and Least-Effective (LE) Groups

	Survey item	ME	LE
C1	The university encourages and facilitates knowledge-sharing.	2	2
C2	A climate of openness permeates the university.	7	5
C3	A climate of trust permeates the university.	16	10
C4	Student (customer) value creation is acknowledged as a major objective of knowledge management.	3	8
C5	Employees take responsibility for their own learning.	15	6
L6	Managing organizational knowledge is central to the university's strategic plan.	14	15
L7	The university understands the revenue-generating potential of its knowledge assets.	12	14
L8	The university develops strategies for selling knowledge assets.	20	18
L9	Individuals are hired for their contributions to the development of organizational knowledge.	11	13
L10	Individuals are evaluated for their contributions tot the development of organizational knowledge.	17	19
L11	Individuals are compensated for their contributions to the development of organizational knowledge.	22	16
L12	A position has been created with the authority and resources to promote the development of knowledge relating to the university's core competencies.	21	22
L13	The university has a stated vision for managing knowledge.	23	23
T14	Technology links all members of the university to one another.	1	1
T15	Technology links all members of the university to all relevant external publics.	5	4
T16	Technology creates an institutional memory that is accessible to the entire university.	10	17
T17	Technology brings the university closer to its students.	8	9
T18	Technology is designed to help employees work more efficiently.	4	7
T19	Technology is designed to help employees make better decisions.	13	11
T20	The university continually upgrades and replaces collaborative hardware and software.	6	3
T21	Information reaches appropriate decision makers in a timely fashion so it can contribute to business decisions.	9	12
M22	The university has invented ways to link knowledge management to the budget.	19	21
M23	The university's annual report to the governing body includes an assessment of how knowledge capital has contributed to bottom-line performance.	24	24
M24	The university has developed specific set of indicators to manage knowledge.	25	25
M25	The measurement system incorporates measures of intangible assets such as intellectual capital.	26	26
M26	The university allocates resources toward efforts that measurably increase its knowledge base.	18	20

KM strategies must have coherence across a number of dimensions, including culture, leadership, technology, and measurement. As the discriminant model suggests, managers implementing KM initiatives would benefit from focusing their efforts on measurement and technology strategies, first. A secondary focus should then be on leadership and culture strategies.

Most organizations tend to make their first move with KM in the domains of technology and culture. There is a caution, however, against a technology-centered knowledge management approach. Setting up an organizational infrastructure for managing knowledge may require hiring new people, training them in new skills, and creating new processes and procedures.

Finding Number Eleven

Ten critical success factors (CSF's) mobilizing around leadership, technology, and measurement tactics were identified.

The critical success factors for effective KM are displayed in order of importance, by effect size, in Figure 14.

Critical Success Factors for Implementing KM Initiatives

1. The university allocates resources toward efforts that measurably increase its knowledge base. (ES = .87) *Measurement*
2. The university understands the revenue-generating potential of its knowledge assets. (ES = .87) Leadership
3. Individuals are evaluated for their contributions to the development of organizational knowledge. (ES = .85) *Leadership*
4. The university has a stated vision for managing knowledge. (ES = .85) *Leadership*
5. The university links all members of the university to one another. (ES = .83) *Technology*
6. Managing organizational knowledge is central to the university's strategic plan. (ES = .83) Technology
7. Information reaches appropriate decision makers in a timely fashion so it can contribute to business decisions. (ES = .82) *Technology*
8. The university has invented ways to link knowledge management to the budget. (ES = .81) Measurement
9. Technology creates an institutional memory that is accessible to the entire university. (ES =.80) *Technology*
10. A climate of trust permeates the university. (ES .80) *Culture*

Figure 14. Critical Success Factors for Implementing KM Initiatives in Research Universities

Discussion. To compete, operate, grow, and achieve increased organizational performance, higher education institutions need strong measurement and technology systems as well as strategic leadership, the total commitment of all their staff, and a culture that supports the idea of continuous quality improvement. Boynton and Zmud (1984) define critical success factors as those few things that must go well to ensure the success for a manager and the organization. They represent those managerial areas that must be given special and continual attention to cause high performance. Moreover, the Critical Success Factor (CSF) analysis provides important meaning to KM through the identification of the core strategies and tactics that are critical to KM implementation. Digman (1999) stresses the usefulness of CSF analysis because he claims that the link between environmental analysis and critical success factor analysis leads to organizational success.

The major factors, or tactics, contributing to KM effectiveness for this study were identified by effect size between the most effective and the least effective universities. Ten critical success factors were most influential to these organizations. As expected, not one strategy alone contributed to KM effectiveness. Rather, a comprehensive set of factors, or tactics, emerged—technology (4 factors), leadership (3 factors), measurement (2 factors) and culture (1 factor). Critical factors focused on employee evaluation, assessment and measurement, initiative (project) planning and design, technology infrastructure, communication, motivation, and organizational climate and culture.

This finding implies that measurement and technology strategies, in terms of the degree of use, are most critical to KM success. These findings are consistent with some previous and current KM research (Linkage, Inc., 1999). However, this finding does not support other beliefs that the culture strategy is the most critical factor for KM implementation (Dougherty, 1999; Scarborough, 1999). The Hewlett-Packard team identified three success factors for implementing and sustaining momentum for knowledge management efforts: (a) continued leadership guidance, support, and modeling of desired behaviors: (b) reinforcement of knowledge measure and performance management systems; and, (c) measuring progress and making continuous improvement to processes, tools, and capabilities. Thus, this result confirms that most organizations consider measurement, leadership, and technology tactics as the most critical factors for the KM success. The reduced strength of culture is supported by Kotter's (1996) findings that culture is the last thing that changes in organizations:

> Culture is not something that you manipulate easily. Attempts to grab it and twist it into a new shape never work because you can't grab it. Culture changes only after you have successfully altered people's actions, after the new behavior produces some group benefit for a period of time, and after people see the connection between the new actions and the performance improvement (pg. 156).

Conclusions

This research sought to examine the current use of the KM strategies and how these strategies contributed to the effectiveness of KM. Immediate value first came

from the high response rate of survey returns. The overall respondents' attitudes toward the KM strategies and processes were examined; and, a general conclusion is that the research universities exhibited above a moderate level of use of the KM strategies and below a moderate level with KM processes. The key to this study, however, was that when data were disaggregated, more apparent differences surfaced in the manner that most effective universities functioned as compared to the least effective universities. Specifically, differences in levels of KM effectiveness were linked to the extent that universities engaged in the culture, leadership, technology, and measurement strategies.

Implications for Higher Education Leaders

Understanding the strategies and tactics that facilitate KM was one objective of this study. As universities make the decision to develop a plan for KM implementation, leaders need to focus on a comprehensive approach. Through the development of the KM classification model and the identification of critical success factors, strategic planning could be facilitated.

Based on the analysis of the data, conclusions drawn, and limitations imposed in this study, the following recommendations are made to university managers interested in strategically managing their organizational knowledge assets. These higher education institutions would benefit from following these steps:

1. Conduct a KM audit by assessing the use of processes and strategies.
2. Using the proposed classification model, determine whether the organization is functioning as a most effective (ME) or least effective (LE) group
3. Identify and articulate primary objectives for KM
4. Target a strategy (culture, leadership, technology, measurement)
5. Focus on the critical success factors

To demonstrate the practical utility of the proposed model and recommendations, these steps are applied to one public Research-Intensive university.

Conduct a KM Audit

The first step in implementing any initiative, naturally, is to assess the organization's current state. An organization must know where it stands before it can know where it is going. By administering the survey to administrators and managers across the university, the current use and importance of the processes and strategies can be determined. Following an assessment, gaps between the current use and the perceived level of importance for each strategy and the tactics can then be identified for possible areas of focus.

Five individuals from the example university complete the assessment survey, and an arithmetic mean was calculated for the "use" of each of the four strategy areas: Culture = 3.60; Leadership = 3.05; Technology = 3.60; and, Measurement = 2.80. The "importance" ratings were higher than "use" ratings across all strategy areas: Culture = 4.48; Leadership = 4.15; Technology = 4.23; and, Measurement = 3.92.

Determine KM Effectiveness Level

There are practical implications related to using the KM Effectiveness classification model. From the perspective of administrators, the first point that

emerges from the data is that both groups of KM effectiveness appear to be a desirable focus of managerial efforts. First, with the data collected from the survey, universities can determine how effectively they are managing (generating, codifying, and transferring) their organizational knowledge. The "use" scores for the example university were plugged into the classification model

$$\text{Effectiveness} = .073\ (C) + .080\ (L) + .680\ (T) + .834\ (M) - 5.152$$

where, C = mean culture score, L= mean leadership score, T = mean technology score, M = mean measurement score, and 5.152 is a constant.

$$\text{Effectiveness} = .073\ (3.60) + .080\ (3.05) + .680\ (3.60) + .834\ (2.80) - 5.152$$
$$\text{Effectiveness} = .2628 + .2440 + 2.448 + 2.345 - 5.152$$
$$\text{Effectiveness} = .1432$$

In this case, the effectiveness score indicates that the example university is functioning as a "least effective" university. The effectiveness score (.1432) was closer to the LE group centroid (-.623) than the ME group centroid (.694). Next, the universities classified as Least Effective can then be compared with those classified as Most Effective, focusing primarily on the critical success factors. Continuing with the example, a comparative analysis of "use" scores of critical success factors was conducted for the example university and the Most Effective universities (Table 9).

Table 9.

Comparative Analysis of Critical Success Factors for Example University and Most Effective Universities

Survey Item	Critical Success Factor	Most Effective Universities	Example University	Effect Size
C3	A climate of trust permeates the university.	3.84	3.20	.84
L6	Managing organizational knowledge is central to the university's strategic plan.	3.79	3.40	.41
L7	The university understands the value-generating potential of its knowledge assets.	3.84	3.40	.45
L10	Individuals evaluated for contributions to the development of organizational knowledge.	3.54	3.00	.52
L13	The university has a stated vision for managing knowledge.	3.10	2.60	.50
T14	Technology links members of university.	4.25	4.00	.48
T16	Technology creates an institutional memory accessible to the entire university.	3.58	3.40	.18
T21	Information reaches appropriate decision makers in a timely fashion to contribute to business decisions.	3.86	3.60	.18
M22	The university has invented ways to link knowledge management to the budget.	3.39	3.00	.35
M26	The university allocates resources toward efforts that measurably increase its knowledge base.	3.54	2.40	.98

As can be seen in Table 9, the example university's ratings for the critical success factors were lower across all areas.

Identify and Articulate Objectives

KM initiatives should be designed with purpose and vision. Communication is key. Once the purpose is established, it should be articulated. There have to be objectives in mind for KM to succeed (Gladstone, 2000). Some common objectives for KM projects may include (a) capturing lessons learned, (b) providing easy access to experts, (c) sharing experiences, (d) leveraging knowledge of the entire organization, (e) improving access and awareness, (f) capturing expertise before it leaves, and (g) embedding knowledge in strategy.

Hall (1992) posited that employee know-how and reputation are perceived as the resources that make the most contribution to business success. He argues that the analysis of intangible resources should play a major role in the strategic management process. The easiest and most impressive benefits of KM involve money saved, improvement in cycle time, and customer satisfaction. These benefits can be translated, for educational institutions, into increased full-time enrollment (FTE), student retention, and student satisfaction.

Choose a KM Strategy

Practitioners can strengthen the effectiveness of KM by targeting specific areas for improvement. However, a KM strategy should first be linked to what the organization is attempting to achieve. For example, if the intent, or objective, of the organization is to implement a KM project for sharing experiences, the culture strategy would be the place to start. If a university were looking to make information and knowledge easily accessible, then a technology strategy would be the appropriate strategy with which to begin.

Another method of choosing a strategy can be decided by the state control status of the university. It was found in the current study, that public universities benefit most from implementing a measurement strategy, first, and then leadership, technology, and culture strategies. On the other hand, private universities would be more successful in implementing a culture strategy, followed by attempts at technology, measurement, then leadership strategies. For the example university, which is public, a strong recommendation is made to focus primarily on measurement and leadership strategies with a secondary focus on technology and culture strategies.

One could also examine effect sizes of strategy scores between the university under study and the Most Effective universities. Table 10 provides an illustration for the example university.

Table 10.
KM Strategy Effect Sizes for the Example University and the Most Effective Universities

Strategy	Most Effective Universities	Example University	Standard Deviation	Effect Size
Culture	3.87	3.60	.65	.42
Leadership	3.46	3.05	.79	.52
Technology	3.91	3.60	.66	.47
Measurement	3.15	2.80	.93	.38

In this example, the greatest practical significance (i.e., highest effect size) is related to the leadership strategy, followed by technology, culture, then measurement. Thus, it would follow that a recommendation be made for this specific university to begin with a leadership strategy.

Technology

A typical objective of KM is to take documents with knowledge embedded in them (i.e., memos, reports, presentations, articles) and store them in a repository where they can be easily retrieved. A well-organized repository is crucial, for a repository without structure is difficult to extract knowledge from. To transfer tacit knowledge from individuals into repositories, Davenport, Javenpaa, and Beers (1998) suggest using a community-based electronic discussion. This type of repository accelerates and broadens the knowledge-sharing that traditionally happens through socialization of newcomers, the generation of stories within communities, and the general transmission of cultural rituals and organizational routines (Brown and Duguid, 1999).

Most organizations begin with a technology strategy. The basic infrastructure is necessary for the implementation of the other strategies. The critical success factors related to the technology strategy include tactics such as: (a) linking all members of the university to one another; (b) making sure that information reaches appropriate decision makers in a timely fashion; and, (c) creating an institutional memory that is accessible to the entire university. Managers should begin by selecting technology tools that give users more capabilities than they already have. Produce a knowledge map of the organization.

Measurement

It is important for an organization to create systems for evaluating attempts to use KM. The measurement strategy is generally used after the KM initiative has been in place for a while. It is generally not the strategy with which to begin. Measurement is useful for: (a) designing future applications, (b) improving current generation, codification, and transfer processes, and (c) ensuring efforts stay on track.

Critical success factors for the measurement strategy include: (a) allocating resources toward efforts that measurably increase the knowledge base; (b) aligning management of organizational knowledge with the university's strategic plan; and, (c) inventing ways to link KM to the budget.

Leadership

Effective leaders always relate to a vision—a picture of a desired future. In keeping with the vision, detailed plans are made to gradually transform the culture so that the rituals, rewards, routine activities, stories, and norms call attention to values embedded in the new vision. Leaders can shape culture in both formal and informal ways. Some major culture-shaping strategies are outlined below: develop a sense of what the institution should and could be; recruit and select staff whose values fit with the institution; resolve conflicts, disputes, and problems directly as a way of shaping values; communicate values and beliefs in daily routines and behaviors; nurture the

traditions, ceremonies, rituals, and symbols that communicate and reinforce the culture. In sum, leadership and top management must be willing to (a) communicate with employees to make knowledge realistic, and (b) coordinate the KM implementation process.

Top management should focus on encouraging processes to promote sharing, or transfer, including set up and funding (Mayo, 1998). In initial stages of KM implementation technology must be implemented and operationalized. This means that an initial investment is necessary to build the infrastructure. Additionally, planning time must be allotted to define the user groups that will be accessing the information. In other words, someone familiar with the content will be required to review the documentation to know which user groups would need to have access to the content.

Critical success factors related to the leadership strategy include tactics such as: (a) understanding the value-generating potential of knowledge; (b) evaluating individuals based on contributions to the knowledge base; and, (c) having a stated vision for managing knowledge. Additional tactics of a leadership strategy include (a) making knowledge management a requirement for evaluation purposes for each employee; (b) recruiting or hiring a leader responsible for harnessing and managing the organization's knowledge; and (c) sending employees to conferences to increase individual knowledge bases.

Linking all members of the university to one another is a very crucial factor. Leadership should encourage creating maps of where knowledge, expertise, and experience resides (people, documents, processes) and which knowledge needs to be shared with whom, when, how, and why. This has provided rapid access to the organization's knowledge and assisted in finding and rewarding key knowledge producers and brokers (Seeman, 1996). Saunders (in Ash, 1998) found that a large proportion of the organizations that failed was attributed to the lack of communication.

Culture

Employees are competitive by nature and may be more inclined to hoard knowledge (Cole-Gomolski, 1997). One of leadership's focal points should be on establishing a culture that respects knowledge, reinforces sharing, retains its people, and builds loyalty to the organization.

Some considerations, especially related to culture, include developing structures that facilitate the growth of communities of practice, as well as enhanced practices of training, development, recruitment, motivation, retention, organization, and job design. Moreover, it is essential that reward systems support the culture of sharing knowledge (Keeler, 2000; Mayo, 1998). The critical success factor related to the culture strategy focuses on creating and sustaining a climate of trust.

Focus on Critical Success Factors

Maintaining a pragmatic rather than a perfectionist approach is crucial. Preparation is everything in implementing a KM initiative. Managers need to combine thoughtful analysis with consideration of practical issues and may become overwhelmed by the girth of the project. The list of critical success factors (CSF) generated from this study provides some direction to research universities.

Implications for Research

The present study extends current knowledge of knowledge management. First, the study serves as a foundation for building a cumulative tradition of research on knowledge management implementation. This study is among the first empirical works to specifically examine strategies, tactics, and processes in institutions of higher education. Although a few other studies have investigated success factors, their scope was limited, and the investigations were neither systematic nor statistically investigated (Davenport and Prusak, 1998; Calabrese, 2000; Weathers, 2000).

Second, the most significant contribution of this study is that it provides a framework for developing an instrument for assessing use of strategies and KM in research universities. From a measurement perspective, this study confirms the survey instrument originally developed by Arthur Andersen and the American Productivity and Quality Center (1997) and modified for the present investigation has now been assessed for both reliability and construct validity. Based on this information, the instrument is recommended for use in assessment and prediction of KM process effectiveness.

Third, this study attempts to identify critical success factors based on a structured survey-questionnaire. Because this was an exploratory effort, however, any one of these factors might be a likely CSF for an organization wishing to implement effective KM initiatives.

Finally, the multivariate analyses conducted in this study revealed that the proposed model is a useful tool for determining how to plan a KM initiative. Of the contextual variables examined, Carnegie classification and state control were the most significant indicators between most effective and least effective universities. To increase the accuracy of the model, perhaps future investigations should examine the influence of other organizational characteristics (i.e. institutional size, level of productivity) on KM effectiveness.

KM provides the perspectives, approaches, and the vision to put investments made in data and information to better use where it is needed the most. It directs decisions on where, how, and when to build, create, accumulate, share, and account for new knowledge. It allows an organization to account for key assets including education, training, and on–the-job experience that are often the largest costs in some organizations. These expenditures are seldom quantified or tracked. Most importantly, though KM allows an organization to retain critical expertise and build an organizational memory by preventing critical knowledge loss due to retirement, downsizing, or employee attrition.

Because KM deals with cultural, strategic, and technological issues, it is important for people to be provided with the proper incentives and tools to share knowledge and that solutions are designed with specific business problems in mind. By focusing strategic planning and execution on the enablers of culture, leadership, technology, and measurement, organizations can ensure results-oriented knowledge management practice where needs are met, opportunities are approached, and organizational performance is improved.

Recommendations For Further Research

The related research and results of the current study indicate that there is a need to continue investigating and examining the strategies and processes related to KM in higher education organizations. The knowledge era calls for different behavior—behavior that is more experimental and risk-taking. Colleges and universities will need to become more proactive in order to take advantage of opportunities and compete strategically for limited resources, especially in this new world order.

On the basis of this study, the following recommendations are made for further research. Some future studies may include: (a) a longitudinal study; (b) a deeper investigation of how KM impacts organizational performance; (c) a study of the relationship between KM and levels of intellectual capital; (d) a qualitative study including focus groups, observations, and an examination of the structure of knowledge repositories; (e) a study to tap into the comparisons of KM characteristics by personality types with the use of Myers-Briggs type indicator, (f) a study that correlates KM practices with different leadership traits; (g) a cross-cultural comparative analysis of knowledge management implementation in research universities among countries; and, (h) further studies designed to enhance the accuracy of the classification model, perhaps by looking at variables such as institutional size, levels of productivity, and amounts of Research and Development money coming into the university.

Final Thoughts

Based upon the findings of this study, it can be concluded that balance is necessary while implementing a KM initiative. What makes knowledge valuable to organizations is ultimately the ability to make better the decisions and actions taken on the basis of the knowledge. If knowledge doesn't improve the decision-making or performance, then what's the point of managing it?

This study requires people to rethink their attitudes on intangible assets and to start recognizing that measuring and strategically managing knowledge may make the difference between mediocrity and excellence. Perhaps, exposure to this survey/questionnaire just may be the catalyst, as it jumpstarts thought processes related to KM. Put directly, in the next century, higher education in the United States will face profound, unavoidable changes and an uncertain environment. Societal expectations and public resources for higher education are and will continue undergoing major shifts. Moreover, changes both within and outside the organization are altering the nature of higher education and the manner in which it will be managed. There exist major external influences on higher education. Conversely, decisions that are made by academic institutions affect the broader society. University administrators need to communicate and understand the concepts of KM and intellectual capital. That is, how can a university or college manager or administrator do at least a reasonably good job, survive, and hopefully even make some major contributions to his institution and society.

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