

# Knowledge Management: Obstacles and Opportunities – What Can NASA Learn from the Consulting Industry?

By

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in Partial Fulfillment of the Requirements for the Degree of

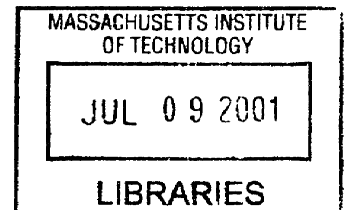
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## **ABSTRACT**

Knowledge Management (KM) has become a strategic business practice that is credited with providing and sustaining a firm's competitive advantage. Organizations skilled at knowledge management evaluate their core processes, capture insights of their findings, combine their skills and experiences, innovate, and apply the newly refined ideas quickly. Herein lies the competitive advantage.

Organizations that excel at maximizing corporate knowledge, such as consulting firms, tend to be the ones that 1) value their employees, 2) have a culture of learning, and 3) have processes for sharing information. This thesis focuses on the KM strategies of consulting firms. In consulting, knowledge is the very cornerstone of the services a firm offers its clients. An extensive literature review, combined with interviews of a cross-section of the consulting industry, provides insight into the KM systems and organizational culture of successful firms.

The knowledge gained from this research will be used in the development and implementation of a KM system at the National Aeronautics and Space Agency (NASA.). NASA is facing the possibility of losing fifty percent of its civil service workforce through retirement over the next five years. Capturing and storing technical and institutional knowledge for future use will help to assure the success and continuity of the nation's space agency.

Although several areas emerge from the research as being key to the success of a firm's KM system, one theme outweighs all others – organizational culture. Information technology alone is inadequate to perform the tasks of managing a firm's knowledge. The firm must create a learning and sharing culture where personal networks and information technology combine to create an environment that maximizes corporate knowledge.

In this thesis, I outline a framework, with suggested diagnostic actions, to assist managers at NASA and other organizations in the assessment of different cultural aspects most likely to affect critical knowledge-related behaviors. Using this framework will allow for more informed decisions concerning the realignment of the firm's culture to effectively support the goals for leveraging organizational knowledge.

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## CHAPTER I. INTRODUCTION

Knowledge has become the currency of our times. It is the only resource that increases with use. Knowledge Management (KM) has become a vital aspect of world class management in today's business environment and should be viewed as a discipline, not just the latest in technological trends. It is a discipline of capturing knowledge-based competencies, storing and using them in order to add value to the firm. Organizations that excel at maximizing corporate knowledge, such as consulting firms, tend to be the ones that value their employees and the learning and sharing culture they have developed.

If knowledge is the currency, how large is the market? The GartnerGroup reports that U.S. businesses paid \$1.5 billion to consultants for Knowledge Management advice in 1996-1997. The same firms are expected to pay \$5 billion a year by 2001 (Nakra, 2000). What is behind this explosive growth? Information resources such as the Internet and the accelerating pace of technological change are just two of the reasons attributed to the sudden interest in knowledge management (Hibbard, 1997). The knowledge-intensive service industries are expected to include 85% of the U.S. job market (KPMG, 1999). The worldwide KM market is projected to grow from \$2 billion in 1999 to \$12.2 billion in 2003 according to International Data Corporation. Table 1 shows how the spending occurs across the different segments of the KM industry (Murray, 1999).

Source: International Data Corporation, 1999

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	1999	2000	2001	2002	2003
Services	1300	2300	3700	5600	7900
Software	330	549	843	1294	1804
Infrastructure	163	285	454	689	970
Internal resources	244	427	631	1034	1456
Total	2037	3561	5678	8617	12130

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Table 1. Worldwide Spending on Knowledge Management: 1999-2003 (\$M)

This thesis will focus on the KM strategies of management consulting firms.

Effective and efficient KM is especially crucial in the consulting industry since knowledge is the very cornerstone of the services it offers its clients. Consultants use a number of methods to transfer and manage knowledge such as sophisticated databases, documented processes, personnel movement, and internal networks. The tactics and processes used so successfully by these firms will be evaluated for adaptation to the needs and environments of NASA.

The landscape at NASA has changed dramatically over the years. The effects of these changes have caused us to re-evaluate the way in which we operate.

When the Saturn Rocket and other large launch vehicles were being developed, the civil service workforce was large and focused on one vision. However, if you

fast-forward thirty years, this workforce is at an all-time low, budgets are smaller, and the technical challenges are even greater. NASA has had to develop new, more economical ways of doing business while maintaining world-class skills and facilities. The transfer of knowledge has had to take new shapes. Learning by doing is no longer the standard model. Knowledge must be transferred more efficiently from program to program and from generation to generation. NASA must find a way to capture the wisdom of the workers within its organizations in order to leverage that knowledge to its' fullest or to preserve it after key individuals are gone from the organization.

## **CHAPTER II. KM DEFINITIONS, DIMENSIONS, & VALUE**

Knowledge Management (KM) has become a familiar concept for everyone who follows the events of the business world. Corporations have begun to invest heavily in building KM systems. Knowledge Management has reached the top of the corporation, and many companies can boast of a Chief Knowledge Officer (CKO). The University of California at Berkeley has recently appointed the first "Professor of Knowledge". There have been hundreds of articles and books written to explore and exploit the value of knowledge. Consulting firms have become experts in developing ways to leverage KM to build long-term competitive advantage.

The concept of knowledge generation, capture, transfer, and sharing has always been used in some fashion by most industries. The formalization of knowledge management has expanded this responsibility to include the ability to connect those who know with those who need to know and to convert personal knowledge into corporate knowledge and assets. However, there are many issues associated with identifying these knowledge assets and being able to transfer and manage them in an efficient and cost-effective manner.

Organizations need to have a consistent vocabulary that ensures that the knowledge is correctly understood. They need to be able to identify, model, and explicitly represent their knowledge. The organization needs to be able to share



and re-use their knowledge among differing applications and various users. And of great importance, the enterprise must create a culture that encourages knowledge sharing. Knowledge engineering models and tools have come a long way towards addressing the use of a company's knowledge assets. Tools allow for a disciplined approach to designing and building knowledge-based applications. They support the capture, modeling, validation, verification, and maintenance of the knowledge assets. However, the tools seldom extend to supporting the processes for managing knowledge at all levels within the organization.

## 1. Knowledge Definitions and Dimensions

As we begin to explore and to learn to think productively about the problems of managing knowledge, we need to be able to distinguish between the concepts of data, information, knowledge and wisdom. Even though we have not reached a general consensus on the boundaries of these terms, a working definition follows for use in this thesis. Figure 1 shows the progression path that data must follow to become useful knowledge and wisdom.

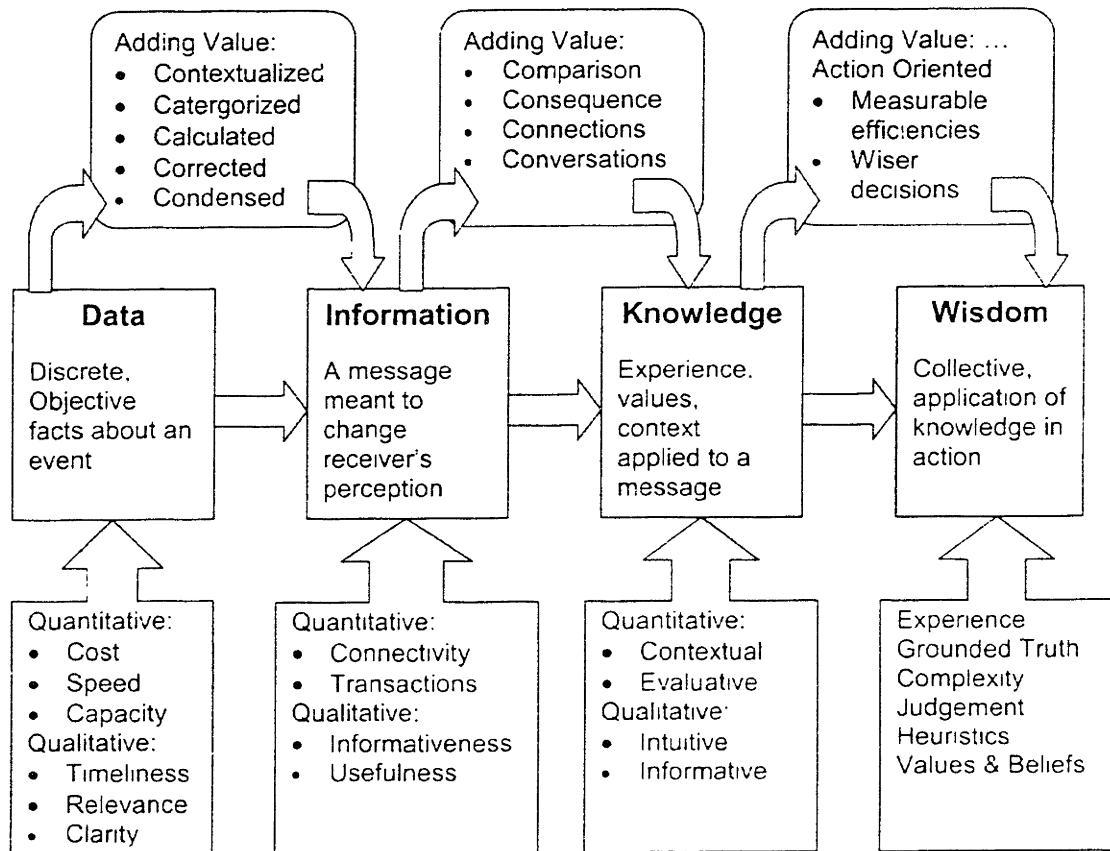


Figure 1. The Knowledge Progression (Liebowitz, 1999)

*Data* shall be defined as raw or unabridged descriptions or observations about states of past, present, or future worlds, and information as patterns that individuals find or imbue in data (Davenport, 1997). Several authors such as Tobin (1996) and Beckman (1997) consider facts, images, or sounds as examples of data.

*Information* results from data that has been interpreted and meaning added. This appears as formatted, filtered, and summarized data.

*Knowledge*, on the other hand, is a product of human reflection and experience. Dependent on context, knowledge is a resource that is always located in an individual or embedded in a routine or process. Embodied in language, stories, concepts, rules, and tools, knowledge results in an increased capacity for decision making and action to achieve some purpose (Blackler, 1997).

*Wisdom* can be then be defined as knowledge that has been seasoned with experience and intuition.

There are two dimensions that are crucial in understanding knowledge in a practical, organizational context. First, knowledge exists at individual, group, and organizational levels. The focus of knowledge management efforts is primarily on improving knowledge creation and use at group and organizational levels. Second, knowledge is either explicit or tacit. Explicit knowledge can be codified and embedded in formal rules, tools, and processes. Tacit knowledge is what we know but cannot explain. Automatically reordering parts when inventory declines to a certain level is explicit knowledge; assessing an individual's potential, or building a cross-functional team, is tacit knowledge.

There appears to be a major source of confusion in discussions about knowledge and knowledge management in organizations today. This breakdown seems to result from the failure to recognize that there are at least three distinct types of

knowledge. De Long and Fahey (2000) define the three types of human, social, and structured knowledge as follows:

*Human Knowledge:* This constitutes what individuals know or know how to do. Human or individual knowledge is manifested in skill (e.g., how to design a rocket engine) or expertise (e.g., deep understanding of why a particular material is better suited for extreme temperatures), and usually combines both explicit and tacit knowledge. This type of knowledge may be sentient that is, located in the body, such as knowing how to type or ride a bicycle. Or it may be cognitive, that is, largely conceptual and abstract (Blackler, 1995).

*Social Knowledge:* This form of knowledge exists only in relationships between individuals or within groups. For example, high-performing teams of research scientists or Web-page designers share certain collective knowledge that is more than the sum of the individual knowledge of the teams' members. Social or collective knowledge is largely tacit, shared by group members, and develops only as a result of working together (Brown & Duguid, 1998). Its presence is reflected by an ability to collaborate effectively.

*Structured Knowledge:* This is knowledge embedded in an organization's systems, processes, tools, and routines. Knowledge in this form is explicit and rule-based. A key distinction between structured knowledge and the first two types is that structured knowledge is assumed to exist independently of humans

in the loop. It is, instead, an organizational resource that is frequently created and embedded in routines, systems, and tools. Take, for example, sophisticated accounting software. The knowledge embedded in the software was originally created by humans in the form of accounting rules and software code, and it is useful only in specific business contexts where it enhances management's decision-making capabilities. Certainly, additional human knowledge may be needed to customize the accounting software in a particular organization, where existing social knowledge will also affect use of the software, but a significant amount of structured knowledge does exist in the program.

The knowledge that is embedded in routines, systems, and tools, and that requires minimal human intervention to perform an activity, is different from information, such as that found in books, manuals, and databases. These resources, no matter how highly analyzed, only become practical knowledge when individuals can apply their own experience and contextual understanding to interpret the details and implications for action (Cohen, 1999).

The primary purpose of the research conducted by De Long and Fahey (2000) is to help executives understand how cultures can shape the creation, sharing, and use of knowledge in general. Understanding these relationships first is essential for thinking productively about the fit between culture and knowledge in any organization. My research for this thesis was conducted on a cross-section of successful consulting firms and will address the importance of culture on their

ability to share and use intellectual capital. This knowledge will be used in conjunction with the results of De Long and Fahey's research to aid in the development of a knowledge management strategy for NASA.

## 2. The Value of Knowledge Management in Consulting Firms

In the consulting industry, knowledge management is perhaps the most critical process within the firm. A consulting firm's core product is the application of knowledge, often in the form of business solutions. Producing and selling knowledge constitutes their core resource or asset. Thus, KM is the basic "production technology" that consultants rely upon.

There is an additional factor that makes the KM process in consulting firms different from that of other organizations. In consulting, the most valuable part of knowledge originates almost entirely from client assignments, while companies in other industries generally acquire their knowledge (e.g., manufacturing technology) through internal experience or outside sources (e.g., joint ventures, consultants, patents).

There are several reasons why knowledge management is so central to the consulting industry. First, recent developments in information technology have provided qualitatively new tools with which to build knowledge capital. With the internet and the web, came the possibility to cast a wider net when searching for

required knowledge. Once the knowledge was located, it could be captured and shared with others in the organization. Information technology has made it possible to categorize and search thousands of entries in a database in a matter of seconds. This has affected all industries, not just consulting. Second, growth and globalization are other factors that have arguably affected consulting significantly more than other industries. The rapid growth of the consulting industry, usually created through mergers or acquisitions, has resulted in inconsistent delivery of services. The support provided by the knowledge management system allows for the sharing of consistent processes and practices with all members of the firm. However, one of the most important reasons for the centrality of KM in consulting is that the basic model of management consulting has changed.

Originally, the consulting firm's value proposition was to provide a resource that consisted of smart people to solve the client's problem. However, the clients began hiring people from the same pool of MBA's from top business schools. Finding smart people is no longer a problem. Rather, clients want to benefit from the consulting firms' broad experience and, more importantly, have access to the knowledge that emerges from this experience. For the consulting firm, it is now no longer enough to show that it has engagement teams working in many different industries and countries for hundreds of corporations. The firm must also show that it is capable of synthesizing these experiences and bringing the results to the client. In other words, the firm must demonstrate the power of its

collective knowledge base. This requires experience (exposure to many real life problems); synthesis (ability to adapt known solutions to new problems); and availability (ability to distribute the firm's knowledge).

Hargadon and Sutton (1996) provide an excellent framework to conceptualize the new model of the management consulting industry. They argue that the best way to think about a consultant is as a broker. Through the consulting assignments, the consultant is connected to many firms in different industries. As a result of this central position, the consultant is aware of a large set of business problems as well as a large set of solutions. Problems and solutions may not always match within an industry. In fact, if they do, industry participants are likely to be aware of them. However, they are typically not aware of solutions that exist in other-especially unrelated-industries. The central position and connectedness of brokers makes them uniquely positioned to identify and facilitate the matching of problems and solutions.

Suppose, for example, that a consulting firm has multiple projects in banking. Each project provides insights with respect to some aspect of the banking industry and the corresponding teams appropriate these insights. If the insights are not compiled and stored it is either impossible or extremely costly for a new team to benefit from them. The new team would need to find and contact each of the previous teams and engage in a long conversation with each to learn the lessons from their projects.



What happens if a firm does not have a KM system? One result may be that the firm will be inefficient because its consultants will spend a considerable amount of time replicating the work of their colleagues. More importantly, the quality of the firm's service may suffer substantially; decisions will be based on insights (anecdotes) rather than a thorough understanding of the underlying business situation. As a consequence, the firm may lose a few clients. Losing clients means losing the opportunity to learn. The most important source of information for the knowledge broker is its clients. An initial disadvantage may quickly turn into a long-term disadvantage. Implementing a good KM system faster than the competition leads to higher quality knowledge that attracts more customers, which in turn provides more experiences from which to learn (Sarvary, 1999).

An effective KM system incorporates the organization's culture. An organization that implements such a system for the first time must sell the system to its employees; it has to ensure that they use it, but also that they feed into it. If people see the system as a powerful resource, they are also more likely to contribute to it. Another important feedback mechanism originates from the fact that KM changes people's daily jobs. People can concentrate on problem solving rather than on number crunching and data collection.

In order to leverage a firm's intellectual capital, data and information must be transformed into knowledge and eventually wisdom. A firm's ability to

accomplish this will determine how well they are able to sustain their competitive edge and remain innovative. Seldom do consultants perform the same jobs for different clients. The engagements may be similar, but the context of the problem may be centered in a different practice area. Consultants are quite proficient at utilizing the knowledge gained from one engagement and applying it in on entirely different situation. This cross-pollination of knowledge and their access to many interesting problems provides the consulting firms an opportunity to learn that is unparalleled in most other industries.

### 3. Why is Knowledge Management Important to NASA?

In order to understand why knowledge management has become so important to the future success of our nation's space agency, we must first understand its' history. This overview will provide insight to the challenges ahead that have resulted from decisions made in the past.

The guiding principles for U.S. exploration of air and space have remained remarkably consistent since the Agency's founding. NASA was established in the National Aeronautics and Space Act of 1958. It was founded by Congress to "lead the expansion of human knowledge of phenomenon in the atmosphere and space." It directs NASA to conduct space activities devoted to peaceful purposes for the benefit of all humankind. As established by Congress, NASA's mission is also to preserve the leadership of the U.S. in aeronautics, space science, and

technology, and, to expand knowledge of the Earth and space. Since it's beginning, NASA has been recognized as a "can do" agency that has compiled an impressive list of successes and accomplishments. The results of NASA missions have contributed to high priority national goals including national security, economic growth, understanding and preservation of the environment, and educational excellence.

Organizationally, NASA is an independent Agency in the Appropriation category of Veterans Affairs, Housing, and Urban Development. The Agency is comprised of 10 Field Centers nationwide and its fiscal year 2000 budget was close to \$13billion. NASA's strategic plan establishes a framework for making management decisions by separating NASA's programs into five externally focused strategic enterprises. These strategic enterprises cut across NASA's 10 Field Centers and are directly related to NASA's mission. Understanding the mission of each strategic enterprise is key.

Finally, government-wide personnel trends and challenges are no more apparent in any government agency than at NASA. NASA grew from a total work force of 26,500 (23,000 civil servants and 3,500 contractors) in 1960 to a total workforce of 406,500 in 1999 of which only 18,500 were civil servants. However, in the period 1990 to 1999, NASA lost a net of 35,300 in its total workforce. This creates huge pressures on an Agency whose strengths are contingent upon the expertise, retention, and continuity provided by its people.

The numbers tell the story about the problems facing the agency in the near future. There are three times more employees over the age of 60 than under 30. In five years, 50% of the workforce will be eligible for retirement. NASA must develop and implement an aggressive knowledge management strategy to capture this valuable corporate knowledge before these experienced personnel retire. If we do not begin to manage our knowledge as an Agency, we are doomed to repeat our mistakes and we may never learn from our successes.

The purpose of knowledge management is to enhance organizational performance by explicitly designing and implementing tools, processes, systems, structures, and cultures to improve the creation, sharing, and use of all three types of knowledge that are critical for decision making. Knowledge management is typically made operational through a series of new projects, processes, and activities. Examples of these are NASA's virtual teamwork using video conferencing to share human expertise between remote sites, the creation of servers to be used by product design teams for the purpose of having all the latest data available all the time by all the team members, and knowledge sharing workshops.

The implementation of new projects to generate and share knowledge has resulted in acknowledged successes. Implementing changes to existing methods and culture are areas where NASA can learn from the consulting firms.

Most of the projects that NASA undertakes are one-of-a-kind and can be likened to the engagements of the consulting firms. The mission may be different, but many of the analyses and system documentation will be similar. However, NASA currently does not re-use this knowledge as effectively as consulting firms. The design and development of each new project begins with white space. Perhaps this results from the majority of the programs being contracted to many different aerospace firms. The knowledge generated by one contractor is seldom shared, used, or trusted by another contractor. The new contractor has no incentive to re-use the existing knowledge. In fact, they would be penalized by a reduction in scope of their contract resulting in a lower fee. Since contractors are held responsible for the success of the missions that they perform, they must have total confidence in the design and analyses of that mission. The use of information generated by another contractor would have to be validated in some fashion. As you can see, the competitive culture of this industry has not developed into one that welcomes knowledge sharing. In order to realize the greatest benefits from a knowledge management system, the cultural changes must start with NASA and spread through our partners in the aerospace industry. Requirements and incentives will have to be modeled to reward sharing and re-use of agency knowledge.

NASA has a very diverse wealth of human, social, and structured knowledge. We have world-renowned experts from many functional areas. We pride ourselves in our ability to deliver earth-changing science through the use of high-

performance teams whose members are located across the country. The growth and development of our employees has always been one of our top priorities. And the systems, processes, and facilities that we operate are state-of-the-art. So what's the problem you might ask? How has NASA been able to sustain a history as a learning organization while all the time not taking care to leverage this human capital for future use?

Over the years we have allowed this valuable corporate knowledge to seep out from the agency before capturing it for use by the next generation. A ten-year hiring freeze created a situation that would result in even greater losses. We either lacked the foresight to predict what would happen or we felt we were unable to spend scarce resources on the capture and preservation of knowledge. We must now use all necessary tools and processes to capture as much knowledge as possible before the exodus begins. Studying the methods and cultures of successful consulting firms will help lay the groundwork for this daunting task.

NASA has taken the first step by recently issuing a Knowledge Management initiative to address and provide solutions to these very problems. A KM team, led by the Jet Propulsion Laboratory with members from each center, has developed the first draft of the "Strategic Plan for Knowledge Management at NASA". After all members of the team have agreed on the strategy, the next step will be the development of an Implementation Plan for use by each center

that will detail the methods, processes, and infrastructure required for the system. The plan should also address the cultural changes necessary to encourage sharing.

## **CHAPTER III. ANALYSIS OF FIVE CONSULTING FIRMS AND NASA**

### **1. Management Consulting industry**

In 1989, large management consulting firms were the first to initiate internal efforts to formally manage knowledge. Price Waterhouse was one of the first to integrate KM into their business strategy. Articles and books began to spring up about this new management discipline. By 1994, consulting firms were offering KM services to their clients (Liebowitz & Beckman, 1998) and there was an explosion of interest and activity in the field of knowledge. This was evidenced by the content of the collegiate business reviews and management bookshelves.

### **2. Knowledge Management Strategies of Consulting Firms**

Since knowledge is the core asset of consulting firms, studying the knowledge management practices of these firms will provide valuable insights into the methods used. Consulting firms tend to employ two very different knowledge management strategies: codification or personalization (Hansen, Nohria, & Tierney, 1999). In some companies the focus is on computers and databases. The data is coded and stored for retrieval and use. This method is referred to as codification strategy. In other companies, knowledge is closely tied to the person who developed it. The knowledge is shared mainly through person-to-person



contact. This is known as a personalization strategy. The choice of strategies depends on the way the company serves their clients and the economics of their businesses. The choice of strategies is central to virtually all companies in the area of knowledge management. Understanding the two strategies and their strengths and weaknesses will enable chief executives to make solid decisions about knowledge management and their investments in it.

Several large consulting firms such as Ernst and Young and Andersen Consulting have chosen to pursue a codification strategy. They have developed complex ways to codify, store, and reuse knowledge. The approach that they are using is one of people to document, compared to people sharing knowledge directly with each other. The knowledge is extracted from the person who developed it and reused by others for various purposes. After finishing a job, all sensitive client information is removed and knowledge objects are developed. The knowledge objects are created by pulling pieces of knowledge from interviewing guides, work schedules, benchmark data, and market segment analyses. It is then stored in an electronic repository for other people in the firm to use. This approach allows many people to search for and retrieve codified knowledge without having to contact the person who originally developed it. This opens up the possibility of achieving economies of scale in knowledge reuse and results in the growth of the business and lower fees to clients (Hansen, et al, 1999).

By contrast, other firms such as McKinsey, Bain, and Boston Consulting Group emphasize a personalization strategy. They focus on dialogue between individuals, not knowledge objects in a database. Knowledge is transferred in brainstorming sessions and one-on-one conversations. Clients receive a more customized solution with deeper understanding of the challenges. This is not to say that these firms do not have and use sophisticated databases to capture, store, and share corporate knowledge. It is that they assign greater value to their networks and culture. A company's strategy for knowledge management should reflect its competitive strategy. It should be noted that neither strategy should be used exclusively. Hansen, et al (1999) reports that an 80-20 split is frequently followed. The firms should evaluate their internal environment and the customers they are serving to determine the best approach for them.

### 3. Research Methods

In order to more fully understand the practices and processes associated with successful KM in the consulting industry, I studied five firms in greater depth.

The firms analyzed are:

- 1) A.T. Kearney
- 2) McKinsey & Company
- 3) PriceWaterhouse-Coopers
- 4) Ernst & Young
- 5) Viant

Several different research methods were used in this analysis. Interviews with employees and clients of the firms combined with extensive review of cases, articles, websites, and publications such as Vault and The Harvard Business School Guide to Careers in Management Consulting provided insight into the firms. An interview with a manager from A.T. Kearney in February 2001, resulted in a demonstration of the knowledge databases and the capabilities of their KM system. I interviewed a principle from McKinsey in January and a program manager in March. The manager explained how a team prepares itself for a new assignment using the knowledge management system and organizational networks. The firm of PriceWaterhouse-Coopers allowed me several opportunities to explore their thoughts on knowledge management. I interviewed a partner in January that had served as chief information officer. I also spent several hours with a member of their Global Strategy Group. In May, a partner from PWC's Global Thought Leadership office shared yet another perspective of the benefits of KM with me. My knowledge of the two remaining firms was derived from discussions with professors having experience with the firms and from researching the websites and published materials.

#### 4. Consulting Firm Reviews

The five firms represent a cross-section of the industry – large and small, codification and personalization strategies, private and public, national and international.

##### 1. A.T. Kearney

The global management consulting firm of A.T. Kearney, Inc. is a wholly owned subsidiary of EDS. The firm has 60 offices located in 34 countries worldwide and is headquartered in Chicago, Illinois. They employ approximately 4,600 professionals generating 1999 revenues totaling \$1.33 billion (Shafir, Geiger, Im, & Audhlam-Gardiner, 2000).

Founded in 1926, A.T. Kearney will be celebrating 75 years of success this year. Early, successful engagements with U. S. Steel and Kroger helped the firm establish a reputation that would put them on the map. The firm has enjoyed rapid growth in the recent decades. The firm has doubled in size every three years since 1984.

The firms' clients are typically Global 1000 companies. Internet companies have also begun to use their e-business solution services. The GartnerGroup ranked the firm as one of the top five e-business consultancies. In concert with EDS,

they have increased their ability to link business solutions with the sophisticated use of information services and technology (Shafir, et al, 2000).

They are particularly strong in the following industries:

- Automotive
- Finance
- Consumer
- Communication/high technology
- Health care
- Pharmaceuticals
- Retail

The firm offers services from strategic insights to organization and operations. Unlike many of their competitors, A.T. Kearney serves their clients through the implementation phase of their projects. The satisfaction and loyalty of their clients gives them a 90% repeat business (Wong, 2000).

A.T. Kearney recruits from the leading business schools around the world. They seek individuals that have significant industry experience and have an excellent educational background. Lifestyle and benefits are considered average for the industry.

An interview with a manager at A.T. Kearney provided the following insight into their highly successful knowledge management system.

#### I. Type of Knowledge Management System

The Information Resource Center is the hub of their knowledge management system. The new “knowledge” that has been generated is sanitized of privileged information and then prepared for inclusion into the Document Management System (DMS) in the form of reports, presentations, analyses, and lessons learned from the latest client. The DMS is where most of the firm's intellectual capital resides. The program manager is responsible for identifying the search topics that will help others retrieve and use this knowledge. The system is structured by using uniform and standard methods and processes. This enables all users, no matter their location or position within the firm, to acquire the data they need without having to take valuable time to “de-code” it for their use.

A.T. Kearney also encourages learning through their e-university. This service is usually delivered via CD's and covers a variety of topics. They also take advantage of their corporate knowledge with a “yellow-pages” service called Practice Knowledge (PK) Specialists. Organizational charts are developed for PK Areas that point to the intellectual capital of the topic area. They use incentives to reward sharing through Intellectual Capital Awards of up to \$10,000.

The system is used most frequently in the earliest phase of an engagement or proposal generation. The team comes together and decides what data they are going to require to accomplish the clients needs and then the data searches are made for knowledge that will assist in the engagement. This system also assists in the development of proposals for potential engagements. One of the negative aspects of the system is the fact that documents are seldom purged and become out-of-date. The searches result in having to do another sort to discard the antiquated data.

## II. Chief Knowledge Officer

The Chief Knowledge Officer (CKO) is a key member of the firm. The CKO works out of their headquarters office in Chicago. Since A.T. Kearney's knowledge system is focused around their Information Resource Center, there is a separate organization designed to maintain the system. The organization is made up of approximately 100 employees and is the responsibility of the Chief Information Officer. These employees work with the project managers to gather the data from a finished engagement.

## III. Codification or personalization

The manager interviewed believes that the firm in general is going away from a heavy reliance on the personalization network and relying more on the

knowledge management system itself. This shift is a result of the improvement in information technology and the rapid growth of the industry. Everyone realizes the value of the knowledge management system and is more willing to keep it populated with the latest knowledge. Once the team finds knowledge that may be relevant to their tasks at hand, they will still frequently contact the person that generated the knowledge for further assistance.

The three most important aspects of knowledge management at A.T. Kearney is the training they provide, the encouragement of knowledge sharing, and the importance of globalization in the firm.



## **2. McKinsey & Company, Inc.**

McKinsey & Company has come to be regarded as the most influential consulting firm in the world. Founded in 1926, McKinsey has remained a privately held company. They enjoy more boardroom access, perform more industry-shaping work, disseminate more knowledge, and earn more money per consultant than any other firm. McKinsey dominates the industry with 82 offices in 43 countries and are headquartered in New York City. They employ more than 6,000 professionals generating 1999 revenues of \$2.9 billion (Wong, 2000).

Their clients are many of the blue chip firms like Pepsi, GE, AT&T, and General Motors. The deep relationships that McKinsey has developed with its' clients makes it difficult for the competition to gain entry. The firm serves huge global companies, innovative start-ups, wealthy commercial banks, leading venture capital firms, and an array of technology companies. They are also acknowledged for their pro bono assistance to educational, social, environmental, and cultural organizations (Shafir, et al, 2000). The industries that they serve include:

- Consumer/Packaged goods
- Financial institutions
- High Tech
- Media & entertainment
- Pharmaceuticals

- Retail
- Telecommunications
- Travel & logistics

McKinsey prides itself on being a company's most trusted external advisor. They are thought to invest more in knowledge development than any of the premier business schools. Generating the most valuable insights in all of the industries it serves is one of their main goals. The firm also generates knowledge through conferences, research projects, online databases, and intra-firm training and communication. In total, McKinsey spends more than \$100 million each year on information gathering, internal research, and analysis (Wong, 2000).

McKinsey is probably the most prominent example of a decentralized, bottom-up approach to KM. Their systems have emerged from the initiative of the firm's consultants, with management involved only in loose coordination of the process. These systems typically put more emphasis on people rather than on information technology. A generalist strategy firm, McKinsey typically deals with very high-level management decisions. Thus, solutions and problems tend to be unique and, as a result, difficult to codify in standard formats. The level of synthesis or abstraction is limited by a high context dependence. Even if general principles can be made available, specific explanations (context) are always needed. It is therefore natural that McKinsey's KM system initially evolved from the effort to connect people more efficiently, rather than from an effort to synthesize the

available problems and solutions. McKinsey has always had a corporate culture where internal communication and networking is extremely important (Sarvary, 1999).

The McKinsey business model results in lessons from the firm's experiences that are hard to categorize. For this reason, management does not prescribe to consultants what topics they should concentrate on. Instead, McKinsey partners who feel that they have acquired valuable knowledge in an industry or functional area decide on their own initiative to invest their time (as well as that of their colleagues) to summarize this knowledge and make it available to the entire firm. One clear advantage of such a system is that it is market driven (Sarvary, 1999).

The consultants at McKinsey come from a variety of backgrounds such as doctors, lawyers, scientists, and engineers as well as MBA's. They look for individuals that are problem-solvers, have people, leadership, and communication skills, and are able to work collaboratively. The firm tends to be moving toward industry specialization. The number of generalists is still quite high, but the hiring of more and more industry experts indicates a shift (Wong, 2000).

McKinsey has adopted and maintained the "one firm" approach in an effort to keep a consistent culture in all of their worldwide offices.

Two interviews were conducted with employees from McKinsey. The first interview was with a principal that has been with the firm for ten years. The second interview was with a project manager with five years at the firm. The difference between the results of the two interviews is an example of the varying values that are placed on knowledge management systems.

### I. Type of Knowledge Management System

The principal reported that the firm is organized around two primary areas- industry practice groups and functional groups. Each group has responsibility for managing knowledge and has a small number of people assigned to this task. It is not a centrally managed activity. The firm uses a database called the Practice Development (PD) Net. This is where the data captured is archived for use by other members of the firm. They have another group that performs research and information gathering. This group looks primarily to external sources. They also have a "yellow-pages" of expertise called Knowledge Resource Directory. These employees act as gatekeepers to particular areas of practice and skills.

The project manager seemed to be better acquainted with the knowledge management system. Perhaps it is because of the frequent use by this manager over the principal. A new project team first visits the PD Net database when starting a new project assignment. This database has over 20,000 intellectual contributions from the firm's global locations. All of the files are in English and

are standardized for easy use. The project managers and the partners decide what goes into the database and the words to be used for searches. The next step is to enlist the help of the Research and Information group. These research analysts look externally at industry trends and latest business tools that may be of help to the client and project team. Approximately 20% of the employees at each location support this activity. The team also has access to the Knowledge Resource Directory for specific questions and assistance. The PD Net database is also used in preparation for meetings with prospective clients and for the generation of proposals, allowing for quicker turn-around times. After a week of taking the “information” and turning it into “knowledge”, the team is well on their way to serving the client.

## II. Chief Knowledge Officer

McKinsey does not have a chief knowledge officer. Nor do they have a CEO or CTO. Titles are not an important part of their culture. They do, however, have people who are responsible for the coordination, standardization, and maintenance of the KM system.

## III. Personalization of Codification

The principal reported that there is no formal corporate structure supporting the exchange of knowledge. They rely heavily on their internal culture and the

incentive program to inspire the generation and sharing of knowledge. They are rated on their impact to the client, contribution to the firm, and research and development - where knowledge development and sharing is evaluated.

The principal believes that McKinsey relies about 50% on its competitive culture and networking and 50% on the databases for their sharing of knowledge.

McKinsey prides itself on everyone being on the same team and sharing knowledge through the relationships they have developed with each other.

The project manager also agreed that it is McKinsey's culture that gives them their competitive advantage. They are "one firm" that just happens to have global locations. The improvements in information technology has made the use of their knowledge management system easier and more comprehensive but it will not replace the culture that has been built over the last 75 years. The cross-training that McKinsey provides is also thought to add to the knowledge gained and shared by each employee. This type of training helps to develop the network with people that are not in the same physical location or have the same expertise.

### **3. Price•Waterhouse Coopers (PWC)**

Following the merger of Price Waterhouse and Coopers & Lybrand in 1998, Price-Waterhouse Coopers became the largest professional services firm in the world. The management consulting services has offices in 150 countries and employs 40,000 professionals. The 1999 revenues for this segment totaled \$5 billion (Shafir, et al, 2000). PWC has been undergoing global strategy planning which may result in dis-aggregating some of its business segments (Shafir, et al, 2000).

PWC has seized the growth opportunities of the e-business market resulting in a 400% increase in their service of this market in 1999. They have hopes for sales in this segment to reach \$1.6 billion. They also have a large investment in incubators and start-ups in Europe and Ireland (Shafir, et al, 2000).

Their services are divided into Strategic Change, Process Improvement, and Technology Solutions. The industries that PWC serves are clustered in the following five groups (Wong, 2000):

- Consumer and Industrial Products
- Energy
- Financial Services
- Services Industry
- Technology Info-Com and Entertainment

PWC recruits undergraduates, MBA's, and experienced professionals. Many of their new employees are offered the chance to work in the area of their choice. The hours are long, as with any consulting position, but PWC has put several programs in place to ease this stress. "More Nights at Home" provides the employee three nights at home each week. "For Your Convenience" is a service that takes care of some of your personal needs such as gift shopping or taking your car in for repairs (Shafir, et al, 2000).

Interviews were conducted with three employees of PWC. The first interview was with a partner and former Chief Information Officer (CIO) that has been with the firm for many years. The next interview was with a member of their Global Strategy Group that has been with the firm less than five years. The third person interviewed is a partner in their Global Thought Leadership group that has been with the firm less than two years. The importance of the length of time at the firm will become apparent.

#### I. Type of Knowledge Management System

PWC has a knowledge management system that uses Lotus Notes to capture their intellectual capital. These searchable databases are used to archive and retrieve information from past projects for use on new ones. The three employees placed different values on the firm's databases.



The former CIO felt that the networks that had been built up over the years were more than adequate to carry the firm into the future when it came to knowledge sharing. Because this employee had been with the firm for many years, they had developed contacts in many functional areas, practice areas, and countries. If a question arose in which they needed advice, they knew whom to call. Going into a database and searching was not considered a valuable expenditure of time.

However, the employee from the Global Strategy group felt that the databases are useful. This employee stated that especially the younger members were using the databases to assist in new project assignments. It was one of the first places that a new project team goes to find information that can help them with their new assignment.

The partner from Global Thought Leadership thought that there were pros and cons of the system. The accounting and financial databases were thought to be of higher value and use. The databases captured the different accounting rules and regulations from different countries. These could be updated easily as changes were regulated. This partner believed that the resume and experience bank of firm employees did not prove to be very beneficial. When putting together a project team, the employees that you had selected from this database were usually busy on another assignment. They also believed that many teams did not have the discipline to submit final reports to the database after finishing an assignment.

## II. Chief Knowledge Officer

PWC no longer has a Chief Knowledge Officer. The position was eliminated after the firm determined that they were not realizing a return in benefits over the costs, however other employees assumed some of the KM functions. It was the opinion of these three employees that PWC would probably not be hiring another CKO unless a strong case could be made that the firm needed one to succeed in today's environment.

## III. Personalization or Codification?

Although PWC uses a system of codification, they rely on the personalized networks. The employees that were interviewed believe that the success of PWC relies heavily on their organizational culture. Their strategy for acquiring, sharing, and leveraging the firm's intellectual capital is to use the strong networks that have been established over the years. This culture of sharing is their strength and what they believe gives them their competitive advantage. It is interesting to note that after the merger of Price Waterhouse and Coopers & Lybrand, the databases were combined resulting in new knowledge for use by the other half of the firm.

#### **4. Ernst & Young LLP**

Ernst & Young is a premier integrated professional service firm. They have offices in 89 cities in the U.S. and 670 worldwide. They employ 13,000 consulting professionals worldwide with 8,000 of those in the U.S. The consulting services practice generated revenues of \$4 billion in 1998 (Wong, 2000).

Ernst & Young clients are among the Fortune 500 firms. They provide the following services for their clients (Wong, 2000):

- Strategy
- E-Commerce
- Financial Advisory Services
- Systems Development and Technology
- Systems Integration/Enterprise Resource Planning
- Business Transformation Management

The firm has developed a reputation of offering their employees the most comprehensive, exciting training for the development and sharing of knowledge. In order to accomplish this, Ernst & Young has developed an extensive knowledge management network. Their Center for Business Knowledge allows

consultants to quickly access skill databases, research project files, and contact industry experts.

Ernst & Young is a pioneer in implementing systems that integrates IT and experts to perform the abstract knowledge-creation process. This top-down type of KM consists of relatively centralized systems that are built and managed from the top. These systems generally rely on advanced information technology. Although they stress the importance of connecting people, they typically establish the connections through large central organizations (often called knowledge centers) whose job also consists of synthesizing and distributing the firm's knowledge. Much of this knowledge is in the operational side rather than on the strategy side. Given a relatively low context dependence, these types of experiences are easier to categorize and synthesize with formal methods. Information technology has always played an important role in this process, which results in more or less standard product/service lines. Many firms have recently moved their businesses to the strategy area and are trying to preserve their IT-based methodology by building knowledge centers (quite independent from the daily practice) that continuously digest the firm's experience (Sarvary, 1999).

A major advantage of central systems is that they provide the opportunity for visionary breakthroughs. For example, Ernst & Young's (2001) "Ernie" product has resulted in a complete redefinition of the consulting industry, leading to what

could be called "retail consulting." Ernie is an Internet based consulting service to which clients can subscribe for an annual fee of a few thousand dollars. In return, they can send questions to Ernst & Young asking for advice to solve their current management problems. They are guaranteed to receive a reply from an expert within two business days. The target market for this service consists of small- and medium-sized companies who otherwise would not be able to afford consulting services. Often these firms only need answers to a few questions and not a full, several-months long consulting study. While Ernie is a great opportunity for Ernst & Young to leverage the current KM system, it also adds to the system in a significant way. The types of questions give insight into emerging topics and allow the firm to get a head start on the possible solutions (Sarvary, 1999).

Ernst & Young recruits heavily from universities. They look for intellectual competence, communication skills, leadership, teamwork, and technical competence. The firm is devoted to the professional development of their employees' technical and managerial capabilities (Wong, 2000).

The Center for Business Innovation has defined eight major processes that are involved in the management of knowledge. The processes include: generating new knowledge; accessing valuable knowledge from external sources; representing knowledge in documents and databases ; embedding knowledge in processes and products/services; transferring existing knowledge around the

organization; using the accessible knowledge in decision-making; facilitating knowledge growth through culture and incentives; and measuring the value of knowledge assets (Ernst & Young, 2001).

As early as 1992, the Center for Business Innovation was conducting research on the emerging trend of knowledge management. They have since completed another survey on a broader population of senior managers in an effort to gauge the impact of early work in knowledge management on executive plans and perceptions. The overall findings indicated that firms are working to better leverage the knowledge of their people. The innovations of the early adopters are being replicated by the fast followers (Ernst & Young, 2001).

This survey reported that the biggest obstacles to knowledge management are cultural and behavioral. Knowledge hoarding, top management's failure to signal the importance of knowledge management, the lack of a shared understanding the strategy used, the organizational structure and the lack of ownership of the initiative were listed as the top five problems. None of these problems are technology related. They can all be solved by cultural or organizational adjustments.

## 5. Viant

Viant was founded in April 1996 as Silicon Valley Internet Partners. The firm specialized in building digital businesses. Viant has offices in 10 cities in the U.S. and Europe and is headquartered in Boston. It has since grown to 500 employees generating 1999 revenues \$61 million. The firm was taken public in June 1999 (Shafrir, et al, 2000).

Viant's client list includes American Express, Kinko's, Compaq, Lucent, and Della.com. They provide e-business strategic consulting, creative design, and technology services. The company sold itself by offering fixed-rate pricing and 90-day web development. It boasts of being able to push an enterprise from concept to launch in nine months (Shafrir, et al, 2000).

Viant's strength lies in taking a holistic approach in firm growth and client service. They use a proprietary method to launch e-businesses called the Experience Architecture process. So far, this method appears to be working (Shafrir, et al, 2000).

Another key strength is Viant's relationship with its employees. Their plans for growth are organic. They do not want to grow through acquiring other companies. Viant recruits on campuses and also hires experienced professionals. Once hired, the new employees go through a three-week training

program called Quick Start. Their emphasis on teamwork is reflected in their workspace--no offices and few interior walls. They have a very flat organization that encourages innovation and knowledge sharing (Shafir, et al, 2000).

The following is a collection of knowledge management methods used by Viant to share knowledge (Stewart, 2000).

Initiation. It's astounding how many companies do not grab the opportunity that orientation provides to give newcomers knowledge of the company, some firm-specific skills, and the beginnings of a network. Every new employee, wherever from or wherever bound, begins their career with a period of time at the firm's main office. Each new employee would leave knowing someone in every office of the company. They would receive their laptop, fully loaded with off-the-shelf and proprietary software and they would learn team skills and get a cram course in the consulting strategy and tools. During this time they'd toggle between classroom work and teams, doing a mock consulting engagement. They'd bond; meet all the officers; hear lots of folklore; and socialize with the CEO.

Location. Office layouts are designed to create a "leaky knowledge environment." It's not just the open-plan offices but subtler arrangements to encourage "knowledge accidents"--where your employees will meet, not really by chance, but because a snack area just happens to be located where four project teams' work areas intersect. Several of the chief officers share one room. But



balancing openness and privacy is tricky. People underestimate how much private offices are used for meetings. Dormitory-style living scales up only to a point. But you can retain a lot of that simplicity. The executives at Cisco Systems have offices--glass-walled, but offices--yet every Friday a lunch cart is wheeled onto the executive floor and parked by some comfortable chairs, a shelf of books, and other amenities to lure whoever wants to schmooze or network.

Rotation. At any given time, the leadership teams consist of a score of ex-officio members and about an equal number of rotating "fellows" nominated by peers in the field. Conventional reporting relationships don't work where people rotate in and out of assignments, so consultants have no fixed relationship to a boss; instead, senior people act as "advocates" for a handful of "advocados." Performance reviews (360 degree, of course) emphasize the growth in the employee's own skill level, while stock options recognize knowledge shared.

Documentation. The forms are simple but inescapable: Before every project, consultants must complete a "quicksheet" that describes the knowledge they'll need, what can be leveraged (i.e., picked up from previous projects), and what they'll need to create, along with the lessons they hope to learn that can be shared later. A longer report, a sunset review, is produced at a team meeting to document what did and didn't work well.

"File and forget" is the common fate of reports like these. Here, forgetting is harder. First, almost every document ends up on the internal Website, hot-linked in various ways. Second, sunset reviews are conducted with a facilitator who wasn't on the team, which helps keep them honest. Third, every six weeks the knowledge-management group prepares, posts, and pushes a summary of what's been learned.

Agitation. The firm has created an unusual and yet valuable role, that of outside agitator. "Project catalyts," picked from the top consultants in the company, are pulled off client work for several months and assigned to 20 or so other projects. They don't supervise, nor are they passive "resource people"--they meddle. What are you doing? How can I help? Looks as if you need an example for a business plan to adapt for your client, let me get one, etc. This is in your face, not just "Call me if you need help." Knowledge sharing might be human nature, but the companies that do it best all have some kind of forcing mechanism, something that lends urgency to the task. This is the job of the agitator.

This matrix provides a summary of the different strategies and tactics used by the firms and NASA for managing knowledge.

	<b>A.T. Kearney</b>	<b>McKinsey</b>	<b>PWC</b>	<b>Ernst &amp; Young</b>	<b>Viant</b>	<b>NASA</b>
<b>Formal Admin. e.g. CKO</b>	Yes	No	No	??	No	No
<b>Directory e.g. Yellow Pages</b>	Yes	Yes	Yes	Yes	No	No
<b>Databases</b>	Yes	Yes	Yes	Yes	Yes	No
<b>Corporate Training</b>	Yes	Yes	Yes	Yes	No	Yes
<b>Job Rotation</b>	??	Yes	No	??	No	Yes
<b>Per- formance Evaluation</b>	Yes	Yes	Yes	Yes	Yes	Yes
<b>Know- ledge Centers</b>	Yes	Yes	No	Yes	No	No
<b>Orien- tation</b>	Yes	Yes	Yes	Yes	Yes	Yes
<b>Project Reports</b>	Yes	Yes	Yes	Yes	Yes	Yes
<b>Catalysts</b>	No	No	No	No	Yes	No

## 5. NASA Tools for Knowledge Transfer and Management

This section provides an understanding of the processes and activities that NASA currently uses to capture and share knowledge. This will serve as a baseline from which to explore other opportunities.

NASA is unlike much of industry in the fact that they seldom ever produce more than one of any product, whether it is a science satellite, a rocket, or a space telescope. Therefore, NASA cannot use economies of scale to race down the learning curve. NASA has had to become more creative and productive in the transfer of knowledge. Learning curves appear more like step functions because the reduction in costs occur from project to project instead of just becoming more efficient at the same tasks. Often times the value added in the transfer of knowledge is not easily measured or is not even acknowledged. For example, when a project manager reads the Lessons Learned from someone else's project, they may file away, in the back of their minds, several ideas that worked well. It may be years later when they apply these ideas to their own project. By then it is difficult to track where the lessons came from. Measuring the benefit of this knowledge is nearly impossible.

### **Lessons Learned**

Toward the completion of projects and programs at NASA, the team begins the development of a "Lessons Learned" document. This document is a compilation

of processes, ideas, risks, solutions, and surprises. It includes what worked and what didn't work. The document also includes recommendations on what the team would do differently next time. Usually team members first generate their own collection of lessons. Then these lessons are shared with the whole team for discussions and inclusion in the document. Developing the document this way avoids the groupthink that can occur. It is very valuable to get the individual perspective of each team member.

The "collection" portion of the knowledge sharing process is then complete. But it does no good to have this great wealth of knowledge if no one else knows about it. NASA does several things to propagate the "sharing" portion of the process. Each Lessons Learned document is submitted to a web site. This site is accessible to all the NASA centers. By doing this, the circulation just increased from 2,500 employees to 16,000 employees. Of course people have to want to read and learn.

Face to face discussions are still the most effective. To enable this, the team that has completed their project and written their lessons will share what they have learned with other project teams. This type of live interaction allows for questions and answers that enrich the written words. Storytelling is a great way to share knowledge. People tend to remember stories better than bare facts.

The key team members make themselves available to the new projects for further discussions as the projects mature. Project managers cannot know everything. But knowing whom to call to acquire the knowledge they need is key.

## **Mentoring**

In the days of healthy budgets and robust workforces, NASA could assign a junior engineer to work alongside a more senior engineer to learn in a safe context. This pair might work together for years before the junior person was assigned tasks to manage on their own. This would seem like a luxury in today's faster, better, cheaper environment. Yet we still must assure the proper training before assigning critical tasks to less experienced employees. Mentoring is one way to meet these needs. Frequently an experienced project manager or chief engineer will be assigned as a mentor to a less experienced person to guide and educate them. This is in addition to the project manager's already full plate. But as we know, when you teach, you also learn.

Mentoring takes a special type of person. They must first possess the proper skills but just as important is the desire to transfer their knowledge to others. The mentor takes an active role in providing the guidance required ensuring the success of the junior employee. This relationship may also last for years. Providing this continuity adds to the success of the mentoring program.

Providing a continuous supply of great mentors is a challenge. Each year a special request is issued to talented employees to become a mentor. This is a voluntary activity. You cannot direct someone to be a great mentor. People must view this as an honor and a privilege.

A program similar to mentoring is “specialist in their field”. In this program a person with a highly specialized skill will provide guidance on an as-needed basis. The specialist may even teach in-house classes on their given expertise. These types of relationships last as long as the need exists.

### **Cross Functional Training**

Too often people do their jobs without giving much thought to the effects that it will have on the next step in the process. NASA tries to remedy this by cross training employees in related areas. For example, a mechanical designer will work in the manufacturing department for several months to learn first hand the characteristics that can make manufacturing easier and perhaps more economical. Nothing can provide this type of experience better or faster. When the designer returns to their home organization, they are more fully aware of the simple decisions that they make that can have large impacts on the product. This method of transferring knowledge is most effective.

## **Design Reviews**

Another process that NASA employs is design reviews. At periodic intervals in the life of a project, reviews are conducted. These include requirements review, preliminary design review, critical design review, design certification review, and pre-ship review. Senior employees perform the reviews. This type of overview allows the transfer of knowledge through evaluations, questions, and responses. Frequently junior engineers are a part of the evaluation teams for the review. This allows them to learn from other projects.

## **In-House Project Development**

Most of the time NASA contracts for the products and services that it requires. This is frequently the most economical solution. However, many years ago NASA performed many of the same tasks as the contractors. The skill level and mix at NASA was more than adequate to do the work or to monitor the contracts it awarded. But after years of outsourcing more and more of the work, NASA's skill levels began to recede. NASA needed to maintain the skills required to be "smart buyers". And nothing can be a better teacher than actually performing the required tasks (design, development, manufacturing, integration, test, verification, and operations). This hands-on type of learning benefits the employees as well as the projects. It is the goal of each NASA center to have one or more in-house projects always under development. These types of projects enable the transformation of knowledge in an experiential way.



## **Knowledge Management Database**

NASA is developing a knowledge management database to assure the widest distribution and use of its' technologies and skills. This database will be used as a program manager tool, as a knowledge-sharing tool, and as a library to see what technologies have been developed or are currently under development. This will help to eliminate the duplication of efforts between NASA centers while sharing information at the same time. The database will allow the transfer of knowledge by allowing employees to search on a particular topic or technology they are interested in. It opens up the possibilities of sharing among all NASA employees instead of just a few.

## **Forum for Master Project Managers**

NASA has initiated an annual forum of project managers that have a depth and breadth of experience not easily matched. Expert project managers from all the NASA centers are invited. The forum affords the managers an opportunity to share their experiences through story telling and best practices. Most project managers seldom get the chance to meet in this type of environment. The best have an opportunity to learn from the best. The project managers develop a network for sharing and learning that is widespread and long lasting. A set of best practices is published after each forum for use by not just the participating managers, but by other managers and employees at the various centers.

## 6. Correlation between Consulting Firms and NASA

The following matrix allows us to look at the similarities and differences between the firms and NASA. From just the number of employees, NASA falls somewhere between PWC and Ernst & Young. However, we want to share and transfer knowledge with our industry partners. This will increase our size to that of PWC. Our 10 field centers are located within the United States. Viant also has 10 locations of which some are in Europe.

The firms represent a mix of publicly and privately owned organizations. NASA is, of course, a government agency. One way to look at that is to say that we are as public as you can get – every citizen is a stockholder! Another way is to think that we are very tightly controlled through the budget and regulations that govern our decisions. Every firm, along with NASA, uses a codified database to some degree. What determines whether a firm falls into the personalization or codification category is whether the firm relies more on the databases or more on their employees and the cultural they have created. Most of the firms believe it is their people and culture that has created their competitive advantage. With NASA, our sharing and learning environment is a direct result of our employees' dedication to the goals of the agency. We do not have the archiving capabilities that most of the firms have developed. As we have discussed, developing and using a KM system will become more critical as our retirement rate increases.

All of the firms recruit from major universities. NASA tends to hire more from science and technology and the firms hire more MBA's. One large advantage that the firms have had is the continual in-flow of new knowledge with their new hires. NASA had a 12-year hiring freeze that stifled the amount of new knowledge that would typically come with new employees. Most of the firms offer training in some form or fashion. Some of it is specific to a particular industry and some on how to become a better consultant or manager. At NASA, the training and educational opportunities are tremendous. If you or your team needs a specialized type of training for the project you are working on, an expert will be brought in to teach you the required skill or knowledge. Any employee can apply to return to college for an advanced degree. There are program management sessions held on a monthly basis. We are definitely a learning organization. Now we have to put the required processes and infrastructure in place to store, share, and re-use all of this knowledge and expertise.

The management consulting industry is known to have a high turnover rate. All the more reason to have a system in place to capture a consultant's knowledge! This high turnover also brings new knowledge and skills into the firm with the new employees that are hired to replace the ones that left. Most people that come to work at NASA are making a lifelong career decision. They usually join the agency because of their love of space and the desire to work for the greater good. The turnover rate is quite low as most people remain with the agency until they retire. The salaries are generally lower than industry but the opportunities to

change positions or locations and the educational opportunities help to compensate. Some of the firms offer monetary incentives for the sharing and development of knowledge. At NASA, the incentives are usually in the form of recognition of some kind. This is an area that needs to be closely examined and perhaps restructured to aid in the capture of knowledge to stock the databases that should be developed.

	<b>A.T. Kearney</b>	<b>McKinsey</b>	<b>PWC</b>	<b>Ernst &amp; Young</b>	<b>Viant</b>	<b>NASA</b>
<b>Size</b>	4,600	6,000	40,000	13,000	500	18,000
<b>Locations</b>	International 60 Offices	International 82 Offices	International 150 Countries	International 670 Offices	International 10 Cities	National 10 Cities
<b>Private/ Public</b>	Wholly owned subsidiary of a public company	Private	Private	Private	Public	Government
<b>Codificat/ Personal.</b>	Personal. Moving to Codificat.	Personal.	Personal.	Codificat.	Personal.	Personal.
<b>Recruit- ment</b>	MBA's and industry experience	MBA's and industry experience	MBA's and industry experience	MBA's and undergrads	MBA's and industry experience	Universities -Scientists -Engineers -Business
<b>Training</b>	e- university	Cross training	Practice expertise	Technical and Managerial expertise	Internal practices	Highly specific to advanced degrees
<b>Careers</b>	13% turnover per year	Move up or move on	Progressive and flexible career planning	15-20% turnover per year	Employees leave only to start own companies	Long term careers
<b>Incentives</b>	Monetary	Cultural	Cultural	Cultural	Cultural	Cultural

## CHAPTER IV. KM IDEAS FROM OTHER INDUSTRIES

Most all organizations generate and use knowledge. As organizations interact with their environments, they absorb information, turn it into knowledge and take action based on it in combination with their experiences, values and internal rules. An organization would not be able to maintain itself as a functioning enterprise without knowledge. Consider five modes of knowledge generation: acquisition, dedicated resources, fusion, adaptation and knowledge networking (Davenport & Prusak, 1998). In each case, the conventions of language force us to discuss knowledge as a thing that can be managed. However, referring back to the definition, knowledge is as much an asset or process as an artifact or thing.

Acquired knowledge does not have to be newly created, only new to the organization. British Petroleum gives a "Thief of the Year Award" to the person who has "stolen" the best ideas in application development. The company recognizes that, when it comes to organizational knowledge, originality is less important than usefulness. Texas Instruments has created a "Not Invented Here, but I Did It Anyway Award" for borrowing a practice from either inside or outside the company. The Spanish proverb "Well stolen is half-done" sums up this idea succinctly. The knowledge-focused firm needs to have appropriate knowledge

available when and where it can be applied, not to generate new ideas for their own sake (Davenport & Prusak, 1998).

The most direct and often most effective way to acquire knowledge is to buy it—that is, to buy an organization or hire individuals who have it. Of course, not all corporate purchases are knowledge acquisitions. Companies buy other companies for various reasons: to generate additional revenue, to achieve a strategic size or product mix, to get access to new markets or to gain the skills of a senior management team (this last reason, however, borders on knowledge acquisition). Increasingly, firms acquire other companies specifically for their knowledge. They are often willing to pay a premium over the market value of the company purchased because of the value they expect to get from adding that new knowledge to their own knowledge stock. One recent example of this is IBM's 1995 purchase of Lotus. IBM paid \$3.5 billion, which was 14 times Lotus's book valuation of \$250 million. Clearly, IBM did not pay that amount of money for the current revenue generated by Notes and other Lotus products or for Lotus's manufacturing and sales capabilities. The \$3.25 billion premium IBM paid represents its appraisal of Lotus's unique knowledge of Notes and other collaborative software applications. The minds that invented Notes are more valuable than the software itself (Davenport & Prusak, 1998).

Renting knowledge really means renting a knowledge source. Hiring a consultant for a project is an obvious example. Unlike rentals of equipment or

facilities, knowledge rentals are likely to involve some degree of knowledge transfer. Although the knowledge source is temporary, some of the knowledge is likely to stay with the firm. Some clients now specify in their consulting contracts that consultants' knowledge be made available in some structured, codifiable format. And consultants are beginning to market their services partly on the basis of transferring knowledge to clients. As with so many investments in knowledge generation, intentions are important. A firm needs to know what it wants in order to have a good chance of getting it. High-level consultants are sometimes surprised by what clients ask of them in terms of knowledge transfer. Firms that hire them for a day or a week at considerable expense might be expected to squeeze as much knowledge out of them as possible. But they usually do not ask the questions that would help them absorb that expertise in practical ways (Davenport & Prusak, 1998).

A customary way to generate knowledge in an organization is to establish units or groups specifically for that purpose. Since the financial returns on research take time to materialize and may be difficult to measure when it does come, a focus on near-term profits may create pressure to cut costs by cutting R&D. While no part of a business can be funded indefinitely if it generates no measurable value, a narrow bottom-line view of that return can lead to "savings" that deplete vital knowledge-generating resources. The premise behind separating R&D from other parts of the firm is to give researchers the freedom to explore ideas without the constraints imposed by a preoccupation with profits and

deadlines. However, this distance may be difficult to bridge when the time comes to transfer the results of R&D to the wider organization. Knowledge creators and users may not even speak the same language. Probably the most notorious case of a costly transfer gap occurred at Xerox's Palo Alto Research Center in the mid-1970s (Smith, 1998). The knowledge workers at Xerox PARC invented key elements of the graphical interface computer, including the mouse, graphical icons and menus. Ironically, the independence that made this breakthrough possible probably contributed to Xerox's inability to understand its importance and potential value. They were not close enough to the research to evaluate the newly created knowledge. Steve Jobs, on the other hand, was prepared for those new ideas by his work at Apple (as well as by culture and temperament) and quickly grasped their significance. A brief tour of Xerox PARC was all he needed to gather the fruits of research funded for years by Xerox. He went back to Apple and built the Macintosh (Davenport & Prusak, 1998).

Whereas the R&D approach is predicated on reducing the pressure and distractions that can stifle productive research, knowledge generation through fusion purposely introduces complexity and even conflict to create new synergy. It brings together people with different perspectives to work on a problem or project, forcing them to come up with a joint answer. The first automatic breadmaking machine is an example of diversity and creative chaos in action (Nonaka & Takeuchi, 1995). Matsushita combined three product divisions with different cultures to develop a successful breadmaking machine, realizing that it



needed the variety of knowledge possessed by groups that had previously made rice cookers, toasters and coffeemakers, and food processors. The new product combined the computer-control expertise of the first group, the second's experience with induction heater technology and the third's knowledge of rotating motors. The creative chaos came from a breakdown of old assumptions and ways of working, an intentional shake-up of the status quo that, as conventionally portrayed, is not always innovative. The combined groups (a total of 1,400 employees) initially almost "spoke different languages." Although fusion can lead to powerful results that are unobtainable in other ways, it is not a shortcut to knowledge generation. A significant commitment of time and effort is required to give group members enough shared knowledge and shared language to be able to work together. Careful management is also necessary to make sure that the collaboration of different styles and ideas is positive, not merely confrontational (Davenport & Prusak, 1998).

Here are five knowledge management principles that can help make fusion work effectively (Davenport & Prusak, 1998):

- 1) Foster awareness of the value of the knowledge sought and a willingness to invest in the process of generating it.
- 2) Identify key knowledge workers who can be effectively brought together in a fusion effort.
- 3) Emphasize the creative potential inherent in the complexity and diversity of ideas, seeing differences as positive rather than sources of conflict, and avoiding simple answers to complex questions.
- 4) Make the need for knowledge generation clear so as to encourage, reward and direct it toward a

common goal. 5) Introduce measures and milestones of success that reflect the true value of knowledge more completely than simple balance-sheet accounting.

New products from competitors, new technologies, and social and economic changes drive knowledge generation because firms that don't change in response to changing conditions will fail. Success is often the enemy of innovation; it has been called the winner's curse. Lulled by past success, companies sometimes fail to see that change is happening or to acknowledge that it can affect them. The appearance of low-cost, high-quality Japanese cars on the U.S. market changed the automotive world, but decades of dominance blinded American automakers to the magnitude of the threat. Similarly, Sears ignored the changes that Wal-Mart was making in the retailing environment until shrinking sales forced it to face reality. A firm's ability to adapt is based on two principal factors: first, having existing internal resources and capabilities that can be utilized in new ways, and second, being open to change or having a high "absorptive capacity." The most important adaptive resources are employees who can acquire new knowledge and skills easily. Since the best predictor of mental nimbleness is proven experience in taking on new tasks, firms should seek out employees who have already mastered a variety of roles and skills. After they've been hired, employees should also be encouraged to change jobs often, to build and manage their own skill portfolios, and to take "learning sabbaticals" to master new work-related disciplines.

Knowledge is also generated by informal, self-organizing networks within organizations that may over time become more formalized. Communities brought together by common interests usually talk in person, on the telephone, and via e-mail and groupware to share expertise and solve problems together. When networks of this kind have enough knowledge in common to be able to communicate and collaborate effectively, their ongoing conversation often generates new knowledge within firms. Although it may be difficult to codify, this process can add to the knowledge of the entire company. In the absence of formal knowledge policies and processes, networks act as critical conduits for much innovative thinking. The common denominator for all these efforts is a need for adequate time and space devoted to knowledge creation or acquisition. In companies committed to dedicated resources, space not only means the laboratories and libraries in which discoveries can be made but also the meeting places where knowledge workers can congregate. In some instances, the shared space may be electronic, but meeting places of some kind must exist. Unfortunately, time, not physical space, is the corporate resource most likely to be begrudged to knowledge activists. It is the scarcest of all resources, the one impossible to replicate and yet most essential to genuine knowledge generation (Davenport & Prusak, 1998).

## CHAPTER V. KNOWLEDGE MANAGEMENT BUILDING BLOCKS

One of the chapters in Jay Liebowitz' book, *Knowledge Management Handbook*, (1999) provides guidance on introducing knowledge management into the organization. This chapter is an adaptation from Karl M. Wiig's book titled *Establish, Govern, and Renew the Enterprise Knowledge Practices* (1999). Analyzing the building blocks provides a framework to start the dialogue among the team members.

An overview of the functions (in approximate order of implementation) and their relationships are explained below. This list is not intended to be all-inclusive nor should it be necessary for every organization to use every block.

- **1. Obtain management buy-in:** Pursue management commitment since it has proven essential for success of KM efforts. This stems from the central position that knowledge occupies in the enterprise.
- **2. Survey and map the knowledge landscape:** Identify the nature, strengths, and weaknesses of the enterprise knowledge assets and situation in view of enterprise direction and operations and market pressures and opportunities.
- **3. Plan the knowledge strategy:** Determine how KM will support the enterprise or business unit strategy and pencil out KM thrusts and expected priorities.

- **4. Create and define knowledge-related alternatives and potential initiatives:** Identify opportunities for improvements such as opportunities for revenue enhancement, creation of new products and services, relief of knowledge-bottlenecks, and other knowledge-related actions with the support of department and enterprise-level priority setting and outline their expected impacts and benefits.
- **5. Portray benefit expectations for knowledge management initiatives:** Delineate expectations to prioritize, guide implementation, and monitor the effectiveness of KM efforts.
- **6. Set knowledge management priorities:** Determine priorities for activities based on KM strategy, expectations for net benefits, needs, and availability of capabilities.
- **7. Determine key knowledge requirements:** Identify knowledge required to deliver quality work in key or complex positions.
- **8. Acquire key knowledge:** Capture knowledge from departing personnel and knowledge required for key critical knowledge functions.
- **9. Create integrated knowledge transfer programs:** Create comprehensive knowledge transfer programs – for example, by coordinating training programs, creating expert networks, or communicating expert knowledge such as concept hierarchies and mental strategies to practitioners (content as subject knowledge and methodologies as metaknowledge).

- **10. Transform, distribute, and apply knowledge assets:** Organize and transfer expert knowledge to practitioners. Reconfigure, deploy, and exploit knowledge through effective use of “best” knowledge in all daily work.
- **11. Establish and update KM infrastructure:** Build and maintain generic capabilities, some of which are specific to KM while most are shared with other activities and functions.
- **12. Manage knowledge assets:** Create, renew, build, and organize knowledge assets to address priority knowledge opportunities.
- **13. Construct incentive programs:** Motivate employees to act intelligently, i.e., be innovative, share knowledge, expend effort to capture knowledge such as lessons learned, ask for assistance when meeting unfamiliar or difficult situations.
- **14. Coordinate KM activities and functions enterprise-wide:** Identify Km-related activities and assist them to coordinate, cooperate, and collaborate to build valuable capabilities and practices.
- **15. Facilitate knowledge-focused management:** Provide high-level activities to change the enterprise “customer service paradigm”, culture, work environment, management philosophy, and practices, operating practices, decision rights, work flows and “opportunities to act intelligently”, and personal motivators.
- **16. Monitor knowledge management:** Provide feedback on progress and performance of KM program and activities.” (Liebowitz, 1999)

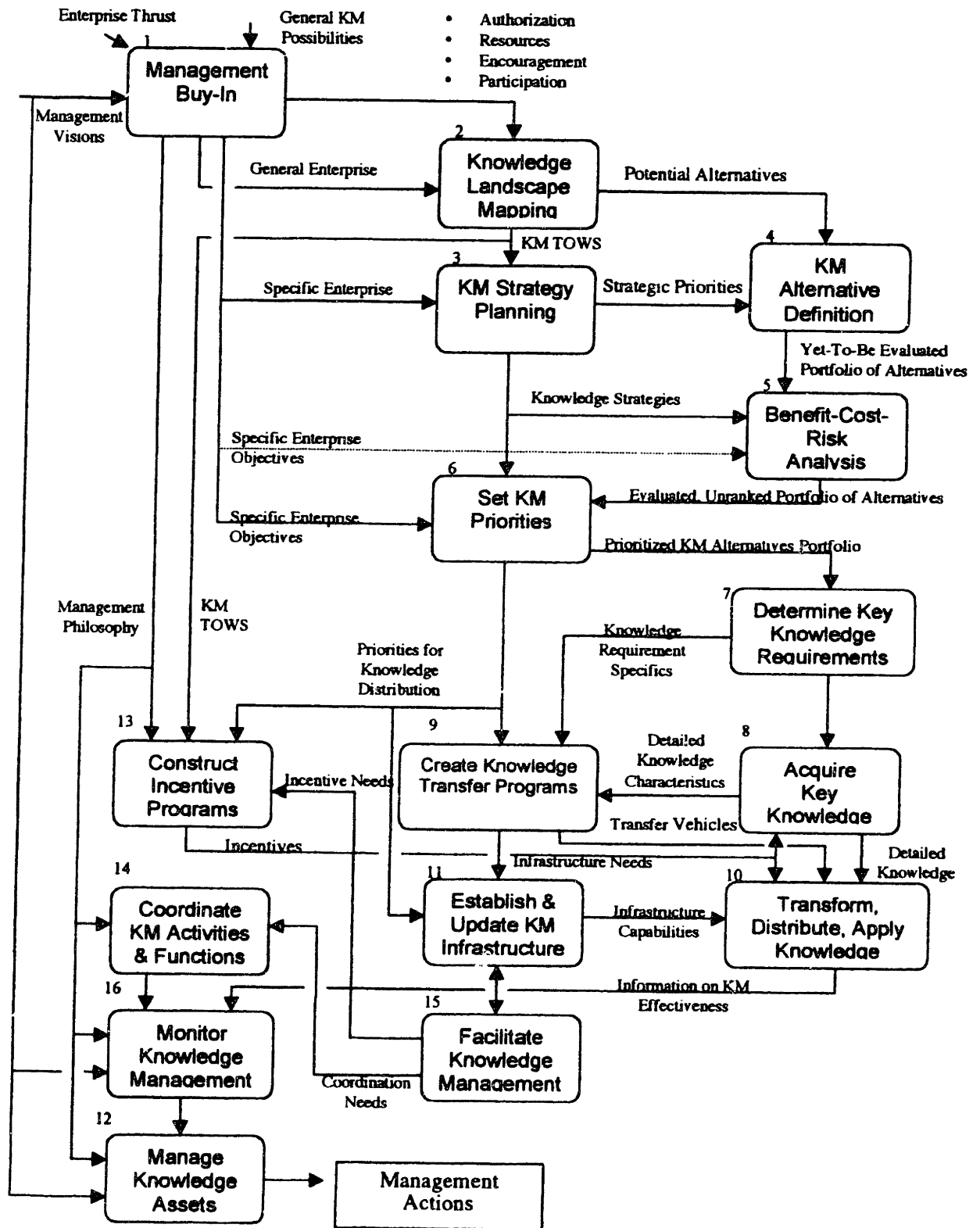


Figure 2. Relationships Between KM Building Blocks (Liebowitz, 1999)

## CHAPTER VI. THE “SPECIAL SAUCE” OF KM

*All of my research to date points to organizational culture as the single, key ingredient to successful knowledge management systems. However, not much has been written about how to adapt the culture to embrace knowledge sharing. I am grateful for the work of David De Long and Liam Fahey as reported in The Academy of Management Executive, November 2000. They have clearly defined the impact of culture on knowledge generation, sharing, and use. They have also provided recommendations for actions that can easily be adapted to the needs of NASA and other government agencies. The examples addressing organizational culture used in this section are from several different industries other than the consulting industry. The importance of culture in successfully managing a firm's knowledge is a cross-cutting theme that is not limited to a particular industry. This chapter is almost a replication of the article based on their company studies, research, chief knowledge officer interviews, and executive training experience. I have provided narrative regarding the NASA environment and possible cultural shifts that will need to be orchestrated to increase the chances of success.*



## 1. Culture – Your biggest obstacle, your best opportunity for success

Organizational culture is increasingly recognized as a major barrier to leveraging intellectual assets. The following four ways describe how culture influences the behaviors central to knowledge creation, sharing, and use. First, cultures and subcultures shape assumptions about what knowledge is and which knowledge is worth managing. Second, culture defines the relationships between individual and organizational knowledge, determining who is expected to control specific knowledge, as well as who must share it and who can hoard it. Third, culture creates the context for social interaction that determines how knowledge will be used in particular situations. And fourth, culture shapes the processes by which new knowledge-with its accompanying uncertainties-is created, legitimated, and distributed in organizations. These four perspectives suggest specific actions that managers can take to assess the different aspects of culture most likely to influence knowledge-related behaviors. This diagnosis is the critical first step in developing a strategy and specific understandings to align the firm's culture in support of more effective knowledge use.

A growing number of executives, consultants, and management theorists have proclaimed in recent years that knowledge now constitutes the major source of competitive advantage for organizations (Thurow, 1999). This knowledge-based view of the firm would indicate that the effectiveness in creating, organizing, and

using knowledge assets is what gives the firm its' edge over the competition. Based on this advice, many firms have launched major programs to manage knowledge better. New titles and positions are showing up in firms such as chief knowledge officer and knowledge manager.

Unfortunately, the efforts of many companies to manage knowledge have not achieved their objectives, and there is a growing sense of disenchantment among executives about the practicality of trying to enhance organizational knowledge. The research conducted by De Long and Fahey (2000) in more than 50 companies pursuing knowledge management projects revealed that **organizational culture** is widely held to be the major barrier to creating and leveraging knowledge assets. While most managers intuitively recognize the importance of culture, they find it difficult or impossible to articulate the culture/knowledge relationship in ways that lead to action.

To effectively diagnose the fit between their existing organization and knowledge management objectives, managers need frameworks to help articulate how culture affects their unit's ability to create and apply knowledge. From that point they can begin to design strategies to either adapt or reshape the culture to support the firm's knowledge management objectives.

## 2. Understanding Links Between Culture and Behavior

The concept of culture, similar to that of knowledge, is often used loosely by executives and consultants without any real attempt to define what it means in practice. Culture is not only intangible and illusive, but it can also be observed at multiple levels in an organization (Schein, 1999). Culture is reflected in values, norms, and practices. At the deepest level, culture consists of values, which are embedded, tacit preferences about what the organization should strive to attain and how it should do so. Values are often difficult to articulate and even more difficult to change. Their impact on knowledge creation and use, however, which is manifested in behaviors, should never be underestimated. In the case of NASA, a core value is safety. From that value, particular behaviors and actions are to be expected. Employees are more likely to be very cautious and conservative in designing, building, and testing hardware and software to assure the safety of all concerned. Values that inspire individuals to regard safety as the agency's top priority are more likely to motivate behaviors that create knowledge focused around safety.

Norms are generally derived from values, but they are more observable and easier for employees to identify. Thus, they are more susceptible to change. Consider, for example, norms associated with sharing information. If employees believe that sharing what they know incurs personal risks and decreases power, then the social norms governing how individuals should interact will not support

the behaviors needed to create and sustain the exchange of knowledge.

Knowledge hoarding is not a predominant behavior in NASA. The incentives are not structured around the use of power and knowledge as would be the case in a sales department that relies heavily on customer data.

Practices are the most visible symbols and manifestations of a culture. They are a way of understanding any widely understood set of repetitive behaviors, such as how people in an organization answer the telephone, fill out time reports, or review a weekly status report. They also include repeated types of interactions that have identifiable roles and social rules, such as performance reviews, weekly staff meetings, and Friday afternoon beer blasts. Practices provide the most direct levers for changing behaviors needed to support knowledge creation, sharing, and use. For example, the ways in which departmental meetings are conducted strongly influence the likelihood of a group's generating new knowledge or leveraging its existing knowledge. Are differences of opinion encouraged and respected, or routinely discounted by group leaders? Is conflict managed constructively, or is it suppressed or smoothed over? Over the last fifteen years, NASA has gone through a huge shift in culture regarding communications and the way knowledge was passed from one level of management to another. The progression has gone from a very closed behavioral style to one of open and free communication. This has had a dramatic effect on the behavior and attitudes of the employees. There was a time when many employees did not feel comfortable reporting bad news so it

was often swept under the mat or made to appear less ominous. It has taken a decade of slow, deliberate behavior modifications to create an environment where people feel comfortable and safe in reporting both good and bad news. This has increased the knowledge that is shared by individuals, groups, and centers many times over.

### 3. Four Frameworks Linking Culture and Knowledge

De Long and Fahey's research on knowledge management initiatives has shown that knowledge and culture are inextricably linked in organizations (Sackmann, 1991). Indeed, any discussion of knowledge in organizational settings without explicit reference to its cultural context is likely to be misleading. Culturally generated and condoned behaviors of both individuals and groups are often inimical to developing and leveraging knowledge.

To evaluate how an organization's current culture influences the creation, sharing, and use of knowledge, managers must first understand how culture actually influences knowledge-related behaviors. These four frameworks provide diagnostic tools for analyzing how culture currently affects a firm's knowledge-related behaviors. This is an essential step before deciding whether to adapt knowledge management objectives to the existing culture, or to try to change the culture. This may be particularly difficult for organizations such as NASA that have locations in different parts of the country and perhaps the world. There is a

slightly different culture at each of the locations. What one center considers knowledge that is vital for succeeding in these days of ever increasing challenges may not be the same for all the other centers. Yet to be the most effective, the knowledge management system at each center should be structured and organized in similar fashions. The implementation at each center should be flexible enough to accommodate the required cultural differences.

### *1. Culture shapes assumptions about which knowledge is important*

Cultures, and particularly subcultures, heavily influence what is perceived as useful, important, or valid knowledge in an organization. Culture shapes what a group defines as relevant knowledge, and this will directly affect the type of knowledge a unit focuses on.

For example, an advertising agency may give priority to human creative knowledge, while an auto parts distributor may value more structured knowledge embedded in supply-chain processes. These beliefs about which knowledge is most important do not occur in an organizational vacuum. They are shaped by values and norms.

In a more specific case, a printed circuit-board design team was supposed to capture lessons learned in its part of the product development process, which was a core process for the company. But the group's members were so

concerned with being able to account for their time in the government-funded work that they initially refused to reflect on their experiences and develop lessons learned (Dixon, 1994). No management initiative to improve knowledge creation could override the team's well-established norm of being billable. The barrier to creating this new knowledge was removed only when the knowledge manager found an administrative accounting code to which time for extracting lessons learned could be charged. Local norms, such as always accounting for time in some explicit form, and practices, such as filling out time sheets, determine the priority that individuals accord to different types of knowledge and learning in every organization. In the case of this design team, the norms associated with being billable were so powerful that they had to be accommodated before new knowledge related to the product development activities could be created and captured.

#### Managerial actions:

This example suggests several actions that managers can take to discover how their culture shapes assumptions about knowledge creation, sharing, and use:

- Explore how your cultures' (or subculture's) priorities are likely to support or undermine more effective creation and sharing of knowledge around a particular activity or process. For example, is being billable always more important than some other knowledge-enhancing activity, such as looking for

patterns in lost customers? Is going to a skill-building training class a lower-status activity than performing daily tasks? Although NASA provides outstanding training opportunities, many times employees feel that they are under too much pressure to accomplish their scheduled duties to be away for training. The culture of the management must be adjusted and become evident to the employees to a culture that supports training.

- Identify behaviors that would demonstrate that a particular set of essential knowledge-building activities is critical to your organization. For example, what would sales managers be doing differently if sharing knowledge about customers across divisions was an established norm in the culture? What would senior management be doing and saying that reflected the importance of this norm? Clarify which existing norms and practices may be barriers to the new behaviors needed. And ask whether those elements of the culture can be changed to support these behaviors.

## *2. Subcultures apply different criteria in defining knowledge*

To understand how conflicts arise about what knowledge is important, it is critical to understand the impact of subcultures. Subcultures consist of distinct sets of values, norms, and practices exhibited by specific groups or units in an organization, such as R&D, sales, engineering, MIS, different levels of management, and different geographic regions. Subcultures have characteristics



that distinguish them from the firm's overall culture, as well as from other subcultures. For example, R&D's values may seem focused on elegant product features to the detriment of product marketability and profits, while finance appears to value only controlling costs. MIS, on the other hand, may seem concerned only with maintaining strict adherence to its technology standards. Organizations usually have both an overall culture and multiple subcultures. However, the influence of the overall culture and the amount of conflict among subcultures will vary across organizations.

Subcultures often lead their members to define important knowledge differently than other groups in the organization. In a major electronics firm, the engineering subculture was entrepreneurial. Its values and norms encouraged lots of experimentation and frequent, informal interactions. Engineers viewed knowledge sharing and personal relationships as integrally related and believed that any attempt to manage knowledge must facilitate such social interactions. The firm's MIS subculture, on the other hand, was procedurally oriented and heavily rule-bound, placing a high value on standardized processes. The department's managers valued the structured knowledge that was embedded in processes, software programs, and documents. This reflected the type of knowledge management system they tried to supply to the engineers.

### Managerial actions:

Such different views of knowledge often lead to miscommunication and conflict between functions, as subcultures apply different criteria in valuing knowledge. And these differences, which often produce conflicting strategies and goals in knowledge management initiatives, suggest the following actions:

- Identify the distinct subcultures involved in your knowledge initiative. How are different groups likely to define knowledge differently? What values are reflected in each definition of knowledge? What are the critical assumptions that underlie these value differences?
- Make explicit what types of knowledge are preferred by each subculture. Engage in discussions to achieve some level of shared understanding about the types of knowledge most important to the business.
- Explore whether your unit's orientation to knowledge (as evidenced in prevailing norms and practices) suggests biases and blind spots that might lead you to overlook critical knowledge-management opportunities. For example, are you too focused on developing human knowledge and skills, while ignoring the need to invest in more structured knowledge for business processes? Are you too committed to placing objects in a knowledge database, while ignoring existing levels of human and social knowledge, as

well as cultural norms and practices, that will inhibit absorbing and applying the system's content?

- Given the different subcultures involved, determine if you are making realistic assumptions about the new behaviors needed to leverage specific types of knowledge. For example, is an informal, entrepreneurial engineering group expected to use a formal, procedurally oriented knowledge repository? Can the system be adapted to fit the culture? Or should management invest in culture change?

### 3. *Culture mediates the relationships between levels of knowledge*

Culture embodies all the unspoken norms, or rules, about how knowledge is to be distributed between the organization and the individuals in it. Culture dictates what knowledge belongs to the organization and what knowledge remains in control of individuals or sub-units. This is most evident when management tries to convince individuals to share the human knowledge they have so that it can be converted into more structured knowledge, which the organization will control. A common instance of this occurs when management tries to convince sales people to contribute their knowledge about individual customers to a common customer database.

As already discussed, human knowledge transferred into databases is really information until interpreted by others with the experience and skills to apply it in a different context. Nevertheless, when people are asked to put what they know into an organizational system, they tend to feel they have lost ownership of knowledge they alone had previously controlled. Often, a company's norms will support this individual ownership, encouraging people to refuse to share their knowledge, even as the organization pursues a business strategy whose success requires individuals to share what they know. In essence, cultural norms and practices determine who is expected to control what knowledge, as well as who must share it, and who can hoard it. Knowledge management objectives must be aligned with these norms and practices if they are to be achieved. In a few isolated areas at NASA, knowledge hoarding was a way to assure that a particular type of work would always have to be awarded to the center that was skilled in that area. This created friction among members of cross-functional, multi-location teams. Sharing and training of these skills has resulted in more productive team relationships.

Three themes are particularly significant when culture is used as a lens to understand who controls what knowledge and where are they located.

## Importance of individual knowledge

Knowledge sharing is too often compromised, if not completely sacrificed, at the altar of norms and practices that advocate and reinforce the supremacy of individual knowledge. Consider the following example in which one manager explained how his company's culture reinforced the value of individual knowledge:

In divisional reviews, the senior manager comes around and says, "Show me something I've never seen before." The goal of the employees is to blow their socks off. Nobody ever says, "Show me where you've worked together with another business unit." The assumption is that the value that executives add in these reviews is to cross-fertilize the organization and to connect related ideas. And the engineers think their role is to show individual engineering brilliance. It's totally individual. They reward you to be competitive, instead of recognizing team-based performance and collective accomplishments.

Management's attempts at generating more collaboration and knowledge sharing in this company will fall short until they directly address how the culture reinforces and values knowledge use at the individual level (Bartlett, 1998)

The CEO of Buckman Labs took on the challenge directly when he implemented a knowledge-sharing network to support global sales operations. At the start,

Robert Buckman recognized that the firm's IT investment would not be sufficient to achieve his knowledge-sharing and business objectives. He knew that the organization's cultural norms condoned hoarding knowledge as a source of power. Bulging file cabinets around the company symbolized individual knowledge banks. This behavior began to change when Buckman told the company, upon launching the computer-based knowledge network: Those of you who have something intelligent to say now have a forum in which to say it. Those of you who will not contribute also will become obvious. If you are not willing to contribute or participate, then you should understand that the many opportunities offered to you in the past will no longer be available (Rifkin, 1996).

This was a first step in Buckman's three-year campaign to reshape norms and practices that defined the relationships between individual knowledge and the organization. The CEO recognized that as long as people benefited from not sharing, the organization's ability to leverage their knowledge would be limited, since the investment in information technology would not change the culture by itself.

#### Low-trust cultures constrict knowledge flow

When a mechanical engineer in an automotive firm sought cost information related to a design project, an employee in the finance department responded: "You're an engineer. You don't need to know that." Cultural norms supporting

departmental autonomy made this an acceptable view of knowledge sharing in this company. But the implicit message of holding internal information proprietary is: "We don't trust you." The level of trust that exists between the organization, its sub-units, and its employees greatly influences the amount of knowledge that flows both between individuals and from individuals into the firm's databases, best practices archives, and other records.

Companies with a history of downsizing face a particular problem in this area. They have to rebuild trust levels in their culture before they can expect individuals to share expertise freely without worrying about the impact of this sharing on their value to the company. To do so requires paying considerable attention to the supporting norms and behavioral practices that manifest trust as an important organizational value.

#### Status differences impede cross-functional knowledge sharing

A culture that clearly values some units over others is more likely to undermine the cross-functional sharing of any type of knowledge, in part by supporting subcultures that seek to defend their own knowledge assets. Managers in one firm clearly recognized that their culture valued R&D, marketing, manufacturing, and information systems, in descending order. This shared sense that functions were valued differently--an example of social knowledge--reinforced a silo

mentality and encouraged employees to spend unproductive time defending their unit's perspective.

If we recognize that culture is the silent broker, or mediator between individual, group, and organizational knowledge, then the importance of renegotiating norms around knowledge distribution, ownership, and access becomes more evident. This is especially important for the complex missions that NASA undertakes where intense integration between functions is critical to success.

Managerial actions:

- Whenever a knowledge-management initiative threatens (intentionally or not) to change patterns of knowledge distribution and use, then management should take the following steps:
- Consider how your knowledge-management strategy proactively intends to change attitudes towards ownership of knowledge.
- Evaluate how your current culture will facilitate or undermine the proposed redistribution of knowledge.
- Identify what new behaviors leaders must exhibit to communicate a shift from valuing individual to collective knowledge.



- Make explicit what practices need to change to reinforce more collaborative knowledge use.

### *3. Culture creates a context for social interaction*

Earlier we said that culture shapes perceptions and behaviors. One way culture does this is by establishing the organizational context for social interaction (Sackmann, 1991). Cultures represent the rules (e.g., "Don't interrupt a superior." "Challenge everyone but the CFO.") and practices (e.g., meeting formats and frequencies, appropriate uses of email versus voice mail), that determine the environment within which people communicate. These cultural ground rules shape how people interact and have a major impact on knowledge creation, sharing, and use.

For example, a major bank was interested in sharing lessons learned from the many electronic commerce initiatives that had sprung up in its different divisions. But a lack of norms or practices to support sharing this knowledge across units meant there was no organizational context where one group's valuable experiences were likely to be passed on to others in the firm. The potential value of applying this knowledge elsewhere in the bank was being lost.

By defining the context for interaction, culture determines how all types of knowledge will be used in a particular situation. It does this primarily by dictating

the norms--the rules, expectations, and penalties--that govern social interactions between individuals and groups, and by shaping people's perceptions of their range of options acceptable to the organization. For example, where functions, such as R&D and manufacturing, are not expected to continually share knowledge and collaborate, and are without routine practices to do so, there is no context for interaction to support this sharing. A new intranet infrastructure or reengineered work process can surely improve the environment for knowledge sharing. But, unless executives address long-standing interaction patterns and beliefs shaped by different subcultures, the benefits of their knowledge-management strategy will be limited. NASA has implemented several practices that can aid in the adjustment of these patterns. Cross-training employees from R & D and manufacturing allows each group to better understand the environment and constraints of the other. Weekly team meetings during the design and manufacturing phases also encourage the sharing of valuable knowledge.

The impact of culture on the context for interaction can be assessed on at least three dimensions: vertical interactions, horizontal interactions, and special behaviors that promote knowledge sharing and use.

## Vertical interactions

Culture shapes vertical interactions in many ways, but two particularly relevant to knowledge creation and sharing are norms determining the acceptability of discussing sensitive topics, and perceived approachability of senior management.

*Sensitive Topics:* At Buckman Labs, shortly after the knowledge network was introduced, the CEO engaged in a lengthy electronic debate about the sales compensation system. For weeks, salespeople argued on-line, sometimes directly with the CEO, about the unfairness of the existing bonus system. The cultural message underlying this open exchange was that anything is discussible, a norm that builds the trust necessary to support vertical knowledge sharing.

*Approachability:* Norms and practices that make executives accessible and approachable also help create a context for effective knowledge sharing. At Chaparral Steel, workers' lockers are intentionally located next to a vice president's office to facilitate informal interactions (Leonard-Barton, 1995). In contrast, executives in one large manufacturing company seemed unaware of how intimidating their high levels of technical and business expertise were to subordinates. One manager explained: "When engineers are put in front of top management, they're thinking, 'I'm not going to say a word unless I'm positive I

can say something that's absolutely accurate.' There's a feeling of intimidation and a fear of looking stupid, so people keep their thoughts to themselves."

Cultures with norms and practices that discourage open and frank exchanges between levels in the hierarchy create a context for communication that undermines effective knowledge sharing. At NASA and other organizations, how a manager handles bad news will ultimately determine how much information he is given. If he punishes an employee by embarrassing them, yells at them, or degrades them, the employees will discontinue the sharing of any type of knowledge for fear of the possible repercussions. A culture must exist where the open sharing of all-important news is welcome.

#### Horizontal interactions

Culture also shapes patterns and qualities of interactions needed to leverage knowledge among individuals at the same level in the organization. Three characteristics differentiate organizations in this area: the volume of interactions, level of collaboration and collective responsibility, and an orientation to seek out existing expertise or knowledge.

## Interactivity

Culture determines the patterns of interaction used to accomplish work. Norms and practices, for example, that bring people together vary from one organization to another. One traditional firm may rely on formal communication processes and meetings designed to periodically bring individuals together, while a more entrepreneurial Internet startup expects frequent, unplanned, and unstructured interactions among employees. In these organizations, formal and informal interactions are valued differently, which results in different patterns of knowledge creation and sharing.

To take advantage of new electronic communication technologies, companies like British Petroleum and Buckman Labs have actively managed the behavioral norms and practices needed to facilitate knowledge sharing. At Buckman Labs, employees using the firm's knowledge network now expect a greater level of interaction when looking for help with a sales or marketing problem. "If you are in a global company, there's somebody awake and working all the time. Having K'Netix – their global knowledge sharing network - gives us the capability to respond," says one executive (Rifkin, 1996). "A new mind-set has taken hold at Buckman. Rather than picking up the phone, someone can communicate with a mass of people faster."

Even though the Internet and other new technologies are greatly reducing communication barriers, unless cultural norms and practices support higher levels of interactivity between the right individuals or groups, these new channels will have relatively little impact on knowledge use (Davenport & Prusak, 1998).

### Collaboration

Another way in which culture shapes the context for horizontal interactions is through norms and practices that promote collaboration. In e-business, the customer's needs are evolving so quickly. The CEO of one Internet company reports that salespeople must feed market information as fast as possible to product developers: "Our salespeople are attuned to what other functions in the company need, so instead of waiting until quarterly product meetings, they are telling our product managers, 'This is what I've seen in at least 10 calls during the week'".

Collaboration and cross-functional problem solving are also expected at Chaparral Steel, where every employee carries a business card reading "member of the sales force." A sense of collective responsibility leads employees to go to great lengths to avoid letting colleagues down, frequently offering help to those in other departments, even though it burdens their own work (Leonard-Barton, 1996). When norms and practices promote collaboration

between functions and operating units, interactions are more likely to lead to creating and sharing new knowledge of all types.

### Reusing Existing Knowledge

Culture also shapes the context for interaction through norms and practices that determine to what lengths employees will go to seek out and build on existing knowledge. Culture may create an organizational context where creative directors for a global ad agency see each new project as unique, or an environment where design engineers for an automaker refuse to search out lessons from their counterparts working on other car platforms. Cultures that primarily reward individual creativity and innovation produce different patterns of interaction around knowledge than cultures where uncovering and leveraging existing expertise is the norm. To encourage the use of existing knowledge, Texas Instruments created an annual "Not-Invented-Here-But-I-Did-It-Anyway" award to recognize those who reuse good ideas from elsewhere.

### Special behaviors promoting knowledge development

There are many desirable behaviors that help shape the context of social interaction to support knowledge sharing and use. Listed below are two that seem most important (Senge, 1990).

## Sharing and teaching

Cultures that explicitly favor knowledge sharing over knowledge acquisition will create a context for interaction that is more favorable to leveraging knowledge. The U.S. Army is one of a growing number of organizations that formally considers knowledge-sharing capabilities when identifying candidates for promotion. Teaching is another behavior that influences the social context, even as it enhances a firm's existing knowledge base. Companies as different as General Motors and Skandia, the Swedish financial services firm, both recognize the value of asking managers to teach what they know about the business as a way of refining and improving their existing knowledge, even as they share it. More and more firms have discovered the benefits of having their employees teach others about core aspects of the business (Tobin, 1998). At NASA, experts frequently teach classes in their respective fields.

## Dealing with mistakes

A large international engineering and construction company trying to build a lessons-learned database found one legacy of large layoffs after a recent business downturn, was that engineers in the firm were reluctant to admit mistakes. This, of course, significantly limited the scope of the lessons that could be captured. How an organization reacts to mistakes is another norm that shapes the context for social interaction. Mistakes may be covered up, explained



away, punished severely, or ignored. Or norms and practices may dictate that mistakes be uncovered and used as a source of learning, as many fast-moving Internet businesses are now doing. In either case, the approach used will influence how people interact, and thus will shape the quality of the knowledge created and applied. In many of the lessons-learned reports that are created at NASA, frequently the most valuable knowledge gained is an insight into what did not work.

Understanding this phenomenon, the U.S. Army is more concerned with the value of recognizing mistakes and fixing them than it is with doing things right the first time. This attitude stems from battlefield experience, where no plan is ever carried out without errors. The ability to evaluate and correct mistakes becomes critical to success. To reinforce the importance of frank interactions for diagnosing and learning from errors, the Army strives to separate its debriefing activities from its evaluation processes. Groups won't learn from their mistakes if the same interactions are being used to fix blame, keep score, or humiliate those involved (Sullivan & Harper, 1996). This is especially true at NASA where the Administrator believes that if you have no failures, you must not be pushing the envelope hard enough.

### Managerial actions:

- Some key characteristics of organizational culture that shape the context for social interaction are noted in Figure 3. Although not a complete list, these characteristics do demonstrate another way in which culture affects knowledge of all types, and it suggests actions that logically follow from understanding this relationship.
- Identify norms and practices that are barriers to discussing sensitive topics.
- Find and evaluate evidence that senior management is perceived as accessible and approachable. Are there elements of the culture that inhibit vertical interactions?
- Find norms and practices in the firm that encourage or discourage:
  - a high frequency of interaction.
  - an expectation of collaborative problem solving.
  - seeking out existing knowledge instead of "reinventing the wheel."
  - teaching others.
  - identifying and learning from mistakes.

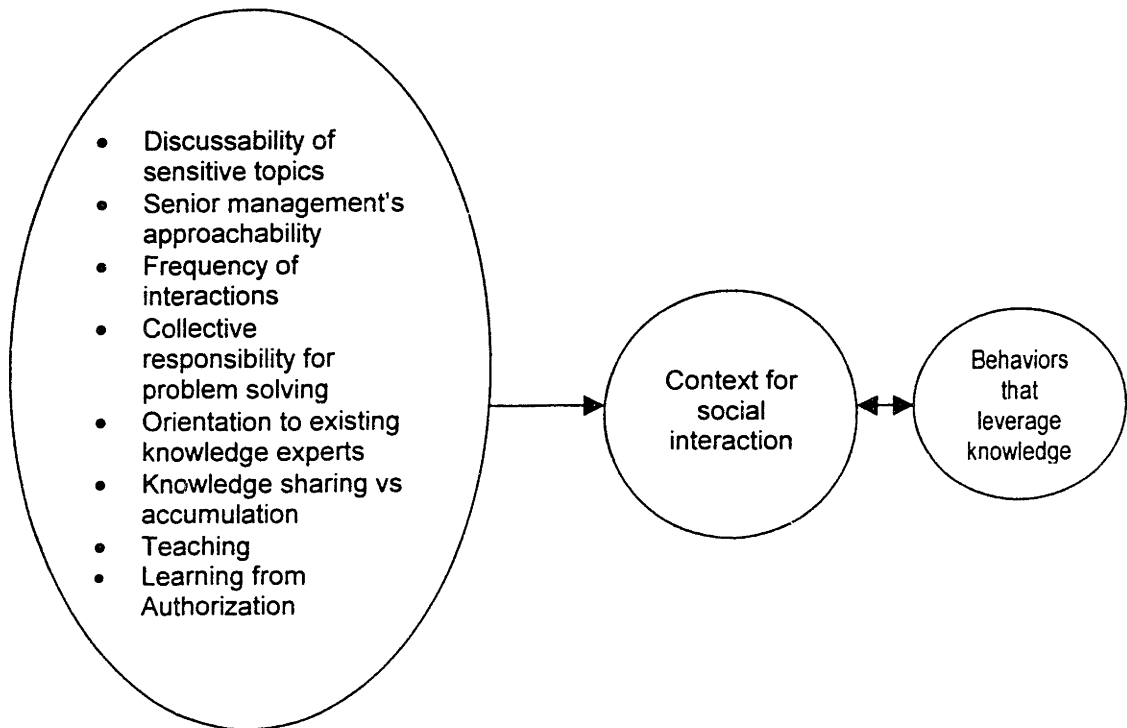


Figure 3. Cultural Characteristics that Shape Social Interaction

#### 4. *Culture shapes creation and adoption of new knowledge*

Knowledge ultimately assumes value when it affects decision-making and is translated into action. New knowledge usually comes in two forms. It can be adopted wholesale from external sources, often in the form of structured knowledge, such as a new software-driven manufacturing process. Or it is created internally by taking information from the external environment and interpreting it in the context of the firm's existing knowledge to create new knowledge that becomes a basis for action. The corporate landscape is littered

with examples of firms that had access to new knowledge about their competitive environments, but that failed to recognize its potential value.

Consider one well-known case. Ford's market research department produced what it viewed as new knowledge: "overwhelming evidence," in the form of projections, that the minivan would be a huge success as a new product in the automobile market. However, Ford's executives, particularly in the finance department, challenged the validity of this new market knowledge, labeling the minivan concept as untested and risky. In this case, the subcultures involved in negotiating the validity of the new knowledge failed to agree and act on the importance of the insights. And Chrysler, of course, went on to capture this major new market, with a product that essentially saved the struggling automaker from bankruptcy (Barabba, 1995).

A firm's culture, and the relationships among its subcultures, heavily shape how new knowledge about the external environment is created, legitimated (or rejected), and distributed throughout an organization, as illustrated in Figure 4. The dynamics of this process represent a special problem for companies pursuing business opportunities through the Internet, because they are regularly confronted by competitive and technological changes that threaten their survival. Organizations need to be able not only to adopt or create new knowledge in all forms, but also to legitimate and distribute it to change strategic direction and resource allocations faster than their rivals. In practice, some firms, such as

Intel, General Electric, Wal-Mart, and Motorola, have historically been more successful at this than others.

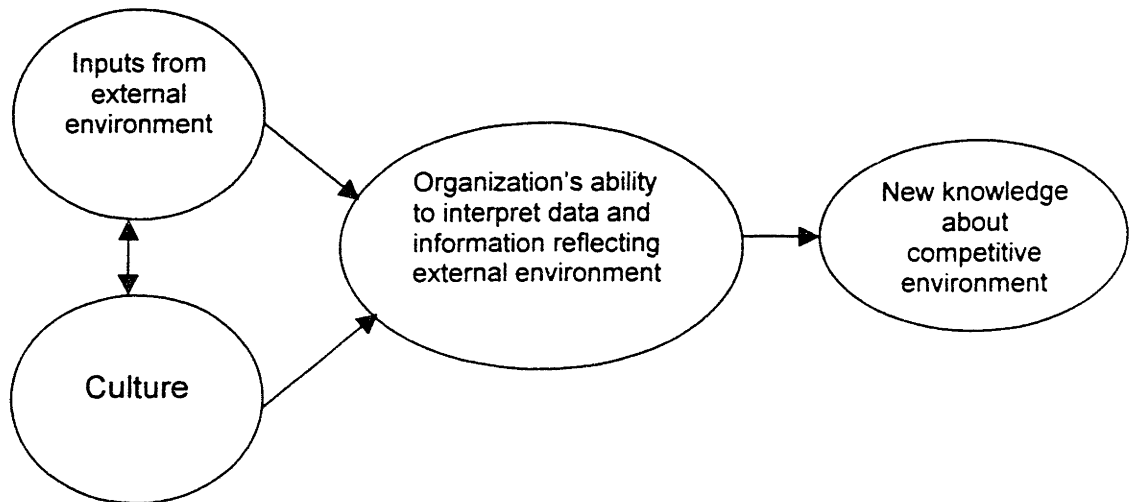


Figure 4. Creating and Adopting New Knowledge

### Effective knowledge-oriented cultures

The fundamental question for management is: What are the characteristics of a culture that will help a firm rapidly acquire and distribute new knowledge throughout the organization to enhance decision making and performance? Four characteristics have been identified in cultures that are more effective at creating and integrating new knowledge from the external environment.

(1) Knowledge from the external environment is expected to be the starting point, not the end, of innovation. In this type of culture, norms and practices strongly

encourage the exploitation of knowledge from the external environment, rather than just being satisfied with absorbing it. For example, when Chaparral Steel bought new rolling mill equipment designed to produce eight-inch slabs of steel, its assumption was that the performance of this new equipment, which represents structured knowledge, could be improved. Indeed, through trial-and-error and continually pushing the technology's capabilities, the equipment was soon producing 14-inch slabs. This level of performance led the supplier to try to buy back the new design. The norm at Chaparral is to expect to build on structured knowledge acquired from outside the organization, not simply to absorb it. Among the practices that make this level of innovation possible are continual experimentation and quick-and-dirty prototyping. But most important is the attitude within the company that existing external knowledge can and must be enhanced if Chaparral is to stay competitive.

(2) Intense debate is encouraged on key strategic issues drawing on extensive internal and external inputs. Intel's Chairman Andy Grove sees intense debate and dialogue as a cornerstone of his company's culture, and a key reason why Intel has been able to adapt and prosper in the highly volatile computer industry (Grove, 1996).

Intel's ability to understand how its computer memory chip business was being transformed was severely tested in the 1980s. Input from the external environment was unmistakable. The Japanese were developing tremendous

new capacity to manufacture memory chips. Their quality levels were better. They had major advantages in access to low-cost capital. And the industry was caught in a downward pricing spiral, so that Intel was losing money on chips. In retrospect, the obvious strategic decision was to get out of the memory chip business, given the knowledge of these events. But this interpretation of external events had to be filtered through the firm's values, norms, and practices before becoming knowledge that Intel could act on. In this case, Intel's identity was closely tied to memory chips, to the point where many employees couldn't imagine the company existing without manufacturing them.

To develop an understanding of what the shifting realities of the marketplace meant for Intel, Grove orchestrated a broad-based, highly emotional debate designed to engage the organization and clarify its strategic options. What the Intel culture labeled "constructive confrontation," Grove concedes is really "ferocious arguing with one another while remaining friends." Such debate and dialogue demands a set of norms that includes the acceptance of intense questioning of all assertions and observations made during meetings. This type of productive conflict is essential to first generate and then reconcile disparate views, and to create new knowledge that will become the basis of action. The absence of these norms, and related underlying values, contributed to the missed opportunity in the Ford minivan case described earlier.

Of course, executives like Grove recognize that not everyone in the firm will accept the perspective ultimately taken by senior management, based on its new knowledge of the environment. But the process of engaging and listening to many views on an issue increases the likelihood of a better decision (Weick, 1995) and broader acceptance of an emerging organizational perspective.

(3) High levels of participation are expected in seeking out, debating, and synthesizing knowledge related to important business issues. Norms and practices must go beyond encouraging debate and dialogue to facilitating contributions from individuals at multiple levels of the organization. Such participation is enabled by practices that involve individuals gathering data from diverse sources, exercising their judgment to transform data into information, and then engaging in intense interaction and discourse to produce new knowledge that can be the basis for action.

Today, Buckman Labs has 50 percent of its employees regularly engaged with customers in the belief that directly interacting with the market is the key to profitability. With a goal of 80 percent of its employees on the front line, Buckman has created a huge natural network that feeds information about customers into the company. Employees are expected to contribute to the databases maintained on all of the firm's customers, and this detailed information is a source of much richer knowledge about the marketplace.



Companies whose cultures are most effective at creating and integrating new knowledge into the organization have norms and practices that demand broad participation in knowledge gathering and distributing information about the external environment.

(4) Organizations find ways to challenge the existing assumptions and beliefs that shaped the firm's earlier successes. This is a special problem for traditional firms trying to move into the Internet-based economy. One vice president of e-commerce observed: "Being a bank doesn't hold us back, but thinking like a bank does. Our challenge is getting people to stop thinking like a bank and to understand that e-commerce means business will be done in a fundamentally different way."

At Intel, Grove found that the company's fundamental beliefs about memory chips were inhibiting its ability to accept the mounting evidence that it could no longer survive in a market where it had once been a major player. For an organization to question fundamental knowledge about its competitive environment or core technologies, it must learn how to diagnose and correct errors in its existing norms and practices. To get out of the memory chip business and move full force into microprocessors, Intel had to abandon the practice of using memory chips as its technology driver. It also had to give up a belief that the company had to offer a full product line of memory chips, microprocessors, and other products to remain competitive (Grove, 1996).

Questioning fundamental beliefs and existing ways of working is a particularly difficult challenge for leadership, but it is usually a key step in creating new knowledge for the organization. One of the reasons Ford decided not to build a minivan, despite overwhelming support from its market research, was that Henry Ford himself objected to the use of costly new front-wheel drive technology. Intel's Grove observes that if managers today are to accurately interpret the profound changes occurring in their competitive environments, they must "adopt an outsider's intellectual curiosity... unfettered by any emotional attachment to the past" (Grove, 1996).

#### Managerial actions:

It is hard to overestimate how difficult it is to achieve this type of detachment. And the reflection required to question existing norms and practices is even more at risk in an Internet world where speed rules and fast decision making is expected from managers. Several diagnostic actions are discussed below:

- Look for important new knowledge that was ignored, discounted, or undiscovered by your firm. How did these examples prove costly to the business? What norms and practices created barriers to adopting, creating, or applying this knowledge?

- Seek out examples of new knowledge adopted or created with inputs from the external environment that led to bursts of innovation within the firm, and try to draw lessons from them.
- Identify the norms and practices in your culture that discourage employees from building on and extending structured knowledge acquired from the external environment.
- Find examples where intense debate and dialogue was encouraged on key strategic issues. Reflect on how conflict played a constructive or destructive role in those discussions. What norms and practices would support more constructive confrontations?
- Look at the evidence you have about the levels of participation in both acquiring and challenging knowledge critical to the business. How do your organization's norms and practices encourage or inhibit high levels of participation in this area?
- Seek out examples showing how your organization questions its fundamental assumptions, beliefs, and projections about the competitive environment, core technologies, and the culture itself. What norms and practices would be needed to support more productive questioning in these areas?

These actions can help executives begin to explore how their own cultures help or hinder the integration of new knowledge into the firm. They suggest areas that may need special attention from senior management, as part of an overall strategy to leverage knowledge more effectively.

### Aligning Culture With Knowledge Management Goals

Managers need frameworks to characterize the links between culture and knowledge so they can design the interventions needed to create behaviors that will support their knowledge management objectives. This research hopes to demonstrate four ways in which organizational culture influences behaviors central to knowledge creation, sharing, and use:

- Culture-and particularly subcultures-shape our assumptions about what knowledge is, and, hence, which knowledge is worth managing.
- Culture mediates relationships between individual and organizational knowledge.
- Culture creates the context for social interaction that ultimately determines how effective an organization can be at creating, sharing, and applying knowledge.

- Culture shapes the processes by which new organizational knowledge-with its accompanying uncertainties-is created, legitimated, and distributed.

Each way of conceptualizing the relationship between culture and knowledge provides a different lens for evaluating the fit between current behaviors and the organization's knowledge management objectives. And each of the four frameworks suggests diagnostic action steps that can be taken to assess different aspects of culture most likely to affect critical knowledge-related behaviors. Once the diagnosis is complete, more informed decisions can be made about how to accommodate or realign the firm's culture to effectively support management's goals for leveraging organizational knowledge.

## CHAPTER VII. CONCLUSIONS

So, what can NASA learn from the consulting industry? First of all, we know the consulting firms do a great job of generating, storing, and sharing knowledge. Knowing that effective knowledge management is, in part, responsible for their competitive advantage, these firms have all developed systems using the latest information technology. They have also developed a culture where sharing knowledge is not only expected, but frequently rewarded. Sometimes the rewards are monetary; sometimes they are in the form of a note from a partner. But you can be assured that each time a consultant visits the database to search for help on a particular assignment, they are always thankful that someone took the time to submit what they have learned. This continued give and take is what assures that the knowledge is there when you need it. The consulting firms are organized in such a way that sharing is not penalized and not sharing is not rewarded.

The consulting firms have demonstrated that a knowledge management system can be effective no matter the diversity of the people or the locations of the offices if their culture is strong enough to support these differences.

We also know that consulting firms continually bring new knowledge into the firm. This occurs in several ways. Each new engagement provides the opportunity to learn something new. This only helps if the new knowledge is made available for

use by the entire firm. By simultaneously working on several different engagements in the same practice area, the firms can recognize new industry trends and business practices. This allows them to get a head start on the competition in developing solutions or new practice areas. The new employees joining the firm also provide new knowledge. The employee may be a recent graduate, having just finished an MBA from a top business school, or may be coming over from another firm. Either way, the firm will gain knowledge that it did not have before.

What correlation can we draw between NASA and these firms? We know that NASA must develop the infrastructure required to implement an effective knowledge management system. This is going to take substantial resources in the form of manpower, budget, and schedule. But that alone won't satisfy our needs. We have seen how NASA has been able to sustain a *learning* culture. Now we need to evaluate that culture, with the help provided by De Long and Fahey, to define what changes need to be made to become a *sharing* culture. Just as we were able to change from a culture that tolerated and even rewarded closed communications to one that provided a safe environment for open communications and dialogue, we have to become a culture that values the capture and sharing of knowledge.

Although several areas emerge from the research as being key to the success of a firm's KM system, one theme outweighs all others – organizational culture. Of

course it is necessary to have the infrastructure to support the system, but successful KM is not about technology. It is about creating a learning and sharing culture where personal networks and information technology work together to create an environment that maximizes corporate knowledge.

Like the consulting firms, NASA undertakes hundreds of new activities each year. We have been letting the opportunity to capture and share this new knowledge slip through our fingers. Imagine the strength we would gain from making this available to all organizations in the agency! Even greater benefits would result from sharing this with our industry partners. According to Peter Drucker in an interview with Brath in 1999, it would take 20 to 30 times a person's salary to replace the knowledge that they possess if they were to walk out the door taking that knowledge with them (Nakra, 2000). We can no longer afford this loss.

A framework, with suggested diagnostic actions, is available to assist in the assessment of different aspects of culture most likely to affect critical knowledge-related behaviors. Using this framework will allow for more informed decisions concerning the realignment of the firm's culture to effectively support the goals for leveraging organizational knowledge at NASA.



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