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■ *Case Studies*

Ten Principles of Knowledge Management and Four Case Studies

Thomas H. Davenport

INTRODUCTION

Many companies are beginning to feel that the knowledge of their employees is their most valuable asset. They may be right, but few firms have actually begun to actively manage their knowledge assets on a broad scale. Knowledge management has thus far been addressed at either a philosophical or a technological level, with little pragmatic discussion on how knowledge can be managed and used more effectively on a daily basis. At this early stage of knowledge management in business, the most appropriate form of dialogue is not detailed tactics, but rather high-level principles. When an organization decides what principles it agrees upon with respect to knowledge management, it can then create detailed approaches and plans based upon the principles.

For the past 2 years I have been working with organizations in the area of knowledge management. Some of them have been working on the topic for years, but only recently realized that they were managing knowledge. More frequently, the topic of knowledge management has only recently emerged in these organizations. But there are enough lessons so that we can begin to articulate and debate some principles and rules of thumb.

Ten principles of knowledge management are listed below. I'm sure that there are more that could be stated, but the decimal system has a strong appeal. With each principle some implications and issues are also discussed. Where I am aware of firms who have wrestled with the principle and taken action on it, their experience is described.

1. Knowledge management is expensive (but so is stupidity!)

Knowledge is an asset, but its effective management requires investment of other assets. There are many particular knowledge management activities requiring investment of money or labor, including the following:

- Knowledge capture, i.e. creation of documents and moving documents onto computer systems.
- Adding value to knowledge through editing, packaging, and pruning.
- Developing knowledge categorization approaches and categorizing new contributions to knowledge.
- Developing information technology infrastructures and applications for the distribution of knowledge.
- Educating employees on the creation, sharing, and use of knowledge.

While few firms have calculated the cost of knowledge management, there are some quantified estimates. Robert Buckman of Buckman Laboratories estimates that his firm spends 7% of its revenues on knowledge management. McKinsey and Company has long had an objective of spending 10% of its revenues on developing and managing intellectual capital.

But while knowledge management is expensive, the obvious retort is that not managing knowledge is even more so. What is the cost of ignorance and stupidity? How much does it cost an organization to forget what key employees know, to not be able to answer customer questions quickly or at all, or to make poor decisions based on faulty knowledge?

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Just as organizations attempting to determine the value of quality determined the cost of poor quality products and services, if we wish to assess the worth of knowledge we can try to measure the cost of not knowing. Of course, such an assessment could lead to political problems, but that is another principle.

2. Effective management of knowledge requires hybrid solutions of people and technology

Business Week recently announced in the title of a recent article on artificial intelligence that, 'Computers that think are almost here . . . The ultimate goal of artificial intelligence-human-like reasoning is within reach.' Reading this headline in 1995 may create a *déjà vu* experience for managers and professionals, who have been hearing about machine-based knowledge since the 1950s. But the fact is that firms wishing to effectively manage knowledge today need a heavy dose of human labor. Humans are very good at certain types of activities, computers at others.

Human beings may be expensive and cantankerous, but they are quite accomplished at certain knowledge skills. When we seek to understand knowledge, to interpret it within a broader context, to combine it with other types of information, or to synthesize various unstructured forms of knowledge, humans are the recommended tool. These are the types of knowledge tasks at which we excel, and we should be employed for these purposes.

Computers and communications systems, on the other hand, are good at different types of things. For the capture, transformation, and distribution of highly structured knowledge that changes rapidly, computers are more capable than people. They are increasingly useful—though still a bit awkward—for performing these same tasks on less structured textual and visual knowledge. But it is still the case that most people don't turn to computers when they want a rich picture of what is going on in a particular knowledge domain.

Given this mixture of skills, we need to construct hybrid knowledge management environments in which we use both humans and people in complementary ways. Just as sophisticated manufacturers have realized that 'lights out' factories aren't necessary the most effective or flexible, we have to build knowledge factories that combine someone to talk to with machines that talk in bits and bytes.

When we are compiling computerized databases of organizational knowledge, we need to include 'pointers to people.' For example, at GM Hughes Electronics, best process re-engineering practices were captured in a database that combined human and computerized knowledge. Each entry was submitted to an editor, who screened it for usefulness and relevance. Entries recorded just enough about the practice to pique the reader's interest, and included the name and phone number of a person who could describe it in detail. Use of the database is solid and growing, and some division presidents have instructed that their divisions be well-represented in the database.

3. Knowledge management is highly political

It is no secret that 'knowledge is power,' and thus it should not surprise anyone that knowledge management is a highly political undertaking. If knowledge is associated with power, money, and success, then it is also associated with lobbying, intrigue, and back-room deals. If no politics appear around the knowledge management initiative, it is a good indication that the organization perceives that nothing valuable is taking place.

What do knowledge politics mean for effective knowledge management? Some managers will decry politics and argue that they only get in the way. But astute managers of knowledge will acknowledge and cultivate politics. They will lobby for the use and value of knowledge. They will broker deals between those who have knowledge and those who use it. They will cultivate influential 'opinion leaders' as early adopters of knowledge management approaches. At the highest level they will try to shape the governance of knowledge to better utilize it across the organization.

4. Knowledge management requires knowledge managers

Key business resources like labor and capital have substantial organizational functions devoted to their management. Knowledge won't be well-managed until some group within a firm has clear responsibility for the job. Among the tasks that such a group might perform are collecting and categorizing knowledge establishing a knowledge-oriented technology infrastructure, and monitoring the use of knowledge.

Several professional services firms already have knowledge management roles in place. McKinsey, Andersen Consulting, Ernst & Young, Price Waterhouse, and A. T. Kearney all have 'Chief Knowledge Officers' in place. Buckman

Laboratories reoriented its Information Systems organization to become managers of knowledge, and now calls the group the Knowledge Transfer department. Hewlett-Packard created one knowledge management group within its corporate Product Processes Organization, and another within its Computer Systems marketing group (see the brief case study on p. 191).

A knowledge management function could inspire resentment and concern within the organization if it seeks to assemble and control all knowledge. The goal of such an organization should merely be to facilitate the creation, distribution, and use of knowledge by others. Furthermore, the knowledge managers themselves should not imply by their words, or actions that they are more 'knowledgeable' than anyone else. In fact, one knowledge manager at Hewlett-Packard argues that the most important qualification for such a role is being 'egoless.'

5. Knowledge management benefits more from maps than models, more from markets than from hierarchies

It is tempting when managing knowledge to create a hierarchical model or architecture for knowledge, similar to the *Encyclopedia Brittanica*'s Propaedia, that would govern the collection and categorization of knowledge. But most organizations are better off letting the knowledge market work, and simply providing and mapping the knowledge that its consumers seem to want. The dispersion of knowledge as described in a map may be illogical, but is still more helpful to a user than a hypothetical knowledge model that is best understood by its creators and rarely fully implemented. Mapping organizational knowledge is the single activity most likely to yield better access.

Knowledge managers can learn from the experience of data managers, whose complex models of how data would be structured in the future were seldom realized. Firms rarely created maps of the data, so they never had any guides to where the information was in the present.

Letting the market work means that knowledge managers try to make knowledge as attractive and accessible as possible, and then observe what knowledge gets requested using what specific terms. For example, at Teltech, a Minneapolis firm that manages a knowledge network of external experts, clients who call for expert referrals are unlikely to always use the same terms as the experts use in describing their work. The function of connecting client needs to available expertise is performed using Teltech's online search and retrieval system, the 'KnowledgeScope.' The KnowledgeScope is effectively a map or thesaurus of over 30,000 technical terms. It is maintained by several full-time 'knowledge engineers,' who add 500 to 1200 new concepts per month to the database and remove outdated ones as well.

Each technical term has a preferred usage and several possible synonyms. Teltech's goal is to have the terms in the database that are used by clients. Therefore, each day the knowledge engineers receive a list of terms sought unsuccessfully in the database by Teltech's knowledge analysts or by clients accessing the database directly. Many of the unsuccessful searches are misspellings, but valid misses are added to the database.

Until recently, Teltech's approach to structuring knowledge had been hierarchical, rather than thesaurus-based. Its previous database was called the 'Tech Tree' and it had several key knowledge branches, including scientific/technical, medical, chemical, etc. However, both clients and Teltech knowledge analysts found it difficult to navigate through the tree, and new terms tended to be added at inappropriate levels of the tree. Teltech has found the thesaurus approach to be much more satisfactory. It has mapped the knowledge world rather than modeling it.

6. Sharing and using knowledge are often unnatural acts

If my knowledge is a valuable resource, why should I share it? If my job is to create knowledge, why should I put my job at risk by using yours instead of mine? We sometimes act surprised when knowledge is not shared or used, but we would be better off as knowledge managers assuming that the natural tendency is to hoard our knowledge and look suspiciously upon that from others. To enter our knowledge into a system and to seek out knowledge from others is not only threatening, but also just plain effort—so we have to be highly motivated to undertake such work.

If the knowledge manager adopted this principle, we wouldn't take sharing and use of knowledge for granted. We wouldn't assume that the installation of Lotus Notes will lead to widespread sharing, or that making information available will necessarily lead to its use. We would realize that sharing and usage have to be motivated through time-honored techniques—performance evaluation, compensation, for example.

There are some firms that are beginning to evaluate and reward personnel for knowledge sharing and use. Lotus Development, now a division of IBM, devotes 25% of the total performance evaluation of its customer support workers to knowledge sharing. Buckman Laboratories recognizes its 100 top knowledge sharers with an annual conference at a resort. ABB evaluates managers based not only on the result of their decisions, but also on the knowledge and information applied in the decision-making process.

7. Knowledge management means improving knowledge work processes

It is important to address and improve the generic knowledge management process, but knowledge is generated, used, and shared intensively in a few specific knowledge work processes. The specific processes vary by firm and industry, but they include market research, product design and development, and even more transactional processes like order configuration and pricing. If real improvements are to be made in knowledge management, improvements must be made in these key business processes.

Two colleagues and I recently carried out research on over 25 firms that had attempted to improve knowledge work processes. We found processes oriented to creating (e.g., research), packaging (publishing), and applying (system development) knowledge. In general, the most effective improvement approaches struck a middle ground between top-down 're-engineering' of the process and bottom-up design by autonomous knowledge workers. Creative knowledge work required less top-down intervention, and knowledge application processes a bit more. However, surveys of companies on their re-engineering efforts have confirmed that knowledge work processes of any type are only rarely addressed in process improvement initiatives.

8. Knowledge access is only the beginning

If knowledge access were sufficient, then there would be long lines outside the nation's libraries. Access is important, but successful knowledge management also requires attention and engagement. It has been said that attention is the currency of the information age.

In order for knowledge consumers to pay attention to knowledge, they must become more than passive recipients. More active involvement with knowledge can be achieved through summarizing and reporting it to others, through role-playing and games based on usage of the knowledge, and through receiving the knowledge through close interaction with providers. This is particularly important when the knowledge to be received is tacit, as Ikujiro Nonaka has long noted.

Some firms have already begun to help their managers and employees engage in knowledge.

Jane Linder, an information (and market research and strategic planning) manager for a division of Polaroid Corporation, worked with a supportive division president to create a 'war games' exercise for division managers and professionals. Participants digested market research and then played roles as competitors of Polaroid in making sales presentations to customers. The marketing-oriented exercises were a big success, and now Polaroid is assessing the use of information engagement approaches for other types of knowledge. Toyota and Nissan have both sent car designers to the United States to receive tacit knowledge by fraternizing with particular customer segments.

9. Knowledge management never ends

Knowledge managers may feel that if they could only get their organization's knowledge under control, their work would be done. However, the tasks of knowledge management are never-ending. Like human resource management or financial management, there is never a time when knowledge has been fully managed.

One reason that knowledge management never ends is that the categories of required knowledge are always changing. New technologies, management approaches, regulatory issues, and customer concerns are always emerging. Companies change their strategies, organizational structures, and product and service emphases. New managers and professionals have new needs for knowledge.

This rapid change in knowledge environments means that firms should not take considerable time in mapping or modeling a particular knowledge environment. By the time they finished, the environment would no longer exist. Instead, descriptions of knowledge environments should be 'quick and dirty,' and only as extensive as usage warrants.

10. Knowledge management requires a knowledge contract

It isn't clear in most organizations who owns or has usage rights to employee knowledge. Is the knowledge of employees owned or rented? Is all of the knowledge in employee heads the property of the employer? How about the knowledge in file cabinets or computer disk drives? What about the knowledge of consultants while they are consulting? Outsourced employees? Few firms have policies to deal with these issues.

Many organizations have held employee knowledge–at least that developed between nine and five—to be the property of the corporation. However, several societal changes make such an approach more difficult. Employees move more quickly to new jobs and new organizations; the distinction between work life and home life is more ephemeral, and there are more contingent workers. In any case, few firms have done a good job of extracting and documenting any employee's knowledge in the past. If knowledge is really becoming a more valued resource in organizations, we can expect to see more attention to the legalities of knowledge management. Perhaps the greatest problem with increased knowledge management is the increased population of lawyers it will engender! Intellectual property law is already the fastest-growing field in the legal profession, and it will only grow faster.

SUMMARY

As one can easily deduce from these principles, managing knowledge in organizations will lead to a variety of new problems and issues. And this type of initiative will face resistance. Knowledge management runs counter to the direction of American society; we prefer television to books, intuition to research, pragmatists to theorists. The serious pursuit of knowledge in organizations will be challenged by an anti-intellectual orientation in the US that has been present since the days of the frontier.

But now the new frontier is in our minds. As free natural resources and cheap labor are exhausted, the last untapped source of commercial advantage is the knowledge of people in organizations. It is very early days for knowledge management, and even the principles and rules of thumb described above will engender considerable disagreement. The good news is that almost anything that a firm does in managing knowledge will be a step forward.

■ *Case Study*

Knowledge Management at Hewlett-Packard, Early 1996

INTRODUCTION

Hewlett-Packard (HP) is a large, successful company with over $31 billion in 1995 revenues. Its fast annual revenue growth approximately 30% from such a large base has astounded observers. The company competes in many markets, including computers and peripheral equipment, test and measurement devices, electronic components, and medical devices. It has 110,000 employees and over 400 locations around the world.

HP is known for its relaxed, open culture. All employees, including the chief executive officer, work in open cubicles. Many employees are technically-oriented engineers who enjoy learning and sharing their knowledge. The company is perceived as being somewhat benevolent to its employees, and fast growth has obviated the need for major layoffs. All employees participate in a profit sharing program.

The company is also known for its decentralized organizational structure and mode of operations. Business units that perform well have a very high

degree of autonomy. There is little organized sharing of information, resources, or employees across units. HP managers feel that the strong business-specific focus brought by decentralization is a key factor in the firm's recent success. Although culturally open to sharing, few business units are willing to invest time or money in 'leveraged' efforts that do not have an obvious and immediate payback for the unit. It is common, however, for employees to move from one business unit to another; this mobility makes possible some degree of informal knowledge transfer within HP.

In mid-1995 it became apparent that several knowledge management initiatives were underway in various HP business units. Some had been in place for several years; others were just beginning. Noticing this phenomenon, Bob Walker, HP's Chief Information Officer and Vice President, and Chuck Sieloff, Manager of Information Systems Services and Technology (ISST), decided to attempt to facilitate knowledge management at HP by holding a series of workshops on the topic. Their idea was to bring together a diverse group of people within the company who were already doing knowledge management in some form, or who were interested in getting started. The corporate ISST group had previously sponsored similar workshop initiatives in the areas of re-engineering and organizational change management. Key objectives for the workshops included the facilitation of knowledge sharing through informal networking, and the establishment of common language and management frameworks for knowledge management. Walker and Sieloff appointed Joe Schneider, an ISST staff member who also focused on Web-based systems, to organize the workshops.

The first workshop was held in October of 1995. An Ernst & Young consultant facilitated the meeting, and presented some proposed definitions and frameworks. About 200 people attended the first session; 13 were from corporate units, and the rest from various business units. Joe Schneider asked participants at the meeting if they were aware of other knowledge management initiatives. From this discussion Schneider compiled a list of more than 20 HP sites where some form of proactive knowledge management was underway. Several of the initiatives are described below.

TRAINER'S TRADING POST

One knowledge management initiative involves HP educators. Bruce Karney is a member of the infrastructure team for the Corporate Education organization, part of HP's Personnel function. Karney estimates that there are more than 2000 educators or trainers distributed around HP, most of whom work within small groups and find it difficult to share knowledge. About two years ago, in response to complaints by the education community that, 'we don't know what's going on,' Karney began work on approaches to knowledge sharing for HP educators. He hoped to make the group more of a community; until this effort, it had no shared history, process, or tool set.

Using Lotus Notes as the technology vehicle, Karney established three different 'knowledge bases' for educators to use:

- Trainer's Trading Post, a discussion database on training topics;
- Training Library, a collection of training documents (e.g. course binders);
- Training Review, a Consumer Reports collection of evaluations of training resources.

Training Review never took off; educators were reluctant to opine on-line about the worth of course materials or external providers, and there was no reward structure for participating. It was therefore merged with Trainer's Trading Post. Trading Library did receive many contributions, but as participants discovered that they could attach materials to submissions to Trainer's Trading Post, that knowledge base became the dominant medium for educator use, and Karney expects that it will be the sole offering in the future.

Karney adopted innovative tactics to get submissions to the knowledge bases. He gave out free Notes licenses to prospective users. When a new knowledge base was established, he gave out 2000 free airline miles for the first 50 readers and another 500 miles for anyone who posted a submission. Later promotions involved miles for contributions, for questions, and for responses to questions. By early 1996, more than two-thirds of the identified educator community had read at least one posting, and more than a third had submitted a posting or comment themselves. Still, Karney was frustrated. Despite his countless attempts with free miles and e-mail and voice mail exhortations, he still felt the need to continually scare up fresh contributions. 'The participation numbers are still creeping up,' he notes, 'but this would have failed without an evangelist. Even at this advanced stage, if I got

run over by a beer truck, this database would be in trouble.'

BUILDING A NETWORK OF EXPERTS

Another knowledge project was initiated by the library function within HP Laboratories, the company's research arm. The goal of this project is to provide a guide to human knowledge resources within the Labs and, eventually, to other parts of HP. If successful, the guide will help to address a problem identified by a previous director of the Labs: 'If only HP knew what HP knows.'

The directory of HP experts, called Connex, is being developed by Tony Carrozza, an 'Information Technical Engineer.' He has been working part-time on the project for almost a year; the system is scheduled to go into its pilot phase soon. It uses a Web browser as an interface to a relational database. The primary content of the database is a set of expert profiles, or guides to the backgrounds and expertise of individuals who are knowledgeable on particular topics. By browsing or searching Connex, it will be easy to find, for example, someone in HP who speaks German, knows ISDN technology, and has a Masters or Ph.D. in a technical field. Upon finding someone, the searcher can quickly link to the individual's home page if it exists.

One concern Carrozza has is how to create a manageable list of knowledge categories in the database that will be widely understood and will accurately reflect the Labs' broad universe of knowledge. Carrozza plans to rely on the experts themselves to furnish their original knowledge profiles and to maintain them over time. He expects that this will be a challenge, and speculated that experts might be given incentives, for example, Carrozza suggested, 'a Dove Bar for each profile' to submit and maintain profiles. As a back-up, a 'nag' feature is built into the system to remind people to update their profiles. Carozza also anticipates that there may be problems with the term 'expert;' he is trying to identify less politically laden terms.

Connex will be implemented originally for the Labs, but Carrozza hopes that the expert network will eventually expand throughout all of HP. He knows that other parts of the company will be developing their own databases, but he hopes that they will use the Connex structure. He is already working with the Corporate Education group described above to create a network of educators using Connex. He adds, 'I know other people are building expert databases. I just don't know who they are.'

KNOWLEDGE MANAGEMENT ON PRODUCT PROCESSES

HP's Product Processes Organization (PPO) is a corporate group with the mission of advancing product development and introduction. It includes such diverse functions as Corporate Quality, Procurement, Product Marketing, Safety and Environmental, and Organizational Change. The Product Generation Information Systems (PGIS) group serves each of these functions. Bill Kay, the PPO director, put PGIS at the center of the PPO organization chart because he felt that information management needed to become a core competence of PPO.

As part of that competence, Kay asked Garry Gray, the manager of PGIS, and Judy Lewis, another PGIS manager, to begin a knowledge management initiative. As a 'proof of concept' the PPO knowledge management group developed Knowledge Links, a web-based collection of product development knowledge from the various PPO functions. Consistent with the philosophy of the knowledge management group, Knowledge Links contained knowledge contributed by 'knowledge reporters and editors,' who obtained it through interviews with experts. The system prototype has been used many times to demonstrate the concept of knowledge management with PPO 'customers,' but the goal of summarizing knowledge across PPO proved overly ambitious, and the system was never built.

The PPO knowledge management group is currently working on three projects. One involves competitor information for HP's Components group. The goal of the second project is to create a Web-based interface to primary and secondary research information. The third system manages international marketing intelligence. Each of these projects are being developed in a collaboration between PGIS and other PPO groups, e.g. Product Marketing and Change Management. The goal is not for PGIS to manage knowledge by itself, but rather to facilitate the process of structuring and disseminating knowledge through the use of information technology.

MANAGING KNOWLEDGE FOR THE COMPUTER DEALER CHANNEL

Perhaps one of the earliest initiatives to explicitly manage knowledge at HP was an effort to capture and leverage HP product knowledge for the Computer Products Organization (CPO) dealer channel. It began in 1985. Technical support for the dealer channel had previously involved answering phone calls; the business unit was growing at 40% annually, and calls from dealers were growing at the same rate. Eventually answering all the phone calls would require all the people in Northern California. HP workers began to put frequently-asked questions on a dial-up database, and the number of dealer support calls began to decline. According to David Akers, who managed the project, the development group views each support call as an error.

The system came to be called HP Network News. It was converted to Lotus Notes and has been remarkably successful in reducing the number of calls. One key reason for the system's effectiveness is the developers' close attention to the actual problems faced by dealers not their own ideas about what knowledge is important. Another important factor is the constant effort by developers to add value to the knowledge. For example, lists are constantly made of the most frequently asked questions, frequently encountered problems, and most popular products. These lists are publicized and dealers are encouraged to download the information from the Notes database. Less valuable information is pruned away. HP Network News is still going after 10 years, and it has been a significant factor in the high support ratings HP receives from its dealers.

SUMMARY

Chuck Sieloff and Joe Schneider are committed to advancing the state of knowledge management, but in a decentralized company like HP it is not clear what steps should be taken. They discuss whether there are actions they could take beyond facilitating the Knowledge Management Workshop. They feel that knowledge is already exchanged well within work groups and even business units, but there is little support in the culture for sharing across units. However, for ISST to try to change the culture just for the purpose of knowledge management seems like the tail wagging the dog.

Schneider and Sieloff also wonder just how different managing 'knowledge' is from managing information. Many of the HP initiatives are arguably a mixture of knowledge and information, and drawing the line between the two is difficult. Sieloff feels that the same fact could be either data, information, or knowledge for different people. Of course, the various information systems groups at HP have a great deal of experience at managing data and information. How relevant is the experience gained in these areas to problems of knowledge management?

Schneider believes that facilitating knowledge management at HP can be viewed as a knowledge management problem. The company has both internal expertise and external sources of knowledge on knowledge management. At the corporate level, Schneider is using the workshops as one mechanism to understand who needs this knowledge and how best to transfer it. He also wants to get the workshop participants involved in an ongoing knowledge management network that shares best practices and transfers emerging knowledge.

However, neither Chuck Sieloff nor Joe Schneider have knowledge management as the only component (or in Sieloff's case, even a major component) of their jobs. They know that other firms are establishing permanent, full-time positions overseeing knowledge management issues at the corporate level—a 'Chief Knowledge Officer,' for example. When Sieloff and Schneider discuss the concept with regard to HP, they question whether a corporate knowledge executive would make sense in such a decentralized company.

The current HP approach, which emphasizes awareness—building and the development of common vocabulary and frameworks through workshops, is a subtle one. The two managers feel it is appropriate for HP's culture, but they are always looking for other techniques and methods that might be introduced.

■ *Case Study*

Knowledge Management at Ernst & Young, 1997

INTRODUCTION

Ernst & Young, one of the world's largest professional services firms, was formed with the merger of Arthur Young and Ernst & Whinney in 1989. Like other 'Big Six' forms, Ernst & Young (E&Y) offered a variety of services to clients, the most important of which were audit, tax, and management consulting. In 1993 Roger Nelson, Managing Partner of E&Y's United States management consulting practice, announced a new strategic plan for consulting that was designed to propel the firm into the forefront of the consulting industry. Called 'Future State '97, (FS '97),' the name of the plan referred to the future vision of E&Y's consulting processes, and the date by which the vision was to be achieved. The plan envisioned $1 billion in 1997 revenues (roughly doubling the 1993 figure) and described operational visions in five key processes: sales, service, delivery, people, and knowledge.

The emphasis on knowledge processes was new to E&Y. Some of the knowledge process goals in Future State '97 included capturing and leveraging knowledge from consulting engagements, having every consultant contribute to the firm's stock of knowledge, and becoming known by clients as a valued source of knowledge and thought leadership. Another key aspect of the strategy was to use knowledge to speed up the process of providing consulting solutions for clients. By 1995 the strategy had been formalized into an approach called the Accelerated Solutions Environment, which involved the rapid application of E&Y knowledge, models, and approaches to client situations in facilitated large group settings.

The strategy also led to the creation of several different knowledge-oriented organizations within the consulting practice, each of which had existed in some form before. In 1990 E&Y had created a center in Boston to perform early-stage research into issues of technology and management. Originally called the Center for Information Technology and Strategy, it became the Center for Business Innovation under FS '97. The Center had worked on such issues as business process reengineering, organizational change management, and knowledge management, and had helped to establish E&Y's reputation for thought leadership. The Center for Business Technology, based in Dallas, had for several years developed methodologies and automated tools to support consulting engagements. It maintained, for example, the firm's Navigator methodology for system development, and supported its Fusion methods for integrating technology and business change. Finally, the Center for Business Knowledge had its origin in the firm's Management Consulting Information Center in Cleveland, which served as a library for consulting methods and techniques as well as engagement documents. The idea behind the three centers was that the Center for Business Innovation would create new knowledge, the Center for Business Technology would structure knowledge into methods and automated tools, and the Center for Business Knowledge would gather and store both the firm's acquired knowledge and external knowledge and information.

Several new positions and oversight committees were also created as an outgrowth of FS '97. John Peetz, who had previously led the firm's Western Regional Performance Improvement Consulting Practice, became the firm's first Chief Knowledge Officer. The role involved overseeing the processes and technologies of the firm that related to knowledge. He and the directors of the three centers were advised by a Knowledge Process Committee consisting of senior consulting partners from around the US practice. The Committee's role was to recommend both topics on which knowledge was necessary and means by which knowledge could be integrated into E&Y's consulting practice. The US E&Y firm also set up a Knowledge Committee to address knowledge management issues that cut across consulting, audit, and tax, and shortly thereafter a Global Knowledge Committee was established to address issues in the entire E&Y organization worldwide. John Peetz served as the head of both committees. In addition, E&Y hired a new Director for the Center for Business Knowledge. Ralph Poole had previously been head of Bain and Company's Experience Center, which had several similar functions to E&Y's Center.

At roughly this same time, the Center for Business Innovation was beginning substantial

research into knowledge management topics. Together with the Strategic Issues Forum, Center researchers held three conferences on knowledge management, all of which were well-attended. The Center also organized a multi-client research program, called Managing the Knowledge of the Organization, in which 15 companies explored topics of mutual interest around knowledge and learning. It was hoped that the Center's research would provide insights that could be applied both to E&Y client engagements and to internal knowledge management activities.

At the same time E&Y was also organizing a consulting practice around knowledge management. About 20 consultants were identified who had either expertise or strong interest in knowledge management issues, and a 'Knowledge Management Network' was formed. Several client engagements were secured in which knowledge management played a key role. Most members of the network felt that it was very helpful in client work to be able to learn from (and refer clients to) work done to manage knowledge internally.

ACTIVITIES OF THE CENTER FOR BUSINESS KNOWLEDGE

With Ralph Poole's arrival, the Center for Business Knowledge (CBK) quickly expanded its functions and became critical to E&Y knowledge strategy and tactics. By the end of 1996 the CBK would have more than 100 professionals. It included a library, a call center for answering consultant requests, and a database of consultant skills. The CBK spent considerable time identifying and tracking subject matter experts, and ensuring that they were present in sufficient number on industry and client teams.

CBK managers also had responsibility for organizing a set of knowledge networks within the consulting practice. A network was organized for each key domain of knowledge within the consulting practice. There were 22 networks in the US practice. Some were based on industries, e.g. energy; some involved particular consulting approaches, e.g. business process re-engineering, and some involved key areas of technology in which the firm consulted, e.g. the SAP package. Some regions also had 'knowledge focus groups' on narrower topics such as activity-based costing or shared corporate services. Each network met occasionally fact-to-face, and had an online discussion and document database in Lotus Notes. Key to the success of the networks were a group of facilitators. Each network was assigned half a person to capture the knowledge from particular engagements, to prompt consultants to add their own learnings, and to edit and prune the discussion and document databases. The consultants who performed these roles had expertise in the domains of the networks they facilitated; they rotated into the knowledge facilitator positions and then back into line consulting positions.

The CBK was also responsible for a database of the skills possessed by E&Y consultants. The firm had long employed such a database to aid in assigning consultants to projects. However, keeping the skill categories updated and relevant to the current consulting environment had always proven difficult. However, the CBK and the Knowledge Process Committee were working on a new model for evaluating and describing competencies. Instead of consultants evaluating themselves, their competencies will be assessed by their supervisors. The competencies will be entered into a new information system from PeopleSoft. Combinations of competencies will also be assessed at the engagement team level to ensure that each client team has the requisite skills to succeed.

Another key task of the CBK was developing a knowledge architecture and taxonomy. The purpose of this architecture was to focus knowledge acquisition and retrieval efforts. In the beginning of E&Y's knowledge management efforts, the philosophy was to 'let 1000 flowers bloom.' As the initiatives matured, however, it was important to focus knowledge management in specific domains. The knowledge architecture would specify the categories and terms in which E&Y needed to gather and store knowledge. The architecture would also be used by consultants and knowledge facilitators in searching databases and document files. Key areas of E&Y knowledge would be represented in 'Power Packs,' a structured and filtered set of online materials including qualifications, sales presentations, proposal templates, and answers to frequently-encountered issues. Some knowledge domains would remain relatively unmanaged, and any E&Y personnel could contribute anything they wished to them.

TECHNOLOGY PLATFORMS FOR KNOWLEDGE MANAGEMENT

E&Y knowledge managers believed that knowledge primarily resided in people, not technology.

However, the scope and geographical distribution of the E&Y knowledge base and its users meant that technology had to be used as an enabler wherever possible. Lotus Notes had been selected as the primary technological platform for capturing and disseminating internal knowledge. By early 1996 there were already 2000 different Notes databases, most of which were discussions in networks and focus groups. The CBK maintained a Notes database of key documents; by 1996 it was being accessed over 16,000 times a month. Notes would continue to be the preferred internal platform in the short run, but E&Y technologists at the Center for Business Technology were exploring the possibility of using Web-based technologies for knowledge management in the future, and they were already the primary tool for external knowledge searches.

As with the knowledge architecture, E&Y had allowed multiple technologies to proliferate in the early days of knowledge management. There were between 200 and 300 local applications and databases. Now, however, the firm wanted consultants to focus on content rather than applications. Approximately 12 to 15 applications would eventually support knowledge management, including Notes, the Web, the skill database, and a few others.

E&Y had also made major investments in technology infrastructure that were not undertaken only for purposes of knowledge management, but certainly benefited that cause. Altogether, E&Y was spending 6% of its consulting practice revenues on knowledge management and technology. A key goal was commonality of hardware and software. E&Y had abandoned its support for Apple Macintosh computers and moved to an all-PC standard in 1995. It adopted common operating system, word processing, spreadsheet, and e-mail software at the same time. These standards meant that programs and documents could be exchanged easily around the firm.

With the extension of the common technology platform around the entire US practice, a key focus was putting knowledge, models, tools and techniques into the Accelerated Solutions Environment (ASE). Substantial progress had already been made on the ASE; many industry and business process models for data and activity flows had been put into a form that ASE-oriented engagements could employ. The ASE was how E&Y consultants would deliver many of their services in the future, and had already been used on several client engagements. In one situation, two banks had merged and had to decide what information systems would be used in the combined bank. A fact base and approaches for using it were put into the ASE automated toolkit, and used in a 3-day event with the client. A more traditional approach might have required several months. E&Y knowledge managers expected that the ASE would become the primary vehicle for the application of knowledge to client work. The Center for Business Technology was constructing the ASE technology environment, while the Center for Business Knowledge developed the knowledge objects, frameworks, and techniques used in it.

CHALLENGES TO KNOWLEDGE MANAGEMENT

While substantial progress had been made in E&Y's approaches to knowledge management, significant challenges remained. Embedding knowledge in technology was an ongoing issue, with the technology options changing rapidly and the support requirements growing with increased use. It was particularly difficult to use technology to support some types of consulting knowledge—e.g. building relationships with senior client executives—which were tacit in nature and difficult to extract from the minds of practitioners.

There were also issues remaining in terms of the culture for knowledge management and use. Senior management support for knowledge as a key competitive advantage was high, and high levels of resources were being directed at knowledge management. In terms of E&Y consulting practitioners, the buy-in to knowledge management had been good in general, but there were still weak spots. The E&Y consulting culture was traditionally based on pragmatism and experience rather than a conceptual orientation; while the culture was changing, there were many consultants who had entered the firm and prospered under the old model and found it difficult to aggressively pursue structured knowledge in systems and documents. The old culture had also placed a strong emphasis on highly structured methodologies, and the new approach was to provide more background knowledge to allow consultants to improvise an approach to suit the particular client situation. This was also a difficult adaptation for less conceptually-oriented consultants. One key question among E&Y knowledge managers, then, was how rapidly to proceed in trying to change the receptiveness to a strong knowledge orientation. One key means for changing the culture was embedding knowledge orientation into the firm's performance evaluation process; consultants were

now evaluated in part on their contributions to and use of knowledge.

Another challenge at E&Y, as in virtually all organizations adopting knowledge management, was assessing its progress and whether the resources devoted to it were justified. The CBK in particular had made numerous attempts to measure its own effectiveness and that of knowledge management in general. It assessed, for example, the number of telephone and computer-based requests for its services, and tried to track sales or engagement wins in which knowledge use had been a critical factor. For each of the firm's knowledge networks Ralph Poole, the CBK director, created a 'dashboard' assessing such topics as value delivered, reusable content created, thought leadership, presence of subject matter expertise, and a good networking environment. Still, Poole and other E&Y knowledge managers felt that it was impossible to fully justify knowledge management investments and that some level of faith was required. In early 1996 the level of faith was quite high, and there was much anecdotal evidence of knowledge impact. The perception that knowledge management led to increased performance was undoubtedly aided by E&Y's recent performance; the US consulting practice's revenues in 1995 were up by 44%, which surpassed both the FS '97 targets and all other 'Big Six' consulting practices in the US

Knowledge management had apparently been successful in consulting, and the next task was to extend it into other E&Y practices and geographies. progress was being made in both areas. The CBK was beginning to support the US audit and tax practices, particularly in sales efforts. The cultural issues around knowledge use were perhaps even greater in these practices than in consulting, but the need for change was high. The audit practice in particular had recently redesigned its processes to place a much greater emphasis on industry and company knowledge.

The implementation of knowledge management was also taking place on a broader geographical basis. Chief Knowledge Officer positions had been established in Canada and Europe, and smaller versions of the CBK were also being set up in both places. The Global Knowledge Committee was discussing what knowledge domains could be shared geographically. Of course, each geographical region and country had its own set of cultural, organizational, and technical issues to be addressed in terms of knowledge management.

While John Peetz, Ralph Poole, and the growing number of E&Y knowledge managers were pleased with the firm's progress thus far, they felt that they were still in the early stages of their efforts. The only thing of which they were certain was that there would still be many changes and challenges that they would have to face in the future.

■ *Case Study*

Teltech: The Business of Knowledge Management

INTRODUCTION

Teltech, a small ($17 million in revenues) company based in Minneapolis, offers instructive lessons to companies wishing to better manage their knowledge and information assets. The company has built a successful business on helping companies get access to external technical expertise and information. However, some of its strategies and services could be adopted by firms wanting to take better advantage of all types of internal knowledge. Specifically, Teltech's business model includes the following information management innovations that will be described in this field profile:

- A hybrid environment of people and technology-based services.
- Pointers to people with expertise.
- Mapping of information sources.
- A structure and a set of techniques for categorizing knowledge.
- Focusing on the information behavior of customers.

Each of these innovations will be described separately after an overview of Teltech and its services.

TELTECH OVERVIEW

Teltech was formed in 1984 by Joe Shuster, a chemical engineer who had already built and sold a successful cryogenics engineering company. Shuster felt that his previous firm would never have been successful without accessing a broad range of experts from outside his organization. As a result, he saw an opportunity to facilitate the process of knowledge gathering for technically-oriented companies (knowledge is defined here as information with a high degree of value-added, i.e. the interpretation, context, and implications of information that experts can provide).

Teltech originally planned to offer only access to a network of technical experts. But early research with potential customers suggested that they also wanted access to online databases. Teltech decided to offer both services. Over time, additional services were added as customer needs became apparent. Now Teltech offers four basic services, each of which is described below.

1. The expert network

Teltech maintains a network of thousands of experts in technical fields. The experts, over 3000 of whom can be found in Teltech's online system, are typically academics, recent retirees from industry, or consultants. When a client calls Teltech, they engage in a dialogue with a Teltech 'knowledge analyst' about their problem, or they are given one or more names of experts who can speak knowledgeably on the customer's issue. These names are principally found in Teltech's expert database. If the client calls the expert and has a discussion, Teltech bills the client and the expert receives a payment from Teltech. Teltech sources suggest that most experts do not participate for the money they receive but rather for the professional networking and the learning.

All Teltech experts have agreed to the pricing for their advice, have pledged to keep the client's information confidential to protect its proprietary interests, and to avoid using the Teltech referral as an opportunity to sell their own consulting services (though clients sometimes ask experts to consult, which does increase the attractiveness of serving as a Teltech expert). The issues on which experts are sought vary widely from call to call, as Exhibit 1 suggests.

Exhibit 1
A sampling of expert network issues
- Antibacterial activity of wood oils
- Patents for engine heaters
- Power plant construction forecasts
- Electronic buoys
- Thermal blankets for jet engines
- Human-powered submarines
- Dicing of sapphire
- Fire-fighting foam

2. Assisted database searches

Teltech offers access to over 1600 online databases. Searches are assisted by Teltech knowledge analysts. When a client calls Teltech for a literature search, he or she dials into Teltech computers. The analyst explores the search topics by telephone with the client and then accesses the appropriate databases. Using special Teltech software, the analyst can then 'take over' the client's screen, displaying the formats and results of searches to the client and discussing the search. Both the client and the analyst are accessing the same screens simultaneously from different sites and are talking on the telephone at the same time. After useful sources have been located, the search results can be saved or printed by the client. The average search interaction takes 25 minutes.

3. Vendor service

Teltech found that clients were often interested in whether vendors existed for particular technical products or services; it now offers a vendor search service. The service begins when the client calls and describes the desired product or service (e.g. an aluminium smelter with extra-wide casting capabilities to produce a new product component) over the telephone. Then, using a combination of databases, printed buyer's guides, and the Teltech expert network, the analyst locates a likely vendor. The analyst calls the vendor, confirms that it offers the product or service, and discusses availability issues. The client is then given the results of the search. The search frequently requires the analyst to get more information from the client, e.g. technical properties and typically extends over two or three days.

4. Technical Alert service

A logical extension of Teltech's work in information management was proactively supplying information on topics deemed critical by Teltech clients. Technical Alerts are weekly briefings for clients provided via computer on the most significant technical developments from researchers around the world. There are several different types of alert services, such as materials, coatings, sensors, and biotechnology. Because the Technical Alert analysts directly contact researchers, in many cases Teltech clients can hear of technical advances well before they are published in trade and professional journals.

Teltech services can be accessed by phone, fax, computer dialup, or Internet. About 70% of service requests arrive by phone, though the Internet channel is growing rapidly. Teltech can deliver the results of its searches across multiple media as well. Until recently, Teltech asked clients to schedule literature searches in advance; now, however, it responds to client calls in real time.

Teltech has approximately 160 employees. A large proportion are knowledge analysts in the expert network, assisted search, and vendor services. The company also has a group of 'knowledge engineers' who structure the information in Teltech's databases; this process is described below. Another group of employees works on information systems for new products and services. In the field, each client typically has two Teltech personnel assigned to it: a sales person, who sells the Teltech service to clients (typically to a vice president of technology or R&D) and a facilitator, who trains client personnel in the use of Teltech services, attempts to increase usage, and addresses problems or barriers to use when necessary. Other employees work in administrative or management functions at Teltech headquarters.

Unlike many information providers, therefore, a high percentage of Teltech's resources are focused on adding value to information. There are many sources of information for Teltech's chosen market, i.e. the technical professional. Few information providers, however, are as broadly focused on providing useful information and expertise to scientists and engineers.

LESSONS FROM TELTECH

Although Teltech is an information-providing company, the design of its business can be instructive for information providing functions in companies outside the information industry. Each of the lessons provided by Teltech is described below:

People-technology hybrid services

Teltech was founded on the assumption that people are effective guides to information and knowledge. Expert, database, and vendor searches are all mediated through the Teltech knowledge analyst. While clients are entitled to search through Teltech's expert database themselves, most do not choose to do so.

Viewing the knowledge analysts at work makes it obvious why their services are desired. Most clients who call Teltech have not perfectly articulated their information need. It is only through the dialogue with the knowledge analyst that the connection between the true information need and the available sources really emerges.

For example, one client from a textiles firm called a knowledge analyst wanting information on 'biodegradable packaging.' After some interaction with the knowledge analyst it became apparent that she actually wanted information on biodegradable test methods for rayon. She thought she wanted to search in chemical databases, but when she was informed that there are specialized databases specifically about textiles, she preferred to search there.

Another client from a pharmaceutical company asked for an expert or literature on 'therapeutic substitutes for ethical drugs.' The client first phrased the question as a scientifically-oriented information need, but upon further discussion it became apparent that the need was marketing-related. The Teltech knowledge analyst was able to elicit the true nature of the client's need, although it took 70 minutes to redirect the search and find the desired information.

The people who perform this work are unusually capable information providers. A librarian in a Minneapolis-based client of Teltech noted that, 'Teltech pays better than any corporate library in town, so they tend to get the best people.' Teltech personnel are also expected to undergo a substantial amount of training on information sources, search techniques, and emerging fields of knowledge. Formal and informal seminars offered recently are described in Exhibit 2. Many courses are taught by Teltech knowledge analysts themselves.

Exhibit 2
Recent Training Programs for Teltech Knowledge Analysts

- Chemical Abstracts Enhancements
- Overview of Defense Files
- Definition of Materials Properties
- Overview of Reports Available on the D&B Gateway System; Dow Jones Basics
- Dow Jones Advanced Topics
- DIALOG 'High Tech' Applications
- DIALOG Biomedical Searching.

The lesson from Teltech here is that purely technical approaches to information and knowledge provision will rarely add as much value as hybrid approaches. Teltech's people aid its clients in defining what information is desired, clarifying concepts and terms, interpreting search results, and knowing when and where to seek further information. Such tasks are unlikely to be the province of machines in our lifetime.

POINTERS TO PEOPLE

A key premise of Teltech's business model is that people are not only guides to information, but also an important repository of expertise. Teltech does not attempt to capture the experts' knowledge in a database (though within the vendor service there is a database of past search results), but only the topics about which they are expert, and the means for connecting topics to people. Capturing the knowledge itself on such a broad range of topics would not be feasible, though Teltech is investigating the feasibility of capturing frequently-asked questions and answers.

Teltech clients find it very helpful to talk to experts when they have a technical problem. As one client, a VP of Technology at an aerospace firm, stated, 'There is nothing like talking to someone who has spent their entire life working on a problem.' Another client described a situation in which an expert was sought to recommend the appropriate material for a new product:

> *'It is very hard to estimate the years of knowledge the experts have. You could hardly research this in a short period of time. I would say it would take probably weeks or months to gather conclusive information. If we selected the wrong material the unit could eventually fail. Unit cost is $600. The customer's confidence in us could also be affected and we could lose the whole program ($1–$2 million).*

One client noted that even when the expert referred by Teltech was not the ideal source for a problem, he or she invariably had enough knowledge about the topic to refer the client to the right expert. The client then has the option of pursuing the referred expert through Teltech.

The useful lesson here is that knowledge management is best accomplished not through copying the knowledge from the heads of people to put it in computers. Instead, computers can store databases of names and locations of individuals, who have not only raw information but also experience and expertise.

MAPPING OF INFORMATION SOURCES

Teltech draws information from a wide variety of sources. In the assisted database search area alone, there are over 1600 databases to which Teltech has access. This is in addition to information from other Teltech services, including vendor databases and Teltech's own expert database. Clients are not always aware of all these potential sources, particularly when they must subscribe to differnt Teltech services in order to receive all possible useful information on a single topic. Teltech currently has access to databases of literature, of vendor sources, and of experts, but up to now these have not been integrated.

A key focus of Teltech's product development over the past several years has been the development of software providing an integrated view of sources of information on a particular topic. This capability, which Teltech currently calls the 'integrated source map,' is approximately 6 months from completion, according to Teltech managers. The software for the map has been developed, but it has not yet been populated with information sources. To do so will require Teltech to negotiate new relationships with information providers.

The idea of the product is that when a client asks (either directly to the system or through a knowledge analyst) for information on, for example, neon lasers, he or she would be informed that there are three experts who could be consulted, 42 patients in the area, 94 articles published within the past three years, an upcoming conference on the topic, and several federal and state codes and regulations governing the use of

the devices. The information would be presented in an easy-to-understand matrix format, and the client's relationship to the information will be via a 'natural language' interface.

Teltech believes that the integrated source map will be a major addition to its organizational capabilities. It will present virtually all the information that a customer might want on a particular topic. The company's plan for pricing its services once the map is available is to not charge the client when creating a 'knowledge map,' but only when he or she pursues and receives a particular item of information. Teltech also believes that the integrated source map may be a saleable product itself.

Particularly in a complex information environment like Teltech's maps to information sources are an extremely valuable resource. If all sources can be integrated into one map, as is planned at Teltech, it becomes easier to use and more valuable to the information consumer. The difficulty of such mapping is evidenced by the still-pending state of Teltech's product development.

A STRUCTURE FOR KNOWLEDGE

Perhaps the most difficult aspect of Teltech's services to emulate would be the structure it has established for categorization and later searching of knowledge. The difficulty comes in the level of initial and ongoing investment in the knowledge databases and biographies that serve as the basis of Teltech's services.

As an example, when clients call for access to experts, they are unlikely to always use the same terms as the experts use in describing their work. Therefore there must be some 'translation' function performed by Teltech in connecting client needs to available expertise. This function is performed by knowledge analysts in combination with Teltech's online search and retrieval system, the 'KnowledgeScope.' The KnowledgeScope includes a thesaurus of over 30,000 technical terms. It is maintained by several full-time 'knowledge engineers' who add 500 to 1200 new concepts per month to the database and remove outdated ones as well.

Each technical term has a preferred usage and several possible synonyms. Teltech's goal is to have the terms in the database that are used by clients. Therefore, each day the knowledge engineers receive a list of terms sought unsuccessfully in the database by knowledge analysts or clients accessing the database directly. Many of the unsuccessful searches are misspellings (one client, for example, searched for information on 'tomatoe'; whether this user was Dan Quayle could not be confirmed by Teltech), but valid misses are added to the database. Only the knowledge engineers are able to add new terms or concepts, but the knowledge analysts often suggest new terms through electronic mail or face-to-face conversations with the knowledge engineers.

Until 2 years ago, Teltech's approach to structuring knowledge had been hierarchical, rather than thesaurus-based. Its previous database was called the Teltech 'Tech Tree' and had several key knowledge branches, including scientific/technical, medical, chemical, etc. However, both clients and knowledge analysts found it difficult to navigate through the tree, and new terms tended to be added at inappropriate levels of the tree. Teltech has found the thesaurus approach to be much more satisfactory.

Teltech also maintains a database of expert biographies, which is linked to the thesaurus through keywords. Each expert is asked on being recruited by Teltech to fill out a detailed biography form. Teltech then constructs a set of keywords that link each expert to the concepts in the thesaurus. A textual description of the expert is also created, which can be read in whole or in part by knowledge analysts as they describe an expert to a client, or as the client accesses the biography directly. The expert biographies are updated annually to reflect new expertise and new terminology. Further, new experts are always being added to the database.

Teltech's efforts in creating a structure for knowledge are instructive for other types of firms. If knowledge is going to be captured and leveraged, it must first be categorized. The thesaurus-based approach employed by Teltech may be promising for many situations, since knowledge is usually communicated and sought in words, and words are the primary unit of knowledge in a thesaurus.

FOCUS ON INFORMATION BEHAVIOR

Teltech is highly oriented to the 'information behavior' of its clients, i.e., how they seek out, use, share, and manage information. In conversations with Teltech employees one often hears references to research or experience about the information behaviors of technical professionals.

In such cases, Teltech attempts to respond to the behavior, as described below for several examples: Engineers may not want to admit they don't already know the answer to a question, so Teltech attempts to create an environment in which clients can take credit for information acquired through Teltech;

- Technical people will normally not travel beyond 40 feet for information, hence Teltech's attempts to provide information at the desktop;
- Teltech clients don't often know exactly what information they are seeking, so the process of requirements definition is structured into interactions with knowledge analysts;
- A survey found that 88% of scientists and engineers say they get the information they need at work themselves, but only 20% are happy with the result; client knowledge of this finding would tend to encourage more Teltech use;
- Another motivator of increased usage is the research finding that technical people who seek external information have more successful projects.

There are no general rules about how to manage information behavior. But Teltech undertakes many projects and actions to try to improve the information behaviors of clients. Individual knowledge analysts reported, for example, that they must often 'sell' the idea of calling an expert to a client. One knowledge analyst enthusiastically described the capabilities of an expert to a client, and then added, 'I've talked to him before, and he's very approachable. Why don't you go ahead and give him a call.'

Teltech has also found that technical professionals are highly motivated by seemingly insignficant technical 'toys'. One of Teltech's marketing approaches is to offer new expert searchers a pen that has a bulb on the top in which a liquid boils from the heat of a finger applied to it. At conferences the company hands out 'Tech Pets,' small pieces of plastic that rotate in mysterious ways; clients are urged to seek the reason for the device's strange behavior from 'Dr Bovee,' an imaginary expert who is listed in the database. These trinkets motivate technical professionals through their technical curiosity.

Finally, Teltech also attempts to influence information behavior through the 'gatekeepers' for external information in firms. One such group is librarians; where librarians exist in firms Teltech attempts to cultivate their understanding and good will toward Teltech. Some librarians are threatened by Teltech services, feeling that using them reflects poorly on the information they provide to clients. Other librarians are content for their technical professionals to use Teltech for expert discussions, but encourage use of their own database search services.

Teltech also attempts to cultivate senior technical or research managers, who typically agree to sign usage agreements with Teltech. Their active encouragement of Teltech use by technical professionals can have a major influence on information behavior. One senior Teltech client executive described how this works:

> *'When I am being given a presentation on the status of a project, I will ask the project team, ''Did you check with a Teltech expert to see if that is a viable concept?'' At first all I got was ''no'' for an answser. But now they see that I am serious about it, and they are starting to turn to Teltech much more frequently.'*

Teltech provides senior client executives with a Service Summary each month, which notes who has used the service and what type of expertise they were seeking. As one client librarian noted, 'Occasionally we see that someone is working on a hobby and seeking expert advice on it. But there is very little incidence of abuse.' Teltech also provides a newsletter for senior client executives called 'Knowledge Notes: News for Leaders of the Knowledge Revolution.'

The best knowledge management environment is of little value unless the knowledge is used. Teltech's focus on information behavior is not motivated by philosophy but by good business sense. If technical professionals do not seek out Teltech's expertise network, Teltech makes no money. Even in companies where the primary product is not information, internal information providers should follow Teltech's lead. At some point they will be evaluated on how their information is used.

SUMMARY

Teltech is a bellwether of new practices in information and knowledge management. It has created a successful business out of a set of practices that can and should be adopted by firms who are not primarily in the information business. The information management innovations described above are relevant to almost any

firm. As evidence of this relevance, Teltech personnel are increasingly being asked not just to provide external expertise and information, but to help their clients design new knowledge management environments.

But adopting the lessons from Teltech will not be easy in the current business environment. Teltech services go 'against the grain' of information management approaches in most firms. They are labor intensive, requiring personnel with both good information skills and good people skills. They require substantial investment in technologies and information sources. They involve developing close, long-standing relationships with information customers, and in many cases mean changing customer behavior, which is always difficult. The challenges of following the Teltech model are attested to by the absence of direct competitors for Teltech.

In short, while many companies talk about knowledge management, 'the learning organization,' and intellectual capital, Teltech is one of the very few companies that can claim to be putting these concepts into practice. As usual, it is much easier to talk about important management innovations than to do something about them.

■ *Case Study*

Knowledge Management at Microsoft, 1997

INTRODUCTION

Since its founding in 1975, one of the competitive advantages of Microsoft Corporation has been the quality of its people. The highly successful software firm goes to extraordinary lengths to hire people with strong intellects and capabilities. According to the authors of *Microsoft Secrets*, a book about the company, one of Microsoft's key strategies is, 'Find smart people who know the technology and the business.'

One of the reasons why Microsoft people need high levels of competence is the fast-changing nature of the industry in which it competes. Microsoft rose to its position of industry dominance in a period of a few years, and Bill Gates, the company's well-known chief executive officer, is determined that the company will stay on top. For example, Gates and other Microsoft executives recently concluded that the company needed to embrace the Internet and incorporate it into virtually all products and services. As a result, software developers and marketers need to be able to acquire new skills quickly.

This unusual attention to human resource capabilities, however, is not restricted to product-oriented personnel. Microsoft's internal Information Technology (IT) group, for example, faces the same pressures to produce software and to adapt to rapid industry change. The IT group consists of over 1000 employees who develop applications, build infrastructure, and operate computers and networks. Unlike many firms, Microsoft's IT group does not tolerate 'legacy people' whose skills have become obsolete. If Microsoft's product set includes, for example, OLE (object linking and embedding) technology, then the internal IT group must rapidly incorporate it into the company's internal systems. The knowledge base for Microsoft IT must always be current.

Therefore, the IT group has focused heavily on the issue of identifying and maintaining knowledge competencies. Neil Evans, the former head of the IT group, is now addressing the issue as a researcher on a National Science Foundation project at the Northwest Center for Emerging Technologies. Chris Gibbon, the current IT director, hired Susan Conway as a Program Manager to take on the issue of knowledge competencies. Conway had developed similar competency programs at Computer Sciences and Texaco before coming to Microsoft.

Conway's goal is to create an online competency profile for jobs and employees within Microsoft IS. A pilot in an 80-person application development group was completed in November 1995, and full implementation is proceeding. The project, called Skills Planning 'und' Development (thus affectionately known as 'SPUD'), is focused not on entry level competencies, but rather on those needed and

acquired to stay on the leading edge of the workplace. However, shortcomings in the educational system must be addressed by competencies acquired on the job.

The SPUD initiative is being managed by the 'Learning and Communication Resources' group with Microsoft IT, which also has responsibility for training and education for IT personnel. The goal is to use the competency model to transfer and build knowledge, not merely to test it. When Microsoft IT employees have a better idea of what competencies are required of them, they will be better consumers of educational offerings within and outside Microsoft. The project is also expected to lead to better matching of employees to jobs and work teams. Eventually the project may be extended throughout Microsoft and into other companies.

There were five major components to the SPUD project:

- Development of a structure of competency types and levels;
- Defining the competencies required for particular jobs;
- Rating the performance of individual employees in particular jobs based on the competencies;
- Implementing the knowledge competencies in an online system;
- Linkage of the competency model to learning offerings.

DEVELOPING THE COMPETENCY STRUCTURE

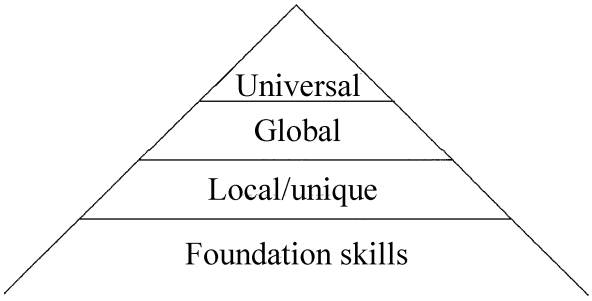
Before the project began Microsoft had already defined certain competencies, but they were largely restricted to entry-level skills. The Northwest Center was also studying entry-level skills for software developers, e.g. requirements definition for a new system. These base-level competencies became known as foundation knowledge in the four type model used in the SPUD project (Exhibit 1).

Exhibit 1

Types of competencies
Above the foundation level there are *local* or unique competencies. These are advanced skills that apply to a particular job type. A network analyst, for example, might need a fault diagnosis competency for local area networks.

The next level of competencies are *global* and would be present in all employees within a particular function or organization. Every worker in the Controller organization, for example, would be competent in financial analysis; every IT employee would be competent in technology architectures and systems analysis.

Exhibit 1



The highest level in the competency structure is *universal* competencies; universal, that is to all employees within a company. Such competencies might be a knowledge of the overall business a company is in, the products it sells, and the drivers of the industry. A course for all employees sought to provide general knowledge of the software industry and Microsoft's strategies.

Within each of the four foundation competencies there are two different types. Explicit competencies involved knowledge of and experience with specific tools or methods, e.g. Excel or SQ 6.0. Requirements definition competency, for example, is an implicit competence. Implicit competencies involve more abstract thinking and reasoning skills. At Microsoft, the implicit competencies are expected to remain quite stable over time, although one new one, Web authoring, was recently added. Explicit competencies, of course, change frequently with rapid changes in fortunes of particular languages and tools. Within all four competency types, there are 137 implicit competencies and 200 explicit ones.

Within each type of competency there are also four defined skill levels. A worker might have, or a job might require, any of the levels below:

- basic
- working
- leadership
- expert

Each skill level for each competency is described in three or four bullet points that make the level clear and measurable. The goal of the skill descriptions is to avoid ambiguity in rating jobs and employees.

A sample competency description for data administration is shown in Exhibit 2.

T430	Data Administration/Repository Mgt.
Definition:	**Development and maintenance of a flexible, efficient and shared data environment utilizing facilities such as data models, data definitions, common codes, reference data bases and data tool-sets.**

Level 1: Basic knowledge of data administration and repository management

- Basic knowledge of the principles and practices employed in the management of data and repositories.
- Familiar with information models and modeling.
- Understands the rationale behind maintaining a centralized, reusable library of the business and enterprise models of a corporation.

Level 2: Working knowledge of data administration and repository management

- Working knowledge of the principles, practices and tools associated with the access to and updating of local repositories.

Level 3: Mastery of data administration and repository management

- Knowledge and demonstrated experience in data management.
- Can assess the impact of functional/regional data changes on the enterprise model.
- Able to integrate the business data and process models into the enterprise model.
- Recognized as a data expert in a functional area.

Level 4: Leadership and recognized expertise in data administration and repository management

- Subject-matter expertise in the management of local, regional and enterprise wide information/data models.
- Recognized as a data expert in major functional areas.
- Reviews information models for compliance, content quality consistency and impact on enterprise models.

Exhibit 2

Sample competency description

DEFINING COMPETENCIES FOR PARTICULAR JOBS

Since one of the purposes of the SPUD project was to match jobs and employee capabilities, each job in Microsoft IT had to be rated in terms of the competencies required to perform it. This task was typically performed by the manager to whom the job would report. There are 40 to 60 competencies in the average job template.

One early problem that emerged with the job ratings was that it took a manager between two and three hours to rate a job in terms of the competencies needed. In order to deal with this issue, managers were encouraged to rate only the highest priority competencies, i.e. those requiring the highest skill levels. The goal was to have the job rating process require only about a half hour. The system also included a 'measurement model' with suggestions for the supervisor about how a particular competency might be evaluated. Because the goal was knowledge transfer rather than testing, employees also had access to the measurement model.

RATING EMPLOYEES ON JOB COMPETENCIES

Another key step in the project involved evaluating workers in terms of the competencies they have exhibited in their current jobs. The initial rating is built in an iterative fashion by the employee and his or her supervisor; eventually the entire work team will participate. After an initial rating by both parties they meet and resolve their differences. The rating process is intended to serve as an occasion for conversation about the employee's competencies; the supervisor may not be aware, for example, of experience with a competency area prior to the current job.

The overall goal of the employee rating process is to build a competency inventory that can be used all across Microsoft. A manager seeking to build a team for a new project can no longer know personally all of the employees who might be qualified for the job. Therefore, the supervisor could query the on-line system and ask, 'Give me the top five candidates who have leadership skill levels on 80% of the competencies for this job

and who are based in Redmond (Microsoft's head-quarters location in Washington).'

In the pilot of the SPUD project, both supervisors and employees tended to require extremely high skill levels to give good ratings. Susan Conway expected that this problem would be solved when the detailed characterizations of skill levels were available, so that the specific experience of the job and the worker could be easily compared to the skill level.

BUILDING AN ONLINE COMPETENCY SYSTEM

The SPUD project involved building an online system that contained the competency structure, the job rating system and ratings database, and the competency levels for employees. Conway had built a prototype of the system for the pilot using Microsoft Access; though it had worked well, the system needed greater performance and robustness, and was being ported to SQL Server. The system would have a Web front end for easy access around the world through Microsoft's Intranet.

Though the technical implementation was fairly straightforward, there were issues to be resolved. One of these was the location of data. After discussion it had been determined that job data would be managed centrally; employee data needed to reside in the group/country of origin, but would be replicated to a central database. Access and security issues were a concern because people data were involved; it was viewed as inappropriate even for managers to have access to all competency profiles for employees at levels below them. It would also be undesirable for managers composing teams to 'raid' existing teams for members with desired competencies. The details of access had yet to be determined.

LINKAGES TO EDUCATIONAL RESOURCES

Because a key goal of the project involved linking competency profiles to educational resources, some linkages to specific course opportunities inside and outside Microsoft had already been developed, although substantial work remained. Ultimately, the Learning and Communications Resources group hoped to be able to recommend not only specific courses, but even specific material or segments within a course that would be aimed at the targeted competency level. Conway hoped to use the system to assess course demand on the basis of role descriptions and the competencies they required. Ultimately, everything from internal brown bag seminars to external courses offered in the Puget Sound area would be rated as to the competencies and skill levels for which they were appropriate.

IMPLEMENTING THE COMPETENCY MODEL

The pilot for the SPUD project had gone well, and now implementation was proceeding with all 1000 people and their jobs in the Microsoft IT group. Implementation was proceeding across geography and function, starting with the Operations function, then the Applications function, and all jobs in Europe.

One issue to be determined was how the competency model might spread to product-oriented software developers within Microsoft. Many of the same competencies were obviously relevant in the product domain. As one way to accomplish this migration, Conway was working on how the competency model might be integrated into Framework, Microsoft's methodology for product development. Since Framework was also marketed externally, embedding the competency model within it might also create a demand for the competency model in other software companies.

Another unresolved issue was the relationship between the competency model and Employee and Management Development, part of Microsoft's overall human resources function. This group had supplied some of the competency descriptions used in the model, specifically some implicit ones (e.g. 'team spirit', 'intellectual horsepower') that were desired throughout Microsoft. Conway envisioned that the group would arbitrate disputes between supervisors and employees on competency ratings, and they would obviously help to define competencies and education linkages outside of the IT domain. But their specific role relative to the competency model had not yet been negotiated.

Some aspects of the role of the competency model within Microsoft could only be determined over time. Susan Conway hoped, for example, that the model would become a vehicle for institutionalizing innovation in this fast-changing industry. If Bill Gates, for example, determined that

employees at Microsoft needed to master a new form of knowledge (e.g. Web-based application development), then he could force development of the competency by insisting upon its presence in all job competency requirements. A means by which needed innovations could be identified and rapidly implemented would seem to be critical in Microsoft's business and industry.

Conway also realized that the success of the project depended upon the behaviors of the individuals who would use it. 'This won't go anywhere unless people feel they are getting something from it,' she commented. She felt that it is critical for employees and supervisors to feel that they contributed to the development of templates for jobs. Then they will buy into the competency model because they had a hand in the design and implementation of it, she hopes. Ultimately, this ambitious attempt to advance knowledge by focusing on individual knowledge competencies requires the active involvement by everyone in the organization.