Corporate Executive

Briefing

Knowledge Management

LINKING PEOPLE TO KNOWLEDGE FOR BOTTOM LINE RESULTS

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Linking People to Knowledge for Bottom Line Results

Executives in large organizations know that they must develop better techniques to manage knowledge, which is increasingly becoming their greatest asset. Organizations currently create and maintain knowledge in isolated systems targeted at specific workgroups. For users outside of the workgroup, that knowledge is virtually invisible. Their only options are to spend time looking for it, recreate it, or do their job without it. Each of these options has a price: time, energy and bad decisions.

Innovative organizations are examining how they can better manage their intellectual capital. This emerging field, called knowledge management, addresses the broad process of locating, organizing, transferring and more efficiently using the information and expertise within an organization. Research firm Dataquest Inc. estimates by 1999 corporations will spend $4.5 billion to better leverage their knowledge resources[1]. Global 2000 organizations are adopting knowledge management techniques at a quickening pace and have combined cultural and process changes with enabling technology to realize bottom line results. For example, the following companies have invested in knowledge management with impressive returns:

Dow Chemical increases annual licensing revenues by $100 million by managing its intellectual assets.[2]

Silicon Graphics manages its product information communications processes and reduces sales training costs from $3 million to $200,000.[3]

Skandia Insurance reduced the startup time for opening a corporate office in Mexico from seven years to six months.[4]

Steelcase realized an upswing in patent applications and a threefold increase in productivity after implementing knowledge sharing processes across multi-disciplinary customer teams.[5]

Texas Instruments avoided the cost of building a $500 million wafer fabrication plant by leveraging internal knowledge and best practices.[6]

Chevron realizes $150 million annual savings in power and fuel expenses from knowledge sharing in energy-use management.[7]

Booz-Allen & Hamilton saves over $7 million a year by reducing the time needed to find and access accurate employee and collaborative information.[8]

With this type of return on investment, the market for knowledge management tools is growing and many vendors of information-oriented products are introducing new knowledge management products or re-labeling their existing products as knowledge management systems. Vendors of all manner of tools from intranet development tools to document management systems to search engines are calling their products knowledge management systems, without regard to what that means. Without new technologies designed to implement the revolutionary changes in the way knowledge workers create, communicate and manage knowledge, a knowledge management system has little chance of improving enterprise knowledge sharing.

This white paper explores the concepts and technologies associated with implementing an effective knowledge management system.

1 Christine Ferrusi Ross, Knowledge Management Focus Report, (Dataquest, 1996). P. 31
2 Britton Manasco, "Dow Chemical Capitalizes on Intellectual Assets," Knowledge, Inc., Vol. 2, No.3, (March 1997): 1-4
3 Britton Manasco, "Silicon Graphics Develops Powerful Knowledge Network," Knowledge, Inc., Vol. 2, No. 1, (January 1997): 1-5
4 Ann Stuart, "Five Uneasy Pieces, Part 2," CIO Magazine (June 1, 1996): 34
5 Ann Stuart, "Five Uneasy Pieces, Part 2," CIO Magazine (June 1, 1996): 34
6 Carla O'Dell and C. Jackson Grayson, If we Only Knew what we know: Identification and Transfer of Internal Best Practices, (Houston, TX: American Productivity and quality Center, 1997). P. 8
7 Carla O'Dell and C. Jackson Grayson, If we Only Knew what we know: Identification and Transfer of Internal Best Practices, (Houston, TX: American Productivity and quality Center, 1997). P. 8
8 Ian Campbell, Director, Collaborative and Intranet Computing, "The Intranet: Slashing the Cost of Business" (International Data Corporation, 1996)

Introduction

Under increasing competitive pressure, many companies are examining how they can better manage their intellectual capital. As the pace of global competition quickens, executives realize that their edge lies in more efficiently transferring knowledge across the organization. The emerging field of knowledge management addresses the broad processes of locating, organizing, transferring and more efficiently using information and expertise within an organization.

New market forces and infrastructure changes have prompted an interest in knowledge management. Market forces include new corporate models that emphasize corporate growth and efficiency, the need for cycle time reduction, knowledge lost from downsizing and the need to share information across the organization, which often means across the globe.

Recent infrastructure changes have significant positive impact on an organization's ability and desire to manage knowledge. The barriers to sharing information have been dramatically lowered by intranet technologies. Now companies comprehend the extent to which knowledge can be shared across the organization; however, they also realize how many of their existing knowledge assets are accessible only to a small part of the organization.

To lower these barriers to sharing knowledge, leading executives recognize the need to institute new knowledge-centric practices. Information technology plays an important role in enabling these processes across distributed enterprises. What executives want to avoid, however, is the cost and disruption of a wholesale change to the organization's information systems.

The promise of technologies aimed at knowledge management is that they will help organizations use the knowledge they have more efficiently without changing the tools they currently use to create it and process it. This is the promise, but unfortunately what many software vendors tout as knowledge management systems are only existing information retrieval engines, groupware systems or document management systems with a new marketing tagline. What executives really need are new technologies designed to implement the revolutionary changes in the way knowledge workers create, communicate and manage knowledge. To help answer that question, this white paper examines the practical aspects of knowledge management and evaluates how various new and existing technologies can be used to create a "knowledge management system" that meets the needs of the organization.

ISOLATED INFORMATION SYSTEMS

Today organizations create and maintain knowledge in isolated systems or "knowledge silos" that provide adequate functionality for specific workgroups or business processes, but are often invisible to or unreachable by others in the organization. For example, a discussion database for a project group is immensely valuable to the members of that group who know where the database is, what's in it and how to use it. But this information is often hidden or inaccessible to others who need it. Knowledge silos are all over the organization in the form of file servers, specialized text repositories (policy and procedures systems, resume systems, etc.), intranet servers and document management systems.

INFOFAMINE OR INFOGLUT?

While corporate knowledge silos and the barriers they often erect contribute to a perceived lack of information, often referred to as infofamine, most knowledge workers increasingly have access to too much information, often called infoglut. The Internet has led to a deluge of information, but most of it is not useful for any given task. Most people have used Internet search engines to look up information on a specific topic, only to have it return thousands or tens of thousands of hits, most of them irrelevant.

Another contributor to infoglut is the overuse of email. While email is undeniably a useful communications medium, it also provides the means to drown people with "just-in-case" information. Most people only need information on a "just-in-time" basis—the right information at the time that they need it.

Value is added to an information system when the information in it is classified using an intuitive or easily learned taxonomy. A taxonomy, or knowledge map, allows other users to access the relevant object or idea more quickly and provides a context for finding related objects or ideas.

There are numerous methods for organizing knowledge assets. Familiar systems include the Dewey Decimal System, the U.S. Library of Congress cataloging methods and the International Standard Serial Number (ISSN) for books. These systems were designed for cataloging general knowledge, yet are not very intuitive when used for organizing knowledge assets in a corporate environment.

PHYSICAL MAPPING OF KNOWLEDGE RESOURCES

The most common way to map information in a corporate environment is to display the physical systems where the information resides. This goes beyond a file/directory metaphor to a higher level that shows databases, file servers, document management systems, groupware systems and other knowledge silos, in addition to the individual files contained in those systems. This classification scheme helps workers find information quickly because it shows them exactly where the information they need resides. However, it is of little use to those who are unfamiliar with or uninterested in learning the information technology (IT) architecture of the organization.

QUALITATIVE/SEMANTIC ORGANIZATION OF KNOWLEDGE

For those who are unfamiliar with or do not want to learn an organization's IT architecture, a qualitative organization of knowledge assets is more useful than file directory organization. Qualitative organization helps workers quickly find the information they are looking for by allowing them to search for it by its topic instead of its location. The qualitative methods appropriate for organizing corporate knowledge assets can be classified as process oriented, functional, or conceptual. "The Process Classification Framework"[9] is a good example of a process-oriented or supply chain model. Process classification uses a generalized model of how a business functions— from understanding customers and markets to managing people, processes and resources—and maps it to the knowledge contained in the organization.

Functional models, which are loosely based on an organizational chart, are common but tend to work better as a corporate archive or "information morgue." They are usually not effective for sharing information across functions, since most workers do not have the time to browse through the knowledge assets of other departments in the hope that they stumble upon something useful.

Conceptual models are often the most useful method of classification, but harder to construct and maintain. Conceptual models organize information around topics, such as proposals, customers or employees. These topical areas contain information originally produced by different departments and across functions which helps in transferring knowledge across the organization.

BEST PRACTICES FOR ORGANIZATION OF KNOWLEDGE

In practice, the best system for helping end-users quickly find what they are looking for depends on individual preferences, the information required and the clues with which they begin the search. For example, a user may know he or she is looking for information from a news feed and that it's stored in a news feed server. In this case, the classification system that helps the user find the desired information is physical, showing the location of the news feed system in relation to other physical information systems.

9 International Benchmarking Clearinghouse, *Process Classification Framework,* (Houston, TX: American Productivity and Quality Center, International Benchmarking Clearinghouse, 1995).

However, if that person is looking for information about a particular customer, a physical classification system offers little value, because knowledge about that customer is likely spread across many physical information systems. In this case, the best classification system is a conceptual knowledge map that includes a customer category.

To truly add value to information spread across the enterprise, organizations must provide multiple ways to categorize it. This allows end users to slice through the information using the method best suited to their specific problem.

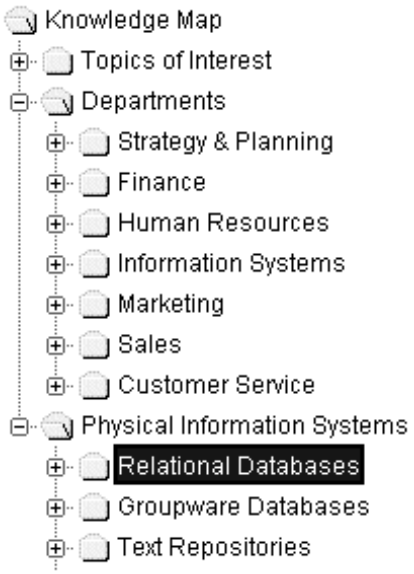

Figure 1 - A Hierarchy containing conceptual, functional and physical models for knowledge classification

The Role of Technology in Knowledge Management

Two distinct factions exist in the knowledge management world. Those who maintain that organizational behavior and individual socialization determine how much knowledge passes between individuals generally believe that technology is not the answer. Rather, they see technology as merely a distraction from issues such as change management, culture and leadership. Information technology evangelists who focus on technology as the solution to the knowledge management question occupy the other end of the spectrum.

Most case studies to date, however, have shown that a successful knowledge management program requires a change in organizational behavior and in technology infrastructure. Technology is not the solution to an organization's knowledge management needs, however it is required to enable the organization's knowledge management processes.

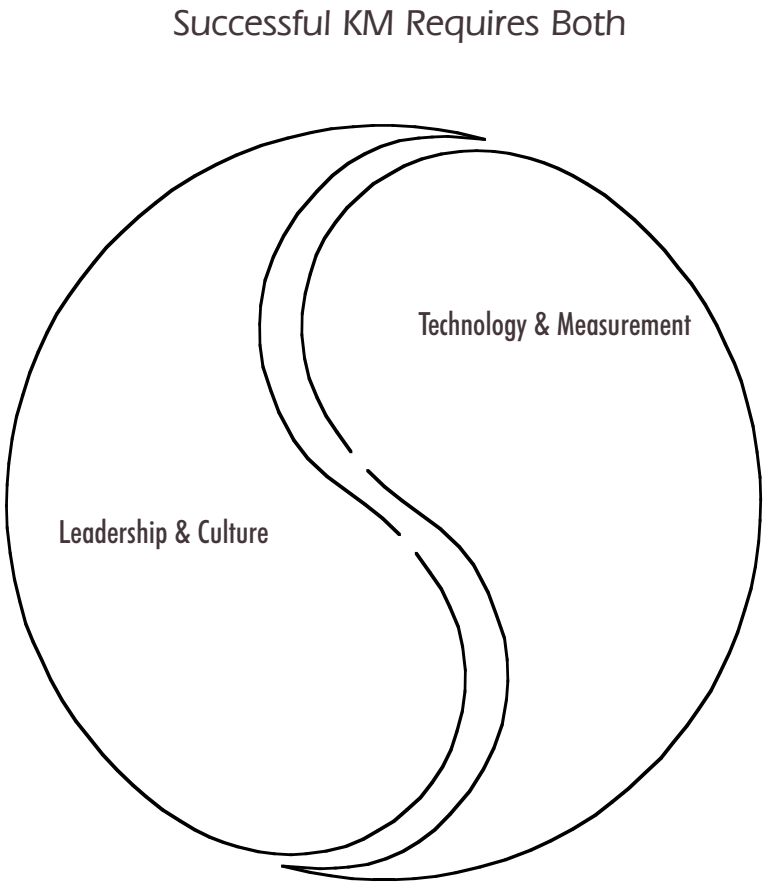

Figure 2 - Successful knowledge management programs require both hard and soft skills

An organization's knowledge management system is the collection of information technologies used to facilitate the collection, organization, transfer and distribution of knowledge between employees. This section addresses some of the characteristics of these systems, while the following section analyzes some of the specific technologies available for constructing a knowledge management system.

BENEFITS OF A KNOWLEDGE MANAGEMENT SYSTEM

Creating an enterprise-wide knowledge management system is not a simple task. However, the benefits of a well-designed system are immense:

Awareness—Everyone knows where to go to find the organization's knowledge, saving people time and effort.

Accessibility—All individuals can use the organization's combined knowledge and experience in the context of their own roles.

Availability—Knowledge is usable wherever it is needed whether from the home office, on the road or at the customer's side. This enables increased responsiveness to customers, partners and coworkers.

Timeliness—Knowledge is available whenever it is needed, eliminating time-wasting distribution of information "just in case" people are interested.

KEY FEATURES OF A KNOWLEDGE MANAGEMENT SYSTEM

Although individual knowledge management systems are as different as each individual organization, they share many basic features.

Open and Distributed

By definition, a knowledge management system unifies existing knowledge silos. Standard protocols and application programming interfaces (APIs) enable integration among systems such as groupware, e-mail, document management and directory services. In implementing a unifying system, organizations must ensure that the information architecture is flexible enough to meet the evolving needs of individual organizations. Knowledge management systems must also be able to be distributed over various host computers and physical locations. The system should allow system administration from any location by using HTML, Java applets or ActiveX controls that are accessible through any compatible web browser.

Customizable

All organizations—and large organizations in particular—require an extremely customizable knowledge management system. The system should supply user interfaces in the form of templates so users can easily customize them using tools such as HTML and JavaScript.

A robust knowledge management system should allow easy integration of existing and new applications. It must include documented application programming interfaces (APIs) and software developer toolkits (SDKs) that allow the organization to link systems to each other. For example, if the system administrator links a monitoring system to a technical documentation repository, he or she can push the appropriate technical documentation directly to a repair technician when the monitoring system senses that a system is malfunctioning.

Measurable

Measurement is a critical aspect of any knowledge management effort to strike the right balance between organizational and technological changes. Only by quantifying and processing the results can organizations determine if the systems are having the desired effect. A knowledge management system includes tools that allow managers to measure and verify usage to get a clear picture of how the system is being used, locate performance bottlenecks and, most importantly, use the data to improve organizational knowledge transfer processes.

Secure

While traditional applications usually require the administrator to grant access to those who need particular information, knowledge management applications focus on maximizing access to knowledge. Therefore they are more likely to require the administrator to prohibit access to specific content areas to those workers who should not have access to them. However, this does not mean that knowledge management systems do not have security. A knowledge management system needs to provide secure repositories and preserve security models present in existing knowledge silos where appropriate, while allowing access across the organization to those who need it.

Creating and managing the enterprise security architecture is a complex problem. However, new standards such as LDAP (Lightweight Directory Access Protocol) aim to unify disparate systems and simplify their management. Using LDAP allows the knowledge management system to access user rights and information, without requiring the administrator to recreate and maintain user directories within the knowledge management system as well as each of the existing knowledge silos.

Technologies for Enabling Knowledge Management

Vendors of information-oriented products are rushing to introduce new knowledge management products and re-label their existing products as knowledge management products in an effort to quickly gain mindshare and marketshare in a potentially enormous market. But computer applications have addressed aspects of knowledge management for years.

No single technology fills all the criteria required of a knowledge management system, because knowledge management is not solely about technology. It is a multi-disciplinary field that draws on aspects of information science, interpersonal communications, organizational learning, cognitive science, motivation, training, publishing and business process analysis. The following sections look at the roles specific technologies play in an enterprise-wide knowledge management environment.

INTRANETS

Intranets have sprung up across corporations at a rate that challenges any previous introduction of new technology. They are ideal environments for sharing information that is both dynamic and richly linked. However, most large organizations quickly reach a point where so much information exists on the intranet that it begins to suffer the same problems that exist on the World Wide Web; no one knows where everything is, so no one can quickly find what he or she is looking for.

Although some evangelists profess that all of an organization's knowledge should be transferred to the intranet, many others take a modified view of what it is best suited to do. The intranet can be broken down into two distinct areas: the technology infrastructure (IP networks, universal web browser, thin client and the HTML format), and the web server as a content repository. These recent changes—the web browser and the web server being the most visible—have enabled greater access to information for broader groups of knowledge workers and increased the speed of integration for application developers.

Allowing users to access all corporate knowledge through a web browser is not equivalent to forcing all knowledge assets onto the web server. Applications, specialized repositories and various other knowledge silos will always exist because they have capabilities that are distinct from those of a generalized knowledge management system. Web sites are best used for hosting and managing content that is constantly changing and linked in a complex manner. But to the organization as a whole, each intranet site is just another type of knowledge silo, the content of which must be integrated in the organization's knowledge management system along with the other silos that exist across the enterprise.

DOCUMENT MANAGEMENT SYSTEMS

Document management systems are repositories of important corporate documents and are therefore important stores of explicit knowledge. They are also valuable tools for creating and processing complex documents, such as new drug applications in pharmaceutical companies. Document management systems excel at controlling the process of document creation, processing and review.

Some companies are approaching enterprise knowledge management based on document management. However, many have found that the bulk of knowledge workers resist using highly structured document management processes for all of their document creation and management tasks. Most users do not participate directly in complex document creation and therefore do not realize enough value from those systems to make an investment in learning how to use them. Therefore, document management systems are important knowledge silos that must be integrated into the corporate knowledge infrastructure, but are not used by most organizations as the basis for a complete knowledge management system.

INFORMATION RETRIEVAL ENGINES

Information retrieval technology, whether it be in the form of corporate text repositories or intranet search facilities, exists in many organizations as a knowledge silo containing legacy information. Information retrieval vendors continue to be concerned with satisfying the needs of information seekers and have added features such as relevancy ranking, natural language querying, summarization and others that have increased the speed and precision of finding information.

GROUPWARE AND WORKFLOW SYSTEMS

Organizations use groupware systems when users in workgroups or departments need to communicate and collaborate. Groupware allows formal and ad hoc conversations in cases when the participants can not communicate in real time. This makes groupware an important technology for enhancing the exchange of tacit information. However, like other applications, groupware databases become knowledge silos that must be integrated into the enterprise knowledge architecture.

Knowledge transfer processes often occur on an ad hoc basis when the need for specific knowledge arises somewhere in the organization, but organizations also have a large number of formalized processes that regulate the flow of information. Workflow systems enable users to codify knowledge transfer processes when they require a more rigid method of dissemination. For example, proposal generation processes often require the proposal writer to collect prior knowledge assets, create new information and gain approval on the entire proposal. This process necessitates structured and ordered information preparation and review, which is what a workflow system facilitates.

PUSH TECHNOLOGIES AND AGENTS

Technologies that automate the transfer of information to end users have received considerable attention recently. Although e-mail served this purpose for over a decade, new web-based technologies have added better presentation, real-time updates and the ability to push applications as well as content. Content push is a dynamic form of electronic publishing and is therefore an important feature of a knowledge management system.

Agents are a specialized form of push technology. Agents are controlled by the end user, who can specify the type of knowledge he or she wants to receive. Agent capabilities are extremely valuable in knowledge-intensive environments, where knowledge workers do not have the time to continually monitor discreet information resources. Knowledge management systems should provide the means for users to easily capture the particular kinds of knowledge assets they need to monitor without requiring them to learn a complex search syntax.

HELP-DESK APPLICATIONS

Many organizations use help-desk technology to respond to both internal and external requests for information. However, the knowledge accumulated in help-desk systems can have much broader applications than answering specific questions. For example, service request logs are valuable tools to assist in product design and improving services. To tap this potentially valuable information, companies will want to integrate their help-desk applications into the knowledge management system.

BRAINSTORMING APPLICATIONS

Brainstorming tools help inspire creative thinking and convert tacit into explicit knowledge. These end user applications help categorize, organize and identify knowledge resources and are therefore useful knowledge creation tools. While it should not try to replicate their functionality, an organization's knowledge management system must provide an easy way for users or these applications to identify, capture and share the results of these activities with others across the enterprise.

DATA WAREHOUSES AND DATA MINING TOOLS

Organizations are creating data warehouses and arming their business managers with data mining tools to optimize existing relationships and discover new ones between customers, suppliers and internal processes. Used primarily by business managers, leading organizations are now broadening their use since everyone in a knowledge-based organization needs to make decisions based on increasingly complex sets of data. Knowledge management systems must provide meaningful access to data warehouses by supporting standard protocols such as Open Database Connectivity (ODBC) and Structured Query Language (SQL). Knowledge management systems also need to provide a way to describe and provide access to common reports so that users not intimately familiar with data mining tools and techniques can find and access current reports on subject areas they are investigating.

THE KNOWLEDGE WAREHOUSE

First RDBMSs, then document management/groupware systems and now web servers. All of these systems have aimed to replace the organization's knowledge silos with a single application. However, stand-alone applications are too feature rich to make this practical or even desirable. The goal of a knowledge warehouse—the core component of the knowledge management system—is to preserve the creation and processing functionality inherent in knowledge silos, while offering all users access to the knowledge contained in the silos. In addition, a knowledge warehouse allows users to submit valuable knowledge even when they are not frequent contributors and therefore do not work through an established knowledge silo. This eliminates the need for all end users in the organization to install and maintain complex client software for all of the application silos.

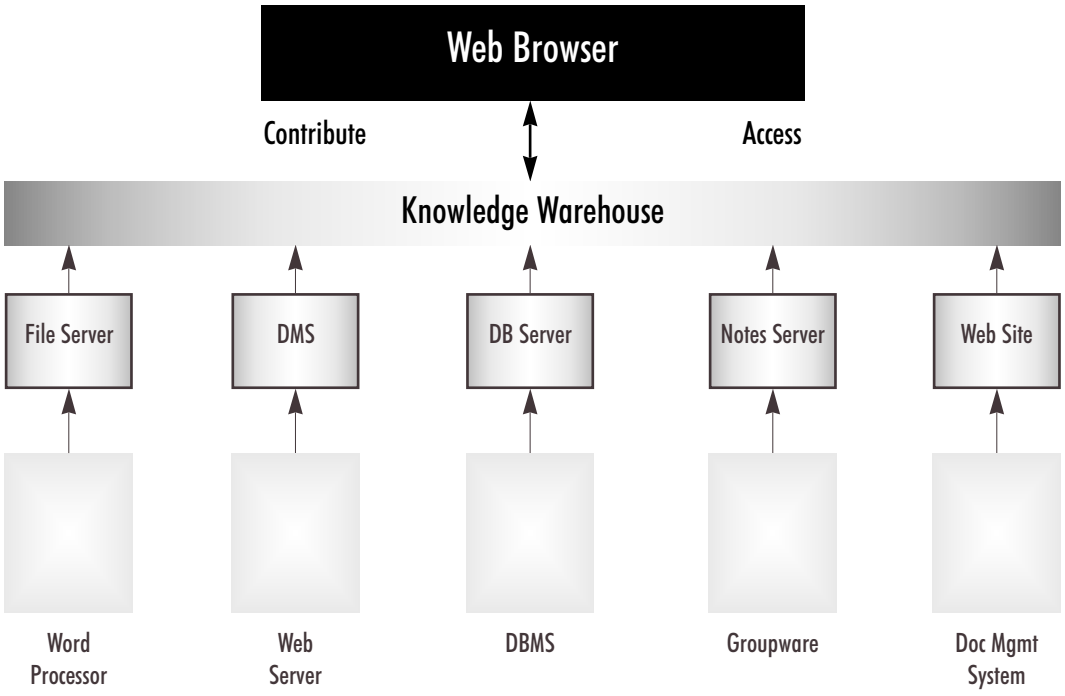

Figure 3- A knowledge warehouse unifies access to organizational knowledge silos without replacing them.

KNOWLEDGE CONTRIBUTION & COLLECTION

End users should be able to easily add content to a knowledge warehouse through their web browsers. The knowledge warehouse must support all of the various desktop document formats as well as graphics, video clips, sound clips and others.

Some knowledge assets benefit from a more structured approach than that provided by a simple document. For example, if all an organization's knowledge workers were asked to contribute skill profiles as word processor documents, they will probably produce thousands of variations in format. However, if they fill out a web-based form instead, they will submit this information in a consistently organized way. Administrators should be able to easily create such forms to allow users to enter such structured knowledge. This not only allows the user to perform fielded searches on the class of knowledge assets, but also enforces a uniform presentation of the resulting information.

To enable or increase the accuracy and speed of information retrieval, knowledge assets need to be associated with categories from the corporate taxonomy or knowledge map. This categorization can be accomplished by the end user on submission or by a content manager. The knowledge warehouse must incorporate categorization into the submission process, yet be flexible enough to adapt to each organization's processes.

KNOWLEDGE RETRIEVAL

The other half of a knowledge management system concerns itself with access to the organization's knowledge assets regardless of whether they were contributed to the knowledge warehouse by end users, or to a knowledge silo linked to the knowledge warehouse by the administrator. This section discusses some of the knowledge retrieval features that make it easier for end users to find the specific knowledge assets they require.

Search

Knowledge workers now demand searching tools that are sophisticated yet easy to use. Some of the more useful advanced searching features for a knowledge warehouse include:

- Natural language searching
- Boolean searching
- Automatic root expansion
- Proximity searching
- Numeric searching
- Term weighted searching
- Thesaurus integration
- Search by object type (e.g., PowerPoint files, internal documents, etc.)
- Search by metadata fields (e.g., knowledge map (taxonomy) categories, author, date, location, etc.)
- Concept searching (e.g., find 'more like this')

Knowledge Mining

Internet information seekers are familiar with entering a seemingly precise query, only to be presented with thousands or tens of thousands of hits, with no easy way to navigate them. To solve this exasperating problem, search results should be clustered or categorized using the knowledge map categories. This enables the user to quickly drill down to or mine the most relevant knowledge assets without having to learn complex query languages. No one search method is best for all people at all times. Whether users prefer to browse or search the knowledge warehouse, knowledge assets should also be clustered by other methods including physical system source, content type, author or other metadata fields.

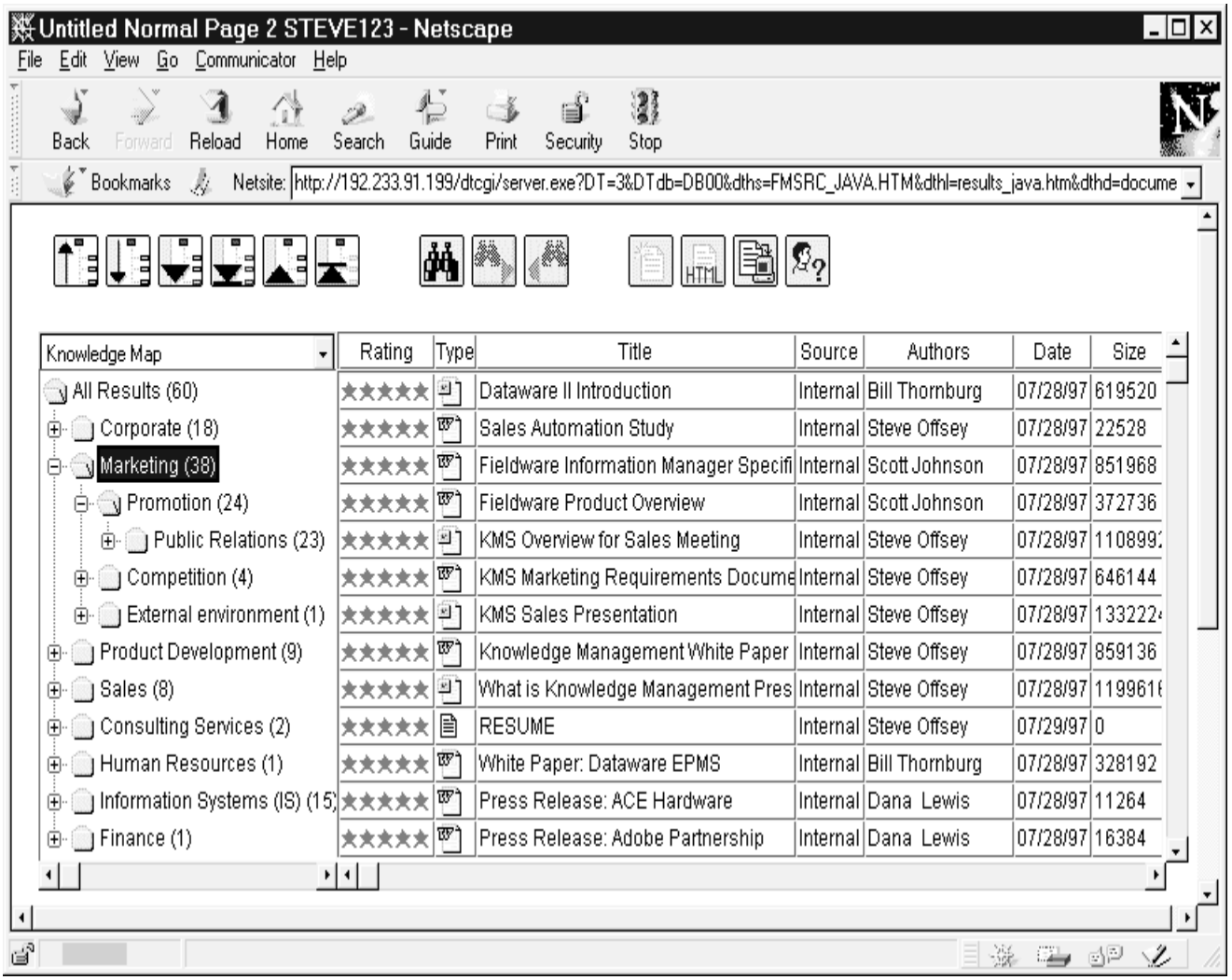

Figure 4 - Knowledge mining provides end users with a way to quickly narrow down a set of knowledge assets.

A knowledge warehouse must be flexible when delivering knowledge assets, since users use the system in different ways, many of which can not be anticipated. Users should be able to view content in a browser, in the original application if present, as HTML, saved to disk or e-mailed.

Benefits of a Knowledge Warehouse Approach

Low overall cost—centrally deployed and managed from the server, standard browser for access

Leverage existing infrastructure investments—in desktop computers, servers, mainframes, databases, applications and networks

Scales from the LAN to the enterprise and beyond—to connect workers in the department and across the enterprise

THE KNOWLEDGE DIRECTORY

Finding "who knows what" in an organization has always been a time-intensive process. A knowledge management system allows users to quickly access peoples' skills and areas of expertise through an integrated knowledge directory. The knowledge directory should allow queries by taxonomy area (for example, who are the experts on marketing?) and return a list of experts ranked by experience. In addition, a knowledge directory should be able to be queried directly or accessed from a document view or result list. A key aspect of the knowledge directory is the ability to include administrator-defined rules (for example, "always make Bob Smith the top expert in network management"). This ensures that particular experts can always be identified (or hidden).

KNOWLEDGE CATEGORIZATION

Many techniques exist for categorizing knowledge, ranging from manual, human-centric approaches to completely automated processes based on artificial intelligence methods. While fully manual processes are time and labor intensive, fully automated approaches do not yield accurate enough results. However, a categorization server that automates a first-level classification of knowledge assets by using knowledge map categories saves a good portion of the labor required to fully classify information. The organization can then incorporate the final classification as part of an editorial or content management process.

KNOWLEDGE AGENTS

After finding a collection of relevant knowledge assets, users need to know when similar assets appear, regardless of the individual knowledge silo in which they reside. Users should be able to set up agents for monitoring the knowledge warehouse based on full text searches, knowledge map categories, author names and other metadata fields. They should be able to set up profiles for filtering news feeds and other dynamic sources. Notification frequency (by time and/or quantity) and method (by e-mail or personal web page) are important parameters that should be selectable by the end user.

Administrators and content editors need to be able to direct specific information to a defined group of users through push mechanisms such as Netscape Netcaster, Microsoft's Channel Definition Format and others.

DISTRIBUTED SYSTEMS

Bandwidth limitations and other concerns will move large organizations to install more than one knowledge warehouse across the enterprise. To keep an integrated approach to finding knowledge, organizations require a query broker that distributes searches across one or more knowledge warehouse and then returns an integrated set of results. Knowledge assets are not merely contained within the knowledge warehouse or within the corporation itself, but also exist on the Internet. A query broker should also provide integrated searching of other repositories, including popular Internet search services.

CONTENT MANAGEMENT

A knowledge management system that leaves content management up to end users quickly succumbs to "information pollution." Successful knowledge management implementations appoint knowledge managers or content editors whose job is to evangelize knowledge management processes and to validate and edit content in their area of expertise. Without a content manager to ensure that information is categorized appropriately and that the content is useful and understandable, users quickly begin to have difficulty finding what they are looking for. The system soon overflows with knowledge assets of questionable value. A knowledge warehouse should be flexible enough to meet the organization's content policies and to operate either with or without editorial approval, or with a combination of end user and content manager supervision. In addition, the administrator should be able to tie the editorial process to particular areas of the taxonomy or particular types of documents.

Conclusion

Chief Information Officers, Chief Knowledge Officers, and other knowledge professionals are finding that vendors of intranet development environments, document management systems, information retrieval engines, relational and object databases, electronic publishing systems, groupware, workflow, push technologies, agents and other technologies are now presenting their products as knowledge management systems. These technologies are well suited to creating, processing and managing particular knowledge assets; however, they rarely meet the need of unifying all of an organization's knowledge.

Accomplishing this task requires an enterprise knowledge management system. An enterprise knowledge management system is defined as the group of information technologies used to facilitate the collection, organization, transfer and distribution of knowledge among employees. A knowledge management system must be open, distributed, customizable, measurable and secure to effectively meet the organization's needs. The core component of a knowledge management system, the knowledge warehouse, should preserve the creation and processing functionality inherent in various knowledge silos, while offering all users access to the knowledge contained there. The knowledge warehouse should also enable web browser submission of valuable knowledge assets to those who do not contribute to the organization through an established silo, or have other explicit knowledge to contribute for which no appropriate silo exists.

However, organizational knowledge goes beyond mere documents, URLs and other explicit forms. Finding "who knows what" in an organization has always been a time-intensive process. A knowledge management solution must include a knowledge directory of peoples' skills and areas of expertise, so employees can quickly find the experts they are looking for.

As global competitive pressures continue to increase, organizations that effectively manage their knowledge assets and continuously improve their knowledge transfer processes will gain substantial competitive advantage. Knowledge management practices, enabled by effective technologies, can add to both the top and bottom lines through reduced cycle times, greater efficiency and greater use of superior solutions across the enterprise.

Appendix I - Knowledge Management Overview

Knowledge management is a field of study that is both old and new. While various parts of the organization have studied aspects of capturing, transferring and sharing knowledge in the past, practitioners of knowledge management tend to take a more holistic, enterprise-wide approach. Knowledge management is a multi-disciplinary field that draws on aspects of information science, information technology, interpersonal communications, organizational learning, cognitive science, motivation, training, publishing and business process analysis.

BASICS OF KNOWLEDGE MANAGEMENT—ORGANIZATIONAL KNOWLEDGE TRANSFER

To begin to manage corporate knowledge, knowledge managers need to first understand how it is transferred within the organization. Individuals are the source of organizational knowledge. For the knowledge to gain value, the organization must provide mechanisms that capture it and transfer it across the organization.

Types of Knowledge

Individuals are the source of two types of knowledge: tacit and explicit. Information technology has traditionally focused on explicit knowledge, or knowledge that you can codify and transmit in a package, such as a spreadsheet. Tacit knowledge is personal, context-specific and is difficult to transmit. Types of tacit knowledge include hands-on skills, special know-how, intuitions and the like. As Michael Polanyi, the first to distinguish tacit from explicit knowledge, stated "We can know more than we can tell."[10] Knowing how to effectively perform a job means understanding both types of knowledge.

Knowledge Conversion

The organization gains only limited benefit from knowledge isolated within an individual; to realize the full value of a knowledge asset it must be transferred from one individual to another. Ikujiro Nonaka and Hirotaka Takeuchi describe four different modes of knowledge conversion in *The Knowledge Creating Company*.[11] Although the four processes have been widely referred to, their names have varied in different representations of Nonaka and Takeuchi's work. They will be referred to here as: socialization, capture, dissemination and internalization.

Socialization is the process of sharing experiences and is often done through observation, imitation and practice. It occurs in apprenticeships and at conferences, as well as at the water cooler. Capture is concerned with articulating tacit knowledge and turning it into an explicit form, for example, writing a report on what you learned at a workshop. When you copy and distribute the report, you convert knowledge from one explicit form to another, and dissemination takes place. Internalization is the process of experiencing knowledge through an explicit source. For example, you read a report about the workshop, mentally put yourself in the situation and combine that experience with previous experiences.

A thorough understanding of these knowledge transfer processes is essential for discerning an organization's strengths and weaknesses. Organizations that have successfully implemented knowledge management principles have used this as a guide to help them design new processes for increasing knowledge capture and sharing.

10 Michael Polyani, The Tacit Dimension (London: Routledge & Kegan Paul, 1966).
11 Ikujiro Nonaka and Hirotaka Takeuchi, The Knowledge-Creating Company (Oxford: Oxford University Press, 1995).

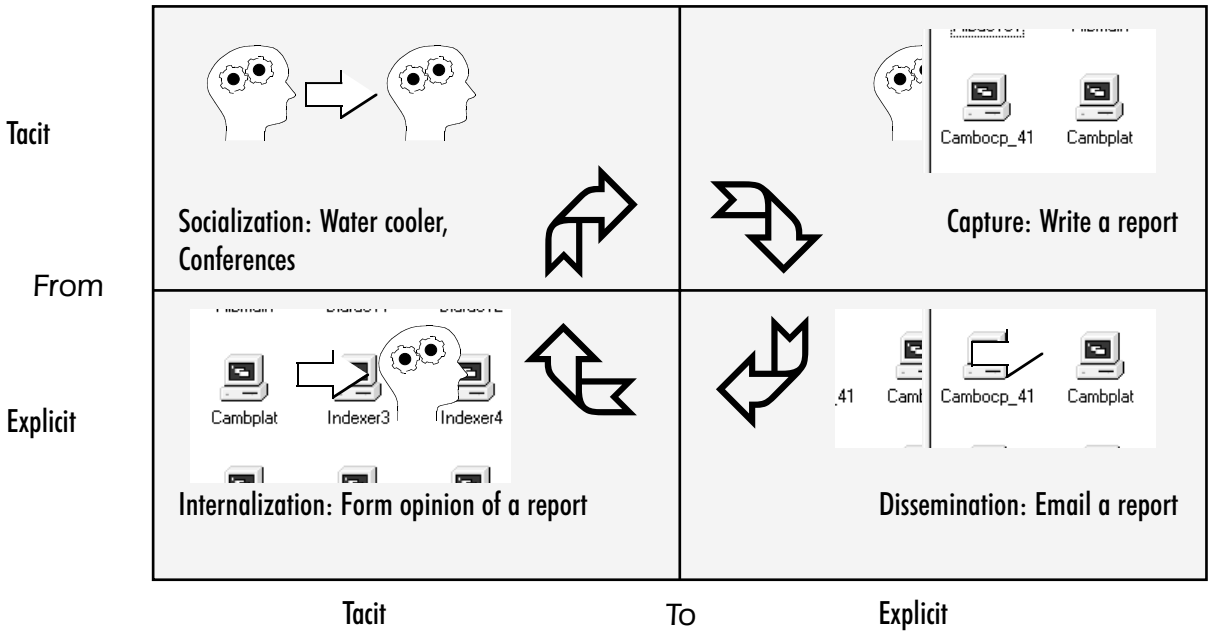

Figure 5 - Knowledge transfer processes

KNOWLEDGE MANAGEMENT ROLES

Knowledge management has brought with it new corporate roles and titles. The most visible of these is the Chief Knowledge Officer, or CKO. As Tom Davenport, professor and director of the Information Management Program at the University of Texas at Austin, describes it, "CKOs have two critical responsibilities: creating a knowledge management infrastructure and building a knowledge culture."[12]

Most organizations that have successfully implemented knowledge management have created a corporate level knowledge management team led by a high level executive (often the CKO, CIO or a line-of-business head). These teams usually consist of a small group (under a dozen) of employees dedicated to coordinating and evangelizing knowledge management principles. In many cases they are responsible for designing, piloting and implementing a knowledge management system.

This small knowledge management group cannot effect enterprise-wide changes by itself. Content managers or knowledge editors are needed to manage the capture and classification of knowledge to guard against information pollution. They are typically spread throughout an organization and spend some part of their job framing and structuring knowledge. Tom Davenport has remarked that:

> "In the rosy future I envision, categorization and organization of knowledge will be a core competence for every firm. This will require strategic thinking about what knowledge is important; development of a knowledge vocabulary (and a thesaurus to accommodate near misses); prolific creation of indices, search tools and navigation aids; and constant refinement and pruning of knowledge categories. Knowledge editors will have to combine sources and add context to transform information into knowledge."[13]

12 Tom Davenport, "Knowledge Roles: The CKO and Beyond," *CIO Magazine* (April 1, 1996)
13 Tom Davenport, "The Future of Knowledge Management," C*IO Magazine* (December 15/January 1, 1996)

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