Corporate Executive Briefing

Seven Steps to Implementing Knowledge Management in Your Organization

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Executive Summary

As the information age has transformed the way organizations do business, it has also transformed the way we measure return on investment (ROI). Today, to have a truly competitive, fast-paced business positioned for profit, success and long-term survival, it is critical to look past the physical assets of the organization. Today, it is essential to recognize the value of "knowledge" and to strive for an improved ROI and better management of your organization's knowledge assets.

Perhaps your organization has already recognized the value of the knowledge that it has spent its hard-earned capital to obtain. If so, you may already be taking steps to formalize the collection of valuable knowledge gained from experience and organizing knowledge in ways that benefit the entire organization. If you have not started to take these steps, your organization is most likely wasting resources by re-inventing knowledge, spending excess time locating difficult to find knowledge and unsuccessfully absorbing and using the growing volumes of new knowledge flowing into your organization every day.

Recent advances in information processing technology, combined with widely available access to high-speed networks, provide organizations with unparalleled opportunities to formalize the collection, protection and use of knowledge. To accomplish this, new software systems and processes have been developed to integrate with existing information systems and spread throughout the enterprise. These new approaches are collectively referred to as "Knowledge Management".

This executive white paper presents a blueprint to start or refine the implementation of Knowledge Management practices and systems in your organization. This paper presents a gradual, "building-block" approach to implementing Knowledge Management that follows three principles:

- build on existing resources and systems
- provide an immediate ROI on knowledge resources
- ensure that each step is a building block that provides a foundation for future enhancements

From these three principles, this paper presents a series of seven steps to implement Knowledge Management, as follows:

Step 1: Identify the Business Problem
Step 2: Prepare for Change
Step 3: Create the KM Team
Step 4: Perform the Knowledge Audit and Analysis
Step 5: Define the Key Features of the Solution
Step 6: Implement the Building Blocks for Knowledge Management
Step 7: Link Knowledge to People

It also presents specific technical solutions and capabilities that allow for a step-by-step implementation of the Knowledge Management Building Blocks mentioned in Step 6. These solutions are:

- Access existing Knowledge Silos to get immediate ROI from your existing resources
- Implement simple Knowledge Mining for more efficient access
- Automatically Categorize to deal with new knowledge
- Build a Knowledge Warehouse to make knowledge widely available
- Enable end-user contribution to allow increased knowledge flow
- Expand the use of metadata and taxonomies for effective categorization of knowledge
- Locate the Experts in the Organization - create a knowledge directory

Results have been very positive in organizations that have started to implement Knowledge Management using this building-block approach. Research information and best practices are shared, experts are identified and cost savings are realized as employees spend less time locating or reinventing knowledge and more time being productive. Overall, these organizations are more competitive and more effective as they integrate Knowledge Management practices into the fabric of their organization - they realize higher value from the assets and capital they have used to obtain knowledge.

As you read this paper, remember that it presents guidelines to effective implementation of Knowledge Management in your organization. Like many other processes, there is no “one way” to implement Knowledge Management -- especially since KM is a combination of technology, culture and practices. This paper provides an overview of some effective, proven ways to plan, implement and evaluate the results of Knowledge Management to help your organization be more effective and successful.

Introduction

Pioneering businesses have been creating knowledge management systems to harness intellectual capital and create value. Peter Robertson, for example, is the executive vice president of the Chevron USA Production Co., who recently described the benefits of knowledge management:

"The fact is [knowledge management and best practice sharing] is good for business. The faster and more effectively we can share ideas, the better we can make our product, the better we can serve our customers, the better we can build a committed team of employees, and—bottom line—the better we can earn profits for our shareholders."[1]

How does one harness intellectual capital for profit? This paper describes steps an organization should expect to take—and avoid—when implementing a successful knowledge management system. In addition, it reinforces this approach by providing a case-study detailing the implementation of knowledge management at a large company – (designated as "Ace Chemical" for the purposes of this paper). The knowledge management challenges at Ace are typical; they concern people, content, and economics more than they concern technology. However, it is the technology—the knowledge management system—that ultimately enables the organization's knowledge management practices.

At the outset, the challenges of knowledge management may sound daunting and perhaps esoteric. Tom Davenport, director of the Information Management Program at the University of Texas at Austin, believes that knowledge management is a costly, political, and ceaseless process—but a process that corporations cannot afford to avoid. He asks a practical question regarding knowledge management: "How much does it cost an organization to forget what key employees know, to be unable to answer customer questions quickly or at all, or to make poor decisions based on faulty knowledge?"[2].

It is this practical approach to implementing knowledge management to bring real benefits to your organization that forms the core ideas presented in this paper.

Step 1: Identifying the Business Problem

KEY CONCEPT: Successful implementation of knowledge management requires a clear identification of the business problem to be solved and an alignment of the knowledge management project with overall business objectives.

Employees charged with implementing a knowledge management system almost always face an initial fear—fear of a hopelessly large amount of up-front work. Consider the quantity and diversity of information recorded in corporate databases, available on the Internet, and stored in peoples' heads at global corporations. Transforming that information into something valuable—something that employees can access anytime from anywhere and apply to their jobs—seems daunting.

This fear is typically grounded in an attitude that knowledge management is an all or nothing proposition. However, knowledge management is a set of business practices and technology implementation that are applied over time to help companies better manage their intellectual capital —knowledge management is not an end in itself. The building blocks for enterprise knowledge management are already familiar to most organizations in the form of basic "information access" applications. These applications take a well defined set of information, such as material safety data sheets or technical documentation, and create an organized repository that enables users to access and search the specific content. Implementation is usually direct, quick, inexpensive, and a good first step toward enterprise knowledge management.

[1] Susan Elliott, "American Productivity & Quality Center Conference Attendees Discover the Value and Enablers of a Successful KM Program," Knowledge Management in Practice, Issue 5, December 1996/January 1997, p. 1
[2] Britton Manasco, "The Trials and Triumphs of the Knowledge Era," Knowledge, Inc., http://webcom.com/quantera/empires.html

Corporations that want to tackle more diverse and dynamic knowledge need not fear up-front costs, either. Organizations need only to attack a single business problem to begin to infuse knowledge management methodologies into their daily activities and add value to the organization. At Echo, Inc., for example, a maker of outdoor power equipment in Lake Zurich, Ill., the problem that inspired knowledge management was a staffing shortage. Trade schools were eliminating specialized engineering training that Echo needed, so Echo decided to capture problem-solving techniques in a central location for widespread use.[3]

Business Objectives Shape Knowledge Management

It is essential that companies align knowledge management projects with business objectives. Dave Ledet, director of shared learning at Amoco Corp., found that if business objectives are not stated or are not clear for the knowledge management effort, it "tends to become just another activity imposed on people for no apparent reason." He lists the following areas of focus: financial objectives, quality, customer satisfaction, and innovation.[4]

Another reason for focusing knowledge management efforts on a set of clear objectives is that most successful knowledge management projects start small and are tested thoroughly. The ideal is to test the process and cultural changes—not merely the software—on a small scale and then refine and apply the techniques to other business problems across the organization.

Finally, clearly focused knowledge management projects avoid information overload. In the 1990s, Arthur Andersen started its Global Best Practices (GBP) knowledge base. Early in the lifecycle of GBP, GBP team responses to experienced user demand for more information lead to content volume increasing thirty-fold. The result was "an unwieldy blob of information"[5] that turned casual users into non-users. The team realized it had sacrificed speed and specificity for size and generality. Eventually, Arthur Andersen chose alternate delivery systems for knowledge details to keep the GBP application focused and more usable.

Step 2: Preparing for Change

KEY CONCEPT: Knowledge management is more than just an application of technology. It involves cultural changes in the way employees perceive the knowledge they develop. A successful implementation of knowledge management also requires endorsement from corporate management.

Only a fraction of the corporate changes required for successful knowledge management are technical. A common problem for those undertaking a knowledge management project is placing technology ahead of the ability or the desire of people to use it. Tom Davenport believes that two-thirds of a knowledge management effort needs to focus on non-technical issues:

"If you're spending more than one-third of your time on technologies for knowledge management, you're neglecting the content, organizational culture and motivational approaches that will make a knowledge management system actually useful."[6]

The good news is that most workers, if given the required time, training and incentives, will begin to capture, manage and share knowledge with enthusiasm. Carla O'Dell and C. Jackson Grayson of the American Productivity and Quality Center (APQC) credit basic human nature:

"We believe that most people have a natural desire to learn, to share what they know, and to make things better. This natural desire is thwarted by a variety of logistical, structural, and cultural hurdles ... we erect in our organizations."[7]

[3] Esther Shein, "Keeping the Motor Humming with Data," PC Week, February 9, 1998, p. 75.
[4] Susan Elliott, "American Productivity & Quality Center Conference Attendees Discover the Value and Enablers of a Successful KM Program," Knowledge Management in Practice, Issue 5, December 1996/January 1997
[5] Wendi Bukowitz, "In the Know," CIO Magazine, April 1, 1996.
[6] Tom Davenport, "Known Evils, Common Pitfalls of Knowledge Management," CIO Magazine, June 15, 1997
[7] Carla O'Dell and C. Jackson Grayson, American Productivity and Quality Center (APQC) "If We Only Knew What We Know: Identification and Transfer of Internal Best Practices" p. 6

Changing to a Knowledge Sharing Culture

One common cultural hurdle to increasing the sharing of knowledge is that companies primarily reward individual performance. Anne Stuart in CIO magazine writes: "Effective knowledge management requires creating a supportive, collaborative culture and eliminating traditional rivalries. For some employees, that may mean painfully 'unlearning' long-standing lessons. Someone who interprets the old axiom 'Knowledge is power' to mean 'To stay strong, I've got to hide and protect what I know' isn't likely to embrace the concept of sharing resources."[8]

Creating a collaborative culture may require redesigning organizational values and implementing incentives to encourage participation in meeting organizational goals. Leaders need to preach the gospel of sharing information. Managers need to rate performance based on employees' cooperative efforts. Rewards, whether they're key chains, peer esteem, or promotions, need to recognize knowledge sharing.

Cultural changes of this magnitude take time. Organizations have to expect that contributions to a knowledge management project and maintenance of a knowledge management system, are an investment in corporate learning and ultimately in corporate efficiency.

Dave Ledet, director of shared learning at Amoco Corporation, describes time and support as two success factors to knowledge management. He encouraged corporations to set aside periods of the workday for learning and practicing knowledge management. "If [knowledge management] becomes what's stacked on top of everything else it gets really difficult to find the time to do it."[9]

Employees with time for knowledge management also need coaching and help. Once people are ready to try knowledge management, Ledet says, the corporation needs to support them with technical tools and coaching: "...everyone's goal is for knowledge management to be instinctive, but we all know it won't be at first. I like to use the example of learning to drive a car. You can read about it all you want, but you really need someone to sit in the passenger's seat with you and provide some coaching help and support before driving can become instinctive."[10]

Executive Support Is Key

Given the changes to corporate culture, behavior, and processes that usually characterize knowledge management, corporate leaders have to be committed to the effort. Davenport writes about the likelihood that a knowledge management project will fail without senior executive support:

"You might be able to build a ... little knowledge repository in some ... domain like purchasing or the research lab without the Big Guy or Gal's support. But don't talk to me about 'transforming our company through knowledge and learning' unless he or she is standing on the front line of knowledge management with you."[11]

Step 3: Creating the Team

KEY CONCEPT: A well staffed team with a strong team leader and "cross departmental" expertise is essential for successful implementation of knowledge management.

Once a problem is selected and the business objective of implementing knowledge management is clear, organizations can determine what kinds of knowledge employees need in order to solve the problem. Questions such as "Who in the company has that knowledge?", "How do they work with it?", "Who else needs it?" and "How might I categorize it so that people who need it can easily find it?" need to be answered. Fortunately, there are professionals in most organizations who are already experts at asking and answering these questions.

[8] Anne Stuart, "5 Uneasy Pieces, Part 2, Knowledge Management," CIO Magazine, June 1, 1996
[9] Susan Elliott, "American Productivity & Quality Center Conference Attendees Discover the Value and Enablers of a Successful KM Program," Knowledge Management in Practice, Issue 5, December 1996/January 1997, page 4
[10] Ibid., page 4.
[11] Tom Davenport, "Known Evils, Common Pitfalls of Knowledge Management," CIO Magazine, June 15, 1997

Building and launching a knowledge management system requires a broad range of expertise in a focused core team. All members of the knowledge management team are united by the project's targeted problems and corporate objectives, but each members' skills and experiences should be diverse.

As previously stated, executive buy-in is a critical factor to successful implementation of knowledge management. An additional key to successful implementation of knowledge management project is a strong team leader. Knowledge management projects encompass a wide range of content and cross organizational boundaries. Therefore a knowledge management team leader requires not only project management skills, but a broad knowledge of the organization and excellent people skills. Since knowledge management practices can not be imposed on employees, the team leader should ideally have skills and experience in change management.

Also essential to the team are individuals familiar with the business problem to be solved, including the content and processes involved. Dan Holtshouse, director of business strategy at Xerox Corp., emphasizes the relationship between knowledge management and its knowledge workers: "Knowledge is largely about people and the work. The [knowledge management] technology should be designed at the start for supporting the character of the knowledge work itself."[12] Departmental subject-matter experts who, in Holtshouse's terms, understand "the character of the knowledge work" are essential to define the knowledge the system needs to map.

Members of IS are also essential to a knowledge management team. They understand existing systems and will customize the knowledge management technical infrastructure.

Knowledge management teams require guidance in organizing content. These kinds of skills are best provided by employees with library science backgrounds. Larry Prusak, writing in CIO magazine, recommends using librarians, whom he calls "information experts," in knowledge management efforts.[13] Corporate librarians are experts at categorizing information. They are knowledgeable about the content and relevance of existing information sources and can help filter information—especially from external sources like third-party researchers and electronic databases—to prevent information overload.

Step 4: Performing the Knowledge Audit

KEY CONCEPT: The knowledge audit identifies sources of knowledge required to solve the business problem. It begins to organize knowledge by developing categories that reflect how your organization operates. The knowledge audit does not have to be a long, complex project. It only needs to answer a few key questions

A Knowledge Audit starts by working with employees to locate the knowledge they need to solve the business problem identified in step 1. At this point, some knowledge pundits propose a process that is long, detailed and tedious. Our experience has shown that this is not necessarily the right way to proceed. In fact, a productive knowledge audit need only concentrate on answering the following question: "In order to solve the targeted problem, what knowledge do I have, what knowledge is missing, who needs this knowledge and how will they use the knowledge?"

The audit begins by breaking that information into two categories: what knowledge currently exists and what knowledge is missing. Once the location or source of the missing information is identified, they can begin to structure the relevant information so that it can be easily found. At the conclusion of the knowledge audit, the knowledge management team has the information necessary to design its knowledge management system on paper.

Identify What's Missing

A common mistake is to limit the knowledge audit to merely cataloging existing explicit information assets, or the information that is documented, transferable and reproducible (e.g. research reports and sales proposals). Certainly, knowledge management teams need to determine what explicit resources currently exist and how they might be

[12] Susan Elliott, "American Productivity & Quality Center Conference Attendees Discover the Value and Enablers of a Successful KM Program," Knowledge Management in Practice, Issue 5, December 1996/January 1997, page 5
[13] Larry Prusak, "The Last Word, Hiring Outside the Box," CIO Magazine, July 1995

categorized for more effective use, but they also must identify which additional resources may be missing, such-as industry-specific news required for competitive analysis.

In addition to capturing explicit information assets, knowledge management systems must be structured to capture tacit knowledge. Tacit knowledge is the hand-on skills and experiences of individuals and it is most often the key to the effective solution of many critical business problems. Examples of tacit knowledge include valuable information about a report that the author knows, but has not documented. Tacit knowledge is typically found in the answer to questions such as "Why was this report written?", "Where else can these results be applied?", "What was the outcome of this proposal?" and "Who else understands the report's contents?" The value of capturing tacit knowledge should not be underestimated. Davenport and Prusak have stated that "having access to knowledge only when its 'owner' has time to share it or losing it entirely if she leaves the company are significant problems that threaten the value of the organization's knowledge capital."[14]

There are two methods for increasing the transfer of tacit knowledge. One way is to make tacit knowledge more accessible by capturing it as metadata — data about an explicit knowledge asset. Asking subject-matter experts what kinds of questions they most often ask others in the process of doing their jobs is a way to identify what tacit knowledge will have the most value by being made explicit.

Another method for increasing the transfer of tacit knowledge is to make it easier for individuals to identify and contact subject-matter experts. Methods of identifying experts that are enhanced by the application of knowledge management techniques include creating skills databases, online communities of practice, and searchable repositories of resumes or skills profiles.

Organizing Knowledge

Knowledge maps present users with the big picture of an organization's intellectual capital. They allow individuals to navigate a company's vast resources so they can quickly find relevant information. There are many methods to organize knowledge, some more effective than others.

The most common, but often most ineffective way to map information in a corporate environment is to organize knowledge based on 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 architecture of the organization.

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. 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.[15]

Functional models, which are loosely based on an organizational chart, commonly exist within companies 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

[14] Thomas Davenport and Laurence Prusak, Working Knowledge, (Boston: Harvard Business School Press, 1998) page 81
[15] See for example, International Benchmarking Clearinghouse, Process Classification Framework, (Houston, TX: American Productivity and Quality Center, International Benchmarking Clearinghouse, 1995).

areas contain information originally produced by different departments and across functions which helps in transferring knowledge across the organization.

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.

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.

Regardless of how an organization chooses to organize its knowledge, knowledge maps help users contribute knowledge to the system and search the system for knowledge. They characterize contributions in a consistent manner and speed searches for knowledge assets by narrowing the search to a category of knowledge, which can then be searched for keywords appearing either in document text or in metadata. Content must be able to be categorized by multiple knowledge maps so users can employ the organization scheme that applies the appropriate context for quickly locating the information they are seeking.[16]

Step 5: Defining Key Features

KEY CONCEPT: Creating a checklist of required key features will ensure that knowledge management technology you acquire will help solve your key business problems while enhancing your overall IT infrastructure.

Although individual knowledge management systems are as different as each individual organization, they share many basic features. Such features, which typically address system openness, measurability, customizability and security, guide IS as it decides what products and technologies to buy or build internally.

Open and Distributed

Open systems ensure that employees can obtain the information they need from any location at any time. Adherence to industry standards, ranging from HTML and TCP/IP to ODBC, enables organizations to implement new technologies quickly and to easily extend and customize them in the future.

Most knowledge management projects will need to distribute components of their systems. Those components might be distributed across servers at a single site to increase system speed, or the components could be geographically distributed in global corporations. The ability of a knowledge management system to handle such distribution is important as the company and its system grows.

Measurable

The most tangible measurements of a knowledge management system involve who contributes or accesses which information. These measurements offer a guide to the value of the information content and to the corporate population that uses the system. They are designed to guide management in measuring the effectiveness of the system. They may also be useful in implementing incentive or compensation policies designed to encourage the contribution of knowledge to these systems.

Another tangible measurement of a knowledge management system involves bottlenecks of the distributed system. Bottlenecks result from inadequate hardware and software. Those measurements assist IS to resolve the bottlenecks.

[16] The case study presented in Appendix A is a useful resource to gain a more thorough understanding about the results of a knowledge audit and the development of a knowledge map.

When examining potential solutions for knowledge management, make sure that the solution you choose has tools and capabilities to perform and report usage and performance measurements to the management staff.

Fuzzier measurement is also key to determining the effectiveness of a knowledge management system. As anecdotes collect about ways the knowledge management system serves the company—helps make a sale, orients a new employee, or shortens a product cycle—those anecdotes should be recorded and communicated in the knowledge management system itself. Success stories about knowledge management can become corporate "myths" that pique user curiosity and help the knowledge management team to apply knowledge management methodologies in other parts of the organization.

Quantification of the system's merit in cold, hard cash may come slowly. Anne Stuart wrote in CIO magazine that when Arthur Andersen surveyed 80 corporations during a 1995 knowledge conference, more than three-quarters called knowledge management an essential or important part of their business strategy. But more than 90 percent admitted they hadn't yet developed reliable ways to link knowledge management to the bottom line.[17]

Although quantifying a return on investment is difficult, many organizations have combined cultural and process changes with enabling technology to achieve bottom line results. For example, the following companies have invested in knowledge management with impressive returns:

- Dow Chemical increased annual licensing revenues by $100 million by managing its intellectual assets.[18]
- Silicon Graphics managed its product information communications processes and reduced sales training costs from $3 million to $200,000.[19]
- Skandia Insurance reduced the startup time for opening a corporate office in Mexico from seven years to six months.[20]
- Steelcase realized an upswing in patent applications and a threefold increase in productivity[21] after implementing knowledge sharing processes across multi-disciplinary customer teams.
- Texas Instruments avoided the cost of building a $500 million wafer fabrication plant by leveraging internal knowledge and best practices.[22]
- Chevron realized $150 million annual savings in power and fuel expenses from knowledge sharing in energy-use management.[23]
- Booz-Allen & Hamilton achieved over $7 million in annual savings by reducing the time needed to find and access accurate employee and collaborative information.[24]

Customizable

A knowledge management system needs to reflect a company's unique products, processes, and people. This requires customization of many aspects of the system, from knowledge maps to metadata. Another aspect of customizability is the user interface. It needs to blend in with the user interface of existing corporate systems, such as the organization's intranet. Ideally, this kind of customization is easily accomplished with basic HTML and Java Script.

Secure

Security has come a long way since corporate users first started navigating internal networks. Security problems with knowledge management tend to be more cultural than technical; organizations often need to question their assumptions about why information should not be accessible to broader audiences than originally intended.

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[17] Anne Stuart, "5 Uneasy Pieces, Part 2, Knowledge Management," CIO Magazine, June 1, 1996
[18] Britton Manasco, "Dow Chemical Capitalizes on Intellectual Assets," *Knowledge, Inc*., Vol. 2, No.3, (March 1997): 1-4
[19] Britton Manasco, "Silicon Graphics Develops Powerful Knowledge Network," *Knowledge, Inc*., Vol. 2, No. 1, (January 1997): 1-5
[20] Ann Stuart, "Five Uneasy Pieces, Part 2," *CIO Magazine* (June 1, 1996): 34
[21] Ann Stuart, "Five Uneasy Pieces, Part 2," *CIO Magazine* (June 1, 1996): 34
[22] 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
[23] 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
[24] Ian Campbell, Director, Collaborative and Intranet Computing, "The Intranet: Slashing the Cost of Business" (International Data Corporation, 1996)

On a technical level, the knowledge management system should preserve the security models of existing corporate applications where appropriate, and avoid duplication of information and effort. As organizations embrace centralized administration of user directories, products that use the lightweight directory access protocol (LDAP) to communicate with existing directories ease the process of creating and maintaining security architectures and reduce the overhead of administering employee information.

Step 6: Building Blocks for Knowledge Management

KEY CONCEPT: Implement knowledge management systems using a phased approach and a smooth "on-ramp". Each phase of the implementation addresses a specific part of the knowledge management solution, lays the foundation for the next phase, provides immediate benefits and provides a measurable ROI.

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. Successful knowledge management projects use technological "building blocks" and take a phased approach that balances the immediate need to unify access to existing information with the long-term goal of improving the way knowledge is captured and managed.

Using this smooth "on-ramp" methodology to implement knowledge management makes the set of functional building blocks critical. Each block has to contribute to the ultimate knowledge management system, while providing a positive ROI. In addition, each block provides immediate, beneficial results that can be seen by the entire organization and each phase in the process provides a foundation used to implement the next phase.

The following table presents a summary of a phased approach using a smooth "on-ramp" methodology. In each of the phases, details about the building blocks used and recommended method of implementation are provided.

Building Blocks Used For Successful Implementation of Knowledge Management

Phase	Goal	Technology Building Blocks Used In This Phase	Recommended Method of Implementation
1	Quickly improve ROI on existing knowledge assets.	Meta-Level search broker and text-based electronic repositories with advanced search and retrieval capabilities	Implement Meta-search software that accepts a single query from users, then submits the query to multiple Internet and intranet-based knowledge silos. Results from these silos are returned to the meta-search engine, which then orders and presents a single set of results to the user. For information that is focused and relatively homogeneous, implement a text-based electronic repository of the information with advanced search and retrieval capabilities. This provides immediate ROI and enables this silo for later inclusion in the knowledge warehouse.
2	Enhance the process of locating applicable knowledge.	Knowledge Mining Software	Add knowledge mining software that allows query results to be sorted and clustered according to a set of pre-defined categories that are applicable to the target business problem.
3	Increase the accuracy and speed of classifying knowledge.	Automated Categorization Tools	Implement automated categorization software and apply it to knowledge in existing silos as well as incoming streams of new knowledge. These tools can be used to assist persons assigned to the task of knowledge classification by providing a preliminary “first cut” based on the contents of a knowledge source.

4	Provide substantially enhanced functionality, security, and performance for the growing knowledge management activity in your organization.	Knowledge Warehouses	Roll-out knowledge warehouses. Integrate existing knowledge silos (implemented in phase 1) into these warehouses through the use of filters which preserve the original source and allow automated updates to the knowledge warehouse when the original source is changed or augmented. As part of the process of initially filling the knowledge warehouses, supply applicable metadata such as the knowledge source and author. Make knowledge warehouses available as knowledge sources through the use of the technology implemented in phase 1.
5	Start capturing valuable "tacit knowledge" that was previously lost to retirement, downsizing and employee turnover. Make the contribution of knowledge easier and faster.	Forms-based contribution of knowledge assets	Allow end-users to directly contribute knowledge to the knowledge warehouses. Create and deploy Internet or intranet-based forms for the most often used types of knowledge assets. These forms provide a structured way to collect required metadata, to start capturing valuable "tacit knowledge". Example forms include resumes, best practices, news articles, research notes or any other types of user-created or user-discovered knowledge.
6	Enable faster access to critical knowledge. Reduce the risks of not finding key information.	Knowledge mapping software	Pre-build taxonomies ("knowledge maps") designed for specific tasks (e.g. quality assurance) or departments (e.g. marketing or research). Examine existing knowledge assets and those that have been contributed to the knowledge warehouse to identify the applicability of pre-configured taxonomies and to identify where existing taxonomies need to be augmented, simplified or eliminated. Connect these taxonomies with the forms implemented in phase 5 to assist in the rapid and accurate classification of new and existing corporate knowledge. Use more sophisticated versions of the Knowledge Mining Tools implemented in phase 2 to quickly find key knowledge assets.
7	Quickly find people in your organization who have specific knowledge.	Knowledge directory software.	Implement knowledge directory software to automate the process of finding people with specific areas of expertise.

Meta-Level Search Broker - Querying Across Existing Repositories

Integration of existing searchable sources of information, including repositories, news feed systems, document management systems, databases and even the Internet, is a powerful first step towards unifying access to knowledge and can be most easily accomplished using a meta-level search broker. A search broker distributes search queries to a broad set of searchable sources and returns an integrated set of results to the end user.

By bridging repositories located in geographically or logically distinct locations, a search broker can substantially improve user productivity by decreasing the amount of time needed to find relevant information. Using the power of the meta-level query broker, multiple physical repositories can appear to the end user as one virtual repository.

Important features for a query broker include automatic translation of queries to the syntax used by different search engines, removal of duplicate query results, and reformatting and merging of results from different search services. To maximize its usefulness, a search broker must support a broad array of search services, including intranet search engines; applications with integrated web-accessible search engines (e.g., document management systems or Lotus Notes or Domino); and Internet search engines such as AltaVista, Yahoo, Northern Light, Excite, Magellan, Webcrawler, Lycos, and others. Compatibility with proxy servers and firewalls is also a key feature for the search broker to fit seamlessly within the organization's IT infrastructure.

Knowledge Mining

Some users will want to perform simple keyword searches across all information sources, while others will want to target specific sources. As the number of information sources increases, end users may be presented with extremely large result sets. Many users are already familiar with this problem from their experiences with Internet search engines; they are often presented with thousands or tens of thousands of hits with no easy way to navigate them. They will have little patience when encountering "info-glut" inside the organization.

The best way to head off this exasperating problem is through categorization of knowledge assets to enable clustering of search results by knowledge map categories. This allows the user to quickly drill down 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, so knowledge assets should be clustered by multiple methods including physical system source, content type, or specialized conceptual taxonomies. Ideally, a well-designed knowledge management system allows the user to choose the method that best fits the task at hand.

Automated Categorization

Regardless of its source, each contribution of knowledge should contain relevant metadata and be associated with categories from the knowledge map to speed navigation within, and location of, the desired information. End users are typically the most knowledgeable resource for capturing metadata and categorizing their own contributions; however, a decision to have end users perform additional tasks must be accompanied by a program of incentives to reward such activities. In some cases knowledge editors may perform or provide additional categorization information since they are able to see across departments or functions and recognize other uses for the information. Categorization does not need to be an entirely manual task — much can be inferred about a knowledge asset simply by knowing something about the asset being contributed. For example, a form for contributing research reports could automatically categorize the source of the report as "internal" and the department as "R&D." With contextual information, the system can supply some categorization and metadata automatically.

For knowledge assets collected from existing information systems the knowledge map categories and metadata fields can often be assigned automatically. For example, administrators can specify the type of category for an asset based on its source (e.g. all records in a discussion database on competition can be automatically categorized under a category for competitive information) or by mapping different views of the information to different categories. Also, metadata values can be mapped from fields in the information source itself.

The Knowledge Warehouse

The purpose of a knowledge warehouse is to provide a secure, scalable repository where content, metadata and full text indices to knowledge can be stored. By providing both security and metadata storage, a Knowledge Warehouse goes well beyond the capability of a simple file index. By including and indexing the content of a document and metadata about the document (e.g. where the document was created, what application was used to create the document, who contributed to the document, etc.) the value of the knowledge in the document is dramatically increased.

A knowledge warehouse also provides the infrastructure for users to easily contribute knowledge to the corporate knowledge store in the form of existing documents or legacy data. This provides a central location for the myriad forms of ad hoc knowledge in an organization that previously resided only in isolated silos. Through forms based contribution where users supply metadata (either in fixed fields or in free format), and optionally attach documents as part of the contribution, valuable knowledge can be quickly and easily captured.

Capturing Tacit Knowledge

The capture and management of tacit knowledge requires more than a searchable repository. A knowledge management system with the ability to create customizable metadata about explicit assets is an important resource in this regard. It should enable the capture and later location of not just documents, but related information such as lessons learned, previous experiences and relevant people. In addition, the system should allow users to submit valuable knowledge even when they are not frequent contributors and therefore may not work through an established knowledge silo. This eliminates the need for all users in the organization to install and maintain complex client software for all of the application silos.

Knowledge Mapping

To increase the accuracy and speed of information retrieval, a knowledge management system associates knowledge assets with categories from one or more taxonomies, or knowledge maps. This categorization can be accomplished by the administrator, the end user on submission of the knowledge or by a designated content manager ("knowledge editor"). The knowledge management system must incorporate categorization into the contribution process, yet be flexible enough to adapt to each organization's unique environment.

Step 7: Linking Knowledge to People

A Knowledge Directory

Finding "who knows what" in an organization has always been a time-consuming process and relying on serendipity is no solution to find the person with the right knowledge. As Davenport and Prusak succinctly state: "Water cooler knowledge exchanges are also hit-or-miss in terms of dealing with a particular business problem or making a key decision. When faced with a need for specific knowledge at a critical point in a project, it would not be a sensible strategy to stand by the water cooler in hopes of picking up exactly what you're looking for from whoever happens to be thirsty."[25]

The need to locate subject-matter experts is not new — and many enterprises have implemented "skills databases" to try to solve this problem. Skills databases depend on end users to manually update their profiles as their competencies and job functions change. A database administrator must be assigned to continually update the database as new employees are hired and existing employees leave or move within the organization.

A knowledge directory enables employees to locate subject-matter experts in order to share tacit knowledge—their experiences, "know how" and insights. A knowledge directory, unlike a simple skills database, can infer what employees know based on the knowledge they contribute and share. After a user specifies the expertise she seeks, a knowledge directory returns a list of ranked subject-matter experts and their contact information based on the explicit

[25] Thomas Davenport and Laurence Prusak, Working Knowledge, (Boston: Harvard Business School Press, 1998) page 91

knowledge assets those employees contributed to the knowledge management system. While a knowledge directory should eliminate the bulk of manual updating, it should also give administrators a way to modify the results returned. Therefore a key aspect of a knowledge directory is the ability to include administrator-defined rules (e.g. "always make Bob Smith the top expert in network management"). This ensures that particular experts can always be identified (or hidden) as required.

The link between knowledge and people distinguishes knowledge management systems from applications that manage explicit knowledge. According to Davenport, "Even the most user-friendly tools won't help much with managing information unless they're strongly linked to people and processes. Knowledge dies when it is disembodied."[26]

Content Management

The value of editorial content management cannot be overemphasized, since knowledge management will not succeed if there are no workers and managers whose primary duties involve gathering and editing knowledge.

Content managers ensure that information is accurate, useful, and categorized so that it is easy to find. Maintaining content, while often perceived as a nuisance, is crucial to success. Content editing is not necessarily a full-time job; however, it can not merely be added on top of a full-time job. Many efforts at knowledge management have failed because content editors were not given time to perform their duties, which resulted in "information pollution" and users abandoning the system.

Technology can support content managers and decrease the time they need to spend managing content. Important features for content managers include the ability to add and modify metadata, add and change categorization information and remove outdated information.

Another aspect of content management involves handling special cases, such as an employee who leaves the company. Content managers need to be able to make sure employees do not waste time trying to contact that person while preserving the knowledge they have contributed.

Conclusion

Implementing a complete knowledge management system is no small feat; however, the results can be impressive and risks can be minimized by taking a phased approach that gives beneficial returns at each step. Senior executive commitment is essential and executives can play an important role in defining the key problems to solve and the corporate objectives to meet. Once the organization defines its objectives and makes a commitment of people and time, the knowledge management team can get to work.

While the knowledge audit is a key process for designing complete systems, it also exposes inefficiencies and holes that can be addressed before the ultimate solution is implemented. Knowledge management projects often stall by trying to do too much in a single step. By using simple solutions, such as query brokers and focused information repositories, to quickly address some of the basic problems found during the knowledge audit, the knowledge management team can quickly show success and win the confidence and participation of important constituencies.

Technology plays an important role in enabling knowledge management methodologies and processes. Packaged applications can ease the burden of creating a customized system without requiring custom programming to enable basic tasks such as locating subject-matter experts, allowing end users to contribute and locate knowledge, and easing the job of content managers to ward off information pollution. The knowledge management system should be open, customizable, measurable, and secure.

No less important than the technical features are human considerations motivating people to contribute, manage and share knowledge. Throughout the life of a knowledge management project, leadership needs to constantly emphasize the quality and value of knowledge management. Workers must learn to collaborate and contributors and users of the knowledge management system need incentives to encourage these activities and keep the system vital.

[26] Anne Stuart, "5 Uneasy Pieces, Part 2, Knowledge Management," CIO Magazine, June 1, 1996

Most organizations that have made this kind of investment in knowledge management realize tangible results. They add to their top and bottom lines through faster cycle times, enhanced efficiency, better decision making and greater use of tested solutions across the enterprise.

Appendix A - Case Study

Case Study: Problems at Ace

This appendix presents a profile of Ace Chemical[27] to illustrate how knowledge management methodologies can be applied to a specific problem. Ace Chemical is a leading, worldwide producer of chemicals for the consumer goods, textile, paper, aerospace, construction, and automotive industries. Ace recently acquired TPA Technologies, specializing in agricultural products. With TPA, Ace intends to integrate biotechnology with its existing businesses. The prospect is alluring: TPA is a major player in the global food, feed and industrial markets. Those markets are valued annually at about $30 billion for crop protection, and $500 billion in world agribusiness.

The executive management of Ace sees the increasing importance of the life sciences—chemistry, biology, and genetics—to the company's future. For example, TPA has produced soybeans with a high concentration of a fatty acid deemed beneficial to humans and is working on creating high-performance polyester from corn. Ace, meanwhile, is using recombinant DNA to create a durable biosilk for textile applications.

But before Ace and TPA can be successfully merged into the brave new world of biotech, a major problem must be solved that the merger will only exacerbate: the poor level of knowledge sharing across Ace research and development (R&D) and between R&D and product management. Ace researchers are making breakthroughs, but product management discovers the breakthroughs too late to solve customer's needs. Two items of intellectual capital suffer as a result: Valuable brainstorming among product managers doesn't occur, and feedback from Product Management to research is negligible.

Although results of Ace research are fairly communicated through worldwide Ace R&D, the Ace/TPA merger has made the need for better tools for scientific collaboration clearer.

Ace Objectives and Pilot Project Scale

Executive management has identified two global strategies critical to continued Ace success: collaboration with outside companies, and the introduction of more environment-friendly products. They believe knowledge management will need to address both Ace's internal knowledge sharing issues and these global strategies.

The CEO calls a meeting to discuss how knowledge management can be applied to solve Ace's problems. The initial focus is knowledge sharing between R&D and Product Management, and richer information exchanges among the increasingly diverse scientists of R&D.

Changes at Ace: Human and Technical

The Vice Presidents of R&D, product management, information systems (IS), and environmental initiatives have misgivings about knowledge management. They feel they have much to lose either if resources in their departments are drained by supporting the knowledge management project too much, or if their employees are singled out as supporting the project too little. The CEO reassures them that it is better that employees err on the side of over-contributing to the effort at first. The VP of human resources is tasked with exploring incentives to encourage employees to share knowledge and to make sure that future performance reviews of Ace employees will have a knowledge-sharing component.

The VPs explore the culture existing between product management and R&D. R&D tends to resent interference from product management; some members of R&D view product managers as less valuable than scientists to Ace. Product management naturally resents the appraisal and also feels frustrated by R&D's inaccessibility and the barriers created by technical jargon.

[27] Ace Chemical is used as an organization for the purposes of illustration. It is not intended to reflect or endorse the operation of any company.

The VP of R&D is optimistic. She thinks her scientists, since they are learning new disciplines and interacting with new players on biotech projects, are in a better position than ever to appreciate educational needs—even those of product management. The VP of human resources agrees.

The VP of product management promises to make any product information of interest to scientists available to R&D. The VP of environmental initiatives asks them all to broadcast the importance of product safety, health, and environmental impact to both scientists and product managers. The VP of IS plans to open access to information across the departments.

The Ace Knowledge Management Team

The ACE VPs choose their knowledge management project leader for his widely respected analytical capabilities, project management skills, broad knowledge of the organization and people skills. Becoming the Director of Knowledge Management, he spends some time coming up to speed on knowledge management by reading white papers, talking to knowledge management directors at other companies, and attending a knowledge management conference. Then, he chooses the following team:

- Corporate librarian and the R&D librarian
- Head of documentation
- Two members of IS, with knowledge about the corporate intranet and other internal applications
- A senior manager of environmental initiatives (a subject-matter expert)
- A senior molecular biologist (a subject-matter expert)
- A mid-level chemical engineer (a subject-matter expert)
- A senior product manager in plastics (a subject-matter expert)
- Director of Human Resources

At the initial meeting, the vice president of R&D sets the tone for the importance and excitement of the project, relays the endorsement of the Senior Executive Team, and then turns the meeting over to the Director of Knowledge Management. The Director of Knowledge Management sketches what he has learned to date about knowledge management then describes the problems involving R&D and Product Management that he wants the knowledge management team to help solve.

The Director also outlines the two corporate objectives concerning collaboration with outside companies and emphasis on environmentally-friendly products that will shape the knowledge management effort.

At this point, the Director asks the subject-matter experts to think about the following questions:

1) What information currently exists that is valuable for scientists to share? This may include information that is currently difficult to access or completely inaccessible but can help product managers formulate product plans and solve customers' problems.
2) What information is currently missing that can help product management and R&D?

Ace Performs a Knowledge Audit

Current solutions aren't helping overcome the knowledge sharing and communications problems that exist across Ace R&D and product management. R&D and product management each have their own Lotus Notes databases and employees in one group do not usually examine the other group's information. The Notes databases for R&D have been designed to support scientific inquiry and most scientists use them regularly to search for Ace information. The Notes databases for product management primarily store competitive information, and also contain several online discussion forums.

The chemical engineer, molecular biologist and product manager on the knowledge management team brainstorm about the kinds of information they typically need. "What's missing for you to come up to speed on R&D?" the Director of Knowledge Management asks the scientists. They respond that they need to be able to find research reports on topics of interest across Ace R&D and all its existing information sources. They also need to be able to find related

knowledge, for example links to related Ace research and products, links to individuals who contributed to the research internally, and links to related external research. This missing information is a candidate for metadata on research reports. Most importantly, the researchers need an easy way to find subject matter experts with whom they can work with to solve specific problems.

“And what information from R&D would help you do your job better?” the director asks the product manager. The product manager needs knowledge about potential applications of research, even in its early stages, to see if prior and in-progress research can be applied to solve his customer’s problems.

The manager of environmental initiatives says that he, too, would benefit from knowledge both about potential applications—possibly captured as a metadata field for research reports, and about R&D contacts for products nearing release—perhaps captured as metadata for product release plans. He also needs to find subject-matter experts easily, along with their resumes, so he can locate employees whom he can contact for further information..

The Director of Knowledge Management then turns the meeting over to the corporate librarian to talk about how indexing and categorization can be used to solve the problems at hand. She starts by explaining why full-text indexing of documents, currently effective in R&D, is an excellent start but not a panacea for finding information across the organization.

“If you have a relatively focused repository of information like a set of operation or maintenance manuals, then full-text searching will get you the results you’re looking for. However, as we begin to unify access to a broader array of information across the organization, simple keyword searching will begin to return results lists as large and unmanageable as those returned from Internet search engines. Categorization is a way to head off this problem before it gets out of hand. For example, if you’re looking for a dictionary of the English language in a library, you walk into the Reference section and find the dictionaries quickly. They don’t make you go to a library computer terminal, search for the word ‘dictionary,’ and wade through a list of all the books that have the word “dictionary” in them—including novels, children’s books and a dictionary of horse-racing terms, etc.” the librarian says.

The team, she continues, needs to create taxonomies—knowledge maps similar to the “map” that leads library visitors to the Reference section for dictionaries. At Ace, taxonomies will map people, documents, opinions, ideas and links to external resources in ways that allow individuals find the knowledge they need quickly.

The taxonomy will structure information according to the context of people’s work in product management and R&D. To provide an example, she quickly sketches a few knowledge maps by departments, scientific processes, products and applications. Ace employees, she explains, will use these knowledge maps to characterize information when they contribute knowledge. When they are searching for information, they can use an appropriate knowledge map to narrow their search, along with familiar techniques like keyword searches.

The librarian starts to categorize the information being discussed into several knowledge maps. She eventually refines the categories, distributes them to team members and asks them to test the maps for comprehensive coverage of the knowledge they use. Team members engage coworkers for more input on missing information and categories.

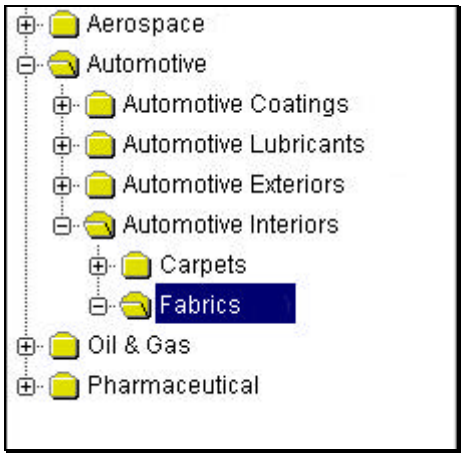

Figure 1 - Part of the Taxonomy Developed By the ACE Implementation Team

Ace Reviews, Shops, and Plans

The Ace knowledge management pilot will operate in two offices, but the goal is to reach all 50 locations worldwide. IS members of the knowledge management team plot their distributed architecture across their TCP/IP-based intranet The IS department has long been a proponent of open systems and states that the knowledge management system must allow users to contribute and access information using a standard web browser.

IS already is experienced with Java applets, and intends to apply that experience to customizing parts of the knowledge management system. For most of the user interface, however, they want to make use of HTML and Java Script, and are looking for products that can be customized with flexible HTML templates. Most users are not trained in Boolean search syntax, so IS looks for products that allow them to create simple search screens with drop-down lists for users to choose “All these terms” or “Any of these terms” for example.

At the end of its research, the IS department at Ace decides to buy integrated applications, rather than picking several unrelated tools to implement its knowledge management initiative. Ace is especially attracted to a vendor that offers built-in hooks to information that Ace has in its existing systems. IS figures it will save time by not having to design, build and maintain a one-of-a-kind system. Also, integrated applications offer security features, measurement capabilities that will help the knowledge management team to monitor system use, and the system architecture and feature list promises to keep custom coding to a minimum.

Ace Implements its Building Blocks

The Ace knowledge management team realizes it can not implement an entire enterprise-wide knowledge management system in one step. Based on the results of its knowledge audit, the team decides to attack two key information access problems and begin a knowledge warehouse pilot project. The team hopes that this strategy will gain support among its constituent end users in R&D and product management, give it immediate visibility with upper management and provide the building blocks for enterprise knowledge management.

Ace Builds a Focused Repository

Material safety data sheets were identified by the knowledge audit as an essential, but difficult to access, explicit asset for Ace R&D. Currently, Ace keeps paper data sheets in binders in a central library but the knowledge management team realizes that keeping this information on paper stands in the way of applying more advanced knowledge management methodologies in Ace R&D. They visualize researchers countering their efforts with questions such as “How do you expect to manage knowledge when we can’t even access material data sheets electronically?”

The Ace knowledge management team launches a side project to create a focused repository for material safety data sheets. They use a robust, scaleable text repository that enables browser-based search and retrieval. The project is implemented quickly and the researchers immediately begin using the new application directly without realizing that it will soon be integrated into the upcoming knowledge management system.

Ace Unifies Search

The knowledge audit at Ace identified a large number of information resources that were underutilized simply because users did not know they existed or how to access them. The knowledge management team realizes that unifying access to these isolated information sources through a single search page on the Ace intranet is a good first step that will provide immediate benefits to end users and give the team some positive exposure throughout the organization.

One of the IS members of the knowledge management team takes on the project. She begins with a technical evaluation of the information sources discovered during the knowledge audit. For each information source she catalogs the uniform resource locator (URL) for the search query, the query syntax, the format used for returning results and whether passwords are required for access.

After a few short weeks of testing, the team unveils a search page on the Ace intranet for simultaneously querying a collection of legacy information stored in a document management system, various corporate intranet sites, the new repository of chemical safety data sheets, an outside chemical research abstract service and several Internet search engines.

Ace Implements a Knowledge Warehouse Pilot

Meanwhile, the knowledge management team begins to implement a knowledge warehouse to solve some of the knowledge contribution and sharing problems in and between R&D and product management. The knowledge warehouse will encompass several Lotus Notes databases—one in R&D, one in product management and one shared between the two groups. The latter is a discussion database where product managers share ideas about future products and scientists are welcome to comment on the ideas. Human resources will contribute basic employee information that employees then expand upon to create skills profiles. Employees in environmental initiatives, R&D and product management will be able to contribute and have access to the following explicit assets:

- Research reports
- Profiles of researchers, product managers, and engineers
- Patents
- Product roll-out schedules
- Research papers published on the Internet
- Newsfeeds
- Feedback from customers
- A discussion database for brainstorming about new products
- Best practices

Example: Browser-based Contribution

A researcher wants to share recent research results on the recycling of polyester. He has already contributed the standard research report to the proper Lotus Notes database, but he has additional related documents and a web page that are useful resources on what he sees as a great integration of business and environmental initiatives related to this research. He also wants to record his primary research interviewing video store chains, which have been enthusiastic about recycling old video cassettes. He accesses a web-based form for contributing related information and adds the interview results, a link to the web page and a link to the primary research report in Lotus Notes.

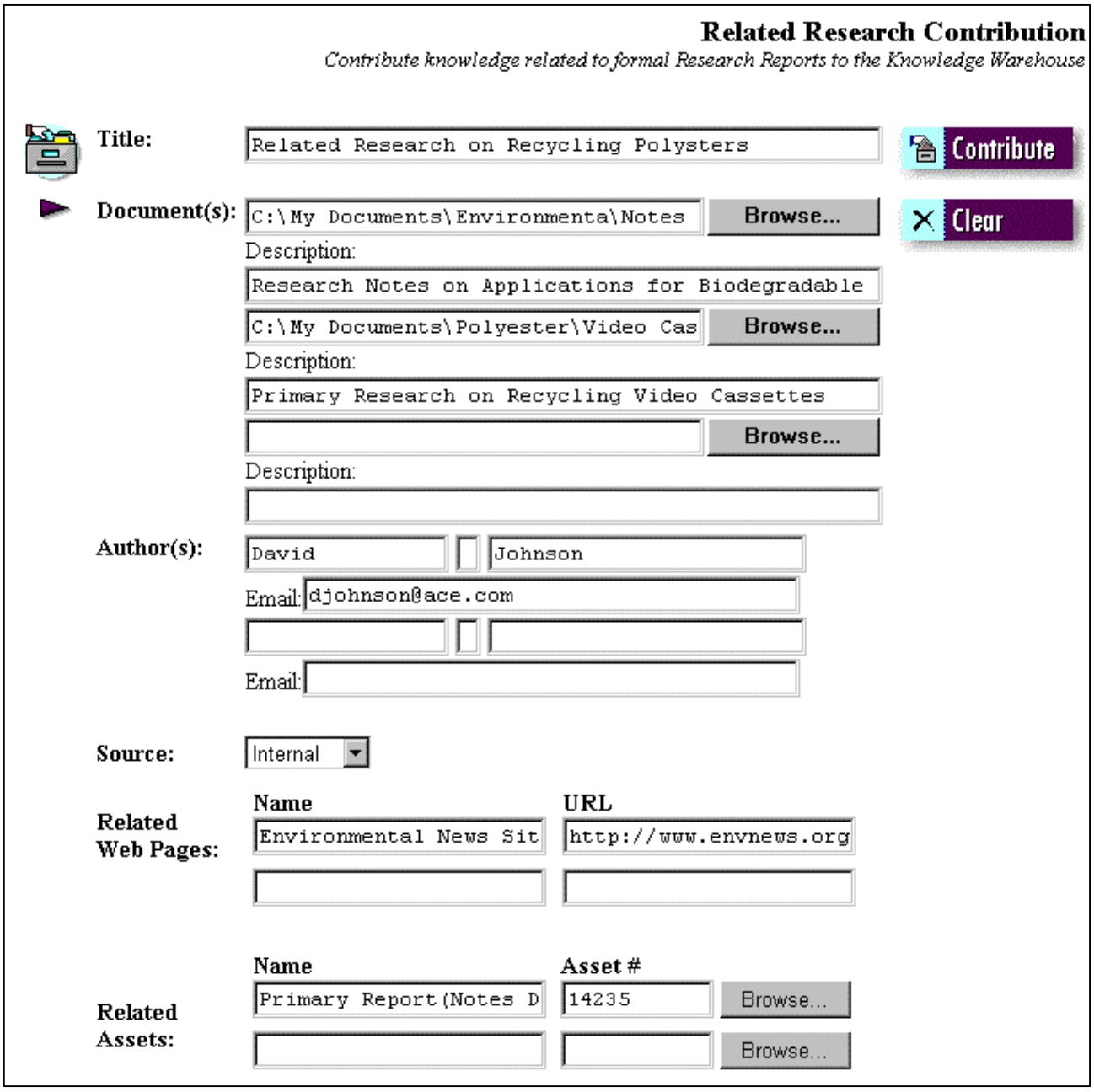

Figure 2 - Knowledge Contribution Form

Ace Enhances its Knowledge Management System

After successfully implementing the material safety data sheet repository, a query broker and a knowledge warehouse pilot, the knowledge management team plans its next steps. Feedback from the knowledge warehouse pilot strongly indicates the need to find subject-matter experts by both researchers and product managers. In addition, users noticed that contributors often became lazy, did not have the time, or simply did not have the knowledge to enter all of the metadata that was required by people looking for that information. In response, the knowledge management team adds some new capabilities to its pilot system and creates a new network of "knowledge managers."

Ace Creates Knowledge Editors

The knowledge management team at Ace thinks long and hard about content editors. The team begins by assigning senior people from different departments to the position of "knowledge manager." It looks for people who are recognized by their peers as experts on specific content areas and already have a willingness to share what they know. The knowledge management team positions the role of knowledge manager as a prestigious position and a reward that recognizes outstanding contributors to the organization. The Director of Knowledge Management works with HR to create a program of incentives and rewards for knowledge managers and works with senior managers to ensure content management is considered an important part of the individual's daily duties.

Next, the knowledge management team rolls out a browser-based tool to make the content management aspect of the knowledge manger's job easier. This knowledge editor permits Ace knowledge managers to review end user contributions in knowledge map categories for which they are responsible. The knowledge manager can re-assign assets that are miscategorized, add and modify metadata and remove outdated or inappropriate content.

Example: Ace Collects Success Stories

The team interviews employees participating in the pilot to learn how to improve the design of the knowledge warehouse and evaluate the relevancy, efficiency and accuracy of the information found. They are pleased to see how metadata and categorization are improving the speed, accuracy and relevancy of information found over simple keyword searches:

Scenario 1

A product manager needs information about new fibers that are stain- and abrasion- resistant and have a potential application as an automotive textile.

- Uses the search keywords: stain, abrasion and resistant
- Limits the search to metadata: Look for keywords "Stain, Abrasion, Resistant" in a metadata field for "Material Properties"
- Drills down through the knowledge map: Applications → Automotive → Automotive Interiors → Fabrics

Limiting the search to a subset of "Material Properties" still yields a thousand plus assets. So the product manager drills deeply into the "Applications" knowledge map until he finds a dozen relevant assets, including research reports about biosynthesized polyester, people's resumes and two Web pages.

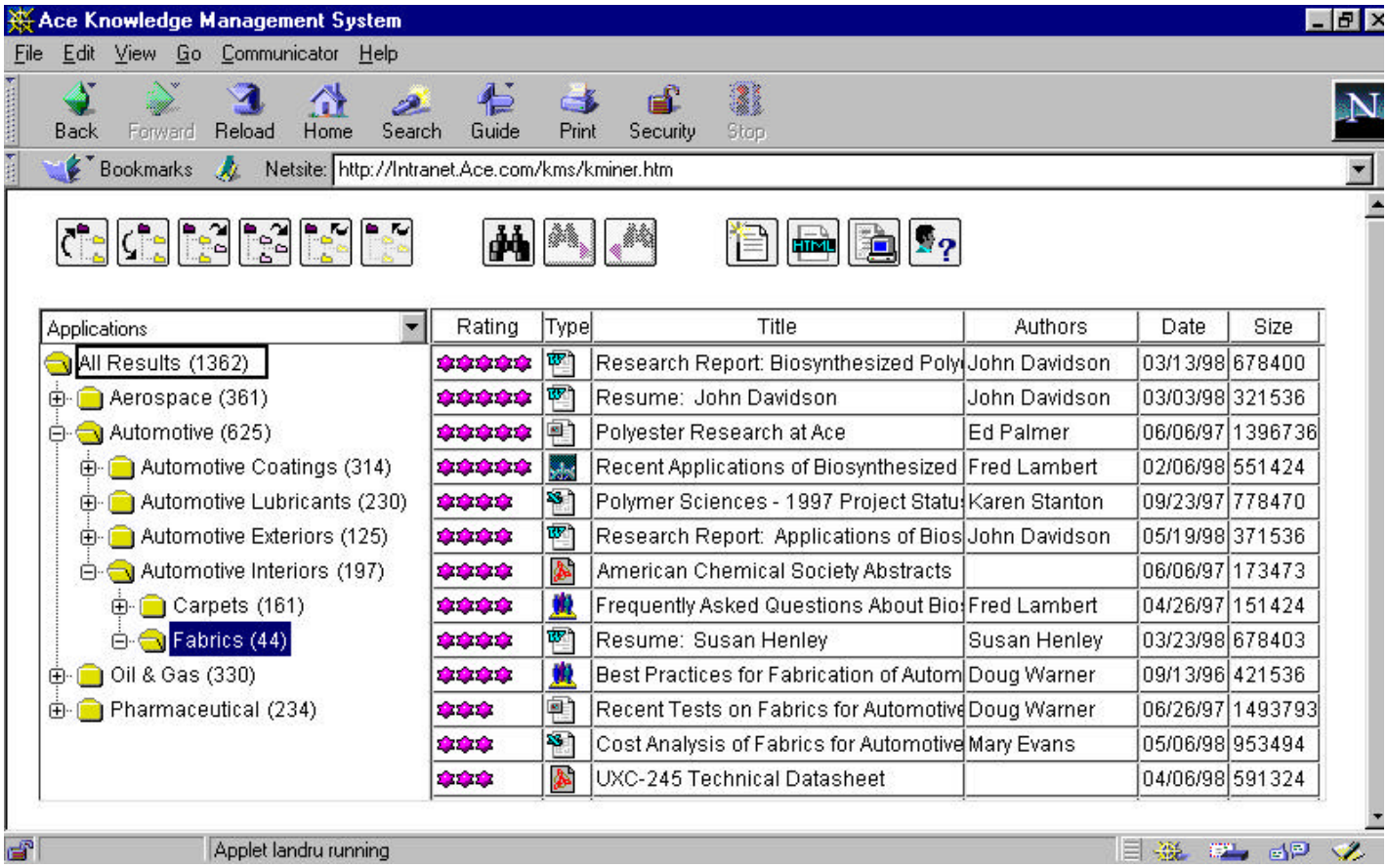

Figure 3 - Using the Knowledge Miner to Locate Relevant Results

Scenario 2

A process engineer needs new information about polyester production.

- Uses the search keyword: Polyester
- Limits the search to metadata: “1/1/97 or later” in metadata field “Date”
- Drills down through the knowledge map: Processes → Biosynthesis → Fermentation

With the keyword “polyester” used in a full-text search and the limitation of only those assets produced since January 1997, the engineer receives search results of hundreds of assets. She uses a knowledge map to narrow her search. She chooses the “Processes” knowledge map, drills through to “biosynthesis” and then drills to “fermentation” to find two reports. She decides to talk to someone about both reports, so she queries a knowledge directory. It returns a list of three experts and their contact information. She reads the resume of the most senior expert and calls him.

Search Results for Experts on 'Processes / Biosynthesis / Fermentation'

Experience Level	Name	Department	Title	Office	Telephone	Resume On File	Find All Assets
Expert	John Davidson	Ace Research	Sr. Scientist	New Brunswick, NJ	(908) 555-3527	Yes	...
Advanced	Donna Maloney	Process Engineering	Sr. Engineer	Atlanta, GA	(404) 555-6475	Yes	...
Advanced	Susan Henley	Ace Research	Research Associate	New Brunswick, NJ	(908) 555-3982	No	...
Novice	Fred Lambert	Product Management	Sr. Product Manager	New York	(212) 555-9376	Yes	...

New search.

Figure 4 - Search Results Showing People Linked to Knowledge Resources

Scenario 3

A program manager in environmental initiatives needs information for an article she's writing about waste reduction for an automotive industry magazine.

- Uses the search keywords: Waste Reduce Biodegradable
- Limits the search to metadata:
- Drills down through the knowledge map: Industries → Automotive

The full text search using the three keywords produces 800 assets. The program manager narrows the search by selecting the automotive industry from the knowledge map. She finds the research report about polyester made from biosynthetic fermentation, whose byproducts are biodegradable. She emails the report's author to ask for an interview.

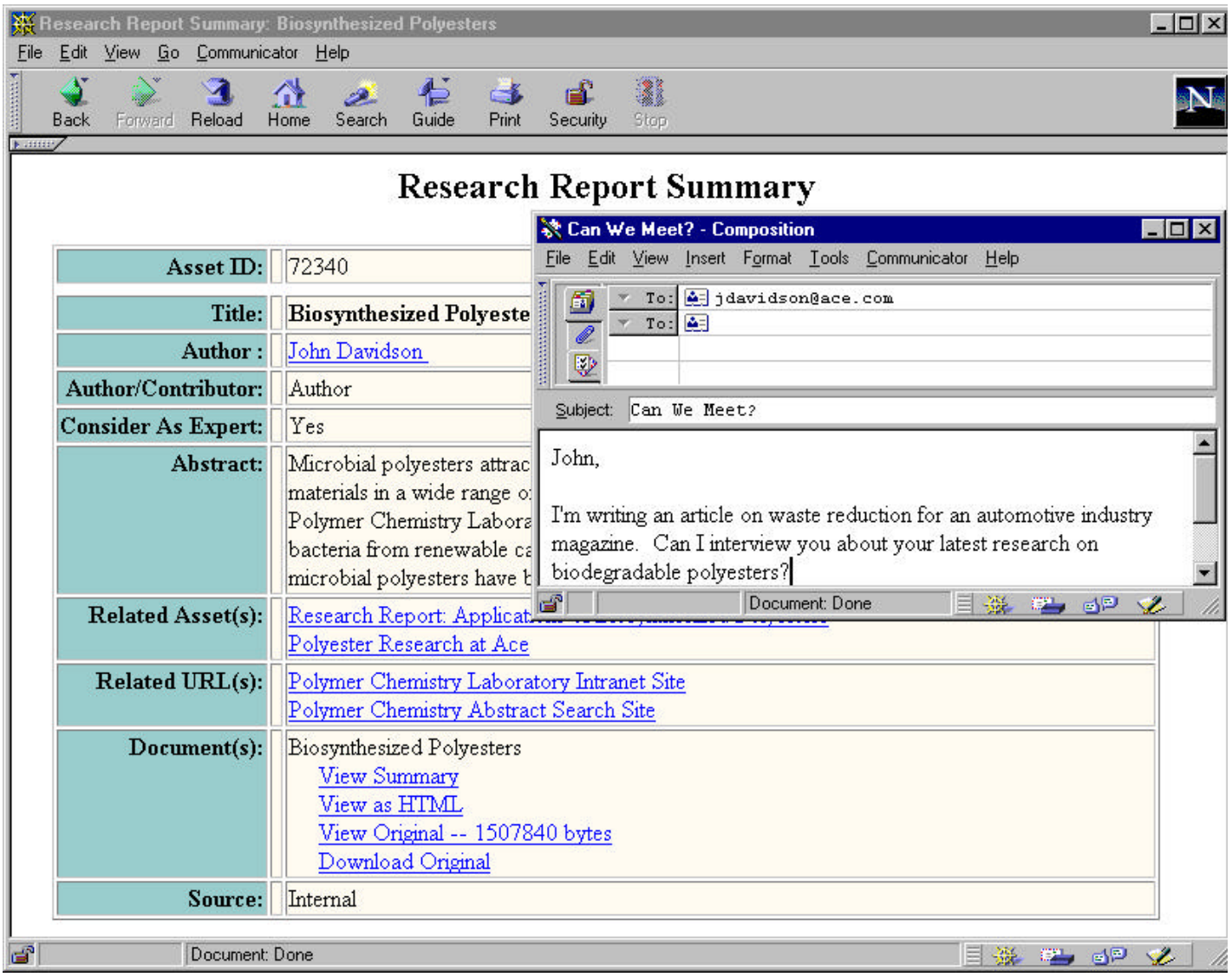

Figure 5 - Contacting Experts After Knowledge Is Located

The investment in up-front planning and design has clearly paid off in improved productivity and effectiveness. The knowledge management team has created a system that is much more than a searchable repository of existing explicit assets. It addresses the problems that Ace researchers and product managers need to solve everyday. With clear success stories the knowledge management team looks for ways to replicate and expand knowledge management throughout the enterprise.

Ace Expands Participation in Knowledge Management

Although positive results at Ace are apparent only a few weeks after rolling out the knowledge warehouse, Ace was careful not to rush what it considered the “beta period” of the knowledge management project. After its controlled pilot of the knowledge management system, the knowledge management team invites several dozen users from R&D, product management, and environmental initiatives to try the system and makes additional improvements to the knowledge map and the user interface.

After edits to the system and another round of usability testing, the first release is ready—a few months after the first team meeting. Ace holds Knowledge Management Fairs in both the New Jersey and Virginia offices. Everyone in

R&D, product management, environmental initiatives, and IS attends to receive a hands-on demo of the system—and a great catered lunch.

Knowledge Management Benefits Appear at Ace

Three months after the release, people start to notice a difference in information and culture. Product managers for textiles use the application to learn of a superior biopolymer undergoing research. They alert aerospace product management about the biopolymer. The aerospace product managers set up a meeting with researchers working on a standard synthetic for aerospace applications. They mutually decide to stop research on the standard synthetic because it's inferior to the biopolymer.

Meanwhile, R&D needs no encouragement to use the new system. As research projects begin, project leaders assign scientists to collect relevant research and make it accessible to the research team through the system. This research includes old reports that need to be scanned in, electronic documents and links to university departments and research associations posting related material. Regardless of who leaves or joins the project, the project knowledge is not lost.

Using the knowledge management system, product managers receive advance notice of a hydro/biodegradable polyester. They use the system to study the polyester and to find the scientists to interview about the polymer.

A third suggestion comes from the new products discussion database, where an employee in environmental initiatives suggests degradable fishing lines and nets to decrease the incidence of sea mammals ingesting or becoming entangled in aquatic trash.

The CEO personally congratulates everyone involved and asks his reports to broadcast the story in the company newsletter and post information for customers about the promise of the polyester on the Ace home page.

Applications of Knowledge Management Expand at Ace

After a year, Ace expands the knowledge management system to Ace scientists and product managers worldwide, and to GeneNow Corp., a genetic engineering firm. Ace R&D and GeneNow collaborate to create a single microorganism with all the enzymes required to turn sugar into a substance used to produce superior polyester. The production of the substance is a low-cost, environmentally sound process involving cornstarch instead of heavy metals, petroleum or toxic chemicals. At the end of the collaboration, the CEO of GeneNow asks the CEO of Ace for advice on starting a knowledge management project.

The Ace VP of environmental initiatives is pleased with such environmental product angles. The leaders of R&D and product management are also impressed: after two years of knowledge management, research costs drop 10 percent without a drop in productivity. New product rates increase by eight percent without significant new hires.

The CEO calls in the director of knowledge management and he pays him a big compliment; he asks him to start planning knowledge management for manufacturing.

Appendix B - About Dataware Technologies, Inc.

Dataware Technologies, Inc., is the leading provider of enterprise knowledge management software. Dataware's solutions enable users to capture, contribute, store, manage, share and distribute knowledge across and beyond the enterprise.

Dataware Partial Client Listing

Today, Dataware software is used by more than 2,000 organizations worldwide - including corporations, government agencies, commercial publishers and educational institutions.

Corporate	***Commercial / Electronic Publishing***	***Professional/Educational***	***Government***
3M	Baker & Taylor	British Library	British Post Office
ACE Hardware	Derwent Information	Georgia Tech	European Patent Office
Air Products & Chemicals	Dun & Bradstreet	Helsinki School of Economics	Inland Revenue Service
Analog Devices	Gale Research	Johns Hopkins University	National Archives
AT&T	Information Handling Services	Legal Support Services	Netherlands Finance Ministry
Eastman Kodak	McGraw-Hill	Library Corporation	Social Security Administration
Exxon	National Geographic Society	Los Alamos National Lab	Statistics Canada
Hitachi	Newsbank	Ropes & Gray	U.S Air Force
LEGO	R.R. Donnelley & Sons	Skadden, Arps	U.S. Army Corps of Engineers
Mobil	Singapore Press Holdings	University of Barcelona	U.S. Department of Commerce
Shell Research	Standard & Poor's	University of Illinois	U.S. Department of Justice
Siemens	Thomas Publishing	University of Nevada	U.S. House of Representatives
Toshiba	Thomson & Thomson	University of Washington	U.S. Navy
Toyota	Ziff-Davis Publishing	White & Case	U.S. Patent Office

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