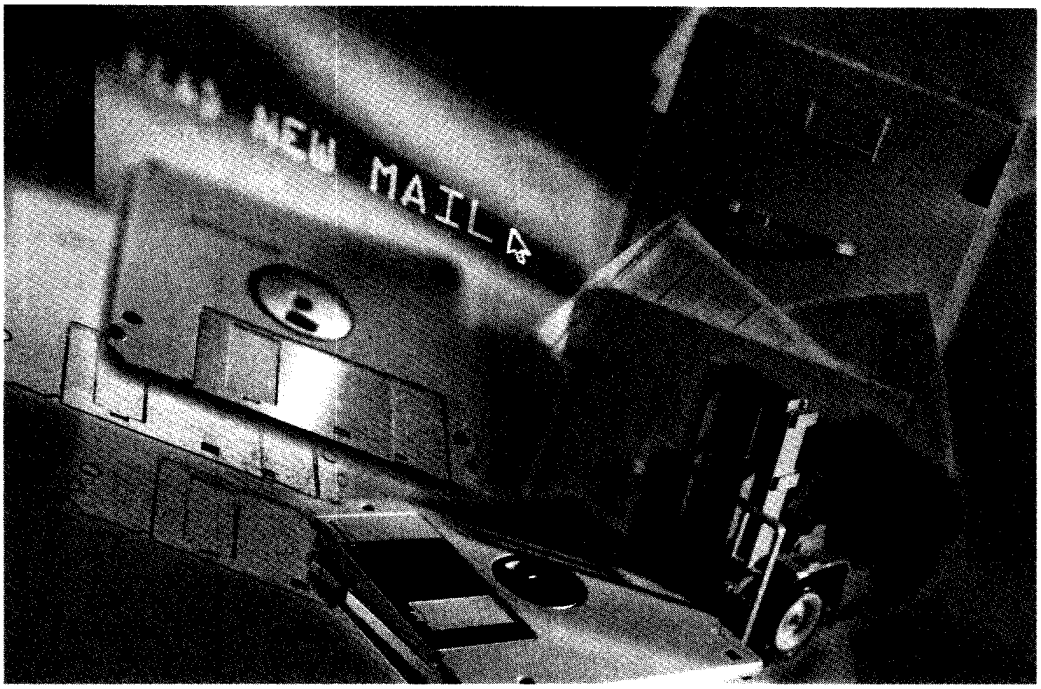
Successful Knowledge Management Projects

Thomas H. Davenport ▪ David W. De Long ▪ Michael C. Beers



Eight key factors can help a company create, share, and use knowledge effectively.

Thomas H. Davenport is the Curtis Mathes Professor, University of Texas at Austin. David W. De Long is a research fellow at Ernst & Young's Center for Business Management. Michael C. Beers is a doctoral student at the Harvard Business School.

Scholars and observers from disciplines as disparate as sociology, economics, and management science agree that a transformation has occurred — knowledge is at center stage.[1] Knowledge is information combined with experience, context, interpretation, and reflection. It is a high-value form of information that is ready to apply to decisions and actions. While knowledge and information may be difficult to distinguish at times, both are more valuable and involve more human participation than the raw data on which we have lavished computerization during the past forty years. Given the importance of such an asset, it is not surprising that organizations everywhere are paying attention to knowledge — exploring what it is and how to create, transfer, and use it more effectively. Knowledge management, in particular, has recently blossomed.[2]

Unfortunately, however, abstract musings on the importance of knowledge, or on the emergence of knowledge-based economies and organizations, too often dilute discussions. Conceptual analysis is of little use to practitioners faced with questions about what specifically they should do as managers of knowledge.

In this article, we address the practical realities of the sometimes heady subject of knowledge management by focusing

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on a tangible, pragmatic entity, the knowledge management project. Such projects are attempts to "do something useful" with knowledge, to accomplish organizational objectives through the structuring of people, technology, and knowledge content. It is through projects and initiatives, however disjointed, that most significant change happens in organizations. Knowledge management projects are changing businesses today, and we believe it is time to examine them and learn from them.

Of course, by selecting the knowledge management project as the unit of analysis, we gain some benefits while forgoing others. None of these projects is optimal. Some beg the question of whether it is really "knowledge" that is being managed, and many are quite limited in impact. Very few contribute to the much touted goal of "organizational transformation." As one might expect, it is proving far easier to talk and write about organizational transformation than it is to achieve it. Nevertheless, for many industries, the importance of knowledge as the basis of future competition is an established fact. Hyperbole and fantasies aside, the question remains: How can organizations use knowledge more effectively?

To understand how companies are managing knowledge today, we studied thirty-one knowledge management projects in twenty-four companies. Where possible, we mention the names of the firms; some sites requested anonymity. (For a list of the projects by type of business, type of knowledge managed, and primary objective, see the *Appendix*.) In most companies, we addressed only one project, but to look at the breadth of knowledge management in a single firm, we also collected data from nine projects in one company, Hewlett-Packard (HP). We visited four firms and interviewed other sources by telephone. Our sources typically were the managers of the knowledge projects or of the knowledge management function across the organization.[4]

First, we briefly discuss the many differences and some similarities of the initiatives and then present a high-level typology of knowledge management projects. We attempt to show what makes a "successful" knowledge project. Success and failure are ambiguous terms when applied to so nascent a field as knowledge management, but we identified eight key characteristics that we judged successful. We conclude by discussing some differences between success factors for knowledge management projects and those for other initiatives, for example, information or data management efforts.

Objectives of Knowledge Management Projects

Because knowledge management is evolving, even the most developed, mature projects we studied were unfinished. In every case, however, a manager could articulate specific business and knowledge management objectives, and a few had already achieved some goals.

We found many variations among the thirty-one projects. They involved many different types of knowledge, from R&D to sales to production. Some were self-funding, using a market-based approach that charged users for knowledge services. Others were funded from overhead. Some took a hybrid approach, for example, relying on corporate funding during rollout but requiring a transition to self-funding over time. Some projects were managed or coordinated by a centralized corporate knowledge management function, while others occurred in a more bottom-up, decentralized fashion. Where some initiatives were fundamental to the very purpose and existence of a firm, others were peripheral; some defied economic justification; others generated revenue from external customers.

In some general ways, of course, all the projects were alike. They all had an individual responsible for the initiative and all demonstrated some commitment of human and capital resources. These investments, however, ranged from a direct marketing firm that appointed a chief knowledge officer (CKO) with no formal budget to a consulting firm with more than seventy positions designated to support knowledge management and an annual budget of more than $10 million. The projects also had similar objectives, which all explicitly focused on knowledge, as opposed to information or data. We identified four broad types of objectives: (1) create knowledge repositories, (2) improve knowledge access, (3) enhance knowledge environment, and (4) manage

knowledge as an asset. While some projects sought to achieve all at once, most had one primary objective.

Create Knowledge Repositories

A lot of the energy in knowledge management has been spent on treating knowledge as an "it" — an entity separate from the people who create and use it. The typical goal is to take documents with knowledge embedded in them — memos, reports, presentations, articles — and store them in a repository where they can be retrieved easily. Another, less structured form of knowledge as an "it" is the discussion database: participants record their own experiences on an issue and react to others' comments.

We found three basic types of repositories: (1) external knowledge, for example, competitive intelligence; (2) structured internal knowledge, such as research reports, product-oriented marketing materials, and techniques and methods; and (3) informal internal knowledge, like discussion databases full of know-how, sometimes referred to as "lessons learned." Some companies are also using artificial intelligence software to manage knowledge, particularly in relatively narrow domains like technical support for customers.[1] Classified as repositories of structured internal knowledge, they have been quite successful in many settings.

Competitive intelligence systems may often be overlooked as knowledge management systems, but most effective ones will filter, synthesize, and add context to information from the external environment, which qualifies them for this category. An automobile manufacturer, for example, had a repository of external competitive intelligence knowledge based on a detailed business model that identified what information it should collect. This repository included analysts' reports and external market research on competitors. Using a tool called GrapeVINE, the knowledge managers for this project not only interpreted raw information — providing context and synthesis that made it more valuable — but also routed the knowledge on different topics to managers with a specific interest in a subject. When something was particularly important, they upgraded the knowledge and sent it to everyone.

The structured repository projects we studied stored both knowledge and information. If the knowledge versus information distinction is considered a continuum instead of a dichotomy, then projects that focus on structured knowledge deal with the middle of the continuum. They usually contain document-based information that represents knowledge to some; at a minimum, however, these repositories are not storing data. At HP, for example, a large, successful project called "Electronic Sales Partner" provided technical product information, sales presentations, sales and marketing tactics, customer/account information, and anything else that might benefit field personnel in the sales process. The leaders of this project — whose business cards read "knowledge manager" — tried to add value to their repository through careful categorizations and pruning. Calling it the "most successful implementation of software I have seen in twenty years," the manager of the sales support area reported "phenomenal feedback from both submitters [of knowledge] and users." We found a similar sales-oriented document repository at Sequent Computer, where managers were just as enthusiastic.

To transfer tacit knowledge from individuals into a repository, organizations usually use some sort of community-based electronic discussion.

Finally, there is the knowledge that resides in the minds of the people in an organization but has not been put in structured, document-based form — commonly referred to as "tacit" (versus explicit) knowledge; the different management approaches for tacit and explicit knowledge have been described elsewhere.[3] To transfer tacit knowledge from individuals into a repository, organizations usually use some sort of community-based electronic discussion. In HP's corporate education division, for example, a knowledge project was capturing tips, tricks, insights, and experiences into a Lotus Notes database and making them available to some 2,000 trainers and educators scattered throughout the corporation's many sites. Thus this type of knowledge repository tries to accelerate and broaden the knowledge sharing that happens traditionally through the socialization of newcomers, the generation of stories within communities, and the general transmission of cultural rituals and organizational routines.[4]

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Improve Knowledge Access

While capturing knowledge is the objective of the knowledge repository, other projects focus on providing access to knowledge or facilitating its transfer among individuals. These projects recognize that finding the person with the knowledge one needs and then successfully transferring it from that person to another are difficult processes. If a library is a metaphor for conceptualizing knowledge repository projects, the *Yellow Pages* might represent the purpose of knowledge access projects. Managers involved in these projects commonly used phrases like "get at the knowledge we know we have" or "sharing our knowledge" — phrases that connote a need for and emphasize connectivity, access, and transfer.

Several companies were building and managing expert networks. At Teltech Resource Network Corporation, the expert network was the primary business — not simply an improvement targeted at some segment of the operation. It provides a technical expert referral service by maintaining a comprehensive database of external technical experts. Teltech provides its services to engineers, researchers, or scientists who have occasional need for expert knowledge in technical domains. It motivates experts to participate in the network by paying them to answer clients' questions when they are contacted. Teltech markets its services to technical managers and professionals within its client companies, while constantly seeking new customers. "Gatekeepers" at clients for Teltech's services include R&D managers and technical librarians. Knowing that engineers don't ask for help easily, Teltech works hard to overcome this predisposition; it offers small prizes, amusing content, and encouragement in phone conversations to technicians seeking knowledge.

Microsoft has developed a form of expert network for making explicit the types of knowledge competencies necessary for software development projects, and for matching software development teams that need people with certain expertise with those who have it. This project has described more than 300 knowledge competencies, both general and technology-specific. Employees, supervisors, and peers rate the competencies jointly. Microsoft's project is unusual in the knowledge management context because it is closely tied to the staffing process for internal systems development projects and to the analysis of requirements for education and training. The project uses a database and Web interface to store the knowledge competency categories and personal profiles. The database currently provides a means of balancing employees' educational and training objectives against current and projected job requirements. Plans are under way at Microsoft to extend the use of the system to software product development.

BP Exploration (BPX), a division of the large, global oil company, successfully completed a pilot of a more internal and infrastructural approach to achieving knowledge access and transfer in its "Virtual Teamwork" project. BPX managers initially felt that much of the important knowledge in its organization was unstructured knowledge in people's heads. Rather than extract it for a repository, managers aimed to facilitate the exchange of this tacit knowledge. They equipped each BPX site with at least one desktop videoconferencing system, document scanning and sharing tools, and the requisite telecommunications networks. They also provided substantial education and coaching on how people could use the system to solve real BPX problems.

When a compressor in an oil field in Colombia, South America, stopped functioning, the new system quickly proved its value. The only internal expert was on the North Slope of Alaska, while the vendor's expert was in Italy. Through the desktop videoconferencing system, experts could deliver the knowledge on how to fix the compressor to the Colombian site in several hours. BP is sufficiently pleased with its knowledge project at BPX that it's expanding the system throughout the company; a similar system for senior executives is already in place. BP is also exploring the use of computer-based knowledge repositories that could augment the face-to-face transfer of knowledge through videoconferencing; experts could answer frequently asked questions for an on-line repository.

Other projects we studied took a lower-tech but even more proactive approach to improving knowledge access

and transfer. These projects focused on the communication of knowledge between people who would not otherwise work together. At Sematech, the semiconductor research consortium in Austin, Texas, managers instituted formal practices for knowledge transfer to ensure that sponsoring companies received research results. Sematech has a knowledge transfer organization and several formal roles for that purpose; it also holds many sessions of which the primary objective is knowledge transfer. Many take place in Austin or at sponsoring firms' locations, but, most important, the company uses "assignees" from sponsoring firms in its R&D processes. Any knowledge they gather during their two or so years at Sematech is effectively transferred when they return to their companies. While Sematech also has several technological channels for knowledge transfer in place, managers credit face-to-face transfers as the most effective by far.

At one large computer company, a series of ongoing efforts encouraged the reuse of a particular kind of knowledge: component designs.

Enhance Knowledge Environment

A third type of knowledge management project involves establishing an environment conducive to more effective knowledge creation, transfer, and use. We saw projects that were trying to build awareness and cultural receptivity to knowledge, initiatives attempting to change behavior relating to knowledge, and attempts to improve the knowledge management process.

Several companies were engaged in high-level and general efforts to change the organizational norms and values related to knowledge. At one large computer company, a series of ongoing efforts encouraged the reuse of a particular kind of knowledge: component designs. Over the years, the attitudes of engineers there have shifted gradually to value time to market more than (or at least as much as) originality of design. A direct marketing firm's goal for its knowledge management efforts was to increase awareness of the knowledge embedded in client relationships and engagements, which, if shared, could enhance organizational performance. In both these organizations, the project managers felt that efforts to improve awareness of knowledge management should precede more formal, structured programs for building repositories.

Some companies make knowledge-related employee behavior a specific target of their projects. A large consulting firm was trying to change employees' perceptions of their jobs — from deliverers of consulting services to creators and distributors of management knowledge. One method was to make contributions to the firm's structured knowledge base a significant factor in compensation decisions. While this effort has not been entirely successful — one knowledge manager reported that some consultants are still "allergic" to knowledge — the average consultant is more aware of, and takes more advantage of, knowledge resources than he or she did five years ago, according to the firm's measurements.

Finally, some companies addressed the processes by which knowledge is created, shared, and used. At a general level, a process orientation meant developing measures of the speed, cost, impact, and customer satisfaction of the knowledge management activities. After interacting with one of Teltech's experts, for example, customers are asked to assess the quality of the expert and the expertise offered. The consulting firm just described kept records of what knowledge resources it employed in what proposals and projects, as well as how that affected "win rates."

At a more detailed level, some companies applied the approaches of process improvement and reengineering to knowledge management. For example, they described the desirable steps for the process of knowledge management. One automotive company's project specified the knowledge to employ during the new-car development process. At each step, guidelines specified the type of knowledge to consult, where it resides, and the types of decisions to make. The company also created "decision audit" programs to assess whether and how employees were applying the knowledge to key decisions. It's too early to say whether this effort will succeed; however, we fear it may be bringing too much structure to knowledge work processes and knowledge-based decisions.

Manage Knowledge as an Asset

A fourth type of project focuses on managing knowledge as an asset. One way an organization does this is by treating knowledge like any other asset on its

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balance sheet. Skandia, the large Swedish financial services company, internally audits its intellectual capital every year for inclusion in its annual report to stockholders. One goal is to persuade investors of the value of Skandia's knowledge capital. Another is to focus the organization on how to increase or decrease its effective use of knowledge assets over time.[7]

Some companies focus on managing specific knowledge-intensive assets more effectively to improve their return. By carefully reviewing and managing its patents, Dow Chemical, for example, saved $4 million during the first year of its new program and expects to generate more than $100 million in licensing revenues that it might otherwise have forgone. Of these two approaches to knowledge assets, we are more positive about managing assets than measuring them. Efforts to measure knowledge assets, while laudable, will eventually require major changes in worldwide accounting systems if they are to become institutionalized; we view such changes as unlikely. Efforts like Dow's yield immediate monetary benefits and can improve investor perceptions, if adequately publicized.

Projects with Multiple Characteristics

The four categories of objectives we've described are "ideal" types. Of course, in real life, ideals rarely exist. Almost all the projects we studied had, in addition to the primary objective, aspects of the other objectives. At the direct marketing firm, for example, the CKO strove to inculcate a knowledge-friendly culture, while at the same time improving knowledge access by setting up formal, face-to-face knowledge transfer programs. At the consulting firm, capturing structured and unstructured knowledge and improving access were objectives for a portfolio of projects, which included the development of an expert network and the creation of internal document repositories and unstructured, lessons-learned knowledge bases. While it is too early to tell, we expect that knowledge management initiatives along multiple fronts will be more effective than those that seek only one objective.

For example, a company could profit from creating a repository and improving the knowledge management environment to motivate people to contribute to and access the repository. This framework, however, does not provide insights into how to allocate knowledge management resources. Overall business strategy, along with identification of core competencies and knowledge resources, should drive those decisions.

The different intentions that become clear in our typology raise questions about how to assess a project's effectiveness, particularly in light of mixed objectives. How do we measure the value created by a knowledge repository, for example? Should we simply count "hits on the database"? And how do we assess a project striving to provide improved access to knowledge or a more knowledge-oriented culture? The project's benefits for the business are usually indirect, and establishing the link between knowledge and financial performance is, at best, tricky.[8] Shareholders do not invest in companies to have a knowledge-sharing culture or a knowledgeable sales-force. They expect businesses to make money. Next we discuss performance measurement specifically and success more generally.

When Are Knowledge Management Projects Successful?

Before we could identify the characteristics associated with success for knowledge management projects, we needed to assess the performance of existing projects. Economic returns on knowledge are difficult to quantify and compare across organizations, so we used additional indicators of success to evaluate the sample projects. We observed these projects at only one point in time, of course, and cannot predict whether current indicators of performance will persist. We used success indicators similar to those for assessing the effectiveness of other business change projects:

- Growth in the resources attached to the project, including people, money, and so on.
- Growth in the volume of knowledge content and usage (that is, the number of documents or accesses for repositories or participants for discussion-oriented projects).

• The likelihood that the project would survive without the support of a particular individual or two, that is, the project is an organizational initiative, not an individual project.
• Some evidence of financial return either for the knowledge management activity itself (for example, it was a profit center) or for the larger organization; this linkage need not be rigorously specified and may be only perceptual.

We didn't ask the managers of knowledge projects if they thought their projects were successful. Given the political pressures to portray new programs as successful and also the high level of hype and expectations about knowledge management in the press and at conferences, we wanted to remove this aspect of subjectivity from the analysis. We did, however, ask about the success indicators described above. The presence or absence of these indicators allowed us to differentiate clearly successful projects from those that were not successful, that is, those likely to fail or not *yet* showing signs of success. We classified eighteen projects as successful and five projects as unsuccessful; eight projects were too new for us to determine success. Each of us rated the projects independently, and, in every case, we agreed on the classification.

The projects we defined as successful had virtually all the indicators. Several had failed to demonstrate financial benefits to date but had plans to show them in the future. In contrast, the unsuccessful or not yet successful projects had few or none of the characteristics. They had to scrounge for resources. They struggled to get organization members to contribute to repositories or use discussion databases. Only one or a few lonely visionaries championed these projects, and any sense that they would make or save money for themselves or their firms was either not under consideration or a long way off. Conditions might change in the future, but these projects were not currently succeeding.

We observed projects that contributed to successful knowledge management on two levels. The most ambitious type produced organizationwide impacts credited with either transforming the way the firm operated or even enabling it to survive. Impacts at this level were rare, however.

Knowledge was at least partially responsible for a major transformation of one large consulting firm. The transformation was extensive in both depth and breadth of impact, and financial results improved markedly during the period of knowledge management. Line consultants drew heavily from the firm's centralized knowledge centers, accessing previous presentations to other clients, process and system design specifications, work plans, and other project-oriented collateral and artifacts. One indicator of the initiative's impact was that the firm increased its "win rate" in proposals to clients; another was a higher than average growth rate compared with that of other large consulting firms. Senior managers described knowledge management as the core of the consulting strategy, and the concept was pervasive in the company's internal and external documents.

At Sematech's R&D consortium, knowledge creation and sharing was critical to its existence. Since it had employed approaches to knowledge management from its inception, it is difficult to argue that these tactics led to transformation, but survival is an equally important measure of success. Sematech has successfully retained its sponsorship over time and, in 1997, voluntarily relinquished its subsidy from the U.S. government. Sematech had a nearby organization from which it could learn: Microelectronics and Computer Corporation. Also based in Austin, Texas, MCC had substantial difficulties in knowledge transfer, partly because it did not devote as much attention to the issue as did Sematech and had fewer face-to-face mechanisms for achieving it.[9] Knowledge management was also critical to survival at Teltech. Its knowledge management approaches seemed to be working, as the company grew and had begun to consult on and even outsource some aspects (such as the operation of corporate libraries) of knowledge management.

The more common type of success in knowledge management involves operational improvements limited to a particular process or function.

Transformation and survival notwithstanding, the more common type of success in knowledge management involves operational improvements limited to a particular process or function. The projects we studied aimed to improve new product development, customer support, education and training, software development, patent management, and many other

functions and processes — and that was the primary form of success we found. It is difficult to evaluate how improvement in these relatively narrow areas translates into broader organizational performance.

What Factors Lead to Knowledge Project Success?

Once we found the successful projects in our sample, we tried to identify the major factors that contributed to their effectiveness. Because these are fundamentally change management projects, many generic critical success factors are also relevant. For example, the broader the initiative, the more crucial executive sponsorship is to its success. But setting aside the well-known change management homilies, we found eight specific factors that were common to the successful knowledge projects we studied. Because this was an exploratory effort, however, associating these factors with effectiveness in knowledge management should be viewed as hypothesized, not proven. Each might be a likely success factor for an organization wishing to build effective knowledge management projects.

- Link to economic performance or industry value
- Technical and organizational infrastructure
- Standard, flexible knowledge structure
- Knowledge-friendly culture
- Clear purpose and language
- Change in motivational practices
- Multiple channels for knowledge transfer
- Senior management support

Link to Economic Performance or Industry Value

The easiest and most impressive benefits from knowledge management projects involve money saved or earned. At Dow, for example, a key focus of the knowledge management initiative was better management of company patents. A specific goal was lowering taxes paid on patents that were no longer useful — an initiative that saved $4 million in the first year. At Texas Instruments, a strategic focus was increasing revenues through licensing of patents and intellectual property; in 1995, TI reportedly earned nearly $200 million — more than half its total profit — from patent licensing.[10]

Benefit calculations may also be indirect, perhaps through improvements in measures like cycle time, customer satisfaction, or even phone calls averted. Hoffmann-LaRoche has designed projects to significantly reduce time to market for new drugs in an industry in which even a day's delay can represent $1 million in lost revenues. Several knowledge management projects in the customer support process attempted to improve customer satisfaction by reducing waiting time for phone support or providing online knowledge. An HP support team studied the problems that dealers were experiencing, as revealed in their phone calls. Then the company preempted any potential calls by alerting customers to the most frequently asked questions and providing solutions through a Lotus Notes database. Another HP project in the customer support area (not officially a research site) reduced the cost of answering customers' calls by 50 percent in two years and also allowed the company to hire less technically experienced support analysts.

Ernst & Young measures the amount of knowledge it reuses in the form of proposals, presentations, and deliverables and the contributions of its knowledge repository to closing sales.

Knowledge management can be expensive, so inevitably it gets support in a firm when it is somehow linked to economic benefit or competitive advantage. Buckman Laboratories, a specialty chemicals company that was an early adopter of a knowledge repository, spends 2.5 percent of its revenues on knowledge management, Ernst & Young calculates 6 percent of its revenues, and McKinsey & Company, 10 percent. In industries like consulting (often described as "knowledge businesses"), the payoff from knowledge management projects remains largely perceptual. Still, consulting firms attempt to demonstrate economic returns. Ernst & Young, for example, measures the amount of knowledge it reuses in the form of proposals, presentations, and deliverables and the contributions of its knowledge repository to closing sales. Buckman Laboratories collects anecdotes of success in using knowledge to sell its specialty chemicals to customers. Company chairman Bob Buckman argues that specialty chemicals is a knowledge-intensive business, and without access

to knowledge on how the chemicals are applied to customers' problems, the company could not succeed for long.

Technical and Organizational Infrastructure

Knowledge projects are more likely to succeed when they use the broader infrastructure of both technology and organization. Of the two, technological infrastructure is more accessible. It consists partially of technologies that are knowledge oriented (for example, Lotus Notes and World Wide Web-based intranets). If these tools and the skills to use them are already in place, an initiative will find it easier to get off the ground. Most of the companies we interviewed employed multiple tools, which can either provide opportunities for organizational learning or increase functional specialization. At National Semiconductor, for example, engineers gravitated toward the Web, while sales and marketing personnel preferred Notes. The latter technology is better suited for workers who travel; they can "replicate" knowledge bases to their personal computers. National's knowledge managers were not worried about the different technologies, because they wanted to learn about the relative merits of Notes and the Web, and because they expected the two technologies to converge technologically over time.

Another aspect of technology infrastructure is a common, pervasive set of technologies for desktop computing and communications. At the simplest level, this means a capable, networked PC on every desk or in every briefcase, with standardized personal productivity tools (for example, word processing and presentation software), so that people can exchange documents easily. HP calls this a "common operating environment," and knowledge managers cite it as an important factor in sharing knowledge. More complex, functional desktop infrastructures can be the basis of some knowledge management projects, such as BP's videoconferencing technology.

Building an organizational infrastructure for knowledge management means establishing a set of roles and organizational groups whose members have the skills to serve as resources for individual projects. The companies we interviewed often found this difficult to do, in part because it involves spending money on new roles. Some firms, however, had multiple levels of new roles, from CKOs to knowledge project managers to knowledge reporters, editors and knowledge network facilitators.

At Ernst & Young's consulting business, for example, there are facilitators of twenty-two different knowledge networks, managers of several new knowledge-oriented organizations that create or distribute knowledge, a CKO, and several new committees to prioritize knowledge projects and set knowledge strategy. These new roles and structures are expensive, but they mean that any new project can get support from them and get up and running quickly. BP has created a team of "coaches" to facilitate use of a sophisticated, global telecommunications infrastructure consisting of real-time desktop video via satellite, supporting document imaging, electronic white boards, and other state-of-the-art features. The coaches work with end users to create value from the technology. Of the first five sites that BP created, the only unsuccessful one had no coaches and had taken a more laissez-faire approach to adoption.

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Standard, Flexible Knowledge Structure

Finding the right balance in the knowledge structure is critical for many projects. Knowledge is fuzzy and closely linked to the people who hold it; its categories and meanings change frequently. Consequently, knowledge often resists engineering. The expert systems movement of the 1980s confirmed this problem; it proved to be difficult to create rules that covered even narrow knowledge domains and even more difficult to update and modify the structure.

If a repository has no structure, however, it is difficult to extract knowledge from. One professional services firm (not in our study) attempted to create a wholly unstructured knowledge repository, searchable on all words in the database. The designer wanted to use powerful parallel computers to make up for the lack of structure. A pilot system was virtually unusable, always yielding either too many or too few items. Firms building a knowledge base or expert network must create some categories and key terms. Another important issue that arises is who controls decisions about the knowledge structure. In an international engineering firm, the manager of the knowledge base

created a relatively unstructured repository, while the company's engineers, who worked with hierarchical mental models, were frustrated by the knowledge structure imposed on them.

Another factor is the continual evolution and flexibility of a knowledge structure. It is often useful to have a thesaurus to connect the searchers' terms with the categorizers' terms. At Teltech, for example, an extensive thesaurus of technical terms allows browsing and searching of the expert network through terms that make sense to users; Teltech employees continually add users' terms to the thesaurus. The structure of the knowledge, therefore, is always changing according to current usage.

Knowledge-Friendly Culture

A "knowledge-friendly" culture, one of the most important factors for a project's success, is one of the most difficult to create if it does not already exist. Organizational culture should have several components with regard to knowledge:

- People have a positive orientation to knowledge — employees are bright, intellectually curious, willing and free to explore, and executives encourage their knowledge creation and use.
- People are not inhibited in sharing knowledge — they are not alienated or resentful of the company and don't fear that sharing knowledge will cost them their jobs.
- The knowledge management project fits with the existing culture.

A culture with a positive orientation to knowledge is one that highly values learning on and off the job and one in which experience, expertise, and rapid innovation supersede hierarchy.

A culture with a positive orientation to knowledge is one that highly values learning on and off the job and one in which experience, expertise, and rapid innovation supersede hierarchy. The firm attracts and hires people who reinforce the positive orientation. It is possible, of course, to pursue knowledge at the expense of work-related objectives, which could be a downside of an overly knowledge-oriented culture. While it is always hard to generalize about culture in large diverse organizations, we found strong evidence of a positive orientation toward knowledge in several of the companies we studied — from large consulting firms and high-tech manufacturers to small, knowledge-oriented businesses like Teltech.

Given the downsizing in many U.S. corporations during the past decade, it is not uncommon to find negative cultural aspects with respect to knowledge. Individuals may believe their knowledge is critical to maintaining their value as employees and may be reluctant to share their knowledge with others. Although we found little evidence of this in our sample of successful projects, we saw frequent examples of it in the firms with unsuccessful projects. The employees of a large engineering company, for example, were unwilling to share knowledge for two reasons. In some cases, fearing layoffs, they were reluctant to share any information about mistakes or failures even though this knowledge was valuable to the company and could prevent others from making the same errors. In other cases, they didn't want to share positive knowledge, believing their value and, therefore, their job security was inextricably tied to their personal expertise.

In other notable examples, culture seemed to inhibit a project's objectives. The CKO of an advertising and direct marketing firm reported a lot of pressure to be creative and original; the attitude was one of "derogating the derivative" and, thus, a disinterest in sharing and using already created knowledge. Trade journals and industry awards reinforce the value of creativity in that industry, giving less prestige to work based on campaign efficacy (getting a consumer to buy your client's product or service). Incentive and reward systems changes were necessary to get the creative people to share their knowledge with their peers.[11] It remains to be seen if and how the firm's internal systems can change to overcome the norms and values at the industry level. High-technology businesses also struggle with this problem. At a large telecommunications firm, engineers had the "hero" mentality, respecting only individual design achievements. Top engineers saw the use of an existing design as a sign of weakness, an admission that they couldn't do it themselves.

The third issue is the fit between an organization's culture and its knowledge management initiatives.

Knowledge management projects are popping up all over at HP, but they are highly decentralized. HP executives believe the company's culture of highly autonomous business units would not support a coordinated, top-down project at the corporate level or even a corporate-level senior knowledge executive. Projects that don't fit the culture probably won't thrive, so management needs to align its approach with its existing culture — or be prepared for a long-term culture change effort.

If the cultural soil isn't fertile for a knowledge project, no amount of technology, knowledge content, or good project management practices will make the effort successful.

In general, if the cultural soil isn't fertile for a knowledge project, no amount of technology, knowledge content, or good project management practices will make the effort successful. Evangelistic knowledge proponents can have some effect, but they will probably be both happier and more successful if they take a different job in a setting that already has a knowledge-friendly culture.

Clear Purpose and Language

Clear purpose and terminology is particularly important for knowledge management. The terms — "knowledge," "information," "organizational learning" — are subject to varied use and interpretation. The successful projects we found had paid attention to this factor, often by excluding some issues and concepts from their charters.

Some were careful to exclude the idea of "data." Managers of a knowledge project at Chrysler tried to ensure that raw data and information did not go into its repositories of knowledge about engineering and design of key automobile components. Chrysler is developing electronic "books of knowledge" in more than 100 areas of automobile design. When an engineer asked to include crash-test information in the repository of chassis design knowledge, the manager of the repository encouraged him to turn the information into knowledge by adding historical context, implications of the findings, comparisons with other cars or competitors, and learning from the crash-test process. Such sources of added value are an effective means of distinguishing "knowledge" from lesser forms of information and data.

Effective knowledge use implicitly means changing the way people think about knowledge, which almost always means changing the language they use. An experienced knowledge manager put it well: "Normal business language gives the impression of being fact based, often drawing on military and natural science metaphors. But knowledge management deals with things like complexity, uncertainty, and organic growth. That calls for a new vocabulary, and managers aren't used to it. The language is more probing, it invites debate, and it exposes the uncertainty we all have."

Gaining acceptance for the more conceptual, abstract vernacular of knowledge-based competition can be a barrier in many ways. Managers at one large engineering firm developed a detailed knowledge management strategy, but its engineering culture rejected it as too grandiose and abstract. Although senior managers supported the overall initiative, their eyes glazed over when presented with the details of the implementation process. As a result, budgets and political sponsorship dwindled.

Knowledge managers must decide when and how to most effectively communicate their objectives. Some people actively avoided the term "knowledge" and framed their project only in already accepted business terms (for example, "we're going to reduce cycle time by finding new ways to reuse our engineering designs"). Others confront the language problem head on, as at Skandia, where the director of intellectual capital conducts an ongoing educational process. Knowledge managers must address the language issue in a way that fits their culture. Moreover, we believe that companies that disguise their knowledge management efforts by using other terminology will face rearguard actions eventually. It's probably better to address the issue up front.

Change in Motivational Practices

Intimately and inextricably bound with people's egos and occupations, knowledge does not emerge from or flow easily across role or functional boundaries. Therefore, the motivation to create, share, and use

knowledge is an intangible critical success factor for virtually all knowledge management projects.

Finding new sources of motivation to increase participation in knowledge-sharing systems is a constant challenge. Motivational aids or incentives cannot be trivial, as some managers had learned. One manager, who had given out frequent flyer miles for browsing or contributing to a discussion database, found that the miles prompted initial use of the system but didn't foster ongoing activity. Another manager of an expert network planned to give a chocolate-covered ice cream bar — admittedly a high-quality one — to any expert who contributed a biography to the system, but the incentive wasn't sufficiently motivating. In a third instance, managers offered computer mouse pads for knowledge contributions; then they realized that most of the likely contributors used laptop computers with trackballs, not mice.

Motivational approaches to encourage more effective behavior should be long-term and should tie in with the general evaluation and compensation structure. Consultants at both Ernst & Young and McKinsey, for example, are evaluated partially on the knowledge they contribute to repositories and human networks.

Shortly after Buckman Laboratories introduced its new knowledge-sharing network, executives rewarded the top 150 "knowledge sharers" with a new laptop computer and an elaborate company trip to a resort.

If an organization chooses short-term incentives, they should be highly visible. Shortly after Buckman Laboratories introduced its new knowledge-sharing network, executives rewarded the top 150 "knowledge sharers" (judged by knowledge managers and knowledge network facilitators) with a new laptop computer and an elaborate company trip to a resort. The high-profile event generated considerable discussion among those not chosen and immediately increased participation in the new knowledge-sharing network. Recently, TI created an annual "Not Invented Here, But I Did It Anyway" award to acknowledge people who borrow good ideas from within and outside the company, and also those who share them.

Multiple Channels for Knowledge Transfer

Successful knowledge managers recognize that knowledge is transferred through multiple channels that reinforce one another. Successful knowledge projects usually address knowledge transfer through various channels, recognizing that each adds value in a different way and that their synergy enhances use. In this day of the Internet, Lotus Notes, and global communications systems, it is easy to devalue the need for face-to-face interaction. But MIT researcher Thomas Allen has found in many studies that scientists and engineers exchange knowledge in direct proportion to their level of face-to-face contact.[12] Some firms with knowledge repositories realized that they had to regularly get contributors together, face to face. In that "high bandwidth" situation, they can establish trust, develop structures for knowledge, and resolve difficult issues.

Sematech places a premium on face-to-face meetings among researchers and research sponsors. Similarly, Chrysler is building knowledge repositories for engineering knowledge, but its managers attribute much of the company's recent success in new car development to putting everyone involved in developing a new car into the same building.

Senior Management Support

Like almost every other type of change program, knowledge management projects benefit from senior management support. We found, however, that strong support from executives was crucial for transformation-oriented knowledge projects but less necessary in efforts to use knowledge for improving individual functions or processes. The types of support that were helpful included:

- Sending messages that knowledge management and organizational learning are critical to the company's success.
- Providing funding and other resources for infrastructure.
- Clarifying what types of knowledge are most important to the company.

A senior manager who must advocate for knowledge management may not need a strong personal orientation to knowledge, but it surely helps. We

found that several executives who were championing knowledge initiatives were themselves relatively cerebral and conceptual. Well read and well educated, they set the tone for a knowledge-oriented culture.

Certainly, other factors affect the success of knowledge projects, but organizations that work on the eight we've discussed will be on their way to succeeding. While it is impossible to prioritize the factors, based on our qualitative observations of the research sites, we have an intuitive feel for the factors that matter most. Unfortunately, they also tend to be the factors most difficult to develop.

Having a knowledge-oriented culture, creating an organizational infrastructure, finding effective motivational tools, and developing senior management support appear to be the most important. Obviously, they are related. A senior management team that is truly committed to knowledge management will probably already have created some aspects of a knowledge-oriented culture and will support changes in performance assessments, which are key to altering motivation. Moreover, supportive executives will more likely allocate the resources needed to create an organizational infrastructure for knowledge management. Without proactive top management support to address the other three factors, a company should begin to manage knowledge only on a small scale, focusing on improving the effectiveness of a single knowledge-oriented function or process. Successes in these small projects can help persuade people that more aggressive exploration is warranted.

The sequence for addressing these factors also matters. There may be a life cycle to building effective knowledge management practices and processes. As with physical construction, there needs to be a foundation. While not adding value in and of itself, a certain amount of infrastructure is needed in order to create value later. Thus knowledge environment projects establish the conditions necessary for subsequent projects to leverage knowledge.

How Are Knowledge Projects Different?

Increasingly, managers are becoming involved with various change programs; certainly, some of the success factors we have signaled here resemble those for programs in information systems, reengineering, or empowerment. Next we consider how knowledge projects differ from other, more familiar change initiatives.

All projects benefit from senior management support, but we noticed that the attributes of executives who support knowledge projects are different. The CKOs in the organizations we studied made frequent public comments like, "We're in the knowledge business," or "Our intellectual capital is at least as important as our financial capital." They seemed to be more conceptual and have an implicit faith that knowledge management will benefit their organizations, although they usually also wanted to see the benefits measured whenever possible.

All change projects also benefit from a culture aligned to support their objectives. But the knowledge-oriented cultures being pursued in conjunction with successful knowledge management projects require more fundamental behavioral shifts than most other change efforts. Moreover, because knowledge is closely linked to power in organizations, these projects can have significant implications for a firm's power structure.

All change projects also benefit from a culture aligned to support their objectives.

Most change projects can profit from a process orientation, but there seem to be more obvious limits to the value of a process focus in knowledge projects. One firm in our study took the process approach to an extreme, defining one "organizational learning" process, four subprocesses, fifteen sub-subprocesses, and fifty-three sub-sub-subprocesses. After the first year, however, the firm had implemented only about 5 percent of the new processes. Certainly, the knowledge management proj-ect manager will find it useful to have a good sense of his or her customer, the customer's level of satisfaction, and the productivity and quality of services offered. But project managers generally did not find it practical to describe in detail the process steps used in knowledge management. This is consistent with previous findings on improving knowledge work processes (if we can conclude that knowledge management is knowledge work).[15]

The need for a combination of technical and human elements is something information systems projects, in particular, have in common with knowledge projects. But, in knowledge management initiatives, we observed that the complexity of human factors to be managed was much greater than for most data or information management projects. Unlike data, knowledge is created invisibly in the human brain, and only the right organizational climate can persuade people to create, reveal, share, and use it. Because of the human element in knowledge, a flexible, evolving structure is desirable, and motivational factors for creating, sharing, and using knowledge are very important. Data and information are constantly transferred electronically, but knowledge seems to travel most felicitously through a human network.

Recent popular change and improvement techniques have had life cycles beginning with revelation and ending with revilement. Hailed at the beginning — "now we finally get it" — as a bold break from the stodgy past, after only a few years, people may view an approach with disdain, often because it is implemented in a halfhearted or even cynical fashion.

Effective knowledge management is neither panacea nor bromide; it is one of many components of good management. Sound planning, savvy marketing, high-quality products and services, attention to customers, the efficient structuring of work, and the thoughtful management of an organization's resources are not diminished in importance by the acknowledgment that knowledge is critical to success and needs to be managed. At the margin, however, when a business faces competitors that perform well on those other dimensions, the difference between success and failure may well turn on how effectively it manages its knowledge.

Appendix

Knowledge Management Projects in Study

Type of Business	Type of Knowledge	Primary Objective
High-tech manufacturer	Systems project management	Capture lessons learned
High-tech manufacturer	Researcher expertise	Have easy access to experts
High-tech manufacturer	Product marketing and support	Answer resellers' questions
High-tech manufacturer	Product development knowledge	Capture lessons learned
High-tech manufacturer	Multiple; product-oriented	Improve product development
High-tech manufacturer	Packaged system implementation	Improve subsequent projects
High-tech manufacturer	Educational offerings	Share experiences
High-tech manufacturer	Sales-oriented documents	Improve access from field
Consulting	Project, client, etc.	Leverage knowledge of entire firm
Consulting	Industry and consulting practice	Leverage knowledge of entire firm
Pharmaceutical	Drug development	Improve development process
Oil and gas	Tacit expert knowledge	Have video access to far-flung experts
Specialty chemicals	Product application knowledge	Improve sales and service
Chemicals	Patented knowledge	Reduce costs, improve returns
Military	Engagement lessons	Learn from experience
Knowledge services	Technical expertise	Provide access to experts
Automobile	Competitive intelligence	Improve access and awareness
Automobile	New car development	Avoid repeating mistakes
Advertising/direct marketing	Client/campaign knowledge	Increase knowledge awareness/use
National laboratory	Nuclear bomb-making	Capture expertise before it leaves
Software	Software development experts	Improve project assignment and education
Electronics	Best practices	Improve process performance
Bank	Lessons learned	Improve learning, avoid mistakes
Bank	Best practices	Improve process performance
Engineering & construction	Project designs and plans	Make projects more efficient
Insurance	Intellectual capital	Measure and publicize
Financial services	Office procedures	Open offices more quickly
Office equipment	No specific	Embed knowledge in strategy
Computer	Sales documents	Improve field access
Biotechnology	Multiple	Improve product development
Defense	Lessons learned	Improve manufacturing

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