

Managing Codified Knowledge

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Abstract

To remain competitive, organizations must efficiently and effectively create, locate, capture, and share their organization's knowledge and expertise. This increasingly requires making the organization's knowledge explicit and recording it for easier distribution and reuse. This article provides a framework for configuring a firm's organizational and technical resources and capabilities to leverage its codified knowledge. This knowledge management architecture is illustrated with examples of two companies that are successfully competing based on their ability to manage their explicit knowledge. The lessons these companies have learned from their implementation experiences are summarized.

Introduction

The concept of treating organizational knowledge as a valuable strategic asset has been popularized by leading management and organization theorists⁽¹⁾. Organizations are being advised that to remain competitive, they must efficiently and effectively create, locate, capture, and share their organization's knowledge and expertise, and have the ability to bring that knowledge to bear on problems and opportunities. Firms are showing a tremendous interest in implementing knowledge management processes and technologies, and are even beginning to adopt knowledge management as part of their overall business strategy⁽²⁾.

Although knowledge management is becoming widely accepted, few organizations today are fully capable of developing and leveraging critical organizational knowledge to improve their performance⁽³⁾. Many organizations have become so complex that their knowledge is fragmented, difficult to locate and share, and therefore redundant, inconsistent or not used at all. In today's environment of rapid change and technological discontinuity, even knowledge and expertise that can be shared is often quickly made obsolete. However, while the popular press calls for effectively managing knowledge, almost no research has been done regarding *how* to do it.

This article focuses on how to configure a firm's resources and capabilities to leverage its codified knowledge. I refer to this broadly as a *knowledge management architecture*. The research on which the framework is based was motivated by several questions. What are the characteristics of explicitly codified

knowledge and how should organizations think about managing it? What role should information technology play? How are organizational capabilities and information technology best integrated and applied to managing knowledge? What lessons have companies learned in these endeavors?

To address these questions, I first describe the characteristics of explicit knowledge and its relationship to competitive advantage. Building on research and knowledge about the design of information products⁽⁴⁾, I describe an architecture for managing explicit knowledge. I use that framework to derive two fundamental and complementary approaches, each of which is illustrated by case study. I conclude with a summary of key issues and lessons learned.

What is Knowledge?

Knowledge is commonly distinguished from data and information. Data represent observations or facts out of context, and therefore not directly meaningful. Information results from placing data within some meaningful context, often in the form of a message. Knowledge is that which we come to believe and value based on the meaningfully organized accumulation of information (messages) through experience, communication or inference⁽⁵⁾. Knowledge can be viewed both as a *thing* to be stored and manipulated and as a *process* of simultaneously knowing and acting - that is, applying expertise⁽⁶⁾. As a practical matter, organizations need to manage knowledge both as object *and* process.

Knowledge can be *tacit* or *explicit*⁽⁷⁾. Tacit knowledge is subconsciously understood and applied, difficult to articulate, developed from direct experience and action, and usually shared through highly interactive conversation, story-telling and shared experience. Explicit knowledge, in contrast, can be more precisely and formally articulated. Therefore, although more abstract, it can be more easily codified, documented, transferred or shared. Explicit knowledge is playing an increasingly large role in organizations, and it is considered by some to be the most important factor of production in the knowledge economy⁽⁸⁾. Imagine an organization without procedure manuals, product literature, or computer software.

Knowledge may be of several types⁽⁹⁾, each of which may be made explicit. Knowledge *about* something is called declarative knowledge. A shared, explicit understanding of concepts, categories, and descriptors lays the foundation for effective communication and knowledge sharing in organizations. Knowledge of *how* something occurs or is performed is called procedural knowledge. Shared explicit procedural knowledge lays a foundation for efficiently coordinated action in organizations. Knowledge *why* something occurs is called causal knowledge. Shared explicit causal knowledge, often in the form of organizational stories, enables organizations to coordinate strategy for achieving goals or outcomes.

Knowledge also may range from general to specific⁽¹⁰⁾. General knowledge is broad, often publicly available, and independent of particular events. Specific knowledge, in contrast, is context-specific. General knowledge, its context commonly shared, can be more easily and meaningfully codified and exchanged, especially among different knowledge or practice communities. Codifying specific knowledge so as to be meaningful across an organization requires its context to be described along with the focal knowledge. This, in turn, requires explicitly defining contextual categories and relationships that are meaningful across knowledge communities. To see how difficult (and important) this may be, ask people from different parts of your organization to define a customer, an order, or even your major lines of business, and see how much the responses vary⁽¹¹⁾.

Explicating Knowledge

Effective performance and growth in knowledge-intensive organizations requires integrating and sharing

highly distributed knowledge⁽¹²⁾. Although tacit knowledge develops naturally as a by-product of action, it is more easily exchanged, distributed, or combined among communities of practice by being made explicit⁽¹³⁾. However, appropriately explicating tacit knowledge so it can be efficiently and meaningfully shared and reapplied, especially outside the originating community, is one of the least understood aspect of knowledge management. Yet organizations must not shy away from attempting to explicate, share and leverage tacit, specific knowledge. This suggests a more fundamental challenge, namely, determining which knowledge *should* be made explicit and which left tacit. The issue is important, as the balance struck between tacit and explicit knowledge can effect competitive performance.

Knowledge may be inherently tacit or may appear so because it has not yet been articulated, usually because of social constraints⁽¹⁴⁾. Articulating particular types of knowledge may not be culturally legitimate, challenging what the firm knows may not be socially or politically correct⁽¹⁵⁾, or the organization may be unable to see beyond its customary habits and practices⁽¹⁶⁾. And of course, making private knowledge public and accessible may result in a redistribution of power that may be strongly resisted in particular organizational cultures. Knowledge also may remain unarticulated because of intellectual constraints in cases where organizations have no formal language or model for its articulation.

Comparing the potential explicability of knowledge to whether or not it has actually been articulated defines four situations regarding the balance between tacit and explicit knowledge (Figure 1). Potentially explicable knowledge that has not been articulated represents a lost opportunity to efficiently share and leverage that knowledge. If competitors have articulated and routinized the integration and application of similar knowledge, then they may obtain a competitive advantage. In contrast, knowledge that is inherently inarticulable yet which firms attempt to make explicit may result in the essence of the knowledge being lost, and performance suffering. Articulable knowledge that has been made explicit represents an exploited opportunity, while leaving inarticulable knowledge in its native form respects the power (and limits) of tacit knowledge. Both indicate appropriate management of the balance between tacit and explicit knowledge.

Organizations often do not to challenge the way knowledge is stored, treated or passed on. However, managers should not blindly accept the apparent tacitness of knowledge. Mrs. Fields Cookies was able to develop process knowledge (baking cookies) to a level sufficiently high to be explicated and articulated in a recipe that produces cookies of consistently high quality⁽¹⁷⁾. The cookies are claimed to be almost as good as those originally baked by Debbie Fields herself. Ray Kroc gained tremendous leverage in articulating and routinizing the process of cooking a hamburger to produce a consistent (if not gourmet) level of quality. But where imagination and flexibility are important, knowledge routinization may be inappropriate. It is the manager's responsibility to know the difference.

To this point, I have defined explicit knowledge, discussed some of its characteristics, and made a case for explicating knowledge. Although explicit knowledge represents only a part of the intellectual landscape of the organization, it plays a crucial role in the overall knowledge strategy of the firm. Its management requires frameworks and well-considered architectures such as that described below.

A Knowledge Management Architecture ⁽¹⁸⁾

The management of explicit knowledge utilizes four primary resources (Figure 2):

- Repositories of explicit knowledge;
- Refineries for accumulating, refining, managing, and distributing that knowledge;
- Organization roles to execute and manage the refining process; and
- Information technologies to support those repositories and processes.

The Knowledge Repository

The design of a knowledge repository reflects the two basic components of knowledge as an object: *structure* and *content*⁽¹⁹⁾. Knowledge structures provide the context for interpreting accumulated content. If the repository is conceived as a "knowledge platform", then many different views of the content may be derived from a particular repository structure⁽²⁰⁾. A high degree of viewing flexibility enables users to alter and combine views dynamically and interactively and to more easily apply the knowledge to new contexts and circumstances. At this point, knowledge-as-object becomes knowledge-as-process.

The basic structural element is the *knowledge unit*, a formally defined, atomic packet of knowledge content that can be labeled, indexed, stored, retrieved and manipulated. The format, size and content of knowledge units may vary depending on the type of explicit knowledge being stored and the context of their use. The repository structure also includes the schemes for linking and cross-referencing knowledge units. These links may represent conceptual associations, ordered sequences, causality or other relationships depending on the type of knowledge being stored.

To reflect the full range of explicit organizational knowledge, repositories should strive to record significant and meaningful concepts, categories, and definitions, (declarative knowledge), processes, actions and sequences of events (procedural knowledge), rationale for actions or conclusions (causal knowledge), circumstances and intentions under which the knowledge was developed and is to be applied (specific contextual knowledge), and the linkages among them. The repository should be indexed according to those concepts and categories, providing access paths that are meaningful to the organization. It should accommodate changes or additions to that knowledge (e.g., by linking annotations) as subsequent authors and creators adapt the knowledge for use in additional contexts.

A knowledge platform may actually consist of several repositories, each with a structure appropriate to a particular type of knowledge or content. These repositories may be logically linked to form a composite or "virtual" repository, the content of each providing context for interpreting the content of the others (Figure 3). For example, product literature, best sales practices, and competitor intelligence for a particular market might be stored separately but viewed as though contained in one repository.

The Knowledge Refinery

The refinery represents the process for creating and distributing the knowledge contained in the repository. This process includes five stages:

- *Acquisition*. Information and knowledge is either created within the organization or can be acquired from many different internal and external sources.
- *Refining*. Captured knowledge, before being added to the repository, is subjected to value-adding processes (refining) such as cleansing, labeling, indexing, sorting, abstracting, standardizing, integrating, and re-categorizing.
- *Storage and Retrieval*. This stage bridges upstream repository creation to downstream knowledge distribution.
- *Distribution*. This stage represents the mechanisms used to make repository content accessible.
- *Presentation*. The value of knowledge is pervasively influenced by the context of its use. Capabilities should be provided for flexibly arranging, selecting, and integrating the knowledge content.

Knowledge Management Roles

A common weakness in knowledge management programs is the overemphasis on information

technology at the expense of well-defined knowledge management roles and responsibilities. Traditional organizational roles typically do not address either knowledge management or the cross-functional, cross-organizational process by which knowledge is created, shared and applied. The architecture presented here suggests a set of organizational roles that should be explicitly defined. First, knowledge management, as a cross-organizational process, should be comprehensively "owned" and managed, and full-time responsibility assigned for an organization's knowledge management architecture. Organizations are creating a Chief Knowledge Officer role to handle this responsibility. Many organizations also cluster those responsible for knowledge management into knowledge or expertise centers, each being responsible for a particular body of knowledge. Their responsibilities typically include championing knowledge management, educating the organization, knowledge mapping, and integrating the organizational and technological resources comprising the knowledge management architecture. Additionally, explicit responsibility should be assigned for each stage of the refinery and the interfaces between them. Assigning responsibility for the seamless movement of knowledge from acquisition through use, as well as the interfaces between these stages, will help ensure that knowledge repositories will be meaningfully created and effectively used.

The Role of Information Technologies

The information technology infrastructure should provide a seamless "pipeline" for the flow of explicit knowledge through the 5 stages of the refining process to enable

- capturing knowledge,
- defining, storing, categorizing, indexing and linking digital objects corresponding to knowledge units,
- searching for ("pulling") and subscribing to ("pushing") relevant content,
- presenting content with sufficient flexibility to render it meaningful and applicable across multiple contexts of use.

Information technologies such as the World Wide Web and Lotus Notes™ offer a potentially useful environment within which to build a multimedia repository for rich, explicit knowledge. Input is captured by forms for assigning various labels, categories, and indices to each unit of knowledge. The structure is flexible enough to create knowledge units, indexed and linked using categories that reflect the structure of the contextual knowledge and the content of factual knowledge of the organization, displayed as flexible subsets via dynamically customizable views.

Effective use of information technology to communicate knowledge requires an organization to share an interpretive context. The more that communicators share similar knowledge, background and experience, the more effectively knowledge can be communicated via electronically mediated channels⁽²¹⁾. At one extreme, the dissemination of explicit, factual knowledge within a stable community having a high degree of shared contextual knowledge can be accomplished through access to a central electronic repository. However, when interpretive context is moderately shared, or the knowledge exchanged is less explicit, or the community is loosely affiliated, then more interactive modes such as electronic mail or discussion databases are appropriate. When context is not well shared and knowledge is primarily tacit, communication and narrated experience is best supported with the richest and most interactive modes such as video conferencing or face-to-face conversation.

A Classification of Knowledge Management Applications

Based on this knowledge management architecture, knowledge processing can be segmented into two broad classes: *integrative* and *interactive* (Figure 4), each addressing different knowledge management objectives. Together, these approaches provide a broad set of knowledge processing capabilities. They

support well-structured repositories for managing explicit knowledge while enabling interaction to integrate tacit knowledge.

Integrative Applications

Integrative applications exhibit a sequential flow of explicit knowledge into and out of the repository. Producers and consumers interact with the repository rather than with each other directly. The repository becomes the primary medium for knowledge exchange, providing a place for members of a knowledge community to contribute their knowledge and views. The primary focus tends to be on the repository and the explicit knowledge it contains, rather than on the contributors, users, or the tacit knowledge they may hold.

Integrative applications vary in the extent to which knowledge producers and consumers come from the same knowledge community. At one extreme, which I label *electronic publishing*, the consumers (readers) neither directly engage in the same work nor belong to the same practice community as the producers (authors). Once published, the content tends to be stable, and those few updates that may be required are expected to originate with authors. The consumer accepts the content as is, and active feedback or modification by the user is not anticipated (although provisions could be made for that to occur). For example, the organization may produce a periodic newsletter, or the human resources department may publish its policies or a directory of employee skills and experience.

At the other extreme, the producers and consumers are members of the same practice community or organizational unit. While still exhibiting a sequential flow, the repository provides a means to integrate and build on their collective knowledge. I label these *integrated knowledge-bases*. A best-practices database is the most common application. Practices are collected, integrated and shared among people confronting similar problems.

Regarding the organizational roles for managing integrative applications, acquisition requires knowledge creators, finders, and collectors. Capturing verbal knowledge requires interviewers and transcribers. Documenting observed experiences requires organizational "reporters". Surfacing and interpreting deeply held cultural and social knowledge may require corporate anthropologists. Refining requires analysts, interpreters, abstractors, classifiers, editors, and integrators. A librarian or "knowledge curator" must manage the repository. Others must take responsibility for access, distribution and presentation. Finally, organizations may need people to train users to critically interpret, evaluate and adapt knowledge to new contexts.

Interactive Applications

Interactive applications are focused primarily on supporting interaction among people holding tacit knowledge. In contrast to integrative applications, the repository is a by-product of interaction and collaboration rather than the primary focus of the application. Its content is dynamic and emergent.

Interactive applications vary by the level of expertise between producers and consumers and the degree of structure imposed on their interaction. Where formal training or knowledge transfer is the objective, the interaction tends to be primarily between instructor and student, or expert and novice, and structured around a discrete problem, assignment or lesson plan⁽²²⁾. I refer to these applications as *distributed learning*.

In contrast, interaction among those performing common practices or tasks tends to be more ad hoc or emergent. I broadly refer to these applications as *forums*. They may take the form of a knowledge brokerage - an electronic discussion space where people may either search for knowledge (e.g., "Does

anyone know...") or advertise their expertise. The most interactive forums support ongoing, collaborative discussions. The producers and consumers comprise the same group of people, continually responding to and building on each individual's additions to the discussion. The flow continually loops back from presentation to acquisition. With the appropriate structuring and indexing of the content, a knowledge repository can emerge. A standard categorization scheme for indexing contributions provides the ability to reapply that knowledge across the enterprise.

Interactive applications play a major role in supporting integrative applications⁽²³⁾. For example, a forum can be linked to an electronic publishing application for editors to discuss the quality of the contributions, or to offer a place for readers to react to and discuss the publication. Best practice databases typically require some degree of forum interaction, so that those attempting to adopt a practice have an opportunity to discuss its reapplication with its creators.

Regarding the organizational roles for managing interactive applications, acquisition requires recruiters and facilitators to encourage and manage participation in interactive forums so that those with the appropriate expertise are contributing. The refining, structuring, and indexing of the content often is done by the communicators themselves, using guidelines and categories built into the application, supplemented by a conference moderator. Assuring the quality of the knowledge may require quality assurance personnel such as subject matter experts and reputation brokers. Managing a conference repository over its lifecycle usually falls to a conference moderator. Others may be required to work with users to help them become comfortable and skilled with accessing and using the application.

Two Examples

This section presents two cases studies of managing explicit knowledge. TRI, Inc.⁽²⁴⁾ provides an example of an integrative architecture for the electronic publishing of knowledge gleaned by industry research analysts⁽²⁵⁾. Buckman Labs illustrates the effective use of an interactive architecture for discussion forums to support servicing their customers⁽²⁶⁾.

TRI, Inc.

Technology Research Inc. (TRI) is a leading international provider of market information and industry analysis to information technology vendors and purchasers. TRI employs more than 300 analysts and annually publishes more than 15,000 research reports addressing over 50 distinct subject areas (called research programs). TRI's knowledge management architecture is shown in [Figure 5](#).

The online knowledge repository comprises a standard set of knowledge units containing the executive summaries, abstracts, main text, graphics, tables, and charts making up research reports. The repository is dynamic in that research reports are being updated continuously. Knowledge units are indexed and linked for flexible access, and users may sequentially navigate from one to the next within a report, access similar units across reports (e.g. executive summaries only), or access particular units directly. Standardization provides the ability to integrate analysts' explicated knowledge across research programs so that it can be subjected to meta-analysis, creating new knowledge not possessed by any one analyst. As technology changes, new research areas emerge that cut across TRI's traditional research programs and internal organizational boundaries. Building repositories using a flexible, yet standard – and therefore integrable – structure has enabled TRI to respond by creating composite virtual research programs. From its repositories, TRI derives standard monthly reports and more frequent ad hoc bulletins for each research program in several electronic formats (web, CD, fax, email).

TRI's refinery encompasses two stages: analysis and publishing. Analysis involves collecting, analyzing, and interpreting market information and reporting the results. The analysts' tacit knowledge of their

and interpreting market information, and reporting the results. The analysts' tacit knowledge of their particular industry is applied to this information to produce an explicitly reported interpretation. The process is similar to investigative reporting, in that analysts try to get "the story behind the numbers."

In the publishing stage, editors convert analysts' reports to a standard format and decompose them into knowledge units, assigning standard document identifiers and keywords and creating links among knowledge units. While perhaps less efficient than having all analysts initially write to a standard format, TRI's approach preserves the analysts' autonomy and creative, entrepreneurial spirit. This tradeoff is one that TRI explicitly manages to foster a balance between knowledge management efficiency and speed on the one hand, and knowledge worker morale, commitment, and performance quality on the other. Distribution of online documents is done primarily via web-enabled Lotus Notes.

TRI's experiences illustrate how digitizing content is not, by itself, adequate to exploit the opportunities for flexibility and innovation in the design and delivery of explicit knowledge. Digitized documents must be structured as knowledge units within a modular and flexible repository from which multiple knowledge views can be rapidly and efficiently created as new user needs arise in new contexts. Additionally, a robust, seamless and scalable technology infrastructure has been key to enabling the flexibility required for an integrative knowledge management refinery. It provides a wide range of user-defined views of rich, multimedia documents, embeds hyperlinks, and provides an efficient yet flexible distribution channel.

Implementing this new architecture has been as much an organizational and social, as a technical, intervention. TRI has explicitly assigned and trained people to perform new roles to shepherd the movement of knowledge from raw to useable product, and this investment has been instrumental in their success. However, existing roles and responsibilities of TRI's analysts, editors, and IT professionals have changed. The move toward process and content standards reduced analysts' level of autonomy and discretion regarding writing format and style, while placing many of those decisions in the hands of editors and production clerks. Ultimately, success with electronic publishing was based as much on effectively managing organizational change as in implementing a sound product architecture and electronic publishing technology.

Buckman Laboratories

Buckman Laboratories (BL), a \$300 million international specialty chemicals company employing over 1200 people (referred to as associates) and operating in over 80 countries, is a recognized leader in knowledge management⁽²⁷⁾.

The basis for competition in BL's industry has changed from merely selling product to solving customers' chemical treatment problems. This requires knowledge not only of products and their underlying chemistry, but knowledge about their application in various contexts. While many of BL's associates have college degrees in chemistry and related fields, selling and applying BL's products requires practical, grounded knowledge gained primarily via experience solving particular customer problems in the field. This knowledge is tacit and resides primarily within the field associates spread throughout the world. Field-based knowledge is complex in that it has to account for many interacting variables, often subconsciously, and can be specific to geography, a mill or even a particular machine. It is dynamic, emergent, and continually evolving. BL believes that in this new competitive environment, strategic advantage results primarily from bringing the most recent practical knowledge and experience of all associates to bear on every customer's problem.

To accomplish this, Bob Buckman, Chairman of BL Holdings (BL's parent company) envisioned an online knowledge management capability founded on several key principles. Individuals should be able to exchange knowledge with one another directly. They should be given universal and unconstrained ability to contribute to and access the knowledge of the firm without regard for time zone, physical location,

language, or level of computer proficiency. A record of the conversations, interactions, contributions and exchanges should be preserved and made easily accessible to and searchable by all. BL implemented this vision as K'Netix[®], The Buckman Knowledge Network.

BL has placed much of its explicit knowledge about customers, products and technologies into online electronic repositories representing a set of integrative knowledge management applications. However, BL has progressed well beyond integrative knowledge management. An online interactive forum, the Tech Forum, supports the core of BL's knowledge strategy (Figure 6). The Tech Forum, accessible to all associates, is used to locate, capture, distribute, share and integrate the practical, applied knowledge and experience of all BL associates in support of the customer⁽²⁸⁾. The forum uses a standard structure; comments are "threaded" in conversational sequence and indexed by topic, author, and date. The content typically comprises questions, responses, and field observations.

Knowledge management roles at BL are explicitly defined and assigned. They are of two broad classes, those that facilitate the direct and emergent exchange of knowledge through the forum, and those that support refining and archiving the record of those exchanges for future use. The first represents the interactive aspect of the architecture, and the second the integrative. BL has successfully integrated the two in terms of organization structure and knowledge flow.

Several knowledge management roles are organized under the Knowledge Transfer Dept. (KTD). Subject experts assigned from around the company take the lead in guiding discussions on their particular area of expertise and provide a measure of quality assurance regarding the advice given by others. With the support of KTD personnel, they periodically review Tech Forum to identify useful threads for storage in an online repository. The threads are extracted, edited, summarized, and assigned keywords. Thus, valuable, emergent content is collected and integrated so that it can be made widely accessible, easily distributed, and profitably reused. KTD personnel continually monitor Tech Forum, encourage participation, and provide end-user support and training. Each operating company throughout the world makes their most technically qualified person available for offering advice via Tech Forum. Product Development Managers use the forum to offer online technical advice to field personnel and to stay current with applications issues arising in the field. Research Librarians assigned to particular industries search for publicly available information about their industries. An information technology group maintains the technical infrastructure.

Customers have stated that BL's ability to leverage its collective knowledge via Tech Forum was instrumental in making the sale. However, the technology is not proprietary or leading-edge. The process is not complex. The true source of BL's advantage is not in the technology or the process, which are easily imitated, but in the culture and structure of the organization. The organization's willingness to create, share and reapply knowledge provides the context for successfully executing BL's knowledge strategy and architecture.

Another important reason for the forum's success is that it has become part of the ongoing habits and practices of the organization⁽²⁹⁾. Everyone expects all others to read the forum on a regular basis, to post their problems, replies and observations there, and to contribute where and when possible. Consistent collective compliance with these expectations creates and continually reinforces the perception of the forum as a reliable and efficient means for sharing knowledge and getting problems solved. Its use, supported by active management of the architecture, has become self-sustaining. BL understands that the confluence of culture, roles, norms, habits and practices leading to this success are very difficult to imitate and, therefore, together with associates' knowledge and the technology infrastructure, provides a true competitive advantage.

Discussion

DISCUSSION

I have described explicit knowledge, proposed an architectural framework for its management and presented two examples of its application. These companies and others with whom I have done research provide insight into how to architect a capability for managing explicit knowledge. The framework provides a coherent approach within which to begin designing that capability. Additionally, they have surfaced several key issues, discussed below, regarding the broader organizational context for knowledge management, the design and management of knowledge processing applications, and the realization of benefits that must be addressed to be successful.

The Context of Knowledge Management

Knowledge architectures exist within four primary contexts that influence the impact knowledge management will have on the organization's performance.

Strategic context. Strategic context addresses an organization's intent and ability to exploit its knowledge and learning capabilities better than the competition⁽³⁰⁾. It includes the extent to which the members of an organization believe that superior knowledge provides a competitive advantage, and how they explicitly link strategy, knowledge and performance. The successful firms I have studied are able to articulate the link between the strategy of their organization and what the members of that organization at all levels need to know, share, and learn to execute that strategy. This articulation guides their deployment of organizational and technological resources and capabilities for explicating and leveraging knowledge, increasing the probability of their adding value.

Knowledge context. Knowledge context addresses the competitiveness of an organization's knowledge. Existing knowledge can be compared to what an organization must know to execute its strategy. Where there are current or future gaps, knowledge management efforts should be directed toward closing them, assuring a strategic focus. Organizations must also assess the quality of their knowledge relative to their competition to determine its strategic value. To the extent that the bulk of a firm's knowledge is common and basic, that knowledge will provide less competitive advantage than if the firm's knowledge is unique and innovative. Explicating and leveraging that innovative knowledge can provide the greatest competitive benefit.

Organizational context. Organizational context reflects the organization roles and structure, formal and informal, as well as the socio-cultural factors affecting knowledge management such as culture, power relations, norms, reward systems, and management philosophy. Beyond the knowledge management roles proposed earlier, effective knowledge creation, sharing, and leveraging requires an organizational climate and reward system that values and encourages cooperation, trust, learning, and innovation and provides incentives for engaging in those knowledge-based roles, activities and processes⁽³¹⁾. I have consistently observed this aspect to be a major obstacle to effective knowledge management.

Technology context. Technology context addresses the existing information technology infrastructure and capabilities supporting the knowledge management architecture. While the adage is that knowledge management is 10% technology and 90% people, without the ability to collect, index, store, and distribute explicit knowledge electronically and seamlessly to where needed when needed, the organizational capabilities and incentives will not be fully exploited. However, as BL and TRI illustrate, the technology need not be complex or leading-edge to provide significant benefit. Its absence, however, would have prevented both from effectively managing their knowledge.

New Organizational Roles

The successful firms I observed have explicitly defined and rewarded roles that facilitate the capturing, refining, retrieval, interpretation and use of knowledge. Perhaps the most important role has been that of

subject matter expert, functioning as an editor to assure quality of *content*, and as a repository manager, assuring quality of *context* by thoughtful abstracting and indexing. TRI, in converting to online knowledge management, found the need for a much greater investment in editors to perform these roles. Buckman Labs showed its commitment by assigning some of its most knowledgeable people to these roles.

Managing Knowledge Processing Applications

Interaction complexity. Knowledge management applications form a continuum from low to high interaction complexity. Forums are the most interactive and complex application because they tend to span the entire tacit/explicit knowledge processing cycle. Establishing a well-defined social community and shared context to support the use of the technology plays a key role in the success of the application. Electronic publishing, in contrast, is perhaps the most straightforward. It represents the one-way distribution of explicit knowledge to a user community that may be loosely affiliated, related only by their need for access to the same knowledge repository, but not necessarily supported by a social community. The greater the interaction complexity, the more the challenges become oriented toward social, cognitive, and behavioral rather than technical issues, requiring well-managed organizational change programs.

Repository lifecycle. Knowledge repositories have a lifecycle that must be managed. Once created, they tend to grow, reaching a point where they begin to collapse under their own weight, requiring major reorganization⁽³²⁾. Their rejuvenation requires deleting obsolete content, archiving less active but potentially useful content, and reorganizing what is left. Content or topic areas may become fragmented or redundant. Reorganizing requires eliminating those redundancies, combining similar contributions, generalizing content for easier reapplication, and restructuring categories as needed. Successful knowledge management organizations proactively manage and reorganize their repositories as an ongoing activity rather than waiting for decline to set in before acting.

Composite applications. Complex knowledge management problems typically require multiple repositories segmented by degree of interactivity, volatility of content, or the structure of the knowledge itself. Each repository may have a different set of processes and roles by which its content is created, refined and stored. Long-cycle knowledge may have a more formal review and approval process, while best practices may receive a more expedited editing, and discussion databases for rapid exchange may have no review process other than after-the-fact monitoring by a forum moderator. Further, use of knowledge repositories typically causes knowledge creation and use to become separated in time and space. Therefore the knowledge must be continually evaluated to ensure that it applies to present context and circumstances. Repositories and their underlying management processes may, therefore, need to be segmented based on the volatility of their context as well as content. For example, the storage structures and processes for managing product knowledge in rapidly changing markets may differ significantly from managing that knowledge in stable markets. Segmenting these repositories and identifying any significant differences in their refinery processes is crucial for successful application, as is their integration to provide seamless access to their knowledge.

Repository structure. For knowledge repositories to be meaningful, their structure must reflect the structure of shared mental models or contextual knowledge tacitly held by the organization. In most organizations, those structures are neither well-defined nor widely shared. Yet their explication is essential for effectively managing explicitly encoded organizational knowledge. This requires defining what is meant by a knowledge-unit and how that collection of knowledge units should be meaningfully indexed and categorized for ease of access, retrieval, exchange and integration. Creating "semantic consensus" even within common practice communities is often a difficult task, let alone across an entire organization. TRI found developing standards to be a particularly difficult challenge, yet one that had to be addressed for the publishing process to function. For example, when TRI first migrated to online

be addressed for the publishing process to function. For example, when TRI first migrated to online publishing, they had no standard spellings for vendor names, technology keywords, or even research programs, all essential for effective repository management. TRI even struggled to create a standard and consistent definition of a knowledge unit. BL had more flexibility within its forums, yet also found that developing a meaningful indexing scheme for its file library was critical for its use. These experiences are not unusual. Different lexicons naturally emerge from different parts of an organization. Standards are in many ways counter to the culture of many organizations. However, the ability to integrate and share knowledge depends on some broadly meaningful scheme for its structure.

Integration of knowledge across different contexts opens an organization to new insights. A practice community's exposure to how its knowledge can be applied in other contexts increases the scope and value of that knowledge. Often the variety of experiences within a local community of practice is not great enough to fully understand some phenomenon. By being able to combine experiences across communities, the variation of experience is enlarged, as is the ability to learn from those experiences. For example, a leading imaging firm with whom I have worked created a standard means to capture and share sales techniques among its market segments. By sharing knowledge of how customers in different market segments made use of a particular product, salespeople in each territory were exposed to patterns, insights and selling opportunities they might not have perceived on their own.

Benefits

The nature of the benefits from managing explicit knowledge depends on the type of application. Electronic publishing and other low interactivity, high-structure applications tend to provide a significant cost saving or increased efficiency. Publishing electronically is much less expensive than the distribution of paper. In the case of distributed learning, distributing pre-packaged knowledge (e.g., electronic textbooks and course notes) electronically can save significant travel expenses. In contrast, the more interactive or emergent-content applications tend to provide support for solving problems, innovating, and leveraging opportunities. The greatest impact, however, comes from combining the two. For example, Buckman Labs is adding a distance learning capability to its other applications, rounding out its portfolio. They are poised to reap the greatest benefit by integrating the capabilities of all applications. The emergent knowledge developed through the forum can be archived not only for searching by individuals in the field, but edited and repackaged for use as training materials within the distance learning application. Thus training will have more of a real-world feel and focus. Actual problems can be presented to students who, after deliberating on their own, can view how they were actually dealt with at the time. And formal training can now take place in the field, giving the students the ability to directly apply or integrate the training materials with their own day-to-day problems. In this way, those materials become more relevant and interwoven into the student's tacit experience and the learning more meaningful and lasting. By integrating the interactive, emergent forums with the structured content and distribution of formal training, a continual cycle of knowledge creation and application can be created. Tacit knowledge is made explicit via the forums, formally transferred via distance learning, and tacitly reapplied in context. That new tacit knowledge is now available for sharing with others via the same cycle. At each turn of the cycle, the knowledge of the organization increases⁽³³⁾, providing potentially greater competitive advantage.

To summarize these findings, organizations that managed knowledge effectively

- understood their strategic knowledge requirements
- devised a knowledge strategy appropriate to the firm's business strategy;
- implemented an organizational and technical architecture appropriate to the knowledge processing needs of the organization; enabling them to
- apply maximum effort and commitment to creating, explicating, sharing, applying, and improving their knowledge

MAN KNOWLEDGE.

While some view knowledge management as merely the current business fad, knowledge lies at the essence of humans as individuals and collectivities. Respecting the role of knowledge and learning may be the most effective approach to building a solid and enduring competitive foundation for business organizations. Firms can derive significant benefits from consciously, proactively and aggressively managing their explicit and explicable knowledge. Doing this in a coherent manner requires aligning the firm's organizational and technical resources and capabilities with its knowledge strategy. It requires mapping the firm's organizational and technical capabilities and constraints to its knowledge processing requirements. It may require significant organizational and technical interventions. The knowledge management architecture provides a framework for guiding this important effort.

Endnotes

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[11.](#) See, for example, Zack 1996

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[22.](#) Although distributed learning applications are typically supplemented with electronically published course materials and assignments (an integrative application), distributed learning refers primarily to the student/instructor interaction (an interactive application).

[23.](#) While these approaches are conceptually distinct, they could be implemented within the same software platform, and in fact, common technology will enable smoother integration.

[24.](#) pseudonym

[25.](#) This information resulted from 12 hours of interviews with the Senior Vice President responsible for information and consulting services, the Director of Information Systems Strategy responsible for the electronic publishing project, the lead architect of the application, and a senior analyst/consultant to the project. Archival documentation including design documents, a discussion database used to support the project team, and related electronic mail messages were also reviewed.

[26.](#) This information resulted from approximately 100 hours of interviews and focus groups with senior executives and managers of various departments at Buckman Labs.

[27.](#) Buckman Labs has won several awards for their knowledge management infrastructure including winning in 1996 the Arthur Andersen Enterprise Award for Sharing Knowledge and, in 1997, the ComputerWorld/Smithsonian Award - Manufacturing Section.

[28.](#) As part of its broad effort to be a truly international firm, BL produces a version of the Tech Forum for Latin America called Foro Latino. BL is in the process of translating its forums, web pages, and other knowledge repositories into several other languages.

[29.](#) M. H. Zack 1994

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[33.](#) Nonaka 1994

