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## ■ KNOWLEDGE MANAGEMENT

The basic challenge in knowledge management is learning how to design an organization's strategy, structure, and systems so that the organization can use what it knows to innovate and adapt. Although the field of knowledge management is still evolving, its terrain may be surveyed by focusing on two themes: the structure of organizational knowledge (i.e., the nature of knowledge in organizations and what makes it distinct from other forms of knowledge) and the processes by which organizations turn knowledge into action and results (i.e., how organizations create, share, and use knowledge).

### **Data, Information, Knowledge**

Information and knowledge are the outcomes of human action and cognition that engage signs, signals, and artifacts in social and physical settings. Knowledge builds on an accumulation of experience. Information depends on an aggregation of data. Consider a document that contains a table of numbers that indicate product sales for the quarter. As they stand, these numbers are data. An employee reads these numbers, recognizes the name and nature of the product, and notices that the numbers are below last year's figures, indicating a downward trend. The data has become information. The employee considers possible explanations for the product decline (perhaps using additional information and personal judgment) and comes to the conclusion that the product is no longer attractive to its customers. This new belief, derived from reasoning and reflection,

is knowledge. Thus, information is data that is given context and vested with meaning and significance. Knowledge is information that is transformed through reasoning and reflection into beliefs, concepts, and mental models.

### **Types of Organizational Knowledge**

Knowledge in organizations is not monolithic, nor is it homogenous; knowledge evolves from different origins and is engaged in different ways. Research suggests that organizational knowledge may be divided into tacit knowledge, explicit knowledge, and cultural knowledge.

#### *Tacit Knowledge*

In organizations, tacit knowledge is the personal knowledge used by members to perform their work and to make sense of their worlds. It is learned through extended periods of experiencing and doing a task, during which time the individual develops a feel for and a capacity to make intuitive judgments about the successful execution of the activity. Examples of tacit knowledge at work would be the technician who can tell the health of a machine from the hum it generates, or the bank manager who develops a gut feeling that a client would be a bad credit risk after a short conversation with the customer. Because tacit knowledge is experiential and contextualized, it cannot be easily codified, written down, or reduced to rules and recipes.

Despite its being difficult to articulate, tacit knowledge can be and is regularly transferred and shared. Tacit knowledge can be learned through observation and imitation. Thus, apprentices

learn their craft by following and copying their masters, professionals acquire expertise and norms through periods of internship, and new employees are immersed in on-the-job training. According to Donald Schön (1983), professionals reflect on what they know during the practice itself (e.g., when they encounter an unusual case) as well as afterward (e.g., in a postmortem) and, in doing so, test and refine their own tacit knowledge. Tacit knowledge can also be shared. Although not completely expressible in words or symbols, tacit knowledge may be alluded to or revealed through rich modes of discourse that include the use of analogies, metaphors, or models and through the communal sharing of stories. Storytelling provides channels for tacit learning because narratives dramatize and contextualize knowledge-rich episodes, allowing the listener to replay and relive as much of the original experience as possible.

Ikujiro Nonaka and Hirotaka Takeuchi (1995) emphasize that tacit knowledge is vital to organizations because it is an important source of new knowledge. New knowledge in the form of discoveries and innovations is often the outcome of creative individuals applying their tacit insights and intuitions to confront novel or difficult problems. Because tacit knowledge resides in people's minds, it is lost when employees leave the organization.

### ***Explicit Knowledge***

Explicit knowledge is knowledge that is expressed formally using a system of symbols and can therefore be easily communicated or diffused. Explicit knowledge may be object based or rule based. Object-based knowledge may be found in artifacts such as products, patents, software code, computer databases, technical drawings, tools, prototypes, photographs, voice recordings, films, and so on. Knowledge is object based when it is represented using strings of symbols (e.g., words, numbers, formulas) or is embodied in physical entities (e.g., equipment, models, substances). In the first case, the symbols directly represent or codify the explicit knowledge. In the second case, explicit knowledge may be extracted from the physical object by, for example, disassembling equipment, inspecting software code, or analyzing the composition of a substance. Explicit knowledge is rule based when the knowledge is codified into rules, routines, or operating procedures. A substantial part of an organization's operational

knowledge about how to do things is contained in its rules, routines, and procedures. Although all organizations operate with standard procedures, each organization will develop its own repertoire of routines, based on its experience and the specific environment in which it functions.

Patrick Sullivan (1998, p. 23) discusses an organization's explicit knowledge that takes the form of "intellectual assets," which he defines as "the codified, tangible, or physical descriptions of specific knowledge to which the company can assert ownership rights." Examples of intellectual assets may include plans, procedures, drawings, blueprints, and computer programs. Intellectual assets that receive legal protection are intellectual property. Five forms of intellectual property are entitled to legal protection in the United States: patents, copyrights, trade secrets, trademarks, and semiconductor masks.

Explicit knowledge codified as intellectual assets is valuable to the organization because it adds to the organization's observable and tradable stocks of knowledge. Moreover, because they have been committed to media, ideas may be communicated more easily. Explicit knowledge serves a number of important purposes in an organization. It encodes past learning in rules, coordinates disparate organizational functions, and signifies competence and rationality. Because explicit knowledge has been codified, it remains with the organization even after its inventors or authors leave the organization.

### ***Cultural Knowledge***

An organization's cultural knowledge consists of the beliefs it holds to be true based on experience, observation, and reflection about itself and its environment. Over time, an organization develops shared beliefs about the nature of its main business, core capabilities, markets, competitors, and so on. These beliefs then form the criteria for judging and selecting alternatives and new ideas, and for evaluating projects and proposals. In this way, an organization uses its cultural knowledge to answer questions such as "What kind of an organization are we?" "What knowledge would be valuable to the organization?" and "What knowledge would be worth pursuing?"

Cultural knowledge includes the assumptions and beliefs that are used to describe and explain reality, as well as the criteria and expectations that

are used to assign value and significance to new information. These shared beliefs, norms, and values form the sense-making framework in which organizational members recognize the saliency of new information. Although cultural knowledge is not written down (but is conveyed in stories, histories, and reward or evaluation systems), it remains with the organization even after employee changes and staff turnover.

There are well-known accounts of organizations in which cultural knowledge is misaligned with its efforts to exploit tacit and explicit knowledge. For example, Xerox PARC (Palo Alto Research Center) in the 1970s pioneered many innovations that later defined the personal computer industry but which Xerox itself did not commercialize. PARC had invented or developed the bit-mapped display technology that was required for rendering graphical user interfaces, software for on-screen windows and windows management, the mouse as a pointing device, the first personal computer (Alto), and an early word-processing software (Bravo) for the Alto. Xerox was not willing to realize the application potential of these inventions because its identity and business strategy was still focused on the photocopier market. Many of the researchers working on these projects subsequently left PARC, taking their knowledge with them.

### Knowledge Creation

Nonaka and Takeuchi (1995, p. 59) suggest that the production of new knowledge involves “a process that ‘organizationally’ amplifies the knowledge created by individuals and crystallizes it as a part of the knowledge network of the organization.” Two sets of activities drive the process of knowledge amplification: (1) converting tacit knowledge into explicit knowledge and (2) moving knowledge from the individual level to the group, organizational, and interorganizational levels. An organization creates knowledge through four modes: socialization, externalization, combination, and internalization.

Socialization is a process of acquiring tacit knowledge through sharing experiences. As apprentices learn the craft of their masters through observation and imitation, so do employees of a firm learn new skills through shared activities such as on-the-job training. Externalization is a process of converting tacit knowledge into explicit con-

cepts through the use of abstractions, metaphors, analogies, or models. Combination is a process of creating explicit knowledge by bringing together explicit knowledge from a number of sources. For example, individuals exchange and combine their explicit knowledge through conversations, meetings, and memos. Computerized databases may be “mined” to uncover new explicit knowledge. Finally, internalization is a process of embodying explicit knowledge into tacit knowledge, internalizing the experiences that are gained through the other modes of knowledge creation in the form of shared mental models or work practices.

### Knowledge Sharing

Promoting the effective sharing and transfer of knowledge is often the centerpiece of knowledge management initiatives. Unfortunately, there are significant cognitive, affective, and organizational barriers to knowledge sharing. Cognitively, the individual who is transferring knowledge must put in mental effort to explain new concepts, demonstrate techniques, answer questions, and so on. Affectively, the individual may experience regret or reluctance about losing ownership of hard-earned expertise. Organizationally, individuals are not rewarded for solving another person’s problems, nor are they usually given the time or support needed to share information. There are also cultural factors in most organizations that inhibit knowledge sharing. Thomas Davenport and Laurence Prusak (1998) consider the most common inhibitors to be lack of trust, different frames of reference, lack of time and opportunity, rewards going to those who own knowledge, lack of capacity in recipients to absorb new knowledge, the not-invented-here syndrome, and intolerance for mistakes.

Max Boisot (1998) points out that diffusion of organizational knowledge is increased and accelerated by the codification and abstraction of personal knowledge. Codification is the process that creates perceptual and conceptual categories that facilitate the classification of phenomena. Whereas codification groups the data of experience into categories, abstraction is accomplished by revealing the structure and cause-and-effect relationships that underlie phenomena. It leads to knowledge that is based on abstract thought and is mainly conceptual and broadly applicable. The more codified and abstract an item of knowledge becomes, the larger the per-

centage of a given population it will be able to reach in a given period of time.

### Knowledge Use

The use of knowledge is a social activity. Whenever organizational knowledge is put in use, its tacit, explicit, and cultural facets bind together in a flow of practice and social interaction. Work groups form around these practices, creating communities of practice. Communities of practice emerge of their own accord and tend to self-organize; people join and stay because they have something to learn and to contribute. By sharing and jointly developing practice, communities of practice evolve patterns of relating and interacting with one another. Over time, they develop a common understanding of the meaning and value of their work, as well as a shared repertory of resources that include both the tacit (e.g., “war stories,” workarounds, heuristics) and the explicit (e.g., notebooks, tools, communication devices). Communities of practice therefore constitute historical and social settings that embrace all three categories of organizational knowledge.

### Knowledge Management in Practice

A thorough understanding of knowledge management can best be obtained by examining specific examples of the process being put into practice. Two good examples are the Xerox Eureka project and the consulting firm of PricewaterhouseCoopers.

#### *Xerox Eureka*

The Eureka project at Xerox is an example of how an organization can tap into the tacit knowledge of its employees, codify that knowledge, and facilitate its diffusion and use. Eureka is also an illustration of how an organization can balance the need for looseness and improvisation with the need for structure and control when managing its knowledge.

In the early 1990s, Xerox was employing approximately twenty-three thousand technicians around the world to repair copiers at client sites. Some of the repair solutions existed only in the heads of the experienced technicians, who had found ways of dealing with tough machine-repair problems. Xerox developed Eureka as a system of practices, procedures, and tools that would allow the personal knowledge of technicians to be vali-

dated and shared. Eureka was initially developed by Xerox PARC and deployed in 1992 for service representatives in Xerox France. By the end of 1999, more than five thousand tips had been entered, and they were available to Xerox service representatives worldwide via their laptop computers.

The following is how Eureka works. Customer service representatives who are on site visits discover solutions to difficult repair problems. They submit these tentative solutions into a “pending tips” database. Pending tips are voted and commented on by other technicians when they try these tips to solve customer problems. Tips that are validated by product leaders or specialists are then edited and entered into the “validated tips knowledge base.” Service representatives are motivated to use Eureka because of its problem-solving benefits. They are motivated to contribute to it by personal recognition (e.g., their names are attached to the tips they submit) and by prizes for frequently used tips.

Priscilla Douglas (1999, pp. 217–218) of Xerox described the effect of Eureka as follows:

Technically, Eureka is a relational database of hypertext documents available online via the Intranet. It can also be viewed as the distributed publishing of local community know-how. In practice, Eureka is an electronic version of war stories told around the water cooler—with the added benefits of a user-friendly search engine, institutional memory, expert validation, and corporate-wide availability. It is a way to simultaneously grow both intellectual capital and social capital.

Eureka saves Xerox about 5 percent on labor and another 5 percent in parts costs in field customer service. It is being used by 15,000 Xerox technicians worldwide. Tom Ruddy, Xerox’s director of knowledge management for worldwide customer services, estimates that Xerox will eliminate approximately 150,000 calls per year with Eureka—worth \$6 million to \$8 million. Savings should actually be higher, since Xerox has implemented the system in its call centers, increasing the expected number of users to more than 25,000.

#### *PricewaterhouseCoopers*

Consulting firms recognize that their products and services are based almost exclusively on knowledge, and many are active in implementing

strategies that leverage their internal knowledge. Organizationally, the approach of PricewaterhouseCoopers (PwC) is based on a four-level structure for managing knowledge:

1. The Global KM Management Team coordinates the overall PwC approach to knowledge management and implements specific, key enterprise-wide initiatives.
2. The KM Council (composed of the Global KM Core Team, lines of service chief knowledge officers, and representatives from stakeholders throughout the firm) coordinates global efforts with those of lines of business and industry clusters.
3. The KM Action Committees are responsible for areas such as content architecture, best practices, knowledge management technologies, professionalism, and people information.
4. The KM Communities of Interest (which comprise approximately one thousand professionals, knowledge managers, researchers/analysts, information specialists, and extranet owners) share innovative thinking in the knowledge management area.

To promote knowledge management as a professional career, the firm has developed a competencies framework and a set of professional principles. Thus, the primary mission of a knowledge management professional is to harvest, share, and build PwC's intellectual capital. Bonuses, promotions, and partner admissions are linked to knowledge sharing. For example, partners are formally assessed on their ability to foster knowledge sharing, and everyone from new hires to partners are encouraged and recognized for their knowledge creation and sharing activities. The firm encourages knowledge sharing by including the names of contributors on documents in knowledge stores, by providing publicity on individuals who make the extra effort to share knowledge, by sending thank-you notes from partners and peers to personnel files, and by awarding "Knowledge Bucks" prizes and spot bonuses (Hackett, 2000).

PwC sees its investment in knowledge management as highly strategic; knowledge sharing increases customer satisfaction and revenues while providing the firm with a competitive advantage. Brian Hackett (2000, p. 66) relates the following example:

In one instance, PwC was providing auditing work to a global client. PwC became aware that the client was dissatisfied with an electronic commerce project that was being conducted by another consulting company. Asked to develop a proposal in one week, this auditing team had to quickly locate PwC's expertise in another area, find expertise pertinent to the client's industry, and develop a responsive proposal. Using PwC's vast network of internal databases, KnowledgeCurve, and other sources, the team located a partner who specialized in e-commerce, another partner with the appropriate industry expertise, database experts, and a change management expert. In less than a week, PwC effectively maximized its internal talent and produced a winning proposal.

Both Xerox and PwC are finding ways to use tacit, explicit, and cultural knowledge to improve corporate performance. In each case, knowledge management is a formal activity.

*See also:* CHIEF INFORMATION OFFICERS; KNOWLEDGE MANAGEMENT, CAREERS IN; MANAGEMENT INFORMATION SYSTEMS.

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## ■ KNOWLEDGE MANAGEMENT, CAREERS IN

Once upon a time an article about careers might well have described a “career ladder.” The concept was a useful one when organizations were hierarchical in nature and one might progress step by step ever higher in the management hierarchy. Many research studies of such diverse careers as college presidents, career army officers, directors of academic libraries, and chief executive officers concluded that successive positions followed a predictable upward pattern (i.e., a career ladder).

At the beginning of the twenty-first century, however, the comfortable clarity and stability that the hierarchy offered is gone. David Skyrme (1999), a frequent writer on knowledge management (KM) topics, summarizes the transformation in business and society that has taken place in the “networked knowledge environment.” The defining characteristics of networked organizations, according to Skyrme, are not so much particular

organizational structures as they are informal human networking processes with the information technology that “underpins and enhances human networking” (p. 15). New ways of working in these environments include self-managed teams, virtual teams, flexible offices, and teleworking. The transition from a hierarchical organization to a postmodern environment can be characterized as “a series of interwoven projects defined by the sense-making and learning of its participants” (Addleson, 2000, p. 151).

The learning organization places less emphasis on rules, detailed specification of tasks, and error avoidance than on creative chaos, risk-taking, and error detection and correction. Organizations that tend to have knowledge management initiatives also usually have (1) senior management who believe that organizational learning and knowledge management are critical success factors, (2) an organizational culture focused on rapid growth, often driven by outside competitors, (3) internal trust, leading to a willingness to share knowledge, and (4) a strong customer orientation.

An IBM-supported study of twenty chief knowledge officers (CKOs) in North America and Europe sought to determine commonalities in the roles and to explore current and evolving knowledge management practices. The model CKO in this study is both a technologist and an environmentalist. He or she (many are female) has a responsibility “to encourage and initiate investment in information technology (IT) and also in the social environment” (Earl and Scott, 1999, p. 6). Most of the CKOs interviewed lacked formal IT training but had past involvement with IT projects. The first initiative for a CKO is often technological—building knowledge-sharing tools such as groupware projects, knowledge directories, and intranets. In the organizational domain, the CKOs create social environments and initiate events and processes to encourage knowledge creation and exchange—for example, through the design of space and by sponsoring events that bring people together to create communities with common interests. Part of the CKO’s job as environmentalist involves a radical redesign of performance measurement systems in order to encourage collective, rather than individual, performance. The CKO also works with any educational or organizational development opportunities as a means of encouraging knowledge creation.