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Knowledge Management Systems: Using Technology to Enhance Organizational Learning

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ABSTRACT

Knowledge management seeks to understand how individuals in organizational settings acquire, create, store, and use knowledge. Technology developments such as the World Wide Web, relational databases, and sophisticated hypertext search engines and navigational tools enable knowledge management processes. Knowledge management systems are centralized computer systems where employees store, structure, and access a corporation's document-based knowledge. Knowledge management systems support organization learning by providing employees with a shared interface to access information during problem solving and decision-making situations and convert this information into performance-enhancing, actionable knowledge. However, the technology subsystem simply supports the system-linked processes that define a learning organization: people, the organizational culture, knowledge, learning, and knowledge management. Corporate knowledge management systems are chartered with providing both logical and physical structures that allow individuals to access and create intellectual capital while performing in their work and task environments.

INTRODUCTION

In their 75th Anniversary issue, the Harvard Business Review (1997) posed this question to Peter Drucker and Peter Senge, both respected authors in the field of business: "What problems or challenges do you see already taking shape for business executives as they move into the next century?" (p. 18). Drucker and Senge identified changes that were not technical or rational in nature as much as cultural: how to lead organizations that create and nurture knowledge and how to maintain, as individuals and organizations, our ability to learn. Zuboff (1988) notes that today's organization may have little choice but to acquire the learning habit, since in a knowledge-based economy one of its principal purposes becomes the expansion of knowledge. This knowledge is not essential for its own sake (as in some academic pursuit), but knowledge that comes to reside at the core of what it means to be productive. Learning is no longer a separate activity that occurs either before one enters the workplace or in classroom settings. Learning takes place as a by-product of people doing their work. The behaviors that define learning and the behaviors that define being productive are one and the same.

When employees learn, they construct actionable knowledge, knowledge that easily translates into performance-enhancing behavior. More specifically, it is organizational knowledge, the information embodied in the set of task-environment specific work practices, theories, skills, processes, and heuristics shared by a firm's employees (Argyris, 1996a; Argyris & Schön, 1987). An organization's task environment is a pattern of interconnected roles operating through a set of norms, strategies, and assumptions that specify how work gets divided and how the tasks get performed (Dixon, 1994).

Central to any organizational learning environment is the effective use of technology to provide employees information needed to solve problems, make decisions, and take effective action (Marquard, 1996; Senge, 1990). Knowledge management systems are centralized computer systems where employees store, structure, and access a corporation's document-based knowledge. Physically, the document-based knowledge is stored in relational databases, encapsulated in word processor files, spreadsheet files, and graphical presentation files and presented to the users through a ubiquitous Internet browser-like interface. Knowledge management systems support organization learning by providing employees with a shared interface to access information during problem solving and decision-making situations and convert this information into performance-enhancing, actionable knowledge.

KNOWLEDGE MANAGEMENT

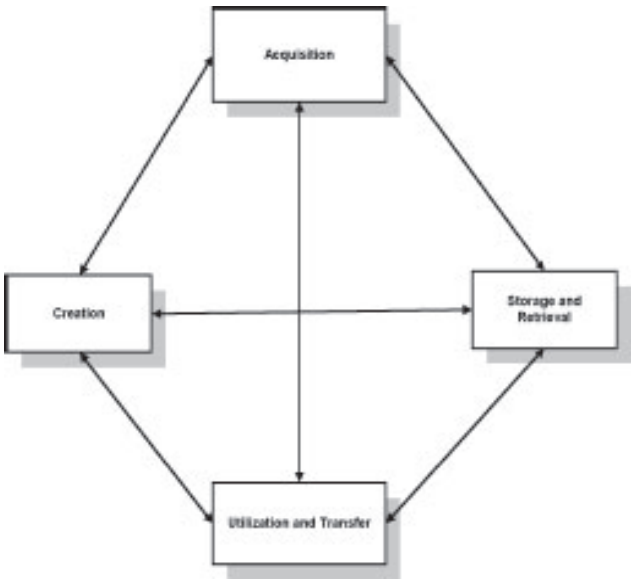
Knowledge management focuses on understanding how knowledge is acquired, created, stored and utilized within an organization. Successful companies are able to acquire, codify, and transfer knowledge more effectively and with greater speed than the competition (Myers, 1996). Organizations provide employees with an environment to learn and share knowledge using technology with the goal of enhancing their productivity.

Learning occurs when individuals create new knowledge by combining explicit knowledge accessed from knowledge management systems, with their prior knowledge, normally in tacit form. The individual utilizes this new knowledge to complete his or her task. The individual publishes the resulting new knowledge into the knowledge management system for use by other employees. This cycle of knowledge creation, publication, and sharing is the central theme of knowledge management. The following knowledge management model presents four processes that enable employees, while interacting with their knowledge management system, to generate and share knowledge.

Knowledge Management Model

Knowledge management is a methodology grounded in the generic process-centric model in Figure 1.

Figure 1 Generic Knowledge Management Model



Knowledge Acquisition

Organizations acquire knowledge from both external and internal sources. Methods to acquire information from external sources include: benchmarking best practices from other organizations; attending conferences; hiring consultants; monitoring economic, social, and technological trends; collecting data from customers, competitors, and resources; hiring new staff; collaborating with other organizations, building alliances, forming joint ventures, and establishing knowledge links with business partners. Organizations acquire knowledge internally by tapping into the knowledge of its staff, learning from experience, and implementing continuous process improvement.

Two important points regarding knowledge acquisition; first, information, whether it is acquired from an external or an internal source is subject to perceptual filters (norms, values, and procedures) that influence what information the organization listens to and ultimately accepts. Second, knowledge acquisition systemically is guided by a firm's core competency strategy. Individuals search for information, internally and externally, which enhances performance and adds to existing knowledge bases. For organizations to meet their strategic objectives, knowledge acquired from multiple sources must self-organize around the firm's key business processes and knowledge domains modeled in a firm's value chain.

Knowledge Creation

Whereas knowledge acquisition is generally adaptive, knowledge creation is generative, where knowledge is actively constructed from information previously stored and new information drawn from the environment (Kozma, 1992). Organizations create new knowledge through numerous activities:

- Action learning—involves working on problems, focusing on the learning acquired, and actually implementing solutions.
- Systematic problem solving—requires a mindset, disciplined in both reductionism and holistic thinking, attentive to details, and willing to push beyond the obvious to assess underlying causes.
- Learning from past experiences —reviews a company's successes and failures, assessing them systematically, and transferring and recording the "lessons learned" in a way that will be of maximum benefit to the organization.

Knowledge Distribution

Core to knowledge management are processes in which multi-disciplinary knowledge is created and distributed to those who need it. Van der Spek and Spijkervet (1997) report in a survey of sixty Dutch organizations, that hardly any structural attention is paid to knowledge management. What is often lacking is coordination between various activities and departments. Synergy, necessary to integrate knowledge across multidisciplinary areas, is often missing. Knowledge distribution processes are charged with disseminating the best knowledge to the right people in the most cost effective and timely fashion.

Knowledge Storage and Retrieval

In order to store and later to retrieve knowledge, an organization must first determine what is important to retain and how best to retain it. Knowledge should be structured and stored so the system can find and deliver it quickly and correctly. When structuring knowledge, it is important to consider how the information will be retrieved by different groups of people. Functional and effective knowledge storage systems allow categorization around learning needs, work objectives, user expertise, use of the knowledge, and location (where the information is stored). However, knowledge is not always present in its optimal form, is not available when needed, and is not present where the work activity is carried out. Additionally, knowledge content is often not complete, not current, and not uniform.

Knowledge transfer and utilization

Knowledge transfer and utilization involves the mechanical, electronic, and interpersonal movement of information and knowledge both intentionally and unintentionally. Organizations intentionally transfer knowledge by written communications, training, internal conferences, internal publications, job rotation and job transfer, and mentoring. Organizations unintentionally transfer knowledge as a function of unplanned human interaction, i.e. job rotation, stories and myths, task forces, and informal networks.

ORGANIZATIONAL LEARNING

Probst and Buchell (1997) define organizational learning as the process by which the organization's knowledge base changes leading to improved problem-solving ability and capacity for effective action. The concept of learning has achieved prominence within management and educational studies. One reason for this heightened awareness is the increasing pressure of change on companies. The rate of change accelerates steadily and companies must retain their competitive advantage in an increasingly complex environment. In the future, learning becomes the only lasting competitive advantage (de Geus, 1988).

Probst and Buchel (1997) note that most psychological definitions of learning remain at the level of learning by the individual. System theoreticians take a different approach: learning by an organization should satisfy the needs of a collective, focusing attention on the organization as a framework for individual action. Most analysts who approach organizational learning from this angle give prominence to interactions between the individual and the organization. Although the relationship between learning at the organizational level and learning by individuals is not fully understood, one can say that learning by individuals is a prerequisite of organizational learning.

Individual Learning

Argyris and Schön (1987) define individual learning as the act of finding relevant information and applying it to the employee's work to make a positive difference in business results. Senge (1990) contends that learning is ultimately related to action.

Action learning involves working on real problems, focusing on the learning acquired, and actually implementing solutions (Handy, 1995). Action learning builds upon the experience and knowledge of an individual or group and the skilled, fresh questioning that creates new knowledge.

People are the pivotal part of managing knowledge. They take data and transform it into valuable knowledge for personal and organizational use. If individuals are to acquire the learning habit, they must possess the skills, or disciplines Senge (1990), of systems thinking, managing mental models, quest for personal mastery, team learning, and shared vision. Each discipline is discussed in the following sections.

Systems thinking

Systems thinking is the way we characterize and describe a problem (Salisbury, 1996). Systems thinkers conceptualize of a problem as a system, not just a linear, cause-to-effect, independent situation. System thinking represents a conceptual framework one uses to make patterns of relationships clearer, and to help one see how to change them effectively (Senge, 1990).

Salisbury (1996) suggests that every system has homeostasis (tendency to repel change). Homeostasis manifests itself as the inclination of a system to move back to a previous state of equilibrium after being disturbed by external forces. Homeostasis suggests that implementing change is more successful if forces are intrinsic, thus modifying an organization's systemic structure.

Knowledge management systems support systemic change by perpetuating knowledge creation and knowledge sharing. Organizational systems exhibit a lesser tendency to repel change if employees feel empowered to develop innovative solutions and publish those solutions in the knowledge management system. Knowledge sharing diffuses the innovative solutions throughout an organization as knowledge workers access the newly created knowledge.

Managing Mental Models

Mental models are constructions of how we understand the world, which then becomes the basis for our actions. For example, our mental models about learning and work impact how we relate and act on the job. Mental models significantly impact how knowledge workers create new knowledge. New insights fail to get put into practice because they conflict with deeply ingrained assumptions of how the world works, assumptions that limit us to familiar ways of thinking and acting.

Although people do not always behave congruently with their espoused theories (what they say, their vision), they do behave congruently with their theories-in-use or mental models (Arygis, 1996a). Senge (1990) recommends that organizations implement the practice of managing mental models; examining deeply ingrained assumptions of reality, sharing those

models with associates and changing the model if appropriate. Unexamined mental models lead to gaps between the model and current reality. The inertia of deeply entrenched mental models can overwhelm even the best systemic insights.

Quest for Personal Mastery

Personal mastery indicates a high level of proficiency in a subject or skill area. It requires commitment to lifelong learning so employees can transform knowledge into expertise and proficiency. Personal mastery requires two underlying movements before it becomes integrated into our lives: (1) continually clarifying what is important to us (vision); (2) continually learning how to see reality more clearly (Senge, 1990). Yet systems thinking suggests that individuals develop a more holistic, multidisciplinary expertise. Knowledge management systems enable individuals to access multi-disciplinary organizational knowledge, knowledge that can aid their lifelong learning ventures.

Team Learning

Team learning focuses on the process of aligning, where a group of people functions as a whole, and developing the team's capacity to learn. Senge (1990) asserts that team learning requires three critical dimensions:

1. The need to think insightfully about complex problems. Team members must manage their mental models, allowing new ideas to surface, and correct their mental models if appropriate.
2. The need for innovative, coordinated actions. Team members must adopt an operational trust, where each team member remains conscious of other team members and can be counted on to act in ways that complement others' actions.
3. Team members must inculcate the practice and skills of their team into other teams, thus sharing knowledge and new mental models.

Shared Vision

The discipline of shared vision involves the skill of uncovering shared perspectives of a desired future state that foster genuine commitment toward a long term objective rather than just compliance (Senge, 1990). Senge suggests that without shared vision, generative learning, the creation of something new during the learning activity, cannot occur; it can only occur when people strive to accomplish something that matters deeply to them. Knowledge management systems provide an interface into a shared information space from which employees examine shared perspectives.

The topic of learning in an organizational environment attracts attention from both business and academic communities. Through continuous learning, organizations adapt and transform their entities into viable, healthy, competitive forces in their marketplaces. Yet individuals are skillful at using defensive routines that inhibit learning. Organizations can neutralize defensive patterns by creating an organizational culture in which learners are empowered to experiment and where learners are self-directed to enhance their learning processes.

TECHNOLOGY AND KNOWLEDGE MANAGEMENT SYSTEMS

A firm's technology subsystem does not create knowledge and cannot guarantee or even promote knowledge generation or knowledge sharing in a corporate culture that does not favor those activities. The assumption that technology can replace human knowledge or create its equivalent has proven false time and again (Davenport & Prusak, 1998). However, developments in technology are among the positive factors fueling interest in knowledge management. Networked computing provides new ways for individuals to share knowledge. Technologies such as Lotus Notes and the World Wide Web make knowledge easier to collect, store in repositories, and distribute to desktops. The recent expanding role of intranet use is one manifestation of the increasing role computer technology plays in communication and knowledge seeking. Businesses are becoming aware both of the potential of this technology to enhance knowledge work and that the potential can be realized only if they understand how knowledge is shared and developed.

Knowledge management systems

Knowledge management take a large, diverse collection of document-based knowledge, provide a physical infrastructure for storing those documents, and provide a logical structure for retrieving information. Individuals, regardless of their roles, use a knowledge management system with the objective of enhancing productivity. Therefore a tight integration between core business practices, which add value to products and services in the firm's value chain, and publication and use processes in the knowledge management system is essential if productivity goals are to be reached. In most cases, knowledge-based systems support knowledge workers directly by performing knowledge-intensive work. To do so successfully requires that knowledge-based systems correspond between the concepts, associations, mental models, conceptual frameworks, and objectives that the knowledge worker employs to perform his or her work (Wiig, 1997).

The rise of Internet technologies and knowledge management disciplines dovetail nicely in that Internet technologies, and particularly the World Wide Web (WWW) technologies, are well suited to the creation of intranets that support key parts of the knowledge management. Intranet web-based technologies provide a centralized storage, structuring, and dissemination mechanisms for unstructured and semi-structured data, including multimedia documents, images, and video.

The following sections present an architectural and functional description of a knowledge management system as implemented at Sequent Computer Systems in Beaverton, OR. IBM recently purchased sequent, however these processes represent knowledge management processes at Sequent prior to the merger. Company white papers, technical manuals, and other company communications constitute sources for information presented in the following sections.

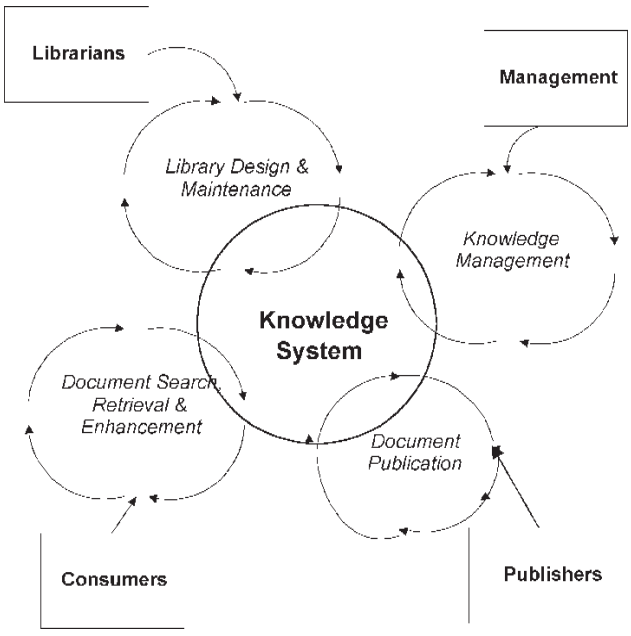
Supported Processes

A knowledge management system supports processes that publish and disseminate organizational knowledge throughout the firm, along the lines of the process model described below.

The Document Publication Process. The knowledge management system begins its work with the document publication process, providing the infrastructure for any publisher to place documents into the organization's knowledge base.

Document publication technology captures not only the document, but all the metadata on the document required to make the document accessible to consumers, and manageable by librarians and management. In addition, the knowledge management system uses its own knowledge concerning which employees are interested in particular classes of information and which employees are required to review particular classes of information, so as to notify those employees when new material is created or modified.

Figure 2. Processes supported by Knowledge management systems. Adapted from Sequent, 1996b.



Document search, retrieval and enhancement. Knowledge management systems also provide the infrastructure for consumers within the firm to:

- search for specific documents, or for general or specific areas of information;
- retrieve any document (subject to security controls) in a form usable by the consumer's local desktop toolkit (wordprocessor, spreadsheet, or email);
- enhance any document in the library by attaching more information to the base document.

Library design and maintenance. Although the core structure of the knowledge management system is frequently built based on a model of the firm's internal and external value chains, many employees still need to view the firm as a set of discrete functions: manufacturing, finance, and marketing. Others need to see the firm as a network of named individuals, each of which contributes well-understood components to the firm's knowledge. Still others need to look at the base of documents in the knowledge management system through the lens of the company's product sets or markets.

The knowledge management system also provides a comprehensive set of mechanisms: to enforce document-level security profiles, to flag and report events associated with any document, to automatically age documents out of the library as the information in the documents becomes stale, and to maintain multiple versions of any one document as documents are edited, modified, republished and retired.

Web-based knowledge management systems

Consumers interact with the knowledge management system through their Web browser, which in turn interacts with a Web server that integrates several important classes of resources:

- the content store, which contains the documents published by knowledge workers, many in multiple formats(word processing or HTML), and multiple revisions or versions.
- the indices, which provide fairly low-level (full-text and near-full-text) access to documents in the knowledge management system via searching.
- the metadata store, which contains information about documents. Information that publishers and consumers need to manage the document store, provide appropriate security and access control, construct card catalogs, institute and manage document aging schemes, and facilitate other administrative and user access tasks.
- external OLTP resources, whose data sets and user interfaces may be represented in the knowledge management system as forms or documents (reports)
- external DSS resources, whose data sets and user interfaces may be represented in the knowledge management system as forms or documents (reports).

Consumers also interact with the knowledge management system via their mail agent. The knowledge management system uses the messaging system to notify consumers who have registered their interest in particular topics, knowledge domains or documents, when new documents are available, when existing documents have been modified, and when material in the library has been locked or removed because the information contained in those documents has aged. The publishing tool and publishing server support the publication process, gather the appropriate metadata at time of publication and in general facilitate the smooth and orderly addition of documents to the knowledge management system.

Summary

The topic of learning in an organizational environment attracts attention from both business and academic communities. Through continuous learning, organizations adapt and transform their entities into viable, healthy, competitive forces in their marketplaces. Individuals learn when expectation failures occur; gaps between espoused theories and theories-in-use. Yet individuals are skillful at using defensive routines that inhibit learning. Organizations can mitigate defensive patterns by creating an organizational culture in which learners are empowered to experiment, where learners share diverse work experiences, and where learners are self-directed to enhance their learning processes.

Knowledge management seeks to understand how individuals in organizational settings acquire, create, store, and use knowledge. Technology developments such as the World Wide Web, relational databases, and sophisticated hypertext search engines and navigational tools enable knowledge management processes. However, the technology subsystem simply supports the system-linked processes that define a learning organization: people, the organizational culture, knowledge, learning, and knowledge management. Corporate knowledge management systems are chartered with providing both logical and physical structures that allow individuals to access and create intellectual capital while performing in their work and task environments.

Using infrastructural technologies, the World Wide Web and relational databases and proven design practices, organizations can create centrally-managed and administered knowledge management systems that serve the desktops of the entire firm, regardless of their location, toolset, or function. In the process giving the firm its first opportunity to understand fully how knowledge is constructed, embodied, disseminated and used within the firm.

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