CHAPTER

12

Knowledge Management and Collaborative Systems

LEARNING OBJECTIVES

- Define knowledge and describe the different types of knowledge
- Describe the characteristics of knowledge management
- Describe the knowledge management cycle
- Describe the technologies that can be used in a knowledge management system (KMS)
- Describe different approaches to knowledge management
- Understand the basic concepts and processes of groupwork, communication, and collaboration

- Describe how computer systems facilitate communication and collaboration in an enterprise
- Explain the concepts and importance of the time/place framework
- Explain the underlying principles and capabilities of groupware, such as group support systems (GSS)
- Understand how the Web enables collaborative computing and group support of virtual meetings
- Describe the role of emerging technologies in supporting collaboration

In this chapter, we study two major IT initiatives related to decision support. First, we describe the characteristics and concepts of knowledge management. We explain how firms use information technology (IT) to implement knowledge management (KM) systems and how these systems are transforming modern organizations. Knowledge management, although conceptually ancient, is a relatively new business philosophy. The goal of knowledge management is to identify, capture, store, maintain, and deliver useful knowledge in a meaningful form to anyone who needs it, anyplace and anytime, within an organization. Knowledge management is about sharing and collaborating at the organization level. People work together, and groups make most of the complex decisions in organizations. The increase in organizational decision-making complexity increases the need for meetings and groupwork. Supporting groupwork, where team members may be in different locations and working at different times, emphasizes the important aspects of communications, computer-mediated collaboration, and work methodologies.

Group support is a critical aspect of decision support systems (DSS). Effective computer-supported group support systems have evolved to increase gains and decrease losses in task performance and underlying processes. So this chapter covers both knowledge management and collaborative systems. It consists of the following sections:

12.1   OPENING VIGNETTE: Expertise Transfer System to Train Future Army Personnel

A major problem for organizations implementing knowledge management systems such as lessons-learned capabilities is the lack of success of such systems or poor service of the systems to their intended goal of promoting knowledge reuse and sharing. Lessons-learned systems are part of the broad organizational and knowledge management systems that have been well studied by IS researchers. The objective of lessons-learned systems is to support the capture, codification, presentation, and application of expertise in organizations. Lesson-learned systems have been a failure mainly for two reasons—inadequate representation and lack of integration into an organization's decision-making process.

The expertise transfer system (ETS) is a knowledge transfer system developed by the Spears School of Business at Oklahoma State University as a prototype for the Defense Ammunition Center (DAC) in McAlester, Oklahoma, for use in Army ammunition career fields. The ETS is designed to capture the knowledge of experienced ammunition personnel leaving the Army (i.e., retirements, separations, etc.) and those who have been recently deployed to the field. This knowledge is captured on video, converted into units of actionable knowledge called "nuggets," and presented to the user in a number of learning-friendly views.

ETS begins with an audio/video–recorded (A/V) interview between an interviewee and a "knowledge harvester." Typically, the recording lasts between 60 and 90 minutes. Faculty from the Oklahoma State University College of Education trained DAC knowledge harvesters on effective interviewing techniques, methods of eliciting tacit information from the interviewees, and ways to improve recorded audio quality in the interview process. Once the videos have been recorded, the meat of the ETS process takes place, as depicted in Figure 12.1. First, the digital A/V files are converted to text. Currently, this is accomplished with human transcriptionists, but we have had promising results using voice recognition (VR) technologies for transcription and foresee a day when most of the transcription will be automated. Second, the transcriptions are parsed into small units and organized into knowledge nuggets (KN). Simply put, a knowledge nugget is a significant experience the interviewee had during his/her career that is worth sharing. Then these

FIGURE 12.1 Development Process for Expertise Transfer System.

KNs are incorporated into the expertise transfer system. Finally, additional features are added to the KNs to make them easy to find, more user friendly, and more effective in the classroom.

KNOWLEDGE NUGGETS

We chose to call the harvested knowledge assets *knowledge nuggets* (KN). Of the many definitions or explanations provided by a thesaurus for *nugget*, two explanations stand out: (1) a lump of precious metal, and (2) anything of great value or significance. A knowledge nugget assumes even more importance because knowledge already is of great value. A KN can be just one piece of knowledge like a video or text. However, a KN can also be a combination of video, text, documents, figures, maps, and so forth. The tools used to transfer knowledge have a central theme, which is the knowledge itself. In our DAC repository, we have a combination of knowledge statements, videos, corresponding transcripts, causal maps, and photographs. The knowledge nugget is a specific lesson learned on a particular topic that has been developed for future use. It consists of several components. Figure 12.2 displays a sample knowledge nugget. A summary page provides the user with the title or "punchline" of the KN, the name and deployment information of the interviewee, and a bulleted summary of the KN. Clicking on the video link will bring the users to the KN video clip, whereas clicking on the transcript link will provide them with a complete transcript of the nugget. The KN text is linked back to the portion of the A/V interview from which it was harvested. The result is a searchable 30- to 60-second video clip (with captions) of the KN. A causal map function gives the user an opportunity to see and understand the thought process of the interviewee as they describe the situation captured by the nugget. The related links feature provides users with a list of regulatory guidance associated with the KN, and the related nuggets link lists all KNs within the same knowledge domain. Also provided is information about the interviewee, recognized subject matter experts (SMEs) in the KN domain, and supporting images related to the nugget.

FIGURE 12.2 A Sample Knowledge Nugget.

One of the primary objectives of the ETS is to quickly capture knowledge from the field and incorporate it into the training curriculum. This is accomplished with the My URL feature. This function allows course developers and instructors to use ETS to identify a specific nugget for sharing, and then generate a URL that can be passed directly into a course curriculum and lesson plans. When an instructor clicks on the URL, it brings him/her directly to the KN. As such, the "war story" captured in the nugget becomes the course instructor's war story and provides a real-world decision-making or problem-solving scenario right in the classroom.

The summary page also includes capabilities for users to rate the KN and make any comments about its accuracy. This makes the knowledge nugget a live and continously updated piece of knoweldge. These nuggets can then be sorted on the basis of higher ratings, if so desired. Each nugget intially includes keywords created by the nugget developer. These are presented as tags. A user can also suggest their own tags. These user-specified tags make future searching faster and easier. This brings Web 2.0 concepts of user participation to knowledge management.

In its initial conceptualization, the ETS was supposed to capture the "lesson learned" of the interviews. However, we quickly learned that the ETS process often

captures "lessons to be learned." That is, the interviewees often found themselves in situations where they had to improvise and be innovative while deployed. Many of their approaches and solutions are quite admirable, but sometimes they may not be appropriate or suitable for everyone. In light of that finding, a vetting process was developed for the KNs. Each KN is reviewed by recognized subject matter experts (SME). If the SMEs find the approach acceptable, it is noted as "vetted." If guidance for the KN situation already exists, it is identified and added to the related links. The KN is then noted as "doctrine." If the KN has yet to be reviewed, it is noted as "not reviewed." In this way, the user always has an idea of the quality of each KN viewed. Additionally, if the site must be brought down for any reason, the alerts feature is used to relay that information.

The ETS is designed for two primary types of users: DAC instructors and ammunition personnel. As such, a "push/pull" capability was developed. Tech training instructors do not have the time to search the ETS to find those KNs that are related to the courses they teach. To provide some relief to instructors, the KNs are linked to DAC courses and topics, and can be *pushed* to instructors' e-mail accounts as the KNs come online. Instructors can opt-in or opt-out of courses and topics at will, and they can arrange for new KNs to be pushed as often as they like. Ammunition personnel are the other primary users of the ETS. These users need the ability to quickly locate and *pull* KNs related to their immediate knowledge needs. To aid them, the ETS organizes the nuggets in various views and has a robust search engine. These views include courses and topics; interviewee names; chronological; and by user-created tags. The goal of the ETS is to provide the user with the KNs they need in 5 minutes or less.

KNOWLEDGE HARVESTING PROCESS

The knowledge harvesting process began with videotaping interviews with DAC employees regarding their deployment experience. Speech in the interviews, in some cases, was converted manually to text. In other cases, the knowledge harvesting team (hereinafter referred to as the "team") employed voice recognition technologies to convert the speech to text. The text was checked for accuracy and then passed through the text mining division of the team. The text mining group read through the transcript and employed text mining software to extract some preliminary knowledge from the transcript. The text mining process provided a one-sentence summary for the knowledge nugget, which became the knowledge statement, commonly known among the team as the "punchline." The punchline created from the transcripts along with the excerpts, relevant video from the interview, and causal maps make up the entire knowledge nugget. The knowledge nugget is further refined by checking for quality of general appearance, errors in text, and so on.

IMPLEMENTATION AND RESULTS

The ETS system was built as a prototype for demonstration of its potential use at the Defense Ammunition Center. It was built using a MySQL database for the collection of knowledge nuggets and the related content, and PHP and JavaScript as the Web language platform. The system also incorporated necessary security and access control precautions. It was made available to several groups of trainees who really liked using this type of tacit knowledge presentation. The feedback was very positive. However, some internal issues as well as the challenge of having the tacit knowledge be shared as official knowledge resulted in the system being discontinued. However, the application was developed to be more of a general knowledge–sharing system as opposed to just this specific use. The authors are exploring other potential users for this platform.

QUESTIONS FOR THE OPENING VIGNETTE

1. What are the key impediments to the use of knowledge in a knowledge management system?
2. What features are incorporated in a knowledge nugget in this implementation?
3. Where else could such a system be implemented?

WHAT WE CAN LEARN FROM THIS VIGNETTE

Knowledge management initiatives in many organizations have not succeeded. Although many studies have been conducted on this issue and we will learn more about this topic in future sections, two major issues seem to be critical. Compilation of a lot of user-generated information in a large Web compilation by itself does not present the needed information in the right format to the user. Nor does it make it easy to find the right knowledge at the right time. So developing a friendly knowledge presentation format that includes audio, video, text summary, and Web 2.0 features such as tagging, sharing, comments, and ratings makes it more likely that users will actually use the KM content. Second, organizing the knowledge to be visible in specific taxonomies as well as search and enabling the users to tag the content enable this knowledge to be more easily discovered within a knowledge management system.

Sources: Based on our own documents and S. Iyer, R. Sharda, D. Biros, J. Lucca, and U. Shimp, "Organization of Lessons Learned Knowledge: A Taxonomy of Implementation," *International Journal of Knowledge Management*, Vol. 5, No. 3 (2009).

12.2 INTRODUCTION TO KNOWLEDGE MANAGEMENT

Humans learn effectively through stories, analogies, and examples. Davenport and Prusak (1998) argue that knowledge is communicated effectively when it is conveyed with a convincing narrative. Family-run businesses transfer the secrets of business learned through experience to the next generation. Knowledge through experience does not necessarily reside in any business textbook, but the transfer of such knowledge facilitates its profitable use. Nonaka (1991) used the term *tacit knowledge* for the knowledge that exists in the head but not on paper. Tacit knowledge is difficult to capture, manage, and share. He also observes that organizations that use tacit knowledge as a strategic weapon are innovators and leaders in their respective business domains. There is no substitute for the substantial value that tacit knowledge can provide. Therefore, it is necessary to capture and codify tacit knowledge to the greatest extent possible.

In the 2000s knowledge management was considered to be one of the cornerstones of business success. Despite spending billions of dollars on knowledge management both by industry and government, success has been mixed. Usually it is the successful projects that see the limelight. Much research has focused on successful knowledge management initiatives as well as factors that could lead to a successful knowledge management project (Davenport et al., 1998). But a few researchers have presented case studies of knowledge management failures (Chua and Lam, 2005). One of the causes for such failures is that the prospective users of such knowledge cannot easily locate relevant information. Knowledge compiled in a knowledge management system is no good to the organization if it cannot be easily found by the likely end users. On the other hand, although their worth is difficult to measure, organizations recognize the value of their intellectual assets. Fierce global competition drives companies to better use their intellectual assets by transforming themselves into organizations that foster the development and sharing of knowledge. In the next few sections we cover the basic concepts of knowledge management.

Knowledge Management Concepts and Definitions

With roots in **organizational learning** and innovation, the idea of KM is not new (see Ponzi, 2004; and Schwartz, 2006). However, the application of IT tools to facilitate the creation, storage, transfer, and application of previously uncodifiable organizational knowledge is a new and major initiative in many organizations. Successful managers have long used intellectual assets and recognized their value. But these efforts were not systematic, nor did they ensure that knowledge gained was shared and dispersed appropriately for maximum organizational benefit. Knowledge management is a process that helps organizations identify, select, organize, disseminate, and transfer important information and expertise that are part of the organization's memory and that typically reside within the organization in an unstructured manner. **Knowledge management (KM)** is the systematic and active management of ideas, information, and knowledge residing in an organization's employees. The structuring of knowledge enables effective and efficient problem solving, dynamic learning, strategic planning, and decision making. KM initiatives focus on identifying knowledge, explicating it in such a way that it can be shared in a formal manner, and leveraging its value through reuse. The information technologies that make KM available throughout an organization are referred to as *KM systems.*

Through a supportive organizational climate and modern IT, an organization can bring its entire organizational memory and knowledge to bear on any problem, anywhere in the world, and at any time (see Bock et al., 2005). For organizational success, knowledge, as a form of capital, must be exchangeable among persons, and it must be able to grow. Knowledge about how problems are solved can be captured so that KM can promote organizational learning, leading to further knowledge creation.

Knowledge

Knowledge is very distinct from data and information (see Figure 12.3). Data are facts, measurements, and statistics; information is organized or processed data that is timely (i.e., inferences from the data are drawn within the time frame of applicability) and accurate (i.e., with regard to the original data) (Kankanhalli et al., 2005). **Knowledge** is information that is contextual, relevant, and actionable. For example, a map that gives detailed driving directions from one location to another could be considered data. An up-to-the-minute traffic bulletin along the freeway that indicates a traffic slowdown due to construction several miles ahead could be considered information. Awareness of an alternative, back-road route could be considered knowledge. In this case, the map is considered data because it does not contain current relevant information that affects the driving time and conditions from one location to the other. However, having the current conditions as information is useful only if you have knowledge that enables you to avert the construction zone. The implication is that knowledge has strong experiential and reflective elements that distinguish it from information in a given context.

Having knowledge implies that it can be exercised to solve a problem, whereas having information does not carry the same connotation. An ability to act is an integral part of being knowledgeable. For example, two people in the same context with the same information may not have the same ability to use the information to the same degree of success. Hence, there is a difference in the human capability to add value. The differences in ability may be due to different experiences, different training, different perspectives, and other factors. Whereas data, information, and knowledge may all be viewed as assets of an organization, knowledge provides a higher level of meaning about data and information. It conveys meaning and hence tends to be much more valuable, yet more ephemeral.
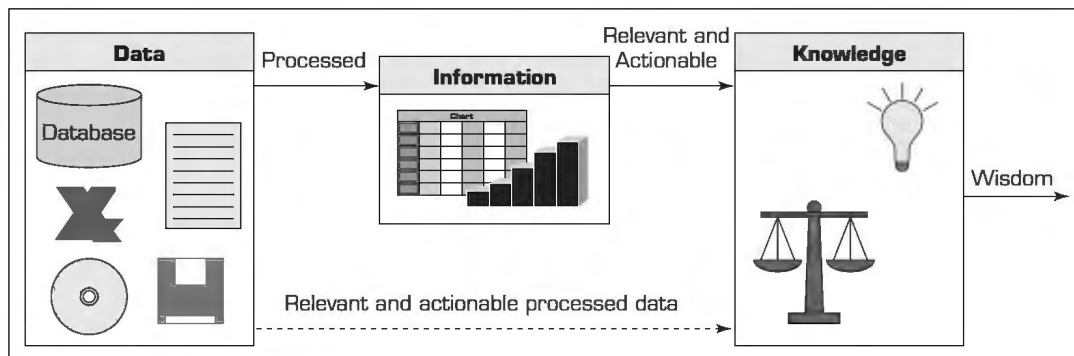
FIGURE 12.3 Relationship Among Data, Information, and Knowledge.

Unlike other organizational assets, knowledge has the following characteristics (see Gray, 1999):

- **Extraordinary leverage and increasing returns.** Knowledge is not subject to diminishing returns. When it is used, it is not decreased (or depleted); rather, it is increased (or improved). Its consumers can add to it, thus increasing its value.
- **Fragmentation, leakage, and the need to refresh.** As knowledge grows, it branches and fragments. Knowledge is dynamic; it is *information in action*. Thus, an organization must continually refresh its knowledge base to maintain it as a source of competitive advantage.
- **Uncertain value.** It is difficult to estimate the impact of an investment in knowledge. There are too many intangible aspects that cannot be easily quantified.
- **Value of sharing.** It is difficult to estimate the value of sharing one's knowledge or even who will benefit most from it.

Over the past few decades, the industrialized economy has been going through a transformation from being based on natural resources to being based on intellectual assets (see Alavi, 2000; and Tseng and Goo, 2005). The **knowledge-based economy** is a reality (see Godin, 2006). Rapid changes in the business environment cannot be handled in traditional ways. Firms are much larger today than they used to be, and, in some areas, turnover is extremely high, fueling the need for better tools for collaboration, communication, and knowledge sharing. Firms must develop strategies to sustain competitive advantage by leveraging their intellectual assets for optimal performance. Competing in the globalized economy and markets requires quick response to customer needs and problems. To provide service, managing knowledge is critical for consulting firms spread out over wide geographical areas and for virtual organizations.

There is a vast amount of literature about what knowledge and knowing mean in epistemology (i.e., the study of the nature of knowledge), the social sciences, philosophy, and psychology. Although there is no single definition of what knowledge and KM specifically mean, the business perspective on them is fairly pragmatic. Information as a resource is not always valuable (i.e., information overload can distract from what is important); knowledge as a resource is valuable because it focuses attention back toward what is important (see Carlucci and Schiuma, 2006; and Hoffer et al., 2002). Knowledge implies an implicit understanding and experience that can discriminate between its use and misuse. Over time, information accumulates and decays, whereas knowledge evolves. Knowledge is dynamic in nature. This implies, though, that today's knowledge may well become tomorrow's ignorance if an individual or organization fails to update knowledge as environmental conditions change.

Knowledge evolves over time with experience, which puts connections among new situations and events in context. Given the breadth of the types and applications of knowledge, we adopt the simple and elegant definition that knowledge is information in action.

Explicit and Tacit Knowledge

Polanyi (1958) first conceptualized the difference between an organization's explicit and tacit knowledge. **Explicit knowledge** deals with more objective, rational, and technical knowledge (e.g., data, policies, procedures, software, documents). **Tacit knowledge** is usually in the domain of subjective, cognitive, and experiential learning; it is highly personal and difficult to formalize. Alavi and Leidner (2001) provided a taxonomy (see Table 12.1), where they defined a spectrum of different types of knowledge, going beyond the simple binary classification of explicit versus tacit. However, most KM research has been (and still is) debating over the dichotomous classification of knowledge.

Explicit knowledge comprises the policies, procedural guides, white papers, reports, designs, products, strategies, goals, mission, and core competencies of an enterprise and its IT infrastructure. It is the knowledge that has been codified (i.e., documented) in a form that can be distributed to others or transformed into a process or strategy without requiring interpersonal interaction. For example, a description of how to process a job application would be documented in a firm's human resources policy manual. Explicit knowledge has also been called **leaky knowledge** because of the ease with which it can leave an individual, a document, or an organization due to the fact that it can be readily and accurately documented (see Alavi, 2000).

TABLE 12.1   Taxonomy of Knowledge

Knowledge Type	Definition	Example
Tacit	Knowledge is rooted in actions, experience, and involvement in specific context	Best means of dealing with a specific customer
Cognitive tacit:	Mental models	Individual's belief on cause-effect relationships
Technical tacit:	Know-how applicable to specific work	Surgery skills
Explicit	Articulated, generalized knowledge	Knowledge of major customers in a region
Individual	Created by and inherent in the individual	Insights gained from completed project
Social	Created by and inherent in collective actions of a group	Norms for intergroup communication
Declarative	Know-about	What drug is appropriate for an illness
Procedural	Know-how	How to administer a particular drug
Causal	Know-why	Understanding why the drug works
Conditional	Know-when	Understanding when to prescribe the drug
Relational	Know-with	Understanding how the drug interacts with other drugs
Pragmatic	Useful knowledge for an organization	Best practices, treatment protocols, case analyses, postmortems

Tacit knowledge is the cumulative store of the experiences, mental maps, insights, acumen, expertise, know-how, trade secrets, skillsets, understanding, and learning that an organization has, as well as the **organizational culture** that has embedded in it the past and present experiences of the organization's people, processes, and values. Tacit knowledge, also referred to as *embedded knowledge* (see Tuggle and Goldfinger, 2004), is usually either localized within the brain of an individual or embedded in the group interactions within a department or a branch office. Tacit knowledge typically involves expertise or high skill levels.

Sometimes tacit knowledge could easily be documented but has remained tacit simply because the individual housing the knowledge does not recognize its potential value to other individuals. Other times, tacit knowledge is unstructured, without tangible form, and therefore difficult to codify. It is difficult to put some tacit knowledge into words. For example, an explanation of how to ride a bicycle would be difficult to document explicitly and thus is tacit. Successful transfer or sharing of tacit knowledge usually takes place through associations, internships, apprenticeship, conversations, other means of social and interpersonal interactions, or even simulations (see Robin, 2000). Nonaka and Takeuchi (1995) claimed that intangibles such as insights, intuitions, hunches, gut feelings, values, images, metaphors, and analogies are the often-overlooked assets of organizations. Harvesting these intangible assets can be critical to a firm's bottom line and its ability to meet its goals. Tacit knowledge sharing requires a certain context or situation in order to be facilitated because it is less commonly shared under normal circumstances (see Shariq and Vendelø, 2006).

Historically, management information systems (MIS) departments have focused on capturing, storing, managing, and reporting explicit knowledge. Organizations now recognize the need to integrate both types of knowledge in formal information systems. For centuries, the mentor–apprentice relationship, because of its experiential nature, has been a slow but reliable means of transferring tacit knowledge from individual to individual. When people leave an organization, they take their knowledge with them. One critical goal of knowledge management is to retain the valuable know-how that can so easily and quickly leave an organization. **Knowledge management systems (KMS)** refer to the use of modern IT (e.g., the Internet, intranets, extranets, Lotus Notes, software filters, agents, data warehouses, Web 2.0) to systematize, enhance, and expedite intra- and interfirm KM.

KM systems are intended to help an organization cope with turnover, rapid change, and downsizing by making the expertise of the organization's human capital widely accessible. They are being built, in part, because of the increasing pressure to maintain a well-informed, productive workforce. Moreover, they are built to help large organizations provide a consistent level of customer service.

SECTION 12.2 REVIEW QUESTIONS

1. Define *knowledge management* and describe its purposes.
2. Distinguish between knowledge and data.
3. Describe the knowledge-based economy.
4. Define *tacit knowledge* and *explicit knowledge*.
5. Define *KMS* and describe the capabilities of KMS.

12.3 APPROACHES TO KNOWLEDGE MANAGEMENT

The two fundamental approaches to knowledge management are the process approach and the practice approach (see Table 12.2). We next describe these two approaches as well as hybrid approaches.

TABLE 12.2   The Process and Practice Approaches to Knowledge Management

	Process Approach	Practice Approach
Type of knowledge supported	Explicit knowledge—codified in rules, tools, and processes	Mostly tacit knowledge—unarticulated knowledge not easily captured or codified
Means of transmission	Formal controls, procedures, and standard operating procedures, with heavy emphasis on information technologies to support knowledge creation, codification, and transfer of knowledge	Informal social groups that engage in storytelling and improvisation
Benefits	Provides structure to harness generated ideas and knowledge Achieves scale in knowledge reuse Provides spark for fresh ideas and responsiveness to changing environment	Provides an environment to generate and transfer high-value tacit knowledge
Disadvantages	Fails to tap into tacit knowledge May limit innovation and forces participants into fixed patterns of thinking	Can result in inefficiency Abundance of ideas with no structure to implement them
Role of information technology (IT)	Requires heavy investment in IT to connect people with reusable codified knowledge	Requires moderate investment in IT to facilitate conversations and transfer of tacit knowledge

Source: Compiled from M. Alavi, T. R. Kayworth, and D. E. Leidner, "An Empirical Examination of the Influence of Organizational Culture on Knowledge Management Practices," *Journal of Management Information Systems,* Vol. 22, No. 3, 2006, pp. 191–224.

The Process Approach to Knowledge Management

The **process approach** to knowledge management attempts to codify organizational knowledge through formalized controls, processes, and technologies (see Hansen et al., 1999). Organizations that adopt the process approach may implement explicit policies governing how knowledge is to be collected, stored, and disseminated throughout the organization. The process approach frequently involves the use of IT, such as intranets, data warehousing, knowledge repositories, decision support tools, and groupware to enhance the quality and speed of knowledge creation and distribution in the organization. The main criticisms of the process approach are that it fails to capture much of the tacit knowledge embedded in firms and it forces individuals into fixed patterns of thinking (see Kiaraka and Manning, 2005). This approach is favored by firms that sell relatively standardized products that fill common needs. Most of the valuable knowledge in these firms is fairly explicit because of the standardized nature of the products and services. For example, a kazoo manufacturer has minimal product changes or service needs over the years, and yet there is steady demand and a need to produce the item. In these cases, the knowledge may be typically static in nature.

The Practice Approach to Knowledge Management

In contrast to the process approach, the **practice approach** to knowledge management assumes that a great deal of organizational knowledge is tacit in nature and that formal controls, processes, and technologies are not suitable for transmitting this type of understanding. Rather than build formal systems to manage knowledge, the focus of this approach is to build the social environments or communities of practice necessary

to facilitate the sharing of tacit understanding (see Hansen et al., 1999; Leidner et al., 2006; and Wenger and Snyder, 2000). These communities are informal social groups that meet regularly to share ideas, insights, and best practices. This approach is typically adopted by companies that provide highly customized solutions to unique problems. For these firms, knowledge is shared mostly through person-to-person contact. Collaborative computing methods (e.g., group support systems [GSS], e-mail) help people communicate. The valuable knowledge for these firms is tacit in nature, which is difficult to express, capture, and manage. In this case, the environment and the nature of the problems being encountered are extremely dynamic. Because tacit knowledge is difficult to extract, store, and manage, the explicit knowledge that points to how to find the appropriate tacit knowledge (i.e., people contacts, consulting reports) is made available to an appropriate set of individuals who might need it. Consulting firms generally fall into this category. Firms adopting the codification strategy implicitly adopt the network storage model in their initial KMS (see Alavi, 2000).

## Hybrid Approaches to Knowledge Management

Many organizations use a hybrid of the process and practice approaches. Early in the development process, when it may not be clear how to extract tacit knowledge from its sources, the practice approach is used so that a repository stores only explicit knowledge that is relatively easy to document. The tacit knowledge initially stored in the repository is contact information about experts and their areas of expertise. Such information is listed so that people in the organization can find sources of expertise (e.g., the process approach). From this start, best practices can eventually be captured and managed so that the **knowledge repository** will contain an increasing amount of tacit knowledge over time. Eventually, a true process approach may be attained. But if the environment changes rapidly, only some of the best practices will prove useful. Regardless of the type of KMS developed, a storage location for the knowledge (i.e., a knowledge repository) of some kind is needed.

Certain highly skilled, research-oriented industries exhibit traits that require nearly equal efforts with both approaches. For example, Koenig (2001) argued that the pharmaceutical firms in which he has worked require about a 50/50 split. We suspect that industries that require both a lot of engineering effort (i.e., how to create products) and heavy-duty research effort (where a large percentage of research is unusable) would fit the 50/50 hybrid category. Ultimately, any knowledge that is stored in a knowledge repository must be reevaluated; otherwise, the repository will become a knowledge landfill.

Knowledge Repositories

A knowledge repository is neither a database nor a knowledge base in the strictest sense of the terms. Rather, a knowledge repository stores knowledge that is often text based and has very different characteristics. It is also referred to as an organizational knowledge base. Do not confuse a knowledge repository with the knowledge base of an expert system. They are very different mechanisms: A knowledge base of an expert system contains knowledge for solving a specific problem. An organizational knowledge base contains all the organizational knowledge.

Capturing and storing knowledge are the goals for a knowledge repository. The structure of the repository is highly dependent on the types of knowledge it stores. The repository can range from simply a list of frequently asked (and obscure) questions and solutions, to a listing of individuals with their expertise and contact information, to detailed best practices for a large organization. Figure 12.4 shows a comprehensive KM architecture designed around an all-inclusive knowledge repository (Delen and
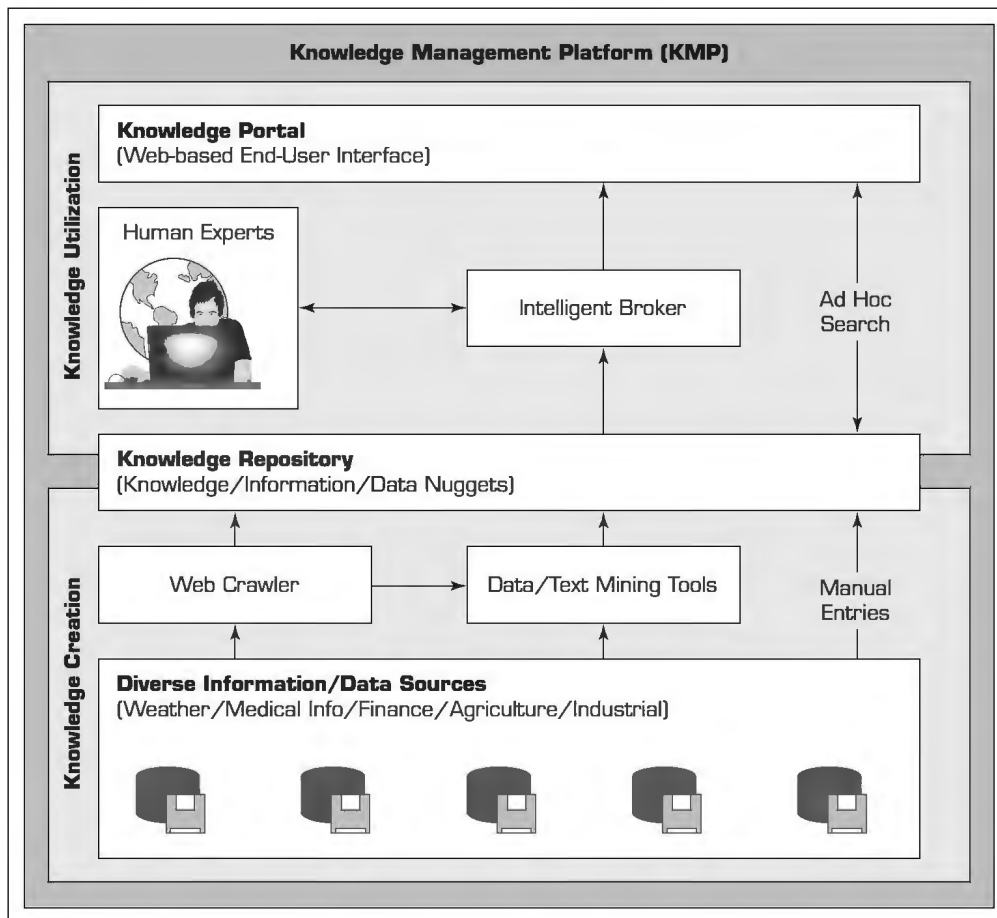
FIGURE 12.4   A Comprehensive View of a Knowledge Repository.   *Source:* D. Delen and S. S. Hawamdeh, "A Holistic Framework for Knowledge Discovery and Management," *Communications of the ACM*, Vol. 52, No. 6, 2009, pp. 141–145.

Hawamdeh, 2009). Most knowledge repositories are developed using several different storage mechanisms, depending on the types and amount of knowledge to be maintained and used. Each has strengths and weaknesses when used for different purposes within a KMS. Developing a knowledge repository is not an easy task. The most important aspects and difficult issues are making the contribution of knowledge relatively easy for the contributor and determining a good method for cataloging the knowledge. The users should not be involved in running the storage and retrieval mechanisms of the knowledge repository. Typical development approaches include developing a large-scale Internet-based system or purchasing a formal electronic document management system or a knowledge management suite. The structure and development of the knowledge repository are a function of the specific technology used for the KMS.

SECTION 12.3 REVIEW QUESTIONS

1. Describe the process approach to knowledge management.
2. Describe the practice approach to knowledge management.
3. Why is a hybrid approach to KM desirable?
4. Define *knowledge repository* and describe how to create one.

12.4 INFORMATION TECHNOLOGY (IT) IN KNOWLEDGE MANAGEMENT

The two primary functions of IT in knowledge management are retrieval and communication. IT also extends the reach and range of knowledge use and enhances the speed of knowledge transfer. Networks facilitate collaboration in KM.

The KMS Cycle

A functioning KMS follows six steps in a cycle (see Figure 12.5). The reason for the cycle is that knowledge is dynamically refined over time. The knowledge in a good KMS is never finished because the environment changes over time, and the knowledge must be updated to reflect the changes. The cycle works as follows:

1. *Create knowledge.* Knowledge is created as people determine new ways of doing things or develop know-how. Sometimes external knowledge is brought in. Some of these new ways may become best practices.
2. *Capture knowledge.* New knowledge must be identified as valuable and be represented in a reasonable way.
3. *Refine knowledge.* New knowledge must be placed in context so that it is actionable. This is where human insights (i.e., tacit qualities) must be captured along with explicit facts.
4. *Store knowledge.* Useful knowledge must be stored in a reasonable format in a knowledge repository so that others in the organization can access it.
5. *Manage knowledge.* Like a library, a repository must be kept current. It must be reviewed to verify that it is relevant and accurate.
6. *Disseminate knowledge.* Knowledge must be made available in a useful format to anyone in the organization who needs it, anywhere and anytime.
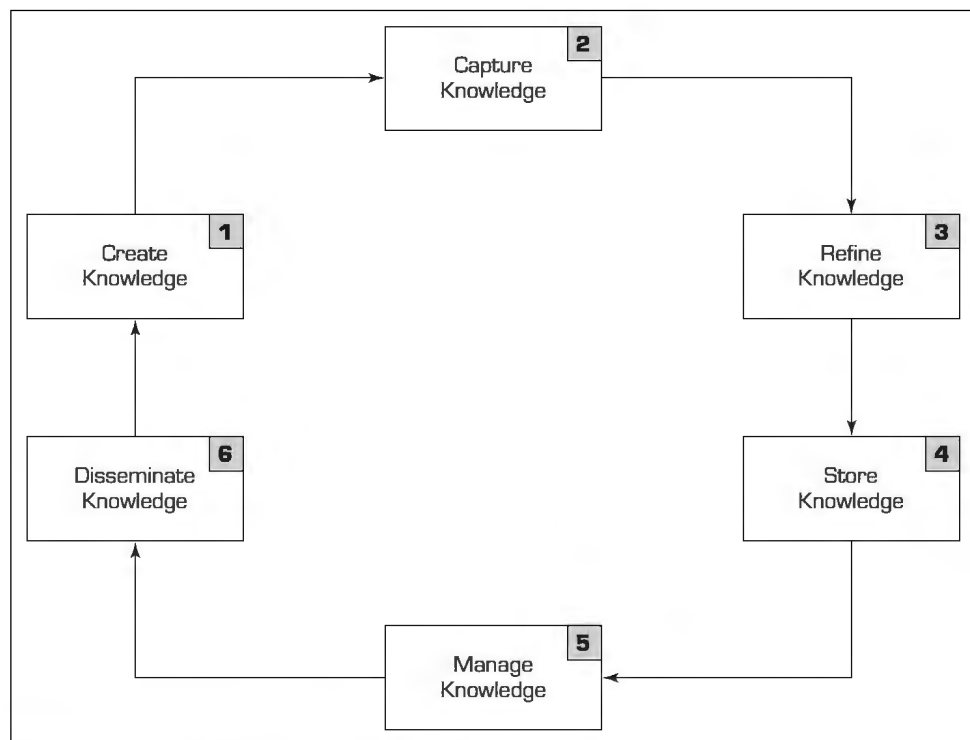

FIGURE 12.5   The Knowledge Management Cycle.

Components of KMS

Knowledge management is more a methodology applied to business practices than a technology or a product. Nevertheless, IT is crucial to the success of every KMS. IT enables knowledge management by providing the enterprise architecture on which it is built. KMS are developed using three sets of technologies: communication, collaboration, and storage and retrieval.

Communication technologies allow users to access needed knowledge and to communicate with each other—especially with experts. E-mail, the Internet, corporate intranets, and other Web-based tools provide communication capabilities. Even fax machines and telephones are used for communication, especially when the practice approach to knowledge management is adopted.

Collaboration technologies (next several sections) provide the means to perform groupwork. Groups can work together on common documents at the same time (i.e., synchronous) or at different times (i.e., asynchronous); they can work in the same place or in different places. Collaboration technologies are especially important for members of a **community of practice** working on knowledge contributions. Other collaborative computing capabilities, such as electronic brainstorming, enhance group-work, especially for knowledge contribution. Additional forms of groupwork involve experts working with individuals trying to apply their knowledge; this requires collaboration at a fairly high level. Other collaborative computing systems allow an organization to create a virtual space so that individuals can work online anywhere and at any time (see Van de Van, 2005).

Storage and retrieval technologies originally meant using a database management system (DBMS) to store and manage knowledge. This worked reasonably well in the early days for storing and managing most explicit knowledge—and even explicit knowledge about tacit knowledge. However, capturing, storing, and managing tacit knowledge usually requires a different set of tools. Electronic document management systems and specialized storage systems that are part of collaborative computing systems fill this void. These storage systems have come to be known as knowledge repositories.

We describe the relationship between these knowledge management technologies and the Web in Table 12.3.

Technologies That Support Knowledge Management

Several technologies have contributed to significant advances in knowledge management tools. Artificial intelligence, intelligent agents, knowledge discovery in databases, eXtensible Markup Language (XML), and Web 2.0 are examples of technologies that enable advanced functionality of modern KMS and form the basis for future innovations in the knowledge management field. Following is a brief description of how these technologies are used in support of KMS.

ARTIFICIAL INTELLIGENCE In the definition of knowledge management, artificial intelligence (AI) is rarely mentioned. However, practically speaking, AI methods and tools are embedded in a number of KMS, either by vendors or by system developers. AI methods can assist in identifying expertise, eliciting knowledge automatically and semiautomatically, interfacing through natural language processing, and intelligently searching through intelligent agents. AI methods—notably expert systems, neural networks, fuzzy logic, and intelligent agents—are used in KMS to do the following:

- Assist in and enhance searching knowledge (e.g., intelligent agents in Web searches)
- Help establish knowledge profiles of individuals and groups

TABLE 12.3 Knowledge Management Technologies and Web Impacts

Knowledge Management	Web Impacts	Impacts on the Web
Communication	Consistent, friendly graphical user interface (GUI) for client units Improved communication tools Convenient, fast access to knowledge and knowledgeable individuals Direct access to knowledge on servers	Knowledge captured and shared is used in improving communication, communication management, and communication technologies.
Collaboration	Improved collaboration tools Enables anywhere/anytime collaboration Enables collaboration between companies, customers, and vendors Enables document sharing Improved, fast collaboration and links to knowledge sources Makes audio- and videoconferencing a reality, especially for individuals not using a local area network	Knowledge captured and shared is used in improving collaboration, collaboration management, and collaboration technologies (i.e., SharePoint, wiki, GSS).
Storage and retrieval	Consistent, friendly GUI for clients Servers provide for efficient and effective storage and retrieval of knowledge	Knowledge captured and shared is utilized in improving data storage and retrieval systems, database management/ knowledge repository management, and database and knowledge repository technologies.

- Help determine the relative importance of knowledge when it is contributed to and accessed from the knowledge repository
- Scan e-mail, documents, and databases to perform knowledge discovery, determine meaningful relationships, glean knowledge, or induce rules for expert systems
- Identify patterns in data (usually through neural networks)
- Forecast future results by using existing knowledge
- Provide advice directly from knowledge by using neural networks or expert systems
- Provide a natural language or voice command–driven user interface for a KMS

WEB 2.0 The Web has evolved from a tool for disseminating information and conducting business to a platform for facilitating new ways of information sharing, collaboration, and communication in the digital age. A new vocabulary has emerged, as mashups, social networks, media-sharing sites, RSS, blogs, and wikis have come to

characterize the genre of interactive applications collectively known as Web 2.0. These technologies have given knowledge management a strong boost by making it easy and natural for everyone to share knowledge. In some ways this has occurred to the point of perhaps making the term *knowledge management* almost redundant. Indeed, Davenport (2008) characterized Web 2.0 (and its reflection to the enterprise world, Enterprise 2.0) as "new, new knowledge management." One of the bottlenecks for knowledge management practices has been the difficulty for nontechnical people to natively share their knowledge. Therefore, the ultimate value of Web 2.0 is its ability to foster greater responsiveness, better knowledge capture and sharing, and ultimately, more effective collective intelligence.

SECTION 12.4 REVIEW QUESTIONS

1. Describe the KMS cycle.
2. List and describe the components of KMS.
3. Describe how AI and intelligent agents support knowledge management.
4. Relate Web 2.0 to knowledge management

Web 2.0 also engenders collaborative inputs. Whether these collaborations are for knowledge management activities or other organizational decision making, the overall principles are the same. We study some basic collaborative mechanisms and systems in the next several sections.

12.5 MAKING DECISIONS IN GROUPS: CHARACTERISTICS, PROCESS, BENEFITS, AND DYSFUNCTIONS

Managers and other knowledge workers continuously make decisions, design and manufacture products, develop policies and strategies, create software systems, and so on. When people work in groups (i.e., teams), they perform groupwork (i.e., teamwork). **Groupwork** refers to work done by two or more people together.

Characteristics of Groupwork

The following are some of the functions and characteristics of groupwork:

- A group performs a task (sometimes decision making, sometimes not).
- Group members may be located in different places.
- Group members may work at different times.
- Group members may work for the same organization or for different organizations.
- A group can be permanent or temporary.
- A group can be at one managerial level or span several levels.
- It can create synergy (leading to process and task gains) or conflict.
- It can generate productivity gains and/or losses.
- The task may have to be accomplished very quickly.
- It may be impossible or too expensive for all the team members to meet in one place, especially when the group is called for emergency purposes.
- Some of the needed data, information, or knowledge may be located in many sources, some of which may be external to the organization.
- The expertise of no team members may be needed.
- Groups perform many tasks; however, groups of managers and analysts frequently concentrate on decision making.
- The decisions made by a group are easier to implement if supported by all (or at least most) members.

The Group Decision-Making Process

Even in hierarchical organizations, decision making is usually a shared process. A group may be involved in a decision or in a decision-related task, such as creating a short list of acceptable alternatives or choosing criteria for evaluating alternatives and prioritizing them. The following activities and processes characterize meetings:

- The decision situation is important, so it is advisable to make it in a group in a meeting.
- A meeting is a joint activity engaged in by a group of people typically of equal or nearly equal status.
- The outcome of a meeting depends partly on the knowledge, opinions, and judgments of its participants and the support they give to the outcome.
- The outcome of a meeting depends on the composition of the group and on the decision-making process the group uses.
- Differences in opinions are settled either by the ranking person present or, often, through negotiation or arbitration.
- The members of a group can be in one place, meeting face-to-face, or they can be a **virtual team**, in which case they are in different places while in a meeting.
- The process of group decision making can create benefits as well as dysfunctions.

The Benefits and Limitations of Groupwork

Some people endure meetings (the most common form of groupwork) as a necessity; others find them to be a waste of time. Many things can go wrong in a meeting. Participants may not clearly understand their goals, they may lack focus, or they may have hidden agendas. Many participants may be afraid to speak up, while a few may dominate the discussion. Misunderstandings occur through different interpretations of language, gesture, or expression. Table 12.4 provides a comprehensive list of factors that can hinder the effectiveness of a meeting (Nunamaker, 1997). Besides being challenging, teamwork is also expensive. A meeting of several managers or executives may cost thousands of dollars per hour in salary costs alone.

Groupwork may have both potential benefits (process gains) and potential drawbacks (process losses). **Process gains** are the benefits of working in groups. The unfortunate dysfunctions that may occur when people work in groups are called **process losses**. Examples of each are listed in Technology Insights 12.1.

TABLE 12.4   Difficulties Associated with Groupwork

• Waiting to speak	• Wrong composition of people
• Dominating the discussion	• Groupthink
• Fear of speaking	• Poor grasp of problem
• Fear of being misunderstood	• Ignored alternatives
• Inattention	• Lack of consensus
• Lack of focus	• Poor planning
• Inadequate criteria	• Hidden agendas
• Premature decisions	• Conflicts of interest
• Missing information	• Inadequate resources
• Distractions	• Poorly defined goals
• Digressions	

TECHNOLOGY INSIGHTS 12.1 Benefits of Working in Groups and Dysfunctions of the Group Process

Benefits of Working in Groups (Process Gains)	Dysfunctions of the Group Process (Process Losses)
• It provides learning. Groups are better than individuals at understanding problems.	• Social pressures of conformity may result in **groupthink** (i.e., people begin to think alike and do not tolerate new ideas; they yield to *conformance pressure*).
• People readily take ownership of problems and their solutions. They take responsibility.	• It is a time-consuming, slow process (i.e., only one member can speak at a time).
• Group members have their egos embedded in the decision, so they are committed to the solution.	• There can be lack of coordination of the meeting and poor meeting planning.
• Groups are better than individuals at catching errors.	• Inappropriate influences (e.g., domination of time, topic, or opinion by one or few individuals; fear of contributing because of the possibility of *flaming*).
• A group has more *information* (i.e., knowledge) than any one member. Group members can combine their knowledge to create new knowledge. More and more creative alternatives for problem solving can be generated, and better solutions can be derived (e.g., through *stimulation*).	• There can be a tendency for group members to either dominate the agenda or rely on others to do most of the work (free-riding).
• A group may produce *synergy* during problem solving. The effectiveness and/ or quality of groupwork can be greater than the sum of what is produced by independent individuals.	• Some members may be afraid to speak up.
• Working in a group may stimulate the creativity of the participants and the process.	• There can be a tendency to produce compromised solutions of poor quality.
• A group may have better and more precise communication working together.	• There is often nonproductive time (e.g., socializing, preparing, waiting for latecomers; i.e., *air-time fragmentation*).
• Risk propensity is balanced. Groups moderate high-risk takers and encourage conservatives.	• There can be a tendency to repeat what has already been said (because of failure to remember or process).
	• Meeting costs can be high (e.g., travel, participation time spent).
	• There can be incomplete or inappropriate use of information.
	• There can be too much information (i.e., information overload).
	• There can be incomplete or incorrect task analysis.

(Continued)

Benefits of Working in Groups (Process Gains)	Dysfunctions of the Group Process (Process Losses)
	• There can be inappropriate or incomplete representation in the group.
	• There can be attention blocking.
	• There can be concentration blocking.

SECTION 12.5 REVIEW QUESTIONS

1. Define *groupwork*.
2. List five characteristics of groupwork.
3. Describe the process of a group meeting for decision making.

12.6 SUPPORTING GROUPWORK WITH COMPUTERIZED SYSTEMS

When people work in teams, especially when the members are in different locations and may be working at different times, they need to communicate, collaborate, and access a diverse set of information sources in multiple formats. This makes meetings, especially virtual ones, complex, with a greater chance for process losses. It is important to follow a certain process for conducting meetings.

Groupwork may require different levels of coordination (Nunamaker, 1997). Sometimes a group may operate at the individual work level, with members making individual efforts that require no coordination. As with a team of sprinters representing a country participating in a 100-meter dash, group productivity is simply the best of the individual results. Other times group members may interact at the coordinated work level. At this level, as with a team in a relay race, the work requires careful coordination between otherwise independent individual efforts. Sometimes a team may operate at the concerted work level. As in a rowing race, teams working at this level must make a continuous concerted effort to be successful. Different mechanisms support groupwork at different levels of coordination.

It is almost trite to say that all organizations, small and large, are using some computer-based communication and collaboration methods and tools to support people working in teams or groups. From e-mails to mobile phones and SMS as well as conferencing technologies, such tools are an indispensable part of one's work life today. We next highlight some related technologies and applications.

An Overview of Group Support Systems (GSS)

For groups to collaborate effectively, appropriate communication methods and technologies are needed. The Internet and its derivatives (i.e., intranets and extranets) are the infrastructures on which much communication for collaboration occurs. The Web supports intra- and interorganizational collaborative decision making through collaboration tools and access to data, information, and knowledge from inside and outside the organization.

Intra-organizational networked decision support can be effectively supported by an intranet. People within an organization can work with Internet tools and procedures through enterprise information portals. Specific applications can include important internal documents and procedures, corporate address lists, e-mail, tool access, and software distribution.

An *extranet* links people in different organizations. For example, **covisint.com** focuses on providing such collaborative mechanisms in diverse industries such as manufacturing, healthcare, and energy. Other extranets are used to link teams together

to design products when several different suppliers must collaborate on design and manufacturing techniques.

Computers have been used for several decades to facilitate groupwork and group decision making. Lately, collaborative tools have received even greater attention due to their increased capabilities and ability to save money (e.g., on travel cost) as well as their ability to expedite decision making. Such computerized tools are called groupware.

Groupware

Many computerized tools have been developed to provide group support. These tools are called **groupware** because their primary objective is to support groupwork. Groupware tools can support decision making directly or indirectly, and they are described in the remainder of this chapter. For example, generating creative solutions to problems is a direct support. Some e-mail programs, chat rooms, instant messaging (IM), and teleconferencing provide indirect support.

Groupware provides a mechanism for team members to share opinions, data, information, knowledge, and other resources. Different computing technologies support groupwork in different ways, depending on the purpose of the group, the task, and the time/place category in which the work occurs.

Time/Place Framework

The effectiveness of a collaborative computing technology depends on the location of the group members and on the time that shared information is sent and received. DeSanctis and Gallupe (1987) proposed a framework for classifying IT communication support technologies. In this framework, communication is divided into four cells, which are shown together with representative computerized support technologies in Figure 12.6. The four cells are organized along two dimensions—time and place.

When information is sent and received almost simultaneously, the communication is **synchronous (real time)**. Telephones, IM, and face-to-face meetings are examples of synchronous communication. **Asynchronous** communication occurs when the receiver
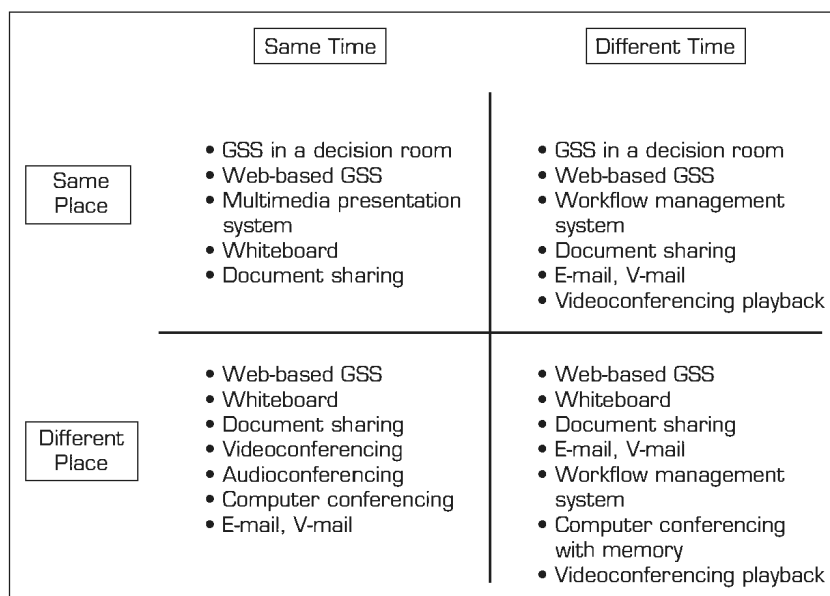
	Same Time	Different Time
Same Place	• GSS in a decision room • Web-based GSS • Multimedia presentation system • Whiteboard • Document sharing	• GSS in a decision room • Web-based GSS • Workflow management system • Document sharing • E-mail, V-mail • Videoconferencing playback
Different Place	• Web-based GSS • Whiteboard • Document sharing • Videoconferencing • Audioconferencing • Computer conferencing • E-mail, V-mail	• Web-based GSS • Whiteboard • Document sharing • E-mail, V-mail • Workflow management system • Computer conferencing with memory • Videoconferencing playback

FIGURE 12.6   The Time/Place Framework for Groupwork.

gets the information at a different time than it was sent, such as in e-mail. The senders and the receivers can be in the same room or in different places.

As shown in Figure 12.6, time and place combinations can be viewed as a four-cell matrix, or framework. The four cells of the framework are as follows:

- *Same time/same place.* Participants meet face-to-face in one place at the same time, as in a traditional meeting or decision room. This is still an important way to meet, even when Web-based support is used, because it is sometimes critical for participants to leave the office to eliminate distractions.
- *Same time/different place.* Participants are in different places, but they communicate at the same time (e.g., with videoconferencing).
- *Different time/same place.* People work in shifts. One shift leaves information for the next shift.
- *Different time/different place (any time, any place).* Participants are in different places, and they also send and receive information at different times. This occurs when team members are traveling, have conflicting schedules, or work in different time zones.

Groups and groupwork (also known as *teams* and *teamwork*) in organizations are proliferating. Consequently, groupware continues to evolve to support effective groupwork, mostly for communication and collaboration.

SECTION 12.6 REVIEW QUESTIONS

1. Why do companies use computers to support groupwork?
2. Describe the components of the time/place framework.

12.7 TOOLS FOR INDIRECT SUPPORT OF DECISION MAKING

A large number of tools and methodologies are available to facilitate e-collaboration, communication, and decision support. The following sections present the major tools that support decision making indirectly.

Groupware Tools

Groupware products provide a way for groups to share resources and opinions. Groupware implies the use of networks to connect people, even if they are in the same room. Many groupware products are available on the Internet or an intranet to enhance the collaboration of a large number of people. The features of groupware products that support commutation, collaboration, and coordination are listed in Table 12.5. What follows are brief definitions of some of those features.

SYNCHRONOUS VERSUS ASYNCHRONOUS PRODUCTS Notice that the features in Table 12.5 may be synchronous, meaning that communication and collaboration are done in real time, or asynchronous, meaning that communication and collaboration are done by the participants at different times. Web conferencing and IM as well as Voice over IP (VoIP) are associated with synchronous mode. Methods that are associated with asynchronous modes include e-mail, wikilogs, and online workspaces, where participants can collaborate, for example, on joint designs or projects, but work at different times. Google Drive (**drive.google.com**) and Microsoft SharePoint (**http://office.microsoft. com/en-us/SharePoint/collaboration-software-SharePoint-FX103479517.aspx**) allow users to set up online workspaces for storing, sharing, and collaboratively working on different types of documents.

TABLE 12.5	**Groupware Products and Features**

General (Can Be Either Synchronous or Asynchronous)

- Built-in e-mail, messaging system
- Browser interface
- Joint Web-page creation
- Sharing of active hyperlinks
- File sharing (graphics, video, audio, or other)
- Built-in search functions (by topic or keyword)
- Workflow tools
- Use of corporate portals for communication, collaboration, and search
- Shared screens
- Electronic decision rooms
- Peer-to-peer networks

Synchronous (Same Time)

- Instant messaging (IM)
- Videoconferencing, multimedia conferencing
- Audioconferencing
- Shared whiteboard, smart whiteboard
- Instant video
- Brainstorming
- Polling (voting), and other decision support (consensus builder, scheduler)

Asynchronous (Different Times)

- Workspaces
- Threaded discussions
- Users can receive/send e-mail, SMS
- Users can receive activity notification alerts via e-mail or SMS
- Users can collapse/expand discussion threads
- Users can sort messages (by date, author, or read/unread)
- Auto responder
- Chat session logs
- Bulletin boards, discussion groups
- Use of blogs, wikis, and wikilogs
- Collaborative planning and/or design tools
- Use of bulletin boards

Companies such as **Dropbox.com** provide an easy way to share documents. Of course, similar systems are evolving for consumer and home use such as photo sharing (e.g., Picasa, Flicker, Facebook).

Groupware products are either stand-alone products that support one task (such as videoconferencing) or integrated kits that include several tools. In general, groupware technology products are fairly inexpensive and can easily be incorporated into existing information systems.

VIRTUAL MEETING SYSTEMS The advancement of Web-based systems opens the door for improved, electronically supported **virtual meetings**, where members are in different locations and even in different countries. For example, online meetings and presentation tools are provided by **webex.com, gotomeeting.com, Adobe.com, Skype.com**, and many others. Microsoft Office also includes a built-in virtual meeting capability. These systems feature Web seminars (popularly called Webinars), screen sharing, audioconferencing, videoconferencing, polling, question–answer sessions, and so on. Even mobile phones now have sufficient interaction capabilities to allow live meetings through applications such as Facetime.

Groupware

Although many of the technologies that enable group decision support are merging in common office productivity software tools such as Microsoft Office, it is instructive to learn about one specific software that illustrates some unique capabilities of groupware. GroupSystems (**groupsystems.com**) MeetingRoom was one of the first comprehensive same time/same place electronic meeting packages. The follow-up product, GroupSystems OnLine, offered similar capabilities, and it ran in asynchronous mode (anytime/anyplace) over the Web (MeetingRoom ran only over a local area network [LAN]). GroupSystems' latest product is ThinkTank, which is a suite of tools that significantly shortens cycle time for brainstorming, strategic planning, product development, problem solving, requirements gathering, risk assessments, team decision makings, and other collaborations. ThinkTank moves face-to-face or virtual teams through customizable processes toward their goals faster and more effectively than its predecessors. ThinkTank offers the following capabilities:

- ThinkTank builds in the discipline of an agenda, efficient participation, workflow, prioritization, and decision analysis.
- ThinkTank's anonymous brainstorming for ideas and comments is an ideal way to capture the participants' creativity and experience.
- ThinkTank Web 2.0's enhanced user interface ensures that participants do not need prior training to join, so they can focus 100 percent on solving problems and making decisions.
- With ThinkTank, all of the knowledge shared by participants is captured and saved in documents and spreadsheets and automatically converted to the meeting minutes and made available to all participants at the end of the session.

Another specialized product is eRoom (now owned by EMC/Documentum at **http://www.emc.com/enterprise-content-management/centerstage.htm**). This comprehensive Web-based suite of tools can support a variety of collaboration scenarios. Yet another product is Team Expert Choice (Comparion), which is an add-on product for Expert Choice (**expertchoice.com**). It has limited decision support capabilities, mainly supporting one-room meetings, but focuses on developing a model and process for decision making using the analytic hierarchy process that was covered in Chapter 9.

Collaborative Workflow

Collaborative workflow refers to software products that address project-oriented and collaborative types of processes. They are administered centrally yet are capable of being accessed and used by workers from different departments and even from different physical locations. The goal of collaborative workflow tools is to empower knowledge workers. The focus of an enterprise solution for collaborative workflow is on allowing workers to communicate, negotiate, and collaborate within an integrated environment. Some leading vendors of collaborative workflow applications are Lotus, EpicData, FileNet, and Action Technologies.

Web 2.0

The term *Web 2.0* refers to what is perceived to be the second generation of Web development and Web design. It is characterized as facilitating communication, information sharing, interoperability, user-centered design, and collaboration on the World Wide Web. It has led to the development and evolution of Web-based communities, hosted services, and novel Web applications. Example Web 2.0 applications include social-networking sites (e.g., LinkedIn, Facebook), video-sharing sites (e.g., YouTube, Flickr, Vimeo), wikis, blogs, mashups, and folksonomies.

Web 2.0 sites typically include the following features/techniques, identified by the acronym SLATES:

- *Search.* The ease of finding information through keyword search.
- *Links.* Ad hoc guides to other relevant information.
- *Authoring.* The ability to create content that is constantly updated by multiple users. In wikis, the content is updated in the sense that users undo and redo each other's work. In blogs, content is updated in that posts and comments of individuals are accumulated over time.
- *Tags.* Categorization of content by creating tags. Tags are simple, one-word, user-determined descriptions to facilitate searching and avoid rigid, premade categories.
- *Extensions.* Powerful algorithms leverage the Web as an application platform as well as a document server.
- *Signals.* RSS technology is used to rapidly notify users of content changes.

Wikis

A **wiki** is a piece of server software available at a Web site that allows users to freely create and edit Web page content through a Web browser. (The term *wiki* means "quick" or "to hasten" in the Hawaiian language; e.g., "Wiki Wiki" is the name of the shuttle bus at Honolulu International Airport.) A wiki supports hyperlinks and has a simple text syntax for creating new pages and cross-links between internal pages on-the-fly. It is especially suited for collaborative writing.

Wikis are unusual among group communication mechanisms in that they allow the organization of the contributions to be edited as well as the content itself. The term *wiki* also refers to the collaborative software that facilitates the operation of a wiki Web site.

A wiki enables documents to be written collectively in a very simple markup, using a Web browser. A single page in a wiki is referred to as a "wiki page," and the entire body of pages, which are usually highly interconnected via hyperlinks, is "the wiki"; in effect, it is a very simple, easy-to-use database. For further details, see **en.wikipedia. org/wiki/Wiki** and **wiki.org**.

Collaborative Networks

Traditionally, collaboration took place among supply chain members, frequently those that were close to each other (e.g., a manufacturer and its distributor, a distributor and a retailer). Even if more partners were involved, the focus was on the optimization of information and product flow between existing nodes in the traditional supply chain. Advanced approaches, such as collaborative planning, forecasting, and replenishment, do not change this basic structure.

Traditional collaboration results in a vertically integrated supply chain. However, Web technologies can fundamentally change the shape of the supply chain, the number of players in it, and their individual roles. In a collaborative network, partners at any point in the network can interact with each other, bypassing traditional partners. Interaction may occur among several manufacturers or distributors, as well as with new players, such as software agents that act as aggregators, business-to-business (B2B) exchanges, or logistics providers.

SECTION 12.7 REVIEW QUESTIONS

1. List the major groupware tools and divide them into synchronous and asynchronous types.
2. Identify specific tools for Web conferencing and their capabilities.
3. Define *wiki* and *wikilog*.
4. Define *collaborative hub*.

12.8 DIRECT COMPUTERIZED SUPPORT FOR DECISION MAKING: FROM GROUP DECISION SUPPORT SYSTEMS TO GROUP SUPPORT SYSTEMS

Decisions are made at many meetings, some of which are called in order to make one specific decision. For example, the federal government meets periodically to decide on the short-term interest rate. Directors may be elected at shareholder meetings, organizations allocate budgets in meetings, a company decides on which candidate to hire, and so on. Although some of these decisions are complex, others can be controversial, as in resource allocation by a city government. Process gains and dysfunctions can be significantly large in such situations; therefore, computerized support has often been suggested to mitigate these complexities. These computer-based support systems have appeared in the literature under different names, including *group decision support systems* (GDSS), *group support systems* (GSS), *computer-supported collaborative work* (CSCW), and *electronic meeting systems* (EMS). These systems are the subject of this section.

Group Decision Support Systems (GDSS)

During the 1980s, researchers realized that computerized support to managerial decision making needed to be expanded to groups because major organizational decisions are made by groups such as executive committees, special task forces, and departments. The result was the creation of group decision support systems (see Powell et al., 2004).

A **group decision support system (GDSS)** is an interactive computer-based system that facilitates the solution of semistructured or unstructured problems by a group of decision makers. The goal of GDSS is to improve the productivity of decision-making meetings by speeding up the decision-making process and/or by improving the quality of the resulting decisions.

The following are the major characteristics of a GDSS:

- Its goal is to support the process of group decision makers by providing automation of subprocesses, using information technology tools.
- It is a specially designed information system, not merely a configuration of already-existing system components. It can be designed to address one type of problem or a variety of group-level organizational decisions.
- It encourages generation of ideas, resolution of conflicts, and freedom of expression. It contains built-in mechanisms that discourage development of negative group behaviors, such as destructive conflict, miscommunication, and groupthink.

The first generation of GDSS was designed to support face-to-face meetings in a decision room. Today, support is provided mostly over the Web to virtual groups. The group can meet at the same time or at different times by using e-mail, sending documents, and reading transaction logs. GDSS is especially useful when controversial decisions have to be made (e.g., resource allocation, determining which individuals to lay off). GDSS applications require a facilitator when done in one room or a coordinator or leader when done using virtual meetings.

GDSS can improve the decision-making process in various ways. For one, GDSS generally provide structure to the planning process, which keeps the group on track, although some applications permit the group to use unstructured techniques and methods for **idea generation**. In addition, GDSS offer rapid and easy access to external and stored information needed for decision making. GDSS also support parallel processing of information and idea generation by participants and allow asynchronous computer discussion. They make possible larger meetings that would otherwise be unmanageable;

having a larger group means that more complete information, knowledge, and skills will be represented in the meeting. Finally, voting can be anonymous, with instant results, and all information that passes through the system can be recorded for future analysis (producing *organizational memory*).

Initially, GDSS were limited to face-to-face meetings. To provide the necessary technology, a special facility (i.e., room) was created. Also, groups usually had a clearly defined, narrow task, such as allocation of scarce resources or prioritization of goals in a long-range plan.

Over time, it became clear that support teams' needs were broader than that supported by GDSS. Furthermore, it became clear that what was really needed was support for virtual teams, both in different place/same time and different place/different time situations. Also, it became clear that teams needed indirect support in most decision-making cases (e.g., help in searching for information or collaboration) rather than direct support for the decision making. Although GDSS expanded to virtual team support, they were unable to meet all the other needs. Thus, a broader term, *GSS*, was created. We use the terms interchangeably in this book.

Group Support Systems

A **group support system (GSS)** is any combination of hardware and software that enhances groupwork either in direct or indirect support of decision making. GSS is a generic term that includes all forms of collaborative computing. GSS evolved after information technology researchers recognized that technology could be developed to support the many activities normally occurring at face-to-face meetings (e.g., idea generation, consensus building, anonymous ranking).

A complete GSS is still considered a specially designed information system, but since the mid-1990s many of the special capabilities of GSS have been embedded in standard productivity tools. For example, Microsoft Office can embed the Lync tool for Web conferences. Most GSS are easy to use because they have a Windows-based graphical user interface (GUI) or a Web browser interface. Most GSS are fairly general and provide support for activities such as idea generation, conflict resolution, and voting. Also, many commercial products have been developed to support only one or two aspects of teamwork (e.g., videoconferencing, idea generation, screen sharing, wikis).

GSS settings range from a group meeting at a single location for solving a specific problem to virtual meetings conducted in multiple locations and held via telecommunication channels for the purpose of addressing a variety of problem types. Continuously adopting new and improved methods, GSS are building up their capabilities to effectively operate in asynchronous as well as synchronous modes.

How GDSS (or GSS) Improve Groupwork

The goal of GSS is to provide support to meeting participants to improve the productivity and effectiveness of meetings by streamlining and speeding up the decision-making process (i.e., efficiency) or by improving the quality of the results (i.e., effectiveness). GSS attempts to increase process and task gains and decrease process and task losses. Overall, GSS have been successful in doing just that (see Holt, 2002); however, some process and task gains may decrease, and some process and task losses may increase. Improvement is achieved by providing support to group members for the generation and exchange of ideas, opinions, and preferences. Specific features such as **parallelism** (i.e., the ability of participants in a group to work simultaneously on a task, such as

brainstorming or voting) and anonymity produce this improvement. The following are some specific GDSS support activities:

*   GDSS support parallel processing of information and idea generation (parallelism).
*   GDSS enable the participation of larger groups with more complete information, knowledge, and skills.
*   GDSS permit the group to use structured or unstructured techniques and methods.
*   GDSS offer rapid, easy access to external information.
*   GDSS allow parallel computer discussions.
*   GDSS help participants frame the big picture.
*   Anonymity allows shy people to contribute to the meeting (i.e., get up and do what needs to be done).
*   Anonymity helps prevent aggressive individuals from driving a meeting.
*   GDSS provide for multiple ways to participate in instant, anonymous voting.
*   GDSS provide structure for the planning process to keep the group on track.
*   GDSS enable several users to interact simultaneously (i.e., conferencing).
*   GDSS record all information presented at a meeting (i.e., **organizational memory**).

For GSS success stories, look for sample cases at vendors' Web sites. As you will see, in many of these cases, collaborative computing led to dramatic process improvements and cost savings.

Facilities for GDSS

There are three options for deploying GDSS/GSS technology: (1) as a special-purpose decision room, (2) as a multiple-use facility, and (3) as Internet- or intranet-based groupware, with clients running wherever the group members are.

DECISION ROOMS The earliest GDSS were installed in expensive, customized, special-purpose facilities called **decision rooms** (or electronic meeting rooms) with PCs and large public screens at the front of each room. The original idea was that only executives and high-level managers would use the facility. The software in a special-purpose electronic meeting room usually runs over a LAN, and these rooms are fairly plush in their furnishings. Electronic meeting rooms can be constructed in different shapes and sizes. A common design includes a room equipped with 12 to 30 networked PCs, usually recessed into the desktop (for better participant viewing). A server PC is attached to a large-screen projection system and connected to the network to display the work at individual workstations and aggregated information from the facilitator's workstation. Breakout rooms equipped with PCs connected to the server, where small subgroups can consult, are sometimes located adjacent to the decision room. The output from the subgroups can also be displayed on the large public screen.

INTERNET-/INTRANET-BASED SYSTEMS Since the late 1990s, the most common approach to GSS facilities has been to use Web- or intranet-based groupware that allows group members to work from any location at any time (e.g., WebEx, GotoMeeting, Adobe Connect, Microsoft Lync, GroupSystems). This groupware often includes audioconferencing and videoconferencing. The availability of relatively inexpensive groupware (for purchase or for subscription), combined with the power and low cost of computers and mobile devices, makes this type of system very attractive.

SECTION 12.8 REVIEW QUESTIONS

1. Define *GDSS* and list the limitations of the initial GDSS software.
2. Define *GSS* and list its benefits.

3. List process gain improvements made by GSS.

4. Define *decision room.*

5. Describe Web-based GSS.

This chapter has served to provide a relatively quick overview of knowledge management and collaborative systems, two movements that were really prominent in the past 20 years but have now been subsumed by other technologies for information sharing and decision making. It helps to see where the roots of many of the technologies today might have come from, although the names may have changed.

Chapter Highlights

- Knowledge is different from information and data. Knowledge is information that is contextual, relevant, and actionable.
- Knowledge is dynamic in nature. It is information in action.
- Tacit (i.e., unstructured, sticky) knowledge is usually in the domain of subjective, cognitive, and experiential learning; explicit (i.e., structured, leaky) knowledge deals with more objective, rational, and technical knowledge, and it is highly personal and difficult to formalize.
- Organizational learning is the development of new knowledge and insights that have the potential to influence behavior.
- The ability of an organization to learn, develop memory, and share knowledge is dependent on its culture. Culture is a pattern of shared basic assumptions.
- Knowledge management is a process that helps organizations identify, select, organize, disseminate, and transfer important information and expertise that typically reside within the organization in an unstructured manner.
- The knowledge management model involves the following cyclical steps: create, capture, refine, store, manage, and disseminate knowledge.
- Two knowledge management approaches are the process approach and the practice approach.
- Standard knowledge management initiatives involve the creation of knowledge bases, active process management, knowledge centers, collaborative technologies, and knowledge webs.
- A KMS is generally developed using three sets of technologies: communication, collaboration, and storage.
- A variety of technologies can make up a KMS, including the Internet, intranets, data warehousing, decision support tools, and groupware. Intranets

are the primary vehicles for displaying and distributing knowledge in organizations.
- People collaborate in their work (called *groupwork*). Groupware (i.e., collaborative computing software) supports groupwork.
- Group members may be in the same organization or may span organizations; they may be in the same location or in different locations; they may work at the same time or at different times.
- The time/place framework is a convenient way to describe the communication and collaboration patterns of groupwork. Different technologies can support different time/place settings.
- Working in groups may result in many benefits, including improved decision making.
- Communication can be synchronous (i.e., same time) or asynchronous (i.e., sent and received in different times).
- Groupware refers to software products that provide collaborative support to groups (including conducting meetings).
- Groupware can support decision making/ problem solving directly or can provide indirect support by improving communication between team members.
- The Internet (Web), intranets, and extranets support decision making through collaboration tools and access to data, information, and knowledge.
- Groupware for direct support such as GDSS typically contains capabilities for electronic brainstorming, electronic conferencing or meeting, group scheduling, calendaring, planning, conflict resolution, model building, videoconferencing, electronic document sharing, stakeholder identification, topic commentator, voting, policy formulation, and enterprise analysis.
- Groupware can support anytime/anyplace groupwork.

- A GSS is any combination of hardware and software that facilitates meetings. Its predecessor, GDSS, provided direct support to decision meetings, usually in a face-to-face setting.
- GDSS attempt to increase process and task gains and reduce process and task losses of groupwork.
- Parallelism and anonymity provide several GDSS gains.

- GDSS may be assessed in terms of the common group activities of information retrieval, information sharing, and information use.
- GDSS can be deployed in an electronic decision room environment, in a multipurpose computer lab, or over the Web.
- Web-based groupware is the norm for anytime/ anyplace collaboration.

Key Terms

asynchronous	groupthink	knowledge management	process approach
community of	groupware	system (KMS)	process gain
practice	groupwork	knowledge repository	process loss
decision room	idea generation	leaky knowledge	synchronous (real-time)
explicit knowledge	knowledge	organizational culture	tacit knowledge
group decision support	knowledge-based	organizational learning	virtual meeting
system (GDSS)	economy	organizational memory	virtual team
group support system	knowledge management	parallelism	wiki
(GSS)	(KM)	practice approach	

Questions for Discussion

1. Why is the term *knowledge* so difficult to define?
2. Describe and relate the different characteristics of knowledge to one another.
3. Explain why it is important to capture and manage knowledge.
4. Compare and contrast tacit knowledge and explicit knowledge.
5. Explain why organizational culture must sometimes change before knowledge management is introduced.
6. How does knowledge management attain its primary objective?
7. How can employees be motivated to contribute to and use KMS?
8. What is the role of a knowledge repository in knowledge management?
9. Explain the importance of communication and collaboration technologies to the processes of knowledge management.

10. List the three top technologies most frequently used for implementing KMS and explain their importance.
11. Explain why it is useful to describe groupwork in terms of the time/place framework.
12. Describe the kinds of support that groupware can provide to decision makers.
13. Explain why most groupware is deployed today over the Web.
14. Explain why meetings can be so inefficient. Given this, explain how effective meetings can be run.
15. Explain how GDSS can increase some of the benefits of collaboration and decision making in groups and eliminate or reduce some of the losses.
16. The original term for group support system (GSS) was group decision support system (GDSS). Why was the word *decision* dropped? Does this make sense? Why or why not?

Exercises

Teradata UNIVERSITY NETWORK (TUN) and Other Hands-on Exercises

1. Make a list of all the knowledge management methods you use during your day (work and personal). Which are the most effective? Which are the least effective? What kinds of work or activities does each knowledge management method enable?

2. Describe how to ride a bicycle, drive a car, or make a peanut butter and jelly sandwich. Now have someone else try to do it based solely on your explanation. How can you best convert this knowledge from tacit to explicit (or can't you)?
3. Examine the top five reasons that firms initiate KMS and investigate why they are important in a modern enterprise.