Unit 5

Managing knowledge for the digital firm

Lesson Structure

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5.0 Objective

After going through this unit you should be able to

- Know about the Knowledge Management in the Organization
- Understand the system and infrastructure for knowledge management
- Learn office and document management system
- Know about Artificial Intelligence and Expert System
- Understand neural networks and fuzzy logic

5.1 Introduction

This chapter examines information system applications specifically designed to help organizations create, capture, distribute, and apply knowledge and information. First, we examine information systems for supporting information and knowledge work. Then we look at the ways that organizations can use artificial intelligence technologies for capturing and storing knowledge and expertise.

5.2 Knowledge Management in the Organization

In an information economy, knowledge-based core competencies—the two or three things that an organization does best—are key organizational assets. Producing unique products or services or producing them at a lower cost than competitors is based on superior knowledge of the production process and superior design. Knowing how to do things effectively and efficiently in ways that other organizations cannot duplicate is a primary source of profit and a factor in production that cannot be purchased in external markets. Some management theorists believe that these knowledge assets are as important for competitive advantage and survival, if not more important, than physical and financial assets.

As knowledge becomes a central productive and strategic asset, organizational success increasingly depends on the firm's ability to produce, gather, store, and disseminate knowledge. With knowledge, firms become more efficient and effective in their use of scarce resources. Without knowledge, firms become less efficient and effective in their use of resources and ultimately fail.

5.3Organizational Learning and Knowledge Management

How do firms obtain knowledge? Like humans, organizations create and gather knowledge through a variety of organizational learning mechanisms. Through trial and error, careful measurement of planned activities, and feedback from customers and the environment in general, organizations create new standard operating procedures and business processes that reflect their experience. This is called "organizational learning." Arguably organizations that can sense and respond to their environments rapidly will survive longer than organizations that have poor learning mechanisms.

Knowledge management increases the ability of the organization to learn from its environment and to incorporate knowledge into its business processes. Knowledge management refers to the set of processes developed in an organization to create, store, transfer, and apply knowledge. Information technology plays an important role in knowledge management as an enabler of business processes aimed at creating, storing, disseminating, and applying knowledge. Developing procedures and routines—business processes—to optimize the creation, flow, learning, protection, and sharing of knowledge in the firm is now a core management responsibility.

Companies cannot take advantage of their knowledge resources if they have inefficient processes for capturing and distributing knowledge, or if they fail to appreciate the value of the knowledge they already possess (Davenport and Prusak, 1998). Some corporations have created explicit knowledge management programs for protecting and distributing knowledge resources that they have identified and for discovering new sources of knowledge. These programs are often headed by a chief knowledge officer (CKO). The chief knowledge officer is a senior executive who is responsible for the firm's knowledge management program. The CKO helps design programs and systems to find new sources of knowledge or to make better use of existing knowledge in organizational and management processes (Flash, 2001; Earl and Scott, 1999).

5.4 Systems and Infrastructure for Knowledge Management

All the major types of information systems described in this text facilitate the flow of information and the management of a firm's knowledge. Earlier chapters described systems that help firms understand and respond to their environments more effectively, notably enterprise and supply chain management systems, external and internal networks, databases, data mining, and communication-based applications. The concept of a "digital firm" refers to a firm with substantial use of information technology to enhance its ability to sense and respond to its environment.

Although all the information systems we have described help an organization sense and respond to its environment, some technologies uniquely and directly address the organizational learning and knowledge management task. Office systems, knowledge work systems (KWS), group

collaboration systems, and artificial intelligence applications are especially useful for knowledge management because they focus on supporting information and knowledge work and on defining and capturing the organization's knowledge base. This knowledge base may include

(1) structured internal knowledge (explicit knowledge), such as product manuals or research reports;

(2) external knowledge of competitors, products, and markets, including competitive intelligence; and

(3) informal internal knowledge, often called tacit knowledge, which resides in the minds of individual employees but has not been formally documented in a structured form

Information systems can promote organizational learning by capturing, codifying, and distributing both explicit and tacit knowledge. Once information has been collected and organized in a system, it can be reused many times. Companies can use information systems to codify their best practices and make knowledge of these practices more widely available to employees. Best practices are the most successful solutions or problem-solving methods that have been developed by a specific organization or industry. In addition to improving existing work practices, the knowledge can be preserved as organizational memory to train future employees or to help them with decision making. Organizational memory is the stored learning from an organization's history that can be used for decision-making and other purposes. Information systems can also provide networks for linking people so that individuals with special areas of expertise can be easily identified and tacit knowledge can be shared.

Office systems help disseminate and coordinate the flow of information in the organization. Knowledge work systems support the activities of highly skilled knowledge workers and professionals as they create new knowledge and try to integrate it into the firm. Group collaboration and support systems support the creation and sharing of knowledge among people working in groups. Artificial intelligence systems capture new knowledge and provide organizations and managers with codified knowledge that can be reused by others in the organization. These systems require an IT infrastructure that makes heavy use of powerful processors, networks, databases, software, and Internet tools.

Knowledge management requires an information technology (IT) infrastructure that facilitates the collection and sharing of knowledge as well as software for distributing information and making it more meaningful. The information systems illustrated here give close-in support to information workers at many levels in the organization.

5.5 Information and Knowledge Work Systems

Information work is work that consists primarily of creating or processing information. It is carried out by information workers who usually are divided into two subcategories: data workers, who primarily process and disseminate information; and knowledge workers, who primarily create knowledge and information.

Examples of data workers include secretaries, sales personnel, bookkeepers, and draftspeople. Researchers, designers, architects, writers, and judges are examples of knowledge workers. Data workers can be distinguished from knowledge workers because knowledge workers usually have higher levels of education and memberships in professional organizations. In addition, knowledge workers exercise independent judgment as a routine aspect of their work. Data and knowledge workers have different information requirements and different systems to support them.

5.5.1Distributing Knowledge: Office and Document Management Systems

Most data work and a great deal of knowledge work take place in offices, including most of the work done by managers. The office plays a major role in coordinating the flow of information throughout the entire organization. The office has three basic functions :

- Managing and coordinating the work of data and knowledge workers.
- Connecting the work of the local information workers with all levels and functions of the organization.
- Connecting the organization to the external world, including customers, suppliers, government regulators, and external auditors.

Office workers span a very broad range: professionals, managers, sales, and clerical workers working alone or in groups. Their major activities include the following:

- Managing documents, including document creation, storage, retrieval, and dissemination.
- Scheduling for individuals and groups.
- Communicating, including initiating, receiving, and managing voice, digital, and document-based communications for individuals and groups.
- Managing data, such as on employees, customers, and vendors.

These activities can be supported by office systems (see Table 5-1). Office systems are any application of information technology that intends to increase productivity of information workers in the office. Fifteen years ago, office systems handled only the creation, processing, and management of documents. Today professional knowledge and information work remains highly document centered. However, digital image processing—words and graphics—is also at

the core of systems, as are high-speed digital communications services. Because office work involves many people jointly engaged in projects, contemporary office systems have powerful group assistance tools such as networked digital calendars. An ideal office environment would be based on a seamless network of digital machines linking professional, clerical, and managerial work groups and running a variety of types of software.

Office Activity	**Technology**
Managing documents	Word processing, desktop publishing, document imaging,Web publishing, work flow managers
Scheduling	Electronic calendars, groupware, intranets
Communicating	E-mail, voice mail, digital answering systems, groupware, intranets
Managing data	Desktop databases, spreadsheets, user-friendly interface to mainframe databases

Table 5-1

Although word processing and desktop publishing address the creation and presentation of documents, they only exacerbate the existing paper avalanche problem. Work flow problems arising from paper handling are enormous. It has been estimated that up to 85 percent of corporate information is stored on paper. Locating and updating information in that format is a great source of organizational inefficiency.

One way to reduce problems stemming from paper work flow is to employ document imaging systems. Document imaging systems are systems that convert documents and images into digital form so they can be stored and accessed by a computer. Such systems store, retrieve, and manipulate a digitized image of a document, allowing the document itself to be discarded. The system must contain a scanner that converts the document image into a bit-mapped image, storing that image as a graphic. If the document is not in active use, it usually is stored on an optical disk system. Optical disks, kept on-line in a jukebox (a device for storing and retrieving many optical disks), require up to a minute to retrieve the document automatically.

5.5.2 Creating Knowledge: Knowledge Work Systems

Knowledge work is that portion of information work that creates new knowledge and information. For example, knowledge workers create new products or find ways to improve existing ones. Knowledge work is segmented into many highly specialized fields, and each field has a different collection of knowledge work systems (KWS) to support workers in that field. Knowledge workers perform three key roles that are critical to the organization and to the managers who work within the organization:

- Keeping the organization up-to-date in knowledge as it develops in the external world—in technology, science, social thought, and the arts.
- Serving as internal consultants regarding the areas of their knowledge, the changes taking place, and the opportunities.
- Acting as change agents evaluating, initiating, and promoting change projects.

Knowledge workers and data workers have somewhat different information systems support needs. Most knowledge workers rely on office systems, such as word processors, voice mail, and calendars, but they also require more specialized knowledge work systems. Knowledge work systems are specifically designed to promote the creation of knowledge and to ensure that new knowledge and technical expertise are properly integrated into the business.

5.5.3 Requirements of Knowledge Work Systems

Knowledge work systems have characteristics that reflect the special needs of knowledge workers. First, knowledge work systems must give knowledge workers the specialized tools they need, such as powerful graphics, analytical tools, and communications and document-management tools. These systems require great computing power in order to handle rapidly the sophisticated graphics or complex calculations necessary to such knowledge workers as scientific researchers, product designers, and financial analysts. Because knowledge workers are so focused on knowledge in the external world, these systems also must give the worker quick and easy access to external databases.

A user-friendly interface is very important to a knowledge worker's system. User-friendly interfaces save time by allowing the user to perform needed tasks and get to required information without having to spend a lot of time learning how to use the computer. Saving time is more important for knowledge workers than for most other employees because knowledge workers are highly paid—wasting a knowledge worker's time is simply too expensive .

Knowledge workstations often are designed and optimized for the specific tasks to be performed, so a design engineer will require a different workstation than a lawyer. Design engineers need graphics with enough power to handle three-dimensional computer-aided design (CAD) systems. However, financial analysts are more interested in having access to

a myriad of external databases and in optical disk technology so they can access massive amounts of financial data very quickly.

Example of Knowledge Work System

Knowledge Work System	Function in Organization
CAD/CAM (Computer-aided design/ computer-aided manufacturing)	Provides engineers, designers, and factory managers with precise control over industrial design and manufacturing
Virtual reality systems	Provide retailers, architects, engineers, and medical workers with precise, photorealistic simulations of objects
Investment workstations	High-end PCs used in financial sector to analyze trading situations instantaneously and facilitate portfolio management

5.6 Artificial Intelligence

Organizations are using artificial intelligence technology to capture individual and collective knowledge and to codify and extend their knowledge base.

What is Artificial Intelligence?

Artificial intelligence (AI) is the effort to develop computer-based systems (both hardware and software) that behave as humans. Such systems would be able to learn natural languages, accomplish coordinated physical tasks (robotics), use a perceptual apparatus that informs their physical behavior and language (visual and oral perception systems), and emulate human expertise and decision making (expert systems). Such systems also would exhibit logic, reasoning, intuition, and the just-plain-common-sense qualities that we associate with human beings. Another important element is intelligent machines, the physical hardware that performs these tasks.

Successful artificial intelligence systems are based on human expertise, knowledge, and selected reasoning patterns, but they do not exhibit the intelligence of human beings. Existing artificial intelligence systems do not come up with new and novel solutions to problems. Existing systems extend the powers of experts but in no way substitute for them or capture much of their intelligence. Briefly, existing systems lack the common sense and generality of naturally intelligent human beings.

Human intelligence is vastly complex and much broader than computer intelligence. A key factor that distinguishes human beings from other animals is their ability to develop associations and to use metaphors and analogies such as like and as. Using metaphor and analogy, humans create new rules, apply old rules to new situations, and, at times, act intuitively and/or instinctively without rules. Much of what we call common sense or generality in humans resides in the ability to create metaphor and analogy.

Human intelligence also includes a unique ability to impose a conceptual apparatus on the surrounding world.

Why Business Is Interested in Artificial Intelligence

Although artificial intelligence applications are much more limited than human intelligence, they are of great interest to business for the following reasons:

- To store information in an active form as organizational memory, creating an organizational knowledge base that many employees can examine and preserving expertise that might be lost when an acknowledged expert leaves the firm.

- To create a mechanism that is not subject to human feelings, such as fatigue and worry. This may be especially useful when jobs may be environmentally, physically, or mentally dangerous to humans. These systems also may be useful advisers in times of crisis.

- To eliminate routine and unsatisfying jobs held by people.

- To enhance the organization's knowledge base by generating solutions to specific problems that are too massive and complex to be analyzed by human beings in a short period of time.

5.7Capturing Knowledge: Expert Systems

In limited areas of expertise, such as diagnosing a car's ignition system or classifying biological specimens, the rules of thumb used by real-world experts can be understood, codified, and placed in a machine. Information systems that solve problems by capturing knowledge for a very specific and limited domain of human expertise are called expert systems. Expert systems capture the knowledge of skilled employees in the form of a set of rules. The set of rules in the expert system adds to the organizational memory, or stored learning of the firm. An expert system can assist decision making by asking relevant questions and explaining the reasons for adopting certain actions.

Expert systems lack the breadth of knowledge and the understanding of fundamental principles of a human expert. They are quite narrow, shallow, and brittle. They typically perform very limited tasks that can be performed by professionals in a few minutes or hours. Problems that cannot be solved by human experts in the same short period of time are far too difficult for an expert system. However, by capturing human expertise in limited areas, expert systems can provide benefits, helping organizations make high-quality decisions with fewer people.

How Expert Systems Work

Human knowledge must be modeled or represented in a way that a computer can process. The model of human knowledge used by expert systems is called the knowledge base. Two ways of representing human knowledge and expertise are rules and knowledge frames.

A standard structured programming construct is the IF–THEN construct, in which a condition is evaluated. If the condition is true, an action is taken. For instance,

IF INCOME >$45,000 (condition)

THEN PRINT NAME AND ADDRESS (action)

A series of these rules can be a knowledge base. Any reader who has written computer programs knows that virtually all traditional computer programs contain IF–THEN statements.

The difference between a traditional program and a rule-based expert system program is one of degree and magnitude. AI programs can easily have 200 to 10,000 rules, far more than traditional programs, which may have 50 to 100 IF–THEN statements .

Knowledge frames can be used to represent knowledge by organizing information into chunks of interrelated characteristics. The relationships are based on shared characteristics rather than a hierarchy. This approach is grounded in the belief that humans use frames, or concepts, to make rapid sense out of perceptions.

For instance, when a person is told, "Look for a tank and shoot when you see one," experts believe that humans invoke a concept, or frame, of what a tank should look like. Anything that does not fit this concept of a tank is ignored. In a similar fashion, AI researchers can organize a vast array of information into frames. The computer then is instructed to search the database of frames and list connections to other frames of interest. The user can follow the pathways pointed to by the system.

The AI shell is the programming environment of an expert system. In the early years of expert systems, computer scientists used specialized artificial intelligence programming languages, such as LISP or Prolog, that could process lists of rules efficiently. Today a growing number of expert systems use AI shells that are user-friendly development environments. AI shells can quickly

generate user-interface screens, capture the knowledge base, and manage the strategies for searching the rule base.

The strategy to search through the rule base is called the inference engine. Two strategies are commonly used: forward chaining and backward chaining

In forward chaining the inference engine begins with the information entered by the user and searches the rule base to arrive at a conclusion. The strategy is to fire, or carry out, the action of the rule when a condition is true. For example beginning on the left, if the user enters a client with income greater than $100,000, the engine will fire all rules in sequence from left to right. If the user then enters information indicating that the same client owns real estate, another pass of the rule base will occur and more rules will fire. Processing continues until no more rules can be fired.

In backward chaining the strategy for searching the rule base starts with a hypothesis and proceeds by asking the user questions about selected facts until the hypothesis is either confirmed or disproved. In our example , ask the question, "Should we add this person to the prospect database?" Begin on the right of the diagram and work toward the left. You can see that the person should be added to the database if a sales representative is sent, term insurance is granted, or a financial advisor visits the client.

5.8 Building an Expert System

Building an expert system is similar to building other information systems, but it is an iterative process with each phase possibly requiring several iterations before a full system is developed. Typically, the environment in which an expert system operates is continually changing so that the expert system must also continually change. Some expert systems, especially large ones, are so complex that in a few years the maintenance costs will equal the development costs.

An AI development team is composed of one or more experts, who have a thorough command of the knowledge base, and one or more knowledge engineers, who can translate the knowledge (as described by the expert) into a set of rules or frames. A knowledge engineer is similar to a traditional systems analyst but has special expertise in eliciting information and expertise from other professionals.

The team members must select a problem appropriate for an expert system. The project will balance potential savings from the proposed system against the cost. The team members will develop a prototype system to test assumptions about how to encode the knowledge of experts. Next, they will develop a full-scale system, focusing mainly on the addition of a very large number of rules. The complexity of the entire system grows with the number of rules, so the comprehensibility of the system may be threatened. Generally, the system will be pruned to achieve simplicity and power. The system is tested by a range of experts within the organization

against the performance criteria established earlier. Once tested, the system will be integrated into the data flow and work patterns of the organization.

5.9Organizational Intelligence: Case-Based Reasoning

Expert systems primarily capture the knowledge of individual experts, but organizations also have collective knowledge and expertise that they have built up over the years. This organizational knowledge can be captured and stored using case-based reasoning. In case-based reasoning (CBR), descriptions of past experiences of human specialists, represented as cases, are stored in a database for later retrieval when the user encounters a new case with similar parameters. The system searches for stored cases with problem characteristics similar to the new one, finds the closest fit, and applies the solutions of the old case to the new case. Successful solutions are tagged to the new case and both are stored together with the other cases in the knowledge base. Unsuccessful solutions also are appended to the case database along with explanations as to why the solutions did not work

5.10 Other Intelligent Techniques

Organizations are using other intelligent computing techniques to extend their knowledge base by providing solutions to problems that are too massive or complex to be handled by people with limited resources. Neural networks, fuzzy logic, genetic algorithms, and intelligent agents are developing into promising business applications.

Neural Networks

There has been an exciting resurgence of interest in bottom-up approaches to artificial intelligence in which machines are designed to imitate the physical thought process of the biological brain. A neural network consists of hardware or software that attempts to emulate the processing patterns of the biological brain.

The Difference Between Neural Networks and Expert Systems

Neural network applications are emerging in medicine, science, and business to address problems in pattern classification, prediction and financial analysis, and control and optimization. Papnet is a neural net-based system that distinguishes between normal and abnormal cells when examining Pap smears for cervical cancer that has far greater accuracy than visual examinations by technicians. The computer is not able to make a final decision, so a technician will review any selected abnormal cells.

Neural networks are being used by the financial industry to discern patterns in vast pools of data that might help investment firms predict the performance of equities, corporate bond ratings, or corporate bankruptcies. VISA International Inc. is using a neural network to help detect credit card fraud by monitoring all VISA transactions for sudden changes in the buying patterns of cardholders.
Unlike expert systems, which typically provide explanations for their solutions, neural networks cannot always explain why they arrived at a particular solution. Moreover, they cannot always guarantee a completely certain solution, arrive at the same solution again with the same input data, or always guarantee the best solution . They are very sensitive and may not perform well if their training covers too little or too much data. In most current applications, neural networks are best used as aids to human decision makers instead of substitutes for them.

Fuzzy Logic

Traditional computer programs require precision: on–off, yes–no, right–wrong. However, we human beings do not experience the world this way. We might all agree that +120 degrees is hot and -40 degrees is cold; but is 75 degrees hot, warm, comfortable, or cool? The answer depends on many factors: the wind, the humidity, the individual experiencing the temperature, one's clothing, and one's expectations. Many of our activities also are inexact. Tractor-trailer drivers would find it nearly impossible to back their rigs into spaces precisely specified to less than an inch on all sides.

Fuzzy logic, a relatively new, rule-based development in AI, tolerates imprecision and even uses it to solve problems we could not have solved before. Fuzzy logic consists of a variety of concepts and techniques for representing and inferring knowledge that is imprecise, uncertain, or unreliable. Fuzzy logic can create rules that use approximate or subjective values and incomplete or ambiguous data.

By expressing logic with some carefully defined imprecision, fuzzy logic is closer to the way people actually think than traditional

IF—THEN rules.

Ford Motor Co. developed a fuzzy logic application that backs a simulated tractor-trailer into a parking space. The application uses the following three rules:

IF the truck is near jackknifing, THEN reduce the steering angle.
IF the truck is far away from the dock, THEN steer toward the dock.
IF the truck is near the dock, THEN point the trailer directly at the dock.

This logic makes sense to us as human beings, for it represents how we think as we back that truck into its berth.

How does the computer make sense of this programming? The answer is relatively simple. The terms (known as membership functions) are imprecisely defined so that, for example, in Figure 10-16, cool is between 50 degrees and 70 degrees, although the temperature is most clearly cool between about 60 degrees and 67 degrees. Note that cool is overlapped by cold or norm. To control the room environment using this logic, the programmer would develop similarly imprecise definitions for humidity and other factors such as outdoor wind and temperature. The rules might include one that says: "If the temperature is cool or cold and the humidity is low while the outdoor wind is high and the outdoor temperature is low, raise the heat and humidity in the room." The computer would combine the membership function readings in a weighted manner and, using all the rules, raise and lower the temperature and humidity

5.11Summary

Leveraging and managing organizational knowledge have become core management responsibilities. Managers need to identify the knowledge assets of their organizations and make sure that appropriate systems and processes are in place to maximize their use.

Systems for knowledge and information work and artificial intelligence can enhance organizational processes in a number of ways. They can facilitate communication, collaboration, and coordination, bring more analytical power to bear in the development of solutions, or reduce the amount of human intervention in organizational processes.

An array of technologies is available to support knowledge management, including artificial intelligence technologies and tools for knowledge and information work and group collaboration. Managers should understand the costs, benefits, and capabilities of each technology and the knowledge management problem for which each is best suited.

5.12 Questions for Exercise

Q1) Define Knowledge Management. Discuss its role in an organization.

Q2) Discuss the infrastructure for Knowledge management.

Q3)Write short notes on

i)Office Management

ii)Document Management

iii)Knowledge Work System

Q4) what do you mean by Artificial Management. Discuss its importance in a system.

Q5) Define Expert System. How it is beneficial in Decision making of an organization.

Q6) Define Organizational Intelligence and discuss some of its techniques.

5.13 Further Readings

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