Chapter 7
Knowledge Management and Specialized Information Systems
Principles and Learning Objectives

• Knowledge management allows organizations to share knowledge and experience among their managers and employees
  – Discuss the differences among data, information, and knowledge
  – Describe the role of the chief knowledge officer (CKO)
  – List some of the tools and techniques used in knowledge management
Principles and Learning Objectives (continued)

• Artificial intelligence systems form a broad and diverse set of systems that can replicate human decision making for certain types of well-defined problems
  – Define the term *artificial intelligence* and state the objective of developing artificial intelligence systems
  – List the characteristics of intelligent behavior and compare the performance of natural and artificial intelligence systems for each of these characteristics
  – Identify the major components of the artificial intelligence field and provide one example of each type of system
Principles and Learning Objectives (continued)

• Expert systems can enable a novice to perform at the level of an expert but must be developed and maintained very carefully
  – List the characteristics and basic components of expert systems
  – Identify at least three factors to consider in evaluating the development of an expert system
  – Outline and briefly explain the steps for developing an expert system
  – Identify the benefits associated with the use of expert systems
Principles and Learning Objectives (continued)

• Virtual reality systems can reshape the interface between people and information technology by offering new ways to communicate information, visualize processes, and express ideas creatively
  – Define the term *virtual reality* and provide three examples of virtual reality applications
Principles and Learning Objectives (continued)

• Specialized systems can help organizations and individuals achieve their goals
  – Discuss examples of specialized systems for organizational and individual use
Knowledge Management Systems

• Data consists of raw facts
• Information is a collection of facts
• Knowledge
  – Awareness and understanding of a set of information and the ways that information can be made useful
• Knowledge management system (KMS)
  – Organized collection of people, procedures, software, databases, and devices
Overview of Knowledge Management Systems

• Explicit knowledge
  – Objective
  – Can be measured and documented in reports, papers, and rules

• Tacit knowledge
  – Hard to measure and document
  – Typically not objective or formalized
Data and Knowledge Management
Workers and Communities of Practice

• Personnel involved in a KMS:
  – **Data workers**: Secretaries, administrative assistants, bookkeepers, other data-entry personnel
  – **Knowledge workers**: People who create, use, and disseminate knowledge

• Communities of practice (COP)
  – Used to create, store, and share knowledge
Obtaining, Storing, Sharing, and Using Knowledge

• Knowledge repository
  – Stores knowledge including documents, reports, files, and databases

• Knowledge workers
  – Use collaborative work software and group support systems to share knowledge

• Knowledge map
  – Points knowledge worker to the needed knowledge
Obtaining, Storing, Sharing, and Using Knowledge (continued)

Knowledge creation → Knowledge storage → Knowledge sharing → Knowledge usage

**Figure 7.3**

Knowledge Management System

Obtaining, storing, sharing, and using knowledge is the key to any KMS.
Technology to Support Knowledge Management

• Tools for capturing and using knowledge:
  – Data mining and business intelligence
  – Enterprise resource planning tools, such as SAP
  – Groupware

• Examples of specific KM products:
  – IBM’s Lotus Notes, Domino
  – Microsoft’s Digital Dashboard, Web Store Technology, Access Workflow Designer
An Overview of Artificial Intelligence

• Artificial intelligence (AI)
  – Computers with the ability to mimic or duplicate the functions of the human brain
Artificial Intelligence in Perspective

• Artificial intelligence systems
  – People, procedures, hardware, software, data, and knowledge needed to develop computer systems and machines that demonstrate characteristics of intelligence
The Nature of Intelligence

• Characteristics of intelligent behavior include the ability to:
  – Learn from experience and apply knowledge acquired from experience
  – Handle complex situations
  – Solve problems when important information is missing
  – Determine what is important
  – React quickly and correctly to a new situation
The Difference Between Natural and Artificial Intelligence

• Experts have disagreed about the difference between natural and artificial intelligence
• Creating machines that can reason
  – Possible only when we truly understand our own processes for doing so
The Difference Between Natural and Artificial Intelligence (continued)

<table>
<thead>
<tr>
<th>Ability to</th>
<th>Natural Intelligence (Human)</th>
<th>Artificial Intelligence (Machine)</th>
</tr>
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<tbody>
<tr>
<td></td>
<td>Low</td>
<td>High</td>
</tr>
<tr>
<td>Use sensors (eyes, ears, touch, smell)</td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td>Be creative and imaginative</td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td>Learn from experience</td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td>Adapt to new situations</td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td>Afford the cost of acquiring intelligence</td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td>Acquire a large amount of external information</td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td>Use a variety of information sources</td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td>Make complex calculations</td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td>Transfer information</td>
<td>✓</td>
<td></td>
</tr>
<tr>
<td>Make a series of calculations rapidly and accurately</td>
<td>✓</td>
<td></td>
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</tbody>
</table>

Table 7.1  
A Comparison of Natural and Artificial Intelligence
The Major Branches of Artificial Intelligence

- AI is a broad field that includes several specialty areas, such as:
  - Expert systems
  - Robotics
  - Vision systems
  - Natural language processing
  - Learning systems
  - Neural networks
The Major Branches of Artificial Intelligence (continued)

- Robotics
- Vision systems
- Learning systems
- Natural language processing
- Expert systems
- Neural networks

Figure 7.5
A Conceptual Model of Artificial Intelligence
Expert Systems

• Hardware and software that stores knowledge and makes inferences, similar to a human expert
Robotics

• Mechanical or computer devices that perform tasks requiring a high degree of precision

• Contemporary robotics
  – Combines high-precision machine capabilities with sophisticated controlling software

• Future robots
  – Will find wider applications in banks, restaurants, homes, doctors’ offices, and hazardous working environments
Vision Systems

• Hardware and software that permit computers to capture, store, and manipulate visual images and pictures
• Used by the U.S. Justice Department to perform fingerprint analysis
• Can be used in identifying people based on facial features
Natural Language Processing and Voice Recognition

- Natural language processing
  - Allows the computer to understand and react to statements and commands made in a “natural” language, such as English

- Voice recognition
  - Converting sound waves into words
Learning Systems

• Combination of software and hardware that:
  – Allows the computer to change how it functions or reacts to situations based on feedback it receives

• Learning systems software
  – Requires feedback on the results of actions or decisions
Neural Networks

• Can simulate the functioning of a human brain
• Can process many pieces of data at the same time and learn to recognize patterns
• Particular skill of neural nets
  – Analyzing detailed trends
Other Artificial Intelligence Applications

• Genetic algorithm
  – An approach to solving large, complex problems in which a number of related operations or models change and evolve until the best one emerges

• Intelligent agent
  – Programs and a knowledge base used to perform a specific task for a person, a process, or another program
An Overview of Expert Systems

• Computerized expert systems
  – Use heuristics, or rules of thumb, to arrive at conclusions or make suggestions

• Knowledge and Information Fusion Exchange (KnIFE) expert system
  – Used by U.S. Army to help soldiers in the field make better military decisions
When to Use Expert Systems

• Develop an expert system if it can:
  – Provide a high potential payoff or significantly reduce downside risk
  – Capture and preserve irreplaceable human expertise
  – Solve a problem that is not easily solved using traditional programming techniques
  – Develop a system more consistent than human experts
Components of Expert Systems

• Knowledge base
  – Stores all relevant information, data, rules, cases, and relationships that the expert system uses

• Tools and techniques used to create a knowledge base:
  – Human experts
  – Fuzzy logic
  – Rules
  – Cases
Components of Expert Systems (continued)

Figure 7.8
Components of an Expert System
The Inference Engine

- Seeks information and relationships from the knowledge base
- Provides answers, predictions, and suggestions the way a human expert would
- Backward chaining
  - Starting with conclusions and working backward to supporting facts
- Forward chaining
  - Starting with facts and working forward to solutions
The Explanation Facility

• Allows a user or decision maker to understand how the expert system arrived at certain conclusions or results
The Knowledge Acquisition Facility

• Provides a convenient and efficient means of capturing and storing the components of the knowledge base

• Knowledge acquisition
  – Can be a manual process or a mixture of manual and automated procedures
The Knowledge Acquisition Facility (continued)

![Diagram of Knowledge Acquisition Facility]

**Figure 7.11**
Knowledge Acquisition Facility

The knowledge acquisition facility acts as an interface between experts and the knowledge base.
The User Interface

• Specialized user interface software
  – Employed for designing, creating, updating, and using expert systems

• Main purpose of the user interface is to:
  – Make an expert system easier for users and decision makers to develop and use
Participants in Developing and Using Expert Systems

- Domain expert
  - Individual or group with the expertise the expert system is trying to capture

- Knowledge engineer
  - Person who has training or experience in the design, development, implementation, and maintenance of an expert system

- Knowledge user
  - Person or group who uses and benefits from the expert system
Participants in Developing and Using Expert Systems (continued)

![Diagram of expert system and participants](image)

- **Domain expert**
- **Knowledge engineer**
- **Knowledge user**

Figure 7.12
Expert Systems Development Tools and Techniques

• Expert systems
  – Can be developed from any programming language

• Expert system shells
  – Collection of software packages and tools used to design, develop, implement, and maintain expert systems
  – Available for both personal computers and mainframe systems
Expert Systems Development Tools and Techniques (continued)

![Diagram showing the development of expert system tools and techniques over time.](image)

**Figure 7.18**
Expert Systems Development
Software for expert systems development has evolved greatly since 1980, from traditional programming languages to expert system shells.
Applications of Expert Systems and Artificial Intelligence

• Credit granting and loan analysis
• Stock picking
• Catching cheats and terrorists
• Hospitals and medical facilities
• Employee performance evaluation
Virtual Reality

• Immersive virtual reality
  – User becomes fully immersed in an artificial, three-dimensional world that is completely generated by a computer

• Virtual reality system
  – Enables one or more users to move and react in a computer-simulated environment
Interface Devices

• Head-mounted display (HMD)
  – Contains a position tracker to monitor the location of user’s head

• CAVE
  – Provides illusion of immersion through projection of stereo images on floors and walls

• Haptic interface
  – Relays sense of touch and other physical sensations
Forms of Virtual Reality

- Mouse-controlled navigation through a three-dimensional environment on a graphics monitor
- Stereo viewing from the monitor via stereo glasses
- Stereo projection systems
- Telepresence systems
Virtual Reality Applications

• Virtual reality can be applied in:
  – Medicine
  – Education and training
  – Business and Commerce
  – Entertainment
Other Specialized Systems

• Segway
  – Now being developed by the military to gather intelligence and transport wounded soldiers to safety

• Game theory
  – Use of information systems to develop competitive strategies for people, organizations, or even countries

• Informatics
  – Combines traditional disciplines, such as science and medicine, with information systems and technology
Summary

• Knowledge management system (KMS)
  – Organized collection of people, procedures, software, databases and devices

• Communities of practice (COP)
  – Group of people dedicated to a common discipline or practice

• Artificial intelligence (AI)
  – Ability of computers to mimic or duplicate the functions of the human brain
Summary (continued)

• Key components of artificial intelligence
  – Expert systems, robotics, vision systems
  – Natural language processing, learning systems,

• Expert system
  – A collection of integrated and related components

• Developing an expert system
  – Determine requirements, identify experts
  – Construct expert system components, implement results, maintaining and review the system
Summary (continued)

- Virtual reality system
  - Enables one or more users to move and react in a computer-simulated environment
  - Can refer to applications that are not fully immersive
- Specialized systems
  - Segway
  - Game theory
  - Informatics