Fundamentals of Information Systems, Fifth Edition

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)

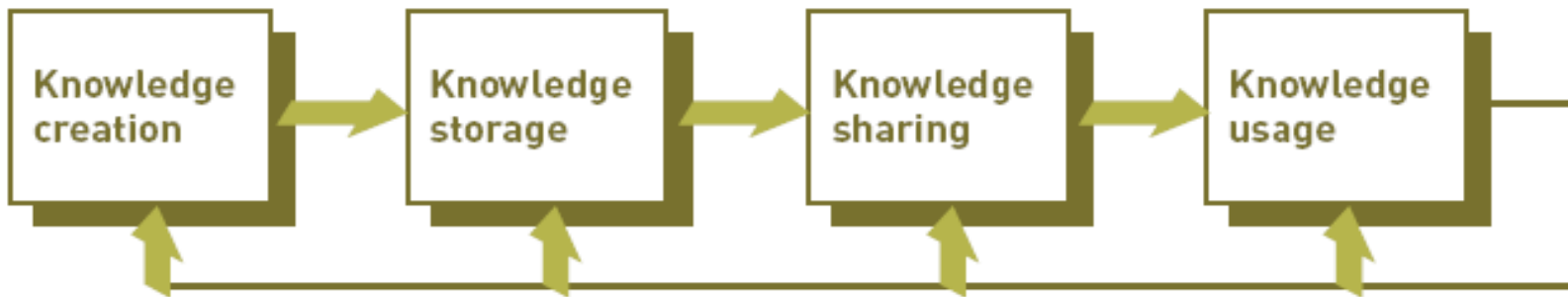| Knowledge creation	→	Knowledge storage	→	Knowledge sharing	→	Knowledge usage

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)

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

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

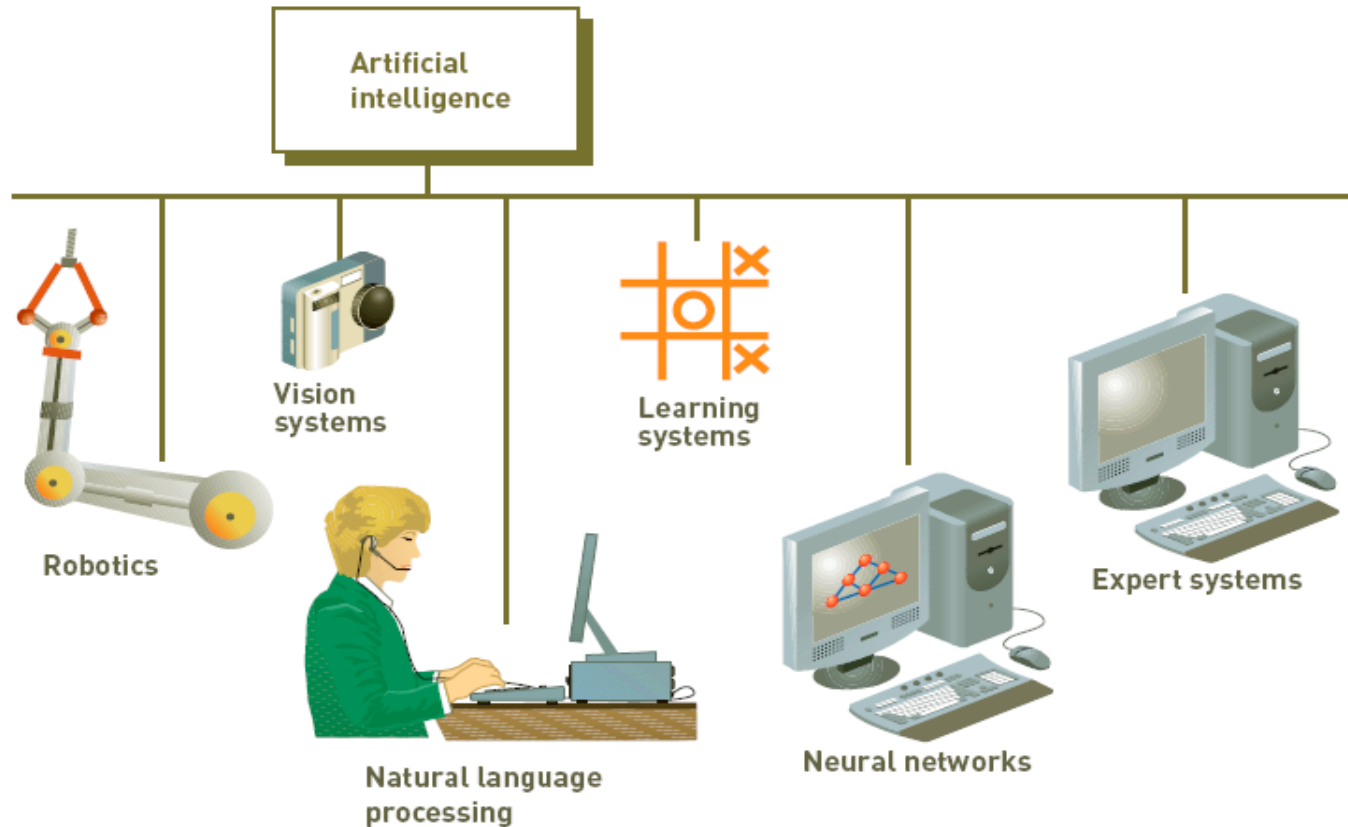# The Major Branches of Artificial Intelligence (continued)

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
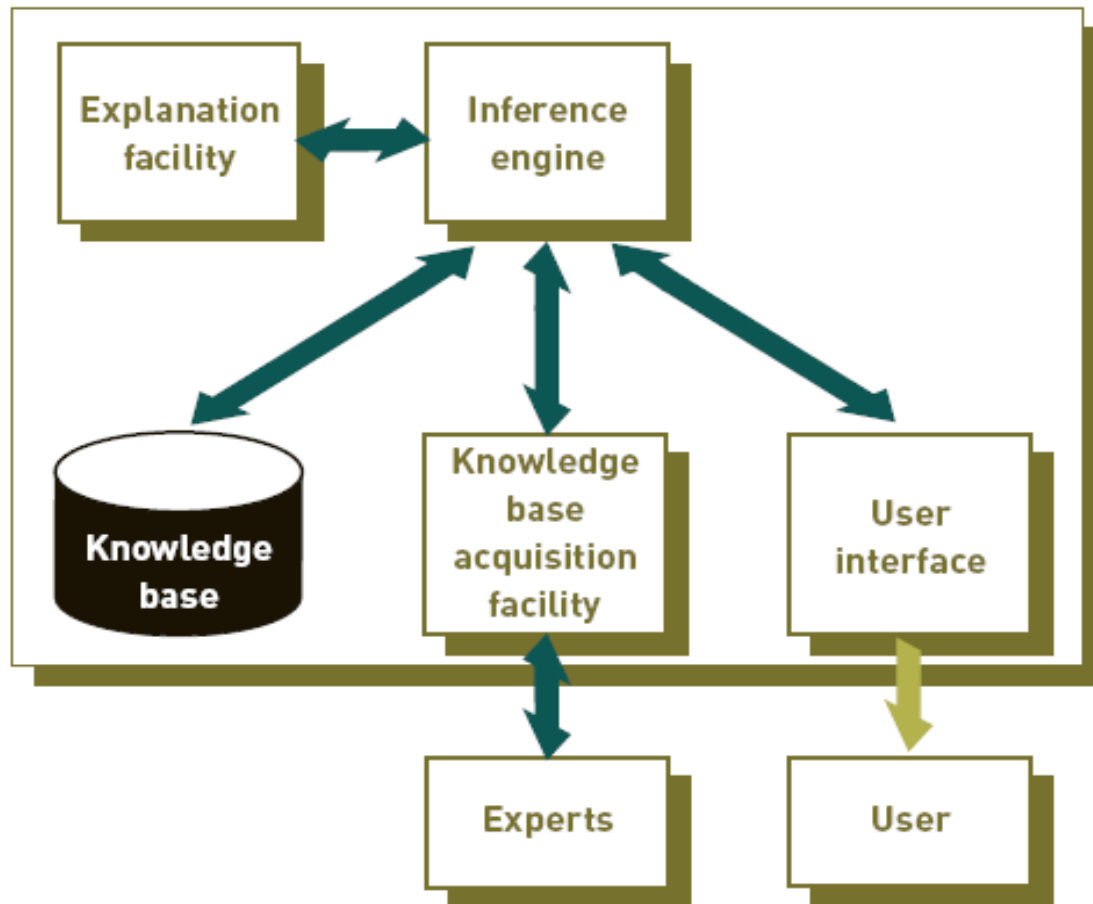
Components of Expert Systems (continued)

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

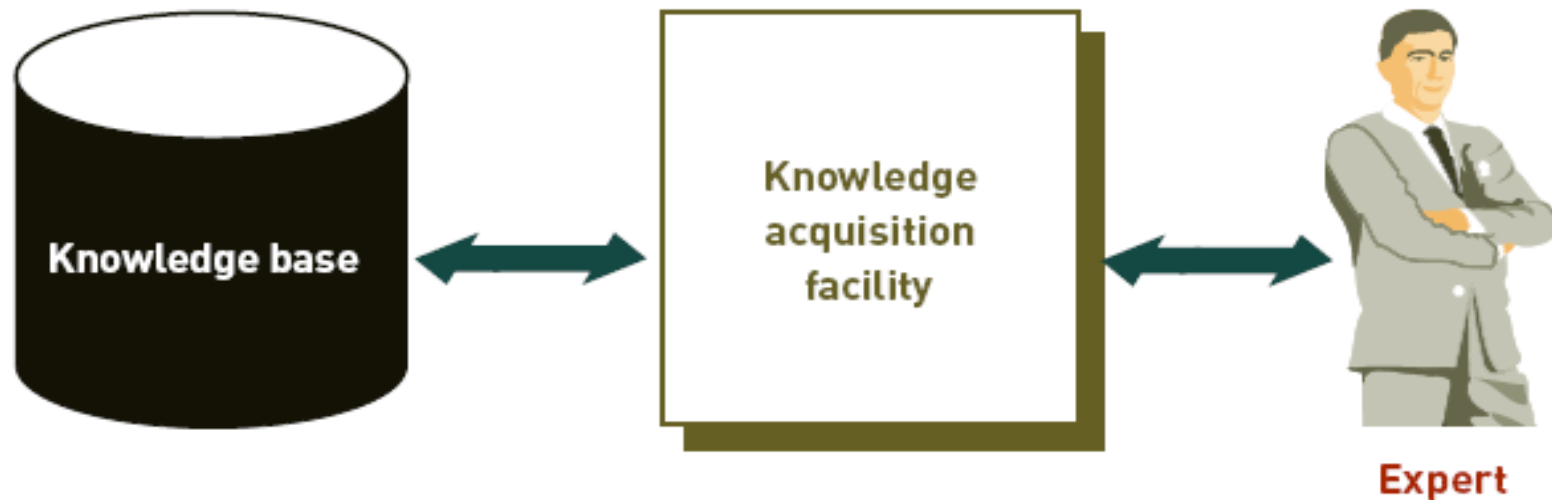# The Knowledge Acquisition Facility (continued)

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

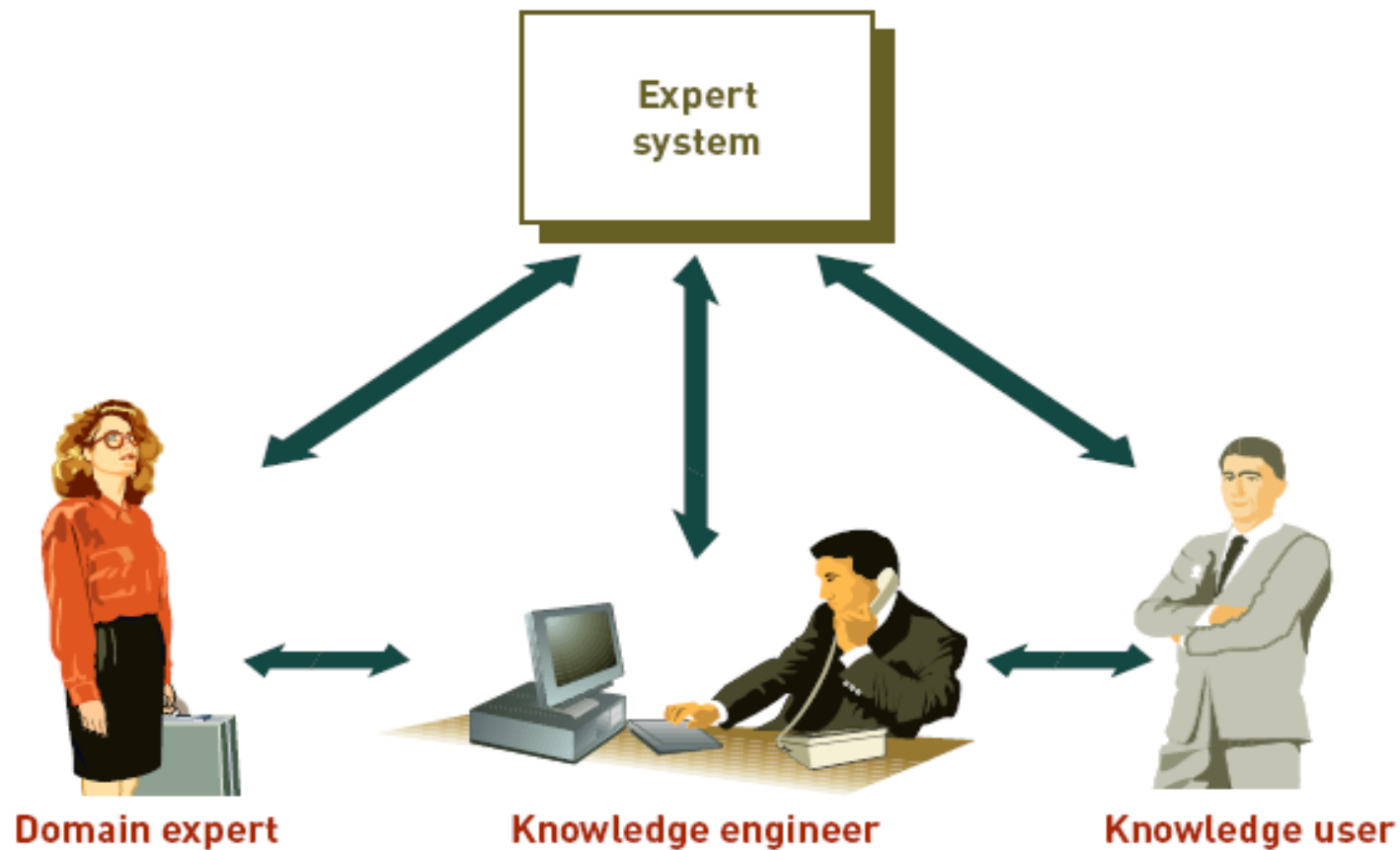# Participants in Developing and Using Expert Systems (continued)

Domain expert   Knowledge engineer   Knowledge user

Figure 7.12

Participants in Expert Systems Development and Use

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

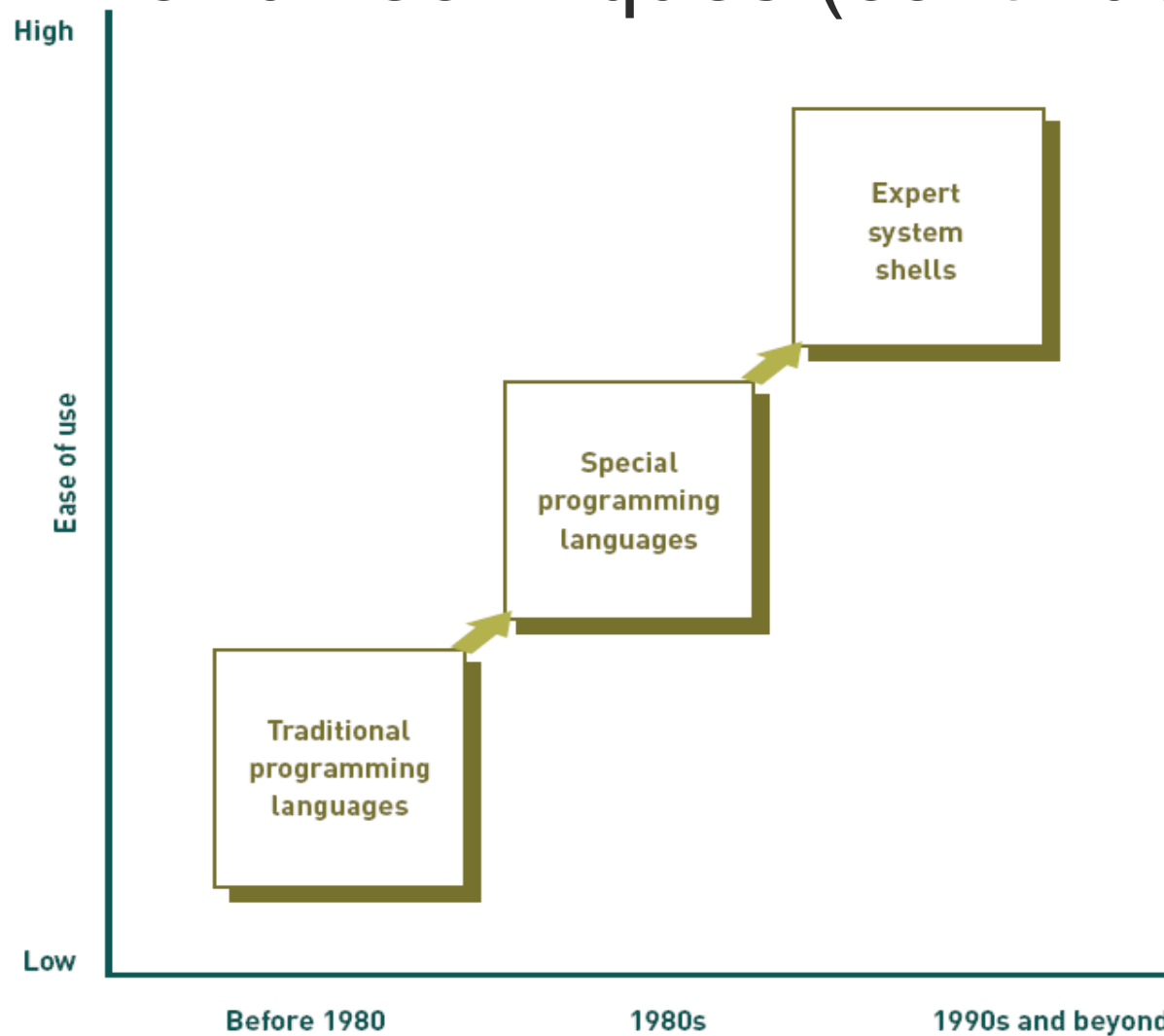# Expert Systems Development Tools and Techniques (continued)

High

Ease of use

Expert system shells

Special programming languages

Traditional programming languages

Low

Before 1980   1980s   1990s and beyond

Figure 7.13

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