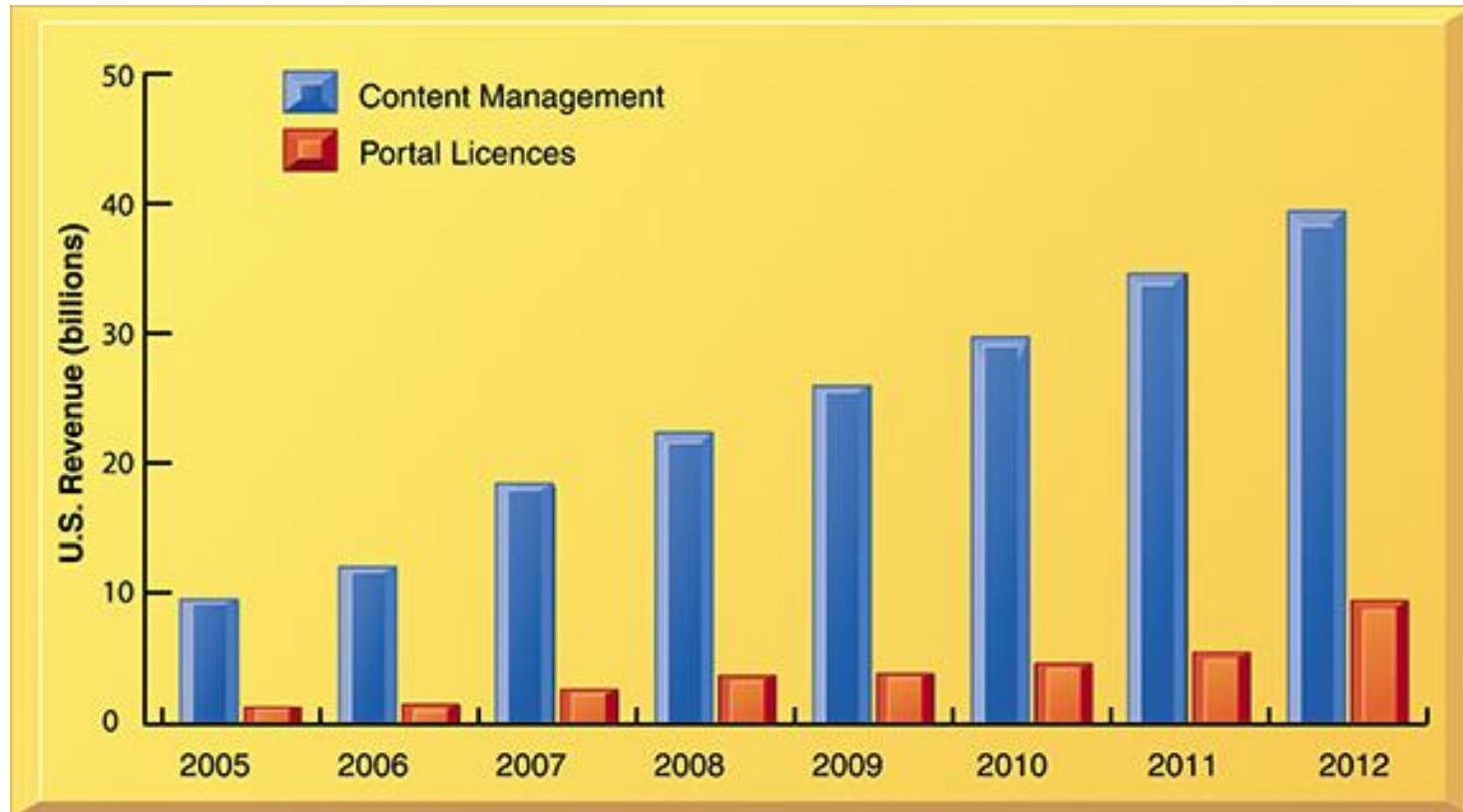# Managing Knowledge in the Digital Firm

U.S enterprise knowledge management software revenues, 2005-2012

Important Dimensions of Knowledge

- **Data:** Flow of captured events or transactions

- **Information:** Data organized into categories of understanding

- **Knowledge:** Concepts, experience, and insight that provide a framework for creating, evaluating, and using information. Can be tacit (undocumented) or explicit (documented)

- **Wisdom:** The collective and individual experience of applying knowledge to the solution of problem; knowing when, where, and how to apply knowledge

Important Dimensions of Knowledge

- **Knowledge is a Firm Asset:**

- **Intangible asset**

- **Requires organizational resources**

- **Value increases as more people share it**

Knowledge has Different Forms:

- Tacit or explicit

- Know-how, craft, and skill

- Knowing how to follow procedures; why things happen

Knowledge has a Location:

- Cognitive event

- Social and individual bases of knowledge

- Sticky, situated, contextual

Organizational Learning and Knowledge Management

- **Organizational learning:** Adjusting business processes and patterns of decision making to reflect knowledge gained through information and experience gathered

- Knowledge management: Set of processes developed in an organization to create, gather, store, disseminate, and apply knowledge

The Knowledge Management Value Chain

- Knowledge acquisition

- Knowledge storage

- Knowledge dissemination

- Knowledge application

- Building organizational and management capital: collaboration, communities of practice, and office environments
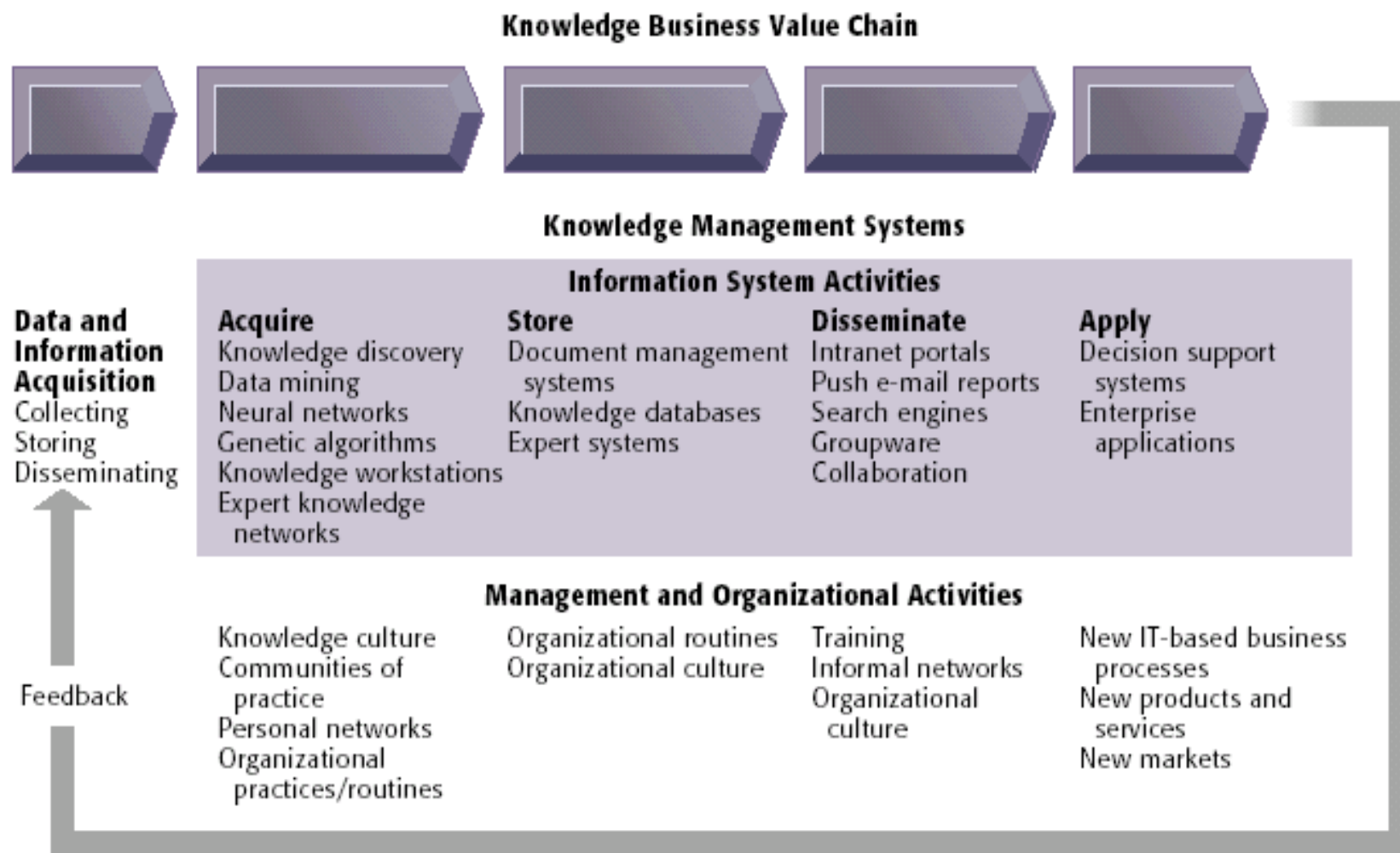
The knowledge management value chain

Knowledge Business Value Chain

Knowledge Management Systems

Information System Activities

Data and Information Acquisition	Acquire	Store	Disseminate	Apply
Collecting	Knowledge discovery	Document management systems	Intranet portals	Decision support systems
Storing	Data mining	Knowledge databases	Push e-mail reports	Enterprise applications
Disseminating	Neural networks	Expert systems	Search engines	
	Genetic algorithms		Groupware	
	Knowledge workstations		Collaboration	
	Expert knowledge networks			

Management and Organizational Activities

Feedback	Knowledge culture	Organizational routines	Training	New IT-based business processes
	Communities of practice	Organizational culture	Informal networks	New products and services
	Personal networks		Organizational culture	New markets
	Organizational practices/routines			

Figure 12-2

The Knowledge Management Value Chain

- **Chief Knowledge Officer (CKO):** Senior executive in charge of the organization's knowledge management program

- **Communities of Practice (COP):** Informal groups who may live or work in different locations but share a common profession

Types of Knowledge Management Systems

- **Enterprise Knowledge Management Systems:** General purpose, integrated, and firm-wide systems to collect, store and disseminate digital content and knowledge

- **Knowledge Work Systems (KWS):** Information systems that aid knowledge workers in the creation and integration of new knowledge in the organization

- **Intelligent Techniques:** Datamining and artificial intelligence technologies used for discovering, codifying, storing, and extending knowledge

Major types of knowledge management systems

Major Types of Knowledge Management Systems

Enterprise-Wide Knowledge Management Systems	Knowledge Work Systems	Intelligent Techniques
General purpose, integrated, firm-wide efforts to collect, store, disseminate, and use digital content and knowledge	Specialized workstations and systems that enable scientists engineers, and other knowledge workers to create and discover new knowledge	Tools for discovering patterns and applying knowledge to discrete decisions and knowledge domains
Structured knowledge systems Semistructured knowledge systems Knowledge network systems	Computer-aided design (CAD) 3D Visualization Virtual reality Investment workstations	Data mining Neural networks Expert systems Case-based reasoning Fuzzy logic Genetic algorithms Intelligent agents

Figure 12-3

Structured Knowledge Systems

- Knowledge repository for formal, structured text documents and reports or presentations

- Also known as content management system

- Require appropriate database schema and tagging of documents

- Examples: Database of case reports of consulting firms; tax law accounting databases of accounting firms

Semistructured Knowledge Systems

- Knowledge repository for less-structured documents, such as e-mail, voicemail, chat room exchanges, videos, digital images, brochures, bulletin boards

- Also known as digital asset management systems

Enterprise-wide knowledge management systems

Enterprise-Wide Knowledge Management Systems Overview
Data and information generation

Databases
Structured documents
Unstructured documents

Enterprise Systems
ERP
SCM
CRM
Web sites

Enterprise Knowledge Management Systems

Document Storage

Corporate Expertise Directories

Supporting Technologies
Portals
Search engines
Communication & collaboration tools
Learning management systems

Knowledge Dissemination and Application

Figure 12-4

KWorld's knowledge domain
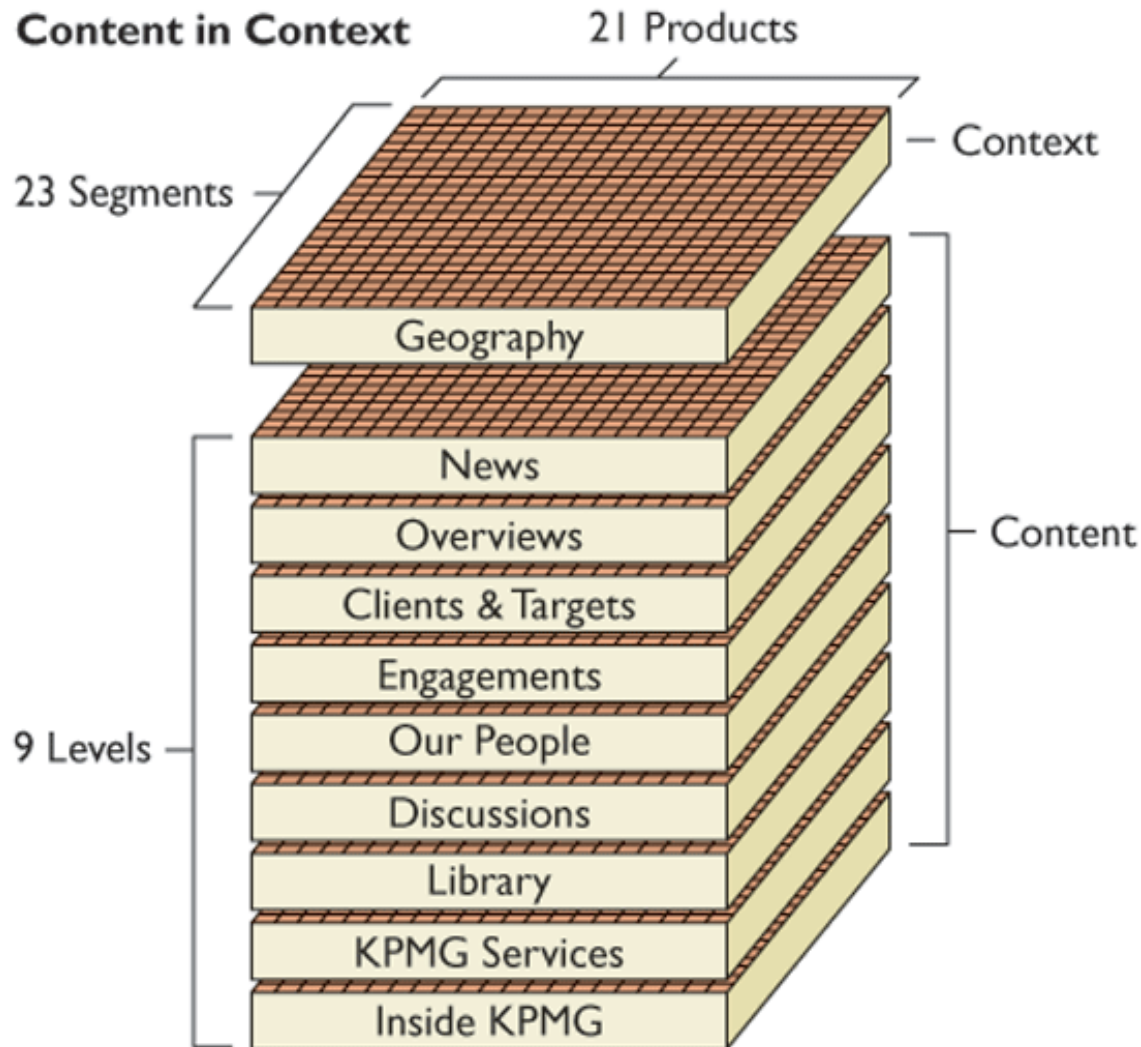
Hummingbird's Integrated Knowledge Management System
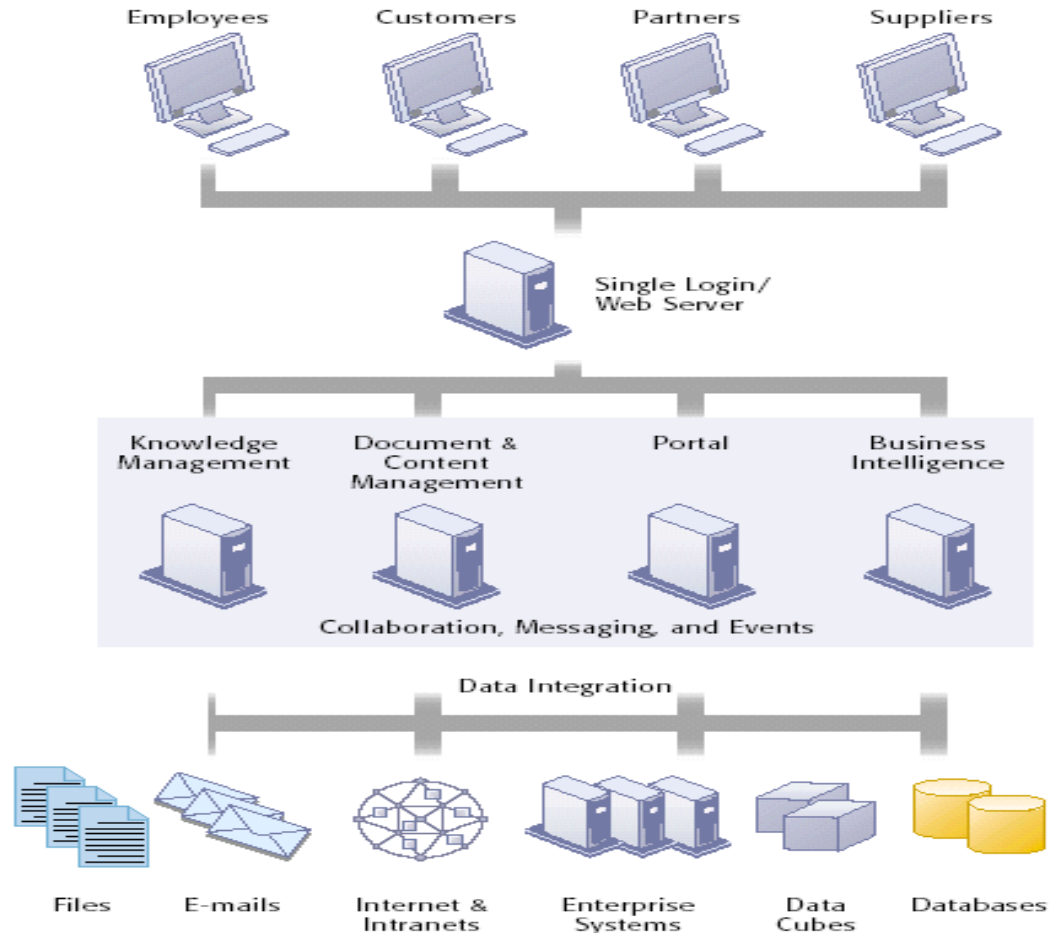
Figure 12-7

Organizing Knowledge: Taxonomies and Tagging

- **Taxonomy:** Scheme of classifying information and knowledge for easy retrieval

- **Tagging:** Marking of documents according to knowledge taxonomy

Knowledge Network Systems

- Online directory of corporate experts, solutions developed by in-house experts, best practices, FAQs

- Document and organize "tacit" knowledge

- Also known as expertise location and management systems

The problem of distributed knowledge

The problem of distributed knowledge:
finding the right person who knows
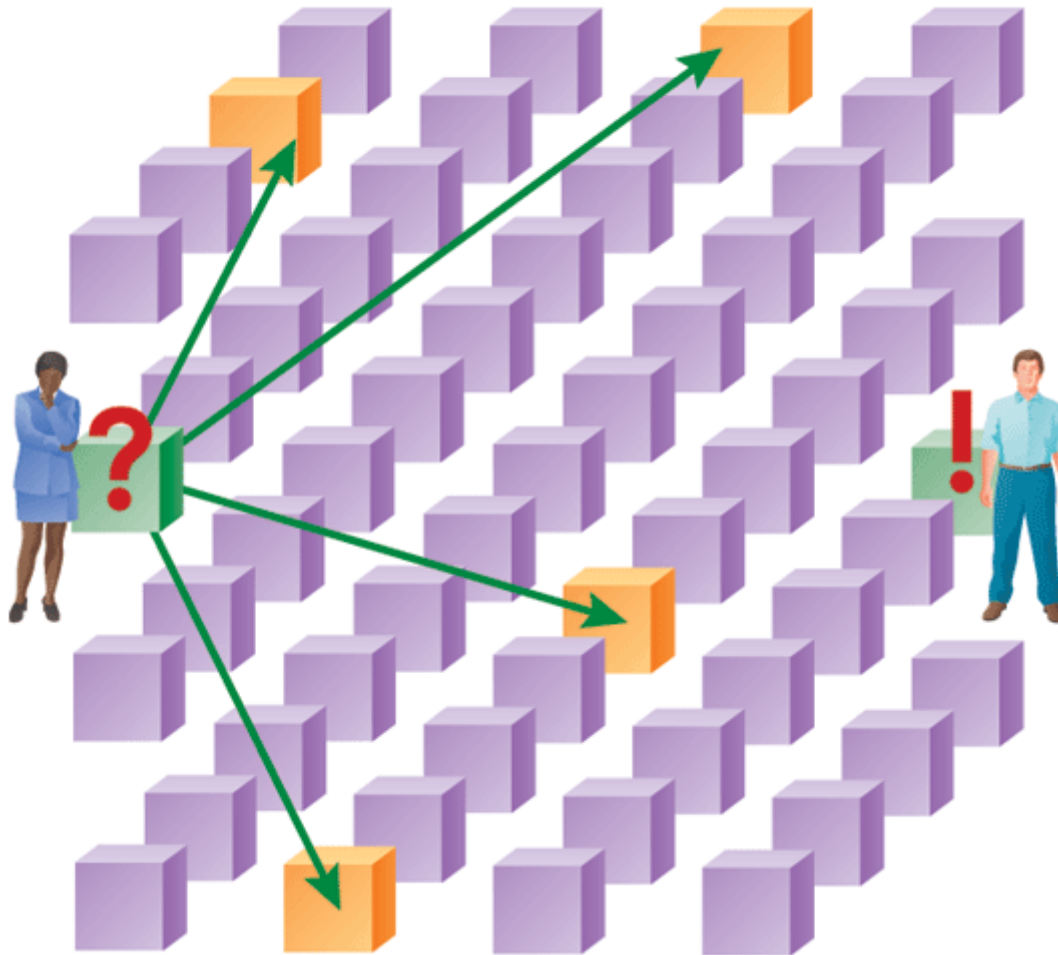
Knowledge Networks

- **Key Functions of an Enterprise Knowledge Network**

  - ↗ Knowledge exchange services

  - ↗ Community of practice support

  - ↗ Autoprofiling capabilities

  - ↗ Knowledge management services

AskMe Enterprise knowledge network system
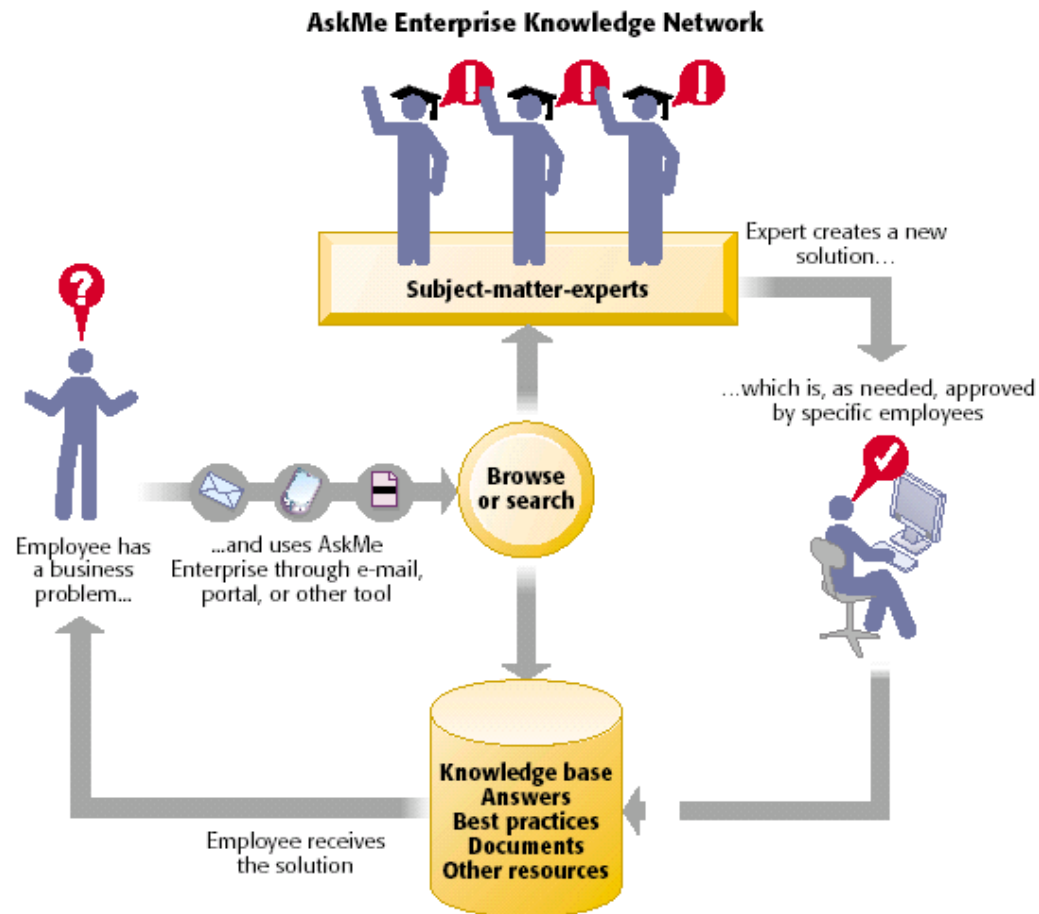
Figure 12-9

Enterprise knowledge portals:

- Access to external sources of information

- Access to internal knowledge resources

- Capabilities for e-mail, chat, discussion groups, videoconferencing

Learning Management Systems (LMS):

- Provides tools for the management, delivery, tracking, and assessment of various types of employee learning and training

- Integrates systems from human resources, accounting, sales in order to identify and quantify business impact of employee learning programs

Knowledge Workers and Knowledge Work

- **Create knowledge and information for organization**

- **Knowledge workers perform 3 key roles:**
  - Keeping the organization current 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 opportunities

  - Acting as change agents, evaluating, initiating, and promoting change projects

# Requirements of knowledge work systems
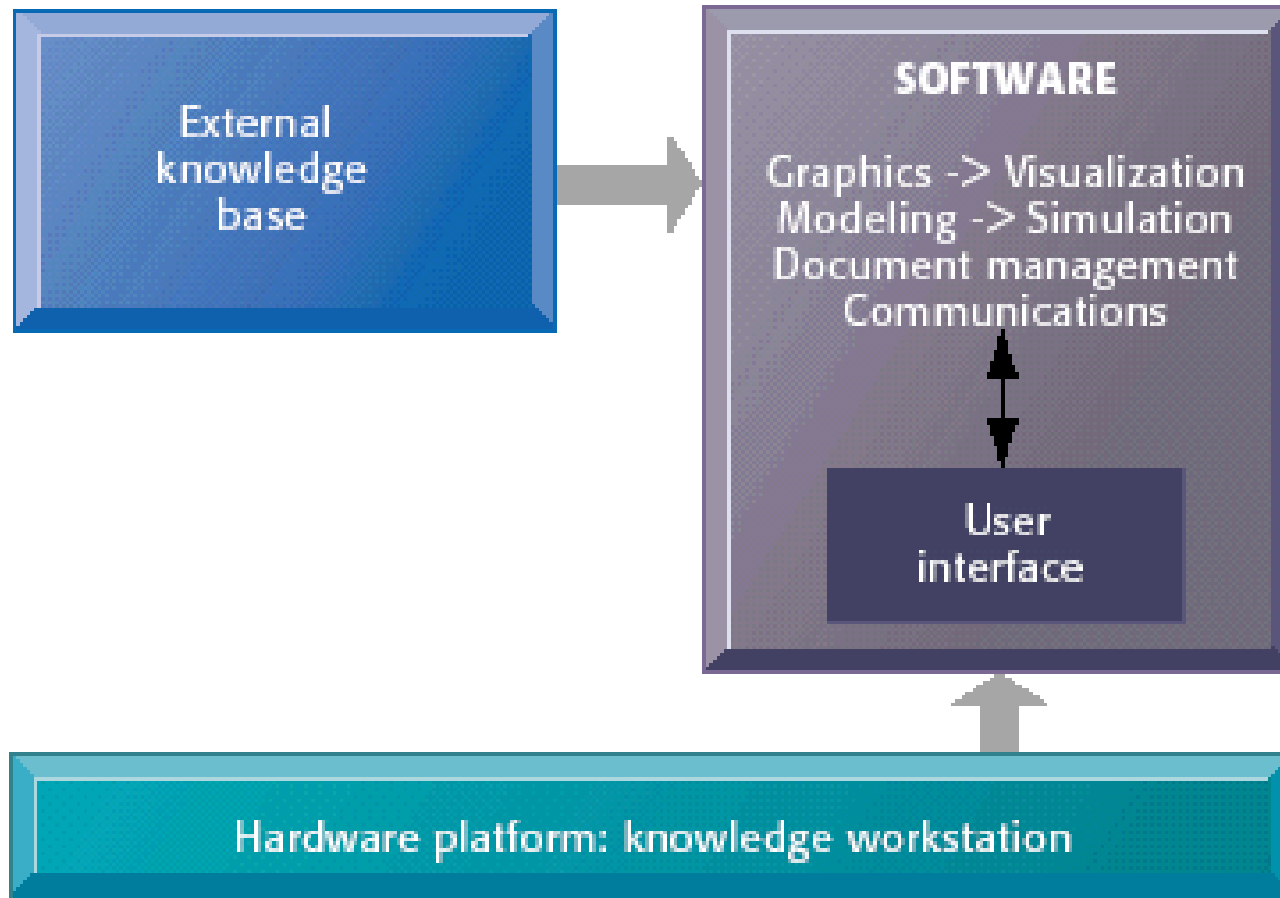
Figure 12-10

Examples of Knowledge Work Systems

- **Computer-aided design (CAD):** Information system that automates the creation and revision of industrial and manufacturing designs using sophisticated graphics software

- **Virtual reality systems:** Interactive graphics software and hardware that create computer-generated simulations that emulate real-world activities or photorealistic simulations

- **Investment workstations:** Powerful desktop computer for financial specialists, which is optimized to access and manipulate massive amounts of financial data

What is AI?
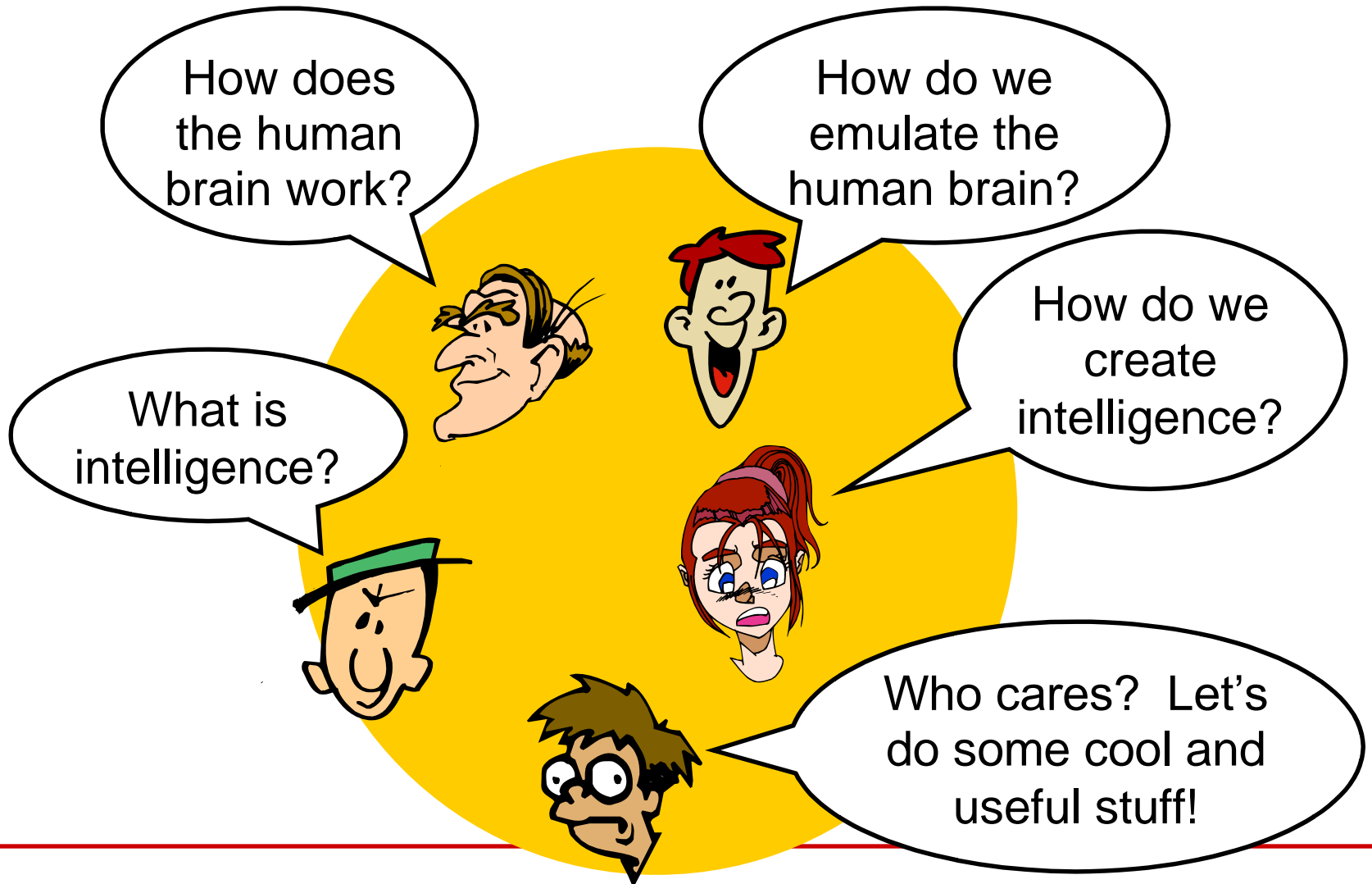
How do we classify research as AI?
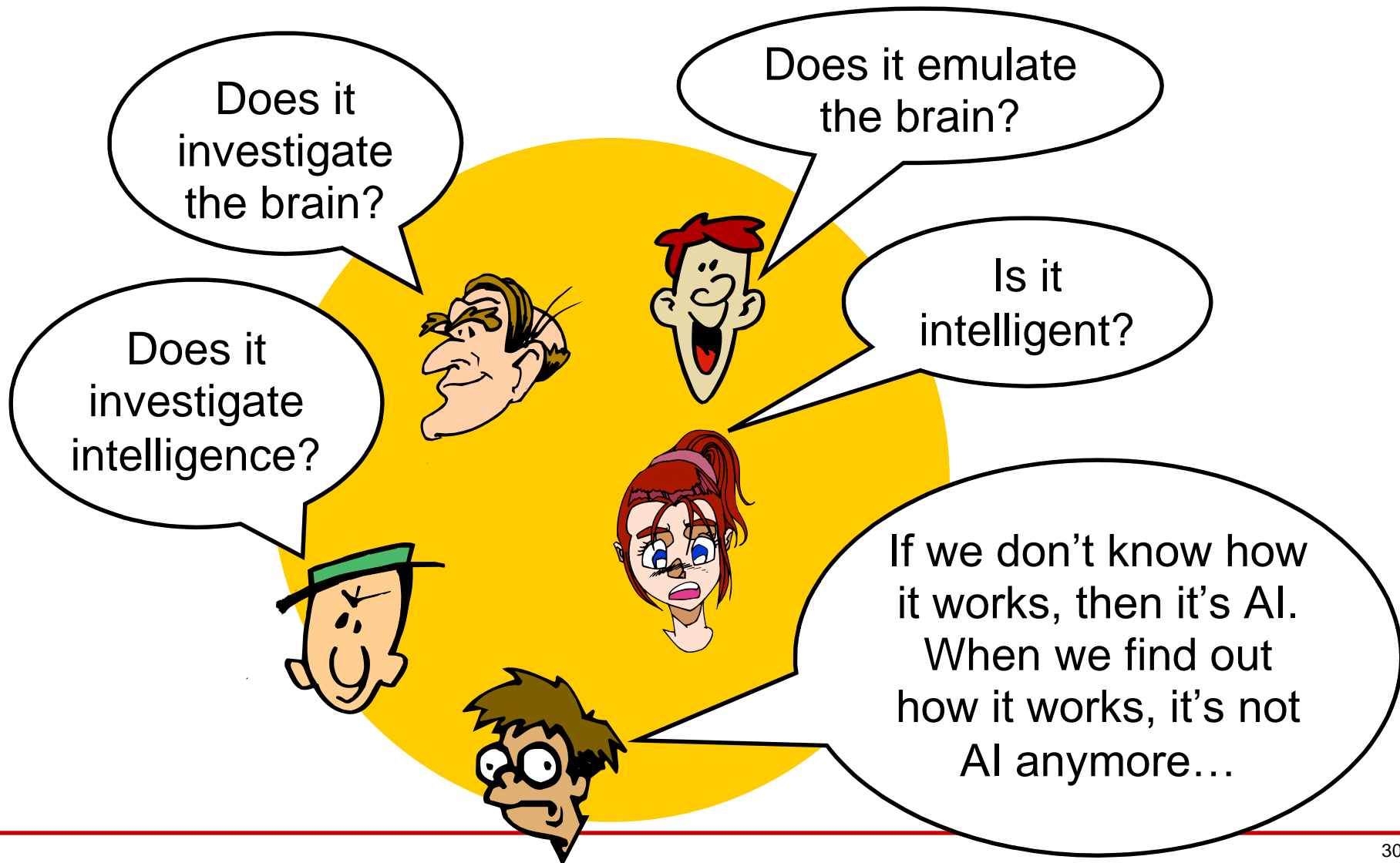
# Capabilities of intelligent Beings

- Thinking and problem solving

- Learning and memory

- Language

- Intuition and creativity

- Consciousness

- Emotions

- Surviving in a complex world

- Perceptual and motor abilities

Why Business is Interested in Artificial Intelligence

- Artificial Intelligence:

  - Stores information in active form

  - Creates mechanism not subjected to human feelings

  - Eliminates routine and unsatisfying jobs

  - Enhances organization's knowledge base

  - Generates solution to specific problems

The Artificial Intelligence Family
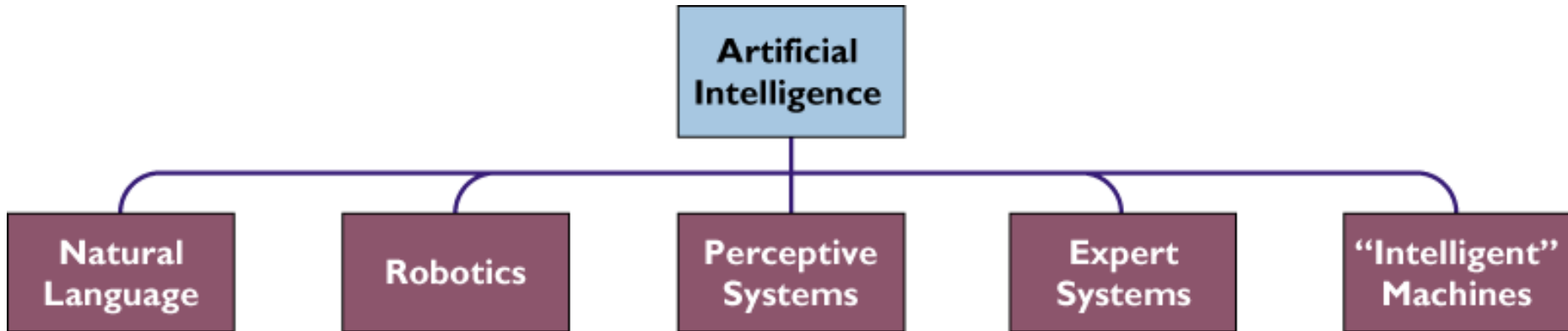
Expert System

- An expert system is a computer program that contains stored knowledge and solves problems in a specific field in much the same way that a human expert would.

- The knowledge typically comes from a series of conversations between the developer of the expert system and one or more experts.

- The completed system applies the knowledge to problems specified by a user.

Comparison of Conventional and Expert Systems

Conventional Systems	Expert Systems
Information and its processing are usually combined in one sequential program	Knowledge base is clearly separated from the processing (inference) mechanism(i.e., knowledge rules separated from the control)
Program does not make mistakes (programmers do)	Program .may make mistakes
Do not (usually) explain why input data are needed or how conclusions were drawn	Explanation is a part of most ES
Changes in the program are tedious	Changes in the rules are easy to accomplish
The system operates only when it is completed	The system can operate with only a few rules as fast prototype)
Execution is done on a step-by-step (algorithmic) basis	Execution is done by using heuristics and logic
Need complete information to operate	Can operate with incomplete or uncertain information
Effective manipulation of large databases	Effective manipulation of large knowledge bases
Representation and use of data	Representation and use of knowledge
Efficiency is a major goal	Effectiveness is the major goal
Easily deal with quantitative data	Easily deal with qualitative data
Capture, magnify, and distribute access to numeric data or to information	Capture, magnify, and distribute access to judgment and knowledge

Application Areas of KBS

Area	Problem addressed
Interpretation	Inferring situation descriptions from observations
Prediction	Inferring likely consequences of given situations
Diagnosis	Inferring system malfunctions from observations
Design	Configuring objects under constraints
Planning	Developing plans to achieve goals
Monitoring	Comparing observations to plans, flagging exceptions
Debugging	Prescribing remedies for malfunctions
Repair	Executing a plan to administer a prescribed remedy
Instruction	Diagnosing, debugging, and correcting student performance
Control	Interpreting, predicting, repairing, and monitoring system behaviors

Benefits of KBS

- **Increased output and productivity:** As compared with humans, KBS can work faster than humans, requiring fewer workers and reducing cost.

- **Increased quality:** KBS can increase quality by providing consistent advice and reducing error rate.

- **Reduced downtime:** Using KBS in diagnosing malfunctions and prescribing repairs, it is possible to reduce downtime significantly.

Benefits of KBS

- **Capture of scarce expertise**
- **Flexibility:** In providing services and in manufacturing
- **Easier equipment operation**
- **Elimination of the need for expensive equipment:** In many cases a human must rely on expensive instruments for monitoring and control. KBS can perform the same tasks with lower-cost instruments because of their ability to investigate more thoroughly and quickly the information provided by instruments.
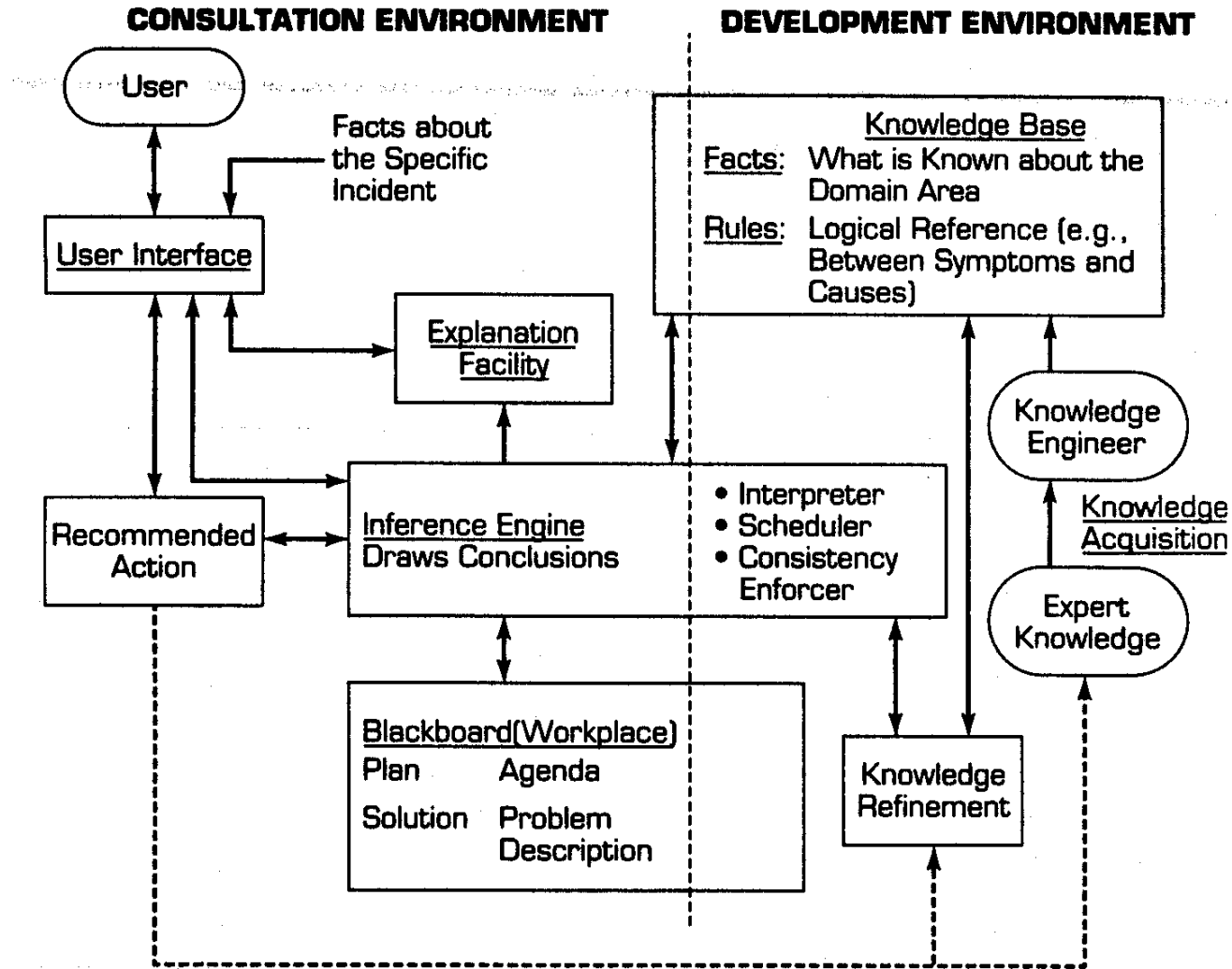- **Operation in hazardous environments**

Benefits of KBS

- **Accessibility to knowledge:** KBS make knowledge and information accessible to people.

- **Reliability:** KBS are reliable in that they do not become tired or bored, and they consistently pay attention to all details and so do not overlook relevant information and potential solutions.

- **Increased capabilities of other applications:** Integration of KBS with other systems makes the systems more effective; they cover more applications, work faster, and produce higher quality results.

- **Ability to work with incomplete and uncertain information**

Capturing Knowledge: Expert Systems

- **Knowledge Base**

- **Rule-based Expert System**

- **Rule Base**

Structure of an Expert System

CONSULTATION ENVIRONMENT **DEVELOPMENT ENVIRONMENT**

User

Facts about the Specific Incident

User Interface

Explanation Facility

Knowledge Base
Facts: What is Known about the Domain Area
Rules: Logical Reference (e.g., Between Symptoms and Causes)

Recommended Action

Inference Engine Draws Conclusions

- Interpreter
- Scheduler
- Consistency Enforcer

Knowledge Engineer

Knowledge Acquisition

Expert Knowledge

Blackboard(Workplace)
Plan   Agenda
Solution   Problem Description

Knowledge Refinement

Domain Knowledge vs Case Knowledge |

Expert knowledge is mainly expressed by rules like:

IF:

   (1) stain of organism is Gram neg. and.

   (2) morphology of organism, is rod and

   (3) aerobicity of organism is aerobic

THEN:

   strong evidence (0.8) that class of organism is Enterobacteriaceae

---

Case specific knowledge by facts like knowledge about ORGANISM-1:

GRAM   =(GRAMNEG 1.0)

MORPH=(ROD 0.9) (COCCUS 0.2)
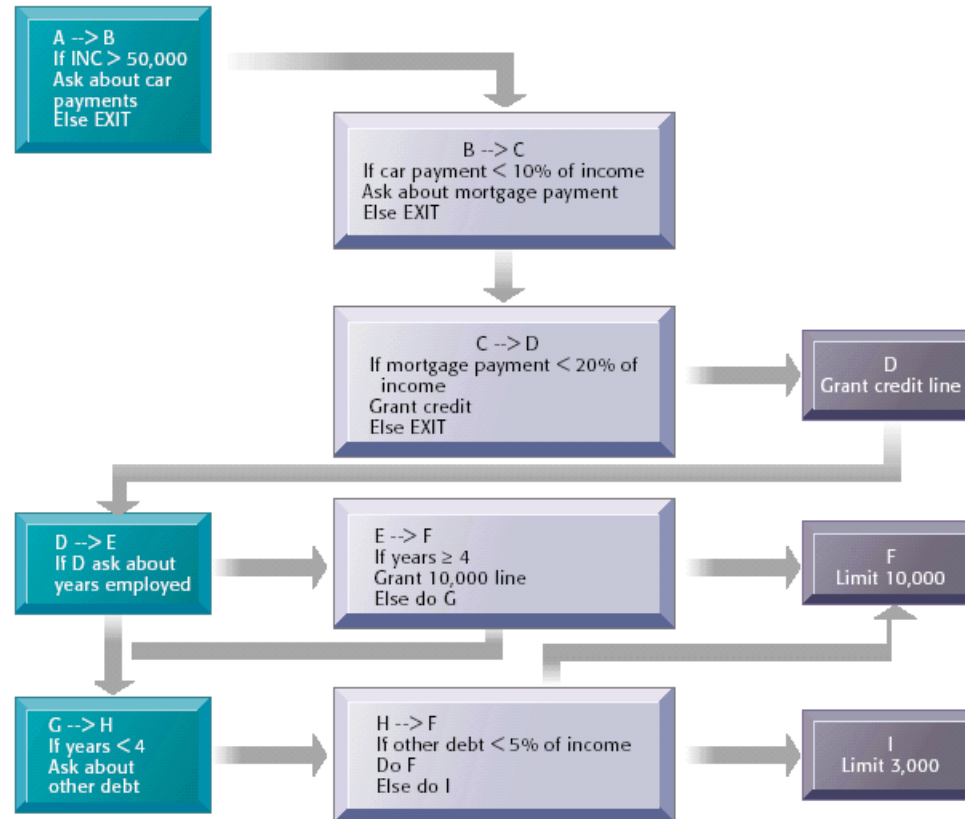
AIR   =(AEROBIC 0.6)

Rules in an AI Program

Figure 12-11

Inference Rules

Deductive Inference Rule:

Modus ponens: Conclude from "A" and "A implies B" to "B".

A

$A \Rightarrow B$

B

Example:

It is raining.

If it is raining, the street is wet.

The street is wet.

Abductive Inference Rule:

Conclude from "B" and "A implies B" to "A".

B

$A \Rightarrow B$

A

Example:

The street is wet.

If it is raining, the street is wet.

It is raining.

Recognize-Act Cycle

- A Rule Interpreter can be described as a recognize-act cycle

1. Match the premise patterns of rules against elements in the working memory

2. If there is more than one rule that can be applied (i.e. that can be "red"), choose one to apply in the conflict resolution. If no rule applicable, stop.

3. Apply the chosen rule, perhaps by adding a new item to the working memory or deleting an old one. If termination condition fulfilled stop, else go to step 1.

- The termination condition is either defined by a goal state or by a cycle condition (e.g. maximally 100 steps)
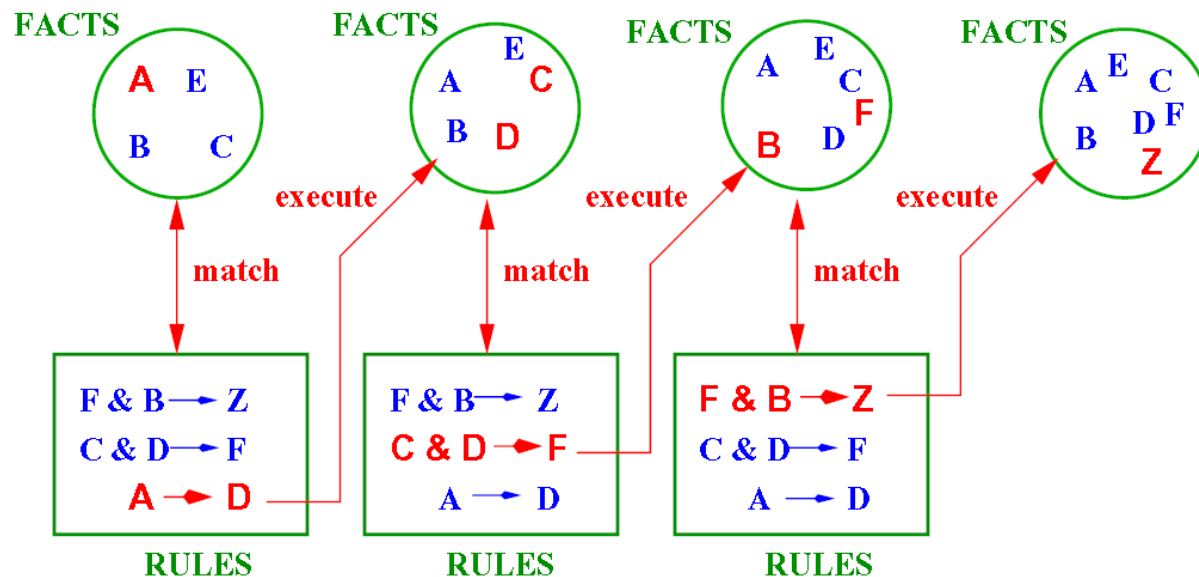
Forward and Backward Chaining

- Expert system shells usually offer one of two reasoning (chaining) modes:
  - ↗ data driven or forward chaining; and
  - ↗ goal-driven of backward chaining.

- Forward and backward chaining are search techniques used in "if-then" rule systems.

- Which side of the rule is considered first determines the direction of chaining.

Forward Chaining

- In forward chaining, the system begins with known facts about the problem and goes through the rules in the knowledge base trying to assert new facts.

- Rules whose left-hand side (IF part or premise) is known to be true are fired, meaning their right-hand side (THEN part, or conclusion) is declared true.

- This process continues until no more rules can be fired. The system then reports its conclusions.

- Forward-chaining rules are also called antecedent rules.

Forward Chaining

- Forward chaining or data-driven inference works from an initial state, and by looking at the premises of the rules (IF-part), perform the actions (THEN-part), possibly updating the knowledge base or working memory.

- This continues until no more rules can be applied or some cycle limit is met, e.g.

Forward Chaining (Cont'd)

- In the example: no more rules, that is, inference chain for this is:
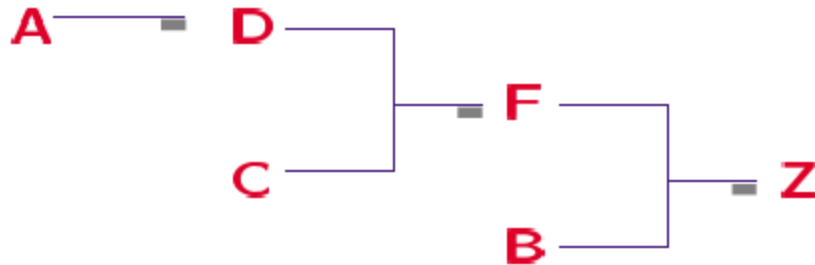
- Problem with forward chaining:
  - ↗ many rules may be applicable.
  - ↗ The whole process is not directed towards a goal.

Backward Chaining

- Backward-chaining inference engines start with a goal, or hypothesis, and work through the rules trying to match that goal with the action clauses (THEN part) of a rule.

- When a match is found, the condition clauses (IF part) of the matching rule become a "subgoal" and the cycle is repeated until a verifiable set of condition clauses is found.

- Backward-chaining rules are also called consequent rules.

Backward Chaining

- Backward chaining or goal-driven inference works towards a final state, and by looking at the working memory to see if goal already there.

- If not look at the actions (THEN-parts) of rules that will establish goal, and set up subgoals for achieving premises of the rules (IF-part).

- This continues until some rule can be applied, which is then applied to achieve goal state.

- Advantage of backward chaining:
  - ↗ search is directed

- Disadvantage of backward chaining:
  - ↗ goal has to be known

Backward Chaining (Cont'd)