Management Decision Support and Intelligent Systems

Objectives

- Describe the concepts of managerial, decision making, and computerized support for decision making.
- Justify the role of modeling and models in decision making.
- Describe decision support systems (DSSs) and their benefits, and describe the DSS structure.
- Describe the support to group (including virtual) decision making.
- Describe organizational DSS and executive support systems, and analyze their role in management support.
- Describe artificial intelligence (AI) and list its benefits and characteristics.
- Define an expert system and its components and describe its benefits and limitations.
- Describe natural language processing and compare it to speech understanding.
- Describe Artificial Neural Networks (ANNs), their characteristics and major applications. Compare it to fuzzy logic and describe its role in hybrid intelligent systems.
- Describe the relationships between the Web, DSS, and intelligent system.
- Describe special decision support applications including the support of frontline employees.

Management

Management is a process by which organizational goals (*outputs*) are achieved through the use of corporate resources (*inputs*). These organizational decisions (*processes*) are typically made by managers.

- A manager's role can be categorized into:
  - Interpersonal - figurehead, leader, liaison
  - Informational - monitor, disseminator, spokesperson
  - Decisional - entrepreneur, problem solver, resource coordinator, and negotiator

Information systems support all three roles especially decisional.

Managers and Decision Making

A decision refers to a choice made between alternatives. Decision making in organizations can be classified into two broad categories: problem solving and opportunity exploitation.

- Why Managers Need the Support of Information Technology. It is very difficult to make good decisions without valid, timely and relevant information.
  - Number of alternatives to be considered is increasing
  - Many decisions are made under time pressure.
  - Due to uncertainty in the decision environment, it is frequently necessary to conduct a sophisticated analysis.
  - It is often necessary to rapidly access remote information.

Can we make better decisions?

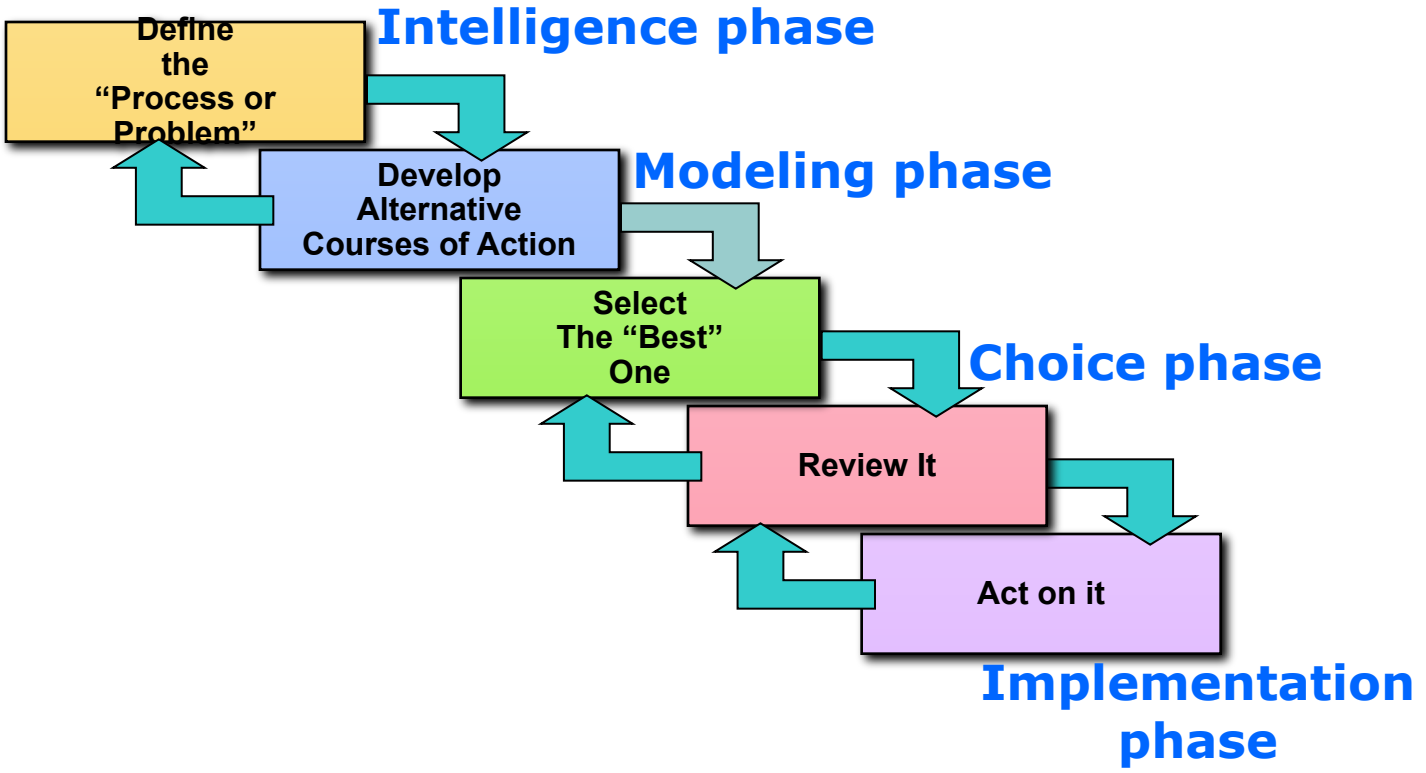
Management Support Systems

Discovery, communication and collaboration tools provide indirect support to decision making, however there are several other information technologies used to directly support decision making.

- Decision Support Systems (DSS) provide support primarily to analytical, quantitative types of decisions.
- Executive (Enterprise) Support Systems (ESS) support the informational roles of executives.
- Group Decision Support Systems supports managers and staff working in groups.
- Intelligent Systems

Decision Process

Decision makers goes through a fairly systematic process.



Models – aiding decision making

A model (*in decision making*) is a simplified representation of reality. Simplified because reality is too complex to copy exactly and much of the processes complexity is irrelevant to a specific problem.

- The benefits of modeling in decision making are:
  - The cost of virtual experimentation is much lower than the cost of experimentation with a real system.
  - Models allow for the simulated compression of time.
  - Manipulating the model is much easier than manipulating the real system.
  - The cost of mistakes are much lower in virtual experimentation.
  - Modeling allows a manager to better deal with the uncertainty by introducing "what-ifs" and calculating the risks involved in specific actions.
  - Mathematical models allow the analysis and comparison of a very large number of possible alternative solutions.
  - Models enhance and reinforce learning and support training.

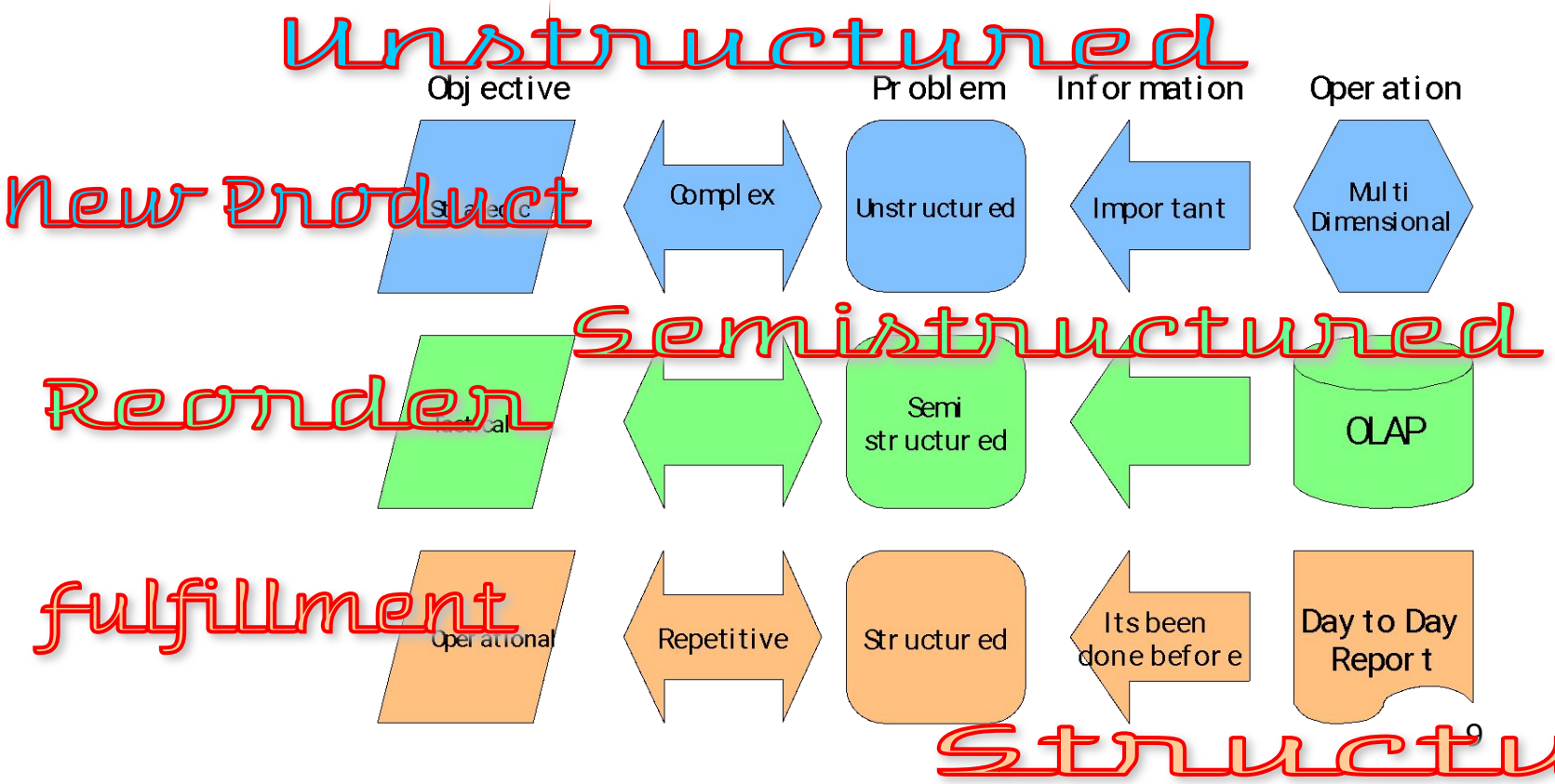
Models – Classifications

Representation by models can be done at various degrees of abstraction. Models are thus classified into four groups according to their degree of abstraction

- An Iconic or Scale model is a physical replica of a system.
- An Analog model does not look like the real system but behaves like it.
- A Mathematical (Quantitative) model describes the system with the aid of mathematics and is composed of three types of variables (decision, uncontrollable and result)
- A Mental models provides a subjective description of how a person thinks about a situation. The model includes beliefs, assumptions, relationships and flows of work as perceived by that individual.

Decision Complexity

Decision making ranges from simple to very complex decisions that fall along a continuum that ranges from structured to unstructured. Structured processes refer to routine & repetitive problems with standard solutions. While Unstructured are "fuzzy," complex problems with no clear-cut solutions.



Decision Support Systems

Decision support system (DSS) is a computer-based information system that combines models and data in an attempt to solve semistructured and unstructured problems with user involvement.

TABLE 12.1 The Capabilities of a DSS

A DSS provides support for decision makers at all management levels, whether individuals or groups, mainly in semistructured and unstructured situations, by bringing together human judgment and objective information.
A DSS supports several interdependent and/or sequential decisions.
A DSS supports all phases of the decision-making process-intelligence, design, choice, and implementation-as well as a variety of decision-making processes and styles.
A DSS is adaptable by the user over time to deal with changing conditions.
A DSS is easy to construct and use in many cases.
A DSS promotes learning, which leads to new demands and refinement of the current current application, which leads to additional learning, and so forth.
A DSS usually utilizes quantitative models (standard and/or custom made).
Advanced DSSs are equipped with a knowledge management component that allows the efficient and effective solution of very complex problems.
A DSS can be disseminated for use via the Web.
A DSS allows the easy execution of *sensitivity analyses*.

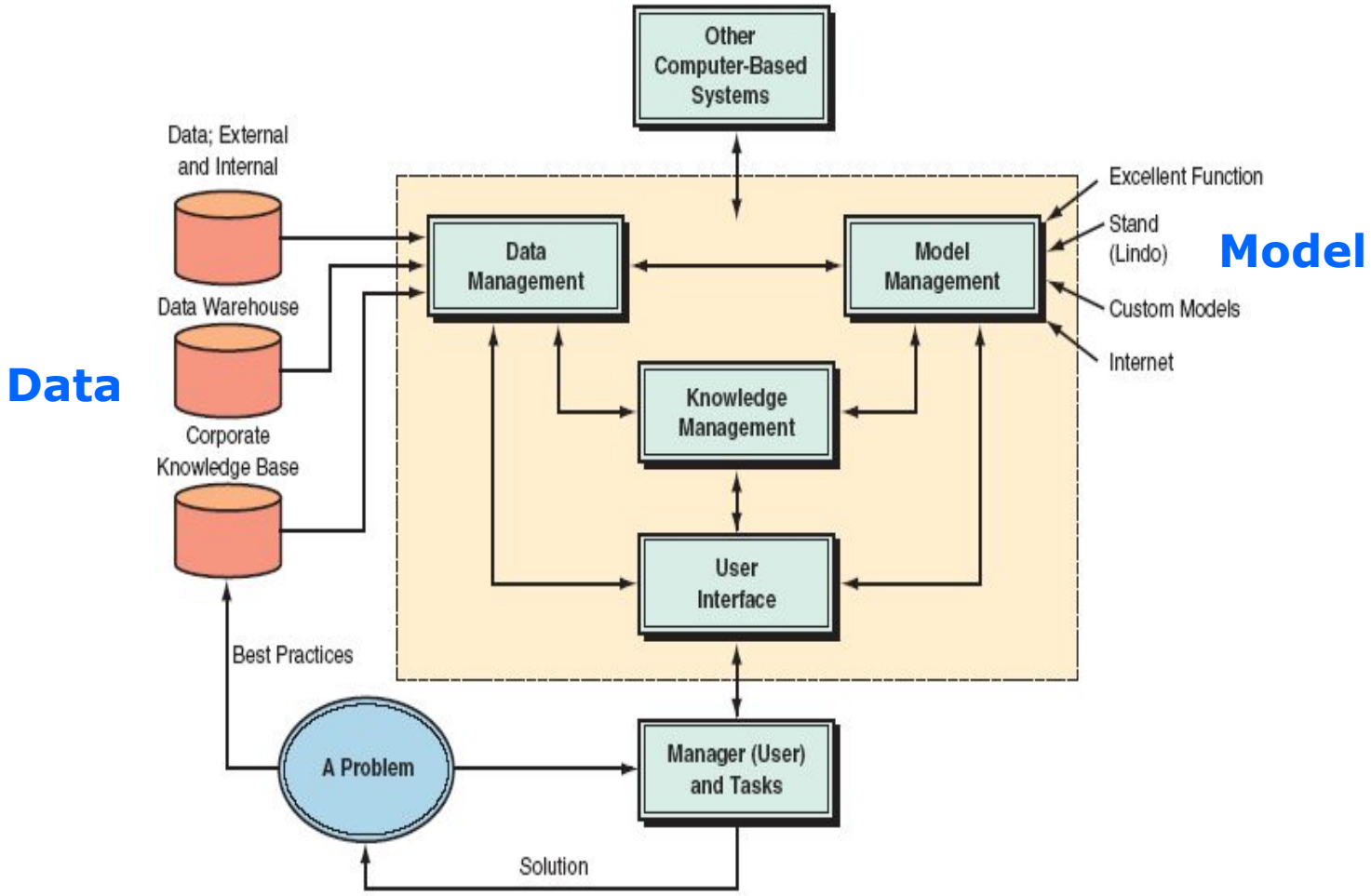
Decision Support Systems - Components

Every DSS consists of at least data management, user interface, model management components, and the end users. A few also contain a knowledge management component.

- A DSS data management subsystem contains all the data that flow from several sources, and are *extracted* prior to their entry into a DSS database or a data warehouse.
- A model management subsystem contains completed models (financial, statistical, management science, or other quantitative models), and the routines to develop DSSs applications.
- The user interface covers all aspects of the communications between a user and the DSS.
- The Users. The person (*manager,* or the *decision maker)* faced with the problem or decision that the DSS is designed to support
- A knowledge-based or intelligent subsystem provides the expertise for solving some aspects of the problem, or the knowledge that can enhance the operation of the other DSS components.

DSS Process

When user has a problem they evaluate it using this processes.



Group Decision Support Systems

The DSS methodology was initially designed to support individual decision makers. However, decision making is frequently a shared process. Where a group may be involved in making the decision. When a decision-making group is supported electronically, the support is referred to as a group decision support system (GDSS).

- Groups
  - One-room group whose members are in one place
  - Virtual group, whose members are in different locations

Organizational Decision Support System

Organizational decision support system (ODSS) provide decision support for the individual, group, and organization. It focuses on an organizational task or activity involving a *sequence* of operations and decision makers.

- Major characteristics of an ODSS are:
  - It affects several organizational units or corporate problems
  - It cuts across organizational functions or hierarchical layers
  - It involves computer-based technologies and communication technologies.
  - It often interacts or integrates with enterprise-wide information systems.

Executive Information (Support) Systems

An executive information system (EIS), also known as an executive support system (ESS), is a technology designed in response to the specific needs of top-level managers and executives.

- EIS are:
  - Very user friendly
  - Is supported by graphics
  - Provides the capabilities of *exception reporting* (reporting only the results that deviate from a set standard)
  - *Provide drill down* (investigating information in increasing detail).
- ESS goes beyond EIS to include:
  - Analyse support
  - Communications
  - Office automation
  - Intelligence support

ESS - Expansion continued

- ESS can be enhanced with:
  - Multidimensional analysis and presentation
  - Friendly data access
  - User-friendly graphical interface
  - Imaging capabilities
  - Intranet access
  - E-mail
  - Internet access
  - Modeling
- ESS goes beyond EIS to include:
  - Analyse support
  - Communications
  - Office automation
  - Intelligence support

Intelligent ESS saves an executive's time in conducting drill downs, exceptions, or identifying trends by automating these activities.

Intelligent Support Systems (ISS)

Intelligent systems is a term that describes the various commercial applications of artificial intelligence (AI). AI is concerned with studying the thought processes of humans and representing those processes via machines (computers, robots, and so on). It's ultimate goal is to build machines that will mimic human intelligence.

- AI applications can be extremely valuable:
  - They can make computers easier to use.
  - They make knowledge more widely available.
  - They significantly increase the speed and consistency of some problem-solving procedures.
  - They handle problems that are difficult to solve by conventional computing and those that have incomplete or unclear data.
  - They increase the productivity of performing many tasks.
  - They helps in handling information overload by summarizing or interpreting information.
  - They assist in searching through large amounts of data.

ISS - Artificial Intelligence

The development of machines that exhibit intelligent characteristics draws upon several sciences and technologies, ranging from linguistics to mathematics.

TABLE 12.4 The Commercial AI Techniques

Name	Short Description
Expert system (ES)	Computerized advisory systems usually based on rules (See Section 12.6.)
Natural language processing (NLP)	Enables computers to recognize and even understand human languages. (See Section 12.7.)
Speech understanding	Enables computers to recognize words and understand short voice sentences. (See Section 12.7.)
Robotic and sensory systems	Programmable combination of mechanical and computer program. Recognize their environments via sensors.
Computer vision and scene recognition	Enable computers to interpret the content of pictures captured by cameras.
Machine learning	Enables computers to interpret the content of pictures captured by cameras.
Handwriting recognition	Enables computers to recognize characters (letters, digits), written by hand.
Neural computing (networks)	Using massive parallel processing, able to recognize patterns in large amount of data. (See Section 12.7.)
Fuzzy logic	Enables computers to reason with partial information. (See Section 12.7.)
Intelligent agents	Software programs that perform tasks for a human or machine master. (See Online Appendix W12.1.)
Semantic Web	An intelligent software program that "understands" content of Web pages. (See Section 12.7.)

Expert Systems (ES) – *One type of ISS*

Expert systems (ESs) are attempts to copy human experts. It is decision-making software that can reach a level of performance comparable to a human expert in some specialized and usually narrow problem area. The idea is simple: expertise is transferred from an expert or other source of expertise to the computer.

- The transfer of expertise from an expert to a computer and then to the user involves four activities:
  - Knowledge acquisition (from experts or other sources)
  - Knowledge representation (organized as rules or frames in the computer)
  - Knowledge inferencing is performed in a component called the inference engine of the ES and results in the recommendation.
  - Knowledge transfer to the user (the expert's knowledge has been transferred to users).

Expert Systems (ES) – *One type of ISS*

Benefits:

TABLE 12.5 Benefits of Expert Systems

Benefit	Description/Example
Increased output and productivity	At Digital Equipment Corp. (now part of Hewlett-Packard), an ES plans configuration of components for each custom order, increasing preparation production fourfold.
Increased quality	ESs can provide consistent advice and reduce error rates.
Capture and dissemination of scarce expertise	Physicians in Egypt and Algeria use an eye-care ESs developed at Rutgers University to diagnose and to recommend treatment.
Operation in hazardous environments	ESs that interpret information collected by sensors enable human workers to avoid hot, humid, or toxic environments.
Accessibility to knowledge and help desks	ESs can increase the productivity of help-desk employees (there are over 30 million in the U.S. alone), or even automate this function.
Reliability	ESs do not become tired or bored, call in sick, or go on strike. They consistently pay attention to details and do not overlook relevant information.
Increased capabilities of other systems	Integration of an ES with other systems makes the other systems more effective.
Ability to work with incomplete or uncertain information	Even with an answer of "don't know" or "not sure," an ES can still produce an answer, though it may not be a certain one.
Provision of training	Novices who work with an ES become more experienced thanks to the explanation facility which serves as a teaching device and knowledge base.
Enhancement of decision-making and problem-solving capabilities	ESs allow the integration of expert judgment into analysis. Successful applications are diagnosis of machine malfunction and even medical diagnosis.
Decreased decision-making time	ESs usually can make faster decisions than humans working alone. American Express authorizers can make charge authorization decisions in 3 minutes without an ES and in 30 seconds with one.
Reduced downtime	ESs can quickly diagnose machine malfunctions and prescribe repairs. An ES called Drilling Advisor detects malfunctions in oil rigs, saving the cost of downtime (as much as $250,000/day).

Simulation Systems

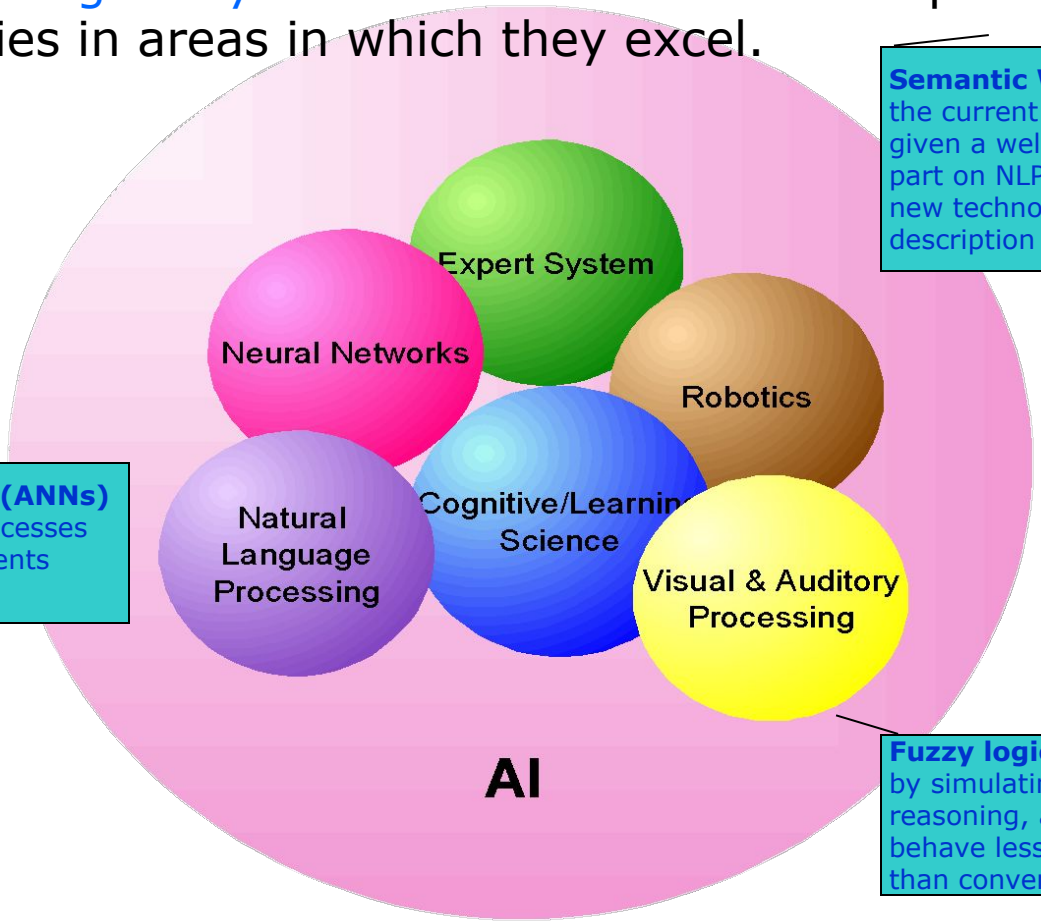
Simulation generally refers to a technique for conducting experiments (such as "what-if") with a computer on a model of a management system. Because DSS deals with semistructured or unstructured situations, it involves complex reality, which may not be easily represented by optimization or other standard models but can often be handled by simulation. Therefore, simulation is one of the most frequently used tools of DSSs.

- **Advantages of Simulation.**
  - Allows for inclusion of the real-life complexities of problems.
  - Is descriptive.
  - Can handle an extremely wide variation in problem types.
  - Can show the effect of compressing time.
  - Can be conducted from anywhere.

Other Intelligent Systems

An expert system's major objective is to provide expert advice. Other intelligent systems can be used to solve problems or provide capabilities in areas in which they excel.

Semantic Web. It is an extension of the current Web, in which information is given a well-defined meaning, based in part on NLP, on XML presentation, and new technologies such as resource description framework (RDF).



Artificial neural networks (ANNs) simulate massive parallel processes that involve processing elements interconnected in a network.

Fuzzy logic deals with uncertainties by simulating the process of human reasoning, allowing the computer to behave less precisely and logically than conventional computers do.

Web-Based Management Support Systems

Deploying decision support capabilities on a global basis via the Web.

TABLE 12.8 The Benefits of Web-Based MSSs

Benefit	Description
Reach rich data sources	The Web can have many resources with multimedia presentation, all accessible with a browser.
Easy data retrieval	Data can be accessed any time, from anywhere. Salespeople for example, can run proposals, using DSS models at a client's place of business.
Ease of use and learning	Use of browser, search engine, hypertext, etc., makes DSSs easy to learn and use. Even top executives are using them directly.
Reduce paperwork and processing efforts for raw data	All data are visible on the Web. If a data warehouse exists, data are organized for view.
Better decisions	With accessibility to more and current information, as well as to DSS models and technology, users of DSSs can make better decisions.
Expanding the use of ready-made DSSs	ASPs are using the Internet to lease DSS models as needed. Soon utility computing will make such distribution a common scenario. Also, more and cheaper applications are available.
Reduced development cost	Building one's own DSS can be cheaper when one uses components (Chapter 14) available on the Web. Also customizing vendor's products is faster and cheaper when done in the Internet environment.

MANAGERIAL ISSUES

- **Cost justification; intangible benefits.** While some of the benefits of management support systems are tangible, it is difficult to put a dollar value on the intangible benefits of many such systems.
- **Documenting personal DSS.** Many employees develop their own DSSs to increase their productivity and the quality of their work. It is advisable to have an inventory of these DSSs and make certain that appropriate documentation and security measures exist.
- **Security.** Decision support systems may contain extremely important information for the livelihood of organizations. Taking appropriate security measures, especially in Web-based distributed applications, is a must.
- **Ready-made commercial DSSs.** With the increased use of Web-based systems and ASPs, it is possible to find more DSS applications sold off the shelf, frequently online. The benefits of a purchased or leased DSS application sometimes make it advisable to change business processes to fit a commercially available DSS.

MANAGERIAL ISSUES Continued

- **Intelligent DSS.** Introducing intelligent agents into a DSS application can greatly increase its functionality.
- **Organizational culture.** The more people recognize the benefits of a DSS and the more support is given to it by top management; the more the DSS will be used.
- **Embedded technologies.** Intelligent systems are expected to be embedded in at least 20 percent of all IT applications in about 10 years. It is critical for any prudent management to closely examine the technologies and their business applicability.
- **Ethical issues.** Corporations with management support systems may need to address some serious ethical issues such as privacy and accountability.