Decision Support System Concepts, Methodologies and Technologies

Objectives:

- understand
  - possible DSS configurations;
  - the essential definition of DSS:
  - DSS components and how they integrate;
  - important DSS classifications;
- describe
  - DSS characteristics and capabilities;
  - the components and structure of each DSS component (***the data***, ***the model*** *and* ***the knowledge-based management system***, ***the user interface subsystem***, *and* ***the user***);
  - DSS hardware and software platforms;
- explain
  - Internet impacts on DSS and vice versa;
  - the unique role of the user in DSS versus management information system (MIS).

Decision Support System Description

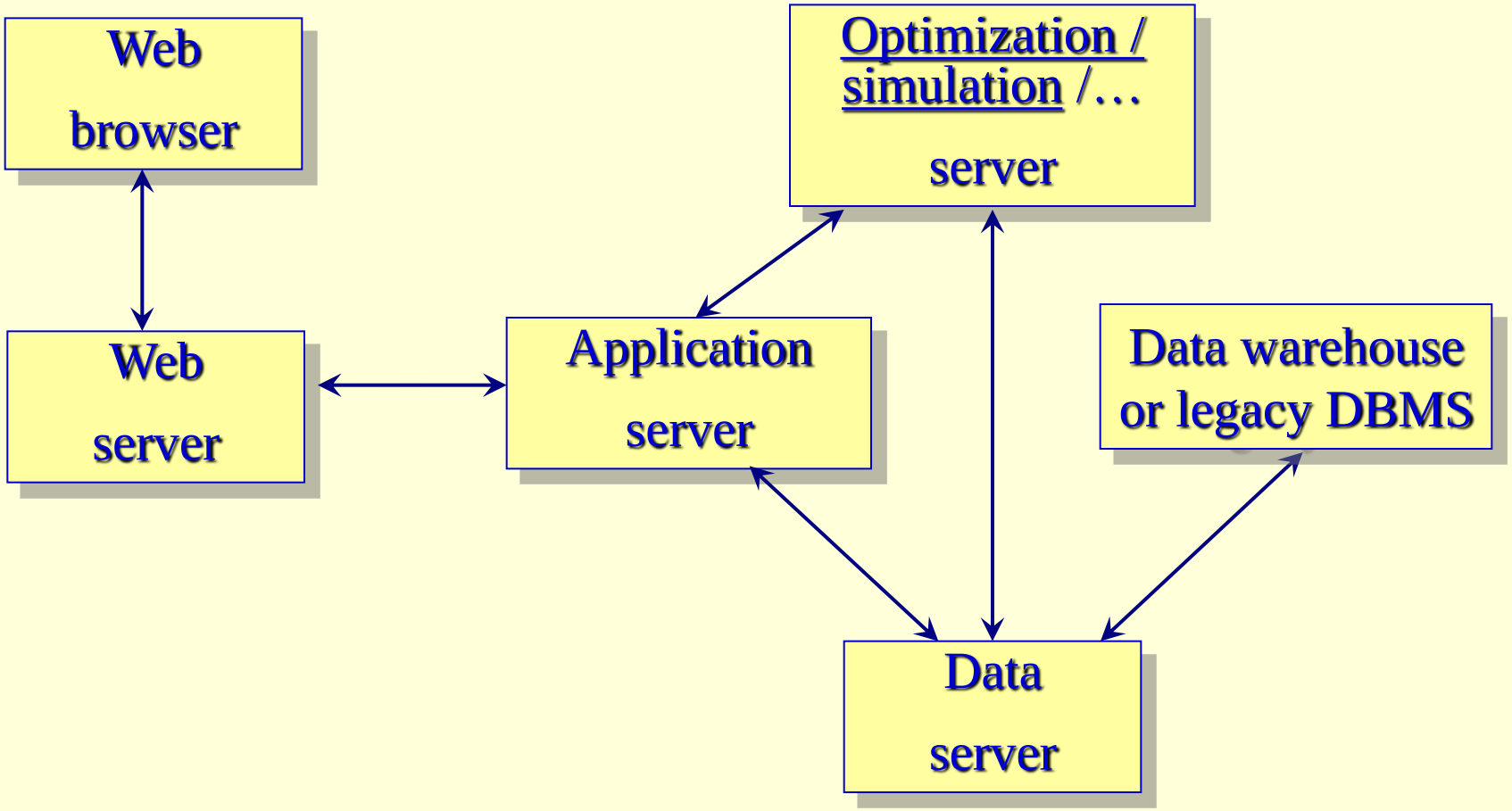
A DSS Application::= a DSS is typically built to support the solution of a certain problem or to evaluate an opportunity.

A DSS::= an approach for supporting decision making.

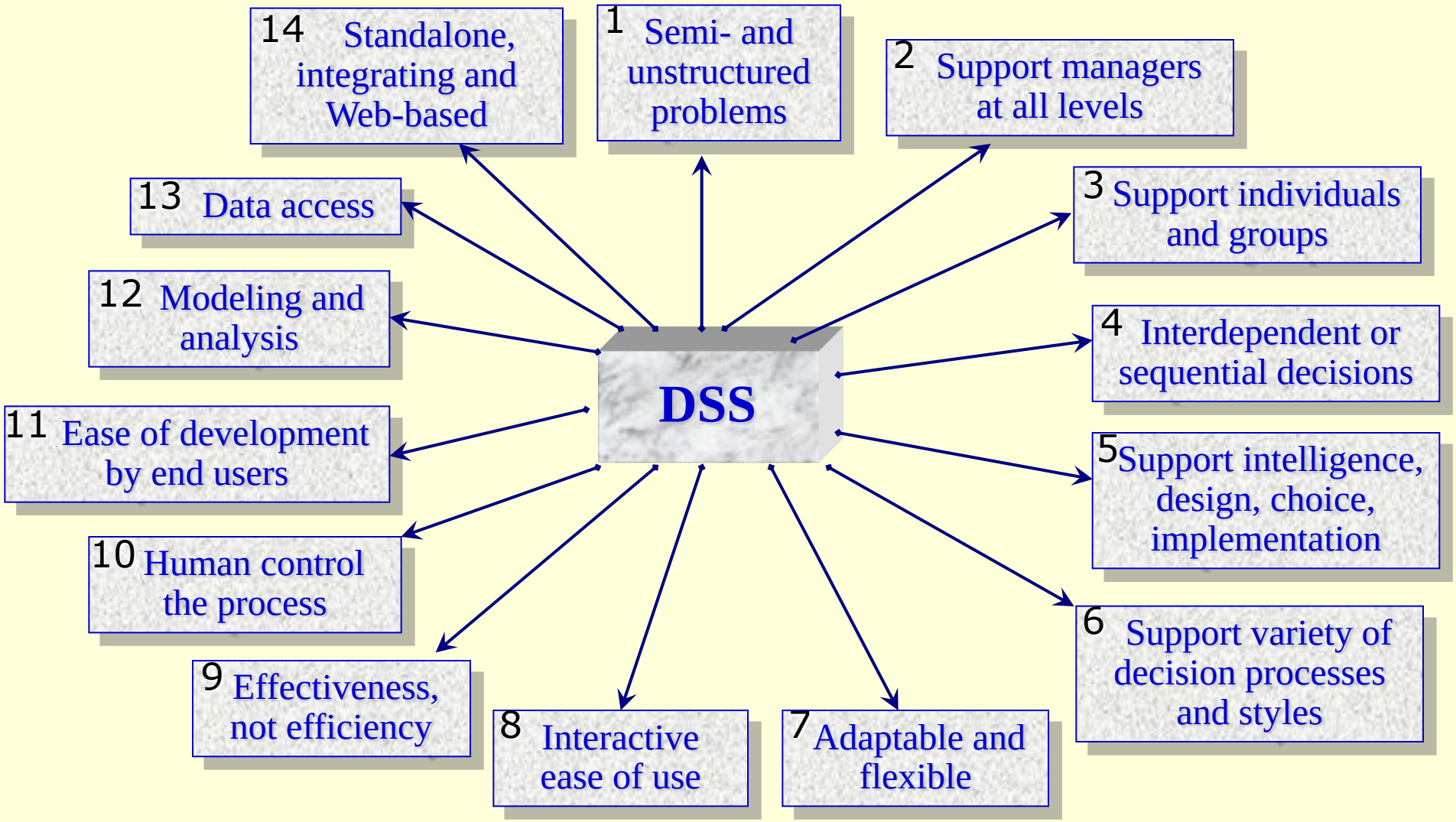
- It uses an interactive, flexible, adaptable *computer-based information system* **CBIS** especially developed for supporting the solution to a specific non-structured management problem.
- It uses data, provides an easy user interface, and can incorporate the decision maker's own insights, includes models and is developed through an interactive and iterative process.
- It support all the phases of decision making and may include a *knowledge component*.
- It can be used by a single user on a PC or can be Web based for use by many people at several locations.

A typical Web-based DSS architecture

Multi-tired Architecture for Incorporating Optimization, Simulation and other Models into ***Web-Based DSS*** (*Decision Support with Web-Enabled Software*, *Interface*, Vol.13, No.2, 2001, pp.109-129).



Decision Support System Description
Characteristics and Capabilities



The **Characteristics and Capabilities** of DSS are:

1. Support for decision makers (mainly in semi- and un-structured situation) by bringing together human judgment and computerized information.
2. Support for all managerial levels, ranging from top executives to line managers.
3. Support for individuals (from different departments, organizational levels or different organizations) as well as groups of decision makers working somewhat independently – virtual teams through collaborative Web tools.
4. Support for independent or sequential decisions that may be made once, several times or repeatedly.
5. Support in all phases of decision-making process (*intelligence*, *design*, *choice*, *implementation*).
6. Support for a variety of decision-making process and style.
7. The decision maker should be reactive, able to confront changing conditions quickly and able to adapt the DSS to meet these changes. DSS are flexible, so users can *add*, *delete*, *combine*, *change or rearrange basic elements*.

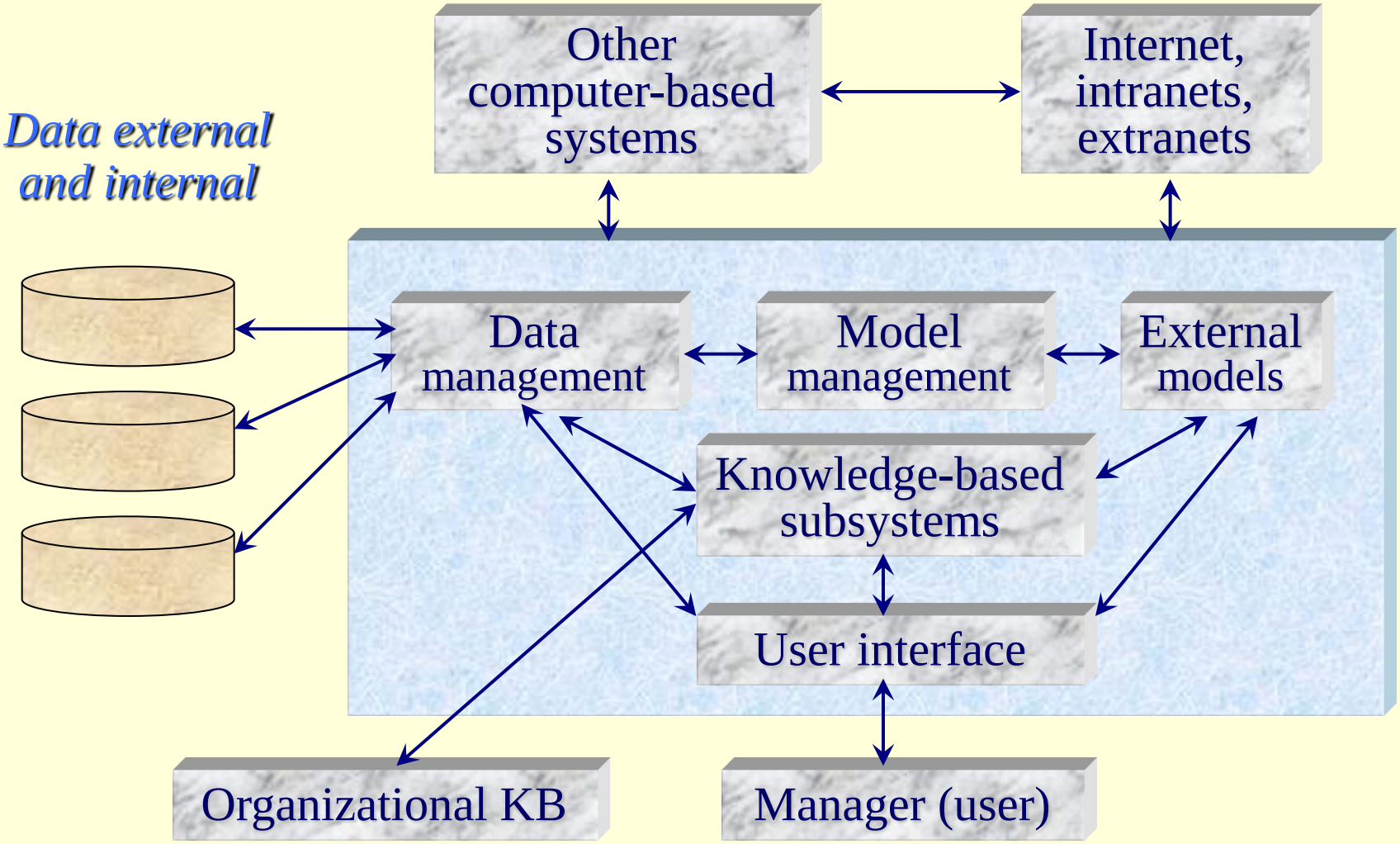
8. User-friendliness, strong graphical capabilities and natural language interactive human-machine interface can greatly increase the effectiveness of DSS, Most new DSS application use Web-based interfaces.
9. Improvement the effectiveness of decision making rather than its efficiency. When DSS are deployed, decision making often takes longer but the decisions are better.
10. The decision maker has complete control over all steps of the decision-making process in solving a problem – a DSS aims to support not to replace the decision maker.
11. End users are able to develop and modify simple systems by themselves. Larger systems can be built with assistance from information system specialist. Online analytical process (OLAP) and data mining software, with data warehouses, allow users to build very large and complex DSS.
12. Models are generally utilized to analyze decision-making situations. The modelling capability enable experimentation with different strategies under different configurations.

13. Access is provided to a variety of data sources, formats and types, including GIS, multimedia and object oriented.
14. Can be employed as a standalone tool used by an individual decision maker in one location or distributed throughout an organisation and in several organizations along the supply chain. It can be integrated with other DSS or applications and it can be distributed internally and externally using networking and Web technologies.

These key DSS *Characteristics and Capabilities* allow decision makers to make better, more consistent decision in a timely manner and they are provided by the major DSS components.

Components of Decision Support Systems

A Schematic view of DSS



The ***Data Management Subsystem*** includes a database that contains relevant data for the situation and managed by software called the ***Database Management System*** (**DBMS**) and can be interconnected with the corporate data ***warehouse***, a repository for corporate relevant decision-making data. Usually, the data are stored or accessed via a database Web server.

The ***Model Management Subsystem*** is a software package that includes *financial, statistical, management science or other quantitative models* that provide the system's analytical capabilities and appropriate software management. Modelling languages for building custom models are also included. This software is called a ***Model Base Management System*** (**MBMS**).

The ***User Interface Subsystem*** allows the interaction between the computer and the decision maker. It is used by the user (is part of system) to communicates with and commands the DSS. The Web browser provides a familiar and consistent ***Graphical User Interface*** (**GUI**) structure for most DSS.

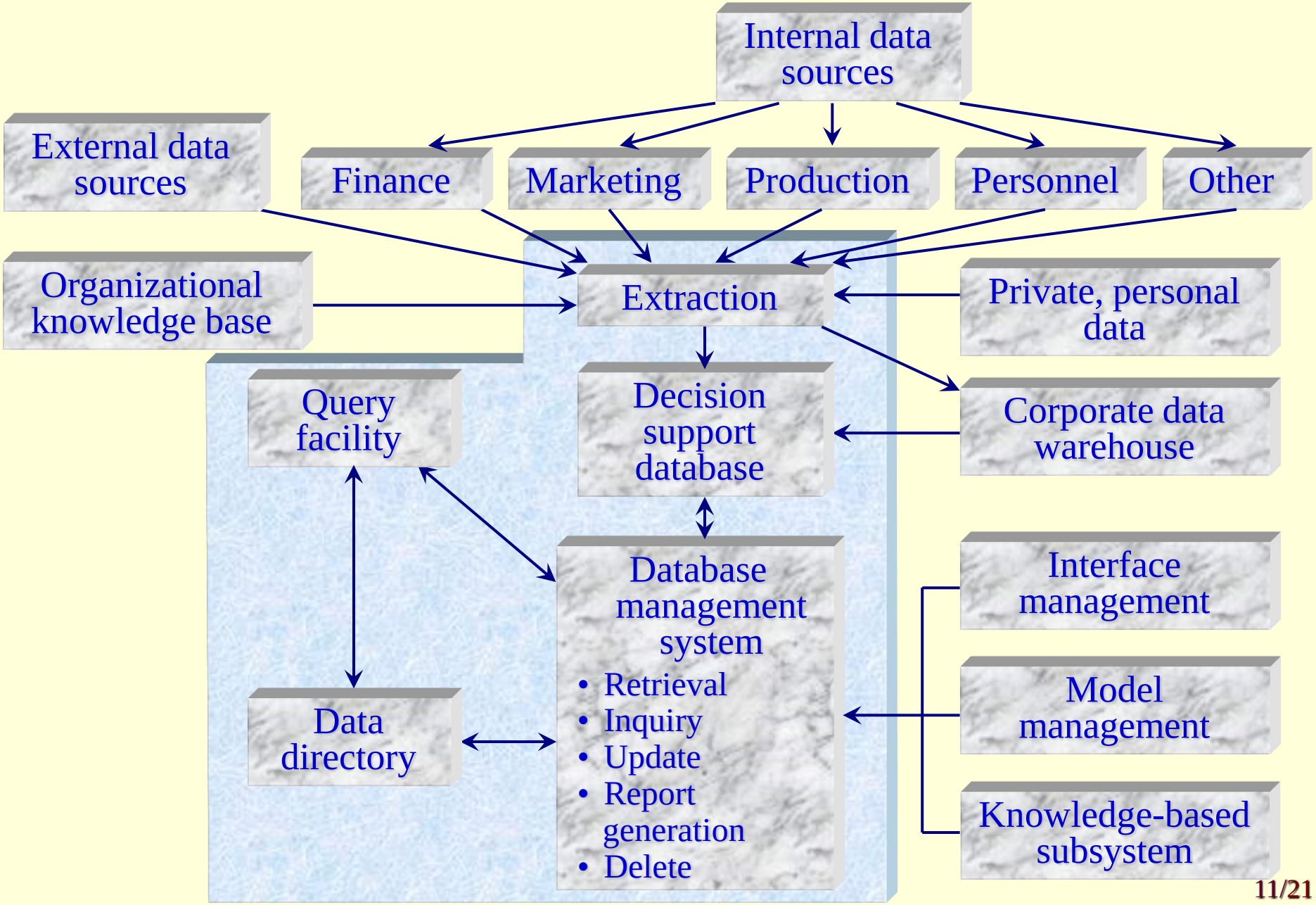
The ***Knowledge-Based Management Subsystem*** can support any of the other subsystems or act as an independent component. It provides intelligence to augment the decision maker's own. It can be interconnected with the organization's knowledge repository (part of the ***Knowledge Management System*** - **KMS**) which is called the ***Organizational Knowledge Base.*** Knowledge can be provided via Web servers. Many artificial intelligence methods have been implemented in Web development system such as Java and are easy to integrate into the other DSS components. A DSS must include the three major components: DBMS, MBMS and *user interface*.

The ***Data Management Subsystem*** is composed of the following elements:

- DSS database,
- SBMS,
- Data directory,
- Query facility.

These elements and the interaction of the data management subsystem with the other parts of the DSS are shown in the next figure.

The Structure of the Data Management Subsystem



A ***Database*** is a collection of interrelated data, organized to meet the needs and structure of an organization that can be used by more than one person for more than one application.

- **Internal data** come mainly from the organization's transaction processing system.
- **External data** include industry data, market search data, census data, regional employment data, government regulation, national economic data, and so on.
- **Private data** can include guidelines used by specific decision makers and assessments of specific data or situation.

Data organization. When a DSS should have a standalone database:

- In small DSS data can be entered directly into models, sometimes extracted directly from larger databases.
- In large organization that uses extensive amounts of data, data are organized in a data warehouse and used when needed for analysis not for transaction process.

Extraction is an operation that enables to create or load a DSS database or a data warehouse – it is often necessary to capture data from several sources. It allows the importing of files, summarization, standardization filtration and condensation of data (corresponding process are ***extraction, transformation*** *and* ***load*** – **ETL**).

The ***Query Facility*** allows to access, manipulate and query data. It accepts requests for data from other DSS components, determines how the results can be filled, formulates the detailed requests and returns the results to the issuer of the request. It includes a special query language (SQL). Important functions of a DSS query system are selection and manipulation operations.

The Data Directory is a catalog of all data in a database. It contains data definitions and its main function is to answer questions about the availability of data items, their source and their exact meaning. It supports the addition of new entries, deletion of entries and retrieval of information about specific objects.

Data Security is required by confidentiality laws. In some situations, unauthorized access extends to modifying data in place or destroying it. Data must be protected from unauthorized access through security measures such is ID and Password protection. It is important to identify exactly who has access to and why they have access to specific sets of data and to what level an individual is allowed to change the data in the system. Data can be encrypted so that even in case of unauthorized access the viewed data is scrambled an unintelligible.

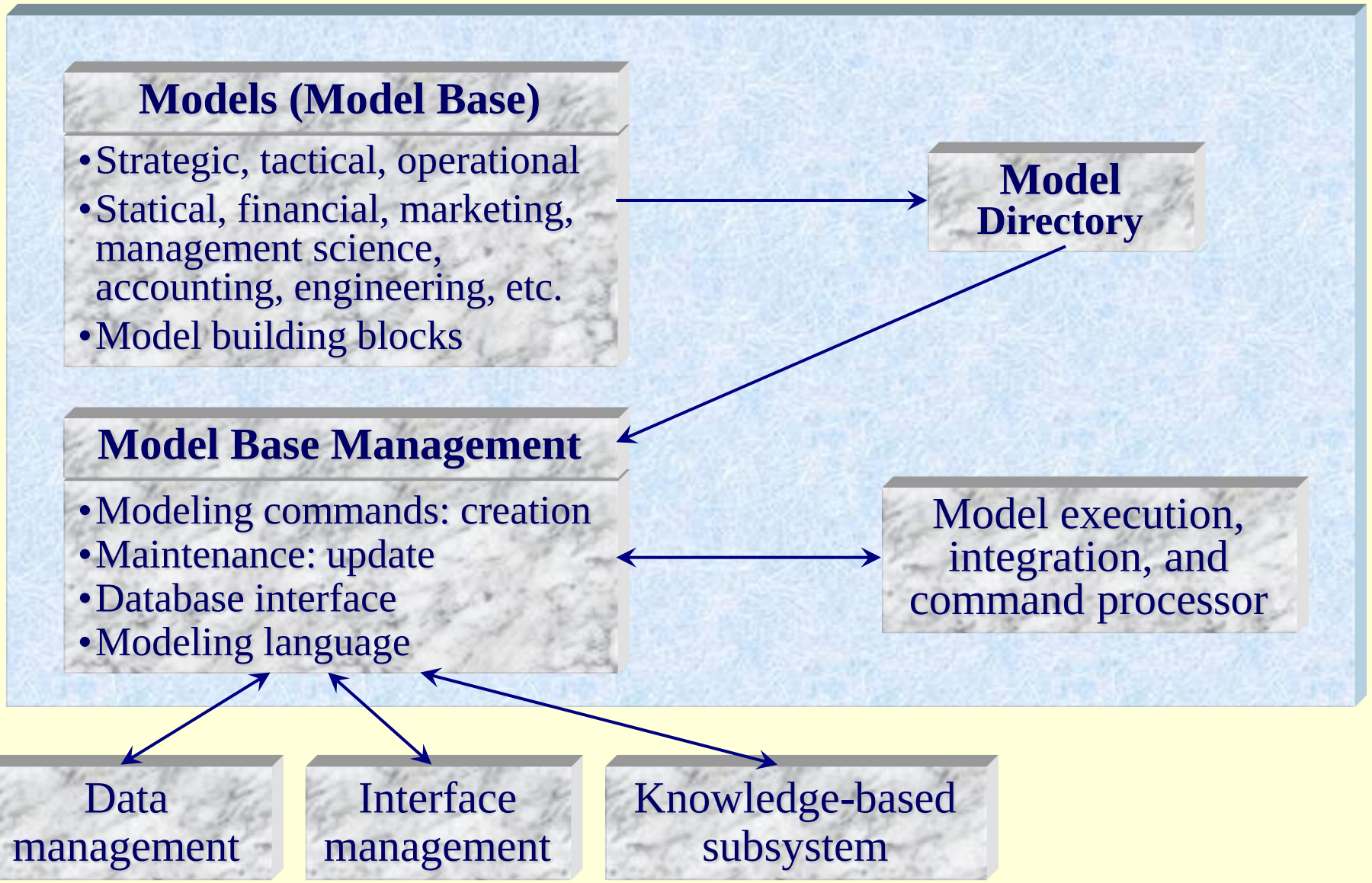
The Model Management Subsystem

The Model Management Subsystem of a DSS is composed of the following elements:

- **Model base** – contains routine and special statistical, financial, forecasting, management science and other quantitative models that provide the analysis capabilities in a DSS. The models can be: strategic, tactical, operational and analytical.
- **Model Building Blocks and Routines - MBMS** – the model base can contain it in addition for such applications as data analysis or can be used as components of larger models.
- **Modeling language** – **.**NET Framework languages, C++, Java, OLAP (work with models in data analysis), SLAM (simulation), SPSS (statistical packages), …
- **Model directory** – similar to a database directory, it is a catalog of all the models and other software in the model base. It contains model definitions and its main function is to answer questions about the availability and capability of the model.
- **Model execution, integration and command processor** – control ***Model execution***, ***Model integration***. A ***model command processor*** is used to accept and interpret modeling instructions from the user interface component to the MBMS, model execution or integrating functions.

These elements and their interfaces with other components are shown in the next figure.

The Structure of the Model Management Subsystem



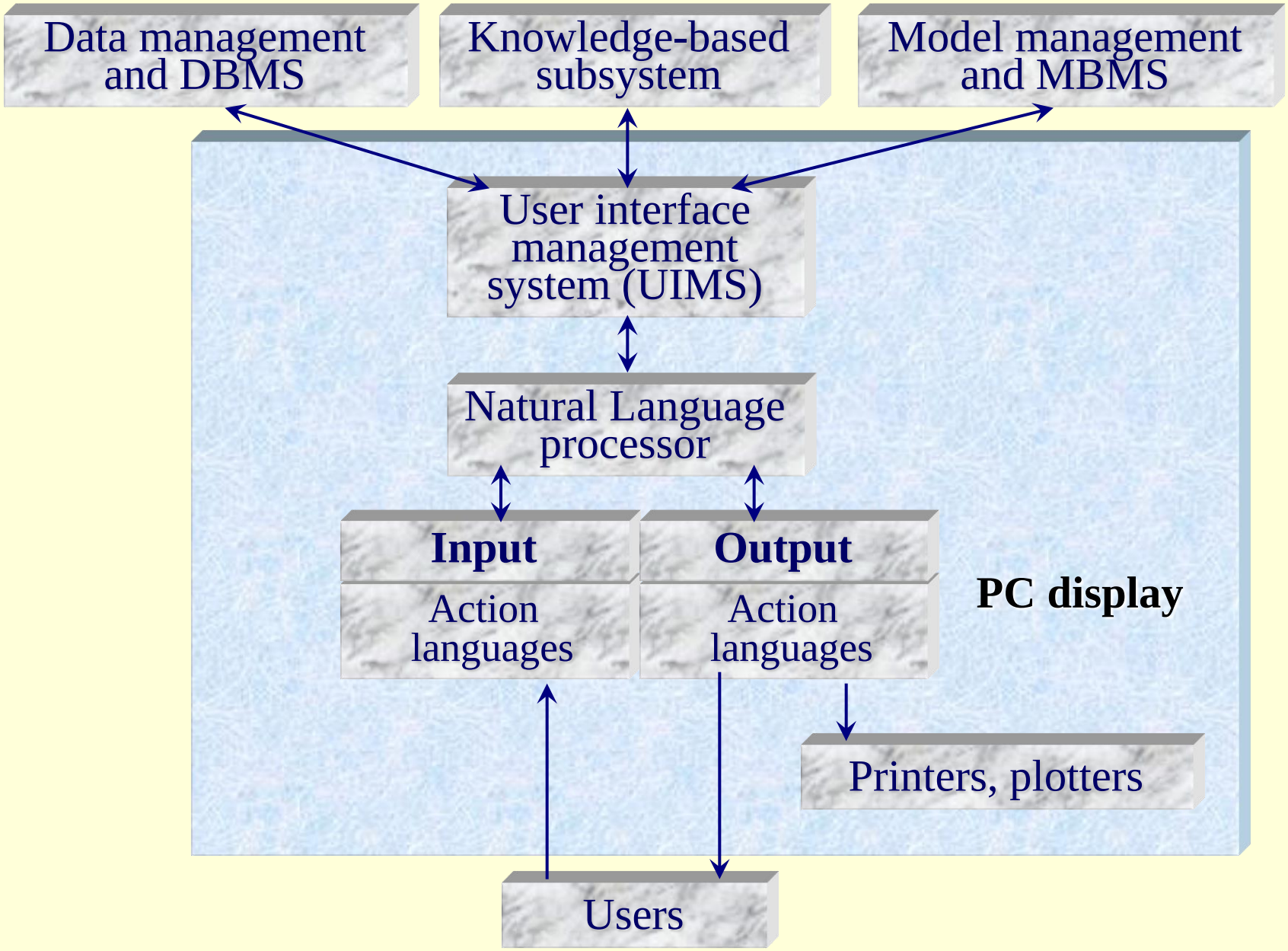
The User Interface (Dialog) Subsystem

The User Interface Subsystem covers all aspects of communication between a user and the DSS. It is managed by software called the ***user interface management system*** (**UISM**) = ***dialog generation and management system***.

The user interacts with the computer via an action language processed by the UIMS. It enables the user to interact with the model management and data management subsystems. The user interface component may include a natural language processor or can use standard objects through a *graphical user interface* (GUI).

A variety of portable devices have been made Web-ready, including notebook and tablet PCs, PDAs, pocket PCs (another type of PDA) and cell phones. Many of these devices include technology to tap directly into the Web. They allow either handwritten input and some DSS user interfaces utilize natural language input (human language). The NASA has developed a voice input/output system for astronauts to use in space.

Schematic View of the User Interface System



The Knowledge-Based Subsystem

Many unstructured or semi-structured problems are so complex that their solutions require expertise provided by an ES or another intelligent system. Advanced DSS are equipped with a component called ***Knowledge-Based Subsystem***.

Knowledge components may be provided by ES, neural networks, intelligent agents, fuzzy logic, case-based reasoning systems, etc. The knowledge component consists of one or more intelligent systems. Knowledge-based management software provides the necessary execution and integration of the intelligent system.

A DSS that includes such a component is called an *intelligent DSS*, a *DSS/ES*, an *expert-support system*, an *active DSS* or a *knowledge-based DSS*.

The Decision Support System User

The user, manager or decision maker can be an individual or a group, depending on who is responsible for the decision, and provides the *human intellect*.

An ***intermediary*** allows a manager to benefit form a DSS:

- ***Staff assistants*** have specialized knowledge about management problems and some experience with decision support technology.
- ***Expert tool users*** perform tasks that the problem solver does not have the skill or training to perform.
- ***Business analysts*** have a knowledge of the application area, a formal business administration education and considerable skill in using DSS construction tools.
- ***Facilitators*** control and coordinate the use of software to support the work of people working in groups, and are also responsible for the conduct of workgroups sessions.

Decision Support System Hardware

Hardware affects the functionality and usability of the MSS. The choice of hardware can be made before, during or after design of the MSS software but is often determined by what is already available in the organization.

Decision Support System Classifications

The design process, operation and implementation of DSS, depends on the type of DSS involved.

The AIS SIGDSS (sigs.aisnet.org/SIGDSS/) classification:

- Communication-driven and group DSS (GSS) – include how computer, collaboration and communication technologies support groups in task.
- Data-driven DSS – database organization plays a major role in the DSS structure.
- Document-driven DSS – are text based.
- Knowledge-driven DSS, data mining and management ES applications – all artificial intelligence-based.
- Model-driven DSS – significant activities in model formulation, model maintenance, model management and what-if analysis.

Resources, Links, Periodicals, Cases

Resources and Links:

- The Data Warehouse Institute (tdwi.org)
- DM Review (dmreview.com)
- The OLAP Report (olapreport.com)
- DSS resources (dssresources.com)

Periodicals:

- Advisor (Advisor.com)
- Baseline Magazine (baselinemag.com)
- Business Intelligence Journal (tdwi.org)
- Computerworld (computerworld.com)
- Decision Support Systems (elsevier.com)

Cases:

- Harvard Business School Case Collection (hbsp.harvard.edu/products/cases.html)
- Business Performance Improvement resource (bpir.com)
- Idea Group Publishing (idea-group.com)
- DSS resources (dssresources.com)