Decision Support System (DSS)

Decision Making

- Every decision and action that humans make is inherently related to decision making.
- But humans have weaknesses (subjective, bias, forgetful, imprecise, and slow) in many cases of decision making.
- Therefore humans need to be assisted by computer-based tools called **DSS** to improve the quality of decision making.

Introduction: *Think how you take decisions in the following situation*

- **How do you go for work?**
- **How do you choose the best university for your master degree?**
- **How do you know the best car to buy?**
- **How do you determine the best land for you agroindustry investment?**
- **How do you deliver your products to many buyers living in different geographical areas?**
- **How do you select your candidate wife/husband?**
- **How do you select qualified papers to be published in an international conference proceeding?**

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Introduction: *who will be participated in these decisions making situations*

- **How do you go for work?**
- **How do you choose the best university for your master degree?**
- **How do you know the best car to buy?**
- **How do you determine the best land for you agroindustry investment?**
- **How do you deliver your products to many buyers living in different geographical areas?**
- **How do you select your candidate wife/husband?**
- **How do you select qualified papers to be published in an international conference proceeding?**

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Introduction: *what aspects are examined in these decisions making situations*

- **How do you go for work?**
- **How do you choose the best university for your master degree?**
- **How do you know the best car to buy?**
- **How do you determine the best land for you agroindustry investment?**
- **How do you deliver your products to many buyers living in different geographical areas?**
- **How do you select your candidate wife/husband?**
- **How do you select qualified papers to be published in an international conference proceeding?**

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Introduction: *which of these decision making situations can besolved with formal or mathetical methods and tools?*

- **How do you go for work?**
- **How do you choose the best university for your master degree?**
- **How do you know the best car to buy?**
- **How do you determine the best land for you agroindustry investment?**
- **How do you deliver your products to many buyers living in different geographical areas?**
- **How do you select your candidate wife/husband?**
- **How do you select qualified papers to be published in an international conference proceeding?**

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Introduction: *rank based on the structuredness of these decisions making situations*

- **How do you go for work?**
- **How do you choose the best university for your master degree?**
- **How do you know the best car to buy?**
- **How do you determine the best land for you agroindustry investment?**
- **How do you deliver your products to many buyers living in different geographical areas?**
- **How do you select your candidate wife/husband?**
- **How do you select qualified papers to be published in an international conference proceeding?**

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Decision Support Systems

- **Decision Support Methodology**
- **Technology Components**
- **Development**

8

Decision Support Systems: An Overview

- **Capabilities**
- **Structure**
- **Classifications**

Decision Making Along a Continuum (Simon)

Highly Unstructured

(Nonprogrammed)

Decisions

Highly Structured

(Programmed)

Decisions

Semistructured Decisions

Three Phase Decision-making Process (Simon)

- **Intelligence**--searching for conditions that call for decisions

- **Design**--inventing, developing, and analyzing possible courses of action

- **Choice**--selecting a course of action from those available

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DSS Configurations

- **Supports individuals and teams**
- **Used repeatedly and constantly**
- **Two major components: data and models**
- **Web-based**
- **Uses subjective, personal, and objective data**
- **Has a simulation model**
- **Used in public and private sectors**
- **Has what-if capabilities**
- **Uses quantitative and qualitative models**

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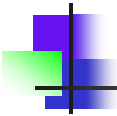
TABLE 3.1 DSS versus EDP.

Dimension	DSS	EDP
Use	Active	Passive
User	Line and staff management	Clerical
Goal	Effectiveness	Mechanical efficiency
Time Horizon	Present and future	Past
Objective	Flexibility	Consistency

Source: Alter [1980].

EDP: Electronic Data Processing
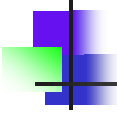
Working Definition of DSS

- **A DSS is an interactive, flexible, and adaptable CBIS, specially developed for supporting the solution of a non-structured management problem for improved decision making. It utilizes data, it provides easy user interface, and it allows for the decision maker's own insights**

- **DSS may utilize models, is built by an interactive process (frequently by end-users), supports all the phases of the decision making, and may include a knowledge component**
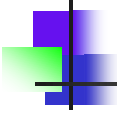
Characteristics and Capabilities of DSS (Figure 3.1)

1. **Provide support in semi-structured and unstructured situations, includes human judgment and computerized information**
2. **Support for various managerial levels**
3. **Support to individuals and groups**
4. **Support to interdependent and/or sequential decisions**
5. **Support all phases of the decision-making process**
6. **Support a variety of decision-making processes and styles**

(more)

---

7. **Are adaptive**
8. **Have user friendly interfaces**
9. **Goal: improve effectiveness of decision making**
10. **The decision maker controls the decision-making process**
11. **End-users can build simple systems**
12. **Utilizes models for analysis**
13. **Provides access to a variety of data sources, formats, and types**

Decision makers can make better, more consistent decisions in a timely manner

FIGURE 3.1 THE IDEAL CHARACTERISTICS AND CAPABILITIES OF DSS
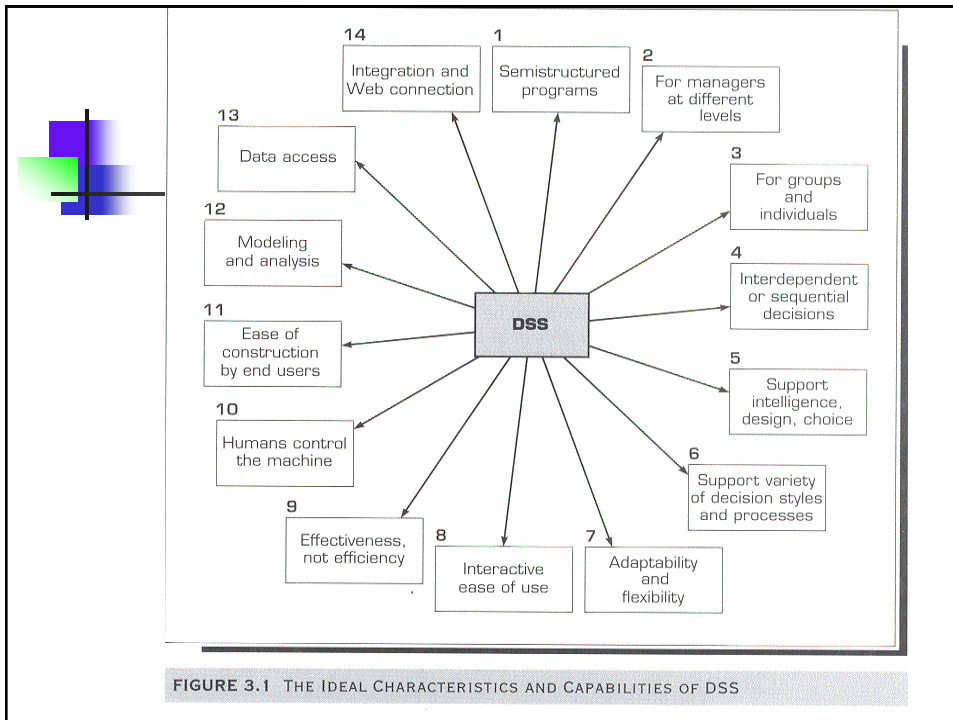
DSS Components

1. Data Management Subsystem

2. Model Management Subsystem

3. Knowledge-based (Management) Subsystem

4. User Interface Subsystem

5. The User

(Figure 3.2)

FIGURE 3.2 A SCHEMATIC VIEW OF DSS

Data: external and internal

Other computer-based systems

Internet, intranets, extranets

Data management

Model management

External models

Knowledge-based subsystems

User interface

Organizational KB

Manager (user)

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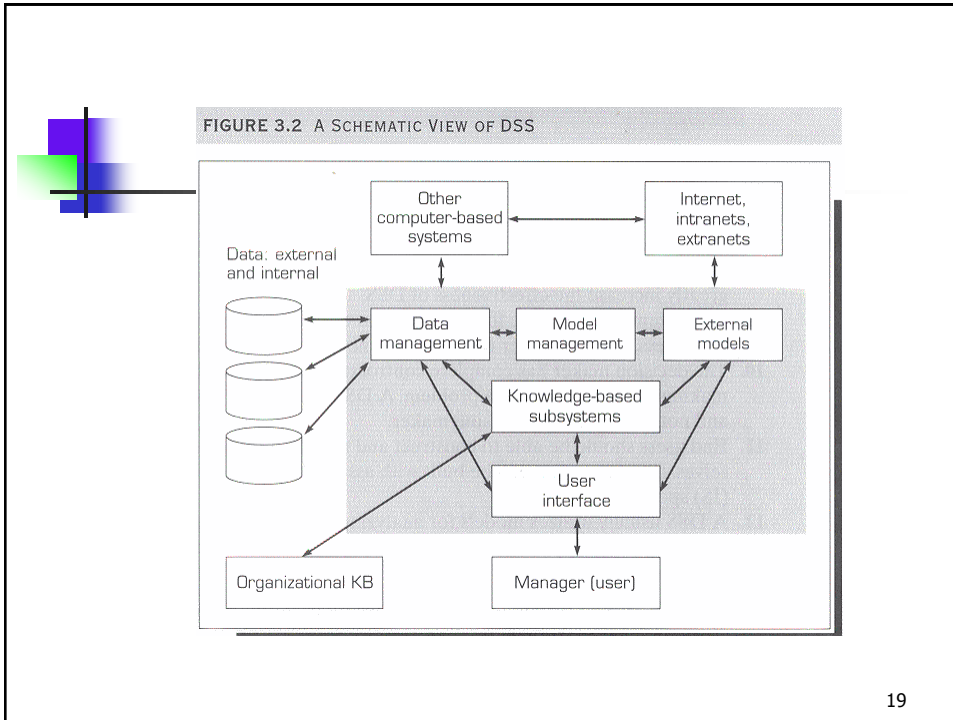
The Data Management Subsystem

- **DSS database**
- **Database management system**
- **Data directory**
- **Query facility (Figure 3.3)**

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FIGURE 3.3 THE STRUCTURE OF THE DATA MANAGEMENT SUBSYSTEM

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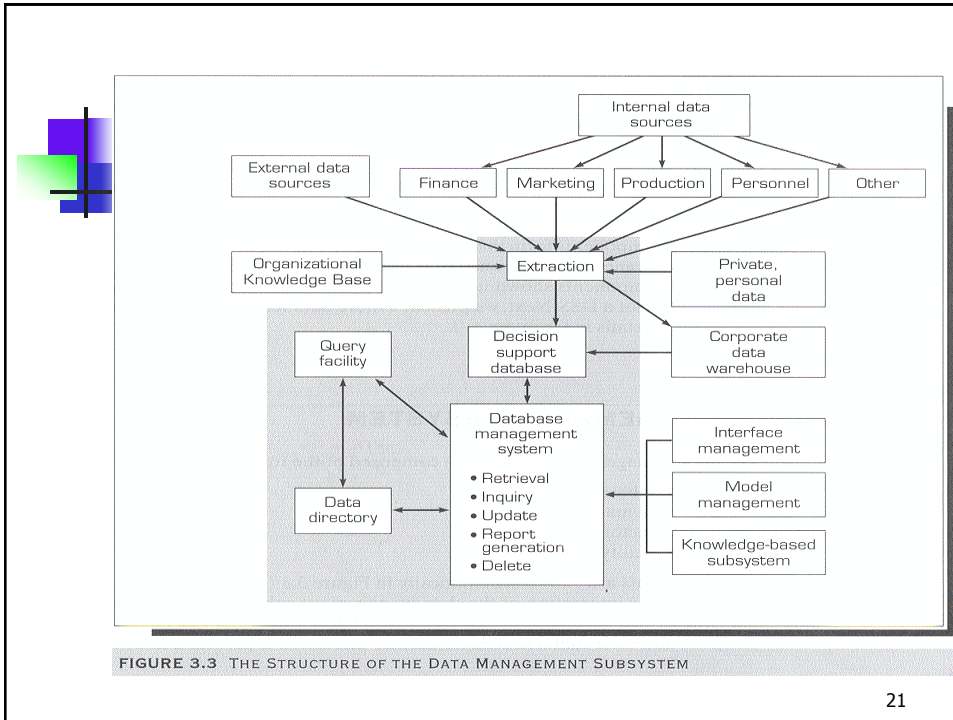
DSS In Focus 3.2: The Capabilities of DBMS in a DSS

- **Captures/extracts data for inclusion in a DSS database**
- **Updates (adds, deletes, edits, changes) data records and files**
- **Interrelates data from different sources**
- **Retrieves data from the database for queries and reports**
- **Provides comprehensive data security (protection from unauthorized access, recovery capabilities, etc.)**
- **Handles personal and unofficial data so that users can experiment with alternative solutions based on their own judgment**
- **Performs complex data manipulation tasks based on queries**
- **Tracks data use within the DSS**
- **Manages data through a data dictionary**

Decision Support Systems and Intelligent Systems, Efraim Turban and Jay E. Aronson, 6th edition
Copyright 2001, Prentice Hall, Upper Saddle River, NJ

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DSS Database Issues

- **Data warehouse**
- **Data mining**
- **Special independent DSS databases**
- **Extraction of data from internal, external, and private sources**
- **Web browser data access**
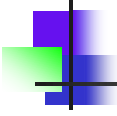- **Web database servers**
- **Multimedia databases**
- **Special GSS databases (like Lotus Notes / Domino Server)**
- **Online Analytical Processing (OLAP)**
- **Object-oriented databases**

- **Commercial database management systems (DBMS)**

The Model Management Subsystem
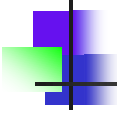
- **Analog of the database management subsystem (Figure 3.4)**
- **Model base**
- **Model base management system**
- **Modeling language**
- **Model directory**
- **Model execution, integration, and command processor**

Models (Model Base)

• Strategic, tactical, operational
• Statical, financial, marketing,
  management science,
  accounting, engineering, etc.
• Model building blocks

Model Directory

Model Base Management

• Modeling commands: creation
• Maintenance: update
• Database interface
• Modeling language

Model execution,
integration, and
command processor

Data management | Interface management | Knowledge-based subsystem

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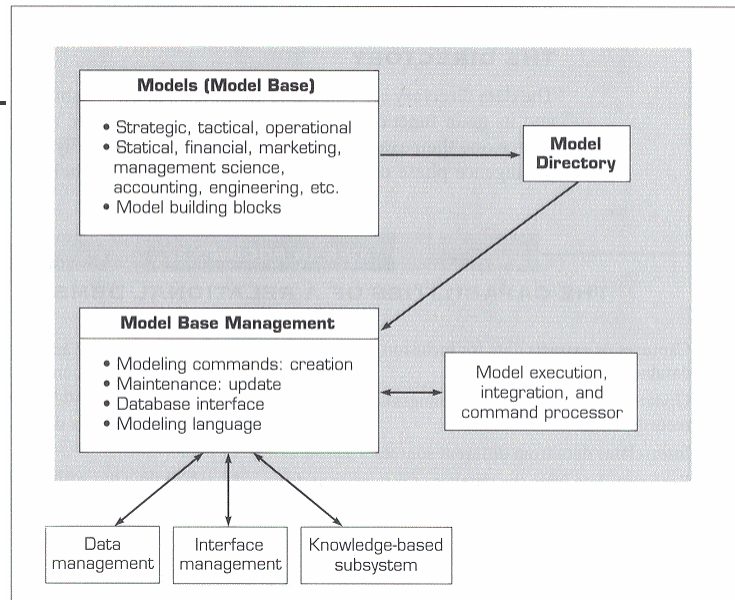
Model Management System

- **Strategic Models: Non routine**
  mergers, impact analysis, capital budgeting

- **Tactical Models: Allocation & Control**

  labor requirements, sales promotion planning

- **Operational Models: Routine-day-to-day**
  production scheduling, inventory control, quality control

- **Analytical Models:** SAS, SPSS, OR, data mining

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Model Management Issues

- **<u>Model level</u>: Strategic, managerial (tactical), and operational**

- **Modeling languages**

- **Lack of standard MBMS activities. <u>WHY?</u>**

- **Use of AI and fuzzy logic in MBMS**

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DSS IN FOCUS 3.3

MAJOR FUNCTIONS OF THE MBMS

- Creates models easily and quickly, either from scratch or from existing models or from the building blocks
- Allows users to manipulate models so that they can conduct experiments and sensitivity analyses ranging from what-if to goal seeking
- Stores, retrieves, and manages a wide variety of different types of models in a logical and integrated manner
- Accesses and integrates the model building blocks

- Catalogs and displays the directory of models for use by several individuals in the organization
- Tracks model data and application use
- Interrelates models with appropriate linkages with the database and integrates them within the DSS
- Manages and maintains the model base with management functions analogous to database management: store, access, run, update, link, catalog, and query
- Uses multiple models to support problem solving

MBMS: Model Base Management System

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The Knowledge Based Subsystem

- **Provides expertise in solving complex unstructured and semi-structured problems**
- **Expertise provided by an expert system or other intelligent system**
- **Advanced DSS have a *knowledge* based (*management)* component**
- **Leads to intelligent DSS**
- **Example: Data mining**

The User Interface (Dialog) Subsystem

- **Includes all communication between a user and the DSS**
- **Graphical user interfaces (GUI)**
- **Voice recognition and speech synthesis possible**

- **To most users, the user interface *is* the system**

FIGURE 3.5 SCHEMATIC VIEW OF THE USER INTERFACE SYSTEM

Data Management and DBMS	Knowledge-based subsystem	Model Management and MBMS

User Interface Management System (UIMS)

Natural Language Processor

Input	**Output**
Action Languages	Display Languages

Terminal

Printers, Plotters

Users
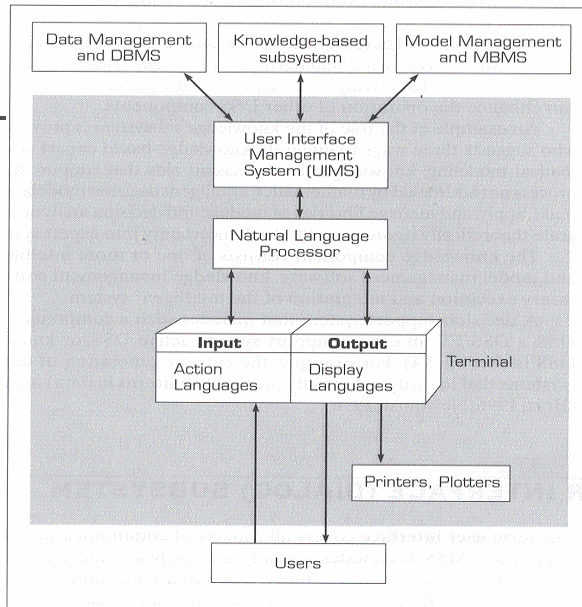
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DSS IN FOCUS 3.5

MAJOR CAPABILITIES OF THE UIMS

- Provides a graphical user interface, frequently using a Web browser
- Accommodates the user with a variety of input devices
- Presents data with a variety of formats and output devices
- Gives users help capabilities, prompting, diagnostic and suggestion routines, or any other flexible support
- Provides interactions with the database and the model base
- Stores input and output data
- Provides color graphics, three-dimensional graphics, and data plotting

- Has windows to allow multiple functions to be displayed concurrently
- Can support communication among and between users and builders of MSS
- Provides training by example (guiding users through the input and modeling process)
- Provides flexibility and adaptiveness so the MSS can accommodate different problems and technologies
- Interacts in multiple, different dialog styles
- Captures, stores, and analyzes dialog usage (tracking) to improve the dialog system; tracking by user is also available

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Overall Capabilities

Create variety of SDSS quickly and easily
Facilitate iterative design process

General Capabilities

Easy to use For routine use, modification, and construction of DSS	Access to a variety of data sources, types, and formats for a variety of problems and contexts	Access to a variety of analysis capabilities with some suggestion or guidance available

Component Capabilities

User Interface	Data	Models

1. Variety of output formats and devices
 	
2. Variety of user input devices
 	
3. Variety of dialog styles and ability to shift
 	
4. Support communication among users and with builder
 	
5. Support knowledge of users (documentation)
 	
6. Capture, store, analyze dialogs (tracking of dialogs)
 	
7. Flexible and adaptive dialog support
	1. Variety of data forms and types
	
	2. Extraction, capture, and integration
	
	3. Data access function
	
	   a. retrieval/query
	   b. report/display
	   c. user/efficient data handling
	
	4. Database management function
	
	5. Variety of logical data views available
	
	6. Data documentation
	
	7. Tracking of data usage
	
	8. Flexible and adaptive data support
		1. Library of models to constitute a model base
		
		   a. many types
		   b. maintain, catalog, integrate
		   c. canned (preprogrammed) library
		
		2. Model-building facility
		
		3. Model-manipulation and use facility
		
		4. Model base management functions
		
		5. Model documentation
		
		6. Tracking of model usage
		
		7. Flexible and adaptive model support

FIGURE 3.8 SUMMARY OF DSS CAPABILITIES

Source: Ralph Sprague and Eric Carlson, *Building Effective Decision Support Systems,* 1982, p. 313.
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The User of DSS

Different usage patterns for the *user*, the *manager*, or the *decision maker*

- **Managers**
- **Staff specialists**
- **Intermediaries**
  1. *Staff assistant*
  2. *Expert tool user*
  3. *Business (system) analyst*
  4. *GSS Facilitator*

Decision Support Systems and Intelligent Systems, Efraim Turban and Jay E. Aronson, 6th edition
Copyright 2001, Prentice Hall, Upper Saddle River, NJ

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DSS Hardware

Evolved with computer hardware and software technologies

Major Hardware Options

- **Mainframe**
- **Workstation**
- **Personal computer**
- **Web server system**
  - Internet
  - Intranets
  - Extranets

Distinguishing DSS from Management Science and MIS

- **DSS is a problem-solving tool and is frequently used to address ad hoc and unexpected problems**
- **Different than MIS**
- **DSS evolve as they develop**

TABLE 3.3 The Major Characteristics of MIS, MS/OR, and DSS
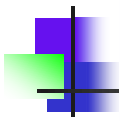
Management Information Systems (MIS)
- The main impact has been on structured tasks, where standard operating procedures, decision rules, and information flows can be reliably predefined.
- The main payoff has been in improving efficiency by reducing costs, turnaround time, and so on, and by replacing clerical personnel or increasing their productivity.
- The relevance for managers' decision making has mainly been indirect (e.g., by providing reports and access to data).
- MIS application is routine and done periodically.

Management Science/Operations Research
- The impact has mostly been on structured problems (rather than tasks), in which the objective, data, and constraints can be prespecified.
- The payoff has been in generating better solutions for general categories of problems (e.g., inventory).
- The relevance for managers has been in the provision of detailed recommendations and new methods handling complex problems.
- Application are nonroutine, as needed.

Decision Support Systems
- The impact is on decisions in which there is sufficient structure for computer and analytic aids to be of value but where the manager's judgment is essential.
- The payoff is in extending the range and capability of managers' decision processes to help them improve their effectiveness.
- The relevance for managers is in the creation of a supportive tool, under their own control, that does not attempt to automate the decision process, predefine objectives, or impose solutions.
- DSS applications are nonroutine, as needed.
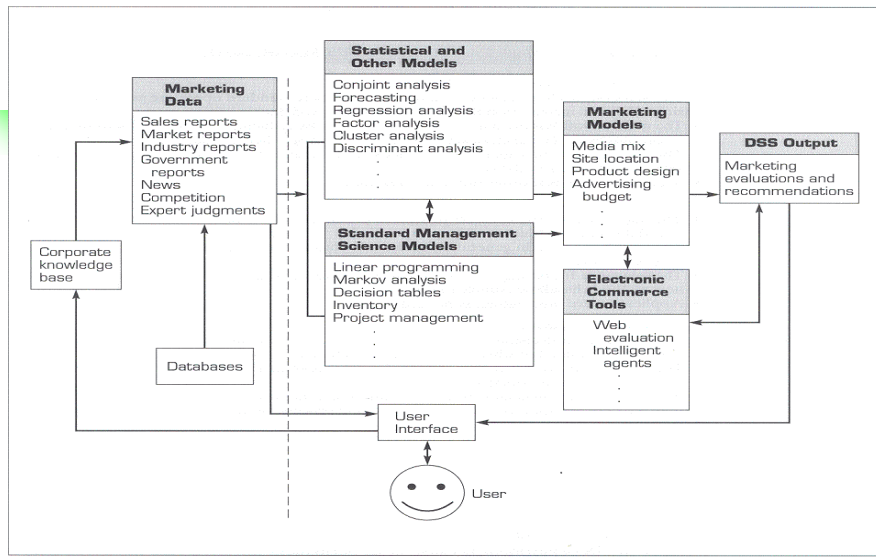
Source: Keen and Scott Morton (1978), pp. 1–2.

FIGURE 3.6 A MARKETING DSS FRAMEWORK

Source: Based on P. Kotler, *Marketing Management,* 8th ed. Englewood Cliffs, NJ: Prentice Hall, 1994.

DSS Classifications

Alter's Output Classification (1980)

- **Degree of action implication of system outputs (supporting decision) (Table 3.4)**

- **Holsapple and Whinston's Classification**
  1. **Text-oriented DSS**
  2. **Database-oriented DSS**
  3. **Spreadsheet-oriented DSS**
  4. **Solver-oriented DSS**
  5. **Rule-oriented DSS**
  6. **Compound DSS**

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TABLE 3.4 Characteristics of Different Classes of Decision Support Systems

Orientation	Category	Type of Operation	Type of Task	User	Usage Pattern	Time
Data	File drawer systems	Access data items	Operational	Nonmanagerial line personnel	Simple inquiries	Irregular
	Data analysis systems	Ad hoc analysis of data files	Operational analysis	Staff analyst or managerial line personnel	Manipulation and display of data	Irregular or periodic
Data or Models	Analysis information systems	Ad hoc analysis involving multiple databases and small models	Analysis, planning	Staff analyst	Programming special reports, developing small models	Irregular, on request
Models	Accounting models	Standard calculations that estimate future results on the basis of accounting definitions	Planning, budgeting	Staff analyst or manager	Input estimates of activity; receive estimated monetary results as output	Periodic (e.g., weekly, monthly, yearly)
	Representational models	Estimating consequences of particular actions	Planning, budgeting	Staff analyst	Input possible decision; receive estimated results as output	Periodic or irregular (ad hoc analysis)
	Optimization models	Calculating an optimal solution to a combinatorial problem	Planning, resource allocation	Staff analyst	Input constraints and objectives; receive answer	Periodic or irregular (ad hoc) analysis
	Suggestion models	Performing calculations that generate a suggested decision	Operational	Nonmanagerial line personnel	Input a structured description of the decision situation; receive a suggested decision as output	Daily or periodic

Source: Condensed from Alter (1980), pp. 90–91.

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Intelligent DSS Categories

- **Descriptive**
- **Procedural**
- **Reasoning**
- **Linguistic**
- **Presentation**
- **Assimilative**

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FIGURE 4.6   Six Types of Knowledge

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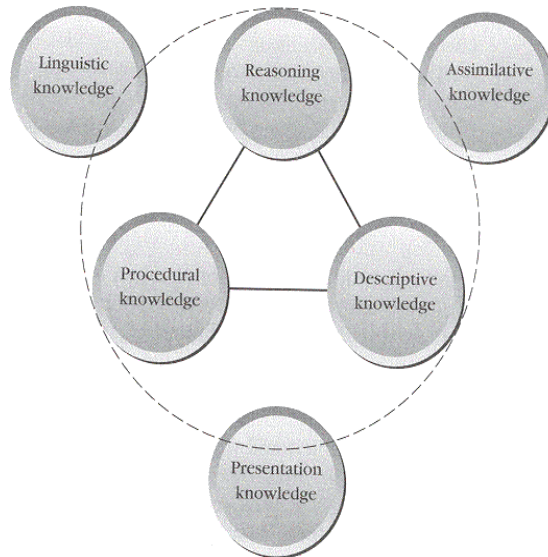
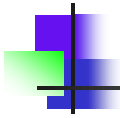# Alternate Categories of Intelligent DSS

- **Symbiotic**
- **Expert-system based**
- **Adaptive**
- **Holistic**

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Other Classifications

Institutional DSS vs. Ad Hoc DSS

- **Institutional DSS deals with decisions of a recurring nature**
- **Ad Hoc DSS deals with specific problems that are usually neither anticipated nor recurring**

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Other Classifications (cont'd.)

- **Degree of nonprocedurality (Bonczek et al., 1980)**

- **Personal, group, and organizational support (Hackathorn and Keen, 1981)**

- **Individual versus group support systems (GSS)**

- **Custom-made versus ready-made systems**
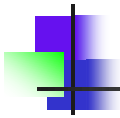
Summary

- **DSS has many definitions**

- **Complexity of managerial decision making is increasing**

- **Computer support for managerial decision making**

- **Several MSS technologies including hybrids**

Summary

- **Fundamentals of DSS**

- **Components of DSS**

- **Major capabilities of the DSS components**

- **Major DSS categories**

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FIGURE 3.7 THE STRUCTURE OF THE JOURNAL-EVALUATION DSS IN HONG KONG

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