Part 2:
Decision Support Systems

- Decision Support Methodology
- Technology Components
- Construction

Chapter 3: Decision Support Systems: An Overview

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

3.1 Opening Vignette: Gotaas-Larsen Shipping Corp. (GLSC)

- Strategic planning
- Not a structured decision situation
- Cargo ship voyage planning
- DSS: Data and Models
- Large-scale DSS

3.2 DSS Configurations

Opening Vignette Illustrates that for the GLSC, the DSS

- **Supports an entire organization**
- **Supports several interrelated decisions**
- **Is used repeatedly and constantly**
- **Has two major components: data and models**
- **Utilizes a simulation model**
- **Uses both internal and external data**
- **Has "what-if" capabilities**
- **Uses several quantitative models**

DSS Definitions

- **Little [1970]**
  "model-based set of procedures for processing data and judgments to assist a manager in his decision making"
  Assumption: that the system is computer-based and extends the user's capabilities.

- **Alter [1980]**
  Contrasts DSS with traditional EDP systems (Table 3.1)

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].

- **Moore and Chang [1980]**

  1.extendible systems
  2.capable of supporting ad hoc data analysis and decision modeling
  3.oriented toward future planning
  4.used at irregular, unplanned intervals

- **Bonczek et al. [1980]**

  A computer-based system consisting of
  1. a language system -- communication between the user and DSS components
  2. a knowledge system
  3. a problem-processing system--the link between the other two components

- **Keen [1980]**

  DSS apply "to situations where a `final' system can be developed only through an adaptive process of learning and evolution"

- **Central Issue in DSS**

  support and improvement of decision making

TABLE 3.2 Concepts Underlying DSS Definitions.

Source	DSS Defined in Terms of
Gorry and Scott Morton [1971]	Problem type, system function (support)
Little [1970]	System function, interface characteristics
Alter [1980]	Usage pattern, system objectives
Moore and Chang [1980]	Usage pattern, system capabilities
Bonczek, et al. [1996]	System components
Keen [1980]	Development process

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**

3.4 Characteristics and Capabilities of DSS

- **DSS (Figure 3.1)**
  1. Provide support in semi-structured and unstructured situations
  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

7. Are adaptive
8. Have user friendly interfaces
9. Goal is to improve the 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

3.5 DSS Components

1. **Data Management Subsystem**
2. **Model Management Subsystem**
3. **Knowledge Management Subsystem**
4. **User Interface Subsystem**
5. **The User**

(Figure 3.2)

3.6 The Data Management Subsystem

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

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

DSS Database Issues

- Data warehouse
- Special independent DSS databases
- Extraction of data from internal, external and private sources
- *Web browser* access of data
- Multimedia databases
- Object-oriented databases
- Commercial database management systems (DBMS)

3.7 The Model Management Subsystem

- **Mirrors the database management subsystem (Figure 3.4)**

Model Management Issues

- **Model level: Strategic, managerial (tactical) and operational**
- **Modeling languages**
- **Lack of standard MBMS activities. WHY?**
- **Use of AI and Fuzzy logic in MBMS**

DSS In Focus 3.3: Major Functions (Capabilities) of the MBMS

- Creates models easily and quickly, either from scratch or from existing models or from the building blocks.
- Allows users to manipulate the models so 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 models 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.

3.8 The Knowledge Management 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 management* component
- Leads to intelligent DSS
- Example: Data mining

3.9 The User Interface (Dialog) Subsystem

- **Includes all communication between a user and the MSS**
- **To most users, the user interface *is* the system**

DSS In Focus 3.5: Major Capabilities of the UIMS

- Provides graphical user interface.
- 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 examples (guiding users through the input and modeling process).
- Provides flexibility and adaptiveness so the MSS will be able to 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 the user is also available.

3.10 The User

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

- **Managers**
- **Staff specialists**
- **Intermediary:**
  1. ***Staff assistant***
  2. ***Expert tool user***
  3. ***Business (system) analyst***
  4. ***Group DSS Facilitator***

3.11 DSS Hardware

Evolved with computer hardware and software technologies

Major Hardware Options

- **organization's mainframe computer**
- **minicomputer**
- **workstation**
- **personal computer**
- **client/server system**

3.12 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 3.4 The Major Characteristics of MIS, MS/OR, and DSS

Management Information Systems
• The main impact has been on structured tasks, where standard operating procedures, decision rules and information flows can be reliable predefined. • The main payoff has been in improving efficiency by reducing costs, turnaround time, and so on, and by replacing clerical personnel. • The relevance for managers' decision making has mainly been indirect; for example, by providing reports and access to data.
Management Science/Operations Research
• The impact has mostly been on structured problems (rather than tasks), where the objective, data, and constraints can be prespecified. • The payoff has been in generating better solutions for given types of problems. • The relevance for managers has been the provision of detailed recommendations and new methodologies for handling complex problems.
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 computerized managers' decision processes to help them improve their effectiveness. • The relevance for managers is the creation of a supportive tool, under their own control, that does not attempt to automate the decision process, predefine objectives, or impose solutions.

Source: Keen and Scott Morton [1978], p. 1.

3.13 DSS Classifications

Alter's Output Classification [1980]

- **Degree of action implication of system outputs (supporting decision) (Table 3.3)**

- **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**

TABLE 3.4 Characteristics of Different Classes of Decision Support Systems.

Orientation	Category	Type of Operation	Type of Task	User	Usage Pattern	Time Frame
Data	File drawer systems	Access data items	Operational	Nonmanager-ial line personnel	Simple inquiries	Irregular
	Data analysis systems	Ad hoc analysis of files of data	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)
	Representa-tional models	Estimating consequences of particular actions	Planning, budgeting	Staff analyst	Input possible decisions; 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	Nonmanager-ial 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.

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**

Other Classifications (cont'd.)

- **Degree of Nonprocedurality (Bonczek, et al. [1980])**
  Personal, Group, and Organizational Support (Hackathorn and Keen [1981])
- **Individual versus Group DSS**
- **Custom-made versus Ready-made Systems**

Summary

- **Fundamentals of DSS**
- **GLSC Case**
- **Components of DSS**
- **Major Capabilities of the DSS Components**

Exercises

1. **Susan Lopez was promoted to be a director of the transportation department in a medium-size university. ... Susan's major job is to schedule vehicles for employees, and to schedule the maintenance and repair of the vehicles. Possibility of using a DSS to improve this situation. Susan has a Pentium PC, and Microsoft Office, but she is using the computer only as a word processor.**

Group Projects

1. **Design and implement a DSS for either the problem described in Exercise 1 above or a similar, real-world one. Clearly identify data sources and model types, and document the problems your group encountered while developing the DSS.**