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DECISION SUPPORT SYSTEMS AND INTELLIGENT SYSTEMS

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DECISION MAKING AND COMPUTERIZED SUPPORT

- **Management Support Systems (MSS)**
  Collection of computerized technologies

- **Objectives**
  - **to support managerial work**
  - **to support decision making**

Chapter 1: Management Support Systems-- An Overview

Emerging and Advanced Computer Technologies for Supporting the Solution of Managerial Problems

- **These Technologies are**
  - **Changing Organizational Structure**
  - **Enabling Business Process Reengineering**
  - **Changing Management Methods**

1.1 Opening Vignette: Decision Support at Roadway Package System (RPS)

- **Business-to-business small package delivery**
- **Extremely competitive**
- **Roadway Package System (RPS) started operations in March 1985**

Decision Support System(s) (DSS)

- ***Location Problem Solution*: Quantitative location model via a DSS using SAS**

  Major Growth lead to 50 Decision Support Applications in 3 Critical Application Areas:
- ***Market Planning and Research***
- ***Operation and Strategic Planning***
- ***Sales Support***

DSS and EIS Upshot

- **Both Managers and Customers access information**
- **Information processing is vital to survival**
- **Help management make timely and effective decisions**
- **Providing reliable and relevant information, in the correct format, at the right time**
- **Help conduct *analysis* easily and quickly**

1.2 Managers and Decision Making
Why Computerized Support?
For RPS Opening Vignette

- **Competition**
- **End-user and customer access**
- **Special data warehouse**
- **Two major technologies**
  - **DSS (supports managers and marketing analysts)**
  - **EIS (supports top managers)**
    Diversity of decisions
- **Much internal and external data**
- **DSS applications separate from the TPS, but use TPS data**
- **Statistical and other quantitative models**
- **The MANAGERS are responsible for decision making**

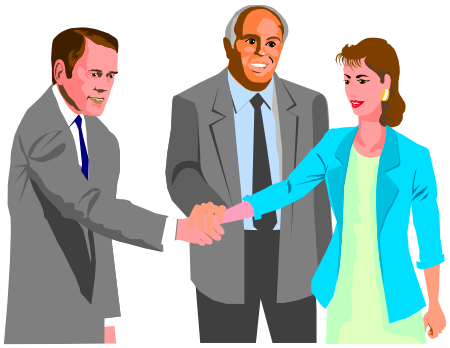
The Nature of Managers' Work

What Do Managers Do?

Mintzberg [1980] (Table 1.1)

Roles of Managers

- **Interpersonal**
  - **Figurehead**
  - **Leader**
  - **Liason**
- **Informational**
  - **Monitor**
  - **Disseminator**
  - **Spokesperson**
- **Decisional**
  - **Entrepreneur**
  - **Disturbance Handler**
  - **Resource Allocator**
  - **Negotiator**



Managers *need* information and *use* computers to support decision making

1.3 Managerial Decision Making and Information Systems

- ***Management*** **is a process by which organizational goals are achieved through the use of resources**

- **Resources: *Inputs***
- **Goal Attainment: *Output***
- **Measuring Success: *Productivity* = *Outputs / Inputs***

- ***All*** **managerial activities revolve around decision making**
- **The *manager* is a decision maker**
- **Decision making was considered a pure art--a talent**
- **Individual styles used, not systematic quantitative scientific methods**
- **Now fast changing, complex environment**

- **See Figure 1.1: Major Factors, Trends and Results Impacting on Managerial Decision Making**

- **Difficult to make decisions**
- **Many alternatives due to improved technology and communication systems**
- **Cost of making errors can be very large**
- **Information may be difficult to access**
- **Decisions must be made quickly**

Trial-and-error approach to management - *Not so Good!*

Use *new* tools and techniques

1.4 Managers and Computerized Support

- **Computer technologies evolve and expand**
- **Impacts on organizations and society increasing**
- **Interaction and cooperation between people and machines rapidly growing**
- **Computerized systems are now used in complex managerial areas**

Information Technology **is vital to the business**
(Survey says "#1 issue)
and executives are implementing technologies extensively (Caldwell [1995])

Computer Applications Evolving from TPS and MIS to Proactive Applications (DSS)

New Modern Management Tools in

- **Data access**
- **On-line analytical processing (OLAP)**
- **Internet / Intranet / Web**

for decision support

1.5 The Need for Computerized Decision Support and the Supporting Technologies

- Speedy computations
- Overcoming cognitive limits in processing and storage
- Cognitive limits may restrict an individual's problem solving capability
- Cost reduction
- Technical support
- Quality support
- Competitive edge: business processes reengineering and empowerment

Primary Decision Support Technologies

Management Support Systems (MSS)

- **Decision Support Systems (DSS)**
- **Group Support Systems (GSS), including Group DSS (GDSS)**
- **Executive Information Systems (EIS)**
- **Expert Systems (ES)**
- **Artificial Neural Networks (ANN)**
- **Hybrid Support Systems**
- **Cutting Edge Intelligent Systems (Genetic Algorithms, Fuzzy Logic, Intelligent Agents, ...)**

1.6 A Classic Framework for Decision Support

- **Figure 1.2 (Proposed by Gorry and Scott Morton [1971])**

Combination of

- **Simon [1977] Taxonomy and**
- **Anthony [1965] Taxonomy**

Simon: Decision-making along a continuum

- Highly structured (*programmed*) decisions to
- Highly unstructured (*nonprogrammed*) decisions

Simon: Three Phase decision-making process

- 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

- ***Unstructured problem*** **has no structured phases**
- ***Semistructured problem*** **has some (or some parts with) structured phases**
- ***Structured problem*** **has *all* structured phases**
  - **Procedures for obtaining the best solution are known**
  - **Objectives are clearly defined**
  - **Management support systems such as DSS and ES can be useful**

- ***Unstructured problem*** **often solved with human intuition**

- ***Semistructured problems*** **fall in between.**

  Solve with both standard solution procedures and human judgment

- **A Decision Support System can help managers understand problems in addition to providing solutions**

- ***Goal of DSS:*** **Increase the Effectiveness of Decision Making**

Anthony's Taxonomy [1965]

Broad Categories encompass *ALL* managerial activities

- **Strategic planning**
- **Management control**
- **Operational control**

- **Combine Anthony and Simon's Taxonomies**
- **Decision Support System (DSS) for semistructured and unstructured decisions**
- **MIS and management science (MS) approaches insufficient**

Computer Support for Structured Decisions

- Since the 1960s
- Repetitive in nature
- High level of structure
- Can abstract and analyze them, and classify them into prototypes
- Solve with quantitative formulas or models
- Method: called Management Science (MS) or Operations Research (OR)

Management Science

- ***Scientific approach*** **to automate managerial decision making**
  1.Define the *problem*
  2.Classify the *problem* into a standard category
  3.Construct a mathematical *model*
  4.Find and evaluate potential solutions to *model*
  5.Choose and recommend a solution to *problem*

  Modeling**:** Transforming the real-world problem into an appropriate prototype structure

1.7 Concept of Decision Support Systems (DSS)

Scott Morton [1971]

- DSS are interactive computer-based systems, which help decision makers utilize *data* and *models* to solve unstructured problems [1971]

Keen and Scott Morton [1978]

- Decision support systems couple the intellectual resources of individuals with the capabilities of the computer to improve the quality of decisions. It is a computer-based support system for management decision makers who deal with semi-structured problems.

DSS: Content-free expression, i.e.,

means different things to different people
There is no universally accepted definition of DSS

DSS as an Umbrella Term

- **DSS sometimes describes any computerized system used to support decision making**

  ***Narrow definition*: specific technology**

Major Characteristics of a DSS

(DSS In Action 1.5: Houston Minerals Case)

- **Initial risk analysis based on decision maker's definition of the situation using a management science approach**
- **Model scrutiny using experience, judgment, and intuition**
- **Initial model mathematically correct, but incomplete**
- **DSS provided very quick analysis**
- **DSS: flexible and responsive to allow *managerial intuition* and *judgment***

Why Use a DSS?

Perceived benefits (Udo and Guimaraes [1994])

- **decision quality**
- **improved communication**
- **cost reduction**
- **increased productivity**
- **time savings**
- **improved customer and employee satisfaction**

Highly Correlated Factors

- **degree of competition**
- **industry**
- **size of company**
- **user-friendliness**

Major Reasons of Firestone Tire & Rubber Co. [1982]

- **Unstable economy**
- **Increasing competition**
- **Increased difficulty in tracking numerous business operations.**
- **Existing computer system did not support objectives**
- **IS Department could not handle needs or *ad hoc* inquiries**
- **Business analysis functions were not inherent within existing systems**

Why major corporations started large-scale DSS

Hogue and Watson [1983]

Factors	Cited by percent
Accurate information is needed	67
DSS is viewed as an organizational winner	44
New information is needed	33
Management mandated the DSS	22
Timely information is provided	17
Cost reduction is achieved	6

- Plus: End-user computing, especially due to PC's and inexpensive DSS software development platforms

1.8 Group Support Systems (GSS)

- Decisions often made by groups
- Supports (improves) the work of groups, anytime, anyplace

GSS also called

- Groupware
- Electronic meeting systems
- Collaborative systems
- Group Decision Support Systems (GDSS)

1.9 Executive Information (Support) Systems (EIS, ESS)

Strictly for Executive Use!

- **Provide an organizational view**
- **Serve the information needs of executives and other managers.**
- **Provide an extremely user friendly (user seductive) interface**
- **Interface customized to individual decision styles**
- **Provide timely and effective tracking and control**
- **Provide quick access to detailed information behind text, numbers, or graphics (Drill Down)**
- **Filter, compress, and track critical data and information**
- **Identify problems (opportunities)**

EIS

- **Started in mid-1980s in large corporations**
- **Going global**
- **Becoming affordable to smaller companies**
- **Serving many managers as *enterprise-wide systems***

1.10 Expert Systems

- **Experts solve complex problems**
- **Experts have specific knowledge and experience**
- **Experts are aware of**
  - **alternatives**
  - **chances of success**
  - **benefits and costs**

Expert systems attempt to mimic human experts

An *Expert System* (ES) is a decision-making and/or problem-solving computer package that reaches or exceeds a level of performance comparable to a human expert in some specialized and usually narrow problem area

1.11 Artificial Neural Networks

- Can work with partial, incomplete, or inexact information
- Artificial Neural Networks (ANN) are mathematical models of the human brain
- Neural networks learn patterns in data

Cutting Edge Intelligent Systems

- **Genetic Algorithms**
  Work in an evolutionary fashion
- **Fuzzy Logic**
  Continuous logic (NOT just True / False)
- **Intelligent Agents**
  Generally in search engines,
  also in electronic commerce

1.12 Hybrid Support Systems

- **Combination of MSS Information Technologies**
- **Integrated Systems can use strengths of each**
- **Goal: *successful solution* of the managerial problem**

  not the use of a specific tool or technique

Some Hybrid Approaches

- **Use each tool independently**
- **Use several loosely integrated tools**
- **Use several tightly integrated**

- **Tools can support each other**

  (e.g., ES adds intelligence to a DSS database)

- **More intelligence is being added (by ES, neural networks, fuzzy logic, intelligent agents) to traditional MSS**

1.13 The Evolution and Attributes of Computerized Decision Aids

- **Summary of the development of computerized procedures used as aids in decision making (Table 1.2)**
- **The support to specific questions provided by DSS (Table 1.3)**

Phase	Description	Examples of Tools
Early	Compute "crunch numbers," summarize, organize.	Calculators, early computer programs, statistical models, simple management science models.
Intermediate	Find, organize, and display decision-relevant information.	Database management systems, MIS, filing systems, management science models.
Current	Perform decision-relevant computations on decision-relevant information; organize and display the results. Query-based and user-friendly approach. "What-if" analysis.	Financial models, spreadsheets, trend exploration, operations research models, CAD systems, decision support systems.
	Interact with decision makers to facilitate formulation and execution of the intellectual steps in the process of decision making.	Expert systems, executive information systems.
Just beginning	Complex and fuzzy decisions situations, expanding to collaborative decision making and to machine learning.	Second generation expert systems, group DSS, neural computing.

Table 1.2: Aids in Decision Making

Evolutionary view of computer-based information systems (CBIS)

1. Time Sequence

- **mid-1950s** **Transaction Processing Systems (TPS)**
- **1960s** **MIS**
- **1970s** **Office Automation Systems**
  DSS
- **1980s** **DSS Expanded**
  Commercial applications of expert systems
  Executive Information Systems
- **1990s** **Group Support Systems**
  Neural Computing
  Integrated, hybrid computer systems

2. Computer evolved over time

3. Systemic linkages in how each system processes data into information

See Figure 1.3 Relationship among these and other technologies

Dimension	Transactions Processing Systems (TPS)	Management Information Systems (MIS)	Decision Support Systems (DSS)	Expert Systems (ES)	Executive Support Systems (EIS)	Neural Computing
Applications	Payroll inventory, record keeping, production and sales information	Production control, sales forecasting, monitoring	Long-range strategic planning, complex integrated problem areas	Diagnosis, strategic planning, internal control planning, strategies	Support to top manage-ment decisions, environ-mental scanning	Complex, repetitive decisions. Diagnosis, control investment
Focus	Data transactions	Information	Decisions, flexibility, user-friendliness	Inferencing transfer of expertise	Tracking, control, "Drill down"	Pattern recognition
Database	Unique to each applica-tion, batch update	Interactive access by programmers	Database management systems, interactive access, factual knowledge	Procedural and factual knowledge; knowledge base (facts, rules)	External (online) and corporate, enterprise wide access (to all databases)	Historical cases, provide learning
Decision Capabilities	No decisions	Structured routine prob-lems using conventional management science tools	Semistruc-tured problems, integrated management science models, blend of judgment and modeling	Systems make complex decisions, unstructured; use of rules (heuristics)	Only when combined with a DSS	Mainly predictions, based on historical cases
Manipulation	Numerical	Numerical	Numerical	Symbolic	Numeric (mainly), some symbolic	Numeric needs preproces-sing
Type of Information	Summary reports, operational	Scheduled and demand reports, structured flow, exception reporting	Informa-tion to support specific decisions	Advice and explanations	Status access, exception reporting, key indicators	Forecasts, classification to patterns
Highest organizational level served	Sub-managerial, low management	Middle management	Analysts and managers	Managers and specialists	Senior executives (only)	Specialists, managers
Impetus	Expediency	Efficiency	Effective-ness	Effective-ness and expediency	Timeliness	Expediency

FIGURE 1.3: **Attributes of the Major Computerized Support Systems**

Relationship among these and other technologies

- Each technology unique
- Technologies interrelated

Each supports some aspects of managerial decision making

- Evolution and creation of the newer tools help expand the role of information technology for the betterment of management in organizations
- Interrelationship and coordination among these tools still evolving

Summary

- **DSS has many definitions**
- **Complexity of managerial decision making is increasing**
- **Computer support for managerial decision making is a must**
- **There are several MSS technologies, including hybrids**

Questions for the Opening Vignette

1. Identify the specific decisions cited in the case. Why, in your opinion, do such decisions need computerized support (be specific, provide an answer for each decision)?
2. It is said that the DSS/EIS helped the company to compete on prices, quality, timeliness and service. Visit a competing company such as UPS and explain the importance of this type of competition.
3. Find information about RPS (use the Internet). Find the volume of their business in terms of packages delivered and their financial statements. How successful is this company?
4. It is said that decision support tools empower employees and customers. Can you identify such empowerment in this case?
5. It is said that the TPS is separate from the DSS/EIS in this case. What kind of TPS can you envision in this type of a shipping company and why is it different from the decision support systems?

Group Exercise

- **Find information on the use of computers to support decisions versus TPS. Each member collects an application in a different industry (e.g., banking, insurance, food, etc.). The group summarizes the findings, points out similarities and differences of the applications.**
  Sources: Companies where students are employed, trade magazines, Internet news groups, and vendor advertisements.
  Prepare: A class presentation on the findings.

Case Application 1.1: Manufacturing and Marketing of Machine Devices

Part A: The 1995 Crisis - Case Questions

1. Which MSS technique is most likely to be selected by Ms. Chen, and why? (If several techniques can be used, rank them by a descending order of likelihood of success and explain your ranking.)
2. Should MSS tool(s) be used in this situation at all?

Part B - Case Questions

Examine the following three alternatives:

1. Hire Mr. Morgan; forget MSS.
2. Accelerate the evaluation of MSS technologies; forget Mr. Morgan.
3. Combine alternatives (1) and (2). Discuss the plusses and minuses of each alternative. Which one would you select and why?
4. Which MSS technique is most likely to be selected by Ms. Chen, and why?

Appendix 1-A: Computer-Based Information Systems in a Personnel Department

Illustration of the content of a typical CBIS

Category	Task
Transaction Processing Systems	Maintain Personnel records; prepare payroll; compute salaries and incentive plans.
Management Information System	Prepare summary reports (e.g., average salaries in each department). Conduct performance tracking of employees, labor budget. Do preparation, monitoring, and analysis. Perform short-term scheduling. Match positions and candidates. Monitor positions control systems. Perform fringe benefits monitoring and control.
Decision Support Systems	Prepare special reports (e.g., safety records, equal opportunity achievements). Do long-range planning for human resources. Design a compensation plan. Provide quantitative support of labor-management negotiation.
Expert Systems	Provide advice on legal, tax, and labor negotiations. Develop a social responsibility plan. Select training media. Design comprehensive training programs. Help in selecting new employees. Assist in annual employee evaluation.
Executive Information Systems	At the corporate level only. Track and display key performance indicators of the department (such as dollar earned or spent per employee).
Group DSS	Supports the process of making controversial major decisions (e.g., personnel policies); electronic brainstorming.
Neural Computing	Screen applicants for jobs. Analyze reasons why people leave, or remain with the company (find patterns).