Decision Support Systems

Lecture 1

Objectives

- Identify information processing as the foundation of managerial work
- Decision support content of different types of information systems
- Differences in characteristics of Information Systems
- Describe Decision Support Systems (DSS)
- Describe major themes
- Describe benefits of DSS
- Discuss different categories of DSS

Introduction

- Decision makers are faced with increasingly stressful environments – highly competitive, fast-paced, near real-time, overloaded with information, data distributed throughout the enterprise, and multinational in scope.
- How managers will respond quickly, innovative and agilely under the above environment?
  - By using computerized support. Take for example Toyota (opening vignette) TSL . They turned to BI to improve communication and to support executives in their effort to know exactly what is going on in each area of operation (real-time)

- Doing so, organization can cut expenses and increase customer satisfaction.
- What is the major objective of the computerized DS?
  - It is to facilitate closing the gap between the current performance of an organization and its desired performance.

Management

- ***Management is decision making***
- **The *manager* is a decision maker**
- **Organizations are filled with decision makers at different level.**
- **Management is considered as art: a talent acquired over years by trial-and-error.**
- **However decision making today is becoming more complicated:**
  - **Technology / Information/Computers : increasing→ More alternative to choose**
  - **Structural Complexity / Competition : increasing→ larger cost of error**
  - **International markets / Consumerism : increasing→ more uncertainty about future**
  - **Changes, Fluctuations : increasing→ need for quick decision**

Management problems

- Most management problems for which decisions are sought can be represented by three standard elements – objectives, decision variables, and constraints.
- **Objective**
  - Maximize profit
  - Provide earliest entry into market
  - Minimize employee discomfort/turnover
- **Decision variables**
  - Determine what price to use
  - Determine length of time tests should be run on a new product/service
  - Determine the responsibilities to assign to each worker
- **Constraints**
  - Can’t charge below cost
  - Test enough to meet minimum safety regulations
  - Ensure responsibilities are at most shared by two workers

Types of Problems

- **Structured:** situations where the procedures to follow when a decision is needed can be specified in advance
  - Repetitive
  - Standard solution methods exist
  - Complete automation may be feasible
- Unstructured: decision situations where it is not possible to specify in advance most of the decision procedures to follow
  - One-time
  - No standard solutions
  - Rely on judgment
  - Automation is usually infeasible
- Semi-structured: decision procedures that can be pre specified, but not enough to lead to a definite recommended decision
  - Some elements and/or phases of decision making process have repetitive elements

DSS most useful for repetitive aspects of semi-structured problems

DSS in Summary

- A MANAGEMENT LEVEL COMPUTER SYSTEM Which:
  - COMBINES DATA,
  - MODELS,
  - USER - FRIENDLY SOFTWARE

FOR SEMISTRUCTURED & UNSTRUCTURED DECISION MAKING.

- It utilizes data, provides an easy-to-use interface, and allows for the decision maker's own insights.

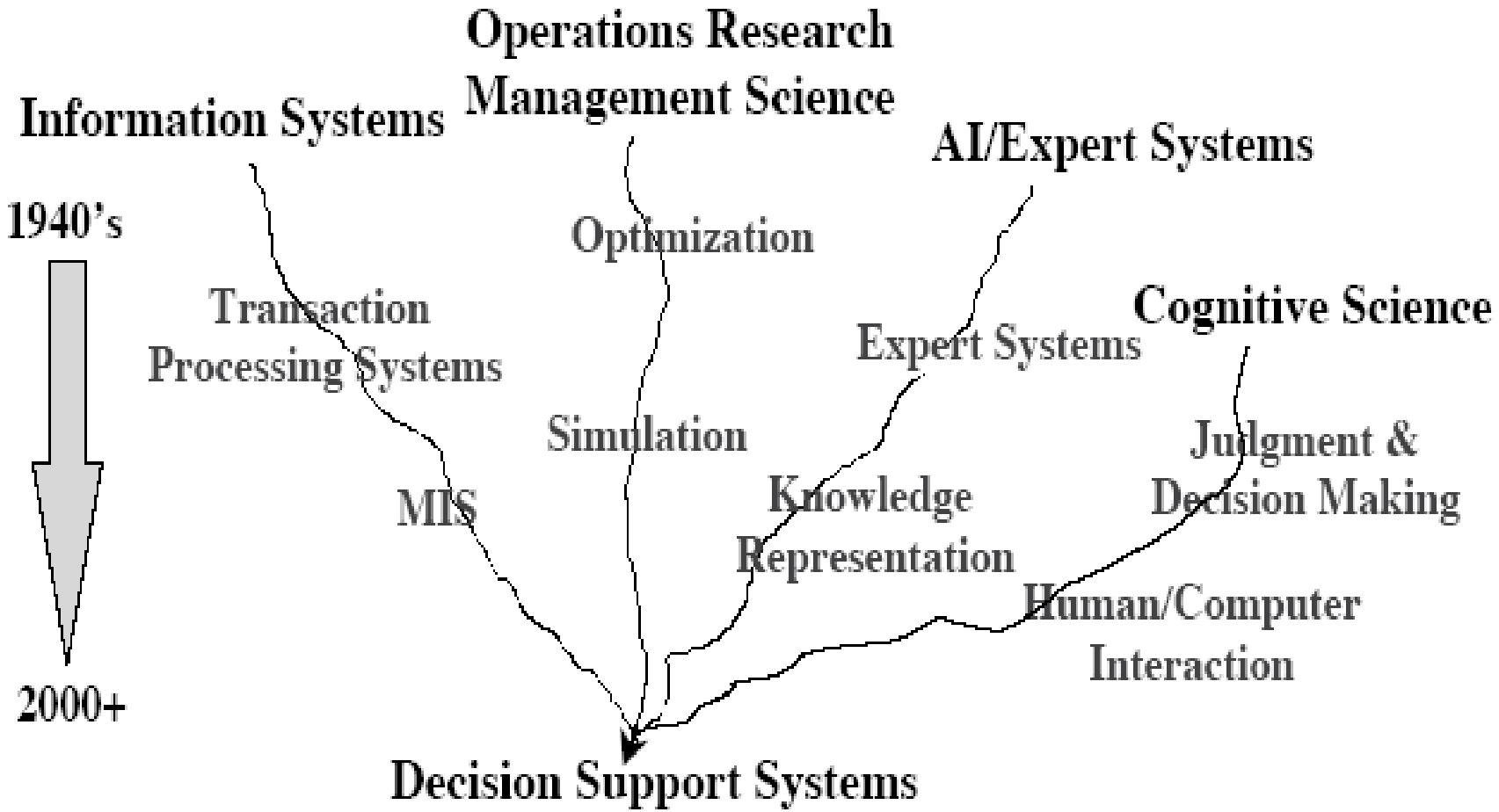
A brief history

- Academic Researchers from many disciplines has been studying DSS for approximately 40 years.
- According to Keen and Scott Morton (1978), the concept of decision support has evolved from two main areas of research: the theoretical studies of organizational decision making done at the Carnegie Institute of Technology during the late 1950s and early 1960s, and the technical work on interactive computer systems, mainly carried out at the Massachusetts Institute of Technology in the 1960s.
- It is considered that the concept of DSS became an area of research of its own in the middle of the 1970s, before gaining in intensity during the 1980s.

A brief history

- In the middle and late 1980s, Executive Information Systems (EIS), group decision support systems (GDSS), and organizational decision support systems (ODSS) evolved from the single user and model-oriented DSS.
- Beginning in about 1990, data warehousing and on-line analytical processing (OLAP) began broadening the realm of DSS.
- As the turn of the millennium approached, new Web-based analytical applications were introduced.

History of DSS



Goal: Use best parts of IS, OR/MS, AI & cognitive science to support more effective decision

Decision Structure

- Nature of decision task- classification by structure

Structured: situations where the procedures to follow when a decision is needed can be specified in advance

- Repetitive
- Standard solution methods exist
- Complete automation may be feasible

Unstructured: decision situations where it is not possible to specify in advance most of the decision procedures to follow

- One-time
- No standard solutions
- Rely on judgment
- Automation is usually infeasible

Semi-structured: decision procedures that can be pre specified, but not enough to lead to a definite recommended decision

- Some elements and/or phases of decision making process have repetitive elements

DSS most useful for repetitive aspects of semi-structured problems

Why use computerized decision support systems?

1. Speedy computations: enables decision makers to perform quick computations, low cost, timely and thousands of alternatives can be evaluated fast
2. Improved communication and collaboration: groups in different locations can use the web-based tools to communicate
3. Increased productivity of group members: using web-based tools saves money and time, since group gathering in one place is no more needed. Also software help decision makers to determine the best way to run a business in a short time

Why use computerized decision support systems?

4. Improved data management: data stored inside and outside the organization (web). Computers transmit, search and store needed data quickly, economically, securely and transparently (how?)
5. Managing giant data warehouses: computers can deal (store, access) with huge digital data of any type quickly (parallel computers)
6. Quality support: quality of decisions can be improved since more data can be accessed, more alternatives can be evaluated, view of experts can be collected quickly, AI methods can be used to derive expertise, and complex simulations can be performed.

Why use computerized decision support systems?

7. Agility support: DS technologies (intelligent systems) can empower people by allowing them to make good decisions quickly, even if they lack knowledge.
8. Overcoming cognitive limits in processing and storing information: the man mind has limited ability to process and store information.
   - Cognitive limits indicates that the individual's problem-solving capability is limited when a wide range of diverse information and knowledge is required.
   - Computerized systems overcome the cognitive limits by quickly accessing and processing vast amount of stored information.
9. Using the Web: the web changed how decision makers are supported.
10. Anywhere, anytime support: using wireless technology

Detrimental DSS Effects

- Design flaws
- Inadequate understanding of task or user
- Inadequate modeling of “reality”
- Inadequate understanding of human information processing constraints
- Can promote cognitive biases!

Taxonomies of DSS

- Using the mode of assistance as the criterion, *Power* (2002) differentiates five types for DSS:
  - Communication-driven DSS,
  - Data-driven DSS,
  - Document-driven DSS,
  - Knowledge-driven DSS, and
  - Model-driven DSS.

Model-driven DSS

- A **model-driven DSS** emphasizes access to and manipulation of a statistical, financial, optimization, or simulation model. Model-driven DSS use data and parameters provided by users to assist decision makers in analyzing a situation; they are not necessarily data intensive. Dicodess is an example of an open source model-driven DSS generator (Gachet 2004).

- Other examples:
  - A spread-sheet with formulas in
  - A statistical forecasting model
  - An optimum routing model

Data-driven (retrieving) DSS

- A **data-driven DSS** or data-oriented DSS emphasizes access to and manipulation of a time series of internal company data and, sometimes, external data.

- Simple file systems accessed by query and retrieval tools provides the elementary level of functionality. Data warehouses provide additional functionality. OLAP provides highest level of functionality.

- Examples:
  - Accessing AMMIS data base for all maintenance Jan89-Jul94 for CH124
  - Accessing INTERPOL database for crimes by …….
  - Accessing border patrol database for all incidents in Sector ...

Model and data-retrieving DSS

- Examples:
  - Collect weather observations at all stations and forecast tomorrow's weather
  - Collect data on all civilian casualties to predict casualties over the next month

Communication-driven DSS

- A **communication-driven DSS** use network and communication technologies to facilitate collaboration on decision making. It supports more than one person working on a shared task.
- examples include integrated tools like Microsoft's NetMeeting or Groove (Stanhope 2002), Vide conferencing.
- It is related to group decision support systems.

Document-driven DSS

- A **document-driven DSS** uses storage and processing technologies to document retrieval and analysis. It manages, retrieves and manipulates unstructured information in a variety of electronic formats.

- Document database may include: Scanned documents, hypertext documents, images, sound and video.

- A **search engine** is a primary tool associated with document drivel DSS.

Knowledge-driven DSS

- A **knowledge-driven DSS** provides specialized problem solving expertise stored as facts, rules, procedures, or in similar structures. It suggest or recommend actions to managers.

- MYCIN: A rule based reasoning program which help physicians diagnose blood disease.

Architecture

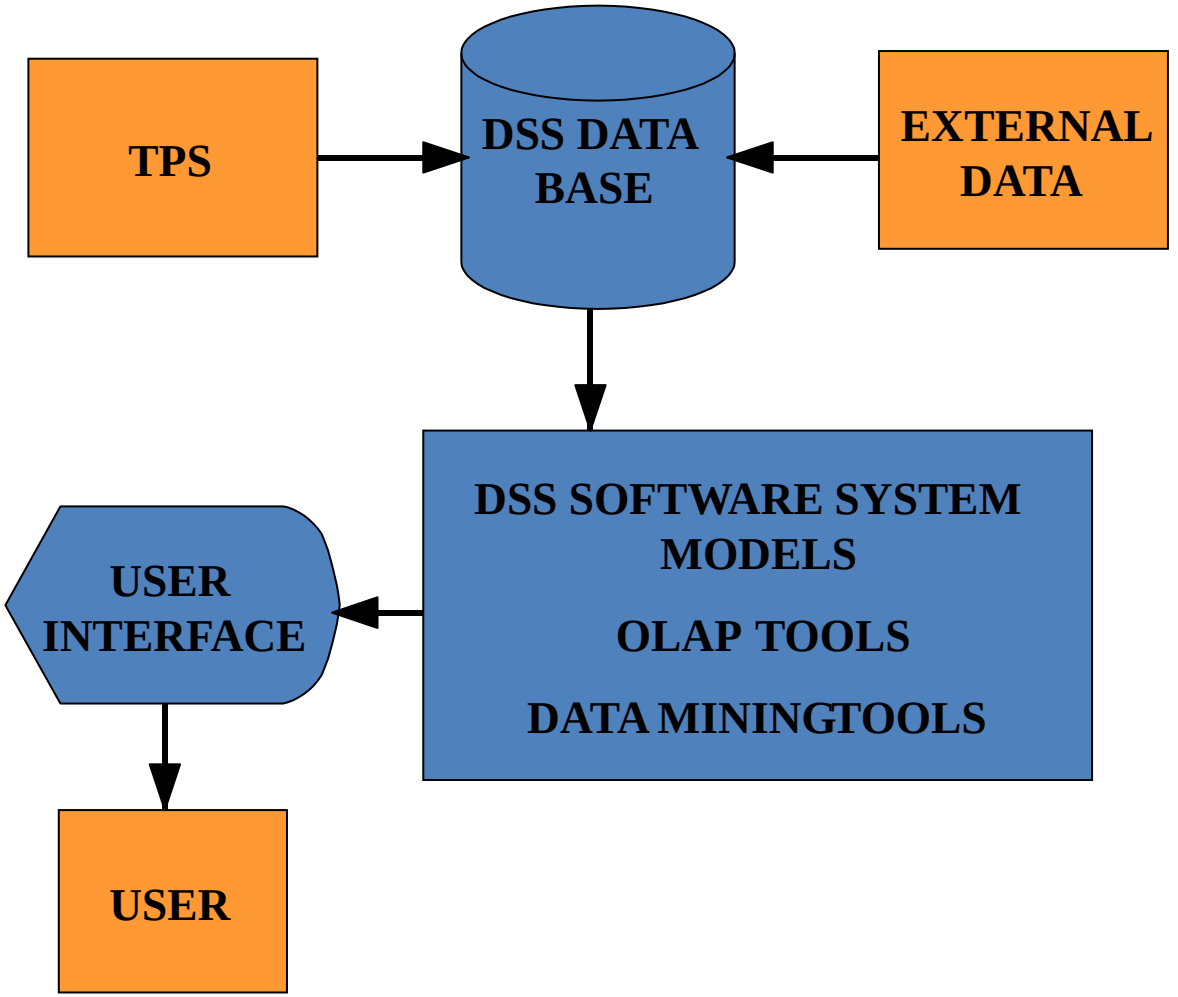
- Three fundamental components of DSS:
  - the database management system (DBMS),
  - the model management system (MBMS), and
  - the dialog generation and management system (DGMS).
- the Data Management Component stores information (which can be further subdivided into that derived from an organization's traditional data repositories, from external sources such as the Internet, or from the personal insights and experiences of individual users);
- the Model Management Component handles representations of events, facts, or situations (using various kinds of models, two examples being optimization models and goal-seeking models); and
- the User Interface Management Component is of course the component that allows a user to interact with the system.

A Detailed Architecture

- Even though different authors identify different components in a DSS, academics and practitioners have come up with a generalized architecture made of six distinct parts:
  - the data management system,
  - the model management system,
  - the knowledge engine,
  - The user interface,
  - the DSS architecture and network, and
  - the user(s)

Typical Architecture

- TPS: transaction processing system
- MODEL: representation of a problem
- OLAP: on-line analytical processing
- USER INTERFACE: how user enters problem & receives answers
- DSS DATABASE: current data from applications or groups
- DATA MINING: technology for finding relationships in large data bases for prediction



The Database Management System

- The two main responsibilities of the DBMS are:
  1. Coordinating the tasks related to storing and accessing information.
  2. Maintenance of the logical independence between the data in the DSS database and the DSS application.

General Functions of the DBMS

- Data definition – providing a data definition language and allowing for interrelation of data
- Data manipulation – providing a query language, allowing for capture and extraction
- Data integrity – allows user to describe rules that maintain integrity and check for errors

General Functions of the DBMS (cont.)

- Access control – allows identification of users, controls access and tracks usage
- Concurrency control – provides procedures for controlling the effects of simultaneous access
- Transaction recovery – provides mechanisms for restart and reconciliation in the event of hardware failure

The Model Base

- A model is a simplification of some event constructed to help study the event.
- The model base is the modeling counterpart to the database; it stores and organizes the various models the DSS uses in its analyses.
- The MBMS (or model base management system) is the counterpart to the DBMS.
- The model base is what differentiates a DSS from other information systems.

General Functions of the MBMS

- Modeling language – allows for creation of decision models, provides a mechanism for linking multiple models
- Model library – stores and manages all models, provides a catalog and description.
- Model manipulation – allows for management and manipulation of the model base with functions (run, store, query, etc.) similar to those in a DBMS.

DSS Knowledge Base

- Any true decision requires reasoning, which requires information.
- The knowledge base is where all of this information is stored by the DSS.
- Knowledge can just be raw information, or rules, heuristics, constraints or previous outcomes.
- This knowledge is different from information in either the database or model base in that it is problem-specific.

Contents of the Knowledge Base

- Knowledge in the base can be categorized into two simple groups.
- Facts represent what we know to be true at a given time.
- Hypotheses represent the rules or relationships we believe to exist between the facts.

Knowledge Acquisition and Retrieval

- One or more people called knowledge engineers gather the information for the knowledge base. These people are specially trained in techniques for extracting this from experts in the domain.
- The inference engine is the part of knowledge base that applies the rules to pull the information out in the form the user desires.

User Interfaces

- An interface is a component designed to allow the user to access internal components of a system.
- In general, the more common the interface, the less training need be provided to users. Think, how many Windows programs use the same menu structure as Microsoft Word?
- The general functions of a DSS interface are the communication language and the presentation language.

DSS Model base

- Model base
  - A software component that consists of models used in computational and analytical routines that mathematically express relations among variables

- Examples:
  - Linear programming models,
  - Multiple regression forecasting models
  - Capital budgeting present value models

DSS Applications

- There are theoretical possibilities of building such systems in any knowledge domain.
  - Clinical decision support system for medical diagnosis.
  - a bank loan officer verifying the credit of a loan applicant
  - an engineering firm that has bids on several projects and wants to know if they can be competitive with their costs.
  - DSS is extensively used in business and management. Executive dashboards and other business performance software allow faster decision making, identification of negative trends, and better allocation of business resources.
  - A growing area of DSS application, concepts, principles, and techniques is in agricultural production, marketing for sustainable development.
  - A specific example concerns the Canadian National Railway system, which tests its equipment on a regular basis using a decision support system.
  - A DSS can be designed to help make decisions on the stock market, or deciding which area or segment to market a product toward.