Decision Support Systems (DSS)

Decision support system examples

Decision support systems are used in a broad array of industries. Example uses include:

1. **GPS route planning**: A DSS can be used to plan the fastest and best routes between two points by analyzing the available options. These systems often include the capability to monitor traffic in real-time to route around congestion.
2. **Crop-planning:** Farmers use DSS to help them determine the best time to plant, fertilize, and reap their crops.
3. **Clinical DSS:** These systems help clinicians diagnose their patients.
4. **ERP dashboards:** These systems help managers monitor performance indicators. User-configurable dashboards allow managers to monitor a variety of performance indicators.
5. **Business intelligence (BI):** Although largely based on historical data, BI solutions allow users to develop and run queries that are used to guide and support decision-making.
6. **Predictive analytics:** helps predict what will happen in the near future. It uses a combination of data mining, statistical tools and machine learning algorithms to determine the likelihood of certain events taking place.
    a. For example, these tools can predict, based on past performance, external data and market feedback, figures for future product demand, product obsolescence and returns.
    b. Banks use these techniques to detect fraud, insurance companies use them to evaluate risk, and ride-hailing firms to determine ticket prices based on demand.
7. **Automated Decision Making**
    Automated Decision Making is a relatively new approach to supporting decision making applies to highly structured decisions. (ADS) (or decision automation systems) is a rule-based system that provides a solution to a repetitive managerial problem in a specific area, e.g., simple-loan approval system. ADS initially appeared in the airline industry called revenue management (or revenue optimization) systems. Dynamically price tickets based on actual demand

Enterprise resource planning (**ERP**) is business management software—usually a suite of integrated applications—that a company can use to store and manage data from every stage of business, including Product planning, cost and development, Manufacturing, Marketing and sales, Inventory management, Shipping and payment

1. Information Systems

An information system is a work system whose activities are devoted to processing (capturing, transmitting, storing, retrieving, manipulating and displaying) information.

1.1 A Computer-based information systems (CBIS) is essentially an IS using computer technology to carry out some or all of its planned tasks. The basic components of computer based information system are:

- *Hardware*- these are the devices like the monitor, processor, printer and keyboard, all of which work together to accept, process, show data and information.
- *Software*- are the programs that allow the hardware to process the data.
- *Databases*- are the gathering of associated files or tables containing related data.
- *Networks*- are a connecting system that allows diverse computers to distribute resources.
- *Procedures*- are the commands for combining the components above to process information and produce the preferred output.

The first four components (hardware, software, database and network) make up what is known as the **information technology platform**.

Certain information systems support parts of organizations; others support entire organizations, and still others, support groups of organizations. Recall that each department or functional area within an organization has its own collection of application programs, or information systems.

1.2 System development life cycle

The systems development life cycle **(SDLC)**, also referred to as the **application development life-cycle**, is a term used in systems engineering, information systems and software engineering to describe a process for planning, creating, testing, and deploying an information system.

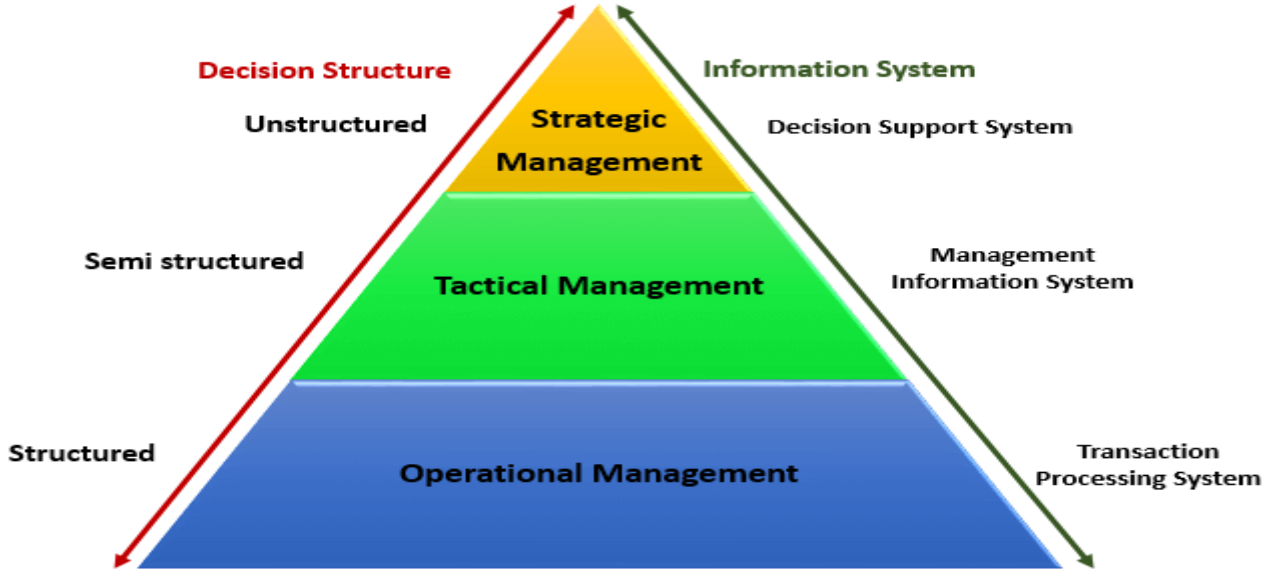
An SDLC aims to produce **high quality** systems that meet or exceed customer expectations, based on **customer requirements**, by delivering systems which move through each clearly defined phase, within scheduled time-frames and cost estimates.

Computer systems are complex and often (especially with the recent rise of **service-oriented architecture**) link multiple traditional systems potentially supplied by different software vendors. To manage this level of complexity, a number of SDLC models or methodologies have been created, such as "**waterfall**"; "**spiral**"; "**Agile software development**"; "**rapid prototyping**"; "**incremental**"; and "**synchronize and stabilize**".

System development is done in stages: • Requirement gathering and analysis • Design • Coding • Testing • Deployment • Maintenance	

4. Types of information systems

The Figure bellow shows the specific types of information systems that correspond to each organizational level.



4.1 Transaction Processing System (TPS)

Transaction processing systems are used to record day to day business transactions of the organization. They are used by users at the operational management level. The main objective of a transaction processing system is to answer routine questions. Examples of transaction processing systems include: Point of Sale Systems – records daily sales, Payroll systems – processing employee's salary, loans management, etc, Stock Control systems – keeping track of inventory levels, Airline booking systems – flights booking managemen

4.2 Management Information System (MIS)

The MIS system analyzes the input with routine algorithms i.e. aggregate, compare and summarizes the results to produced reports that tactical managers use to monitor the organization's current performance status, control and predict future performance.

For example, input from a point of sale system can be used to analyze trends of products that are performing well and those that are not performing well. This information can be used to make future inventory orders i.e. increasing orders for well-performing products and reduce the orders of products that are not performing well. Sales management systems is an examples of management information– they get input from the point of sale system.

4.3 Decision Support Systems

- Decision support systems are used by senior management to make non-routine decisions.

- Decision support systems use input from internal systems (transaction processing systems and management information systems) and external systems.

- The main objective of decision support systems is to provide solutions to problems that are unique and change frequently.

- Decision support systems use sophisticated mathematical models, and statistical techniques (probability, predictive modeling, etc.) to provide solutions, and they are

very interactive. They offer access to databases, analytical tools, allow "what if" simulations, and may support the exchange of information within the organization.

- A Decision Support System is often used to analyze existing structured information and allow managers to project the potential effects of their decisions into the future. Such systems are usually interactive and are used to solve ill structured problems.

- Decision Support Systems (DSS) is a specific class of computerized information system that supports business and organizational decision-making activities. DSS helps people in solving both semi-structured and unstructured problems.

- DSS is an interactive computer-based systems intended to help decision makers utilize data and models to identify and solve problems and make decisions.

Executive Information Systems are strategic-level information systems that are found at the top of the Pyramid. They help executives and senior managers analyze the environment in which the organization operates, to identify long-term trends, and to plan appropriate courses of action. The information in such systems is often weakly structured and comes from both internal and external sources. Executive Information System are designed to be operated directly by executives without the need for intermediaries and easily tailored to the preferences of the individual using them.

Group Decision Support System (GDSS) Contains most of the elements of DSS plus software to provide effective support in group decision-making settings (Communication capability using Special software (also called GroupWare))

3. A Brief History of DSS

During the 1970s and 1980s, the concept of decision support systems (DSS) grew and evolved out of two previous types of computer support for decision making.
One was management information systems (MIS), which provided

(1) Scheduled reports for well-defined information needs.
(2) Demand reports for ad hoc information requests.
(3) The ability to query a database for specific data.

The second contributing discipline was operations research/management science (OR/MS), which used mathematical models to analyze and understand specific problems.

- 1970s —MIS reporting —static/periodic reports
- 1980s —Executive Information Systems (EIS)
- 1990s —OLAP, dynamic, multidimensional, ad-hoc reporting -> The term BI was coined by the Gartner Group in the mid-1990s
- 2005+ —Inclusion of AI and Data/Text Mining capabilities; Web-based Portals/Dashboards

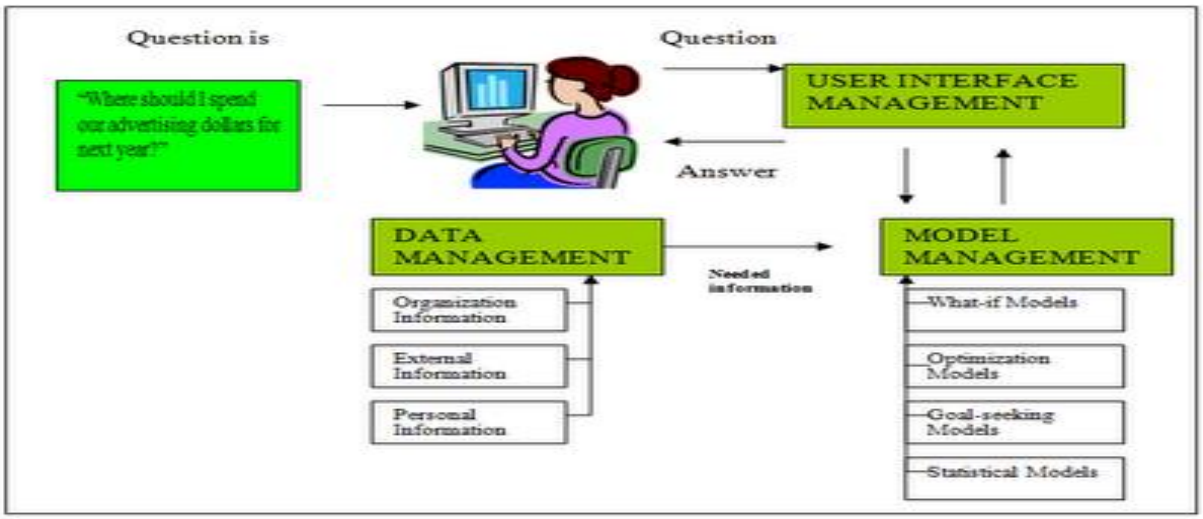
5. Components of Decision Support Systems

Decision support systems consist of three key components: the data management, Model management, and user interface.

5.1 Data Management Component

The data management component performs the function of storing and maintaining the information of the Decision Support System.

DSS database draws on a variety of sources, including data internal to the organization, data generated by applications, and external data purchased from third parties or mined from the Internet (Various branches of federal government, Dow Jones, etc).



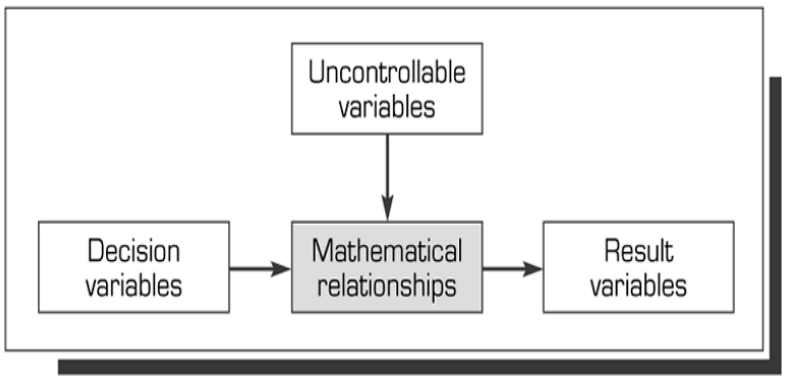
5.2 Model Management Component

The model management system stores and maintains the Decision Support System's models**.** Its function of managing models is similar to that of a database management system. The model management component cannot select the best model for you to use for a particular problem that requires your expertise but it can help you create and manipulate models quickly and easily.

Businesses use models to represent variables and their relationships. Mathematical Models Link decision variables, uncontrollable variables, parameters, and result variables together

- Decision variables describe alternative choices.
- Uncontrollable variables are outside decision-maker's control.
- Result variables are dependent on chosen solution and uncontrollable variables.

Figure 4.6 The General Structure of a Quantitative Model



For example, you would use a statistical model called analysis of variance to determine whether newspaper, TV advertising are equally effective in increasing sales.
You would use what-if analysis to see what effect the change of one or more variables will have on other variables, or optimization to find the most profitable solution given operating restrictions and limited resources.
Spreadsheet software such as excel can be used as a Decision Support System for what-if analysis.

5.2.1 Important DSS Models

- Algorithm-based models
- Statistic-based models
- Linear programming models
- Graphical models
- Quantitative models
- Qualitative models
- Simulation models

5.2.2 Common DSS analysis techniques

- **What-If Analysis**. An end user makes changes to variables, or relationships among variables, and observes the resulting change in the value of other variables.
- **Sensitivity Analysis**. A special type of what-if analysis in which the value of only one variable is changed repeatedly, and the resulting changes on other variables are observed.
- **Goal-Seeking Analysis**. Instead of observing how changes in a variable affect other variables, goal-seeking analysis sets a target value for a variable, and then repeatedly changes other variables until the target value is achieved.
- **Optimization analysis**. A more complex goal-seeking model. Instead of setting a specific target value for a variable, the goal is to find the optimum value for one or more target variables, given certain constraints.

In multi-criteria decision making, when we ask for sensitivity studies we mean to analyze how the priorities of the alternatives change as we vary the priority of a criterion.
For example, if Price becomes much more important, does the best choice of car change? To which one? By how much? Sensitivity can be studied for each criteria, and for each sub criterion.

5.3 User Interface Management Component

The user interface management component allows you to communicate with the Decision Support System. Dashboards and other user interfaces that allow users to interact with and view results.

6. Categorizing Decision Support Systems

In general, decision support systems are a broad category of information systems.
The terms business intelligence, collaborative systems, data mining, data warehousing, knowledge management and online analytical processing (OLAP) are all used by some vendors and managers to label DSS and decision support software.

Based on the dominant component (**dominant technology**), **Five** generic categories is discussed in this section: Some DSS are **hybrid** systems driven by more than one major DSS component. The following expanded DSS framework helps categorize the most common DSS currently in use.

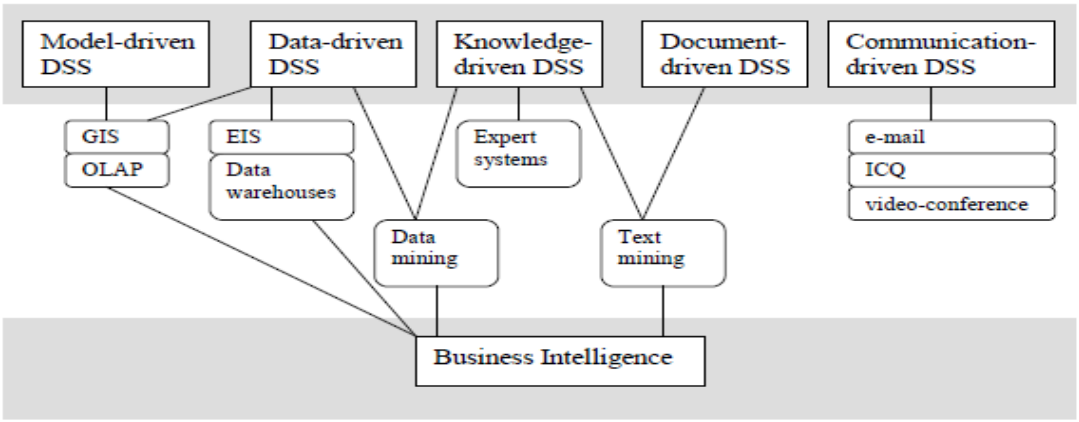


Figure 2: Components of BI and DSS

6.1 Communications-driven A communication-driven DSS enables cooperation, supporting more than one person working on a shared task; examples include integrated tools like Google Docs or Microsoft SharePoint Workspace. These systems were developed first in the mid-1980s. Group DSS (GDSS) focuses on supporting groups of decision makers to analyze problem situations and perform group decision-making tasks.

6.2 Data-driven DSS include management reporting systems, data warehousing and analysis systems, executive information systems (EIS) and spatial decision support systems (SDSS). Business intelligence systems linked to a data warehouse are also examples of data-driven DSS. Data-driven DSS emphasize access to and manipulation of large databases of structured data and especially a time series of internal company data.

6.3 Document-driven DSS integrate a variety of storage and processing technologies to provide complete document retrieval and analysis. A search tool that creates text summaries and rates document relevance provides decision support functionality, but the dominant component is the document base. Examples of documents that might be included in a document database include policies and procedures, product specifications, catalogs, and corporate historical information, including minutes of meetings, corporate records, and important correspondence (cf. Fedorowicz, 1993; Swanson & Culnan, 1978).

6.4 Knowledge-driven DSS or what Alter termed suggestion DSS can suggest or recommend actions to managers. These DSS contain specialized problem-solving expertise. The "expertise" consists of knowledge about a particular domain, understanding of problems within that domain, and "skill" at solving some of those problems.
As an example **Expert systems** are computer applications developed to solve complex problems in a particular domain, at the level of extra-ordinary human intelligence and expertise. An expert systems is composed of **:**

- Knowledge Base: Knowledge Acquisition by the Knowledge Engineers and representation (formalization the knowledge in the knowledge base. It is in the form of IF-THEN-ELSE rules).
- Inference Engine that uses Forward Chaining (answer the question, “What can happen next?”) and Backward Chaining (answer to the question, “Why this happened?”).

- User Interface

6.5 Model-driven DSS emphasize access to and manipulation of a model, for example, statistical, financial, optimization, multi-criteria models and/or simulation models. Simple statistical and analytical tools provide the most elementary level of functionality**.**

7. Business Intelligence

- BI is an evolution of decision support concepts over time
- BI systems are enhanced with additional visualizations, alerts, and performance measurement capabilities.
- BI's major objective is to enable easy access to data (and models) to provide business managers with the ability to conduct analysis.
- BI helps transform data, to information (and knowledge), to decisions and finally to action

BI components:

- A data warehouse. Originally, the data warehouse included only historical data that was organized and summarized. Today, some data warehouses include access to current data as well, so they can provide real-time decision support.
- Business analytics, a collection of tools for manipulating, mining, and analyzing the data in the data warehouse; business analytics are the tools that help users transform data into knowledge (e.g., queries, data/text mining tools, etc.).
- Business performance management (BPM) for monitoring and analyzing performance
- A user interface (e.g., dashboard) that provides a comprehensive graphical/pictorial view of corporate performance measures, trends, and exceptions.

8. Decision support system software (www.cio.com)

According to Capterra, the popular decision support system software includes:

- Information Builders WebFOCUS. This data and analytics platform is geared for enterprise and mid-market companies that need to integrate and embed data across applications. It offers cloud, multi-cloud, on-prem, and hybrid options.
- QlikView. QlikView is Qlik's classic analytics solution, built on the company's Associative Engine. It's designed to help users with their day-to-day tasks using a configurable dashboard.
- SAP BusinessObjects. BusinessObjects consists of reporting and analysis applications to help users understand trends and root causes.
- TIBCO Spotfire. This data visualization and analytics software helps users create dashboards and power predictive applications and real-time analytics applications.
- Salesforce Analytics Cloud. This AI-driven, cloud-based analytics solution is built on Salesforce.com's platform to help organizations spot opportunities and predict outcomes.
- Powernoodle. Powernoodle is a cloud-based decision engagement platform that leverages cognitive, behavioral, and decision science. It offers pre-built templates that address common decision types, and support for modeling the workflows of multiple stakeholder groups.
- 1000minds Decision Making. 1000minds is an online suite of tools and processes for decision-making, prioritization, and conjoint analysis. It is derived from research at the University of Otago in the 1990s into methods for prioritizing patients for surgery.

- Briq. Briq is a predictive analytics and automation platform built specifically for general contractors and subcontractors in construction. It leverages data from accounting, project management, CRM, and other systems, to power AI for predictive and prescriptive analytics.