Decision Support Systems

When it comes to good decision making, relying too heavily on automatic decisions stemming from perception or depending too much on conventions when information is bombarded on to us from all sides can be dangerous. Sometimes, you fail to either notice or seek out crucial information that supports decision making. This may be because of our biasness or shortage of time, funds and other resources.

However, when it comes to organizational decision making, perhaps you wouldn't want to take risk. The reasons are obvious. One wrong decision can make many things go awry, including your brand image, product lifecycle, financial standing and employer brand. In many situations, you're unable to apply fundamentals of economics, statistics and operations research to make lucid choices.

So, you need some knowledge-based systems that support business decision making activities. This is where a decision support system comes into picture. **It is a computer-based system that helps you make planning, manufacturing, operations and management decisions, based on information available**. But you must remember that these systems are not the decision makers. They just aid in decision making, by offering insights that you may be missing and providing exact calculations. The ultimate decision maker is only you.

Say, for example, you need to devise a supply chain movement strategy. How will you do this? A DSS analyzes the stock of inventory and production movement. Basis the data available, it compares the outcomes of different decisions, helping you figure out what may work best currently. It helps you establish a supply chain movement that works.

Let's take *another example*. Suppose you want to optimize your sales. How will you do it? Obviously, you'll make some assumptions, collect data, facts and figures, generate reports, examine patterns and finally make a decision. When you do it manually, you never know what mistakes you're committing. A DSS, in such a situation, can gather and analyze data and make predictions by monitoring existing patterns. It speeds up the whole process, giving you insights into how you can optimize your sales process.

What is a Decision Support System (DSS)?

Now that we know what a decision support system does, let's understand what exactly it is and how it works. A decision support system is:

- a computer-based application or program
- that compiles, combines and analyzes raw data, documents, fundamentals of social science, applied science, mathematics and managerial science, and personal knowledge (of decision maker/s)
- to identify problems and determine their solutions
- in order to facilitate optimal decision making

A decision support system is an interactive computer application that has complete access to information about your organization. When used, it offers comparative figures between one period and the next. It projects revenue figures based on assumptions related to product sales. A DSS is smart enough to help you understand the expenses involved in and consequences resulting from different decision alternatives.

A decision support system helps overcome the barriers to a good decision making, including:

- lack of experience
- biasness
- shortage of time
- wrong calculations

- not considering alternatives

Brief History of Decision Support System

The journey of decision support system began in the late 1960s with model-driven DSS. 1970s saw theory development in this area and it was in mid 1980s when implementation of spreadsheet based DSS, financial planning systems and Group DSS took place. Late 19080s and early 1990s saw the evolution of business intelligence, data warehouses, ODSS (Organization Decision Support System) and EIS (Executive Information System). Mid 1990s marked the beginning of knowledge-based and web-based decision support systems. The Decision Support Systems can be divided into following categories:

1. **Model-driven DSS**

A model-driven DSS was based on simple quantitative models. It used limited data and emphasized manipulation of financial models. A model-drive DSS was used in production planning, scheduling and management. It provided the most elementary functionality to manufacturing concerns.

2. **Data-driven DSS**

Data-driven DSS emphasized the access and manipulation of data tailored to specific tasks using general tools. While it also provided elementary functionality to businesses, it relied heavily on time-series data. It was able to support decision making in a range of situations.

3. **Communication-driven DSS**

As the name suggests, communication-driven DSS uses communication and network technologies to facilitate decision making. The major difference between this and the previous classes of DSS was that it supported collaboration and communication. It made use of a variety of tools including computer-based bulletin boards, audio and video conferencing.

4. **Document-driven DSS**

A document-driven DSS uses large document databases that stores documents, images, sounds, videos and hypertext docs. It has a primary search engine tool associated for searching the data when required. The information stored can be facts and figures, historical data, minutes of meetings, catalogs, business correspondences, product specifications, etc.

5. **Knowledge-driven DSS**

Knowledge-based DSS are human-computer systems that come with a problem-solving expertise. These combine artificial intelligence with human cognitive capacities and can suggest actions to users. The notable point is that these systems have expertise in a particular domain.

6. **Web-based DSS**

Web-based DSS is considered most sophisticated decision support system that extends its capabilities by making use of worldwide web and internet. The evolution continues with advancement in internet technology.

As you can see, previously, the focus was on speeding up the decision making; however, as the concept evolved, it shifted to building interactive computer-based systems that could utilize data and offer insights to solve ill structured problems. The definition, design, intelligence and scope of DSS continue to evolve with time. The modern-day DSS is more intricate and equipped to help make more complex decisions.

Decision support systems have gained immense popularity in various domains, including military, security, medicine, manufacturing, engineering and business. These can support decision making in situations where precision is of importance. Additionally, they provide access to relevant knowledge by integrating various forms and sources of information, aiding human cognitive deficiencies. While DSS employs artificial intelligence to address problems, you shouldn't overestimate its importance. It's a way to get comparative figures basis some or a combination of some formal techniques. The end decision remains with you.

Categorization/Classification of DSS

We have already seen the classification of decision support systems on the basis of technologies used in the history section. Let's now look at the categorization on the basis of nature of operations:

1. **File Drawer System:** As the name suggests, a file drawer decision support system provides information useful for making a specific decision. It works like a file drawer where different types of information are stored under different names or categories.
2. **Data Analysis Systems:** These decision support systems are based on a formula; and therefore, are used to make comparative analysis. These make use of simple data processing tools, such as inventory analysis.
3. **Information Analysis System:** This kind of decision support system analyzes different sets of data to generate informational reports that can be used to assess a situation for decision making.
4. **Accounting and Financial Support System:** This type of support system is based on to keep track of cash and inventory.
5. **Representation or Solver Model:** This type of system performs or represents decision making in a particular domain or for a specific problem. It calculates and compares the outcomes of different decision paths. The decision maker can conduct a 'what if' analysis and make an informed decision basis on the outcomes generated.
6. **Optimization Model:** This DSS is based on stimulated models, majorly providing guidelines for operations management. The focus is on providing optimal solutions on job scheduling, product mix and material mix decisions.
7. **Suggestion System:** This type of support system suggests optimal decision for a particular situation by assisting in collecting and structuring data.

Categorization of DSS on the Basis of Inputs

- Text-Oriented DSS
- Database Oriented
- Spreadsheet Oriented
- Rule Oriented
- Solver (specific situation) Oriented
- Compound/Hybrid: This support system combines two or more structures from above to offer multiple functionalities.

Categorization of DSS on the Basis of Support Offered

- Personal DSS
- Group DSS
- Organizational DSS

Categorization of DSS on the Basis of Type and Frequency of Decision Making

- **Institutional DSS:** An institutional decision support system supports recurring decisions on an ongoing basis. Basically, this is for programmed decisions, which are made on daily basis. For example, establishing routine for handling technical problems, taking disciplinary actions, unit manufacturing, a mechanic process of troubleshooting, etc.
- **Ad-hoc DSS:** An ad-hoc decision support system supports one kind of decision in an unanticipated situation. The decision made is unique to a problem. This type of system is used to support non-programmed decisions as the information available is incomplete.

Components of a Decision Support System

Like any other software system, DSS also has components and phases of development. No matter what kind of decision support system you're looking to develop, you must plan around these four components:

- **Input:** What kind of input does it require to carry out the analysis? As mentioned earlier, it can be rule, problem, spreadsheet, text or database oriented.
- **User Knowledge/Expertise:** Whether inputs will require manual analysis by the user or not
- **Output:** Should the outcomes be comparative or generic?
- **Decisions:** Whether it should be a suggestion support system? Or you just want it to analyze the data and outcome of different actions?

Designing and Building a Decision Support System

A lot goes into designing and building a decision support system. It works as a support system only after it is fed intelligence during its development. Developing a DSS is a complex process and thus, takes longer. It goes repetitively through three stages - inputs, activities and outputs during each phase of system development lifecycle. You provide an input, carry out the desired activity and measure the output. You move further, if it produces the right output or else you come back to the input phase and make adjustments.
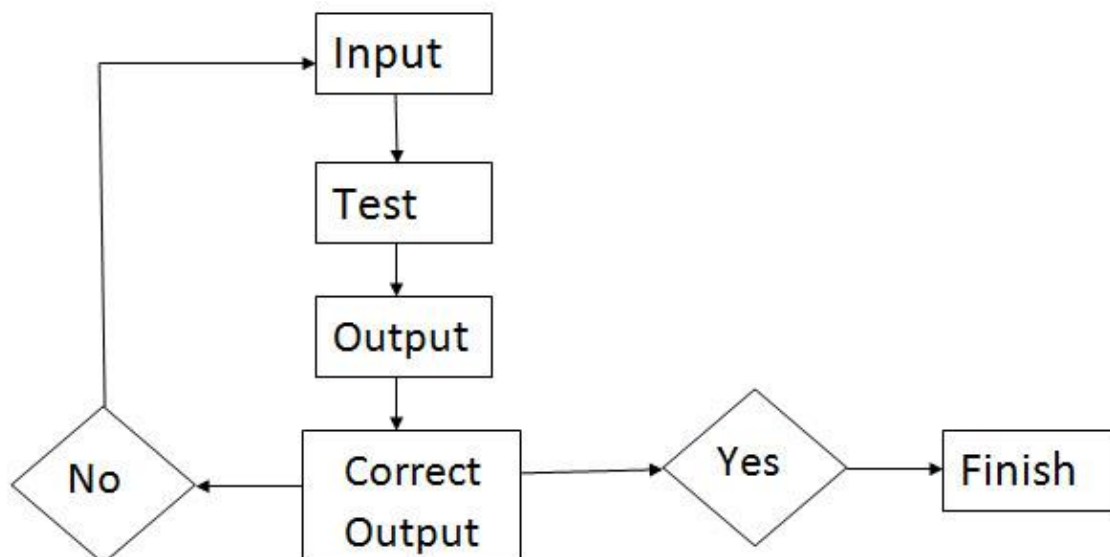
A DSS framework design and development goes through these stages:

1. **Intelligence**

   At this stage, the objective is to search for problems/situations/conditions that call for decision.
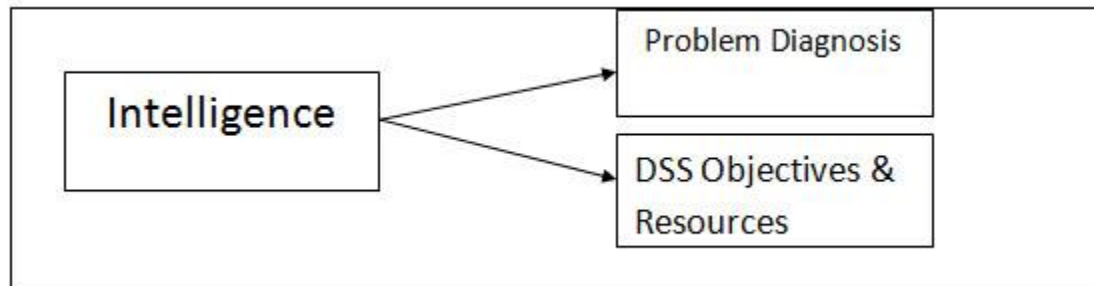
   You, as a business, are expected to identify and define the problem context for which support is required. You must define the objectives and available resources, so that the outcomes generated meet your expectations.

2. **Design**

   This stage deals in analyzing all possible actions, along with the determination of system design and system construction.
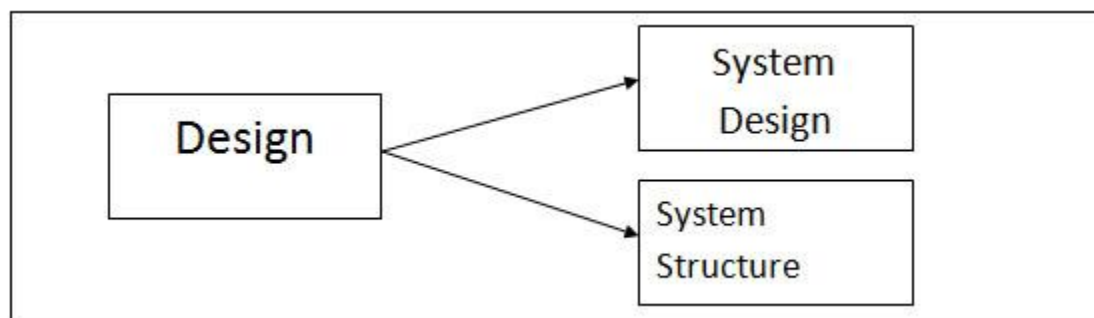
   System design includes determination of components, platform, function libraries and special languages while system structure is about deciding the prototype approach. This stage also includes identifying hardware requirements. The development starts here.

3. **Choice**

   Once you shortlist and analyze all possible courses of actions in step 2, now is the time to choose the best from among them, depending upon your business objectives and results generate.

4. **Implementation**

   This is the final stage where testing, evaluation, adjustments and deployment take place. However, this is the final product but this can be tweaked, refined and upgraded basis your activities and requirements.

When developing a custom DSS, these are important factors that must be kept in mind:

- Data management functions
- Available hardware platforms
- User interface
- Compatibility with other applications
- Cost

A decision support system helps improve your bottom line, only if it's customized to your specific needs and is implemented correctly.

Decision support systems (DSS) are interactive software-based systems intended to help managers in decision-making by accessing large volumes of information generated from various related information systems involved in organizational business processes, such as office automation system, transaction processing system, etc.

DSS uses the summary information, exceptions, patterns, and trends using the analytical models. A decision support system helps in decision-making but does not necessarily give a decision itself. The decision makers compile useful information from raw data, documents, personal knowledge, and/or business models to identify and solve problems and make decisions.

Programmed and Non-programmed Decisions

There are two types of decisions - programmed and non-programmed decisions.

Programmed decisions are basically automated processes, general routine work, where −

- These decisions have been taken several times.
- These decisions follow some guidelines or rules.

For example, selecting a reorder level for inventories, is a programmed decision.

Non-programmed decisions occur in unusual and non-addressed situations, so −

- It would be a new decision.
- There will not be any rules to follow.
- These decisions are made based on the available information.
- These decisions are based on the manger's discretion, instinct, perception and judgment.

For example, investing in a new technology is a non-programmed decision.

Decision support systems generally involve non-programmed decisions. Therefore, there will be no exact report, content, or format for these systems. Reports are generated on the fly.

Attributes of a DSS

- Adaptability and flexibility

- High level of Interactivity

- Ease of use

- Efficiency and effectiveness

- Complete control by decision-makers

- Ease of development

- Extendibility

- Support for modeling and analysis

- Support for data access

- Standalone, integrated, and Web-based

Characteristics of a DSS

- Support for decision-makers in semi-structured and unstructured problems.
- Support for managers at various managerial levels, ranging from top executive to line managers.
- Support for individuals and groups. Less structured problems often requires the involvement of several individuals from different departments and organization level.
- Support for interdependent or sequential decisions.
- Support for intelligence, design, choice, and implementation.
- Support for variety of decision processes and styles.
- DSSs are adaptive over time.

Benefits of DSS

- Improves efficiency and speed of decision-making activities.

- Increases the control, competitiveness and capability of futuristic decision-making of the organization.
- Facilitates interpersonal communication.
- Encourages learning or training.
- Since it is mostly used in non-programmed decisions, it reveals new approaches and sets up new evidences for an unusual decision.
- Helps automate managerial processes.

Components of a DSS

Following are the components of the Decision Support System −

- **Database Management System (DBMS)** − To solve a problem the necessary data may come from internal or external database. In an organization, internal data are generated by a system such as TPS and MIS. External data come from a variety of sources such as newspapers, online data services, databases (financial, marketing, human resources).
- **Model Management System** − It stores and accesses models that managers use to make decisions. Such models are used for designing manufacturing facility, analyzing the financial health of an organization, forecasting demand of a product or service, etc.
  Support Tools − Support tools like online help; pulls down menus, user interfaces, graphical analysis, error correction mechanism, facilitates the user interactions with the system.

Classification of DSS

There are several ways to classify DSS. Hoi Apple and Whinstone classifies DSS as follows −

- **Text Oriented DSS** − It contains textually represented information that could have a bearing on decision. It allows documents to be electronically created, revised and viewed as needed.
- **Database Oriented DSS** − Database plays a major role here; it contains organized and highly structured data.
- **Spreadsheet Oriented DSS** − It contains information in spread sheets that allows create, view, modify procedural knowledge and also instructs the system to execute self-contained instructions. The most popular tool is Excel and Lotus 1-2-3.
- **Solver Oriented DSS** − It is based on a solver, which is an algorithm or procedure written for performing certain calculations and particular program type.
- **Rules Oriented DSS** − It follows certain procedures adopted as rules.
- **Rules Oriented DSS** − Procedures are adopted in rules oriented DSS. Export system is the example.
- **Compound DSS** − It is built by using two or more of the five structures explained above.

Types of DSS

Following are some typical DSSs −

- **Status Inquiry System** − It helps in taking operational, management level, or middle level management decisions, for example daily schedules of jobs to machines or machines to operators.
- **Data Analysis System** − It needs comparative analysis and makes use of formula or an algorithm, for example cash flow analysis, inventory analysis etc.
- **Information Analysis System** − In this system data is analyzed and the information report is generated. For example, sales analysis, accounts receivable systems, market analysis etc.
- **Accounting System** − It keeps track of accounting and finance related information, for example, final account, accounts receivables, accounts payables, etc. that keep track of the major aspects of the business.
- **Model Based System** − Simulation models or optimization models used for decision-making are used infrequently and creates general guidelines for operation or management.

Expert System in MIS (Management Information System)

An **expert system** is the highest form of automation of the management computing office which allows document communication and manipulation. Decision support systems help with problem-solving by allowing data and model manipulation. **Expert systems** go beyond conventional manipulation of this kind, as they allow experts to 'teach' computers about their fields so that fewer expert decision-makers can support the system more of the decision-making process.

Expert systems are one of the most cutting-edge information technology facts. That is, in some of the most complex and least-understood human information handling tasks, i.e. decision-making, problem-solving, diagnosis and learning, they help people. We do this by holding a large amount of factual information on a subject area, along with lines of reasoning employed in that field by human experts.

Expert System Components

The key components of Expert System are as followings,

1. **User Interface**:
   It contains a computerized system between the user and the machine for friendly communication. This system provides an interface to the user in a graphical way.
2. **Interference Engine**:
   It regains & determines the data process. It performs this task to deduce new facts which are subsequently used to draw further conclusions. This component is associated with an expert system as the brain of the expert system.
3. **Knowledge Base**:
   This is the most important element of an expert system because it holds the expert's knowledge of problem-solving. It is here that the expert's elicited knowledge is stored. It contains the rules, facts and object descriptions, etc. The knowledge base is always stored in the data with the newest expert system products. The knowledgebase information is all that is needed to understand & formulate the problem, and then solve it.
4. **Data Acquisition Subsystem**:
   The specialist has to learn the information reflected in the knowledge base. Information acquisition software is used by a person who has problem experience to build, incorporate or modify the base of knowledge. Potential knowledge sources include human experts, research reports, textbooks, databases and the experience of the user himself.

Advantages of Expert System

Expert System (ES) gives clear responses for routine actions, procedures and activities
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- Expert System (ES) retains significant levels of the knowledge base.
- Expert System (ES) supports organizations to explain the rationale of their decision-making.

Disadvantages Expert System

- Expert System (ES) doesn't reply creatively as a human expert in unusual ways.
- Expert System (ES) requires more technical aspects due to this difficult in use.
- Highly costlier system.