Introduction to the concept of Decision Support System

Decision Support Systems have evolved over the past three decades from simple model-oriented systems to advanced multi-function entities. During the 1960s, most Decision Support Systems were fairly based on powerful (and expensive) mainframe computers which provided managers with structured, periodic reports. MIS theory developments during the 1970s saw Decision Support Systems evolve into more elaborate computer-based systems that supported production, promotion, pricing, marketing and some logistical functions.

By early 1980s Decision Support Systems enjoyed more interests from academics and the framework for Decision Support Systems was greatly expanded by the end of the decade. It was only during the 1990s that a paradigm shift occurred in Decision Support Systems and more complex systems, which incorporated, advanced database technology and client/server capabilities, were emerging from many areas in business processes.

As many organizations started to upgrade their network infrastructure, object-oriented technology and data warehousing started to make its mark on Decision Support Systems.

The rapid expansion of the Internet provided additional opportunities for the scope of Decision Support Systems and consequently many new innovative systems such as OLAP and other web-drive systems were developed. In this unit, we will discuss the concept of decision support systems.

Decision Support Systems

Decision support systems are software tools that are developed for the specific purpose of assimilating pertinent data and generating a detail analysis of a given situation. The results of the decision support system or DSS can then be utilized in making an informed decision regarding just about any action or set of circumstances.

A decision support system (DSS) is a computer program application that analyzes business data and presents it so that users can make business decisions more easily. It is an “informational application” (to distinguish it from an “operational application” that collects the data in the course of normal business operation).

Typical decision support systems are designed for easy use by end users who may or may not be comfortable with using computer technology as part of the decision making process. Often, the software will be make use of formats such as spreadsheets or databases that work with the use of fields to enter data.

Once the information is entered, it is possible to query the system with a series of questions that can allow the user to project not only a range of possible courses of action, but also get some idea on the possible outcomes associated with each option.

In terms of dealing with many managerial and executive decisions that are made daily in the workplace, decision support systems can be a great tool for supervisors, department heads, and site managers. The system can be configured to work within just about any area that involves dealing with labor issues. Human resource personnel can make use of decision support systems that include data about all applicable local and federal laws governing the rights and protections relevant to employees, making the process of administering promotions, dealing with a leave of absence, or developing an equitable approach to disciplinary action much easier. Supervisors can also use decision support systems as part of the identifying strengths and weaknesses among employees in their charge, which can take a lot of the guesswork out of performing period employee evaluations.

Over the last few years, decision support systems have become better known as Business Intelligence systems. However, many persons who have made use of the software for a number of years still tend to make use of the identification of decision support software, which has led many producers of the software to continue use of the DSS identification.
Typical information that a decision support application might gather and present would be:
_ Comparative sales figures between one week and the next
_ Projected revenue figures based on new product sales assumptions
_ The consequences of different decision alternatives, given past experience in a context that is described.

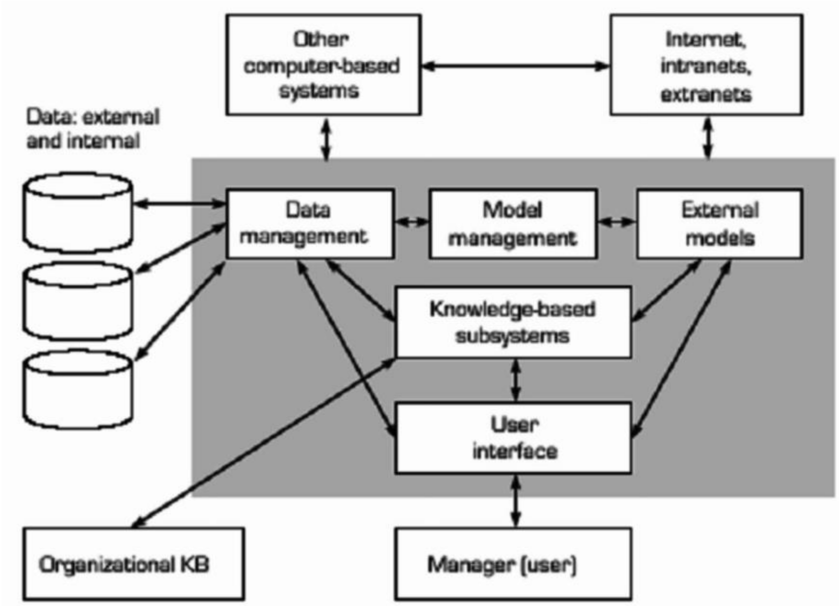
Configuration and Characteristics of DSS

Configuration of DSS

The major characteristics of a decision support system utilised in network configuration would be the flexibility to include in the model every significant element of a specific supply chain and every possible option concerning supply chain configuration, regarding facility location, opening or closing of facilities, etc. Decision support system Configuration:
_ Supports individuals and teams
_ Used repeatedly and constantly
_ Two major components: data and models
_ Web-based
_ Uses subjective, personal, and objective data
_ Has a simulation model
_ Used in public and private sectors
_ Has what-if capabilities
_ Uses quantitative and qualitative models

Characteristics of DSS

A decision support system is an internal business element that provides owners, executives, and other employees with information for making informed decisions. Common characteristics of decision support systems include facilitation, interaction, and task-oriented activities within the system. Other characteristics may also exist, such as ancillary options or measures of decision impact. Most effective decision support systems will have these features readily available.



Those who create and implement the system are often responsible for measuring its effectiveness and proper application.

_ ***Facilitation:*** Facilitation helps ensure the system provides the correct data and information for upcoming decisions. The decision-making activities and processes must coincide when using a support system. A decision process typically defines the individual activities one must use when making decisions. The support system facilitates information through each individual activity so

that the decision maker does not spend too much time gathering data. Multiple individuals can also use the support system to pass information through the pipeline in order to shorten the lead time spent on making decisions.

_ ***Interaction:*** Interaction also represents important characteristics of decision support systems. Many of these systems in current businesses make extensive use of technology, primarily personal computers and decision-making software. When multiple individuals are able to access the software and input information for the decision-making process, interaction occurs.

Task-oriented activities: Task-oriented activities are also common elements of decision support systems. This element means that the support system can handle more than one activity at a time, which is essential. Many companies provide inputs for multiple outcomes related to one or a few different decisions. Therefore, the multiple tasks in the system must be able to handle all this information. The choice among the various alternatives here can represent the decision one must make for a company. Companies can define their own characteristics of decision support systems. While some companies may design their own mix of computerized and manual systems, others may use a third-party package. A third-party package often has customizable aspects that allow a company to change various aspects in the system. In short, the characteristics can match the needs and wants of a company.

Components of DSS

A typical Decision support systems has four components: data management, model management, knowledge management and user interface management

Data Management Component

The data management component performs the function of storing and maintaining the information that you want your Decision Support System to use. The data management component, therefore, consists of both the Decision Support System information and the Decision Support System database management system. The information you use in your Decision Support System comes from one or more of three sources:

Organizational information: You may want to use virtually any information available in the organization for your Decision Support System. What you use, of course, depends on what you need and whether it is available. You can design your Decision Support System to access this information directly from your company's database and data warehouse.

However, specific information is often copied to the Decision Support System database to save time in searching through the organization's database and data warehouses.

External information: Some decisions require input from external sources of information. Various branches of federal government, Dow Jones, and the internet, to mention just a few, can provide additional information for the use with a Decision Support System.

Personal information: You can incorporate your own insights and experience your personal information into your Decision Support System. You can design your Decision Support System so that you enter this personal information only as needed, or you can keep the information in a personal database that is accessible by the Decision Support System.

Model Management Component

The model management component consists of both the Decision Support System models and the Decision Support System model management system. A model is a representation of some event, fact, or situation. As it is not always practical, or wise, to experiment with reality, people build models and use them for experimentation. Models can take various forms. Businesses use models to represent variables and their relationships. Decision Support Systems help in various decision-making situations by utilizing models that allow you to analyze information in many different ways. The models you use in a Decision Support System depend on the decision you are making and, consequently, the kind of analysis you require. variables will have on other variables, or optimization to find the most profitable solution given operating restrictions and limited resources. 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.

User Interface or Dialogue Management Component

The user interface management component allows you to communicate with the Decision Support System. It consists of the user interface management system. This is the component that allows you to combine your know-how with the storage and processing capabilities of the computer.

The user interface is the part of the system you see through it when enter information,

commands, and models. If you have a Decision Support System with a poorly designed user interface, if it is too rigid or too cumbersome to use, you simply won't use it no matter what its capabilities. The best user interface uses your terminology and methods and is flexible, consistent, simple, and adaptable. To accomplish these goals, it uses a Decision Support System which performs three tasks:

Data management: The Decision Support System stores customer and product information. In addition to this organizational information, Lands' End also needs external information, such as demographic information and industry and style trend information.

Model management: The Decision Support System has to have models to analyze the information. The models create new information that decision makers need to plan product lines and inventory levels.

User interface management: A user interface enables Lands' End decision makers to access information and to specify the models they want to use to create the information they need.

Knowledge Management Component

The knowledge management component, like that in an expert system, provides information about the relationship among data that is too complex for a database to represent. It consists of rules that can constrain possible solution as well as alternative solutions and methods for evaluating them.

Dialogue Management

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.

Dialogue Management for DSS

While the quality and reliability of modeling tools and the internal architectures of DSSs are important, the most crucial aspect of DSSs is, by far, their user interface. Systems with user interfaces that are cumbersome or unclear or that require unusual skills are rarely useful and accepted in practice. The most important result of a session with a DSS is insight into the decision problem. In addition, when the system is based on normative principles, it can play a tutoring role; one might hope that users will learn the domain model and how to reason with it over time, and improve their own thinking.

A good user interface to DSSs should support model construction and model analysis, reasoning about the problem structure in addition to numerical calculations and both choice and optimization of decision variables.

The term "process" in the context of user interface process refers to the flow of information (a) from the user to the system and (b) from the system to the user. It is handled by the User Interface Management System (UIMS). The UIMS processes user commands, issued in whatever action language it requires, and passes them on to the data and model management subsystems.

In the reverse direction, it presents information from those subsystems to the user.

Support for Model Construction and Model Analysis

User interface is the vehicle for both model construction (and model choice) and for investigating the results. Even if a system is based on a theoretically sound reasoning scheme, its recommendations will be as good as the model they are based on. Furthermore, even if the model is a very good approximation of reality and its recommendations are correct, they will not be followed if they are not understood. Without understanding, the users may accept or reject a system's advice for the wrong reasons and the combined decision-making performance may deteriorate even below unaided performance. A good user interface should make the model on which the system's reasoning is based transparent to the user.

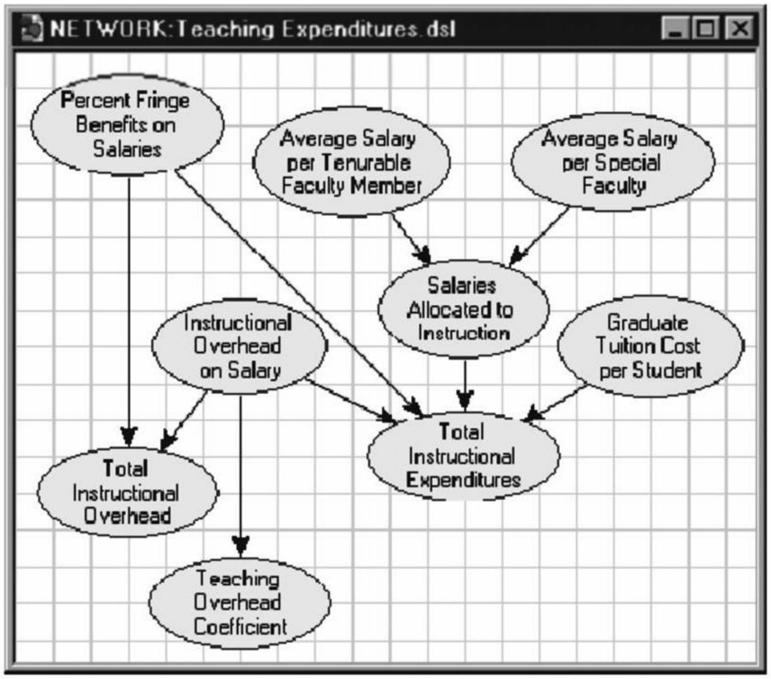
Modeling is rarely a one-shot process, and good models are usually refined and enhanced as their users gather practical experiences with the system recommendations A good user interface should include tools for examining the model and identifying its most sensitive parts, which can be subsequently elaborated on. Systems employed in practice will need their models refined, and a good user interface should make it easy to access, examine, and refine its models.

Support for Reasoning about the Problem Structure in Addition to Numerical Calculations

While numerical calculations are important in decision support, reasoning about the problem structure is even more important. Often when the system and its model are complex it is insightful for the decision maker to realize how the system variables are interrelated.

Graphical models, such as those used in decision analysis or in equation-based and hybrid systems, are particularly suitable for reasoning about structure. Under certain assumptions, a directed graphical model can be given a causal interpretation. This is especially convenient in situations where the DSS autonomically suggests decision options; given a causal interpretation of its model, it is capable of predicting effects of interventions. A causal graph facilitates building an effective user interface.

Support for both Choice and Optimization of Decision Variables



Many DSSs have an inflexible structure in the sense that the variables that will be manipulated are determined at the model-building stage. This is not very suitable for planning of the strategic type when the object of the decision-making process is identifying both the objectives and the methods of achieving them. For example, changing policy variables in a spreadsheet-based model often requires that the entire pread sheet be rebuilt. If there is no support for that, few users will consider it as an option. This closes the world of possibilities for flexible reframing of a decision problem in the exploratory process of searching for opportunities.

Support for both choice and optimization of decision variables should be an inherent part of DSSs.

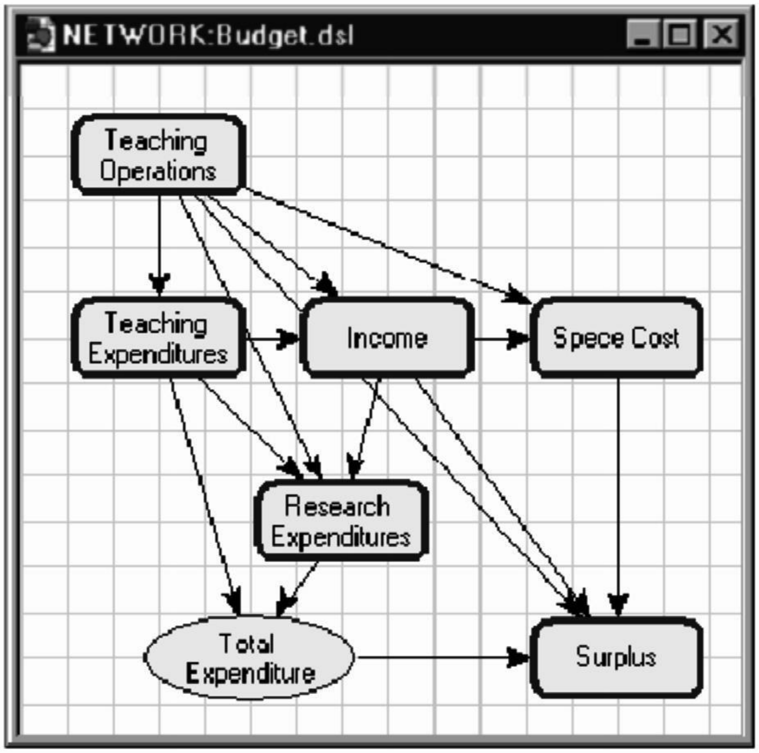
Graphical Interface

Insight into a model can be increased greatly at the user interface level by a diagram representing the interactions among its components. For example, a drawing of a graph on which a model is based is shown in Figure 4.1.

This graph is a qualitative, structural explanation of how information flows from the independent variables to the dependent variables of interest.

As models may become very large, it is convenient to structure them into sub-models, groups of variables that form a subsystem of the modeled system. Such sub-models can be again shown graphically with interactions among them, increasing simplicity and clarity of the interface.

Figure 4.2 shows a sub-model- level view of a model developed in our ESP project. Note that the graph in Figure 4.1 is an expanded version of the Teaching Expenditures sub-model in Figure 4.2.


NETWORK:Budget.dsl
Teaching Operations
Teaching Expenditures
Income
Spece Cost
Research Expenditures
Total Expenditure
Surplus

Data Management

The data management subsystem is composed of: DSS database
_ DBMS
_ Data directory
_ Query facility

These are discussed below:
_ Database: Internal data come mainly from the organization's transaction processing system.

External data include industry data, market research data, census data, regional employment data, government regulations, tax rate schedules, and national economic data. Private data can include guidelines used by specific decision makers and assessments of specific data and/or situations.

_ Data extraction: The process of capturing data from several sources, synthesizing them, summarizing them, determining which of them are relevant, and organizing them, resulting in their effective integration.
_ DBMS: Software for establishing, updating, and querying (e.g., managing) a database

_ Query Facility: The (database) mechanism that accepts requests for data, accesses them, manipulates them, and queries them

_ Directory: A catalog of all the data in a database or all the models in a model base. Key database and database management system issues include:

Data quality
Data integration
Scalability
Data security

Model Management for DSS

Model management is one of the most important areas and is widely recognized as a key component of decision support systems. One of the prime tasks of model management is to perform mod integration which consists of combining existing DSS models and components.

It involves tasks such as connecting models, formulating composite models from existing models, collection of models an model reuse and analysis.

A collection of pre-programmed quantitative models (e.g., statistical, financial, optimization) organized as a single unit. Four categories of models with the model base:

_ Strategic models _ Tactical models

_ Operational models _ Analytical models

Strategic Models: Models that represent problems for the strategic level (i.e., executive level) of Management.

Tactical Models: Models that represent problems for the tactical level (i.e., mid-level) of management. Operational Models: Models that represent problems for the operational level of management. Analytical Models: Mathematical models into which data are loaded for analysis.

Model Building Blocks and Routines

Model building blocks are Pre-programmed software elements that can be used to build computerized models.

Example: A random-number generator can be employed in the construction of a simulation model.

Model Base Management System

MBMS software has four main functions:
_ Model creation, using programming languages, DSS tools and/or subroutines, and other building blocks
_ Generation of new routines and reports _ Model updating and changing
_ Model data manipulation
Model Directory

Model execution is the process of controlling the actual running of the model
Model integration involves combining the operations of several models when needed
A model command processor is used to accept and interpret modeling instructions from the user interface component and route them to the MBMS, model execution, or integration functions
Examples of different type of DSS

Decision Support Systems (DSS) are a class of computerized information system that support decision-making activities. DSS are interactive computer-based systems and subsystems intended to help decision makers use communications technologies, data, documents, knowledge and/or models to complete decision process tasks.

A decision support system may present information graphically and may include an expert system or artificial intelligence (AI). It may be aimed at business executives or some other group of knowledge workers.

Typical information that a decision support application might gather and present would be, (a) Accessing all information assets, including legacy and relational data sources; (b) Comparative data figures; (c) Projected figures based on new data or assumptions; (d) Consequences of different decision alternatives, given past experience in a specific context.

There are a number of Decision Support Systems. These can be categorized into five types:

Communication-driven DSS
Most communications-driven DSSs are targetted at internal teams, including partners. Its purpose are to help conduct a meeting, or for users to collaborate. The most common technology used to deploy the DSS is a web or client server. Examples: chats and instant messaging softwares, online collaboration and net-meeting systems.

Data-driven DSS
Most data-driven DSSs are targeted at managers, staff and also product/service suppliers. It is used to query a database or data warehouse to seek specific answers for specific purposes. It is deployed via a main frame system, client/server link, or via the web. Examples: computer-based databases that have a query system to check (including the incorporation of data to add value to existing databases.

Document-driven DSS
Document-driven DSSs are more common, targeted at a broad base of user groups. The purpose of such a DSS is to search web pages and find documents on a specific set of keywords or search terms. The usual technology used to set up such DSSs are via the web or a client/server system.

Knowledge-driven DSS:
Knowledge-driven DSSs or 'knowledgebase' are they are known, are a catch-all category covering a broad range of systems covering users within the organization setting it up, but may also include others interacting with the organization - for example, consumers of a business. It is essentially used to provide management advice or to choose products/services. The typical deployment technology used to set up such systems could be client/server systems, the web, or software running on stand-alone PCs.

- Model-driven DSS

Model-driven DSSs are complex systems that help analyze decisions or choose between different options. These are used by managers and staff members of a business, or people who interact with the organization, for a number of purposes depending on how the model is set up - scheduling, decision analyses etc. These DSSs can be deployed via software/hardware in stand-alone PCs, client/server systems, or the web.

Systems Analysis and Design for DSS

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.

Models in the context of DSS: Algorithms and Heuristics

All DSS above the simplest data-oriented ones are based on models. Their purpose is to hence the decision maker who is using it to predict what would happen in the real world if certain choices were made.

This enables the decision maker to evaluate alternative actions without trying them out in practice – obviously saving in time, expense and overall hassle to say nothing of reducing the likelihood of seriously wrong decision that could do major damage to an organization.

Models

Model is a representation of an actual system.
Models embody system characteristics that are important to the model's users.
At the same time, models simplify reality by eliminating other characteristics that are not important for their purpose.
The central idea of a model is that important relationships that apply to the system being modeled also apply to the model.

Type of Models

Static vs Dynamic Models

- **Static Models**

- Shows the values that system attributes take when the system is in balance (steady). Static model can model either a static system or a dynamic system.

- Showing when a system is in balance, can tell decision makers how the system will eventually tabilize even if it does not show them how it gets to that point. Because it involves much less data, it can be easier for a decision maker to analyze.

- May also be able to provide results more quickly than a dynamic one, allowing decision makers to consider more options in a given amount of time.

Ex: estimate next year's profits from calculate profits of sales volume for each of the firm's five products

- **Dynamic Models**

- Follows the changes over time that result from system activities. The passage of time

With cause and effect relationships connecting one time period to the next is essential to system behavior.

Continuous VS Discrete-Event Model

- **Continuous models :**

Describe physical or economic processes in which the numbers that describe the system vary continuously. Ex: Blood pressure varies continuously over time.

- **Discrete-event models :**

Deal with systems in which individual events occur at identifiable points in time and change the state of the system instantaneously from one value to a different one.

Discrete-event Simulation Models

A model that allows us to predict the behavior of a business system by modeling the expected behaviors and interactions of its components over time.
This is useful because we often know how each system components behaves but we are unable to assess the impact of their interactions of the behavior of the overall system.
Ex: barbershop
Model Types

- A Graphical model Data flow diagram
- A narrative model Natural language such as English
- A physical model

A smaller or idealized representation of the real system such as a model railroad or an architecturel model of a building being designed.

DSS Applications in different functions

Uses of DSS

Being used by knowledge workers, it is possible to consider using decision support systems in any knowledge domain. In fact, they are so widespread that people don't consider that they are using DSS. The spreadsheet is a simple DSS that is very commonly used in many different situations!

When you use a search engine, you have used a DSS to organize a huge amount of information, in the form of text files, images and videos, in order to make your decision.

Here we have examples of more complex DSS and how they have been used in various contexts.

A DSS used in medicine is called a clinical DSS and, in fact, it is said that if used properly, clinical decision support systems have the potential to change the way medicine has been taught and practised.

Colorado State has used a DSS to provide information about floods and potential hazards throughout the State. It includes real-time weather conditions, local and county data about floods, as well as historical data, floodplain boundaries and much more.

Real estate investment companies typically use DSS to manage the day to day running of their businesses. Information about and from each property can be processed to give access to data across the enterprise that allows for not just day to day running but also for future planning.

Universities need to fill places every year. Too few students and they lose money and may lose funding the following year. Too many and they still lose money because they will have to bear the extra costs themselves. And, of course, they want the best students possible! And then there's the issue of predicting how many students will want to enrol in a particular course. Enter DSS used in central clearing houses...

DSS have been used to forecast the demand for water in particular areas. Using information about the local geography, historical information about water consumption in the area as well as prediction models, planners can predict and plan for future consumption needs in the area.

DSS have also been used in integrating weather conditions and air traffic management, for optimizing reservoir operations, auditing health insurance claims, financial planning for small business and designing freight networks.

Of course, many businesses have integrated DSS applications into their day to day operations in order to analyze large amounts of data such as budget sheets, sales figures and forecasts. They rapidly sift through available data and are used extensively to allow faster decision-making, identification of market trends and improved allocation of resources.

Advantages of DSS

- Improves performance and effectiveness of the user
- Allows for faster decision-making
- Reduces the time taken to solve problems
- These combine to save money!
- Has been seen to improve collaboration and communication within groups
- Reduces training times because the experience of experts is available within the programs algorithms
- Provides more evidence in support of a decision
- May increase decision-maker satisfaction
- Providing different perspectives to a situation
- Helps automate various business systems

Disadvantages

- Too much emphasis/control given to the machines.
- May reduce skill in staff because they become dependent on the computers
- Reduction in efficiency because of information overload

- Shift of responsibility - easy to blame computer!
- Disgruntled employees who feel they are now only doing clerical work
- False sense of being objective - humans still feed information in and decide how exactly to process it.

Design of interfaces in DSS;

- While the quality and reliability of modeling tools and the internal architectures of DSSs are important, the most crucial aspect of DSSs is, by far, their user interface. Systems with user interfaces that are cumbersome or unclear or that require unusual skills are rarely useful and accepted in practice.

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- A good user interface should make the model on which the system"s reasoning is based transparent to the user.

- Modeling is rarely a one-shot process, and good models are usually refined and enhanced as their users gather practical experiences with the system recommendations.

- Sensitive parts, which can be subsequently elaborated on. Systems employed in practice will need their models refined, and a good user interface should make it easy to access, examine, and refine its models.

Support for Reasoning about the Problem Structure in Addition to Numerical Calculations

• While numerical calculations are important in decision support, reasoning about the problem structure is even more important. Often when the system and its model are complex it is insightful for the decision maker to realize how the system variables are interrelated.

• This is helpful in designing creative decision options but also in understanding how a policy decision will impact the objective.

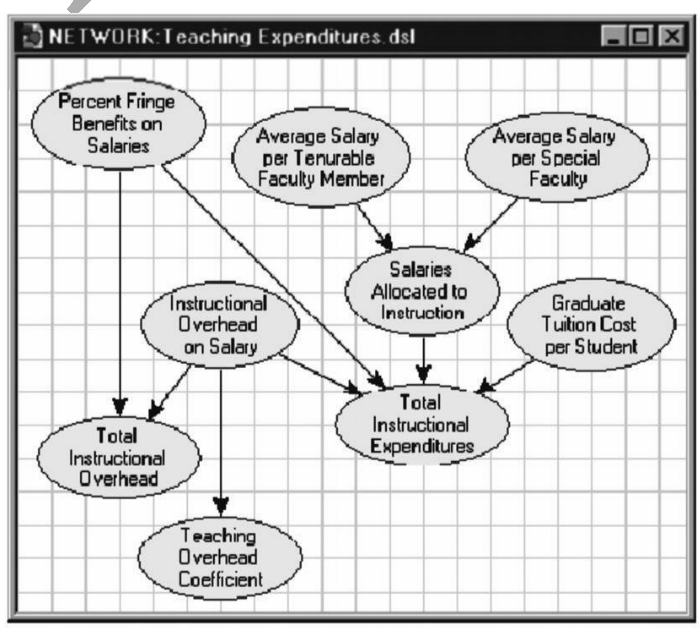
• Graphical models, such as those used in decision analysis or in equation-based and hybrid systems, are particularly suitable for reasoning about structure. Under certain assumptions, a directed graphical model can be given a causal interpretation.

• This is especially convenient in situations where the DSS autonomically suggests decision options; given a causal interpretation of its model, it is capable of predicting effects of interventions. A causal graph facilitates building an effective user interface.

Support for both Choice and Optimization of Decision Variables

• Many DSSs have an inflexible structure in the sense that the variables that will be manipulated are determined at the model-building stage. This is not very suitable for planning of the strategic type when the object of the decision-making process is identifying both the objectives and the methods of achieving them.

• For example, changing policy variables in a spreadsheet-based model often requires that the entire spreadsheet be rebuilt. If there is no support for that, few users will consider it as an option. This closes the world of possibilities for flexible reframing of a decision problem in the exploratory process of searching for opportunities.



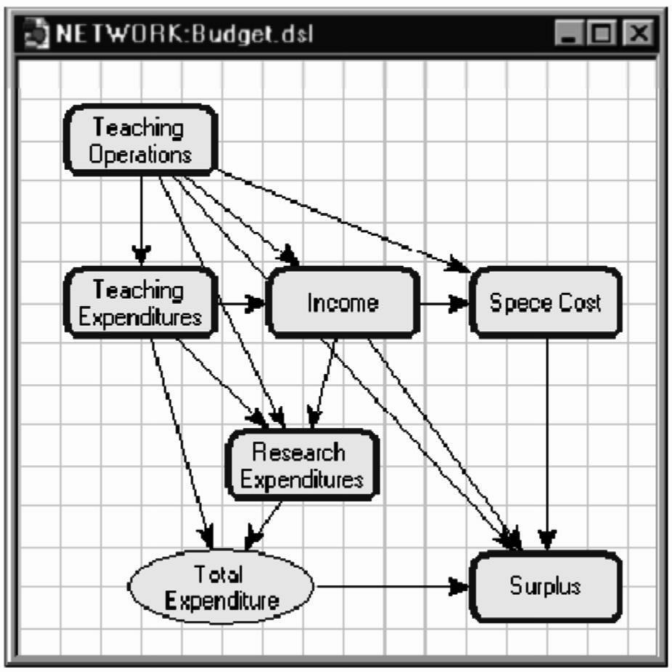
Support for both choice and optimization of decision variables should be an inherent part of DSSs.

• Insight into a model can be increased greatly at the user interface level by a diagram representing the interactions among its components.

For example, a drawing of a graph on which a model is based is shown in Figure 4.1.

• This graph is a qualitative, structural explanation of how information flows from the independent variables to the dependent variables of interest.

As models may become very large, it is convenient to structure them into sub-models, groups of variables that form a subsystem of the modeled system. Such sub-models can be again shown graphically with interactions among them, increasing simplicity and clarity of the interface. Figure 4.2 shows a sub-model-level view of a model developed in our ESP project. Note that the graph in Figure 4.1 is an expanded version of the Teaching Expenditures sub-model in Figure 4.2.



User Interface or Dialogue Management Component

• The user interface management component allows you to communicate with the Decision Support System. It consists of the user interface management system. This is the component that allows you to combine your know-how with the storage and processing capabilities of the computer. The user interface is the part of the system you see through it when enter information, commands and models.

• If you have a Decision Support System with a poorly designed user interface, if it is too rigid or too cumbersome to use, you simply won‟t use it no matter what its capabilities. The best user interface uses your terminology and methods and is flexible, consistent, simple, and adaptable.

• Customers in these target markets receive catalogs of merchandise that they are likely to buy, saving Lands‟ End the expense of sending catalogs of all products to all 20 million customers. To predict customer demand, lands end needs to continuously monitor buying trends. And to meet that demand, lands end must accurately forecast sales levels. To accomplish these goals, it uses a Decision Support System which performs three tasks:

_ Data management: The Decision Support System stores customer and product information. In addition to this organizational information, Lands End also needs external information, such as demographic information and industry and style trend information.

_ Model management: The Decision Support System has to have models to analyze the information. The models create new information that decision makers need to plan product lines and inventory levels.

_ User interface management: A user interface enables Lands‟ End decision makers to access information and to specify the models they want to use to create the information they need.

DSS generator

DSS generator is a comprised of programs such as data management tools, electronic spreadsheets, report generators, and statistical packages to facilitate systems development.

• A set of software that provides tools and capabilities to help developers build a specific DSS is called a "DSS generator" (Sprague, 1980). These tools could serve as a foundation for building multiple kinds of model-based DSS, including those incorporating multiobjective optimization technologies.

• Power and Sharda (2007) list a number of commercially available DSS generators for optimization applications (e.g., the AIMMS Modelling System, Evolutionary computing methods have been incorporated in several of those tools) Many of these DSS generators include a number of optimization techniques and tools, and are provided either as standalone application environments and/or as spreadsheet add-ins (to allow easy DSS prototyping).

• However, what is missing in this commercial software landscape is a DSS generator that integrates EMO technologies flexibly and quickly to construct robust prototype applications.

• A typical spreadsheet package, such as the ubiquitous Microsoft Excel, is the most familiar example of a DSS generator for creating model-drive DSS.

• The use of Excel by practicing engineers for everyday modeling tasks has become widespread over the last few decades because it provides virtually all of the graphical user interface, database, modeling, data analysis and programming tools required for creating small to medium size DSS with minimum effort. The introduction of a macro language and Visual Basic for Applications (VBA) together with add-in programs, makes Excel an even more powerful and useful generator of model-based DSS.

• They conclude that spreadsheets can be powerful tools for supporting decision making for water allocation by identifying under-utilized resources and by allowing trade-offs to be evaluated in water scarce basins. Thanks to the availability of the Solver add-in for Microsoft Excel, the popularity of spreadsheets for solving optimization problems has increased to the point that Solver is probably the most widely used general purpose optimization modeling system. The add-in employs a generalized reduced gradient algorithm (Lasdon et al., 1978) and can solve small linear and non linear optimization problems as well as mixed integer programming problems. However, in addition to limits on the size of problems that can be tackled and the relatively low execution speed (when compared to the compiled, stand-alone DSS), Solver does not provide any multi objective optimization capabilities.

Requirements of DSS

- In order to bring the power of multi objective optimization closer and faster to the intended users, a new DSS generator called GANetXL, which will address some of the difficulties associated with the development and use of model-based DSS in water engineering practice, has been envisaged.

The basic requirements considered for the new DSS generator are:

1. To provide easy access to efficient EMO optimization algorithms to users who are optimization non-specialists in order that they could consistent ly find good Pareto solutions to problems. These solutions are expected to be better than those that could be found through trial-and-error experimentation (i.e., using simulation only);

2. To develop a new general-purpose DSS generator as a n Excel add-in thereby allowing a large number of users to take advantage of integrating powerful optimization with modeling capabilities of spreadsheet technology;

3. To provide an intuitive Graphical User Interface (GUI) that will allow the easy creation of specific DSS applications. The interface should all inexperienced users to define an optimization problem, configure and execute an optimization run and analyze the obtained results through intuitive visualization of Pareto-optimal solutions in both decision and objective spaces;

4. To minimize the need for complex coding of the interface between optimization and any simulation routines that have to be used to evaluate potential solutions.

Group Decision Support Systems (GDSS)

A group decision support system (GDSS) is an interactive computer based system that facilitates a number of decision-makers (working together in a group) in finding solutions to problems that are unstructured in nature.

They are designed in such a way that they take input from multiple users interacting simultaneously with the systems to arrive at a decision as a group.

The tools and techniques provided by group decision support system improve the quality and effectiveness of the group meetings. Groupware and web-based tools for electronic meetings and videoconferencing also support some of the group decision making process, but their main function is to make communication possible between the decision makers.

In a group decision support system (GDSS) electronic meeting, each participant is provided with a computer. The computers are connected to each other, to the facilitator‟s computer and to the file server. A projection screen is available at the front of the room. The facilitator and the participants can both project digital text and images onto this screen.

A group decision support system (GDSS) meeting comprises different phases, such as idea generation, discussion, voting, vote counting and so on. The facilitator manages and controls the execution of these phases. The use of various software tools in the meeting is also controlled by the facilitator.

Components of Group Decision Support System (GDSS)

A Group decision support system (GDSS) is composed of 3 main components, namely hardware, software tools, and people.

- Hardware: It includes electronic hardware like computer, equipment used for networking, electronic display boards and audio visual equipment. It also includes the conference facility, including the physical setup – the room, the tables and the chairs – laid out in such a manner that they can support group discussion and teamwork.

- Software Tools: It includes various tools and techniques, such as electronic questionnaires, electronic brainstorming tools, idea organizers, tools for setting priority, policy formation tool, etc. The use of these software tools in a group meeting helps the group decision makers to plan, organize ideas, gather information, establish priorities, take decisions and to document the meeting proceedings. As a result, meetings become more productive.

- People: It compromises the members participating in the meeting, a trained facilitator who helps with the proceedings of the meeting, and an expert staff to support the hardware and software. The GDSS components together provide a favorable environment for carrying out group meetings.

Decision Conferencing

A brief history of Decision Conferencing:
Decision Conferencing was developed in the late 1970s by Dr Cameron Peterson and his colleagues at Decisions and Designs, Inc., largely as a response to the difficulty in conducting a single decision analysis for a problem with multiple stakeholders, each of whom takes a different

perspective on the issues. The approach was taken up in 1981 at the LSE‟s Decision Analysis Unit by Dr Larry Phillips, who integrated into the facilitator's role many of the findings about

groups from work at the Tavistock Institute of Human Relations. The service and supporting MCDA software continued to be developed throughout the 1980s in association with International Computers Limited and Krysalis Limited. As Decision Conferencing spread around the globe, facilitators needed to share experiences, so they created the International Decision Conferencing Forum, which meets annually, and the UK Decision Conferencing Forum, which gathers twice a year. Decision Conferencing is now offered by about 20 organisations located in England, the United States, Australia, Portugal and Hungary.

• Generating a sense of common purpose and agreeing the way forward is often desired in organisations but not always achieved. The reasons are many: local concerns may conflict with the aims of the organisation, personalities may clash, individuals may be too averse to taking risks, plans that are best for each unit in the organisation may not be collectively best. Whatever the reason, there may be a place for an improved approach to decision making, so people can arrive at a shared understanding of the issues, develop a sense of common purpose and achieve commitment to action. Those are the purposes of Decision Conferencing.

What is Decision Conferencing?
Decision Conferencing is a series of intensive working meetings, called decision conferences, attended by groups of people who are concerned about some complex issues facing their organisation. There are no prepared presentations or fixed agenda; the meetings are conducted as live, working sessions lasting from one to three days. A unique feature is the creation, on-the-spot, of a computer model which incorporates data and the judgements of the participants in the groups.

• The model is often based on multi-criteria decision analysis (MCDA), which provides ample scope for representing both the many conflicting objectives expressed by participants, and the inevitable uncertainty about future consequences. The model is a „tool for thinking‟ enabling participants to see the logical consequences of differing viewpoints, and to develop higher-level perspectives on the issues. By examining the implications of the model, then changing it and trying out different assumptions, participants develop a shared understanding and reach agreement about the way forward.

• Stages in a typical Decision Conference. Four stages typify most decision conferences, though every event is different. The first phase is a broad exploration of the issues. In the second stage, a model is constructed of participants‟ judgements about the issues, incorporating available data. All key perspectives are included in the model, which is continuously projected so all participants can oversee every aspect of creating the model.

• In the third stage, the model combines these perspectives, reveals the collective consequences of individual views, and provides a basis for extensive exploration of the model, always done on-line.

Discrepancies between model results and members‟ judgements are examined, causing new intuitions to emerge, new insights to be generated and new perspectives to be revealed. Revisions are made and further discrepancies explored; after several iterations the new results and changed intuitions are more in harmony.

• Then the group moves on to the fourth stage, summarizing key issues and conclusions, formulating next steps and, if desired, agreeing an action plan or set of recommendations. The facilitator prepares a report of the event‟s products after the meeting and circulates it to all participants. A follow-through meeting is often held to deal with afterthoughts, additional data and new ideas.

Role of the facilitators.
The group is aided by two facilitators from outside the organisation who are experienced in working with groups. The main tasks of the facilitators are to see and understand the group life, and to intervene, when appropriate, to help the group stay in the present and maintain a task orientation to its work. The facilitators attend to the processes occurring in the group, provide structure for the group‟s tasks, but refrain from contributing to content. They structure the discussions, helping participants to identify the issues and think creatively and imaginatively. The facilitators help participants in how to think about the issues without suggesting what to think.

Benefits of Decision Conferencing.
The marriage in Decision Conferencing of information technology, group processes and modelling of issues provides value-added to a meeting that is more than the sum of its parts. Follow-up studies, conducted by the Decision Analysis Unit at the London School of Economics and by the Decision Techtronics Group at the State University of New York, of decision conferences in the United Kingdom and the United States, for organisations in both the private and public sectors, consistently show higher ratings by participants for decision conferences than for traditional meetings. Organisations using Decision Conferencing report that the process helps them to arrive at better and more acceptable solutions than can be achieved using usual procedures, and agreement is reached more quickly. Many decision conferences have broken through stalemates created previously by lack of consensus, by the complexity of the problem, by vagueness and conflict of objectives, by ownership and by failure to think creatively and freshly about the issues.

Why Decision Conferencing works.
Decision Conferencing is effective for several reasons. First, participants are selected to represent all key perspectives on the issues, so agreed actions are unlikely to be stopped by someone else arguing that the group failed to consider a major factor. Second, with no fixed agenda or prepared presentations, the meeting becomes „live‟, the group works in the „here -and-now‟, and

participants get to grips with the real issues that help to build agreement about the way forward. Third, the model plays a crucial role in generating commitment. All model inputs are generated by the participants and nothing is imposed, so that the final model is the creation of the group, thereby „owned" by participants. Perhaps most important, the model helps to minimise the threat

to individuality posed by the group life: the model reveals higher-level perspectives that can resolve differences in individual views, and through sensitivity analysis shows agreement about the way forward in spite of differences of opinion about details. Fourth, computer modelling helps to take the heat out of disagreements. The model allows participants to try different judgements without commitment, to see the results, and then to change their views. Instant play-back of results which can be seen by all participants helps to generate new perspectives, and to stimulate new insights about the issues.

When is Decision Conferencing appropriate?
Decision Conferencing can be applied to most major issues facing private organisations, government departments, charities and voluntary organisations. Topics typically cover operations, planning or strategy. For example, organisations have used Decision Conferencing to develop corporate plans and strategies; to evaluate alternative visions for the future; to prioritise R&D projects and create added value; to design factories, ships and computer systems; to resolve conflict between groups; to allocate limited resources across budget categories; to evaluate the effectiveness of government policies, schemes and projects; to improve utilisation of existing buildings and plant; to determine the most effective use of an advertising budget; to assess alternative sites for a technological development; to deal with a crisis imposed by potentially damaging claims in a professional journal; to develop a strategy to respond to a new government initiative and to create a new policy for health care provision. Any issue that would benefit from a meeting of minds in the organisation can be effectively resolved with Decision Conferencing, which provides a way for „many heads to be better than one."

Expert System

Expert system is programs that attempt to perform the duty of an expert in the problem domain in which it is defined. Expert systems are computer programs that have been constructed (with the assistance of human experts) in such a way that they are capable of functioning at the standard of (and sometimes even at a higher standard than) human experts in given fields that embody a depth and richness of knowledge that permit them to perform at the level of an expert.

Rule-based System

Using a set of assertions, which collectively form the „working memory‟, and a set of rules that specify how to act on the assertion set, a rule-based system can be created. Rule-based systems are fairly simplistic, consisting of little more than a set of if-then statements, but provide the basis for so-called "expert systems" which are widely used in many fields. The concept of an expert system is this: the knowledge of an expert is encoded into the rule set. When exposed to the same data, the expert system will perform in a similar manner as the expert.

Components of Rule-based Expert System

Rule-based systems are a relatively simple model that can be adapted to any number of problems.
To create a rule-based system for a given problem, you must have (or create) the following:

_ A set of facts to represent the initial working memory. This should be anything relevant to the beginning state of the system.

_ A set of rules. This should encompass any and all actions that should be taken within the scope of a problem, but nothing irrelevant. The number of rules in the system can affect its performance, so you don‟t want any that aren‟t needed.

_ A condition that determines that a solution has been found or that none exists. This is necessary to terminate some rule-based systems that find themselves in infinite loops otherwise.

In fact, there are three essential components to a fully functional rule based expert system: the knowledge base, the working memory and the inference engine.

The Knowledge Base Notes

The knowledge base is the store in which the knowledge in the particular domain is kept. The knowledge base stores information about the subject domain. However, this goes further than a passive collection of records in a database. Rather it contains symbolic representations of experts‟ knowledge, including definitions of domain terms, interconnections of component entities, and cause-effect relationships between these components. The knowledge in the knowledge based is expressed as a collection of fact and rule. Each fact expresses relationship between two or more object in the problem domain and can be expressed in term of predicates IF condition THEN conclusion where the condition or conclusion are fact or sets of fact connected by the logical connectives NOT, AND, OR.

The Working Memory

The working memory is a temporal store that holds the fact produced during processing and possibly awaiting further processing produced by the Inference engine during its activities.

The Inference Engine

The core of any expert system is its inference engine. This is the part of expert system that manipulates the knowledge based to produce new fact in order to solve the given problem. An inference engine consists of search and reasoning procedures to enable the system to find solutions, and, if necessary, provide justifications for its answers. In this process it can used either forward or backward searching as a direction of search while applying some searching technique such as depth first search, breath first search, etc. The roles of inference engine are:

_ It identified the rule to be fired. The rule selected is the one whose conditional part is the same as the fact been considered in the case of forward chaining or the one whose conclusion part is the one as the fact been considered in the case of backward chaining.

_ It resolve conflict when more than one rule satisfy the matching this is called conflict resolution which is based on certain criteria mentioned further.

_ It recognizes the goal state. When the goal state is reached it reports the conclusion of searching.

Theory of Rule-based Systems

The rule-based system itself uses a simple technique: It starts with a knowledge-base, which contains all of the appropriate knowledge encoded into IF-THEN rules, and a working memory, which may or may not initially contain any data, assertions or initially known information. The system examines all the rule conditions (IF) and determines a subset, the conflict set, of the rules whose conditions are satisfied based on the working memory. Of this conflict set, one of those rules is triggered (fired). Which one is chosen is based on a conflict resolution strategy. When the rule is fired, any actions specified in its THEN clause are carried out. These actions can modify the working memory, the rule base itself, or do just about anything else the system programmer decides to include. This loop of firing rules and performing actions continues until one of two conditions is met: there are no more rules whose conditions are satisfied or a rule is fired whose action specifies the program should terminate.

Which rule is chosen to fire is a function of the conflict resolution strategy. Which strategy is chosen can be determined by the problem or it may be a matter of preference. In any case, it is vital as it controls which of the applicable rules are fired and thus how the entire system behaves. There are several different strategies, but here are a few of the most common:
_ First Applicable: If the rules are in a specified order, firing the first applicable one allows control over the order in which rules fire. This is the simplest strategy and has a potential for a large problem: that of an infinite loop on the same rule. If the working memory remains the same, as does the rule-base, then the conditions of the first rule have not changed and it will fire again and again. To solve this, it is a common practice to suspend a fired rule and prevent it from re-firing until the data in working memory, that satisfied the rule‟s conditions, has changed.

_ Random: Though it doesn‟t provide the predictability or control of the first-applicable strategy, it does have its advantages. For one thing, its unpredictability is an advantage in some circumstances (such as games). A random strategy simply chooses a single random rule to fire from the conflict set. Another possibility for a random strategy is a fuzzy rule based system in which each of the rules has a probability such that some rules are more likely to fire than others.

_ Most Specific: This strategy is based on the number of conditions of the rules. From the conflict set, the rule with the most conditions is chosen. This is based on the assumption that if it has the most conditions then it has the most relevance to the existing data.

_ Least Recently Used: Each of the rules is accompanied by a time or step stamp, which marks the last time it was used. This maximizes the number of individual rules that are fired at least once.
_ Best rule: For this to work, each rule is given a „weight," which specifies how much it should be considered over the alternatives. The rule with the most preferable outcomes is chosen based on this weight.

Direction of Searching

There are two broad kinds of direction of searching in a rule-based system: forward chaining systems, and backward chaining systems. In a forward chaining system you start with the initial facts, and keep using the rules to draw new conclusions (or take certain actions) given those facts. In a backward chaining system you start with some hypothesis (or goal) you are trying to prove, and keep looking for rules that would allow you to conclude that hypothesis, perhaps setting new sub-goals to prove as you go. Forward chaining systems are primarily data-driven, while backward chaining systems are goal-driven. We‟ll look at both, and when each might be useful.

Forward Chaining Systems

In a forward chaining system the facts in the system are represented in a working memory which is continually updated as rules are invoked. Rules in the system represent possible actions to take when specified conditions hold on items in the working memory – they are sometimes called condition-action rules. The conditions are usually patterns that must match items in the working memory, while the actions usually involve adding or deleting items from the working memory.

The inference engine controls the application of the rules, given the working memory, thus controlling the system‟s activity. It is based on a cycle of activity sometimes known as a recognize act cycle. The system first checks to find all the rules whose conditions hold, given the current state of working memory. It then selects one and performs the actions in the action part of the rule. (The selection of a rule to fire is based on fixed strategies, known as conflict resolution strategies.) The actions will result in a new working memory, and the cycle begins again. This cycle will be repeated until either no rules fire, or some specified goal state is satisfied.
Backward Chaining Systems

So far we have looked at how rule-based systems can be used to draw new conclusions from existing data, adding these conclusions to a working memory. This approach is most useful when you know all the initial facts, but don‟t have much idea what the conclusion might be. If you DO know what the conclusion might be, or have some specific hypothesis to test, forward chaining systems may be inefficient. You could keep on forward chaining until no more rules apply or you have added your hypothesis to the working memory. But in the process the system is likely to do a lot of irrelevant work, adding uninteresting conclusions to working memory.

This can be done by backward chaining from the goal state (or on some state that we are interested in). Given a goal state to try and prove (e.g., inflation rise) the system will first check to see if the goal matches the initial facts given. If it does, then that goal succeeds. If it doesn‟t the system will look for rules whose conclusions (previously referred to as actions) match the goal.

One such rule will be chosen, and the system will then try to prove any facts in the preconditions of the rule using the same procedure, setting these as new goals to prove.

Techniques of Searching

The order that rules fire may be crucial, especially when rules may result in items being deleted from working memory. The system must implement a searching technique that is used to process the knowledge base. Some of these technique are:

Depth First Search

In depth first search technique, the most recently fact added to the working memory is first selected for processing. We can thus implement it using stack so that the rule we have recently added to the working memory will be the one to be selected for the next cycle.

Breadth First Search

In the breath first search technique, the fact selected in the working memory for processing are selected in the order in which they were added in the working memory. We can use queue data structure to implement it. Since the rule to be processed will be selected in the front of the queue and the new fact are added at the rear of the queue.

Creation of Expert Systems Notes

The best way to do this is to use an expert system shell. An expert system shell can be viewed as an expert system minus the domain knowledge (the analogy would be the difference between a database tool and a database system). It allows knowledge of a domain to be encoded in a specific format and put into the system to create expert systems for different domains. The advantage of using a shell is that it avoids the need for computer programming and allows the developer to focus only on the domain knowledge. This enables even non-computer professionals to create expert systems. For instance, one could create a system by just keying in the rules which were given. The shell would provide the interface, the inference engine and the explanation system.

Benefits of Expert System

The main benefits of expert systems are:-
_ Permanence: Expert systems do not forget which may happen with human experts. Actually it is accumulation of experts knowledge.

_ Reproductive: Many copies of an expert system can be made, but training new human experts is time-consuming and expensive.

_ Complex Problem Solving & Decision Making: If there is a maze of rules (e.g. tax and auditing), then the expert system can work out the maze easily.

_ Productivity: Expert Systems can increase output & productivity which may result in decreased personnel costs.

_ Inexpensive maintenance: Although expert systems are expensive to build and maintain, they are inexpensive to operate. Development and maintenance costs can be spread over many users. The overall cost can be quite reasonable when compared to expensive and scarce human experts.

_ Consistency: With expert systems similar transactions are handled in the same way. The system will make comparable recommendations for like situations whereas humans are influenced by recency effects (most recent information having a disproportionate impact on judgment) & primacy effects (early information dominates the judgment).

_ Documentation: An expert system can provide permanent documentation of the decision process.

_ Completeness: An expert system can review all the transactions where a human expert can only review a sample.

_ Timeliness: Fraud and/or errors can be prevented. Information is available sooner for decision making.
_ Breadth: The knowledge of multiple human experts can be combined to give a system more breadth that a single

person is likely to achieve.

Problems with Expert Systems

• On the technical side, there is the problem of the size of the database and using it efficiently. If the system consists of several thousand rules, it takes a very powerful control program to produce any conclusions in a reasonable amount of time. If the system also has a large quantity of information in the working memory, this will also slow things down unless you have a very good indexing and search system.

• A second problem that comes from a large database is that as the number of rules increases the conflict set also becomes large so a good conflict resolving algorithm is needed if the system is to be usable.

• A more obvious problem is that of gathering the rules. Human experts are expensive and are not extremely likely to want to sit down and write out a large number of rules as to how they come to their conclusions. More to the point, they may not be able to. Although they will usually follow a logical path to their conclusions, putting these into a set of IF ... THEN rules may actually be very difficult and maybe impossible.

• It is quite possible that many human experts, though starting off in their professions with a set of rules, learn to do their job through experiential knowledge and „just know‟ what the correct solution is. Again they may have followed a logical path, but mentally they may have „skipped some steps‟ along the way to get there. An Expert System cannot do this and needs to know the rules very clearly.

Limitations of Expert System

However, Expert Systems suffer from following limitations:
_ Common sense: In addition to a great deal of technical knowledge, human experts have common sense. It is not yet known how to give expert systems common sense.

_ Creativity: Human experts can respond creatively to unusual situations whereas expert systems cannot.

_ Learning: Human experts automatically adapt to changing environments; expert systems must be explicitly updated. Case-based reasoning and neural networks are methods that can incorporate learning.

_ Sensory Experience: Human experts have available to them a wide range of sensory experience; expert systems are currently dependent on symbolic input

Success Factors Notes

Two major of success factors of expert system include:

_ Champion in Management
_ User Involvement and Training
Other success factors are:

_ The level of knowledge must be sufficiently high
_ There must be (at least) one cooperative expert

_ The problem to be solved must be qualitative (fuzzy) not quantitative _ The problem must be sufficiently narrow in scope

_ The ES shell must be high quality, and naturally store and manipulate the knowledge _ A friendly user interface

_ The problem must be important and difficult enough
_ Need knowledgeable and high quality system developers with good people skills

_ The impact of ES as a source of end-users‟ job improvement must be favorable. End user attitudes and expectations must be considered _ Management support must be cultivated.

Expert systems need end-user training programs.

Introduction to GlS; Case study on GIS in MIS

- Geographical Information System (GIS) is a technology that provides the means to collect and use geographic data to assist in the development of Agriculture. A digital map is generally of much greater value than the same map printed on a paper as the digital version can be combined with other sources of data for analyzing information with a graphical presentation.

- The GIS software makes it possible to synthesize large amounts of different data, combining different layers of information to manage and retrieve the data in a more useful manner. GIS provides a powerful means for agricultural scientists to better service to the farmers and farming community in answering their query and helping in a better decision making to implement planning activities for the development of agriculture.

Components of GIS

GIS enables the user to input, manage, manipulate, analyze, and display geographically referenced data using a computerized system. To perform various operations with GIS, the components of GIS such as software, hardware, data, people and methods are essential.

Software
GIS software provides the functions and tools needed to store, analyze, and display geographic information. Key software components are (a) a database management system (DBMS) (b) tools for the input and manipulation of geographic information (c) tools that support geographic query , analysis, and visualization (d) a graphical user interface (GUI) for easy access to tools. GIS software are either commercial software or software developed on Open Source domain, which are available for free. However, the commercial software is copyright protected, can be expensive and is available in terms number of licensees.

Hardware
Hardware is the computer on which a GIS operates. Today, GIS runs on a wide range of hardware types, from centralized computer servers to desktop computers used in stand-alone or networked configurations.

Data
The most important component of a GIS is the data. Geographic data or Spatial data and related tabular data can be collected in-house or bought from a commercial data provider. Spatial data can be in the form of a map/remotely-sensed data such as satellite imagery and aerial photography. These data forms must be properly geo- referenced (latitude/longitude). Tabular data can be in the form attribute data that is in some way related to spatial data. Most GIS software comes with inbuilt Database Management Systems (DBMS) to create and maintain a database to help organize and manage data.

Users
GIS technology is of limited value without the users who manage the system and to develop plans for applying it. GIS users range from technical specialists who design and maintain the system to those who use it to help them do their everyday work.
These users are largely interested in the results of the analyses and may have no interest or knowledge of the methods of analysis.

The user-friendly interface of the GIS software allows the nontechnical users to have easy access to GIS analytical capabilities without needing to know detailed software commands.

A simple User Interface (UI) can consist of menus and pull-down graphic windows so that the user can perform required analysis with a few key presses without needing to learn specific commands in detail.

Methods

A successful GIS operates according to a well-designed plan and business rules, which are the models and operating practices unique to each organization.

Functions of GIS

General-purpose GIS software performs six major tasks such as input, manipulation, management, query and analysis, Visualization.

Input

The important input data for any GIS is digitized maps, images, spatial data and tabular data. The tabular data is generally typed on a computer using relational database management system software. Before geographic data can be used in a GIS it must be converted into a suitable digital format.

The DBMS system can generate various objects such as index generation on data items, to speed up the information retrieval by a query. Maps can be digitized using a vector format in which the actual map points, lines, and polygons are stored as coordinates. Data can also be input in a raster format in which data elements are stored as cells in a grid structure (the technology details are covered in following section).

The process of converting data from paper maps into computer files is called digitizing. Modern GIS technology has the capability to automate this process fully for large projects; smaller jobs may require some manual digitizing. The digitizing process is labour intensive and time-consuming, so it is better to use the data that already exist.

Today many types of geographic data already exist in GIS-compatible formats. These data can be obtained from data suppliers and loaded directly into a GIS.

Manipulation

GIS can store, maintain, distribute and update spatial data associated text data. The spatial data must be referenced to a geographic coordinate systems (latitude/longitude). The tabular data associated with spatial data can be manipulated with help of data base management software. It is likely that data types required for a particular GIS project will need to be transformed or manipulated in some way to make them compatible with the system. For example, geographic information is available at different scales.

Before these can be overlaid and integrated they must be transformed to the same scale. This could be a temporary transformation for display purposes or a permanent one required for analysis. And, there are many other types of data manipulation that are routinely performed in GIS. These include projection changes, data aggregation, generalization and weeding out unnecessary data.

Management

For small GIS projects it may be sufficient to store geographic information as computer files. However, when data volumes become large and the number of users of the data becomes more than a few, it is advised to use a database management system (DBMS) to help store, organize, and manage data. A DBMS is a database management software package to manage the integrated collection of database objects such as tables, indexes, query, and other procedures in a database.

There are many different models of DBMS, but for GIS use, the relational model database management systems will be highly helpful.

In the relational model, data are stored conceptually as a collection of tables and each table will have the data attributes related to a common entity. Common fields in different tables are used to link them together with relations. Because of its simple architecture, the relational DBMS software

has been used so widely. These are flexible in nature and have been very wide deployed in applications both within and without GIS.

Query

The stored information either spatial data or associated tabular data can be retrieved with the help of Structured Query Language (SQL). Depending on the type of user interface, data can be queried using the SQL or a menu driven system can be used to retrieve map data. For example, you can degin to ask questions such as:

Where are all the soils are suitable for sunflower crop?
What is the dominant soil type for Paddy?
What is the groundwater available position in a village/block/district?

Both simple and sophisticated queries utilizing more than one data layer can provide timely information to officers, analysts to have overall knowledge about situation and can take a more informed decision.

Analysis

GIS systems really come into their own when they are used to analyze geographic data. The processes of geographic analys is often called spatial analysis or geo-processing uses the geographic properties of features to look for patterns and trends, and to undertake "what if" scenarios. Modern GIS have many powerful analytical tools to analyse the data. The following are some of the analysis which are generally performed on geographic data.

Executive Information Systems (EIS).

An Executive Information System (EIS) is a type of management information system intended to facilitate and support the information and decision making needs of senior executives by providing easy access to both internal and external information relevant to meeting the strategic goals of the organization. It is commonly considered as a specialized form of a Decision Support System (DSS).

The emphasis of EIS is on graphical displays and easy-to-use user interfaces. In general, EIS are enterprise-wide DSS that help top-level executives analyze, compare, and highlight trends in important variables so that they can monitor performance and identify opportunities and problems. EIS and data warehousing technologies are converging in the marketplace.

History

Traditionally, executive information systems were developed as mainframe computer-based programs. The purpose was to package a company‟s data and to provide sales performance or market research statistics for decision makers, as such financial officers, marketing directors, and chief executive officers, who were not necessarily well acquainted with computers. The objective was to develop computer applications that would highlight information to satisfy senior executives‟ needs. Typically, an EIS provides data that would only need to support executive level decisions instead of the data for all the company.

Today, the application of EIS is not only in typical corporate hierarchies, but also at personal computers on a local area network. EIS now cross computer hardware platforms and integrate information stored on mainframes, personal computer systems, and minicomputers. As some client service companies adopt the latest enterprise information systems, employees can use their personal computers to get access to the company‟s data and decide which data are relevant for their decision makings. This arrangement makes all users able to customize their access to the proper company‟s data and provide relevant information to bo th upper and lower levels in companies.

Components of EIS

\The components of an EIS can typically be classified as:

1. Hardware : When talking about hardware for an EIS environment, we should focus on the hardware that meet the executive‟s needs. The executive must be put first and the executive‟s needs must be defined before the hardware can be selected.

The basic computer hardware needed for a typical EIS includes four components:

- Input data-entry devices. These devices allow the executive to enter, verify, and update data immediately;

- The central processing unit (CPU), which is the kernel because it controls the other computer system components;

- Data storage files. The executive can use this part to save useful business information, and this part also help the executive to search historical business information easily;

- Output devices, which provide a visual or permanent record for the executive to save or read. This device refers to the visual output device or printer. In addition, with the advent of local area networks (LAN), several EIS products for networked workstations became available. These systems require less support and less expensive computer hardware. They also increase access of the EIS information to many more users within a company.

2. Software : Choosing the appropriate software is vital to design an effective EIS. Therefore, the software components and how they integrate the data into one system are very important. The basic software needed for a typical EIS includes four components:

3. Text base software. The most common form of text is probably documents;

4. Heterogeneous databases residing on a range of vendor-specific and open computer platforms help executives access both internal and external data;

5. Graphic base. Graphics can turn volumes of text and statistics into visual information for executives. Typical graphic types are: time series charts, scatter diagrams, motion graphics, sequence charts, and comparison-oriented graphs (i.e., bar charts);

6. Model base. The EIS models contain routine and special statistical, financial, and other quantitative analysis.

Perhaps a more difficult problem for executives is chosing from a range of highly technical software packages. Ease of use, responsiveness to executives‟ requests, and price are all reasonable considerations. Further, it should be considered whether the package can run on existing hardware.

User Interface : An EIS needs to be efficient to retrieve relevant data for decision makers, so the user interface is very important. Several types of interfaces can be available to the EIS structure, such as scheduled reports, questions/answers, menu driven, command language, natural language, and input/output. It is crucial that the interface must fit the decision maker‟s decision-making style. If the executive is not comfortable with the information questions/answers style, the EIS will not be fully utilized. The ideal interface for an EIS would be simple to use and highly flexible, providing consistent performance, reflecting the executive‟s world, and containing help information.

Telecommunication : As decentralizing is becoming the current trend in companies, telecommunications will play a pivotal role in networked information systems. Transmitting data from one place to another has become crucial for establishing a reliable network. In addition, telecommunications within an EIS can accelerate the need for access to distributed data.

Applications of EIS

EIS enables executives to find those data according to user-defined criteria and promote information-based insight and understanding. After realizing its advantages, people have applied EIS in many areas, especially, in manufacturing, marketing, and finance areas which are as follows :

1. Manufacturing : Basically, manufacturing is the transformation of raw materials into finished goods for sale, or intermediate processes involving the production or finishing of semi-manufactures. It is a large branch of industry and of secondary Manufacturing operational control focuses on day-to-day operations, and the central idea of this process is effectiveness and efficiency. To produce meaningful managerial and operational information for controlling manufacturing operations, the executive has to make changes in the decision processes. EIS provides the evaluation of vendors and buyers, the evaluation of purchased materials and parts, and analysis of critical purchasing areas. Therefore, the executive can oversee and review purchasing operations effectively with EIS. In addition, because production planning and control depends heavily on the plant‟s data base and its communications with all manufacturing work centers, EIS also provides an approach to improve production planning and control.

2. Marketing : In an organization, marketing executives‟ role is to create the future. Their main duty is managing available marketing resources to create a more effective For this, they need make judgments about risk and uncertainty of a project and its impact on company in short term and long term. To assist marketing executives in making effective marketing decisions, an EIS can be applied. EIS provides an approach to sales forecasting, which can allow the market executive to compare sales forecast with past sales.

3. Financial : A financial analysis is one of the most important steps to companies today. The executive needs to use financial ratios and cash flow analysis to estimate the trends and make capital investment decisions. An EIS is a responsibility-oriented approach that integrated planning or budgeting with control of performance reporting, and it can be extremely helpful to finance executives. Basically, EIS focuses on accountability of financial performance and it recognizes the importance of cost standards and flexible budgeting in developing the quality of information provided for all executive levels. EIS enables executives to focus more on the long-term basis of current year and beyond, which means that the executive not only can manage a sufficient flow to maintain current operations but also can figure out how to expand operations that are contemplated over the coming years.

Advantages and Disadvantages

Advantages

- Easy for upper-level executives to use, extensive computer experience is not required in operations
- Provides timely delivery of company summary information
- Information that is provided is better understood
- Filters data for management

- Improves to tracking information
- .Offers efficiency to decision makers

Disadvantages

- Functions are limited, cannot perform complex calculations
- Hard to quantify benefits and to justify implementation of an EIS
- Executives may encounter information overload
- System may become slow, large, and hard to manage
- Difficult to keep current data
- May lead to less reliable and insecure data
- Small companies may encounter excessive costs for implementation