**CCS 4406: DECISION SUPPORT SYSTEMS**

**Prerequisites:** CCS 4302 Principles of Artificial Intelligence

**Purpose:** To provide students with fundamental knowledge on decision support systems.

**Expected Learning Outcomes**

At the end of this course the student should be able to:

i. Understand conceptual foundations of decision support systems;
ii. Identify the informational needs of an organization and propose appropriate managerial models to help analyzing different business scenarios, develop feasible solutions, interpret results, and suggest possible decisions;
iii. Use computerized analysis aids to enhance the management decision making processes for major functional areas in an organization;
iv. Emphasize organization environment, technology, decision models, and performance evaluation as the major determinants of decision support systems success;
v. Highlight the use of major methodologies of developing decision support systems to suit the organizational needs and capabilities.

**INTRODUCTION AND BASICS OF DSS.**

Decision making is the process of choosing a course of action from a set of options.
Decision making involves the selection of a course of action between two or more possible alternatives in order to reach a solution to a given problem.

Decision making is a fundamental function of the management and reflects the success and failure of an organization.

Decision making is considered to be a choice among competing alternatives and the implementation of the chosen alternative. It is a process of making a choice from a number of alternatives to achieve a desired result.

**Types of decisions**

Decisions can be classified into three categories based on the level pf management at which they occur.

i) Strategic decisions set the course of an organization.

ii) Tactical decisions are decisions about how things will get done.

iii) Operational decisions refer to decisions that employees make each day to make the

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In the present day environment, organizations are faced with thousands of decisions and how they make these decisions have an enormous impact on their performance level.

**Decision making environment**

The quality of the decisions made in an organization will dictate the success or failure of the said business.

The type of decision making environment has an impact on the way the decision is taken.

**There are three decision-making environments:**

- Decision making under certainty.
- Decision making under uncertainty.
- Decision making under risk.

**Categories of Decision Making environment.**

a. **Decision making under certainty,**

The future state-of-nature is assumed known.

Decision maker *knows with certainty* the consequences of every alternative or decision choice. Tool used i.e. linear programming.

Such type of environment is very sure and certain by its nature. This means that all the information is available and at hand. Such data is also easy to attain and not very expensive to gather.

b. **Decision Making Under Risk:**

There is some knowledge of the probability of the states of nature occurring

Involves situations where the probability of each outcome is known or can be estimated.

This helps decision-makers to use statistical methods to analyze the options and make the best decision.

tools used, decision trees, SWOT analysis, queuing theory, simulation, decision trees, queuing theory etc

c. **Decision Making Under Uncertainty:**

There is no knowledge about the probability of the states of nature occurring

The decision maker *does not know* the probabilities of the various outcomes

**Tools used Monte Carlo analysis,** game theory. **Monte Carlo Simulation**

**Decision making tools**

- Linear Programming
- Decision Tree
- Network analysis
- Queuing Model
- Game Theory
- Network analysis
- Simulation

The quality of the decisions made in an organization will dictate the success or failure of the said business.

**DECISION SUPPORT SYSTEMS - DSS**

An information system that aids a business in decision-making activities.

A Decision Support System (DSS) is a computer-based tool designed to organizations in making informed decisions.

In general, decision support systems (DSSs) provide support for decision makers by bringing together human judgment and computerized information in an attempt to improve the effectiveness of decision-making

It integrates data, models, and analytical tools to solve complex problems.

The primary purpose of a DSS is to provide timely and relevant information & facilitate analysis to help decision-makers evaluate potential outcomes

A decision support system increases the speed and efficiency of decision-making activities.

DSS helps improve the quality of decisions, reduce uncertainty, and support strategic planning. Their importance lies in their ability to handle large volumes of data, apply sophisticated algorithms, and generate insights that guide effective choices.

**Decision Making Challenges in Today's Uncertain Business World.**

The decision-making process can pose barriers and challenges to business managers

The following are barriers to overcome in the decision making process.

- Bounded Rationality
- Escalation of Commitment
- Time Constraints
- Uncertainty
- Conflict

**Bounded Rationality.** The idea that rationality is limited when individuals make decisions.

Under these limitations, rational individuals will select a decision that is satisfactory rather than optimal.

**Escalation of commitment** is the idea that leaders and managers remain committed to a poor decision, or find it hard to remove themselves from a poor decision rationally.

**Time constraints** are when there is little time available to collect information with rationality and make an effective decision.

**Uncertainty** is the act of not knowing an outcome until said outcome has transpired.

**Process Conflict** – conflict about the best way to find a solution

N.B: DSS helps organizations streamline their operations by automating routine tasks and reducing manual effort. With the ability to integrate various data sources and perform complex calculations quickly, DSS eliminates the need for manual data manipulation and analysis.

DSS contributes to better decision outcomes, increased efficiency, and a competitive advantage in today's data-driven world.

**Examples of decision support system.**

Decision support systems are used in many of industries as follows.

- Personal Finance: DSS helps with budgeting and planning investments.
- Healthcare: DSS assists doctors in diagnosing and treating patients.
- Retail: DSS helps retailers with inventory and pricing decisions.
- Transportation: DSS improves routes and schedules for public transportation.
- Emergency Management: DSS helps manage resources and make decisions during emergencies and disasters.

**Applications of decision support systems.**

**a) DSS and Route optimization.**

Route optimization is the process of determining the most cost-efficient route.

DSS can be used to optimize routes for vehicles by analyzing factors such as traffic, road conditions, and weather.

This can help transportation companies to reduce travel time, fuel consumption, and operating costs.

The goal of an optimization algorithm is to find the optimal solution that minimizes or maximizes a given objective function.

The optimization process involves taking a given set of parameters and finding the optimal solution that maximizes value or minimizes cost, depending on the objective function being optimized.

**A.I Tools used**: Optimization algorithms.

Optimization algorithms are used to find the best possible solution to a given problem.

The goal of an optimization algorithm is to find the optimal solution that minimizes or maximizes a given objective function

Machine learning optimization aims to lower the degree of error in a machine learning model, improving its accuracy at making predictions on data.

Common optimization algorithms include:

- Gradient Descent
- Fibonacci Search
- Evolution algorithms
- Bayesian optimisation
- Swarm intelligence algorithms**:**
- Metaheuristic algorithms
- Linear Programming

**b) DSS for Capacity planning**:

Capacity planning is the process of determining the production capacity needed by an organization to meet changing demands for its products.

Capacity planning is the process to determine the production capacity to meet manufacturing demand.

By using formulations to consider the number of machines, staff size, available shifts, product mix, utilization and efficiency, capacity can be calculated to determine whether a company will meet forecasted demand.

This allows decision-makers to add or scale back capacity resources to improve overall efficiency and meet service commitments.

**Examples of capacity planning algorithms**

**i)Heuristic algorithms**

They can help you find good solutions in a short time, and cope with the challenges and complexities of the production system.

- Neural Networks
- Genetic algorithms
- Linear programming models

**c)Crop planning.** Farmers use DSS to help determine the best time to plant, fertilize, and reap their crops. Bayer Crop Science has applied analytics and decision support to every element of its business, including the creation of "virtual factories" to perform "what-if" analyses at its corn manufacturing sites.

**d) DSS in Asset management**:

DSS can be used to manage assets such as vehicles, infrastructure, and equipment by analyzing data such as maintenance schedules, repair history, and usage patterns.

This information can be used to optimize asset utilization, reduce downtime, and improve safety. Risk management.

Examples

Predictive Analytics algorithms used to predict market trends, identify investment opportunities, and optimize portfolio allocation.

By analyzing historical price data, economic indicators, and news sentiment, predictive analytics algorithms can generate insights that guide investment decisions.

**e) DSS in Supply chain management**: DSS can be used to optimize supply chain management by analyzing data such as inventory levels, shipping times, and customer demand.

This information can be used to optimize logistics operations, reduce costs, and improve customer satisfaction.

**f)DSS & Risk management**: DSS can be used to manage risks such as accidents, theft, and other incidents by analyzing data such as incident history, safety records, and environmental factors.

This information can be used to identify potential hazards and take action to prevent or mitigate them.

**g) DSS in agriculture Crop management.**

These systems focus on helping farmers make better decisions about crop selection, planting schedules, irrigation, and fertilization

Farmers use DSS to help determine the best time to plant, fertilize, and reap their crops. water management

**h)DSS in healthcare**

**Clinical DSS.** These systems help clinicians diagnose their patients and achieve better outcomes. Fresenius Medical Care has developed a system that leverages predictive analytics, machine learning, and cloud computing to proactively identify when kidney dialysis patients might be suffering a potentially life-threatening complication.

Example predictive model using machine learning to identify when kidney dialysis patients might be suffering a potentially life-threatening complication.

**i) ERP and DSS**

ERP systems are software packages that integrate various business processes, such as accounting, inventory, production, and human resources, into a unified database and interface. ERP systems can benefit from DSS by using them to perform advanced planning, optimization, simulation, and forecasting tasks that are beyond the scope of ERP modules.

For example, a DSS can help an ERP system to optimize the production schedule, allocate resources, balance inventory levels, and predict demand and sales.

**ERP dashboards.** These systems help managers monitor performance indicators. Digital marketing and services firm Clearlink uses a DSS system to help its managers pinpoint which agents need extra help.

**j) CRM and DSS**

CRM systems are software applications that manage the interactions between a business and its customers, such as marketing, sales, service, and support.

CRM systems can benefit from DSS by using them to enhance customer segmentation, targeting, personalization, and loyalty.

For example, a DSS can help a CRM system to analyze customer behavior, preferences, and feedback, and provide recommendations for cross-selling, upselling, retention, and satisfaction.

**COMPONENTS OF A DECISION SUPPORT SYSTEM**

The three main components of a DSS framework

### *1. User Interface*

Dashboards and other user interfaces that allow users to interact with and view results.

The user interface includes tools that help the end-user of a DSS navigate through the system.

### *2. Model Management System*

The system that fetch data and from DBMS and transform data into information that helps decision making.

Made up of mathematical and analytical models which are utilized for the analysis of complex data.

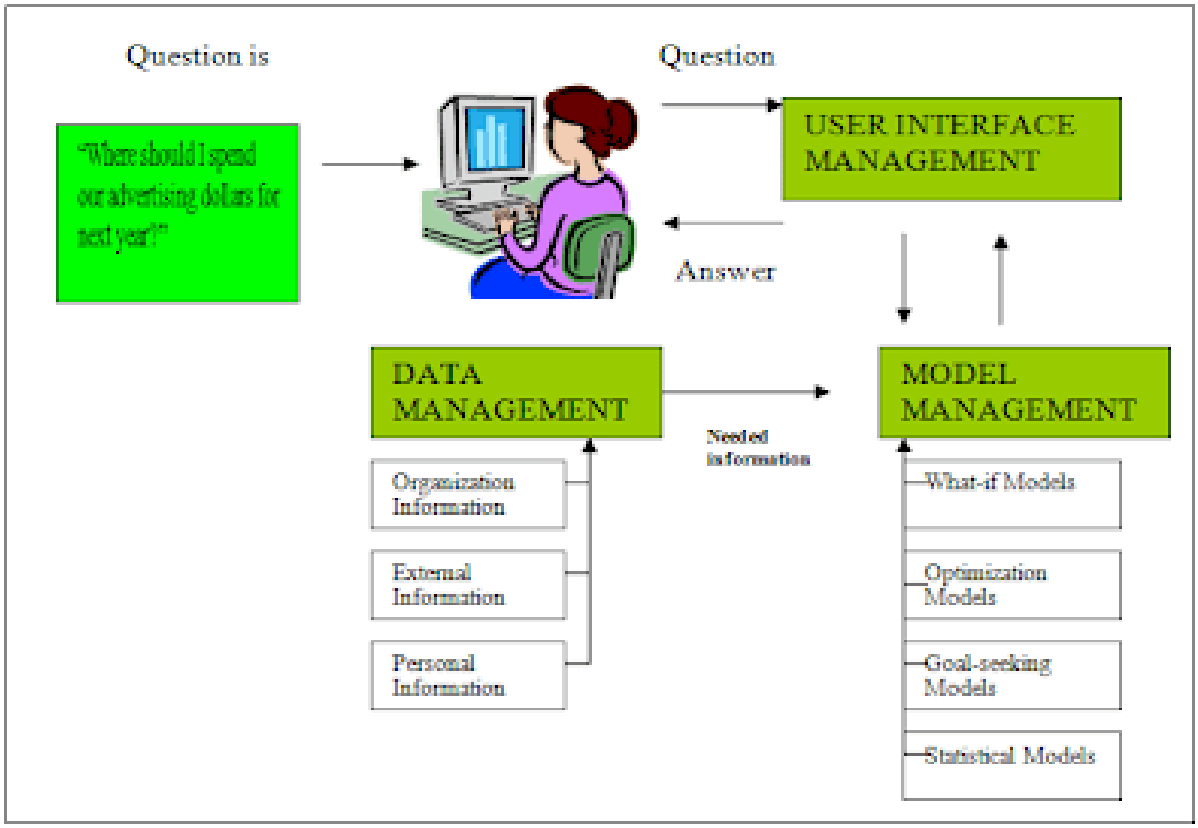
The model management system stores models that managers can use in their decision-making. The models are used in decision-making regarding the financial health of the organization and forecasting demand for a good or service.

Examples.

- **Statistical models.** These models are used to establish relationships between events and factors related to that event. For example, they could be used to analyze sales in relation to location or weather.
- **Sensitivity analysis models.** These models are used for "what-if" analysis.
- **Optimization analysis models.** These models are used to find the optimum value for a target variable in relation to other variables.
- **Forecasting models.** These include regression models, time-series analysis, and other models used to analyze business conditions and make plans.
- **Backward analysis sensitivity models.** Sometimes called goal-seeking analysis, these models set a target value for a particular variable and then determine the values other variables need to hit to meet that target value.

### *3. Knowledge Base/ data management component.*

Performs the function of storing and maintaining data that the Decision Support System use.The knowledge base includes information from both internal sources and external sources.




**Types of Decision Support Systems**:

a)- **Model-Driven DSS**: These systems rely heavily on *mathematical models*. For instance:

- What-If Analysis**:** Users explore different scenarios by adjusting input variables. An example is *financial forecasting*.

b)- **Optimization Models**: Linear programming, integer programming, and goal programming fall under this category.

c)- **Data-Driven DSS**: These systems analyze historical data to identify patterns and trends. Examples include *data mining* and *predictive analytics*.

d)- **Document-Driven DSS**: These focus on unstructured information. *Text analytics tools* help extract insights from documents, emails, and reports.

**Advantages of Integrating DSS with business applications.**

i. Improving the quality, speed, and accuracy of decisions,
ii. Increasing the productivity and efficiency of business processes,
iii. Enhancing the customer experience and satisfaction,

iv. Creating competitive advantages and innovation.
v. Can examine multiple alternatives,
vi. better understanding of the processes,
vii. identification of unpredicted situations,
viii. enhanced communication,
ix. cost effectiveness,
x. Better use of data and resources.