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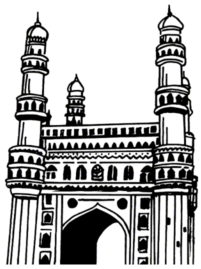

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CONTENTS

DECISION SUPPORT SYSTEMS

STUDY MANUAL

SOLVED PREVIOUS QUESTION PAPERS

SYLLABUS

UNIT - I

Introduction to Decision Support Systems (DSS): Evolution of DSS-Definition of DSS – Need and benefits of DSS. Decision Making Process-Types of Decisions, A framework For DSS Support- DSS as Information System- Types of DSS – Individual, Group.

UNIT - II

Development and Implementation of DSS and Models in DSS: DSS Architecture- Hardware, Software Tools for DSS- Approaches to Development – Implementation, Models in DSS – Types of Models.

UNIT - III

Group DSS and Groupware: Group Decision Making - problems with groups-MDM Support Technologies-Distributed Group DSS- Distributed DSS Technologies- Executive Information Systems-definition-EIS Components – Making the EIS work – The Future of Executive Decision Making and The EIS.

UNIT - IV

Artificial Intelligence (AI) and Expert System (ES): Definition of Artificial Intelligence – Artificial Intelligence vs. Natural Intelligence- The Intelligence of AI-Expert Systems- Definition, Structure of ES- Designing and Building ES- Benefits of ES – Examples of ES- Intelligent Software Agents.

UNIT - V

Data Ware Housing and Data Mining: Data Ware house – Definition- Data Marts, Data Stores, Meta Data – Characteristics of Data Ware House – Data Warehouse Architecture- Implementing Data Warehouse. Data Mining- Definition-Online Transaction Processing Techniques use to Mine Data, Data Mining Techniques-Limitations of Data Mining- Data Visualization.

Contents

UNIT - I

UNIT - II

UNIT - IV

UNIT - V

Topic No.		Page No.

UNITWISE IMPORTENTS TOPICS

UNIT - I

1. Definition of DSS and Evolution of DSS
2. Need and benefits of DSS.
3. Decision Making Process and Types of Decisions
4. A framework For DSS Support
5. Individual DSS Vs. Group DSS

UNIT - II

1. DSS Architecture
2. Hardware, Software Tools for DSS
3. Approaches to Development of DSS
4. DSS Implementation
5. Models in DSS and Types of Models.

UNIT - III

1. Group Decision Making and Problems with Groups
2. MDM Support Technologies
3. Distributed Group DSS and Technologies
4. Definition of EIS and Components
5. Making the EIS Work
6. The Future of Executive Decision Making and The EIS.

UNIT - IV

1. Definition of Artificial Intelligence and Discuss
2. Artificial Intelligence vs. Natural Intelligence
3. The Intelligence of AI
4. Definition and Structure of Expert Systems
5. Designing and Building ES
6. Benefits of ES
7. Intelligent Software Agents.

UNIT - V

1. Define Data Ware house and Discuss
2. Characteristics of Data Ware House
3. Data Warehouse Architecture
4. Implementing Data Warehouse.
5. Define Data Mining and Discuss.
6. Online Transaction Processing Techniques use to Mine Data
7. Data Mining Techniques and Limitations of Data Mining
8. Data Visualization.

UNIT I	**Introduction to Decision Support Systems (DSS):** Evolution of DSS- Definition of DSS – Need and benefits of DSS. Decision Making Process-Types of Decisions, A framework For DSS Support- DSS as Information System- Types of DSS– Individual, Group.

1.1 EVOLUTION OF DECISION SUPPORT SYSTEM (DSS)

The first ones processed numerical data, as in solving equations. Many advances in computing were made under the pressure of World War II needs. During that conflict, computers calculated the effective range of depth charges and optimal trajectories for artillery shells.

Computing power in that era was typically measured by the roomfuls of mathematicians that an "electronic brain" could replace, a popular comparison that ignored the difference between a clerk with a desk calculator and a true mathematician.

Electronic computers found commercial uses in the 1950s. The first large-scale system to process businesslike data was a Univac I at the U.S. Census Bureau in 1951. It has been stated that, without computers, data for the 1950 census could not have been tabulated before the next census began a decade later.

By the mid-1950s, large corporations had adopted computers for their own repetitive calculations, such as processing the corporate payroll.

This activity was known as automatic data processing—a term that previously referred to electro-mechanical punched card processing—or electronic data processing (EDP). These terms were shortened to data processing (DP) as computers came into wide use and manual data processing became a historical relic.

Later, when the term *data processing* came to encompass all the computer applications of an organization, the term transaction processing was coined to describe the repetitive processing of common business events and the recording of their associated data.

Managers were quick to realize that suitably summarized transaction data had potential decision-making value. They asked their organizations' data processing staffs for information that could be obtained from data that was already stored in their computers.

At the time, direct-access storage devices and on-line terminals, to say nothing of integrated databases with query software, were not in general use. There was, therefore, no easy way to obtain a single data element upon re-quest. The only way to satisfy such a request was to produce a voluminous report containing every data element which could possibly be relevant.

Information Re-porting Systems (IRS) thereby arose. Managers found thick reports, typically on 17-inch-wide paper with green and white horizontal bars across the page, on their desks every Monday morning. Some of these reports got lots of use; others were discarded unread when the next Monday's report arrived.

Outmoded as paper-based IRS might seem at the dawn of a new century, the re-ports did demonstrate that computers contained a great deal of useful management data.

As technology evolved to permit instant access to this data, the concept of a management information system (MIS) evolved with it. The idea behind MIS was to store all of a firm's data: customers, orders, inventory, production schedules, suppliers, employees, payroll, and so forth, for access and correlation on demand by non-technical managers.

In 1970's the Modest information system to help in making specific types of decisions has introduced i.e., decision support system. (DSS). It is evolved further during the 1980's to provide easier end-user access to the data.

In the 1990's decision making evolved into the data warehouse which is close approximation of the early MIS concept.

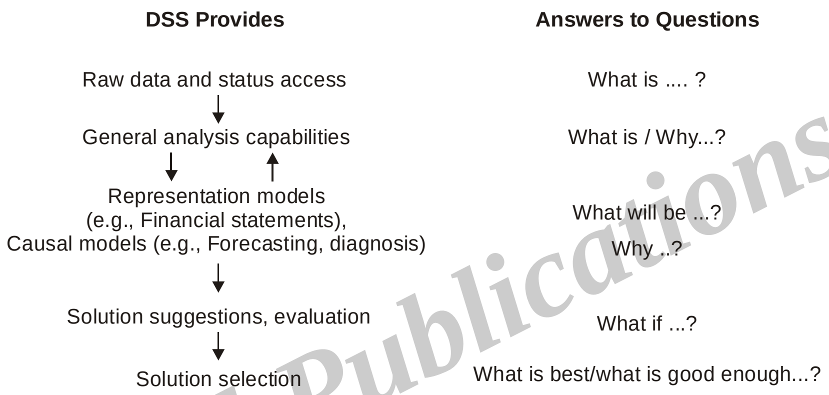
1.2 DEFINITION OF DSS

A decision support systems (DSS) is a computer-based information system that supports business or organizational decision-making activities. DSSs serve the management, operations, and planning levels of an organization and help to make decisions, which may be rapidly changing and not easily specified in advance.

DSSs include knowledge-based systems. A properly designed DSS is an interactive software-based system intended to help decision makers compile useful information from a combination of raw data, documents, personal knowledge, or business models to identify and solve problems and make decisions.

Typical information that a decision support application might gather and present are :

- ➢ inventories of information assets (including legacy and relational data sources, cubes, data warehouses, and data marts),
- ➢ comparative sales figures between one period and the next,
- ➢ projected revenue figures based on product sales assumptions.



Decision support systems (DSS) are a diverse group of interactive computer tools—primarily customizable software –designed to assist managerial decision making. They fall into a broader class known as management support systems (MSSs).

The goal of a DSS is to make management more efficient and effective, particularly with ad hoc and discretionary decisions (versus routine or programmatic ones that require little judgment).

1.3 NEED AND BENEFITS OF DSS

Need of DSS

One example is the clinical decision support system for medical diagnosis. Other examples include a bank loan officer verifying the credit of a loan applicant or an engineering firm that has bids on several projects and wants to know if they can be competitive with their costs.

DSS is extensively used in business and management. Executive dashboard and other business performance software allow faster decision making, identification of negative trends, and better allocation of business resources.

A growing area of DSS application, concepts, principles, and techniques is in agricultural production, marketing for sustainable development.

DSS are also prevalent in forest management where the long planning time frame demands specific requirements. All aspects of Forest management, from log transportation, harvest scheduling to sustainability and ecosystem protection have been addressed by modern DSSs.

Benefits of DSS

1. **Improving Personal Efficiency** Many DSS don't do anything a person couldn't do himself or herself. People prepared budgets for centuries before spreadsheet software came into use. DSS help them do it far faster and with less chance of error. Today, few spreadsheet users would willingly revert to manual techniques.

2. **Improving Problem Solving** The previous category referred to efficiency in carrying out a specific calculation or data retrieval task. This category of DSS ben-efits refers to solving the overall problem of which that task is a part. A DSS can make it possible for a person or a group to solve a problem *faster* or *better* than they could without it. There is a relationship between the two, of course: Increased efficiency in a small task, if properly applied, hopefully contributes to solving the problem as a whole.

3. **Facilitating Communication** Alter found that DSS facilitate interpersonal communication in several ways. In addition, technology developments that have occurred since his research have opened up new ways for DSS to provide this ben-efit. One way ,n which DSS facilitate communication is when used as a tool forpersuasion. The system can indicate when a particular action should be taken in the future (offensive use) or when a particular action was justified in the past (de-fensive use).

   - Example of offensive use. A carefully constructed spreadsheet can persuade a manager to approve a subordinate's budget request. That subordinate may, as a result, obtain more resources than subordinates whose requests are not as well documented. (This is not necessarily unethical. A manager can hardly be ex-pected to approve budget requests that are not well justified.)

- Example of defensive use. A financial forecast can explain, after the fact, why a project that failed was still a good bet based on what was known when it was approved.

Both these examples involve decisions that initially appear to be individual deci-sions, but that turn out to be group decisions when viewed in a broader organiza-tional context. The proliferation of graphic embellishment capabilities in modern spreadsheet packages is eloquent testimony to the importance of using spread-sheets for persuasion in the business world

4. **Promoting Learning or Training** Improved learning was seldom a goal of early DSS. However, it often occurred as a by-product of their use. Today it is often deliberately incorporated into DSS design. Learning via a DSS occurs when a DSS is used repeatedly: Its user gets to see the types of decisions it favors under different situations, and experience over time lets the user see the results of these decisions.

   The sort of DSS that facilitates learning, therefore, has to go beyond one that simply retrieves data from a database and presents the data to its user. There isn't much one can learn from a DSS that does that, though such a DSS can be valuable in other ways.

5. **Increasing Organizational Control** This factor refers to using a DSS to con-strain individual decisions to conform to organizational norms, guidelines, or re-quirements. By requiring managers to develop salary increase forecasts using a computerized system, a firm can ensure a level of consistency across organiza-tional units.

   Another example of this type of consistency occurs in judicial sen-tencing. Both of these were also used as examples of improved problem solving; they are both. Managers believe that consistent decisions are better than inconsis-tent ones in these situations and wish to control the organization to ensure that consistency is achieved.

1.4 CHARACTERISTICS AND APPLICATIONS OF DSS

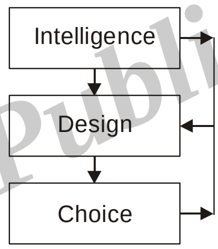
- Must assess data from a variety of sources.
- Must allow users to transform the enormous amount of data into information.
- Must provide a good user interface through which users can easily navigate and interact

Applications of DSS

- Strategic Planning
- Market Planning and Research
- Operations Planning
- Logistics Planning
- Sales Support

1.5 DECISION MAKING PROCESS

Decision making is a process which the decision maker uses to arrive at a decision. The core of this process is described by Herbert Simon in a model. He describes the model in three phases as shown in Fig (a)Intelligence; (b) Design; and (c) Choice. MIS follows this model in its development state.



- **Intelligence :** Raw data collected, processed and examined. Identifies a problem calling for a decision.
- **Design :** Inventing, developing and analyzing the different decision alternatives and testing the feasibility of implementation. Assess the value of the decision outcome.
- **Choice :** Select one alternative as a decision, based on the selection criteria.

In the intelligence phase, the MIS collects the data. The data is scanned, examined, checked and edited. Further, the data is sorted and merged with other data and computations are made, summarized and presented. In this process, the attention of the manager is drawn to all the problem situations by highlighting the significant differences between the actual and the expected, the budgeted or the targeted.

In the design phase, the manager develops a model of the problem situation on which he can generate and test the different decisions to facilitate its implementation. If the model developed is useful in generating the decision alternatives, he then further moves into phase of selection called as choice.

In the phase of choice, the manager evolves a selection criterion such as maximum profit, least cost, minimum waste, least time taken, and highest utility. The criterion is applied to the various decision alternatives and the one which satisfies the most is selected.

In these three phases, if the manager fails to reach a decision, he starts the process all over again from the intelligence phase where additional data and information is collected, the decision making model is refined, the selection criteria is changed and a decision is arrived at.

1.5.1 Methods of Decision Making

MIS is a technique for making programmed decisions. If we include the computer and management science as integral parts or tools of computer –based information systems, the prospects for a revolution in programmed decision making are very real.

Just as a manufacturing process is becoming more and more automated so is the automation of programmed decisions increasing to support this production and other information needs through out the organization.

Type of Decision	Methods of decision making	
	OLD	NEW
Programmed Repetitive and Routine	Habit Standard operating procedure Organization structure, policy etc	Management Information System
Non-Programmed	Judgement, Intution, Insight experience Training and Learning	Systematic Approach to problem solving & Decision making

1. Programmed Decisions

The Programmed decisions in Management of an organization are concerned with the relatively routine problems. These decisions are taken in the regular course of any business operations and occur at a day-to-day frequency.

These decisions are repetitive and structured in nature. They are small and have a low scope of impact.

The Information related to these types of decisions are readily available and can be processed in a pre-determined manner. These demand very little time and effort as there are pre-determined decision rules and procedures.

These are taken at lower levels of management

For example, a decision regarding a personnel coming late regularly.

2. Non- Programmed Decisions

The Non-programmed decisions in management are concerned with unique or unusual problems. They are encountered in a very non-frequent manner.

These decisions are unstructured, non-recurring and ill-defined in nature. Such decisions are relatively complex and have a long-term impact. The Information regarding these problems are not easily available. As such, they require high degree of executive judgement and deliberation.

These are generally taken at higher levels in the organization.

Eg-Decisions regarding the expansion of business.

Difference between Programmed and Non-programmed Decisions

	Programmed Decisions	Non-programmed Decisions
1.	Concerned with relatively routine problems. They are structured and repetitive.	Concerned with unique or unusual problems. They are unstructured, non-repetitive and ill defined.
2.	Such decisions are relatively simple and have a small impact.	Such decisions are relatively complex and have a long-term impact.
3.	The information related to these problems is readily available and can be processed in a pre-determined manner.	The information related to these problems is not readily available.

4.	It takes very little time and effort, as there are pre-determined decision rules and procedures.	They demand a high degree of executive judgement and deliberation.
5.	Taken at lower levels of management.	Taken at higher levels in the the organisation
6.	Eg-Personnel coming in late habitually.	Eg-Expansion of business.

1.6 TYPES OF A DECISIONS

In order to discuss the support of decisions and what these tools can or should do, it is necessary to have a perspective on the nature of the decision process and thus what it means to support it. One way of looking at a decision is in terms of three areas or components.

The first component is the data collected by a decision maker to be used in making the decision. The second component is the process selected by the decision maker to combine this data. Finally, there is an evaluation or learning component that compares decisions and examines them to see if there is a need to change either the data being used or the process that combines the data.

These components of a decision interact with the characteristics of the decision being made. One approach to categorizing decisions is to consider the degree of structure in the decision-making activity.

There are basically three types of decisions :

1) Structured decisions
2) Unstructured decisions
3) Semi-structured decisions

1) Structured Decisions

A structured decision is one in which all three components can be fairly well specified, i.e., the data, process, and evaluation are determined. Usually structured decisions are made regularly and therefore it makes sense to place a comparatively rigid framework around the decision and the people making it.

An example of this type of decision may be the routine credit-granting decision made by many businesses. It is probably the case that most firms collect rather similar sets of data for credit granting decision makers to use. In addition the way in which the data is combined is likely to be consistent (for instance, household debt must be less than 25 percent of gross income).

Finally, this decision can also be evaluated in a very structured way (specifically when the marginal cost of relaxing credit requirements equals the marginal revenue obtained from additional sales). For structured decisions it is possible and desirable to develop computer programs that collect and combine the data, thus giving the process a high degree of consistency.

However, because these tend to be routine and predictable choices, a DSS is typically not needed for highly structured decisions. Instead, there are any number of automated tools that can make the decision based on the predefined criteria.

2) Unstructured Decisions

At the other end of the continuum are unstructured decisions. These decisions have the same components as structured ones; however, there is little agreement on their nature. For instance, with these types of decisions, each decision maker may use different data and processes to reach a conclusion.

In addition, because of the nature of the decision there may also be few people that are even qualified to evaluate the decision. These types of decisions are generally the domain of experts in a given field. This is why firms hire consulting engineers to assist their decision-making activities in these areas. To support unstructured decisions requires an appreciation of individual approaches, and it may not be terribly beneficial to expend a great deal of effort to support them.

Generally, unstructured decisions are not made regularly or are made in situations in which the environment is not well understood. New product decisions may fit into this category for either of these reasons. To support a decision like this requires a system that begins by focusing on the individual or team that will make the decision.

These decision makers are usually entrusted with decisions that are unstructured because of their experience or expertise, and therefore it is their individual ability that is of value. One approach to support systems in this area is to construct a program that simulates the process used by a particular individual.

These have been called "expert systems." It is probably not the case that an expert decision maker would be replaced by such a system, although it may offer support in terms of providing another perspective of the decision.

Another approach is to monitor and document the process that was used so that the decision maker(s) can readily review what has already been examined and concluded.

An even more novel approach used to support these decisions is to provide environments that are specially designed to give these decision makers an atmosphere that is conducive to their particular tastes, a task well suited for a DSS.

The key to support of unstructured decisions is to understand the role that individual experience or expertise plays in the decision and to allow for individual approaches.

3) Semi-structured Decisions

In the middle of the continuum are semi-structured decisions, and this is where most of what are considered to be true decision support systems are focused. Decisions of this type are characterized as having some agreement on the data, process, and/or evaluation to be used, but there is still a desire not to place too much structure on the decision and to let some human judgment be used.

An initial step in analyzing which support system is required is to understand where the limitations of the decision maker may be manifested, i.e., will it be in the data acquisition portion, or in the process component, or possibly in the evaluation of outcomes.

For instance, suppose an insurance executive is trying to decide whether to offer a new type of product to existing policyholders that will focus on families with two or more children that will be ready to attend college in six to nine years. The support required for this decision is essentially data oriented.

The information required can be expressed in terms of the following query on the insurance company's database: "Give me a list of all of our policyholders that have a college education and have more than two children between ages 10 and 12."

1.7 A FRAMEWORK FOR DSS SUPPORT

There are three basic components in a DSS :

- a database
- a model base
- a user interface

Depending on the system, each of these components may be very simple or highly elaborate. The database, or in advanced systems, a database management system (DBMS) or a data warehouse, consists of structured, real-life information, such as customer account records, product sales history, employee schedules, or manufacturing process statistics.

The model base, or model base management system (MBMS), contains one or more models for the kind of analysis the system will perform. For example, if the purpose of the system is to supply sales projections under different conditions, one model might be a linear regression formula derived from past sales and other factors.

The user interface integrates the two into a coherent system and provides the decision maker with controls for—and possibly feedback about managing the data and the models.

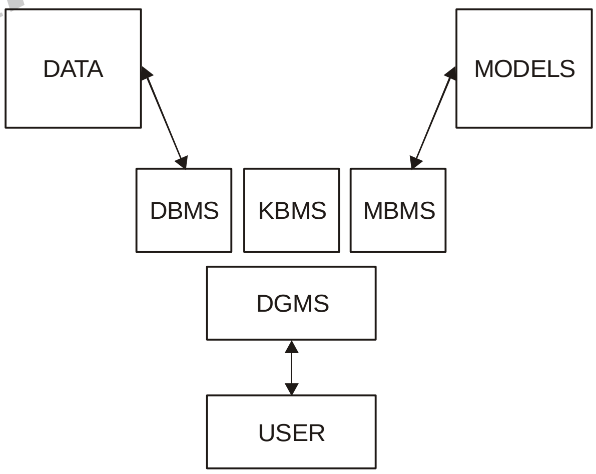
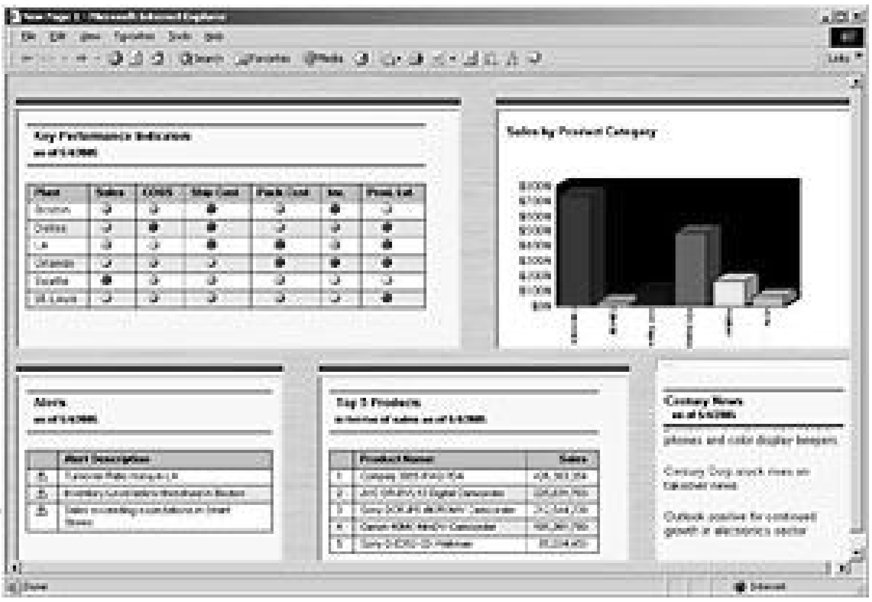


Fig.: Decision Support Framework

1.8 DSS AS INFORMATION SYSTEM

Decision Support Systems (DSS) are a specific class of computerized information system that supports business and organizational decision-making activities.

A properly designed DSS is an interactive software-based system intended to help decision makers compile useful information from raw data, documents, personal knowledge, and/or business models to identify and solve problems and make decisions. The best decision support systems include high-level summary reports or charts and allow the user to drill down for more detailed information.



Typical information that a decision support application might gather and present would be :

- Accessing all of your current information assets, including legacy and relational data sources, cubes, data warehouses, and data marts
- 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.

1.9 TYPES OF DECISION SUPPORT SYSTEMS (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 :

1) **Communication-driven DSS :** Most communications-driven DSSs are targeted 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.

2) **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.

3) **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.

4) **Knowledge-driven DSS :** Knowledge-driven DSSs or 'knowledge base' 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.

5) **Model-driven DSS :** Model-driven DSSs are complex systems that help analyse 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.

1.10 INDIVIDUAL AND GROUP DSS

Decision support systems can also be categorized on the basis of the type of group, if any, that they support. Certain DSS are used by individuals making indi-vidual decisions. A marketing manager deciding on next year's ad budget is in that situation. This person wants to pick the ideal advertising budget for his or her firm. The final decision is made by the marketing manager alone, though people in that type of situation often discuss options with colleagues and seek their advice.

At the lowest level, a data-oriented DSS that provides information on the cost, reach, and likely impact of different media choices can help this person make an informed decision. An analysis information system could automate some simple calculations on these data. Moving up from there, an accounting model could consolidate the data and calculate the total exposure of an overall advertising program: seven half-page black-and-white ads in *Time,* a one-minute commercial every week for a month on major league baseball's "Game of the Week," . . . Such a model could provide a chart that tells the marketing man-ager how many people will see one of the ads, how many will see two ads, and so on.

A representational model could predict the impact of these impressions on purchase decisions over time, providing guidance not only in selecting the right advertising program but also in making sure enough stock is in stores to satisfy the anticipated demand.

Other DSS are used by individuals in making decisions that are made by many people across an organization, where consistency is required. A bank may want to make sure that all its loan officers apply certain criteria to the applications they re-view, even though the loan officers make each decision individually. We call such DSS multi-individual DSS.

Finally, some DSS support decisions that are inherently made by a group as a whole. Such **group DSS** must take into account not only the models and data of the decision, but also the dynamics of the group decision-making process.

Model-oriented			
Data-oriented			
	Individual	Multi-individual	Group

Table : Two-dimensional Grid of DSS Types

Software designed to support the work of a group is often called *groupware.* This term includes both group DSS and other packages, such as electronic mail or meeting scheduling, that are inherently group-oriented but which are not usually consid-ered decision-support systems as such. We'll discuss group DSS in Chapter 10.

An individual or multi-individual DSS takes on some group DSS characteristics if the individuals' managers review and comment on the decisions in question. A department manager may use a spreadsheet program to develop a budget for the department. For that purpose the spreadsheet—or the model built with its help—is an individual DSS. If the budget is subject to review and approval by the division manager, however, the decision is a group decision; it may be a small group, since it consists of only two people, but a group nonetheless. Any tool used to help make that decision therefore has aspects of a group DSS.

The expectation of using an essentially individual DSS in this fashion may af-fect its design. The department manager mentioned previously may format and label the budget spreadsheet beyond his or her own informational needs. This is done with a view to showing the spreadsheet to the division manager, justifying its contents, and possibly vying with other department managers for a share of the di-visional resources.

The classification of DSS into data-oriented and model-oriented DSS, and clas-sification into individual, multi-individual, and group DSS, are separate issues. Both dimensions can be visualized as shown in Figure. In the figure, the verti-cal axis shows the way the DSS supports the decision-making task: data-oriented or model-oriented.

The horizontal axis reflects the individual, multi-individual, or group nature of the decision. We'll revisit this two-dimensional approach to classi-fying DSS in more detail in Chapter 10, where we'll also look at some of the kinds of DSS that could go into the (currently empty) boxes of the figure.

1.11 GROUP DECISION MAKING

Group decision making is a situation faced when people are brought together to solve problems in the anticipation that they are more effective than individuals under the idea of synergy. But cohesive groups display risky behavior in decision making situations that led to the devotion of much effort, especially in the area of applied social sciences and other relevant fields of specialization.

There are several aspects of group cohesion which have a negative effect on group decision making and hence on group effectiveness. Risky-shift phenomenon, group polarisation, and group-think are negative aspects of group decision making which have drawn attention.

Group-think is one of the most dangerous traps in our decision making. It's particularly because it taps into our deep social identification mechanisms - everyone likes to feel part of a group - and our avoidance of social challenges. But consensus without conflict almost always means that other viewpoints are being ignored, and the consequences of group-think can be disastrous.

Issues facing any work group concerning decision making are: how should decisions be made? Consensus? Voting? One-person rule? Secret ballot? Consideration of the various opinions of the different individuals and deciding what action a group should take might be of help.

Formal Systems

- Consensus decision-making tries to avoid "winners" and "losers". Consensus requires that a majority approve a given course of action, but that the minority agree to go along with the course of action. In other words, if the minority opposes the course of action, consensus requires that the course of action be modified to remove objectionable features.

Voting-Based Methods

- Range voting lets each member score one or more of the available options. The option with the highest average is chosen. This method has experimentally been shown to produce the lowest Bayesian regret among common voting methods, even when voters are strategic.
- Majority requires support from more than 50% of the members of the group. Thus, the bar for action is lower than with unanimity and a group of "losers" is implicit to this rule.
- Plurality, where the largest block in a group decides, even if it falls short of a majority.
- Dictatorship, where one individual determines the course of action.

UNIT II	**Development and Implementation of DSS and Models in DSS:** DSS Architecture - Hardware, Software Tools for DSS- Approaches to Development – Implementation, Models in DSS – Types of Models.

2.1 DSS ARCHITECTURE

An important issue to consider before planning individual systems is developing an overall enterprise information systems architecture. The architecture of an information system refers to the way its pieces are laid out, what types of tasks are allocated to each piece, how the pieces interact with each other, and how they in-teract with the outside world.

Information system architecture is a high-level concept. The architecture does not specify that a Compaq Model XYZ will be installed in each purchasing agent's office, that the manufacturing local area network (LAN) will support 17 users, or that a market planning model will become operational in June 2002. The following definition of an information systems architecture, from [MART91], ap-plies well to DSS :

A written expression of the desired future for information use and management in an or-ganization, that creates the context within which people can make consistent decisions.

The intent of an information systems architecture, whether for decision support systems or for any other information systems, is to achieve the following :

➢ Interoperability of systems, so that information can be brought to the point of use quickly and easily.

➢ Compatibility of systems, so that resources can be shared easily and leveraged across the organization.

➢ Expandability of systems, so that limited single-function components do not create bottlenecks that obstruct the growth of the organization.

An information system architecture corresponds to a city master plan. The plan estimates future needs and builds on those estimates. It lays out areas for homes, shopping, and industry; indicates what type of roadways will be needed and ap-proximately where; and suggests when infrastructure elements such as sewage treatment facilities will need expansion.

An information systems architecture must reflect the needs of all users in the organization. It must balance the desire for instant access to every byte of data with financial realities. It must be practical for today's technology without unduly constraining the future. It must be specific enough to guide system developers, yet flexible enough to meet needs not yet foreseen and adapt to technologies not yet predicted. All in all, a tall order.

Technical benefits of a DSS architec-ture include the ability to plan systems in an effective and coordinated fashion and to evaluate technology options within a context of how they will work rather than abstractly.

Achieving all these benefits requires that both IS professionals and prospective system users—who, after all, are the ones who understand the prob-lems that the system is to help solve—must cooperate closely in developing the architecture.

The overall architecture of a DSS should be laid out and understood before spe-cific hardware and software selection decisions are made. The nature of this archi-tecture depends on the DSS.

Mini-DSS developed by individuals for their own use do not justify an architectural planning effort, though the overall IS architecture of the organization may determine some aspects of how and where they fit into the picture. Enterprise wide DSS do require careful advance planning if they are to succeed.

To lay out a DSS architecture you must consider the spectrum of DSS that your organization will use. To do this systematically, you should consider :

- Strategic, tactical (management control), and operational decisions.
- Unstructured, semistructured, and structured decisions.
- All levels of management and knowledge workers in the organization.
- All major functional, product or line of business, and geographic divisions of the organization.

If your DSS architecture allows for needs in all these categories, it will be suffi-ciently comprehensive and robust to stand the test of time. Your DSS architecture must reflect the following elements:

- Its database or databases, including any existing databases, internal or external to the organization, and any databases that are created specifically for DSS use.

  The architecture should state who is responsible for different types of databases—at the personal, departmental, and enterprise levels—for ensuring their accuracy, currency, and security.

- Its model or models, including information about their sources of data, the orga-nizational responsibility for maintaining them, limits on access to them, and so forth. It may not be practical to specify every individual model at the initial stages, but it should be possible to define the major categories.

- Its users, including any assumptions about their locations, jobs, levels of educa-tion, and any other factor that may affect their use of the DSS.

  "Location" in this context means both geographic location, type of working environment (office, factory, construction site, home, truck cab, and so on) and any other factors that will affect the delivery of decision support system services to those users.

- Software tools through which the users access the database and the models. Some of these, especially for simple database queries, may be provided by the database package itself.

  Others may be developed or obtained separately. One major category of software tool that will require careful consideration is on-line analytical processing software for accessing a data warehouse.

- Software tools through which system administrators manage the database and the models, again over and above those provided by their underlying platforms.

- Hardware and operating system platforms, at a generic level, on which the data-bases and models reside, on which the programs run, and through which users access the DSS.

  Any constraints, such as a policy to standardize on products of a given vendor or products that use a given operating system, should be stated here, with due allowance for upgrades to both hardware and software as technol-ogy evolves.

➢ Networking and communication capabilities through which these platforms are interconnected. These must reflect individual needs to connect to one or more servers and databases, workgroup needs to communicate within each group, and enterprise needs to link workgroups to each other, to shared data, and perhaps to customers or to external databases.

If it is the intent to standardize on one or two of several alternative technologies—for example, in high-speed LAN connec-tions to the desktop—this should be specified here.

In many DSS situations the interconnection mechanism will simply be the corporate network, either an existing one or one that is planned within an overall corporate information systems architecture.

The content of the information technology architecture is deepening with time because more and more capabilities are being included in the platforms upon which applications are built. In the early days of computers one bought bare hardware.

Figure below shows a generic view of a DSS architecture.

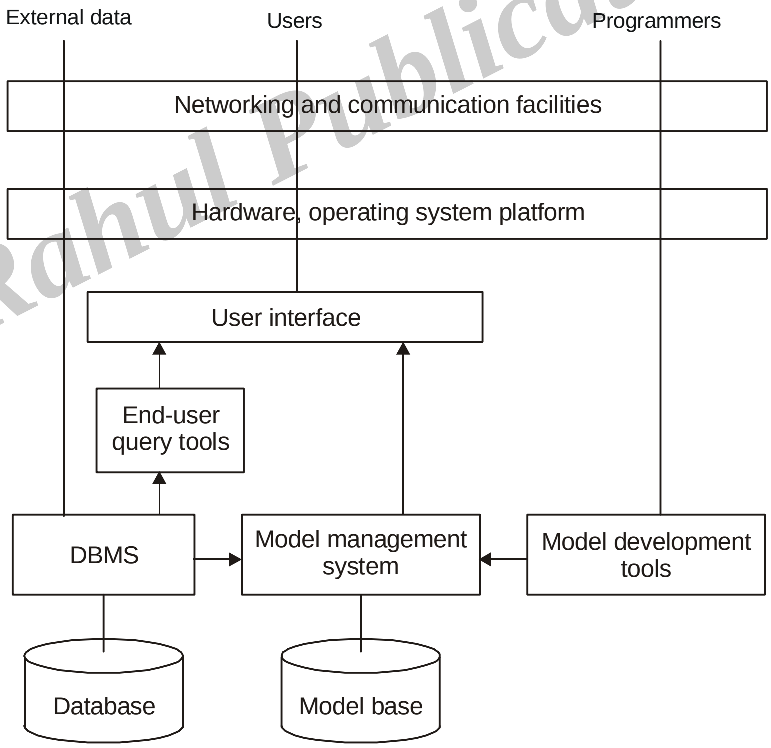


Fig.: Conceptual DSS Architecture

2.2 HARDWARE AND OPERATING SYSTEM FOR DSS

The term platform refers to the combined hardware/operating system environ-ment that supports the applications, which for our purposes are decision support systems.

DSS can run on several types of platforms.

1. The central corporate system.
2. The central system linked to other computers on users' desktops via a network an internal corporate network, the Internet, or an intranet (an internal network using Internet-based user interfaces).
3. A separate system that obtains data from the central system and provides it to users, again usually over a network.
4. A freestanding system at the user's desk.
5. A combination of the above.

1. DSS On The Central Corporate System

Virtually every medium-sized or larger organization, and every major division of large organizations, has a central computer system. These systems run operational transaction-based applications such as accounting, order entry, and time billing. They also often run strategic applications such as electronic data interchange with customers or facilities for rapid inquiry into the status of critical orders. Such cen-tral multiuser systems usually use an integrated database management system for the organization's important information.

The hardware platform of a central multiuser system is usually a mainframe or a large minicomputer. Transaction processing users usually access the system through terminals or via desktop microcomputers equipped with a terminal emula-tion package. (Accessing it via microcomputers, which function as computers in their own right, and handle part of the application, is called *client/server comput-ing.*

2. DSS and Client/Server Computing

Many organizations deal with the aforementioned disadvantages by providing in-dividual users, via their desktop computers, with access to data on the central computer. The desktop computers then handle the computations and other processes of a DSS. These processes usually include supporting the usual elements of today's easy-to-use graphical user interfaces, such as windows, pull-down menus, and the use of a mouse or other pointing device.

This approach is referred to as client/server computing. The system storing the database is called a server. The server system, in this example, acts as a data repository. The client system, typically on the user's desktop, runs the application using data from the server. The result is a close matching of each partner's capa-bilities to its role in the overall system.

The term *client/server* describes any situation in which an application is parti-tioned to run on two or more systems of different capabilities, using each to best advantage. Many people are familiar with small LAN versions of client/server: Using a print server to share a color laser printer among several client PCs, or using a file server to eliminate the need for each PC to have its own copy of all ap-plication programs are examples.

3. The Internet And Client/Server Computing In DSS

As you know, the Internet is a giant worldwide information source. The World Wide Web, especially, provides easy access to information on a wealth of topics. Much of this information can be useful for decision making. It is possible to take this same technology and this same interface and use them to access a corporate DSS.

The Web architecture, the HyperText Markup Language (HTML) for de-veloping Web pages, the Java language that most browsers can interpret, the JavaScript language for commands added to HTML, and the standards that Web browsers must follow define, in effect, a platform for applications. DSS can use this platform so that any user with a Web browser can access those DSS easily.

A network computer (NC) is the limiting step in the direction of thin clients (see page 174). A network computer amounts to a single-function computer that can access the Internet (and specifically the World Wide Web), can run programs written in Java or another Internet-based language that it downloads from the 'Net, but has no freestanding computing capability of its own. Network computers pro-vide many of the same advantages as terminals on multiuser computers low hardware cost, central control over applications, reduced end-user support costs with the widely familiar and easy-to-use Web browser user interface.

4. DSS Using Shared Data on a Separate System

It is not necessary for the server in a client/server system to be the central corpo-rate computer that stores the live, operational database. It is often a good idea to extract meaningful decision support data from the operational database and load it into a different computer. That second computer can then be accessed directly via terminals, or can act as a server in the client/server computing model.

The new system can range from a microcomputer to a “supermini.” The choice depends on the required capacity, the required software tools, and the number of concurrent users. If the DSS is to be used by more than one person, minicomput-ers or multiprocessor servers are popular choices.

The linked-system approach is effective when the application allows for a deci-sion support database that is separate from the firm’s transaction-processing data-base.

There are several reasons why an organization might want to separate its decision support data from its transaction data. These include :

- To use a database structure that is well suited for decision support applications, whereas its corporate database is in a different one for transaction processing.
- To consolidate data from two or more existing databases, when it would be too dif-ficult to merge them into a single database. (Perhaps each supports a separate set of existing applications, which would require conversion to use a common database.)
- Along the same lines, to incorporate external data into the DSS database.
- To avoid overloading the computer that houses the existing database with the in-cremental DSS workload.
- To accommodate different security requirements for accessing the two types.
- To take a “snapshot” of the operational database to use as a common basis for decision making while the operational database continues to change.

5. DSS on a Stand-alone System

Many decision support systems do not access a central database. Some run models whose input, consisting of only a few numbers, comes entirely from its user’sknowledge or from external sources and can be keyed in easily for each run. A budgeting system may take all its input from its user, eventually creating a spread-sheet that can be carried to another system on diskette or sent to it over a network for consolidation. DSS that helps real estate agents choose houses to show a po-tential buyer, or a system in a new car showroom helping buyers select the options they want, need only the answers to some simple questions.

DSS that do not access a large central database are typically model-oriented or process-oriented. Whereas some of them use databases that are developed and maintained locally by their individual users, such databases are unlikely to be large or complex. A "real" data-oriented DSS normally requires some form of link to an existing or external database. Its hardware would therefore usually fall into one of the previous categories.

6. Open Systems and DSS

You may have heard or read the term open systems. You may have heard the UNIX operating system, mentioned briefly above, discussed in this context. With more and more organizations moving toward open systems, there's a good chance that your employer (now or after graduation) will be one of them. Furthermore, and importantly for the purposes of this book, open systems and DSS have a close relationship.

2.3 SOFTWARE TOOLS FOR DSS

There are four fundamental ways to obtain any software capability: to purchase a turnkey package, to customize a package, to use specialized tools or "generators" designed for the task at hand, or to write the necessary programs from scratch. Since a decision support system is software, these approaches apply to DSS as well. The choice between packages (customized or not) and custom software usu-ally depends on two factors:

1. **The degree to which your needs resemble those of many other organizations.** This determines the likelihood that software developers will have found the market for the capability you need attractive enough to develop packages for resale.
2. **The financial impact of the application,** which determines the value of getting exactly the capability you want versus what you can get in a standard package. The size of the organization is a factor here. A system that cost $300,000 and could increase the profits of General Motors by 1 percent of gross sales would be a wise investment. The same $300,000 investment would not be advisable if the result was a 1 percent-of-sales increase in the profits of Sid's and Suzie's Sandwich and Soda Shoppe (S&SS&SS).

These factors, and the areas where each approach is usually applicable, are shown graphically in Figure. This suggests that you should look toward standard packages and tools where your application is common to many firms or where your firm is small.

If your application is unique and your organization is large, consider custom development. Below that part of the graph, in medium-sized or-ganizations and for applications with some standard features, customized pack-ages play a part.

If your application is unique and your firm is small, you may have to forego an application-specific DSS unless you can find a creative way to reduce its cost. Possible cost-reduction measures include :

- Developing a system for future resale to other firms with similar needs. The Mrs. Fields' chain of cookie stores developed software to forecast demand as a function of time of day, day of week, weather, holidays, type of store location (business street, shopping mall), and other factors that affect cookie sales. It then recouped much of the cost by going into the software business.
- Sharing the cost with similar firms that do not compete directly with yours, ei-ther because their lines of business are not quite the same, because they serve a different geographic sales territory, or some other reason.
- Finding IS students who will develop your system as a term project. A small family-owned ice cream shop on Cape Cod has a sophisticated, customized de-mand forecasting and supply ordering program of which any large firm would be proud because its owners' son needed a senior project for his operations management major.
- Finding a software developer perhaps a start-up firm in need of user assis-tance in developing a new program or penetrating a new market, which will, in turn, work with you to apply that program to your needs.
- Persuading one of your suppliers to develop the program or to fund its develop-ment for later licensing to you and to their other customers.

2.3.1 Standard Packages

Standard packages to help make specific decisions have been developed for a few common decisions.

The characteristics of decision that make it attractive to package suppli-ers are

- Many people make these decisions, so the potential market is large.
- The decision has financial importance to many of these potential users.
- The underlying factors are the same for all of them. (Individual investors vary in the importance they attach to different performance measures and in the set of stocks of potential interest, but a price-volume chart is a price-volume chart to everyone.)
- The support infrastructure public databases that can provide the necessary data to anyone, free or for a small fee already exists.

Decisions having these characteristics are, unfortunately, rare, and especially so in the business world. Where they exist, and where companies have developed DSS to help with them, these companies often do not want to give away their secrets to their competitors.

2.3.2 Specialized Tools and Generators

Although few decision support applications are sufficiently general to justify the de-velopment of packages that do nothing else, many DSS applications do have common features. DSS tools and DSS generators allow DSS developers to utilize standard-ized "building blocks," which support these common features, to develop their own custom applications. As a potential DSS developer, you should be aware of the tools that are available so you can choose the best one for your needs on each project.

The terms DSS tool and DSS generator, both quite common in the DSS litera-ture, create a great deal of confusion. The use of DSS generators is associated with the higher level, more business-oriented, roles.

The proliferation of customizable packages such as spreadsheet programs has made this approach less popular than it once was. A graphing package to graph data from some other source, which is useless without such a source, would be a DSS tool.

The major categories of specialized software used to assist DSS development are

1. Database management packages.
2. Information retrieval (query and reporting) packages.
3. Specialized modeling packages (including spreadsheets) and languages.
4. Statistical data analysis packages.
5. Forecasting packages.
6. Graphing packages

2.3.3 Programming Languages for DSS

The final approach to DSS development is to write the necessary software from scratch. "From scratch" is a bit of a misnomer here, since true from scratch soft-ware development is a rarity today. Few if any DSS would not take advantage of at least some capabilities listed in the previous section. However, important compo-nents of many DSS cannot be satisfied by standard tools and are still written in a programming language of some type.

1. Third-Generation Programming Languages

While so-called experts have been predicting their demise for decades, third-generation languages (3GLs) such as Pascal and C even the older COBOL, which dates from the early 1960s remain the mainstay of system developers as the 21st century opens. Despite substantial progress in more advanced languages and standard software packages, most programmers still work at the procedural (3GL) level. New languages such as Java, designed for developing Web-based ap-plications, are unquestionably in the traditional 3GL mold.

Third-generation languages have the advantage of standardization. Compilers for popular 3GLs have been refined over the years and produce code that utilizes hardware efficiently. High-volume transaction processing programs fall into this category.

2. Fourth-Generation Programming Languages

The defining characteristic of a fourth-generation language (4GL) is that its user specifies what the computer is to do, not how the computer is to do it. Do you need a sales report by region for the past three years ? List the items to be reported on, how you want them organized and totaled, and let the 4GL do the work.

A 4GL user trades flexibility and run-time efficiency for speed of development. Where the built-in capabilities of the 4GL suffice, and where the utmost in ma-chine utilization efficiency is not required, a 4GL can cut application development time by an order of magnitude.

2.3.4 DSS User Interfaces

Since decision support systems are intended to work closely with human decision makers in carrying out their tasks, a DSS can only be as effective as its interface with those humans permits. Compared to the clerical and administrative workers who are the primary users of transaction processing and information reporting sys-tems, the knowledge workers and managers who use DSS tend to have the follow-ing characteristics :

- They use DSS for only a fraction of their working day. They spend the rest of their time performing other tasks, many of which do not require a computer.
- They are chosen for their positions for reasons other than computing skills. These skills, or even their attitude toward computers, may not be considered in hiring.
- Their tasks are less standardized.
- Each execution of their tasks has greater impact on organizational performance.
- They exercise more individual judgment as to the best way to perform their tasks.
- Their high pay makes it cost-effective to accommodate their personal prefer-ences at the expense of additional system development effort or computer re-sources.
- Their relatively high organizational status (compared to, say, order entry opera-tors) conditions them to expect organizational accommodation of their individ-ual needs.

These factors make it important to give a DSS the proper interface to its users. While DSS user interfaces are often determined or at least constrained by the software packages used in the DSS.

2.4 APPROACHES TO DEVELOPMENT OF DSS

Three approaches to information system development are commonly used :

1. The traditional system development life cycle (SDLC) approach.
2. The prototyping approach, with two major variations.
3. End-user development, often with professional support.

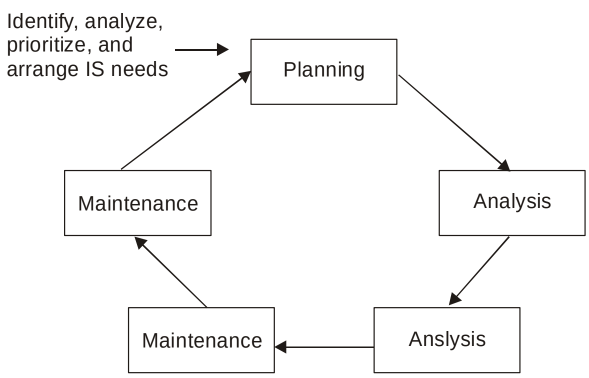
2.4.1 SDLC

System - an organized collection of independent tasks and processes that is designed to work together in order to accomplish specific objectives. The processes and tasks typically receive input(s) from and provide output(s) to other processes and tasks and even other systems. The tasks and processes may or may not be supported by automation.

SDLC refers to a methodology for developing systems. It provides a consistent framework of tasks and deliverables needed to develop systems. The SDLC methodology may be condensed to include only those activities appropriate for a particular project, whether the system is automated or manual, whether it is a new system, or an enhancement to existing systems.

The SDLC methodology tracks a project from an idea developed by the user, through a feasibility study, systems analysis and design, programming, pilot testing, implementation, and post-implementation analysis. Documentation developed during the project development is used in the future when the system is reassessed for its continuation, modification, or deletion.

SDLC Phases



Phases in SDLC are

1) Planning,
2) Analysis,
3) Design,
4) Implementation, and
5) Maintenance/Sustainment/Staging

1) **Project planning, feasibility study:** Establishes a high-level view of the intended project and determines its goals.

2) **Systems analysis, requirements definition:** Refines project goals into defined functions and operation of the intended application. Analyzes end-user information needs.

3) **Systems design :** Describes desired features and operations in detail, including screen layouts, business rules, process diagrams, pseudo code and other documentation.

   Convert recommended solution to system specifications.

   - **Logical design :** Functional features described independently of computer platform.
   - **Physical design :** Logical specifications transformed to technology-specific details.

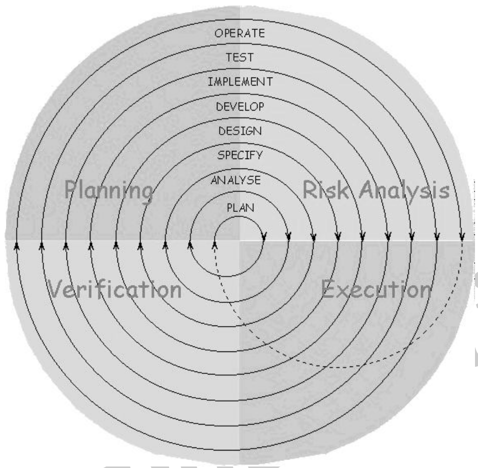
4) **Implementation (Development) :** The real code is written here. Code, test, install, and support the information system.

   - **Integration and testing :** Brings all the pieces together into a special testing environment, then checks for errors, bugs and interoperability.
   - **Acceptance, installation, deployment :** The final stage of initial development, where the software is put into production and runs actual business.

5) **Maintenance :** What happens during the rest of the software's life: changes, correction, additions, moves to a different computing platform and more. Systematically repair and improve the information system.

2.4.2 Spiral Model

The spiral model emphasizes the need to go back and reiterate earlier stages a number of times as the project progresses. It's actually a series of short waterfall cycles, each producing an early prototype representing a part of the entire project. This approach helps demonstrate a proof of concept early in the cycle, and it more accurately reflects the disorderly, even chaotic evolution of technology.



2.4.3 Prototyping Model

The Prototyping Model is a systems development method (SDM) in which a prototype (an early approximation of a final system or product) is built, tested, and then reworked as necessary until an acceptable prototype is finally achieved from which the complete system or product can now be developed. This model works best in scenarios where not all of the project requirements are known in detail ahead of time. It is an iterative, trial-and-error process that takes place between the developers and the users.

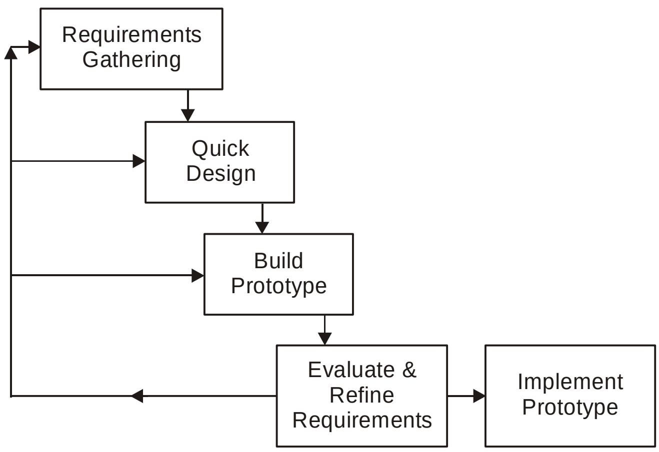
There are several steps in the Prototyping Model :

1. The new system requirements are defined in as much detail as possible. This usually involves interviewing a number of users representing all the departments or aspects of the existing system.
2. A preliminary design is created for the new system.
3. A first prototype of the new system is constructed from the preliminary design. This is usually a scaled-down system, and represents an approximation of the characteristics of the final product.

4. The users thoroughly evaluate the first prototype, noting its strengths and weaknesses, what needs to be added, and what should to be removed. The developer collects and analyzes the remarks from the users.
5. The first prototype is modified, based on the comments supplied by the users, and a second prototype of the new system is constructed.
6. The second prototype is evaluated in the same manner as was the first prototype.
7. The preceding steps are iterated as many times as necessary, until the users are satisfied that the prototype represents the final product desired.
8. The final system is constructed, based on the final prototype.
9. The final system is thoroughly evaluated and tested. Routine maintenance is carried out on a continuing basis to prevent large-scale failures and to minimize downtime.

2.4.4 Rapid Prototyping

In the rapid prototyping (sometimes called rapid application development) model, initial emphasis is on creating a prototype that looks and acts like the desired product in order to test its usefulness. The prototype is an essential part of the requirements determination phase, and may be created using tools different from those used for the final product. Once the prototype is approved, it is discarded and the "real" software is written.



2.4.5 Incremental Model

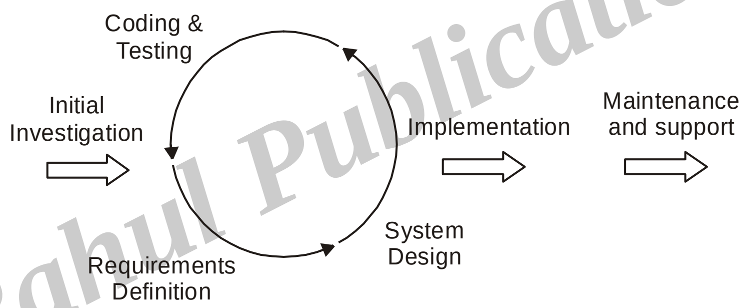
The incremental model divides the product into builds, where sections of the project are created and tested separately. This approach will likely find errors in user requirements quickly, since user feedback is solicited for each stage and because code is tested sooner after it's written.

2.4.6 Iterative models

By definition have an iterative component to the systems development. It allows the developer to take a small segment of the application and develop it in a fashion that, at each recursion, the application is improved.

Each of the three main sections: requirements definition, system design, and coding and testing are improved with each cycle through the process.

Iterative Model



2.5 IMPLEMENTATION OF DSS

As you probably learned in a systems analysis course, the program or system has to be rolled out to its user community. This part of the system life cycle is called implementation. A typical definition of implementation is "the process of assuring that the information system is operational and then allowing users to take over its operation for use and evaluation"

Figure below shows graphically the place of implementation in the overall system development process, along with some of its major subtasks. The phases are shown as overlap-ping because they do. The lines indicating the ends of the phases slope because implementation phases may continue for some parts of the system or the database after they have finished for others.

We'll use the word implementation to include everything that takes place from the mo-ment that system developers determine that their system is technically ready to be placed in the hands of its intended users, until the system is fulfilling its purpose for members of the organization.

If a DSS is developed using end-user computing tools and will not be made available to a large user community, implementation may be trivial: Its developer starts using it, and that's that. However, many DSS are developed via either the traditional SDLC or a prototyping approach. In these cases, implementation is crit-ical:

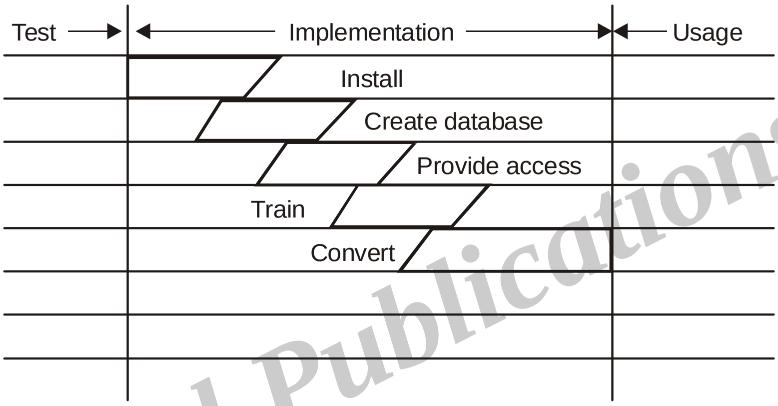


Fig.: Implementation Stage of Systsem Development Process

Implementation includes the following activities. All must be included in the overall DSS project plan, with the necessary resources allocated to each. You can see that the complexity of each activity can vary dramatically from one DSS to an-other. A DSS that is simple in one aspect of its implementation will often be com-plex in another.

- **Obtaining and installing the DSS hardware.** This does not apply if the intended user community is already using the required hardware for other purposes. How-ever, a new DSS often involves upgraded central systems, new LANs, new servers, new or upgraded desktop hardware, new networking connections, and perhaps more. These must be installed and fully operational before the next step can begin.
- **Installing the DSS and making it run on its intended hardware.** This will be triv-ial if the system was developed on the same computer on which it is intended to run in production use. In that case it is already installed,

and its users need only be made aware of how to invoke it. Installation is more of an issue if a system must be installed in multiple computers throughout an organization, or if it was developed on a dedicated "software factory" computer and must now be trans-ferred to its production environment.

- **Providing user access to the system.** This is trivial if the system is installed in microcomputers on the users' desks. In more complex situations, providing user access may require installing networks, extensive new wiring, and either termi-nals or a terminal emulation hardware/software package in the users' microcom-puters. It may also require registration of the users on the system, including passwords, creation of electronic "mailboxes," assignment to groups, granting of priority levels, allocation of disk storage, and more.

- **Creating and updating the database.** Again, this activity can be trivial or nonex-istent if an existing database is to be accessed without modification. In many sit-uations, though, a specialized DSS database (or data warehouse; see the next part of the book) must be created, perhaps combining existing corporate files and databases with data from external databases.

  In a data warehouse, creating the database is often the single most complex part of the entire project. The DSS database may also have to be distributed to a number of computers or LAN servers. This should have been done at least once during system testing. Now it is necessary to make the procedure a regular, and hopefully automated, activity.

- **Training the users on the new system.** People who don't know how to use a sys-tem can hardly be expected to use it willingly or to obtain the maximum benefit from it. Training should not be left to programmers, who are often impatient with nontechnical end users. A systems analyst with good people skills can be used in a pinch, but trained trainers are the ideal.

  In a mainframe or minicomputer environment, or if multiple microcomputers, servers, and LANs are involved, it may also be necessary to train system opera-tors, administrators, and other support personnel on the operational aspects of the new system.

- Documenting the system for its users and for those who will be responsible for maintaining it in the future. Ideally, much documentation will have been written as the DSS was developed.

Reality, however, suggests, otherwise. Pressure to get the system working, and the common reluctance of many programmers to write documentation, combine to make this an afterthought. The implementation process is not complete until all the required types of system documentation have been written and are known to be satisfactory.

- Making arrangements to support the users as the system is used. This is espe-cially important for DSS, whose users often use the system infrequently (thus forgetting details from one session to the next), use it in different ways each time (thus using different commands, options, etc.) and, as managers or senior professionals, may expect better support in all aspects of their work than their clerical colleagues do.
- Transferring ongoing responsibility for the system from its developers to the op-erations or maintenance part of the MIS group. Specifics will depend on how the organization's MIS group is organized.
- Switching over to the new system from previous methods of making decisions or obtaining information to make them.
- Evaluating the operation and use of the system. This is the only way manage-ment can determine if it is receiving the benefits it expected when it commis-sioned the DSS—and, if not, why not. Whether the answer to this question is in the affirmative or in the negative, this answer is important for the future of DSS in the organization. The evaluation must include objective assessments such as usage frequency,

These steps, at the topic level, resemble the implementation steps you studied for information systems in general in your introductory MIS course. However, there are some differences in their application to DSS.

2.6 MODELS IN DSS

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 purposes, though these characteristics may be quite impor-tant in other contexts. Here's a more formal description of this concept:

The central idea in structure-mapping is that an analogy is a mapping of knowledge from one domain (the base) to another (the target) which conveys that a system of rela-tions that holds among the base objects also holds among the target objects. Thus an analogy is a way of focusing on the relational commonalities independently of the ob-jects in which those relations are embedded.

In simpler language, the central idea of a model is that important relationships that apply to the system being modeled also apply to the model. Most management decisions are based on information about the real world rather than on physical characteristics of something in the real world. For exam-ple, if a factory manager is told that Plan A will produce 10 percent more dish-washers per shift than Plan B with the same equipment and only 2 percent more workers, that manager can choose Plan A without actually seeing the finished products appear.

Therefore, if a model can provide decision makers with the same information that observation of the real world would provide, while at the same time offering advantages over observing the real world, that model will be a useful tool. That is the essence of model usage in DSS.

2.7 MODEL TYPES

Basic types of system models include graphical models, narrative models, physical models, mathematical models, and symbolic or information-based models.

- A **graphical model** gives the description of the data flow diagram. A map is another, familiar type of graphical model.
- A **narrative model** describes a system in a natural language such as English. The definition of a DSS on page 12 is a highly simplified narrative model of a decision support system. (One could also say that the above definition of a model is a narrative model of a model.)
- A **physical model** is a smaller or idealized representation of the real system, such as a model railroad or an architectural model of a building being designed.

These three types of models, while often useful, are generally not part of decision support systems. Figure below shows several types of models.

Since decision support systems are information systems, the models used in DSS represent reality by information about reality. This type of model is often called a symbolic model. The term information-based model is more accurate, though it is not used as widely because it is a bit more cumbersome.

The data elements in an information-based model can be of any of the data types that computers and computer programs can deal with. These include

- **True/false or yes/no values :** that an investor should, or alternatively should not, invest in common stocks. (Such data elements are often called Boolean vari-ables, after the mathematician George Boole who studied their properties in the mid-nineteenth century.)
- **Character strings :** that this investor might consider a common stock represented by the letters GM, GE, or IBM.
- **Numerical values :** that this investor should purchase 200 shares, or should buy if the price per share drops to $35. The mathematical aspect of the model, where the DSS has one, usually emphasizes its numerical data elements.

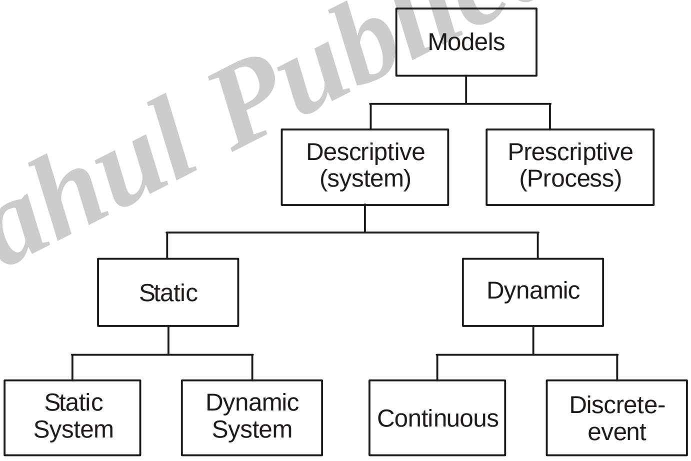


Fig.: "Family Tree" of Model Types

Models incorporate **procedures** and **formulas** to manipulate their data elements. These procedures and formulas derive new data element values from values of other data elements in the model and from external values entered into the model. External values can come from the user, from a database, from a device such as a product inspection system, or over a communication link from another organiza-tion such as a customer or a stock exchange.

A useful characteristic of most models, which applies even to this mini-example, is that the model remains valid when the data change. That allows us to change one or more variables and see the effect of the change(s).

In other models, the procedure may enable a model to reflect the passage of time. In a business model, the closing inventory of one day may become the open-ing inventory of the next. In a factory production model, a component that enters a painting process at a given time may emerge, a half hour later, painted and ready for the next step.

Within a computer, the progress of this component may be repre-sented by a numeric variable changing from 6 to 7. In many software tools that are used to develop this type of model, these internal values are hidden from the user, but they always exist in some form behind the scenes.

Discrete-event Simulation Models

A simulation model is, for our purposes, a dynamic, usually stochastic, discrete-event model that allows us to predict the behavior of a business system by model-ing the expected behaviors and interactions of its components over time. This is useful because we often know how each system component behaves, but we are un-able to assess the impact of their interactions on the behavior of the overall system. To recap some concepts from earlier in this chapter:

- A dynamic model is one which explicitly reflects changes in the system over time.
- A stochastic model is one whose output reflects statistically defined uncertain-ties in system behavior.
- A discrete-event model is one in which changes in the system are taken as oc-curring at instants in time, rather than extending over a finite interval.

The terms simulation, model, and (in combination) simulation model are often used interchangeably or nearly so. This usually doesn't cause problems but there is a difference. The **model** is the description of the system, usually in the form of a computer program. We call it a simulation model when we want to make it clear that we're not discussing some other type of model or some other use of a model.

Simulation is the process of using this model to study a system. A model is a thing. Simulation is a process. Simulation can't exist without a suitable model, and a model meant for use in simulation may be useless for anything else, but the con-cepts are different.

The Concept of Discrete-Event Simulation

The basic concepts of discrete-event simulation are simple, though a discrete- event simulation model of a complex system is full of complex detail. The model represents the state of the system by the values of data elements (variables) in the computer. The values of these variables change as events occur in the system. If we know how often different types of events occur, we can know when and how the variables change. The changes in the values of these variables reflect what would happen to the system in the real world.

For instance, the arrival of a car at a filling station may change the state of one pump and the attendant from "idle" to "busy." This would be represented in the model by variables going from "idle" to "busy," from "false" to "true," or from 0 to l, depending on how a programmer, working within the constraints of a specific programming language, chose to represent them.[5] Subsequently, running the pro-grams that implement the model will (again via the values of suitable variable.

UNIT III	**Group DSS and Groupware:** Group Decision Making - problems with groups- MDM Support Technologies- Distributed Group DSS- Distributed DSS Technologies- Executive Information Systems-definition-EIS Components– Making the EIS work – The Future of Executive Decision Making and The EIS.

3.1 GROUP DECISION MAKING

Group decision making is a type of participatory process in which multiple individuals acting collectively, analyze problems or situations, consider and evaluate alternative courses of action, and select from among the alternatives a solution or solutions. The number of people involved in group decision-making varies greatly, but often ranges from two to seven.

The individuals in a group may be demographically similar or quite diverse. Decision-making groups may be relatively informal in nature, or formally designated and charged with a specific goal. The process used to arrive at decisions may be unstructured or structured.

The nature and composition of groups, their size, demographic makeup, structure, and purpose, all affect their functioning to some degree. The external contingencies faced by groups (time pressure and conflicting goals) impact the development and effectiveness of decision-making groups as well.

In organizations many decisions of consequence are made after some form of group decision-making process is undertaken. However, groups are not the only form of collective work arrangement. Group decision-making should be distinguished from the concepts of teams, teamwork, and self managed teams.

3.1.1 Differences between Decision Making Groups and Teams

Specific differences between decision making groups and teams:

- The group has a definite leader, but the team has shared leadership roles
- Members of a group have individual accountability; the team has both individual and collective accountability.

- The group measures effectiveness indirectly, but the team measures performance directly through their collective work product.
- The group discusses, decides, and delegates, but the team discusses, decides, and does real work.

3.1.2 Group Decision Making Methods

There are many methods or procedures that can be used by groups. Each is designed to improve the decision-making process in some way. Some of the more common group decision-making methods are brainstorming, dialetical inquiry, nominal group technique, and the delphi technique.

1. Brain Storming

Brainstorming involves group members verbally suggesting ideas or alternative courses of action. The "brainstorming session" is usually relatively unstructured. The situation at hand is described in as much detail as necessary so that group members have a complete understanding of the issue or problem.

The group leader or facilitator then solicits ideas from all members of the group. Usually, the group leader or facilitator will record the ideas presented on a flip chart or marker board. The "generation of alternatives" stage is clearly differentiated from the "alternative evaluation" stage, as group members are not allowed to evaluate suggestions until all ideas have been presented.

Once the ideas of the group members have been exhausted, the group members then begin the process of evaluating the utility of the different suggestions presented. Brainstorming is a useful means by which to generate alternatives, but does not offer much in the way of process for the evaluation of alternatives or the selection of a proposed course of action.

2. Dialetical Inquiry

Dialetical inquiry is a group decision-making technique that focuses on ensuring full consideration of alternatives. Essentially, it involves dividing the group into opposing sides, which debate the advantages and disadvantages of proposed solutions or decisions. A similar group decision-making method, devil's advocacy, requires that one member of the group highlight the potential problems with a proposed decision. Both of these techniques are designed to try and make sure that the group considers all possible ramifications of its decision.

3. Nominal Group Technique

The nominal group technique is a structured decision making process in which group members are required to compose a comprehensive list of their ideas or proposed alternatives in writing.

The group members usually record their ideas privately. Once finished, each group member is asked, in turn, to provide one item from their list until all ideas or alternatives have been publicly recorded on a flip chart or marker board. Usually, at this stage of the process verbal exchanges are limited to requests for clarification no evaluation or criticism of listed ideas is permitted.

4. Delphi Technique

The Delphi technique is a group decision-making process that can be used by decision-making groups when the individual members are in different physical locations. The technique was developed at the Rand Corporation. The individuals in the Delphi "group" are usually selected because of the specific knowledge or expertise of the problem they possess.

In the Delphi technique, each group member is asked to independently provide ideas, input, and/or alternative solutions to the decision problem in successive stages. These inputs may be provided in a variety of ways, such as e-mail, fax, or online in a discussion room or electronic bulletin board.

3.1.3 Advantages and Disadvantages of Group Decision Making

However, some research indicates that diverse groups, if effectively managed, tend to generate a wider variety and higher quality of decision alternatives than demographically homogeneous groups.

Despite the fact that there are many situational factors that affect the functioning of groups, research through the years does offer some general guidance about the relative strengths and weaknesses inherent in group decision making. The following section summarizes the major pros and cons of decision making in groups.

Advantages

- Group decision-making, ideally, takes advantage of the diverse strengths and expertise of its members. By tapping the unique qualities of group members, it is possible that the group can generate a greater number of alternatives that are of higher quality than the individual. If a greater number of higher quality alternatives are generated, then it is likely that the group will eventually reach a superior problem solution than the individual.
- Group decision-making may also lead to a greater collective understanding of the eventual course of action chosen, since it is possible that many affected by the decision implementation actually had input into the decision.
- This may promote a sense of "ownership" of the decision, which is likely to contribute to a greater acceptance of the course of action selected and greater commitment on the part of the affected individuals to make the course of action successful.

Disadvantages

- There are many potential disadvantages to group decision-making. Groups are generally slower to arrive at decisions than individuals, so sometimes it is difficult to utilize them in situations where decisions must be made very quickly.
- Research suggests that certain characteristics of groups contribute to groupthink. In the first place, if the group does not have an agreed upon process for developing and evaluating alternatives, it is possible that an incomplete set of alternatives will be considered and that different courses of action will not be fully explored.
- Many of the formal decision-making processes (e.g., nominal group technique and brain-storming) are designed, in part, to reduce the potential for groupthink by ensuring that group members offer and consider a large number of decision alternatives.
- Secondly, if a powerful leader dominates the group, other group members may quickly conform to the dominant view. Additionally, if the group is under stress and/or time pressure, groupthink may occur. Finally, studies suggest that highly cohesive groups are more susceptible to groupthink.

- Group polarization is another potential disadvantage of group decision-making. This is the tendency of the group to converge on more extreme solutions to a problem. The “risky shift” phenomenon is an example of polarization; it occurs when the group decision is a riskier one than any of the group members would have made individually.

This may result because individuals in a group sometimes do not feel as much responsibility and accountability for the actions of the group as they would if they were making the decision alone.

3.2 PROBLEMS WITH GROUPS

The one thing we know for sure about groups is that some unique processes occur when a group of individuals gets together; however, we just don’t know what all those processes are Despite widespread research into MDM and various group processes, less than wide-spread agreement can be found regarding the relative effectiveness and benefits associ-ated with managers making decisions as individuals versus as members of an MDM. Much of the literature praises the relative virtues of consensus and collective decision making.

On the other hand, literature criticizing the significant disadvantages associated with the MDM approach also can be found. In this next section, we focus on these issues as addi-tional preparation for our discussion of specific methods of support for MDM contexts.

1 Size

The number of members of a particular MDM structure is probably the most widely studied and consequential component of group decision making. Compared to indi-vidual decision making where the number of participants is fixed at one, MDM struc-tures can involve from two to an indeterminable large number

MDM size strongly relates to a number of behavioral phenomena. Studies show that as the size of the group increases, individual satisfaction tends to decrease. One reason is that the size of an MDM is tied to the relative amount of participation avail-able to its members. As the size increases, the less active members tend to become noticeably less productive. Further, logic suggests that the management of an MDM requiring consensus or majority is easier when the size is small (five to seven partici-pants) as opposed to large (25 or more participants).

Another reason that size plays such a significant role in MDM success is that member cohesiveness decreases as MDM size increases. Studies indicate that when membership is high, subgroups and internal coalitions tend to form that serve to redi-rect the focus of the participants away from the common goal of the collective and toward the local interests of the coalition.

Another issue related to MDM size is the increased likelihood for certain members of large MDMs to feel threatened or reluctant to participate because the size magnifies the impersonal nature of the problem context. Generally speaking, the larger the membership, the more likely a particular member is to receive negative feedback. This situation tends to contribute to the likelihood of coalitions forming and of members becoming dissatisfied.

2 Groupthink

Irving Janis, a noted social psychologist, was one of the first to identify a phenomenon uniquely associated with multiparticipant decision making. He coined the term *group- think* to refer to "a mode of thinking that people engage in when they are deeply involved in a cohesive ingroup, when the members' striving for unanimity overrides their motivation to realistically appraise alternative courses of action" Groupthink results in a deterioration of the collective mental efficiency, the propen-sity to test reality, and the overall moral judgment of an MDM.

Harrison (1986) expanded upon Janis's definition of groupthink by suggesting that "the more friendly and cooperative the members of a group, the greater the likelihood that independent critical thinking will be suspended in deference to group norms and in observance of group cohesiveness" . Groupthink results in a relative ineffectiveness of the MDM at best, and a generally unfavorable set of outcomes at worst.

Other Sociological Issues

1. Conflict

Several additional issues related to MDM structures and member behavior bear men-tion. The quest for consensual support often brings with it a number of social liabilities.

For example, as with groupthink, the desire to be viewed as a "good" member and to be accepted by the other participants often leads to conflict avoidance. Conflict is inher-ent in most human endeavors (and managerial decision making is certainly no excep-tion), but avoidance of conflict is generally associated with a withdrawal from the source of the confrontation. If that source becomes a salient issue to the decision out-come or even the MDM structure itself, the effectiveness of the MDM is inevitably weakened.

The principal problem with conflict avoidance or suppression is that such actions only conceal the basic issues of disagreement rather than resolve them. Natural group dynamics such as the struggle for power, individual role dissatisfaction, person-ality attributes, and divergence in goals can all result in some form of conflict (or con-flict avoidance) and a reduced effectiveness of MDM choice outcomes.

2 Anonymity

One common method used to control sources of potential conflict and to support other MDM processes is participant anonymity. Most group support technologies provide for individuals to express their opinions, offer analyses, and vote all anonymously.

When the identity of an individual is separated from his or her proposal, then the pro-posal can be evaluated without regard to the status of its author. Moreover, the "safety" associated with being able to express oneself without fear of retribution or conflict can result in more equal participation among MDM members and allow for more open contributions. In many cases, anonymity results in the generation of more and better information and, thus, better decision outcomes.

3 Gender Differences and Similarities

During the early stages of the industrial revolution women were not commonly involved in managerial decision making. Women filled their assigned social roles that essentially precluded them from any meaningful participation in the day-to-day mana-gerial functions of an organization. At the dawning of the digital revolution, however, the role of women changed dramatically.

Today, women constitute more than 40 per-cent of the U.S. workforce and their enrollment worldwide in MBA programs contin-ues to rise astronomically. This rise in the number of women in positions of consequen-tial managerial authority resulted in more extensive research into issues related to gender.

Most notably, much of the research focuses on issues related not to how men and women may actually differ but rather to how people think they differ. The per-ceived differences associated with gender appear to affect issues related to decision making in both the individual and MDM realms.

Negotiating And Deciding

When more than one person is involved in the role of decision maker, the probability of negotiation increases. The very presence of more than one person responsible for a given decision implies that leaving the specific decision in the hands of a single decision maker would be inappropriate. The decision most likely involves multiple viewpoints that are not in harmony with each other, thus the need to negotiate.

In a negotiated decision, opposing perspectives or factions enter into a series of confrontations focus-ing on issues of ends, means, or both. A common scenario for negotiation can be found in contract talks between management and labor unions. Neither side really wants to go without a decision but both sides have an obligation to ensure the best possible deal for their constituents. Think of negotiation as a tug of war between multiple players.

Each player pulls on a rope connected to all other ropes, trying to pull the end of the other ropes nearer to his or her position. When the negotiation is complete, the center has changed but each player has agreed to the new position.

Most important to the design of a support mechanism for MDM contexts is the need to accommodate the inevitable activities of negotiation. Issues such as organiza-tion and control of conflicting criteria and preferences, creation of equitable access to all relevant information, and support for the wide variety of possible communication structures must be addressed when deciding on an MDM support technology.

3.3 MDM SUPPORT TECHNOLOGIES

Before we focus on the various technologies available to support multiparticipant deci-sion making, it is important to pause briefly and consider the maturity level of this technology and its rate of growth.

In most business organizations today, when groups of executives meet, they gather in a room that is little different from the one in which their pre-decessors met a hundred or more years ago. Technology is evident only in the electric light, the air conditioning, and perhaps a telephone.

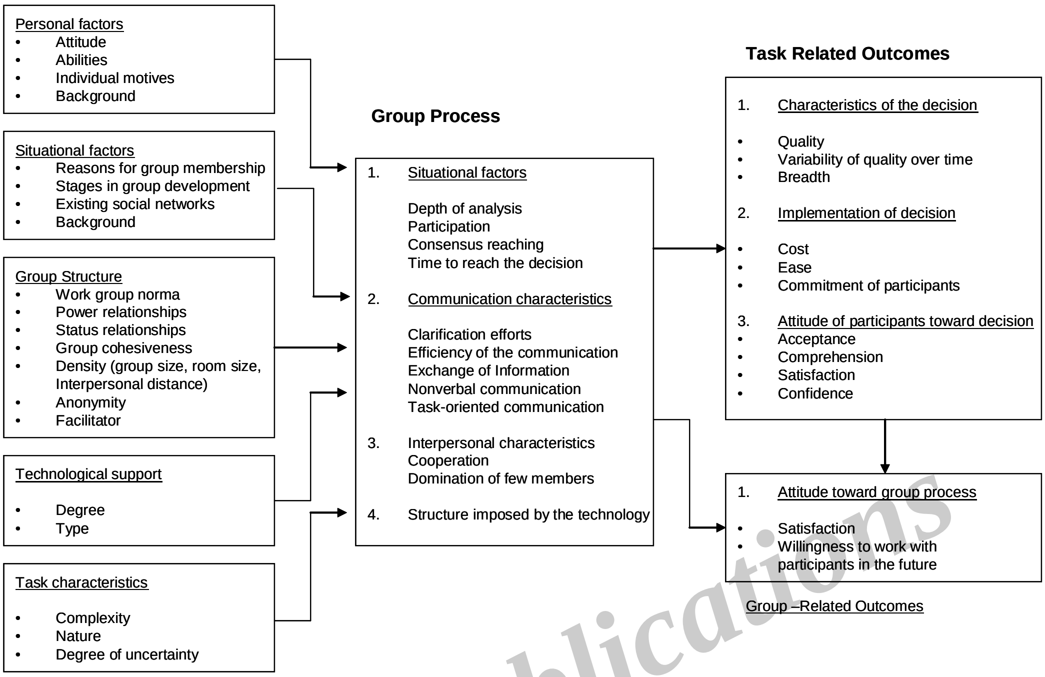


Fig. MDM Support Technology Variables

The information available during the deliberations is combined in a few memoranda or a note-book or financial and other reports. They may receive verbal briefings made with the aid of charts or slides. However, as discussion proceeds around the table and various alternatives are considered, the decision-makers have to rely principally on what is in their heads and what has been told to them.

Gray's description of group meetings appeared in one of the first papers on group decision support systems. Consider two important issues here:

(1) A great number of changes occurred with regard to available technology, knowledge, and understanding of MDM processes;

(2) The preceding quotation is still quite an accurate descrip-tion of a large majority of the world's organizations.

The rate of maturity of multi- participant decision making is curving upward exponentially, but the maturity level measured in terms of widespread use of support technologies is still in its infancy. In this section we focus on the past and present state of MDM support technologies and lay the foundation for development of an understanding and vision of the next genera-tion of MDM technologies.

Basic Concepts and Definitions

During the last two decades a variety of new terms and acronyms evolved with regard to MDM support technologies. One problem, however, is the variety of definitions that developed along with those new terms. Many researchers express differing views on what these definitions should be and what components they should include.

Even in areas of emerging consensus, the definitions tend to be stated quite broadly in an effort to apply them to the myriad of situations present within an MDM context. In this text, we adopt a simple categorization method based on a series of concentric circles for the various types of MDM support in order to include various perspectives. Over time, researchers and practitioners may converge on these various definitions and use this convergence to further the maturity of multiparticipant decision making as a field. Figure contains this author's basic categorization scheme for MDM sup-port technologies.

The four basic levels of MDM technology in Figures are congruent to the tax-onomy of MDM structures outlined in Section Using this simple approach, the majority (if not all) of the present applications of MDM support technologies can be positioned. No categorization scheme is worth its salt, however, if it does not provide explicit definitions for its categories. To that end, in this text we adopt the following definitions for the four basic levels :

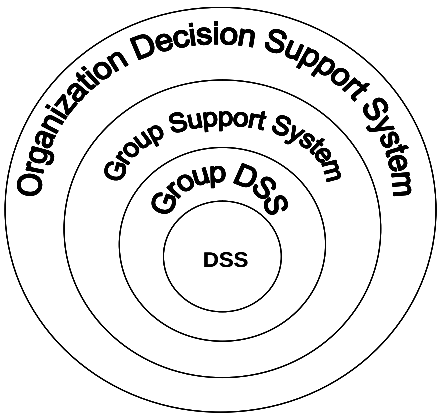


Fig. MDM Support Technology Categorization

1. **Organizational Decision Support System (ODSS).** A complex system of computer- based technologies —including those that facilitate communication —that pro-vides support for decision makers spanning the range of organizational roles and functional levels and accommodates decision contexts that cut across organiza-tional units (George, 1991).

2. **Group Support System and Groupware (GSS).** A collective of computer-based tech-nologies used to aid multiparticipant efforts in identifying and addressing prob-lems, opportunities, and issues (Huber. Valacich, and Jessup, 1993).

3. **Group Decision Support System (GDSS).** A collective of computer-based technolo-gies specifically designed to support the activities and processes related to multi- participant decision making.

4. **Decision Support System (DSS).** A system under the control of one or more deci-sion makers that assists in the activity of decision making by providing an orga-nized set of tools intended to impart structure to portions of the decision-making situation and to improve the ultimate effectiveness of the decision outcome. With the aid of these definitions, we can begin to study and position the various types and

Objectives of MDM Support Technologies

We know from our prior discussion that a collective of individuals brings with it several advantages and disadvantages associated with successful decision outcomes. We can think of these advantages and disadvantages as gains and losses associated with the MDM process.

The primary objective of any support technology in this realm is to apply process-related approaches in such a way that the gains are maximized and the losses minimized. Although that goal sounds simple enough, we know that the complexity of the MDM process and the multitude of variables contained in decision contexts suggest otherwise.

MDM support can be provided through four basic approaches as identified by Nunamaker et al.:

(1) process support,

(2) process structure,

(3) task support, and

(4) task structure (1993).

The approaches can be used either singularly or in combina-tion depending on the specific characteristics of the problem context.

Process support involves various mechanisms focused on facilitating participant interaction, communication, knowledge gathering, and memory. These mechanisms are integral in current deployments of GSS and groupware applications.

Process structure focuses on mechanisms that govern the various communication activities among participants including the pattern of interaction, the timing, and some-times even the content. The primary benefit of process structuring approaches is their ability to coordinate MDM activities.

Task support applies mechanisms that can select, organize, or even derive informa-tion and knowledge specifically relevant to the task or decision at hand. Task support enhances MDM activities through greater access to knowledge, an increase in partici-pant synergies, and a reduction in losses associated with failure to fully analyze either the task itself or the knowledge necessary to effectively solve the problem.

Lastly, task structure mechanisms provide access to various techniques that assist the participants in filtering, organizing, combining, and analyzing knowledge relevant to the task or problem context as well as in controlling when that knowledge is generated. Similar to task support, task structuring reduces the losses associated with partial problem analysis while simultaneously increasing the gains associated with improved evaluation associated with MDM processes.

Classes and Types of MDM Support Technologies

Just as we discussed in earlier chapters focusing on DSSs, the design and implementa-tion of MDM systems must begin with a thorough understanding of the context in which the system will be used and, therefore, of the specific features necessary to sup-port that context. As such, various classes of MDM technologies can be identified

1 Classification by Features

The three-level classification scheme for MDM systems proposed by DeSanctis and Gallupe (1987), which is based on the features offered in support of the multi-participant decision-making activities. Each level contains the features associated with the previous level in addition to features specific to that level.The table shows how the features available in each of the three levels correspond to specific MDM participant needs.

The Level 1 system is primarily intended to facilitate communication among the participants. Its main objective is to speed up and stimulate the exchange of messages and to reduce or remove the barriers to communication associated with MDM activities.

The Level 2 systems are designed to reduce the uncertainty that can evolve from an MDM problem-solving activity. Both process and task structuring mechanisms are typi-cally found in this class of MDM support.

The Level 3 system contains all of the features from the previous two levels and expands the support mechanisms through an increase in process structuring techniques intended to control participant interaction. The Level 3 system adds a sense of rigor to the MDM activities not found in the prior two levels.

2 Classification by Technology

Another method of MDM system classification was proposed by Kraemer and King (1988). This approach focuses on the technologies applied in a particular MDM con-text.

In this classification the increasing use and complexity of the technologies employed establishes the boundaries for each system type. The simplest type of MDM support system using this approach is the electronic boardroom in which the primary technology is used in support of audiovisual and multimedia activities. The highest level of system is the decision room in which sophisticated computer technologies pro-vide support for virtually all MDM activities and needs. These systems provide tools to support such activities as brainstorming, analysis of issues, commentary, and consensus.

Collaborative Support Technologies

The trend toward collaboration in the modern organization accelerates daily, fueled by a number of sources, including the proliferation of networks that facilitate widespread connectivity. Another source is found in the increased global competition facing the world's organizations. The economic pressures common in the operation of a firm in a competitive setting is yet a third force moving the workplace into a collaborative pos-ture. Finally, as organizations strive to take advantage of new technologies that offer greater efficiency and effectiveness, they find that their mainstay hierarchical infra-structures are no longer adequate. As such, the businesses of tomorrow are reinventing themselves through the use of groupware.

Groupware

The term *groupware* refers to a particular type of MDM support technology specifi-cally focused on issues related to collaborative processes among people. In one sense, groupware is people. It is a tool that, when deployed and used appropriately, positively affects the way people communicate with each other, resulting in improvements in the way people work and the decisions people make.

The concept of groupware is really a simple computer-based extension of the tra-ditional tools of the workplace. One of the key elements of success in any organization is the development and preservation of organizational memory. The knowledge gained in the process of conducting business must somehow be captured and stored in a man-ner that affords easy access for present and future decisions. The tools and stores of organizational memory can be seen throughout the workplace: people, policy and pro-cedure manuals, bulletin boards, newsletters, filing cabinets, in and out boxes, planning boards, and computers.

Classification of Groupware

1. **Conferencing Systems** The second class of groupware overcomes the asynchronous limita-tion of messaging systems by facilitating an electronic version of the typical face-to-face meeting. They provide a great advantage through their elimination of the requirement for same-place communication during multiple real-time interactions. Each participant using a conferencing system can be in a convenient location while communicating with others in a synchronous manner. The media available for such conferences can be audio, video, or both. In addition, the environments in which this communication can take place range from a specially equipped meeting room to an individual's private workspace.

   The advent of desktop teleconferencing technology allows participants to both see and hear each other while simultaneously allowing computer presentation of graphics, deployment of analysis tools, or sharing of data or applications.

2. **Collaborative Authoring Systems** This level of groupware allows multiple participants to collaborate either synchronously or asynchronously on the

creation and revision of a common document or set of documents. Activities such as segment revision, comment-ing, formatting, and development of tables and graphics can be conducted by a group of individuals, and the outcome can be seen immediately by all other participants.

In addition, each individual's activities can be recorded for later review and deadlines associated with forthcoming events can be transmitted to the proper individuals, thus facilitating the management of the decision-making process.

3. **Group Decision Support Systems** The key characteristic defining this level of groupware technology is its focus on directly assisting multiparticipant decision making. As previ-ously discussed, a GDSS can facilitate the generation of ideas, commentary, analysis, ?nd consensus.

4. **Coordination Systems** Coordination systems facilitate the integration of participant activities associated with achieving the objective(s) of the collective. For instance, a coordination system may inform one participant of the degree of completion of other activities and suggest that completion is sufficient for commencement of the next stage. Likewise, it may be used to inform a participant that his or her work is due or overdue.

   A common activity associated with coordination systems is referred to as workflow management. The facilitation of document routing, approvals, multilevel data collection, and information transfer are all activities associated with workflow management.

5. **Intelligent Agent Systems** The final class of groupware technology employs some form of artificial intelligence to carry out a series of steps associated with a particular task. Functions available through intelligent agent systems range from a simple filter that determines the appropriate electronic filing folder for a new e-mail message to more complex "personal assistants" that can schedule meetings, forward messages, or per-form background tasks associated with MDM processes. This area of groupware is still in its early stages of development but it nonetheless promises to be a significant factor in MDM support environments.

3.4 DISTRIBUTED GROUP DSS

Distributed Group Decision Support System (DGDSS)

Decision Support Systems (DSS) emerged in the 1970s and is a computer-based system designed to actively interact with an individual decision maker in order to assist her/him to make better decisions based on information obtained (Keen & Scott-Morton, 1978; Sprague & Carlson, 1982). Group Support System (GSS), which are closely related to DSS, are computer-based information systems employed to facilitate collaborative work within groups.

In the early 1980s, Group DSS (GDSS) was developed to support the group decision making process (Gray, 1987). It amalgamates techniques from both DSS and GSS. GDSS is a combination of communication, computer software, decision support technologies and structure group techniques (e.g. normal group and Dephi techniques) to assist decision makers in formulating and generating the optimal solution for their unstructured problems. (See Figure)

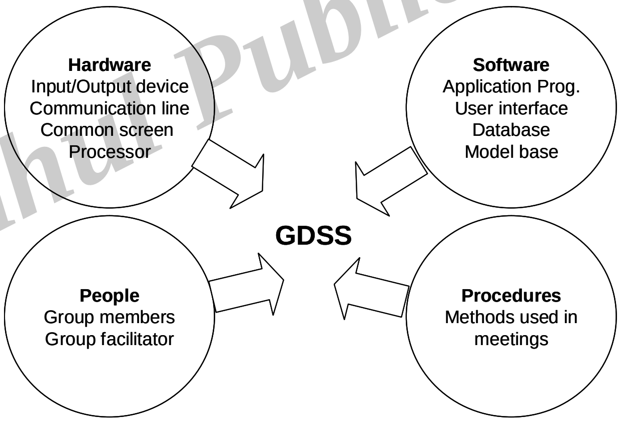


Figure 1. Components of Group Decision Support System (GDSS)

Distributed Group Decision Support System (DGDSS) are GDSS designed to facilitate decision making amongst dispersed groups. According to Tung & Turban (1998), there are two types of Distributed Group Support System (GSS): synchronous DGSS and asynchronous DGSS. Similarly, there are two types of DGDSS: synchronous DGDSS and asynchronous DGDSS. This paper focuses on the synchronous DGDSS in which all distributed group members can interact with each other in real time mode.

The development and delivery platforms of DSS/GDSS are now shifting to the Web environment (Dennis & et al., 1996; Shim & et al, 2002). A Web-based GDSS refers to a computerized system that provides decision tools and decision support information to its users who are accessing it via a Web browser (e.g. Netscape Navigator or Internet Explorer). The salient benefits of a Web-based environment for GDSS are the reduction of geographical barriers, improved delivery processes, and reductions to operating cost. As the focus of this research is a synchronous DGDSS, a web-based approach is the logical choice for implementing such a system.

Business decisions are regularly complex. There are often a set of alternatives that needed to be evaluated against a set of sometimes conflicting criteria to determine an optimal solution. Such a decision making process can be referred to as Multi-Criteria Decision making (MCDM). As the aim of the proposed DGDSS is to assist business executives in their joint decision making, the system therefore should support MCDM.

3.5 DISTRIBUTED DSS TECHNOLOGIES

Web Technologies and DSS Tasks

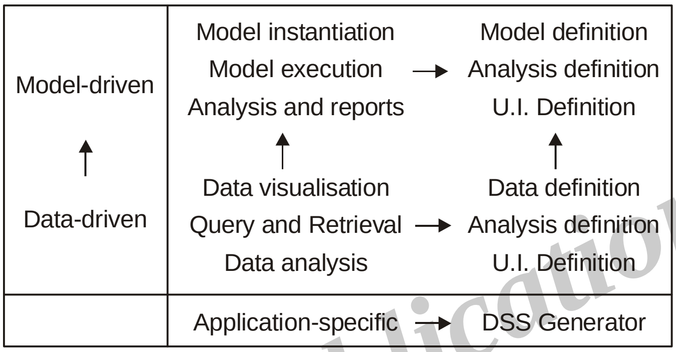
To understand how Web technologies can influence the development, deployment and use of Decision Support Systems, we have examined the major tasks at various stages of using and building Data and Model-Driven DSS. Web technologies are making it possible to perform all of these tasks via a remote Web client.

In thinking of such tasks, it is useful to recall the distinction made by Sprague (1980) about application-specific DSS that consist of software, data, and models for a specific decision problem and DSS generators that provide tools and algorithms for building a variety of specific DSS. Applicationspecific DSS are far easier to build, but rarely reusable; DSS generators are far more complex to build but can be adapted to build many specific systems.

Figure summarizes the relationships among 10 major tasks involved in building and using Data and Model-Driven DSS. For example, using an application-specific Model-Driven DSS, a user would be given the relevant decision models and data, and would focus on tasks such as model execution, development of reports, or analysis.

Using a corresponding DSS generator, on the other hand, would require the performance of additional tasks such as model definition and creation of a custom user interface. Model-driven DSS often involve all the tasks in the model rows as well as the tasks in the data-driven DSS rows.

Similarly, using a DSS generator involves the tasks listed in the DSS generator column as well as those for an Applicationspecific DSS. The 10 distinct DSS related tasks that can be executed by users from a Web browser include: model instantiation, model execution, creation of analyses and reports, data visualization, query and retrieval, data analysis, model definition, data definition, analysis definition, and user interface definition. From a browser, one can create decision support capabilities for others or use predefined capabilities.



3.6 EXECUTIVE INFORMATION SYSTEM

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) [1]

The emphasis of EIS is on graphical displays and easy-to-use user interfaces. They offer strong reporting and drill-down capabilities. 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.

In recent years, the term EIS has lost popularity in favour of Business Intelligence (with the sub areas of reporting, analytics, and digital dashboards).

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, such as 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.

3.7 EIS COMPONENTS

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:

1. Input data-entry devices. These devices allow the executive to enter, verify, and update data immediately;
2. The central processing unit (CPU), which is the kernel because it controls the other computer system components;
3. 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;
4. Output devices, which provide a visual or permanent record for the executive to save or read. This device refers to the visual output device such as monitor 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:

1. **Text base software.** The most common form of text are probably documents;
2. **Database.** Heterogeneous databases residing on a range of vendor-specific and open computer platforms help executives access both internal and external data;
3. **Graphic base.** Graphics can turn volumes of text and statistics into visual information for executives. Typical graphic types are: time series charts, scatter diagrams, maps, motion graphics, sequence charts, and comparison-oriented graphs (i.e., bar charts);
4. **Model base.** The EIS models contain routine and special statistical, financial, and other quantitative analysis.

Perhaps a more difficult problem for executives is choosing 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.

1. 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.

2. 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.

3.8 APPLICATIONS OF EIS

EIS enables executives to find those data according to user-defined criteria and promote information-based insight and understanding.

Unlike a traditional management information system presentation, EIS can distinguish between vital and seldom-used data, and track different key critical activities for executives, both which are helpful in evaluating if the company is meeting its corporate objectives. After realizing its advantages, people have applied EIS in many areas, especially, in manufacturing, marketing, and finance areas.

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 production. 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 future. For this, they need make judgments about risk and uncertainty of a project and its impact on the 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. EIS also offers an approach to product price, which is found in venture analysis.

The market executive can evaluate pricing as related to competition along with the relationship of product quality with price charged. In summary, EIS software package enables marketing executives to manipulate the data by looking for trends, performing audits of the sales data, and calculating totals, averages, changes, variances, or ratios. All of these sales analysis functions help marketing executives to make final decisions.

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 integrates 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.

3.9 ADVANTAGES AND DISADVANTAGES OF EIS

Advantages of EIS

- 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 of EIS

- System dependent
- Limited functionality, by design
- Information overload for some managers
- Benefits hard to quantify
- High implementation costs
- System may become slow, large, and hard to manage
- Need good internal processes for data management
- May lead to less reliable and less secure data

3.10 FUTURE TRENDS

The future of executive info systems will not be bound by mainframe computer systems. This trend allows executives escaping from learning different computer operating systems and substantially decreases the implementation costs for companies. Because utilizing existing software applications lies in this trend, executives will also eliminate the need to learn a new or special language for the EIS package.

Future executive information systems will not only provide a system that supports senior executives, but also contain the information needs for middle managers.

The future executive information systems will become diverse because of integrating potential new applications and technology into the systems, such as incorporating artificial intelligence (AI) and integrating multimedia characteristics and ISDN technology into an EIS. EIS - timely, efficient and effective in supporting the decision making process.

3.11 MAKING THE EIS WORK

In one sense, building an EIS is much like building any other type of modern informa-tion system. A structured development approach needs to be followed, requirements gathered, prototypes developed, logical models revised, cost analyses performed, and the final system implemented. In another sense, the unique character of an EIS indi-cates that we still have much to learn about successfully building one. For some devel-opers, their next EIS project will also be their first. They will be thrust into the realm of executives:

A world where success has often been realized without a computer, time and patience may be both precious and limited, the problems are often unstructured, and computer literacy and acumen may vary considerably. Furthermore, the physical considerations associated with building an EIS, such as determining the hardware, find-ing and accessing the necessary data, and integrating the system into the existing com-puting infrastructure, also contribute to the uniqueness of the challenge. Top these issues off with political issues such as middle management's fear that "Big Brother will be watching," and it becomes easy to see why building a successful EIS may be one of the most formidable development efforts analysts and developers will ever face. This section focuses on many of the issues surrounding these challenges.

An EIS Development Framework

Numerous researchers and practitioners focused their efforts on studying and refining our understanding of the processes associated with building and implementing a suc-cessful EIS. Watson, Rainer, and Koh (1991) provide a touchstone to this ongoing investigation with their EIS development framework. A development framework pro-vides the terminology, concepts, and guidelines necessary for building a system; it is somewhat analogous to a generic instruction manual or road map. Their framework is divided into three major components:

(1) The structural perspective, where the key ele-ments that are critical to EIS development and their relationships are delineated;

(2) The development process, where the dynamics and interactions of the necessary activities are identified; and

(3) The user-system dialog, the interface that directs the system's actions, presents the output, and provides the user with the tools to use the system effectively.

A detailed discussion of this framework is beyond the scope of this text; however, we will briefly discuss the three components and their importance to a successful EIS. Figure illustrates the elements contained in the structural perspec-tive and their relationships to the EIS.

1 **Structural Perspective :** In this component, the focus is on people and data as they relate to the EIS. Key play-ers such as the sponsors or advocates of the system, the user group, the developers and designers, personnel from the various functional areas within the organization, and any vendors and consultants associated with the system are identified and positioned.

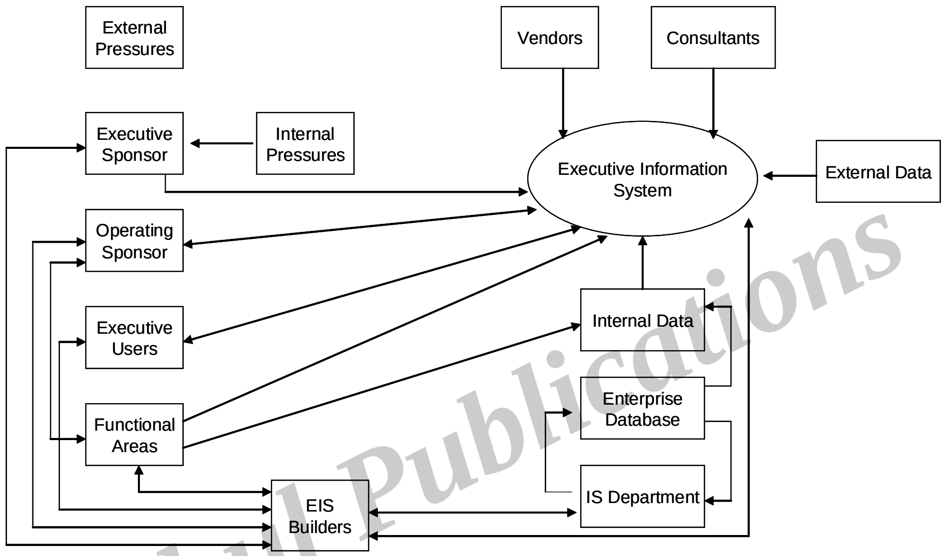


Fig. Structural Perspective of EIS Development Framework

In addition, the various sources of internal and external data are identified and posi-tioned. Finally, an acknowledgment of the various forces and pressures either driving or affecting the successful development of the system is included. The structural perspec-tive provides a model for understanding the relationships among the various elements and their potential interaction during the various phases of development of the EIS.

2 **EIS Development Process :** The development process builds upon the elements and their relationships contained within the structural model and adds a time dimension to the framework. In this com-ponent, the various activities and sequences of events are delineated and actual project management issues relating to time, critical path, and milestones are established. Figure illustrates the various phases of the EIS development process.

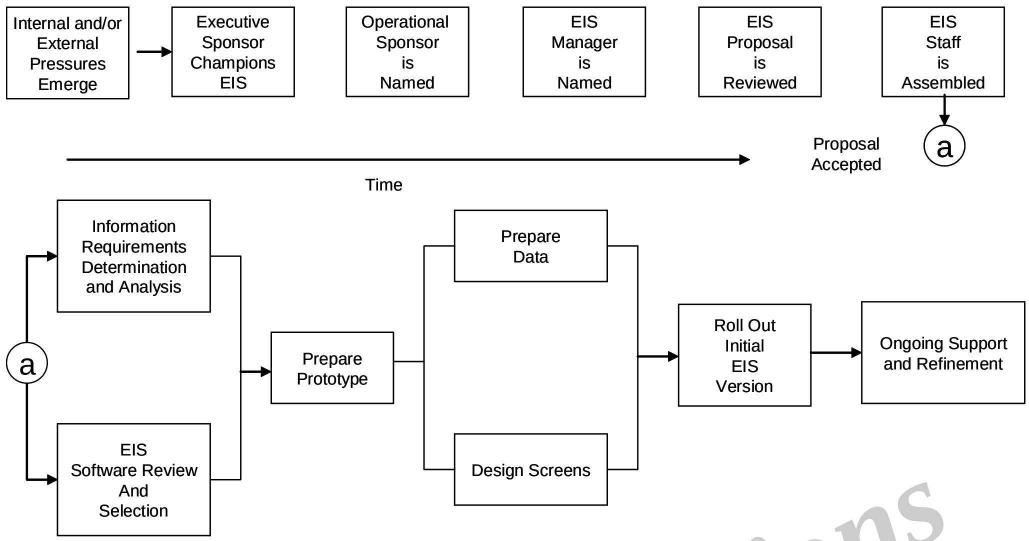


Fig. Development Process

3 **User-System Dialog :** In this component of the framework, we can see the most commonalities between the design and development of an EIS and other related tools such as DSS or MDM sys-tems. The dialog system contains an action language for processing the various com-mands and elements of manipulation. With this language the user is directed in how to use the system. The action language element can be thought of as the incoming com-munication channel from the executive to the EIS.

In contrast, the dialog component also contains a presentation language that serves as the EIS counterpart to the action language. The presentation language com-ponent guides the outflow of information and the form in which this information is presented. Characteristics typical of this component include textual, graphical, and tabu-lar formats, voice annotation, and audio and video capabilities.

The third element in this component is the knowledge base. Covered in greater detail in Chapter 1, the knowledge base is the sum of what the executive knows about using the system and all of the support mechanisms designed to assist in its use. Experience shows that executives simply do not read documentation (unlike you or me, of course). Therefore, the knowledge base must provide the executive with a con-sistent and context-dependent help system if the EIS is to be used effectively.

Some EIS Limitations and Pitfalls to Avoid

The development and implementation of an EIS brings significant benefits to an orga-nization, and its potential for improving both competitive advantage and performance is a driving factor in its increasing popularity. Its benefits are not without some caveats, however. Here, we summarize several of the limitations and caveats associated with EIS development.

1 **Cost :** The majority of this annual operating cost was allo-cated to personnel and additional training. In other words, the benefits derived from an EIS are costly, and the cost of maintenance of the system after development can easily exceed the original development costs over the life of the system. The decision to adopt an EIS into an organization must be made with the understanding that the ongoing commitment of significant organizational resources is critical if the expected benefits are ever to be realized.

2 **Technological Limitations :** The essence of an EIS resides in its ability to bring all of the dispersed data and infor-mation necessary to make executive decisions into the executive suite and contain it in an easy-to-use system. The myriad of data sources necessary to accomplish this task and the wide variety of media in which they can reside pose a formidable technical chal-lenge for the EIS designer. To accomplish this seemingly magical feat, developers may need to learn new file structures, data formats, and programming languages as well as enlist the services and support of a variety of data providers and other MIS personnel.

3 **Organizational Limitations :** Aside from the technological issues facing the EIS designer, we must also consider those of an organizational nature. These issues can often be more complex and, thus, more difficult to address than the technical limitations. Millet and Mawhinney (1992) suggested three main categories of potential negative impacts of an EIS on organiza-tions: (1) biased agendas and time orientations, (2) loss of managerial synchronization, and (3) organizational destabilization.

Failure is Not an Acceptable Alternative

As with any development effort, the possibility of partial or total failure for a particular EIS is always present. An EIS failure occurs when the development effort fails to produce a working system or when the installed system fails to be usable or deliver the desired bene-fits. Crockett (1992) clearly demonstrated that an EIS development effort that fails to sat-isfy its targeted users can be a severe setback not only for the organization but for the indi-viduals involved.

Competitive edge and opportunity can be lost, many people will be disappointed, careers will undoubtedly be adversely affected, and most important, the organization will likely become reluctant to engage in any future EIS development efforts. As Apollo 13 Flight Director Gene Kranz put it, "Failure is not an option."

Prevention of EIS failure is not a topic that is readily prescriptive in nature. The need for broad-based executive support for the project is essential, however. Training and regular communication among all the participants are also key elements to suc-cess. Finally, being aware of the various factors that can contribute to EIS failure and paying constant attention to minimizing those factors are both important steps toward the successful implementation of an EIS within today's organization.

3.12 THE FUTURE OF EXECUTIVE DECISION MAKING AND THE EIS

The future of EIS technology and, thus, executive decision making is one where several conditions will merge to transform the technology. Some of these conditions are fairly easy to predict because they exist today, whereas others have yet to emerge. Nonetheless, we will spend some time looking forward to see what the EIS of the future might be.

Conditions of Transformation

1. Increased Comfort with Computing Technology

One current condition that will continue is the executives' developing comfort level with technology. In the early years of EIS development, a significant roadblock to the acceptance of the technology was executives' lack of experience with hands-on use of computers. An increased focus on training combined with the growing realization that information systems like EISs are valuable to the organization significantly reduces this roadblock. Furthermore, the executive suite is becoming younger.

Emerging lead-ers grew up in the age of technology and developed an early understanding of and comfort level with computer-based systems throughout the organization. As the resis-tance to computers dissipates, new and more powerful EIS systems will emerge.

2. Broadening of Executive Responsibilities

The organization will continue to flatten and "rightsize." These conditions will create a leaner, more flexible and responsive structure but will also increase the worker-to- executive ratio. Most of the reduction in workforce will come from staff and middle management levels and the future executive will have direct contact with and respon-sibility for a much broader span of personnel. We can assume that EIS technology will play a major role in facilitating the management of this flatter organizational structure.

The boundaries of the organization will also continue to expand. Global markets will intensify the competition for market share, natural resources, and labor. With these factors will come continued increases in regulation driven by social and environmental concerns. The scope of responsibility of the executive will clearly include these increas-ing complexities, and the need for accurate, more diverse, and immediate information will continue to grow.

The EIS of Tomorrow

The trend toward the integration of applications and technologies into seamless enterprise-wide systems bodes well for the future of executive information systems. Technological and conceptual advances in telecommunications, information systems, and decision support systems will all contribute to new EIS features and potentially new and more powerful EIS applications. Watson, Houdeshel, and Rainer (1997) sug-gest that the EIS of the future may become an executive intelligence system.

1. **The Intelligent EIS :** The amount of data provided to the executive is literally overwhelming. Even with an EIS, the potential for information overload is constant. Artificial intelligence (AI) can perform some of the data screening for the executive, reducing the amount of time spent searching for relevant data.

2. **The Multimedia EIS :** A database component is necessary within an EIS for retrieving, analyzing, manipulat-ing, and updating files. A multimedia database management system (MMDBMS) can increase the future EIS user's resources to manipulate text, voice, and images effec-tively within an integrated database structure.

   MMDBMSs provide the traditional benefits of a database management system as well as concatenation of voice, transfor-mation of information, rotation of images, scaling of objects, and merging of various data types. The problem with these systems, especially for the executive user, is the complex interface. As the functionality of these systems continues to increase, more applications for their use will be developed. By combining more applications with an easy-to-use system, an opportunity for a competitive advantage develops.

3. **The Informed EIS :** We know that most of the decisions made by executives require some element of exter-nal data. Strategic decisions require significant access to data about the market, the environment, the economy, regulatory and technological changes, and the competition. Although access to external data via an EIS is not new, the degree to which the EIS will be able to manipulate and assemble those data will be.

4. **The Connected EIS :** The Internet and the World Wide Web facilitate the electronic interconnection of com-panies to their customers and suppliers. The addition of Web-centric groupware tech-nologies such as Lotus Notes moves organizations even closer toward mass intercon- nectivity. One massive current development is the dawning of electronic commerce (e-commerce). Firms use the Internet to advertise and communicate new product developments to both current and future customers. Emerging virtual markets are making Internet-based commerce and finance a reality.

UNIT IV	**Artificial Intelligence (AI) and Expert System (ES):** Definition of Artificial Intelligence – Artificial Intelligence vs. Natural Intelligence- The Intelligence of AI- Expert Systems- Definition, Structure of ES- Designing and Building ES- Benefits of ES – Examples of ES- Intelligent Software Agents.

4.1 ARTIFICIAL INTELLIGENCE

Definition of AI

Artificial intelligence (**AI**) is the intelligence of machines and the branch of computer science that aims to create it. AI textbooks define the field as "the study and design of intelligent agents" where an intelligent agent is a system that perceives its environment and takes actions that maximize its chances of success. John McCarthy, who coined the term in 1956, defines it as "the science and engineering of making intelligent machines."

The field was founded on the claim that a central property of humans, intelligence the sapience of Homo sapiens can be so precisely described that it can be simulated by a machine. This raises philosophical issues about the nature of the mind and the ethics of creating artificial beings, issues which have been addressed by myth, fiction and philosophy since antiquity.

Artificial intelligence has been the subject of optimism, but has also suffered setbacks and, today, has become an essential part of the technology industry, providing the heavy lifting for many of the most difficult problems in computer science.

AI research is highly technical and specialized, deeply divided into subfields that often fail to communicate with each other. Subfields have grown up around particular institutions, the work of individual researchers, the solution of specific problems, longstanding differences of opinion about how AI should be done and the application of widely differing tools.

The central problems of AI include such traits as reasoning, knowledge, planning, learning, communication, perception and the ability to move and manipulate objects. General intelligence (or "strong AI") is still among the field's long term goals.

4.1.1 Applications of AI

1. **Game playing :** You can buy machines that can play master level chess for a few hundred dollars. There is some AI in them, but they play well against people mainly through brute force computation—looking at hundreds of thousands of positions. To beat a world champion by brute force and known reliable heuristics requires being able to look at 200 million positions per second.

2. **Speech Recognition :** In the 1990s, computer speech recognition reached a practical level for limited purposes. Thus United Airlines has replaced its keyboard tree for flight information by a system using speech recognition of flight numbers and city names. It is quite convenient. On the other hand, while it is possible to instruct some computers using speech, most users have gone back to the keyboard and the mouse as still more convenient.

3. **Understanding Natural Language :** Just getting a sequence of words into a computer is not enough. Parsing sentences is not enough either. The computer has to be provided with an understanding of the domain the text is about, and this is presently possible only for very limited domains.

4. **Computer vision :** The world is composed of three-dimensional objects, but the inputs to the human eye and computers' TV cameras are two dimensional. Some useful programs can work solely in two dimensions, but full computer vision requires partial three-dimensional information that is not just a set of two-dimensional views. At present there are only limited ways of representing three-dimensional information directly, and they are not as good as what humans evidently use.

5. **Expert systems :** A "knowledge engineer" interviews experts in a certain domain and tries to embody their knowledge in a computer program for carrying out some task. How well this works depends on whether the intellectual mechanisms required for the task are within the present state of AI.

   When this turned out not to be so, there were many disappointing results. One of the first expert systems was MYCIN in 1974, which diagnosed bacterial infections of the blood and suggested treatments. It did better than medical students or practicing doctors, provided its limitations were observed. Namely, its ontology included bacteria, symptoms, and treatments and did not include patients, doctors, hospitals, death, recovery, and events occurring in time.

Its interactions depended on a single patient being considered. Since the experts consulted by the knowledge engineers knew about patients, doctors, death, recovery, etc., it is clear that the knowledge engineers forced what the experts told them into a predetermined framework.

In the present state of AI, this has to be true. The usefulness of current expert systems depends on their users having common sense.

6. **Heuristic classification :** One of the most feasible kinds of expert system given the present knowledge of AI is to put some information in one of a fixed set of categories using several sources of information. An example is advising whether to accept a proposed credit card purchase. Information is available about the owner of the credit card, his record of payment and also about the item he is buying and about the establishment from which he is buying it.

4.2 DIFFERENCE BETWEEN NATURAL INTELLIGENCE AND ARTIFICIAL INTELLIGENCE

The difference between natural intelligence (e.g human intelligence) and artificial intelligence is hard to define, as not much is known about natural intelligence. Artificial Intelligence (AI) can learn, just like natural intelligence (NI). When programmed to, Artificial Intelligence can sense changes in its environment and react accordingly. It can then refer to the ways it reacted to previous changes to help decide what to do the next time a similar change occurs.

Both Artificial Intelligence and natural intelligence are mortal. Like humans, Artificial Intelligence can cease working and all that is needed is a natural or man-made disaster to occur. One big difference between Artificial Intelligence and natural intelligence is the fact that natural intelligence can forget and lose information. Artificial Intelligence could do this if it was program to do so, but this would be counter-productive.

Another big difference is accuracy. Artificial Intelligence, when given the same information can be exact, every time with speed. When natural intelligence is given the same information, it can not be as exact, and is slower.

4.3 THE INTELLIGENCE OF AI

Mainstream thinking in psychology regards human intelligence not as a single ability or cognitive process but rather as an array of separate components.

Components of AI

Research in AI has focused chiefly on the following components of intelligence: learning, reasoning, problem-solving, perception, and language-understanding.

- **Learning :** Learning is distinguished into a number of different forms. The simplest is learning by trial-and-error. For example, a simple program for solving mate-in-one chess problems might try out moves at random until one is found that achieves mate.

  The program remembers the successful move and next time the computer is given the same problem it is able to produce the answer immediately. The simple memorising of individual items—solutions to problems, words of vocabulary, etc.—is known as rote learning. Rote learning is relatively easy to implement on a computer. More challenging is the problem of implementing what is called generalisation.

- **Reasoning :** To reason is to draw inferences appropriate to the situation in hand. Inferences are classified as either deductive or inductive. An example of the former is "Fred is either in the museum or the cafŽ; he isn't in the cafŽ; so he's in the museum", and of the latter "Previous accidents just like this one have been caused by instrument failure; so probably this one was caused by instrument failure".

  The difference between the two is that in the deductive case, the truth of the premises guarantees the truth of the conclusion, whereas in the inductive case, the truth of the premises lends support to the conclusion that the accident was caused by instrument failure, but nevertheless further investigation might reveal that, despite the truth of the premises, the conclusion is in fact false.

- **Problem-solving :** Problems have the general form: given such-and-such data, find x. A huge variety of types of problem is addressed in AI. Some examples are: finding winning moves in board games; identifying people from their photographs; and planning series of movements that enable a robot to carry out a given task.

  Problem-solving methods divide into special-purpose and general-purpose. A special-purpose method is tailor-made for a particular problem, and often exploits very specific features of the situation in which the problem is embedded.

A general-purpose method is applicable to a wide range of different problems. One general-purpose technique used in AI is means-end analysis, which involves the step-by-step reduction of the difference between the current state and the goal state.

- **Perception :** In perception the environment is scanned by means of various sense-organs, real or artificial, and processes internal to the perceiver analyse the scene into objects and their features and relationships. Analysis is complicated by the fact that one and the same object may present many different appearances on different occasions, depending on the angle from which it is viewed, whether or not parts of it are projecting shadows, and so forth.

  At present, artificial perception is sufficiently well advanced to enable a self-controlled car-like device to drive at moderate speeds on the open road, and a mobile robot to roam through a suite of busy offices searching for and clearing away empty soda cans.

- **Language-understanding :** A language is a system of signs having meaning by convention. Traffic signs, for example, form a mini-language, it being a matter of convention that, for example, the hazard-ahead sign means hazard ahead. This meaning-by-convention that is distinctive of language is very different from what is called natural meaning, exemplified in statements like 'Those clouds mean rain' and 'The fall in pressure means the valve is malfunctioning'.

  An important characteristic of full-fledged human languages, such as English, which distinguishes them from, e.g. bird calls and systems of traffic signs, is their *productivity*. A productive language is one that is rich enough to enable an unlimited number of different sentences to be formulated within it.

4.4 EXPERT SYSTEMS

Introduction

Experts systems are computer programs that are derived from a branch of computer science research called Artificial Intelligence (AI). AI's scientific goal is to understand intelligence by building computer programs that exhibit intelligent behavior. It is concerned with the concepts and methods of symbolic inference, or reasoning, by a computer, and how the knowledge used to make those inferences will be represented inside the machine.

A computer application that performs a task that would otherwise be performed by a human expert. For example, there are expert systems that can diagnose human illnesses, make financial forecasts, and schedule routes for delivery vehicles. Some expert systems are designed to take the place of human experts, while others are designed to aid them.

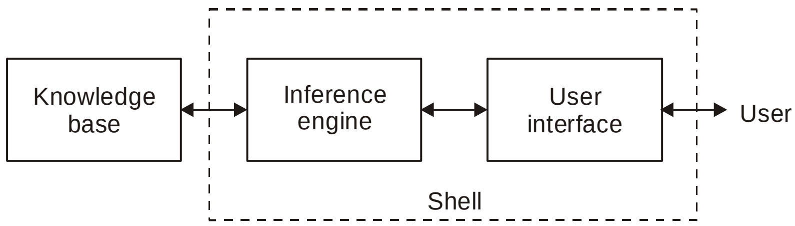
Expert systems are part of a general category of computer applications known as artificial intelligence . To design an expert system, one needs a knowledge engineer, an individual who studies how human experts make decisions and translates the rules into terms that a computer can understand.

Building an expert system is known as knowledge engineering and its practitioners are called knowledge engineers. The knowledge engineer must make sure that the computer has all the knowledge needed to solve a problem.

The knowledge engineer must choose one or more forms in which to represent the required knowledge as symbol patterns in the memory of the computer — that is, he (or she) must choose a knowledge representation. He must also ensure that the computer can use the knowledge efficiently by selecting from a handful of reasoning methods. The practice of knowledge engineering is described later. We first describe the components of expert systems.

4.5 STRUCTURE OF EXPERT SYSTEMS

The knowledge base an expert uses is what he learned at school, from colleagues, and from years of experience. Presumably the more experience he has, the larger his store of knowledge. Knowledge allows him to interpret the information in his databases to advantage in diagnosis, design, and analysis.



Inference Engine

The database gives the context of the problem domain and is generally considered to be a set of useful facts. These are the facts that satisfy the condition part of the condition action rules as the IF THEN rules can be thought of.

The rule interpreter is often known as an inference engine and controls the knowledge base using the set of facts to produce even more facts. Communication with the system is ideally provided by a natural language interface. This enables a user to interact independently of the expert with the intelligent system.

4.6 THE BUILDING BLOCKS OF EXPERT SYSTEMS

Every expert system consists of two principal parts: the knowledge base; and the reasoning, or inference, engine.

The knowledge base of expert systems contains both factual and heuristic knowledge. Factual knowledge is that knowledge of the task domain that is widely shared, typically found in textbooks or journals, and commonly agreed upon by those knowledgeable in the particular field.

Heuristic knowledge is the less rigorous, more experiential, more judgmental knowledge of performance. In contrast to factual knowledge, heuristic knowledge is rarely discussed, and is largely individualistic. It is the knowledge of good practice, good judgment, and plausible reasoning in the field. It is the knowledge that underlies the "art of good guessing."

Knowledge representation formalizes and organizes the knowledge. One widely used representation is the production rule, or simply rule. A rule consists of an IF part and a THEN part (also called a condition and an action). The IF part lists a set of conditions in some logical combination.

The piece of knowledge represented by the production rule is relevant to the line of reasoning being developed if the IF part of the rule is satisfied; consequently, the THEN part can be concluded, or its problem-solving action taken. Expert systems whose knowledge is represented in rule form are called rule-based systems.

Another widely used representation, called the unit (also known as frame, schema, or list structure) is based upon a more passive view of knowledge. The unit is an assemblage of associated symbolic knowledge about an entity to be represented. Typically, a unit consists of a list of properties of the entity and associated values for those properties.

Since every task domain consists of many entities that stand in various relations, the properties can also be used to specify relations, and the values of these properties are the names of other units that are linked according to the relations. One unit can also represent knowledge that is a “special case” of another unit, or some units can be “parts of” another unit.

The problem-solving model, or paradigm, organizes and controls the steps taken to solve the problem. One common but powerful paradigm involves chaining of IF-THEN rules to form a line of reasoning. If the chaining starts from a set of conditions and moves toward some conclusion, the method is called forward chaining.

If the conclusion is known (for example, a goal to be achieved) but the path to that conclusion is not known, then reasoning backwards is called for, and the method is backward chaining. These problem-solving methods are built into program modules called inference engines or inference procedures that manipulate and use knowledge in the knowledge base to form a line of reasoning.

The knowledge base an expert uses is what he learned at school, from colleagues, and from years of experience. Presumably the more experience he has, the larger his store of knowledge. Knowledge allows him to interpret the information in his databases to advantage in diagnosis, design, and analysis.

Though an expert system consists primarily of a knowledge base and an inference engine, a couple of other features are worth mentioning: reasoning with uncertainty, and explanation of the line of reasoning.

Knowledge is almost always incomplete and uncertain. To deal with uncertain knowledge, a rule may have associated with it a confidence factor or a weight. The set of methods for using uncertain knowledge in combination with uncertain data in the reasoning process is called reasoning with uncertainty. An important subclass of methods for reasoning with uncertainty is called “fuzzy logic,” and the systems that use them are known as “fuzzy systems.”

Because an expert system uses uncertain or heuristic knowledge (as we humans do) its credibility is often in question (as is the case with humans). When an answer to a problem is questionable, we tend to want to know the rationale. If the rationale seems plausible, we tend to believe the answer. So it is with expert systems. Most expert systems have the ability to answer questions of the form: “Why is the answer X?” Explanations can be generated by tracing the line of reasoning used by the inference engine

The most important ingredient in any expert system is knowledge. The power of expert systems resides in the specific, high-quality knowledge they contain about task domains. AI researchers will continue to explore and add to the current repertoire of knowledge representation and reasoning methods.

But in knowledge resides the power. Because of the importance of knowledge in expert systems and because the current knowledge acquisition method is slow and tedious, much of the future of expert systems depends on breaking the knowledge acquisition bottleneck and in codifying and representing a large knowledge infrastructure.

Knowledge Engineering

Knowledge Engineering is the art of designing and building expert systems, and knowledge engineers are its practitioners. Knowledge engineering is the same, perhaps more so. We stated earlier that knowledge engineering is an applied part of the science of artificial intelligence which, in turn, is a part of computer science.

Theoretically, then, a knowledge engineer is a computer scientist who knows how to design and implement programs that incorporate artificial intelligence techniques. The nature of knowledge engineering is changing, however, and a new breed of knowledge engineers is emerging. We'll discuss the evolving nature of knowledge engineering later.

Tools, Shells,and Skeletons

Compared to the wide variation in domain knowledge, only a small number of AI methods are known that are useful in expert systems. That is, currently there are only a handful of ways in which to represent knowledge, or to make inferences, or to generate explanations. Thus, systems can be built that contain these useful methods without any domain-specific knowledge. Such systems are known as skeletal systems, shells, or simply AI tools.

Building expert systems by using shells offers significant advantages. A system can be built to perform a unique task by entering into a shell all the necessary knowledge about a task domain. The inference engine that applies the knowledge to the task at hand is built into the shell. If the program is not very complicated and if an expert has had some training in the use of a shell, the expert can enter the knowledge himself.

Bricks and Mortar

The fundamental working hypothesis of AI is that intelligent behavior can be precisely described as symbol manipulation and can be modeled with the symbol processing capabilities of the computer.

In the late 1950s, special programming languages were invented that facilitate symbol manipulation. The most prominent is called LISP (LISt Processing). Because of its simple elegance and flexibility, most AI research programs are written in LISP, but commercial applications have moved away from LISP.

4.7 BENEFITS OF AN EXPERT SYSTEM

- Capture expertise before it is lost
- Reduce dependence upon one expert
- Reduce / eliminate error and inconsistency
- Allow non-experts to reach scientifically supportable conclusions
- Knowledge sharing

Advantages

- Provides consistent answers for repetitive decisions, processes and tasks
- Holds and maintains significant levels of information
- Encourages organizations to clarify the logic of their decision-making
- Never "forgets" to ask a question, as a human might
- Can work round the clock
- Can be used by the user more frequently
- A multi-user expert system can serve more users at a time

Disadvantages

- Lacks common sense needed in some decision making
- Cannot make creative responses as human expert would in unusual circumstances
- Domain experts not always able to explain their logic and reasoning
- Errors may occur in the knowledge base, and lead to wrong decisions
- Cannot adapt to changing environments, unless knowledge base is changed.

4.8 EXAMPLES OF EXPERT SYSTEMS

1. **Medical Expert System :** The basic tasks that are carried out by the medical expert system is diagnosis, prognosis, treatment, monitoring. In terms of treatment, the patient or the physician could access the system through internet. The feedback is sent to the user through internet so that the treatment can be performed. Expert must also access this system, to update the data stored in the knowledge base.

   Who are the users ?

   The main purpose for the creation of the medical expert system was to support the physicians and doctors.

2. **Blue Cross :** Blue cross is an expert system that automates insurance claim processing. The expert system handles up to 200 routine claims each day allowing human clerks to spend more time on tough situations that require human judgment.

   The users are who use the insurance policy of Blue Cross. If they have claims that are not too tough they use the expert system.

   Advantages

   ➢ Human clerks can see to other tough situations which means they get a lot more claims done in a day than they would if human clerks attended each and every one.

   ➢ Work will be done faster as it is an expert system and done automatically

   ➢ Gives experience when it is after office hours

   ➢ It combines the knowledge of more than one person when the result of the claim is given

3. **Music Composition**

4. **Oil Exploitations**

   OSCAR (On Scene Coordinator's Advisor for Responding) to oil spills ....

   Choosing appropriate responses to an oil spill can be a complex decision. This prototype is intended to demonstrate, in a simple way, the feasibility of using expert systems for decision support or training in oil spill response.

5. **Air Traffic Control :** Expert system for air traffic control and controller training

A expert system form of artificial intelligence for control of air traffic which may also be utilized for air traffic controller training. The expert system receives input data representing the altitude and heading of all aircraft in the control area. The aircraft data is compared with the data of the other aircraft. Sequencing and local flow control is optimized and if a potential conflict arises between two aircraft, clearances are transmitted to the aircraft to resolve the conflict.

6. **Detecting Problems in Computer / Help Desk :** A help desk is a type of expert system which allows customers to obtain service or help when detect problems relating to a certain object, for example, a person is having problems connecting to the internet, there will be a message that appears on the screen that may give a specific error number, and the system will allow the customer to go through a series of questions and tries to solve the problem. There are many forms of a help desk, for example telephone, online services or troubleshooting programs for various programs.

Some other successful expert systems are :

- DENDRAL SYSTEM
- MYCIN (Diagnosis of infections)
- PROSPECTOR (Ore and oil exploration)
- INTERNIST (Internal medicine)
- CRYSALIS
- Diagnosis in an area of medicine
- Adjusting between economy class and business class seats for future flights
- Diagnosing paper problems in rotary printing

4.9 INTELLIGENT SOFTWARE AGENTS

Intelligent Software Agent (ISA)

A software agent that uses Artificial Intelligence (AI) in the pursuit of the goals of its clients.

Artificial Intelligence is the imitation of human intelligence by mechanical means. Clients, then, can reduce human workload by delegating to ISAs tasks that normally would require human-like intelligence.

Many researchers that formerly referred to their work as AI are now actively engaged in “agent technology”. Thus the word “agent” by itself generally connotes ISAs in the terms of the present-day research community.

Delegacy for ISAs is far more absolute. ISAs have the capability to generate and implement novel rules of behavior which human beings may never have the opportunity or desire to review. As ISAs can engage in extensive logical planning and inferencing, the relationship of trust between the client and the agent is or must be far greater, especially when the consumption of client resources is committed for reasons unexplained or multiple complex operations are actuated before human observers can react.

Competency as practiced by ISAs adds higher order functionality to the mix of capabilities. In addition to communicating with their environment to collect data and actuate changes, ISAs can often analyze the information to find non-obvious or hidden patterns, extracting knowledge from raw data. Environmental modes of interaction are richer, incorporating the media of humans such as natural language text, speech, and vision.

Amenability in ISAs can include self-monitoring of achievement toward client goals combined with continuous, online learning to improve performance. Adaptive mechanisms in ISAs mean that they are far less brittle to changes in environment and may actually improve.

In addition, client responsiveness may go so far as to infer what a client wants when the client himself does not know or cannot adequately express the desired goals in definitive terms.

Agent Variants

1. **Mobile Agents** : Also known as traveling agents, these programs will shuttle their being, code and state, among resources. This often improves performance by moving the agents to where the data reside instead of moving the data to where the agents reside.

   The alternative typical operation involves a client-server model. In this case, the agent, in the role of the client, requests that the server transmit volumes of data back to the agent to be analyzed.

   Mobile agent frameworks are currently rare, however, due to the high level of trust required to accept a foreign agent onto one's data server. With advances in technologies for accountability and immunity, mobile agent systems are expected to become more popular.

2. **Distributed Agents** : Load-balancing can be achieved by distributing agents over a finite number of computational resources. Some mobile agents are self-distributing, seeking and moving to agent platforms that can offer the higher computational resources at lower costs.

3. **Multiple Agents** : Some tasks can be broken into sub-tasks to be performed independently by specialized agents. Such agents are unaware of the existence of the others but nonetheless rely upon the successful operations of all.

4. **Collaborative Agents** : Collaborative agents interact with each other to share information or barter for specialized services to effect a deliberate synergism.

   While each agent may uniquely speak the protocol of a particular operating environment, they generally share a common interface language which enables them to request specialized services from their brethren as required.

5. **Social Agents** : Anthropomorphism is seen by some researchers as a key requirement to successful collaboration between humans and agents.

   To this end, agents are being developed which can both present themselves as human-like creations as well as interpret human-generated communications such as continuous speech, gestures, and facial expressions.

4.10 APPLICATIONS OF ISA

To date, ISAs have been successfully employed in multiple application endeavors, some of which are listed below.

- Data Collection and Filtering
- Pattern Recognition
- Event Notification
- Data Presentation
- Planning and Optimization
- Rapid Response Implementation

One might imagine an agent which is involved in all of these activities, sequencing through each of those states in response to environmental events, acting independently or in collaboration with a human client.

4.11 EXPERT SYSTEM TECHNOLOGIES HALL OF FAME

Since the emergence of the expert system, its growth has been significant both in terms of numbers of systems and diversity of vertical market application. A section included at the end of this chapter lists and briefly describes many of the more popular and suc-cessful commercial ES deployments. Though not comprehensive, this list represents.

Expert System Technologies Hall of Fame DENDRAL (1965-1983)

The DENDRAL project was one of the earliest expert systems. DENDRAL began as an effort to explore the mechanization of scientific reasoning and the formalization of scientific knowledge by working within a specific domain of science, organic chemistry.

Another concern was to use AI methodology to better understand some fundamental questions in the philosophy of science, including the process by which explanatory hypotheses are discovered or judged adequate.

After more than a decade of collabora-tion among chemists, geneticists, and computer scientists, DENDRAL became not only a successful demonstration of the power of rule-based expert systems but also a significant tool for molecular structure analysis, in use in both academic and industrial research labs.

Using a plan-generate-test search paradigm and data from mass spec-trometry and other sources, DENDRAL proposes plausible candidate structures for new or unknown chemical compounds. Its performance rivals that of human experts for certain classes of organic compounds, and it resulted in a number of papers that were published in the chemistry literature. Although no longer a topic of academic research, the most recent version of the interactive structure generator, GENOA, has been licensed by Stanford University for commercial use.

META-DENDRAL (1970-1976)

META-DENDRAL is an inductive program that automatically formulates new rules for DENDRAL to use in explaining data about unknown chemical compounds. Using the plan-generate-test paradigm, META-DENDRAL successfully formulates rules of mass spectrometry, both by rediscovering existing rules and by proposing entirely new rules. Although META-DENDRAL is no longer an active program, its contributions to ideas about learning and discovery are being applied to new domains.

Among these ideas are the following: induction can be automated as heuristic search; for efficiency, the search can be broken into two steps approximate and refined; learning must be able to cope with noisy (unfiltered or nonhomogenous) and incomplete data; and learning multiple concepts at the same time is sometimes inescapable.

MYCIN (1972-1980)

MYCIN is an interactive program that diagnoses certain infectious diseases, prescribes antimicrobial therapy, and can explain its reasoning in detail. In a controlled test, its performance equaled that of specialists. In addition, the MYCIN program incorporated several important AI developments. MYCIN extended the notion that the knowledge base should be separate from the inference engine, and its rule-based inference engine was built on a backward-chaining, or goal-directed, control strategy. Because it was designed as a consultant for physicians, MYCIN was given the ability to explain both its line of reasoning and its knowledge. Because of the rapid pace of developments in medicine, the knowledge base was designed for easy augmentation.

And because medi-cal diagnosis often involves a degree of uncertainty, MYCIN'S rules incorporated cer-tainty factors to indicate the importance (i.e., likelihood and risk) of a conclusion. Although MYCIN was never used routinely by physicians, it substantially influenced other AI research. MYCIN led to work in TEIRESIAS, EMYCIN, PUFF, CENTAUR, VM, GUIDON, and SACON, all described here, and to ONCOCIN and ROGET.

TEIRESIAS (1974-1977)

The knowledge acquisition program TEIRESIAS was built to assist domain experts in refining the MYCIN knowledge base.TEIRESIAS developed the concept of metalevel knowledge, which means that in addition to using knowledge directly, the system can examine it, reason about it, and direct its use.

TEIRESIAS makes clear the line of rea-soning used in making a diagnosis and aids physician experts in modifying or adding to the knowledge base. Much of this capability was incorporated into the EMYCIN frame-work. The flexibility and understandability thatTEIRESIAS introduced into the knowl-edge base debugging process provided models for the design of many expert systems.

EMVCIN (1974-1979)

The core inference engine of MYCIN, together with a knowledge engineering inter-face, was developed under the name EMYCIN, or "Essential MYCIN." It is a domain-independent framework that can be used to build rule-based expert systems for consul-tation problems such as those encountered in diagnosis or troubleshooting. EMYCIN continues to be a primary example of software that can facilitate building expert sys-tems and has been used in a variety of domains, both medical (e.g., PUFF) and nonmedi-cal (e.g., SACON).The system has been widely distributed in the United States and abroad and is the basis for the Texas Instruments software system called Personal Consultant.

PUFF (1977-1979)

The PUFF system was the first program built using EMYCIN. PUFF's domain is the interpretation of pulmonary function tests for patients with lung disease. The program can diagnose the presence and severity of lung disease and produce reports for the patient's file. Once the rule set for this domain had been developed and debugged, PUFF was transferred to a minicomputer at Pacific Medical Center in San Francisco, where it is used routinely to aid with interpretation of pulmonary function tests. A ver-sion of PUFF has been licensed for commercial use.

CENTAUR (1977-1980)

The CENTAUR system was designed to experiment with an expert system that com-bines both rule- and frame-based approaches to represent and use knowledge about medicine and medical diagnostic strategies. For purposes of comparison, CENTAUR was developed for the same task domain as PUFF, interpretation of pulmonary func-tion tests. CENTAUR performed well, demonstrating the effectiveness of this repre-sentation and control methodology.

VM (1977-1981)

The Ventilator Manager (VM) program interprets online quantitative data in the intensive care unit (ICU) and advises physicians on the management of postsurgical patients needing a mechanical ventilator to help them breathe. Although based on the MYCIN architecture, VM was redesigned to allow for the description of events that change over time.

Thus, it can monitor the progress of a patient, interpret data in the context of the patient's present and past condition, and suggest adjustments to therapy. VM was tested in the surgical ICU at Pacific Medical Center in San Francisco. Some of the program's concepts have been built directly into more recent respiratory monitor-ing devices.

GUIDON (1977-1981)

GUIDON is an experimental program intended to make available to students the expertise contained in EMYCIN-based systems. GUIDON incorporates separate knowledge bases for the domain itself and for tutoring, and engages the student in a dialogue that presents domain knowledge in an organized way over a number of ses-sions.

Using the MYCIN knowledge base as the domain to be taught, work in GUIDON explored several issues in intelligent computer-assisted instruction (ICAI), including means for structuring and planning a dialog, generating teaching mate-rial, constructing and verifying a model of what the student knows, and explaining expert reasoning.

Although GUIDON was successful in many respects, it also revealed that the diagnostic strategies and some of the medical knowledge contained implicitly in the

MYCIN rules had to be made explicit in order for students to understand and remember them easily, which led to the development of a new expert system, NEOMYCIN.

SACON (1977-1978)

SACON was implemented as a test of the EMYCIN framework in an engineering con-text. SACON advised structural engineers on the use of MARC, a large structural analysis program, and served as a prototype of many advisory systems.

MOLGEN (1975-1984)

The MOLGEN project applied AI methods to research in molecular biology. Initial work focused on acquiring and representing the expert knowledge needed to design and simulate experiments in the domain. This work led to the development of UNITS, described next. The second phase of research resulted in two expert systems, repre-senting distinct approaches to the design of genetic experiments. One system used "skeletal plans," which are abstracted outlines of experiment designs that can be applied to specific experimental goals and environments.

The other system was based on planning with constraints, in which planning decisions are made in the spaces of overall strategy, domain-independent decisions, and domain-dependent laboratory decisions, and the interaction of separate steps or subproblems of an experiment con-stitute constraints on the overall problem. These two systems were later synthesized into a third system, called SPEX. Current work, known as MOLGEN-II, is investigat-ing the process of theory formation in molecular biology.

UNITS (1975-1981)

The frame-based UNITS system was developed in the MOLGEN project as a general- purpose knowledge representation, acquisition, and manipulation tool. Designed for use by domain experts with little previous knowledge of computers, it provides an interface that allows the expert to describe both factual and heuristic knowledge. It contains both domain-independent and domain-specific components, including modi-fied English rules for describing the procedural knowledge. Stanford University licensed UNITS for commercial development.

AM (1974-1980)

The AM program explored machine learning by discovery in the domain of elementary mathematics. Using a framework of 243 heuristic rules, AM successfully proposed plausible new mathematical concepts, gathered data about them, noticed regularities, and, completing this cycle, found ways of shortening the statement of those hypotheses by making new definitions. However, AM was not able to generate new heuristics. This failing was inherent in the design of AM; related work on discovering new heuristics was done as part of EURISKO.

EURISKO (1978-1984)

A successor to AM, EURISKO also investigated automatic discovery, with a particular emphasis on heuristics, their representation, and the part played by analogy in their discovery. Several hundred heuristics, mostly related to functions, design, and simula-tion, guide EURISKO in applying its knowledge in several domains. In each domain, the program performs three levels of tasks: working at the domain level to solve prob-lems; inventing new domain concepts; and synthesizing new heuristics that are specific and powerful enough to aid in handling tasks in the domain.

EURISKO applications include elementary mathematics; programming, where it uncovered several LISP bugs; naval fleet design, where it won the Traveller Trillion Credit Squadron tournament; VLSI design, where it created some novel and potentially useful three-dimensional devices; oil-spill cleanup; and a few other domains.

RLL (1978-1980)

RLL (for Representation Language Language) is a prototype tool for building cus-tomized representation languages. RLL is self-descriptive that is, it is itself described in terms of RLL units. It has been used as the underlying language for EURISKO and other systems.

Contract Nets (1976-1979)

The Contract Nets architecture is an early contribution to work on computer archi-tectures for parallel computation. Recently, it received much attention in the litera-ture on multiprocessor architectures for symbolic computation. In the Contract Nets architecture, problem solving is distributed among decentralized and loosely coupled processors.

These processors communicate about task distribution and answers to sub-problems through an interactive negotiation analogous to contract negotiation in the building trades:

The "contract" is given to the processor that can handle the task at the lowest system cost, and failure to complete a task results in its reassignment to another processor.

CRYSALIS (1976-1983)

The CRYSALIS project explored the power of the blackboard model in interpreting X-ray data from crystallized proteins. The overall strategy was to piece together the three-dimensional molecular structure of a protein by successively refining descrip-tions of the structure. Although the knowledge base was developed for only a small part of the problem, the blackboard model with its hierarchical control structure proved powerful for solving such highly complex problems. Results from CRYSALIS are currently being incorporated in other KSL work and have contributed to improved models of control.

AGE (1976-1982)

The AGE (for Attempt to GEneralize) project sought to develop a software laboratory for building knowledge-based programs. AGE-1, the knowledge engineering tool that resulted, is designed for building programs that use the blackboard problem-solving framework. It can aid in the construction, debugging, and running of a program. A number of academic laboratories as well as industry and the defense community use AGE-1 for various applications.

QUIST (1978-1981)

QUIST combines AI and conventional database technology in a system that optimizes queries to large relational databases. QUIST uses heuristics embodying semantic knowledge about the contents of the database to make inferences about the meanings of the terms in a query. It reformulates the original query into an equivalent one whose answer can be found in the database more efficiently. Then conventional query opti-mization techniques are used to plan an efficient sequence of retrieval operations.

GLisp (1982-1983)

GLisp is a programming language that allows programs to be written in terms of objects and their properties and behavior. The GLisp compiler converts such programs into efficient LISP code. The compiler has been released to outside users, along with the GEV window-based data inspector, which displays data according to their GLisp description. GLisp is now being distributed from the University of Texas.

XCON (1980 to present)

XCON is probably one of the most famous of all expert systems due to its enormous success. Developed by Digital Equipment Corporation, XCON manages the complex process of configuring the variety of specifications associated with typical customer orders for Digital's products. Before XCON, the configuration of Digital's systems was performed manually by a team of highly skilled computer professionals. Despite their skills, the manual configuration process often resulted in configuration errors or incomplete orders. Following the installation of XCON, however, configuration orders attained an accuracy level of 98 percent compared with 65 percent using the previous manual system. Initial cost savings due to XCON were estimated to be in excess of $15 million with later estimates soaring as high as $40 million per year. XCON still operates today and remains one of the greatest single success stories in the history of expert systems.

UNIT V	**Data Ware Housing and Data Mining:** Data Ware house – Definition- Data Marts, Data Stores, Meta Data – Characteristics of Data Ware House – Data Warehouse Architecture-Implementing Data Warehouse. Data Mining- Definition- Online Transaction Processing Techniques use to Mine Data, Data Mining Techniques-Limitations of Data Mining- Data Visualization.

5.1 DATA WAREHOUSE

Definition

Data from different data sources is stored in a relational database for end use analysis. Data from different data sources is stored in a relational database for end use analysis Data is organized in summarized, aggregated, subject oriented, non volatile patterns.

Data in a data warehouse is consolidated, flexible collection of data, Supports analysis of data but does not support online analysis of data.

Online Analytical Processing

A tool to evaluate and analyze the data in the data warehouse using analytical queries. A tool which helps organize data in the data warehouse using multidimensional models of data aggregation and summarization. Supports the data analyst in real time and enables online analysis of data with speed and flexibility.

5.1.1 Characteristics of a Data Warehouse

So far we established the reasons why data warehousing is an important innovation in decision support, and we formally defined the DW to be

1. Subject oriented
2. Data integrated
3. Time variant
4. Nonvolatile

1. Subject Orientation

The first feature of the DW is its orientation toward the major subjects of the organi-zation, which clearly contrasts with the more functional orientation of the various applications associated with the firm's legacy systems.

The operational world of the organization is typically designed around processes and functions such as inventory or human resources, each of which exhibit specific data needs with most of the data elements local to that process or function. The DW, on the other hand, contains data primarily oriented to decision making and, as such, is organized more around the major subject areas relevant to the firm, such as customers or vendors.

This distinct subject orientation results in several specific differences between typi-cal applications and the data warehouse.

2. Data Integrated

According to Inmon (1992b), the essence of the DW environment is that the data con-tained within the boundaries of the warehouse are integrated. This integration mani-fests itself through consistency in naming convention and measurement attributes, accuracy, and common aggregation.

3. Time Variant

In an operational application system, the expectation is that all data within the data-base are accurate as of the moment of access. When a customer service representative for your credit card company checks on your current balance, his or her expectation (and yours) is that the value returned will be accurate as of that moment.

It would not be particularly useful for the credit representative to tell you that your balance was $459.00 as of 3 weeks ago. In the realm of data warehouses, however, data are simply assumed to be accurate as of some moment in time and not necessarily "right now." Typically, the data are assumed to be accurate at the moment they were loaded into the DW. In this regard, data within a data warehouse are said to be time variant.

The time variance of the warehouse data manifests itself in a variety of ways. Typically, the time horizon for the data in the warehouse is long from 5 to 10 years. In contrast, the typical operational environment time horizon is much shorter anywhere from current values to 60 to 90 days. The level of performance associated with high- volume transaction processing necessitates the shorter time horizons in operational applications. In DW environments, however, the desire is generally to analyze data over longer time periods in an effort to reveal trends and temporal relationships.

4. Nonvolatility

In keeping with the restriction of not changing or updating the data contained in a DW, it makes sense that the typical activities of inserts, deletes, and changes performed regularly in an operational application environment are completely nonexistent in a DW environment. Only two data operations are ever performed in the data ware-house: data loading and data access.

5.2 DATA WAREHOUSING

'Data warehousing' is a collection of decision support technologies that enable the knowledge worker, the statistician, the business manager and the executive in processing the information contained in a data warehouse meaningfully and make well informed decisions based on outputs.

The Data warehousing system includes backend tools for extracting, cleaning and loading data from Online Transaction Processing (OLTP) Databases and historical repositories of data. It also consists of the Data storage area composed of the Data warehouse, the data marts and the Data store.

It is important to distinguish between a "Data warehouse" and "Data warehousing".

A 'Data warehouse' is a component of the data warehousing system. It is a facility that provides for a consolidated, flexible and accessible collection of data for end user reporting and analysis.

'A data warehouse is a Historical, subject-oriented, integrated, time-variant and non-volatile collection of data in support of management's decision making process".

By Historical we mean, the data is continuously collected from sources and loaded in the warehouse. The previously loaded data is not deleted for long period of time. This results in building historical data in the warehouse.

By Subject Oriented we mean data grouped into a particular business area instead of the business as a whole. By Integrated we mean, collecting and merging data from various sources. These sources could be disparate in nature.

By Time-variant we mean that all data in the data warehouse is identified with a particular time period. By Non-volatile we mean, data that is loaded in the warehouse is based on business transactions in the past, hence it is not expected to change over time.

5.3 DIFFERENCES BETWEEN DWH AND OLTP

The data warehouse and the OLTP data base are both relational databases. However, the objectives of both these databases are different.

The OLTP database records transactions in real time and aims to automate clerical data entry processes of a business entity. Addition, modification and deletion of data in the OLTP database is essential and the semantics of the application used in the front end impact on the organization of the data in the database.

The data warehouse on the other hand does not cater to real time operational requirements of the enterprise. It is more a storehouse of current and historical data and may also contain data extracted from external data sources.

The differences between these two relational databases, is tabulated below for information.

Data warehouse database	OLTP database
Designed for analysis of business measures by categories and attributes.	Designed for real time business operations.
Optimized for bulk loads and large, complex, unpredictable queries that access many rows pertable.	Optimied for a common set of transactions, usually adding or retrieving a single row at a time per table.
Loaded with consisten, valid data; requires no real time validation.	Optimized for validation of incoming data during transactions; user validation data tables.
Supports few concurrent users relative to OLTP	Supports thousands of concurrent users.

5.4 DATA MART

A data mart is a repository of data gathered from operational data and other sources that is designed to serve a particular community of knowledge workers. In scope, the data may derive from an enterprise-wide database or data warehouse or be more specialized. The emphasis of a data mart is on meeting the specific demands of a particular group of knowledge users in terms of analysis, content, present.

In practice, the terms data mart and data warehouse each tend to imply the presence of the other in some form. However, most writers using the term seem to agree that the design of a data mart tends to start from an analysis of user needs and that a data warehouse tends to start from an analysis of what data already exists and how it can be collected in such a way that the data can later be used.

A data warehouse is a central aggregation of data (which can be distributed physically); a data mart is a data repository that may derive from a data warehouse or not and that emphasizes ease of access and usability for a particular designed purpose. In general, a data warehouse tends to be a strategic but somewhat unfinished concept; a data mart tends to be tactical and aimed at meeting an immediate need.

5.5 META DATA

Users need to understand what rules applied while cleaning and transforming data before storage. This information needs to be stored separately in a relational database called Metadata. Metadata is "data about data". Mapping rules and the maps between the data sources and the warehouse; Translation, transformation and cleaning rules; date and time stamps, system of origin, type of filtering, matching; Pre-calculated or derived fields and rules thereof are all stored in this database.

In addition the metadata database contains a description of the data in the data warehouse; the navigation paths and rules for browsing the data in the data warehouse; the data directory; the list of pre-designed and built in queries available to the users.

5.6 OPERATIONAL DATA STORE (ODS)

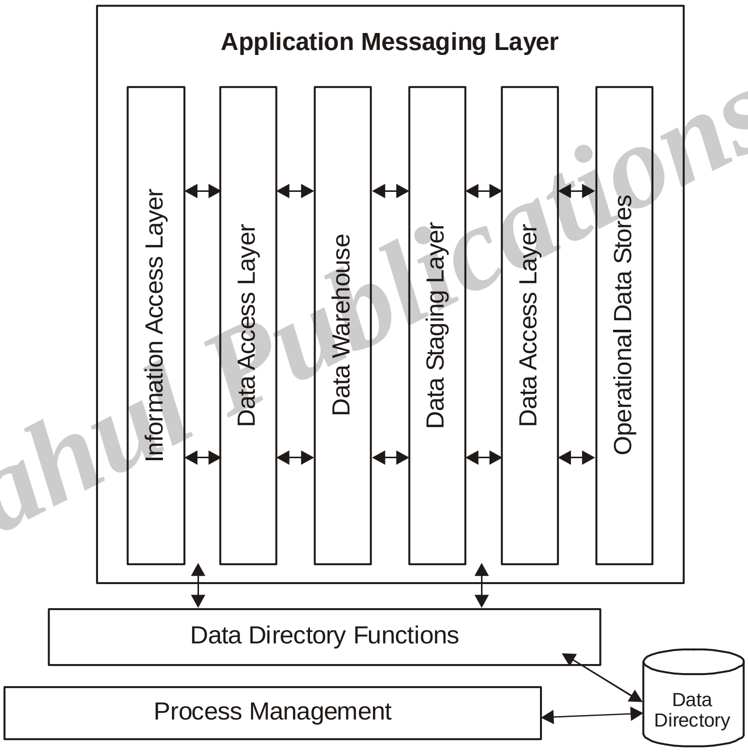
Operational Data Store (ODS) is layer of repository that resides between a data warehouse and the source system. The current, detailed data from disparate source systems is integrated, grouped subject areas wise in the ODS. The ODS is updated more frequently than a data warehouse. The updates happen shortly after a source system data changes. There are two objectives of an ODC

1. Source DWH with detailed, integrated data.

2. Provide organization with operational Integration.

5.7 DATA WAREHOUSE ARCHITECTURE

A data warehouse architecture (DWA) is a method by which the overall structure of data, communication, processing, and presentation for end-user computing within the enterprise can be represented. Figure illustrates the various interconnected ele-ments that make up the DWA.



1. Operational And External Database Layer

The operational and external database layer represents the source data for the DW. This layer comprises, primarily, operational transaction processing systems and external secondary databases. The goal of the data warehouse is to free the information locked up in the operational databases and to mix it with information from other, often exter-nal, sources.

An additional objective of the DW is to have a minimal impact on the per-formance and operation of the systems found in this layer. In other words, the addition of the necessary extraction software to this environment should go unnoticed in terms of performance of the operational applications whose databases are being accessed.

Large organizations frequently acquire additional data from outside databases. The ubiquitous nature of the Web and the Internet makes it easy and economical for firms to access and incorporate such data into their DW.

Data related to demographic, econometric, competitive, and purchasing trends typically found in public- or subscriber-access databases via the Internet are treated in the same manner as the ODS data and, following extraction and conditioning for consistency, are loaded into the data warehouse.

2. Information Access Layer

The end user deals directly with the information access layer of the DWA. In particular, it represents the tools that the end user normally uses day to day to extract and analyze the data contained within the DW. This layer consists of the hardware and software involved in displaying and printing reports, spreadsheets, graphs, and charts for analysis and presentation. At the information access layer, the DSSs use the DW data to sup-port the various categories and types of decision making throughout the organization.

3. Data Access Layer

As shown in Figure the data access layer serves as a sort of interface or interme-diary between the operational and information access layers and the data warehouse itself. This layer spans the various databases contained within the DW and facilitates common access by the DW users.

The data access layer not only spans multiple data-bases and file systems on the same hardware, it also spans the wide variety of manufac-turers and network protocols. A successful DW provides end users with universal data access so that, theoretically at least, end users should be able to access any or all of the enterprise's data necessary for them to do their job, regardless of location or informa-tion access tool. It is the role of the data access layer to make this access happen.

4. Metadata Layer

In order to provide for universal data access, it is absolutely necessary to maintain some form of data directory or repository of metadata information.

Examples of metadata include the directory of where the data are stored, the rules used for summarization and scrubbing, or possibly records of operational data sources.

5. Process Management Layer

The process management layer focuses on scheduling the various tasks that must be accomplished to build and maintain the data warehouse and data directory informa-tion. This layer can be thought of as the scheduler or the high-level job control for the many processes (procedures) that must occur to keep the DW up to date. Tasks such as periodic download from identified operational data stores, scheduled summarization of operational data, access and download of external data sources, and update of the metadata are typically performed at this layer of the DWA.

6. Application Messaging Layer

The application messaging layer transports information around the enterprise comput-ing network. This layer is also referred to as "middleware," but it can typically involve more that just networking protocols and request routing. Application messaging, for example, can be used to isolate applications, operational or informational, from the exact data format on either end, thus facilitating a seamless interface between the uniqueness of a particular data format and the specific format requirements of the analysis tool being used.

This layer can also be used to collect transactions or mes-sages and deliver them to a certain location at a certain time. In this sense, the applica-tion messaging layer can be thought of as the transport system underlying the DW.

7. Physical Data Warehouse Layer

The physical data warehouse layer is where the actual data used for decision support throughout the organization are located. In some cases, one can think of the DW sim-ply as a logical or virtual view of data, because, as we will see shortly, in some instances the data warehouse may not actually store the data accessed through it.

8. Data Staging Layer

The final component of the DWA is the data staging layer. Data staging (sometimes referred to as copy or replication management) includes all of the processes necessary to select, edit, summarize, combine, and load data warehouse and information access data from operational and external databases.

Data staging often involves complex programming, but more and more vendors market data warehousing tools intended to reduce the complexities associated with this process. Data staging may also require data quality analysis programs and other such filters that identify patterns and data structures within existing operational data.

9. Data Warehousing Typology

As mentioned previously, although the data warehouse may appear to be the source of data for various organizational analysis initiatives and decision-making activities, it may not physically be the location of the data being accessed. Numerous hybrid mechanisms exist to structure a DW, but three basic configurations can be identified: virtual or point-to-point, central, and distributed data warehouses.

Before we review each configuration, we must note that no single approach to con-figuring a DW schema is best in all situations. Each option fits a specific set of require-ments, and a data warehousing strategy may ultimately include all three options.

a) **The Virtual Data Warehouse :** A virtual or point-to-point data warehousing strategy allows the end users to access the operational data stores directly using tools enabled at the data access layer. This approach provides a great deal of flexibility as well as the minimum amount of redundant data that must be loaded and maintained; however, it can also put the largest unplanned query load and performance degradation on operational applica-tion systems.

   Virtual warehousing is often an initial strategy in organizations with a broad but largely undefined need to get at operational data by a relatively large class of end users. In such situations, the likely frequency of requests is low. Virtual data ware-houses often provide a relatively low-cost starting point for organizations to assess what types of data end users are really looking for.

b) **The Central Data Warehouse :** Central data warehouses are what most people think of when first introduced to the concept of a data warehouse. The central data warehouse is a single physical database that contains all of the data for a specific functional area, department, division, or enterprise.

This warehousing approach is often selected when users demonstrate a common need for informational data and large numbers of end users are already con-nected to a central computer or network. A central data warehouse may contain data for any specific period of time and usually contains data from multiple operational applications.

The central data warehouse is real. The data stored in the DW are physically located in and accessible from one place and must be loaded and maintained on a regu-lar basis. This configuration is the most common of the three basic types and represents the de facto standard for DW implementation due to the wide variety of construction and manipulation tools being offered.

c) **The Distributed Data Warehouse :** A distributed data warehouse is just what its name implies: a data warehouse whose components are distributed across a number of different physical databases. As large organizations push decision making down to lower and lower levels of the organiza-tion, the data needed for decision making is also pushed down (or out) to the LAN or local computer serving the local decision maker.

Many older DW implementations use the distributed approach because initially it was easier to create several small data warehouse databases than to facilitate one all-encompassing one. The advent of mod-ern DW implementation and management applications, however, reduced the need for multiple or distributed DWs.

5.8 DATA WAREHOUSE IMPLEMENTATION

The challenge of providing access to the aggregated data of an organization is not a new one. The 1970s saw the advent of the information center, an ill-fated concept that required a dedicated high-powered computer and severely drained resources in terms of hardware, software, and personnel needed.

The 1980s brought an emphasis on data reengineering using the extended relational model. This model, too, suffered from complexities and severe performance degradation issues. The 1990s' answer appears to be the data warehouse. If we are to avoid the problems of the past and realize the sue- cesses assumed to be associated with total access to data, IT management and organi-zational data warehouse champions must not only understand what needs to be done, but also just how to do it.

Following a closer look in the next chapter at the data ware-house from a data visualization perspective, in Chapter 12 we will focus in detail on the issues surrounding the implementation of a data warehouse in the modern organiza-tion. For our purposes in this chapter, however, we simply need to begin thinking about the unique nature of the data warehouse with regard to implementation.

Denis Kozar (1997), vice president of Enterprise Information Architecture for Chase Manhattan Bank, assembled the "seven deadly sins" of data warehouse imple-mentation. Each of these errors can result in the failure of an otherwise valuable data warehouse initiative. Table 10-5 lists the "seven deadly sins" of data warehousing.

Sin1: "If You Build It, They Will Come"

Kozar suggested that the first of the seven sins is one of blind faith. It is the failure to recognize the importance of developing a clear set of business objectives for the data warehouse prior to its construction. A successful data warehouse plan considers the needs of the entire enterprise and develops a documented set of requirements to guide the design, construction, and rollout of the project. The data warehouse cannot simply be built in the hope that someone will find a use for it.

Sin 2: Omission Of An Architectural Framework

One of the most important factors in a successful data warehouse initiative is the development and maintenance of a comprehensive architectural framework. Such a framework serves as the blueprints for construction and use of the various DW com-ponents. Issues such as the expected number of end users, the volume and diversity of data, and the expected data-refresh cycle, among many others, must be considered (and reflected) in the DW architecture.

Sin 3: Underestimating The Importance Of Documenting Assumptions

The assumptions and potential data conflicts associated with the DW must be included in the architectural framework for the project. They must be ascertained and codified within the document as early in the project as possible to ensure their reflection in the final product.

Several questions must be answered during the requirements phase of the project to reveal important underlying assumptions about the DW. How much data should be loaded into the warehouse? What is the expected level of data granularity? How often do we need to refresh the data? On what platform will the DW be deveU oped and implemented? Accurate answers are essential to the success of a data ware-house project.

Sin 4: Failure To Use The Right Tool For The Job

The design and construction of a data warehouse is, in many ways, much different from the construction of an operational application system. A DW project requires a differ-ent set of tools than those typically found in an application development effort.

Data warehouse tools can be categorized into four discrete groupings:

(1) Analysis tools,

(2) Development tools,

(3) Implementation tools, and

(4) Delivery tools.

Within each of these categories are specialized tools designed specifically to accommodate the unique design activities associated with data warehouse development.

1. **Analysis Tools :** The tools in this category identify data requirements, the primary sources of data for the DW, and the construction of the data model for the warehouse. Modern CASE tools belong to this category. Another analysis tool is the code scanner. These applica-tions scan source code for file or database definitions and data usage identifiers. This information helps to build the initial data model for the warehouse by determining the data requirements contained within the source ODS.

2. **Development Tools :** This class of tools is responsible for data cleansing, code generation, data integration, and loading of the data into the final warehouse repository. These tools are also the pri-mary generators of metadata for the warehouse.

3. **Implementation Tools :** This category contains the data acquisition tools used to gather, process, clean, repli-cate, and consolidate the data to be contained within the warehouse. In addition, infor-mation storage tools from this category may be used to load summarized data from external data sources.

4. **Delivery Tools :** Delivery tools assist in the data conversion, data derivation, and reporting for the final delivery platform. This category includes specific tools for querying and reporting and the generation of and access to data glossaries intended to help end users identify what data are actually contained within the warehouse.

Sin 5 : Life Cycle Abuse

This sin is the failure of the DW developers to realize the differences between the data warehouse life cycle (DWLC) and the traditional system development life cycle (SDLC) methodologies. Although similar, these two approaches differ in one critical aspect: The DWLC never ends.

The life cycle of a data warehouse project is an ongoing set of activities that flow from initial investigation of DW requirements through data administration and back again. Typically, as each phase of the DW is completed, a new one is started due to new data requirements, additional user groups, and new sources of data. The DW developers must realize that the project must never end if the warehouse is to remain a viable source of decision-making support.

Sin 6: Ignorance Concerning The Resolution Of Data Conflicts

The justification for a new data warehouse initiative is often predicated on the need for greater quality data for decision making within the organization. Although it offers a laudable objective for a DW project, it is simply the tip of the iceberg with regard to actually putting the warehouse into operation. People and organizations tend naturally to be highly protective and territorial when it comes to their data and associated appli-cations.

As a result, a great deal of often-tedious analysis must be conducted to deter-mine the best data sources available within the organization. Once these systems are identified, the conflicts associated with disparate naming conventions, file formats and sizes, and value ranges must be resolved.

This process may involve working with the data owners to establish an understanding with regard to future planned or unplanned changes to the source data. Failure to allow sufficient time and resources to resolve data conflicts can stall a warehouse initiative and result in an organizational stalemate that can threaten the success of the project.

Sin 7: Failure To Learn From Mistakes

The ongoing nature of the DWLC suggests that one data warehouse project simply begets another. Because of this tendency, careful documentation of the mistakes made in the first round will directly affect the quality assurance activities of all future proj-ects. By learning from the mistakes of the past, a strong data warehouse with lasting benefits can be built.

5.9 AN INTRODUCTION TO DATA MINING

Definition of Data Mining

Data mining, the extraction of hidden predictive information from large databases, is a powerful new technology with great potential to help companies focus on the most important information in their data warehouses.

Data mining tools predict future trends and behaviors, allowing businesses to make proactive, knowledge-driven decisions. The automated, prospective analyses offered by data mining move beyond the analyses of past events provided by retrospective tools typical of decision support systems.

Data mining tools can answer business questions that traditionally were too time consuming to resolve. They scour databases for hidden patterns, finding predictive information that experts may miss because it lies outside their expectations. Most companies already collect and refine massive quantities of data.

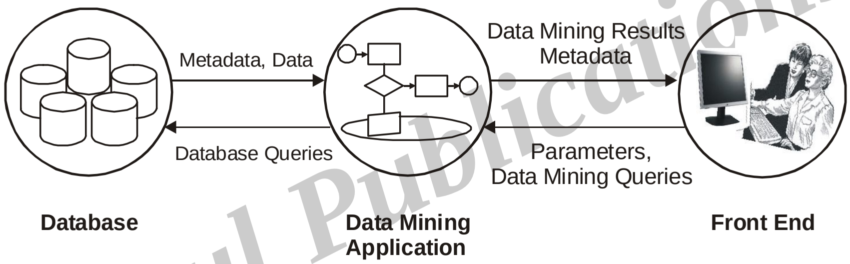
Data mining techniques can be implemented rapidly on existing software and hardware platforms to enhance the value of existing information resources, and can be integrated with new products and systems as they are brought on-line. Environment as well as a basic description of how data warehouse architectures can evolve to deliver the value of data mining to end users.

5.9.1 Data Mining Architecture

The technological objective in KDD process is to design architecture for Data Mining. In addition to the architecture, it is also intended to address the process-related issues. It is assumed that the implementation of the Data Mining Technology would be a processing, memory and data intensive task as against one that requires continuous interaction with the database.

It is also assumed that the Data Preparation (Data Extraction, Transformation, Cleansing and Loading) is outside the scope of the Data Mining architecture. To preserve the accuracy of the data mining results, the Data Preparation process must be addressed before the Data Mining process as explained in the earlier topic.

The following diagram depicts generic 3-tier architecture for Data Mining.

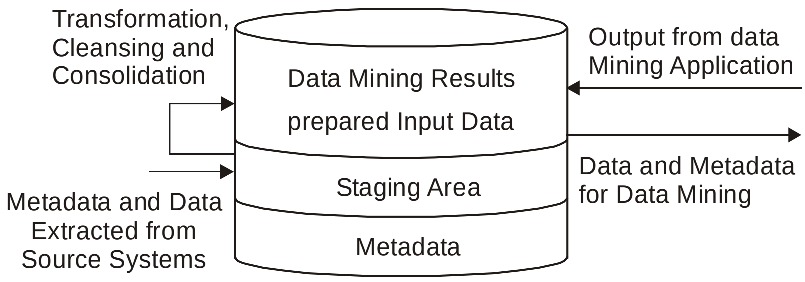


The first tier is the database tier where data and metadata is prepared and stored. The second tier is called Data Mining Application where the algorithms process the data and store the results in the database. The third tier is the Front-End layer, which facilitates the parameter settings for Data Mining Application and visualization of the results in interpretable form.

Database

It is not necessary that the Database tier is hosted on an RDBMS. It can be mixture of RDBMS and Files System or a file system only. E.g. the data from source systems may be staged on a files system and then loaded onto an RDBMS. The Database tier consists of various layers. The data in these layers interface with multiple systems based on the activities in which it participates. Following diagram represents various layers in the Database tier.

Metadata Layer



The Metadata layer is the common and most frequently used layer. It contains information about sources, transformations and cleansing rules and the Data Mining Results. It forms the backbone for the data in entire Data Mining Architecture.

Data Layer

This layer comprises of Staging Area, Prepared / Processed Data and Data Mining Results.

The Staging Area is used for temporarily holding the data sourced from various source systems. It can be held in any form e.g. flat files, tables in RDBMS. This data is transformed, cleansed, consolidated and loaded into a structured schema during Data Preparation process.

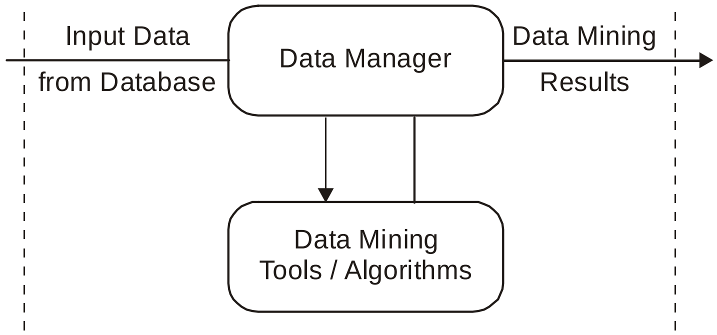
This prepared data is used as Input Data for Data Mining. The base data may undergo summarization or derivation based on the business case before it's presented to the Data Mining Application.

The Data Mining output can be captured in the Data Mining Results layer so that i can be made available to the users for visualization and analysis.

5.9.2 Data Mining Application

Data Mining Application has two primary components as shown in the figure.

- Data Manager
- Data Mining Tools / Algorithms



Data Manager

As the name suggests, this layer manages the data in the Database Tier and controls the data flow for data mining purpose. It has following functionality.

- **Manage Data Sets :** Classification of input data will be necessary for Building the Data Mining Model, Final Testing and Deployment tasks. The data manager layer will aid in dividing the data into multiple set so that it can be utilized during various stages of the Data Mining task. Same is the case with results of the Data Mining task, which might be utilized for further processing.

- **Input Data Flow :** The data need to be extracted from the database in the required format of the Data Mining task. Also the data flow needs to be controlled as per the Data Mining task requirements i.e. row by row or bulk load. The Data Mining task may also require data in specific format (like itemized data for Associations). A few transformation routines will be necessary to transform the data from Database tier into the required format as per the specifications. Another option of transforming the data at database can be considered.

- **Output Data Flow :** The results generated by the Data Mining task will need to be managed and facilitated to target systems (Front End or other systems like CRM) in required data format and data flow specifications.

The Data Manager layer needs to be portable depending on the database from which data has to be extracted and the Data Mining tool.

5.9.3 Data Mining Tools / Algorithms

This is the heart of the complete architecture. The Data Mining Tool will contain different tasks. The prime functionality of the task will be analyzing the data and generate the results. Various techniques / algorithms can be utilized depending upon the business case. These are described in the data mining techniques.

Numerous tools are available in the market to give best possible result as output e.g. SAS, SPSS, Teradata Miner and IBM Intelligent Miner. These tools merely facilitate the application of algorithms on the input data. But the most important task, which is always aligned to the specific business case, is setting the parameters for the algorithms and

Front End

Front End is the user interface layer. It has following prime functionalities.

1. Administration
2. Input Parameter Settings
3. Data Mining Results / Visualization

1. **Administration :** Administration screens for the ETL and Data Mining tasks are usually provided as a part of the products / tools. These are utilized to administer the following primary tasks
   - Data flow processes (e.g. Extracts, Loads)
   - Data Mining routines
   - Error reporting and correction is also handled through the administration screens.
   - User security settings
2. **Input Parameter Settings :** During the Data Mining Model build, iterations are inevitable. These iterations are needed to fine-tune the model by changing various parameters involved in the model. For executing a Data Mining task, the user needs to provide respective input parameters. Then observe the effect on the results and change the parameters if needed based on the interpretation and understanding of the results. This facility is provided in the Front End.

3. **Data Mining Results :** The results of the data mining task need formatting, conversion to user understandable form and reporting to the user. The front-end caters to the predefined formats of the out files generated by the respective Data Mining technique. The user will have the flexibility to view and analyze the results of Data Mining. Reporting utility performs the job of displaying the report, charts and smart reports (e.g. Clusters, Trees, and Networks).

5.10 ONLINE TRANSACTION PROCESSING SYSTEMS (OLTP)

Online Transaction Processing Systems (OLTP) are transactional systems that perform the day to day business operations. In other words, OLTP are the automated day to day business processes. In the world of DWH, they are usually one of the types of source system from where the day to day business transactional data is extracted. OLTP systems contain the current valued business data that is updated based on business transactions.

1. Legacy Systems

Legacy system is the term given to a system having very large storage capabilities. Mainframes and AS400 are the two examples of legacy systems. Applications running on legacy systems are generally OLTP systems. Due to their large storage capabilities the business transactional data from legacy applications and other OLTP systems is stored on them and maintained for a long period of time. In the world of DWH, legacy systems are often used to extract past historical business data.

2. Data Profiling

This is a very important activity mostly performed while collecting the requirements and the system study. Data Profiling is a process that familiarizes you with the data you will be loading into the warehouse/mart.

In the most basic form, data profiling process would read the source data and report on the Type of data – Whether data is Numeric, Text, Date etc.

Data statistics – Minimum and maximum values, most occurred value. Data Anomalies like Junk values, incorrect business codes, invalid characters, values outside a given range.

Using data profiling we can validate business requirements with respect to business codes and attributes present in the sources, define exceptional cases when we get incorrect or inconsistent data.

A lot of Data Profiling tools are available in the market. Some examples are Trillium Software and IBM Websphere Data Integrator's Profile Stage.

In the simplest form of data profiling, we can even hand code (programming) data profile application specific to projects. Programming languages like PERL, Java, PLSQL and Shell Scripting can be very handy in creating these applications.

5.11 TECHNIQUES USE IN MINE DATA

With the popularity of data mining growing at a lightning-fast pace, the cadre of new and innovative techniques to mine the warehouse data is exploding as well. Many of the new techniques are refinements of previous methods, although some can truly be classified as major innovations. Because of a lack of standardization across vendors, however, innovations in data mining are often limited to a particular vendor platform and, thus, cannot be used across the board to advance the state of the art.

Rather than concentrate on vendor-specific techniques and mining methods, we will focus on devel-oping an understanding of the basic categories of mining techniques currently in use. Regardless of the specific technique, data mining methods may be classified by the function they perform or by their class of application.

Using this approach, four major categories of processing algorithms and rule approaches emerge:

1) Classification
2) Association,
3) Sequence, and
4) Cluster.

1. Classsification

The classification approach includes mining processes intended to discover rules that define whether an item or event belongs to a particular subset or class of data. This category of techniques is probably the most broadly applicable to different types of business problems. The technique involves two subprocesses: (1) building a model, and (2) predicting classifications.

Generally speaking, classification methods develop a model composed of common IF-THEN rules. Because the idea is to gain insight into probable members of a class, the standard approach to determining whether a specific rule is satisfied is relaxed to allow for three possible conditions and, thus, three possible subclasses:

a. **Exact rule.** Permits no exceptions—that is, each IF object is an exact element of the THEN class. This approach creates the highest probability class of members: 100 percent probability.

b. **Strong rule.** Some exceptions allowed but an acceptable range of exceptions is prescribed. This approach creates a subclass of strong probability members: 90 to 100 percent probability.

c. **Probabilistic rule.** Relates the conditional probability P(THENIIF) to the proba-bility /'(THEN). This approach creates a measured probability subclass of mem-bers: *x* percent probability.

2. Association

Techniques that employ association or linkage analysis search all details or trans-actions from operational systems for patterns with a high probability of repetition. This approach results in the development of an associative algorithm that correlates one set of events or items with another set of events or items.

Patterns derived from the algo-rithm are generally expressed as, for example, "Eighty-three percent of all records that contain items A, B. and C also contain items D and E." The specific percentage sup-plied by the associative algorithm is referred to as the confidence factor of the rule. Associations can involve any number of items on either side of the rule.

3. Sequence

Sequencing or time series analysis methods relate events in time, such as the prediction of interest rate fluctuations or stock performance, based on a series of preceding events. Through this analysis, various hidden trends, often highly predictive of future events, can be discovered.

Common applications of sequence analysis methods can be found in the direct mail industry. Sequences are often analyzed as they relate to a specific customer or group of customers. Using this information, a catalog containing specific product types can be target mailed to a customer associated with a known sequence of purchases.

For example, a known buying sequence might be that parents tend to buy promotional toys associated with a particular movie within two weeks after renting the movie. This sequence would suggest that a flyer campaign for promotional toys should be linked to customer lists created as a result of movie rentals.

Another sequential pattern might be the determination of a set of purchases that frequently precedes the purchase of a microwave oven. By monitoring buying patterns of customers, particularly using credit card transactions, highly targeted mailing lists can be generated to focus promotions and marketing campaigns on those customers most likely to be persuaded to buy.

4. Cluster

In some cases, it is difficult or impossible to define the parameters of a class of data to be analyzed. When parameters are elusive, clustering methods can be used to create parti-tions so that all members of each set are similar according to some metric or set of met-rics.

A cluster is simply a set of objects grouped together by virtue of their similarity or proximity to each other. For instance, a clustering approach might be used to mine credit card purchase data to discover that meals charged on a business-issued gold card are typically purchased on weekdays and have a mean value of greater than $250, whereas meals purchased using a personal platinum card occur predominately on weekends, have a mean value of $175, and include a bottle of wine more than 65 percent of the time.

Clustering processes can be based on a particular event, such as the cancellation of a credit card by a customer. By analyzing the characteristics of members of this class, clustering might derive certain rules that could assist the credit card issuer in reducing the number of card cancellations in the future.

Data Mining Technologies

By now you should begin to realize the potential power of data mining with regard to providing new answers to old questions and to the development of new knowledge and understanding through discovery.

Unlimited types of questions can be asked and answered. Numerous techniques are available to assist in mining the data, along with numerous technologies for building the mining models. Most of these technologies are covered in greater detail in other chapters, but for purposes of continuity, they are mentioned briefly again here.

1. Statistical Analysis

Statistical analysis, despite requiring specialized capabilities to truly grasp all its impor-tance, is the most mature of all data mining technologies and is the easiest to under-stand. If 69 percent of people who purchase product *X* using a credit card also pur-chase product *Y*, and product *Y* never sells independently, then it is relatively easy to build a model predicting product *Y* sales with an accuracy of 69 percent. Of greater interest, of course, is to be able to predict the sales of product *X*.

At this point, the traditional statistical analysis methods and data mining methods begin to diverge.

Traditional statistical modeling techniques such as regression analysis are fine for building linear models that describe predictable data points; however, com-plex data patterns are often not linear in nature. Further, traditional statistical methods can frequently be negatively affected or problematic if the data are not well described by a linear model or if the data set contains a large number of outliers.

Data mining requires the use of statistical techniques—which are beyond the scope of the discussion in this text—that are capable of accommodating the conditions of nonlinearity, multi-ple outliers, and nonnumerical data typically found in a data warehouse environment.

2. Neural Networks, Genetic Algorithms, and Fuzzy Logic

By studying combinations of variables and how different combinations affect data sets, it is possible to develop nonlinear predictive models that "learn." Machine learning techniques, such as genetic algorithms and fuzzy logic, can derive meaning from complicated and imprecise data and can extract patterns from and detect trends within the data that are far too complex to be noticed by either humans or more con-ventional automated analysis techniques. Because of this ability, neural computing and machine learning technologies demonstrate broad applicability to the world of data mining and, thus, to a wide variety of complex business problems.

3. Decision Trees

In a simple decision tree involv-ing the performance of an activity indoors or outdoors, if “indoors” is selected from the initial choice set, then the next decision will more likely be “upstairs/downstairs” rather than “sun/shade.” By continually breaking data sets into separate, smaller groups, a predictive model can be built. Decision trees used in data mining applications assist in the classification of items or events contained within the warehouse.

This analysis, using Poly Analyst’s Decision Trees exploration algorithm, determined what attributes influence the percentage of passengers flying in the first-class section. The analysis helped predict the optimal per-centage of first-class seats for each flight, thus allowing Saudi Arabian Airlines to maxi-mize revenue and increase customer satisfaction levels.

5.12 DATA MINING TECHNIQUES

Neural Networks/Pattern Recognition - Neural Networks are used in a black box fashion. One creates a test data set, lets the neural network learn patterns based on known outcomes, then sets the neural network loose on huge amounts of data.

For example, a credit card company has 3,000 records, 100 of which are known fraud records. The data set updates the neural network to make sure it knows the difference between the fraud records and the legitimate ones. The network learns the patterns of the fraud records.

Then the network is run against company’s million record data set and the network spits out the records with patterns the same or similar to the fraud records. Neural networks are known for not being very helpful in teaching analysts about the data, just finding patterns that match. Neural networks have been used for optical character recognition to help the Post Office automate the delivery process without having to use humans to read addresses.

1. Memory Based Reasoning

This technique has results similar to neural network but goes about it differently. MBR looks for "neighbor" kind of data, rather than patterns. If you look at insurance claims and want to know which the adjudicators should look at and which they can just let go through the system, you would set up a set of claims you want adjudicated and let the technique find similar claims.

2. Cluster Detection/Market Basket Analysis

This is where the classic beer/diapers bought together analysis came from. It finds groupings. Basically, this technique finds relationships in product or customer or wherever you want to find associations in data.

3. Link Analysis

This is another technique for associating like records. Not used too much, but there are some tools created just for this. As the name suggests, the technique tries to find links, either in customers, transactions, etc. and demonstrate those links.

4. Visualization

This technique helps users understand their data. Visualization makes the bridge from text based to graphical presentation. Such things as decision tree, rule, cluster and pattern visualization help users see data relationships rather than read about them. Many of the stronger data mining programs have made strides in improving their visual content over the past few years.

This is really the vision of the future of data mining and analysis. Data volumes have grown to such huge levels, it is going to be impossible for humans to process it by any text-based method effectively, soon.

We will probably see an approach to data mining using visualization appear that will be something like Microsoft's Photosynth. The technology is there, it will just take an analyst with some vision to sit down and put it together.

5. Decision Tree/Rule Induction

Decision trees use real data mining algorithms. Decision trees help with classification and spit out information that is very descriptive, helping users to understand their data. A decision tree process will generate the rules followed in a process.

For example, a lender at a bank goes through a set of rules when approving a loan. Based on the loan data a bank has, the outcomes of the loans (default or paid), and limits of acceptable levels of default, the decision tree can set up the guidelines for the lending institution. These decision trees are very similar to the first decision support (or expert) systems.

6. Genetic Algorithms

GAs are techniques that act like bacteria growing in a petri dish. You set up a data set then give the GA ability to do different things for whether a direction or outcome is favorable. The GA will move in a direction that will hopefully optimize the final result. GAs are used mostly for process optimization, such as scheduling, workflow, batching, and process re-engineering.

Think of GA as simulations run over and over to find optimal results and the infrastructure around being able to both run the simulations and the ways to set up which results are optimal.

7. OLAP – Online Analytical Processing

OLAP allows users to browse data following logical questions about the data. OLAP generally includes the ability to drill down into data, moving from highly summarized views of data into more detailed views. This is generally achieved by moving along hierarchies of data. For example, if one were analyzing populations, one could start with the most populous continent, then drill down to the most populous country, then to the state level, then to the city level, then to the neighborhood level.

OLAP also includes browsing up hierarchies (drill up), across different dimensions of data (drill across), and many other advanced techniques for browsing data, such as automatic time variation when drilling up or down time hierarchies. OLAP is by far the most implemented and used technique. It is also generally the most intuitive and easy to use.

5.13 DATA MINING USES

1. Classification

This means getting to know your data. If you can categorize, classify, and/or codify your data, you can place it into chunks that are manageable by a human. Rather than dealing with 3.5 million merchants at a credit card company, if we could classify them into 100 or 150 different classifications that were virtually dead on for each merchant, a few employees could manage the relationships rather than needing a sales and service force to deal with each customer individually.

Likewise, at a university, if an alumni group treats its donors according to their classifications, part-time students might be the representatives who work with minor donors and full-time professionals might receive incoming calls from the donors whose names appear on buildings on campus.

2. Estimation

This process is useful in just about every facet of business. From finance to marketing to sales, the better you can estimate your expenses, product mix optimization, or potential customer value, the better off you will be. This and the next use are fairly self-evident if you have ever spent a day at a business.

3. Prediction

Forecasting, like estimation, is ubiquitous in business. Accurate prediction can reduce inventory levels (costs), optimize sales, blah, blah, blah. If you can predict the future, you will rule the world. Affinity Grouping/Market Basket Analysis - This is a use that marketing loves.

Product placement within a store can be set up based on sales maximization when you know what people buy together. There are several schools of thought on how to do it. For example, you know people buy paint and paint brushes together.

One, do you make a sale on paint then jack up the prices on brushes, two do you put the paint in aisle 1 and the brushes in aisle 7 hoping that people walking from one to the other will see something else they will need, three do you set cheap stuff on the end of the aisle for everyone to see hoping they will buy it on impulse knowing they will need something else with that impulse buy. As you can see, knowing what people buy together has serious benefits for the retail world.

4. Clustering / Target Marketing

Target marketing saves millions of dollars in wasted coupons, promotions, etc. If you send your promo to only the most likely to accept the offer, use the coupon, or buy your product, you will be much better served. If you sell acne medication, sending coupons to people over sixty is usually a waste of your marketing dollars.

If, however, you can cluster your customers and know which households have a 75% chance of having a teenager, you are pushing your marketing on a group most likely to buy your product.

5. Description

Very similar to classification, but geared more toward explanation. Classification may put more women as candidates for breast cancer, while description will point out the reasons why that classification is the way it is. Users who deal with demographics are often concerned with description.

Information services, for example, both classifies and describes. They need to classify for obvious reasons. They need to describe so they can make their money. If they can tell a major manufacturer why advertising one way versus another will be more effective, that manufacturer is more likely to buy their services.

5.14 LIMITATIONS OF DATA MINING

While data mining products can be very powerful tools, they are not self-sufficient applications. To be successful, data mining requires skilled technical and analytical specialists who can structure the analysis and interpret the output that is created. Consequently, the limitations of data mining are primarily data or personnel related, rather than technology-related.

Although data mining can help reveal patterns and relationships, it does not tell the user the value or significance of these patterns. These types of determinations must be made by the user. Similarly, the validity of the patterns discovered is dependent on how they compare to "real world" circumstances.

For example, to assess the validity of a data mining application designed to identify potential terrorist suspects in a large pool of individuals, the user may test the model using data that includes information about known terrorists. However, while possibly re-affirming a particular profile, it does not necessarily mean that the application will identify a suspect whose behavior significantly deviates from the original model.

Another limitation of data mining is that while it can identify connections between behaviors and/or variables, it does not necessarily identify a causal relationship.

For example, an application may identify that a pattern of behavior, such as the propensity to purchase airline tickets just shortly before the flight is scheduled to depart, is related to characteristics such as income, level of education, and Internet use. However, that does not necessarily indicate that the ticket purchasing behavior is caused by one or more of these variables.

In fact, the individual's behavior could be affected by some additional variable(s) such as occupation (the need to make trips on short notice), family status (a sick relative needing care), or a hobby (taking advantage of last minute discounts to visit new destinations)

5.15 DATA VISUALIZATION

Data visualization is the study of the visual representation of data, meaning "information which has been abstracted in some schematic form, including attributes or variables for the units of information".

According to Friedman the "main goal of data visualization is to communicate information clearly and effectively through graphical means. It doesn't mean that data visualization needs to look boring to be functional or extremely sophisticated to look beautiful.

To convey ideas effectively, both aesthetic form and functionality need to go hand in hand, providing insights into a rather sparse and complex data set by communicating its key-aspects in a more intuitive way. Yet designers often fail to achieve a balance between design and function, creating gorgeous data visualizations which fail to serve their main purpose — to communicate information".

Data visualization is closely related to Information graphics, Information visualization, Scientific visualization and Statistical graphics. In the new millennium data visualization has become active area of research, teaching and development. According to Post et al (2002) it has united the field of scientific and information visualization".

KPI Library has developed the "Periodic Table of Visualization Methods", an interactive chart displaying various different data visualization methods. It details 6 types of data visualization methods: data, information, concept, strategy, metaphor and compound.

Data Visualization Scope

There are different approaches on the scope of data visualization. One common focus is on information presentation such as Friedman (2008) presented it. On this way Friendly (2008) presumes two main parts of data visualization: statistical graphics, and thematic cartography. In this line the "Data Visualization: Modern Approaches" article gives an overview of seven subjects of data visualization :

- Mindmaps
- Displaying news
- Displaying data
- Displaying connections
- Displaying websites
- Articles & resources
- Tools and services

All these subjects are all close related to graphic design and information representation. On the other hand, from a computer science perspective, Frits H. Post (2002) categorized the field into a number of sub-fields.:

- Visualization algorithms and techniques
- Volume visualization
- Information visualization
- Multire solution methods
- Modelling techniques and
- Interaction techniques and architectures.

5.16 DIFFERENCE BETWEEN DATA MINING AND DATA WAREHOUSING

Data Mining provides the Enterprise with intelligence and Data Warehousing provides the Enterprise with a memory.

Data warehousing is the process that is used to integrate and combine data from multiple sources and format into a single unified schema. So it provides the enterprise with a storage mechanism for its huge amount of data.

On the other hand, Data mining is the process of extracting interesting patterns and knowledge from huge amount of data. So we can apply data mining techniques on the data warehouse of an enterprise to discover useful patterns.

SHORT NOTES

UNIT - I

1) Definition of DSS

A decision support systems (DSS) is a computer-based information system that supports business or organizational decision-making activities. DSSs serve the management, operations, and planning levels of an organization and help to make decisions, which may be rapidly changing and not easily specified in advance.

2) Decision-making

Decision-making is the process of sufficiently reducing uncertainty and doubt about alternatives to allow a reasonable choice to be made from among them.

3) Decision Support System

Decision Support Systems (DSS) are a specific class of computerized information system that supports business and organizational decision-making activities.

4) Group Decision Making

Group decision making is a situation faced when people are brought together to solve problems in the anticipation that they are more effective than individuals under the idea of synergy. But cohesive groups display risky behavior in decision making situations that led to the devotion of much effort, especially in the area of applied social sciences and other relevant fields of specialization.

5) Benefits of DSS

Some of the important DSS usage patterns:

i) Improving Personal Efficiency

ii) Improving Problem Solving

iii) Facilitating Communications

iv) Promoting Learning or Training

v) Increasing Organizational Control

6) Types of Decisions

Main types of decisions include,

i) Programmed Decisions: Programmed decision is one that is made repeatedly, on a routine basis, according to pre-established set of alternatives.

ii) **Non-Programmed Decisions:** Non-programmed decision is one that is new and unique for the decision maker, a decision made in a poorly structured situation one in which there are no preexisting, ready-made courses of action.

7) Characteristics of DSS

- Must assess data from a variety of sources.
- Must allow users to transform the enormous amount of data into information.
- Must provide a good user interface through which users can easily navigate and interact

8) Components of Generic Framework for DSS

Some important compoenents of Generic Framework for DSS:

i) Language System

ii) Presentation System

iii) Knowledge System

iv) Problem- Processing System

9) Types of DSS in Extended Framework

Main types of DSS included in Extended Framework include,

i) Communications-Driven DSS

ii) Data-Driven DSS

iii) Document-Driven DSS

iv) Knowledge-Driven DSS

v) Model-Driven DSS

10) Types of Decision Support Systems

Types of DSS include,

i) File Drawer Systems

ii) Data Analysis Systems

iii) Analysis Information Systems

iv) Accounting Models

v) Representational Models

vi) Optimization Models

vii) Suggestion Models

11) Individual Decision Support Systems

Certain DSS are used by individuals making individual decisions. A.marketing manager deciding on next year's ad budget is in that situation. This person wants to pick the ideal advertising budget for his or her firm. The final decisions is made by the Marketing Manager alone, though people in that type of situation ofter discuss options with colleagues and seek their advice.

12) Applications of DSS

- Strategic Planning
- Market Planning and Research
- Operations Planning
- Logistics Planning
- Sales Support

UNIT - II

1) DSS Architecture

Information system architecture is a high-level concept. The architecture does not specify that a Compaq Model XYZ will be installed in each purchasing agent's office, that the manufacturing local area network (LAN) will support 17 users, or that a market planning model will become operational in June 2002. The following definition of an information systems architecture, from [MART91], ap-plies well to DSS :

2) Specialized DSS Tools

The major categories of specialized software used to assist DSS development are

i) Database Management packages,

ii) Information retrieval (query and reporting) packages,

iii) Specialized modeling packages (including spreadsheets) and languages,

iv) Statistical data analysis packages

v) Forecasting packages,

vi) Graphing packages.

3) Approaches to Development of DSS

Three approaches to information system development are commonly used :

1. The traditional system development life cycle (SDLC) approach.
2. The prototyping approach, with two major variations.
3. End-user development, often with professional support.

4) Steps in SDLC

SDLC approach is based on a series of formal seven steps:

i) Confirm user requirements;

ii) Systems analysis;

iii) System design;

iv) Programming;

v) Testing;

vi) Implementation; and

vii) Use and evaluation.

5) Steps in Rapid Prototyping

A typical prototyping methodology usually includes five steps:

i) Identify user requirements.

ii) Develop and test a first iteration DSS prototype.

iii) Create the next iteration DSS prototype.

iv) Test the DSS prototype and return to step (iii) if needed.

v) Pilot testing, phased or full-scale implementation

6) SDLC

Refers to a methodology for developing systems. It provides a consistent framework of tasks and deliverables needed to develop systems. The SDLC methodology may be condensed to include only those activities appropriate for a particular project, whether the system is automated or manual, whether it is a new system, or an enhancement to existing systems.

7) Types of DSS Models

List of DSS mode'

i) Graphical Modei

ii) Narrative Model

iii) Physical Model

iv) Symbolic Model

v) Information-Based Model

vi) Mathematical Model

8) Ways to Obtain DSS Software

There are four fundamental ways to obtain any software capability and they are as follows:

i) To purchase a turnkey package,

ii) To customize a package,

iii) To use specialized tools or "generators" designed for the task at hand,

iv) To write the necessary programs from scratch.

9) Spiral Model

The spiral model emphasizes the need to go back and reiterate earlier stages a number of times as the project progresses. It's actually a series of short waterfall cycles, each producing an early prototype representing a part of the entire project. This approach helps demonstrate a proof of concept early in the cycle, and it more accurately reflects the disorderly, even chaotic evolution of technology.

10) Incremental Model

The incremental model divides the product into builds, where sections of the project are created and tested separately. This approach will likely find errors in user requirements quickly, since user feedback is solicited for each stage and because code is tested sooner after it's written.

11) DSS Implementation

Development process for decision support systems, so far has taken us to the point of a working program - If the proper inputs go in, the proper outputs will come out. A working program - even a working system - is not the end of the process, however, unless its developer is to be its only user. The program or system has to be rolled-out to its user community. This part of the system lifecycle is called implementation.

12) DSS Platforms

DSS can run on several .ypes of platforms which are as follows:

i) Central corporate system.

ii) Separate svstei that obtains data from the central system and provides it to users, again usually over a network.

iii) Freestanding system at the user's desk.

iv) Combination of above.

UNIT - III

1) Group Decision Making

Group decision making is a type of participatory process in which multiple individuals acting collectively, analyze problems or situations, consider and evaluate alternative courses of action, and select from among the alternatives a solution or solutions. The number of people involved in group decision-making varies greatly, but often ranges from two to seven.

2) Group Decision-Making Process

Following are steps in Decision-Making Process

i) Implement the Solution

ii) Evaluate Options and Select Best One

iii) Brainstorm Potential Solutions

iv) Establish Criteria

v) Analyze the issue under discussion

vi) Identify the Decision to be Made

3) Multi participant Decision Making(MDM)

The MDM is a common and growing reality. Diverse modern business structures such as virtual companies, the strategic alliances, the "cooperation-competence" relations, and the new philosophies and management modes require forms, methodologies, and techniques applied to the decisions that surpass space and time limitations.

4) Multi participant Decision Maker

In contrast, a decision-maker's knowledge assets and processing skills can be distributed across multiple participants jointly engaged in the process that leads to a decision. Collectively, the multiple participants tend to has greater knowledge assets and greater knowledge-processing skills than a single-participant decision-maker.

5) Wheel Network

In a wheel network, each participant can communicate with the decision-maker at the center but cannot interact with any of the other participants. The decision-maker can communicate with any or all participants depending upon his or her specific needs.

6) Levels of MDM Support Technologies

MDM support technologies can be categories four basic levels as shown in figure below.

i) Organizational Decision Support System(ODSS)

ii) Group support system(GSS')

iii) Group decision support system(GDSS)

iv) Decision Support System(DSS)

7) Characteristics of ODSS

The major characteristics of an ODSS are:

i) It affects several organizational units or corporate problems,

ii) It cuts across organizational functions or hierarchical layers, and

iii) It involves computer-based technologies and usually also communications technologies.

8) Group Decision Support System (GDSS).

A collective of computer-based technolo-gies specifically designed to support the activities and processes related to multi- participant decision making.p decision-making settings.

9) Groupware

The term *groupware* refers to a particular type of MDM support technology specifi-cally focused on issues related to collaborative processes among people. In one sense, groupware is people. It is a tool that, when deployed and used appropriately, positively affects the way people communicate with each other, resulting in improvements in the way people work and the decisions people make.

10) Intelligent Agent Systems

The final class of groupware technology employs some form of artificial intelligence to carry-out a series of steps associated with a particular task. Functions available through intelligent agent systems range from a simple filter that determines the appropriate electronic filing folder for a new e-mail message to more complex "personal assistants" that can schedule meetings, forward messages, or perform background tasks associated with MDM processes.

11) Distributed Decision

In contrast to group decision made by a set of actors who work together to achieve a common purpose, there are many situations in decentralized organizations where decisions are made and implemented by various interrelated decision making units. These decisions typically require communication and coordination among the organizational units involved in the decision task, so called distributed decision.

12) Distributed Decision Support System

A distributed decision support system is a collection of devices or services that are organized in a dynamic, unreliable and unpredictable network of hardware and software entities working co-operatively for a common decision support purpose.

13) Executive Information System

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).

14) Hardware Components of EIS

Some of the hardware included in EIS are:

i) Input data-entry devices.

ii) The central processing unit (CPU).

iii) Data storage files.

iv) Output Devices.

15) Software Components of EIS

Some of the software included in EIS are:

i) Text base software.

ii) Database.

iii) Graphic base.

iv) Model base.

v) Interface.

vi) Telecommunication.

16) Disadvantages of EIS

- System Dependent
- Limited Functionality, By Design
- Information Overload For Some Managers
- Benefits Hard To Quantify
- High Implementation Costs
- System May Become Slow, Large, And Hard To Manage
- Need Good Internal Processes For Data Management
- May Lead To Less Reliable And Less Secure Data

UNIT - IV

1 Artificial intelligence (AI)

Artificial intelligence (AI) is the intelligence of machines and the branch of computer science that aims to create it. AI textbooks define the field as "the study and design of intelligent agents" where an intelligent agent is a system that perceives its environment and takes actions that maximize its chances of success.

2) Attributes of Intelligent Behavior

Some of important attributes of intelligent behavior include,

i) Think and reason.

ii) Use reason to solve problems.

iii) Learn or understand from experience.

iv) Acquire and apply knowledge.

v) Exhibit creativity and imagination.

3. Features of Expert System

Some of important features include,

i) High-Level Expertise

ii) Predictive Modeling Power

iii) Institutional Memory

iv) Ability to Provide a Training Facility

4. Components of Expert Systems

Main components of Experts Systems include,

i) Knowledge acquisition subsystem,

ii) Knowledge Base

iii) Inference Engine

iv) User Interface

v) Blackboard (workplace),

vi) Explanation subsystem (justifier), and

vii) Knowledge-refining system.

5. Benefits of an Expert System

- Capture expertise before it is lost
- Reduce dependence upon one expert
- Reduce / eliminate error and inconsistency
- Allow non-experts to reach scientifically supportable conclusions
- Knowledge sharing

6. Types of Intelligent Software Agents

Types of Intelligent Software Agents

i) Directed-Action Agents

ii) Reasoned-Action Agents

iii) Learned-Action Agents

7. Medical Expert System

The basic tasks that are carried out by the medical expert system is diagnosis, prognosis, treatment, monitoring. In terms of treatment, the patient or the physician could access the system through internet. The feedback is sent to the user through internet so that the treatment can be performed. Expert must also access this system, to update the data stored in the knowledge base.

8. Visual Perception Problem

In AI, the process of perception is studied as a set of operations. A visual scene may be encoded by sensors and represented as matrix of intensity values. These are processed by detectors that search for primitive picture components like line segments, simple curves, corners, etc. These in turn are processed to infer information regarding the objects in the scene. The ultimate aim is to represent the scene by a suitable model. This model may be a high level description of the scene like a hill with a tree on top.

9. Case-Based Reasoning

Case-based reasoning is built on the premise that humans use an analogical or experiential reasoning approach to learn and to solve complex problems. The idea, much like its human counterpart, is to adapt solutions of similar problems to the problem at hand. Case-based reasoning is most useful in knowledge domains where precedence-based reasoning is appropriate.

UNIT - V

1. Data Warehouse

Data from different data sources is stored in a relational database for end use analysis. Data from different data sources is stored in a relational database for end use analysis Data is organized in summarized, aggregated, subject oriented, non volatile patterns. Data in a data warehouse is consolidated, flexible collection of data, Supports analysis of data but does not support online analysis of data.

2. Characteristics of a Data Warehouse

So far we established the reasons why data warehousing is an important innovation in decision support, and we formally defined the DW to be

1. Subject oriented
2. Data integrated
3. Time variant
4. Nonvolatile

3. Data Warehousing

'Data warehousing' is a collection of decision support technologies that enable the knowledge worker, the statistician, the business manager and the executive in processing the information contained in a data warehouse meaningfully and make well informed decisions based on outputs.

4. Principles of Data Warehousing.

Data warehouse basic principle include:

i) Load Performance.

ii) Load Processing.

iii) Data Quality Management.

iv) Query Performance.

v) Terabyte Scalability.

5. Advantages of Data Warehousing.

Some advantages of data warehousing include:

i) One consistent data store for reporting, forecasting, and analysis.

ii) Easier and timely access to data.

iii) Improved end-user productivity.

iv) Improved IS productivity.

v) Reduced costs.

6. Disadvantages of Data Warehousing

Some disadvantages of data warehousing include:

i) Installation Cost.

ii) Time-Taking.

iii) Change Resistance.

iv) Specific Skills Required.

v) Complex.

vi) Management Acceptance.

xii) Security Issues.

7. ROLAP.

A relational OLAP (ROLAP) model, that is, an extended relational DBMS that maps operations on multidimensional data to standard relational operations;

8. MOLAP.

A multidimensional OLAP (MOLAP) model, that is, a special-purpose server that directly implements multidimensional data and operations.

9. Data Mart

A data mart is a repository of data gathered from operational data and other sources that is designed to serve a particular community of knowledge workers. In scope, the data may derive from an enterprise-wide database or data warehouse or be more specialized. The emphasis of a data mart is on meeting the specific demands of a particular group of knowledge users in terms of analysis, content, present.

10. Data Warehouse Database.

The central data warehouse database is a corner stone of the data warehouse environment. Certain data warehouse attribute such as very large database size, ad hoc query processing and the need for flexible user view creation including aggregates multi-table joins and drill down have become drivers for different technological approaches to data warehouse database.

11. Data Stores.

A Data Store (DS) is a subject-oriented database that contains structured data generated directly from transaction data sources. Usually, it will contain very little summarized and historical data. DS is stored independently of the production system database. It contains current, or near current, data extracted from transaction systems. The objective of a DS is to meet the ad hoc query, tactical day-to-day, heeds of operational users.

12. Meta Data.

Meta data is most commonly defined as "data about data". A repository is a place where this data is managed and maintained.

13. Types of Meta-Data.

Two main types of meta data include:

i) **Technical:** If any meta data is captured by your organization, it will likely be this category. Examples of technical meta data include table names, column types and sizes, indexes and system names.

ii) **Business:** A layer of meta data that we should gather and keep in repositories has to do with the business- related aspects of the data being stored and processed in the warehouse. Example include p_id.

14. Legacy Systems

Legacy system is the term given to a system having very large storage capabilities. Mainframes and AS400 are the two examples of legacy systems. Applications running on legacy systems are generally OLTP systems. Due to their large storage capabilities the business transactional data from legacy applications and other OLTP systems is stored on them and maintained for a long period of time. In the world of DWH, legacy systems are often used to extract past historical business data.

15. Data Mining Engine.

This is essential to the data mining system and ideally consists of a set of functional modules for tasks uch as characterization, association, classification, cluster analysis, and evolution and deviation analysis.

16. Clustering.

Clustering is a technique used for combining observed objects into groups or clusters such that:

i) Each group or cluster is homogeneous or compact with respect to certain characteristics. That is, objects in each group are similar to each other.

ii) Each group should be different from other groups with respect to the same characteristics; that is, objects of one group should be different from the objects of other groups.

17. Genetic Algorithm.

Genetic algorithms are particularly suitable for solving complex optimization problems and for applications that require adaptive problem-solving strategies. Genetic algorithms are search algorithms based on the mechanics of natural genetics, i.e., operations existing in nature. The advantage is that they can search complex and large amount of spaces efficiently and locate near-optimal solutions pretty rapidly.

18. Online Analytical Processing(OLAP).

The term Online Analytical Processing (OLAP) was coined by E.F. Codd in 1993 to refer to a type of application that allows a user interactively analyze data.

19. Online Transaction Processing(OLTP) Techniques.

Online transaction processing, or OLTP, refers to a class of systems that facilitate and manage transaction- oriented applications, typically for data entry and retrieval transaction processing. OLTP has also been used to refer to processing in which the system responds immediately to user requests.

20. Data visualization

Data visualization is the study of the visual representation of data, meaning "information which has been abstracted in some schematic form, including attributes or variables for the units of information".

21. Uses of Data Visualization.

Some of important uses of data visualization include,

i) Explorative Analysis: It means that involves data cleaning and provides hypotheses.

ii) Confirmative Analysis: Data visualization confirms or rejects hypotheses.

iii) Presentation: It helps to communicate work.

Objective Type

UNIT - I

Fill in the Blanks

1. An information system that help people make decisions is called _______.
2. The three phases of a decision-making process are _______ , _______ and _______.
3. The _______ phase finds, identifies and formulates the problem that needs a decision.
4. The end product of _______ phase is a decision.
5. In _______ decision all phases of a decision making processes are unstructured.
6. Three categories of decisions based on scope are strategic, tactical and _______.
7. A payroll system is an example of a _______ system.
8. A _______ represents a real system or object.
9. A decision support system in which a decision is made by a group of people is called _______ .
10. The three broader categories of DSS are data-oriented, model-oriented and _______.

ANSWERS

1. Decision support system
2. Intelligence, design, choice
3. Intelligence
4. Choice
5. Unstructured
6. Operational
7. Information
8. Model
9. Group DSS
10. Process oriented.

Choose the Correct Answers

1. In decision support system, a database is used for, [a]
   (a) Read-only
   (b) Write-only
   (c) Both
   (d) None
2. This phase of decision-making process develops alternatives, [b]
   (a) Intelligence
   (b) Design
   (c) Choice
   (d) None
3. This decision will affect the entire organization. [c]
   (a) Operational (b) Tactical
   (c) Strategic (d) None
4. Tactical decisions are made by these managers, [b]
   (a) Top-level (b) Middle-level
   (c) Low-level (d) None
5. Data warehouse is an example of this DSS, [c]
   (a) Model-oriented (b) Process-oriented
   (c) Data-oriented (d) None
6. These decisions are taken by low-level managers [a]
   (a) Operational (b) Tactical
   (c) Strategic (d) None
7. Most organizational decisions are of this type, [b]
   (a) Structured (b) Semistructured
   (c) Unstructured (d) None
8. An example of a structured operational decisions is, [a]
   (a) Accounts receivable (b) Production scheduling
   (c) Financial management (d) Building new plant.

9. There are ________ types of decisions. [c]
   (a) 7 (b) 8
   (c) 9 (d) 10
10. These decisions are made by top-level managers [c]
   (a) Operational (b) Tactical
   (c) Strategic (d) None.

UNIT - II

Fill in the Blank

1. ________ monitors the load of central system as new applications are developed and as the user community grows.
2. In a client/server computing ________ system acts as a data repository.
3. A client computer that relies on the server to perform the data processing is called ________.
4. A client computer that provides rich functionality independently of the central server is called ________.
5. A database that stores the data in two-dimensional table is called ________.
6. ________ is used to retrieve information from the relational database for decision support.
7. The three stages of a change process are unfreezing, ________ and refreezing.
8. ________ conversion strategy runs, both the old and the new systems and compare their results.
9. Two types of dynamic system models are continuous-system simulation model and ________.
10. A ________ is the description of the system usually in the form of a computer program.

ANSWERS

1. Capacity planners
2. Server
3. Thin client
4. Thick client

5. Relational database
6. Structured query language
7. Moving
8. Parallel conversion
9. Discrete-event model
10. Model

Choose the Correct Answer

1. The hardware platform of a central multiuser system is usually a ______. [c]
   (a) Microcomputer (b) Minicomputer
   (c) Mainframe (d) None
2. The database structure that provides more flexibility in the way different files are linked. [b]
   (a) Hierarchical (b) Network
   (c) Relational (d) Hybrid
3. The database that is mostly suitable for DSS. [c]
   (a) Hierarchical (b) Network
   (c) Relational (d) Hybrid
4. This is the factor(s) that effect the desired DSS user interface. [d]
   (a) Time (b) Versatility
   (c) Errors (d) All
5. The popular programming language used for DSS, [d]
   (a) First generation (b) Second generation
   (c) Third generation (d) Fourth generation
6. This is a high-risk conversion strategy, [a]
   (a) Direct conversion (b) Parallel conversion
   (c) Pilot conversion (d) Phased conversion

7. A model whose outputs are fixed for a given set of inputs. [c]
   (a) Static (b) Dynamic
   (c) Deterministic (d) Stochastic
8. The most common type of dynamic system model used in real DSS. [d]
   (a) Static system (b) Dynamic system
   (c) Continuous system (d) Discrete-event
9. This model changes the state of the system instantaneously, [d]
   (a) Static system (b) Dynamic system
   (c) Continuous system (d) Discrete event
10. It models the process that humans follow in making a decision about a system, [b]
   (a) System model (b) Process model
   (c) Deterministic model (d) Stochastic model.

UNIT - III

Fill in the Blanks

1. Group decision-making results in potential synergy associated with ________ activity.
2. MDM structure is characterized in terms of both the properties of ________ and of its ________
3. Team and committee structures are classified as ________.
4. The four types of communication networks are ________.
5. The factors used in determining decision structure include the degree of ________.
6. The basic levels of MDM technology are ________.
7. ________ system overcomes the asynchronous limitation of messaging system.
8. The abbreviation of MMDBMS is ________.
9. The three methods for determining executive information requirements are ________.
10. The advanced EIS applications include ________

ANSWERS

1. Collaborative
2. Set of entities, individual member
3. Non collaborative
4. Wheel, chain, circle, completely connected networks
5. Structuredness, participant motivation, potential conflict
6. ODSS, GSS, GDSS, DSS
7. Conferencing
8. Multimedia database
9. By-product, Null, CSF
10. Intelligent EIS, multimedia EIS, connected EIS, informed EIS

Choose the Correct Answers

1. Group MDM structure consists of [d]
   (a) Single decision maker with no participant interaction
   (b) Single decision maker with complete participant interaction
   (c) Multiple decision maker with no participant interaction
   (d) Multiple decision maker with complete participant interaction.

2. ________ network provides all members an equal opportunity for communication. [b]
   (a) Wheel network (b) Circle network
   (c) Chain network (d) Completely connected network.

3. In individual MDM structure ________ conditions apply in making decisions.[b]
   (a) High structuredness, high importance
   (b) Decision-maker expertise, high structuredness
   (c) Participant motivation, potential conflicts
   (d) Acceptance critical, acceptance probable.

4. Participant interaction tends to ________ as size increase. [b]
   (a) Increase (b) Decrease
   (c) Remain constant (d) None of the above.

5. _______ mechanism provide access to different techniques which assist the participants in filtering, organizing, combining and analyzing knowledge relevant to problem context. [d]

   (a) Process support (b) Process structure

   (c) Task support (d) Task structure.

6. The highest level of MDM system based on MDM technology classification is [d]

   (a) Electronic boardroom

   (b) Group network

   (c) Information centre

   (d) Decision room.

7. _______ system allows multiple participants to collaborate either synchronously or asynchronously while creating common document. [d]

   (a) Messaging system

   (b) GDSS

   (c) Coordination system

   (d) Collaborative authority system.

8. The three major component of EIS development framework are, [a]

   (a) Structure perspective, development process, user-system dialog

   (b) Hardware, software, MDM participants

   (c) Development process, critical success factors, key indicators

   (d) Resources, group network, user-system dialog.

9. _______ rganizational issue has potential negative impact on organization.[a]

   (a) Agenda and time biases

   (b) Cost

   (c) Technological issues

   (d) Size and conflicts.

10. _______ approach gathers information from sample of top executive in the organization while determining executive information needs. [c]

   (a) Key indicator (b) CSF

   (c) Total study (d) Nun

UNIT - IV

Fill in the blanks

1. ________ is a step-by-step procedure to solve the problem.
2. The mechanical learning capabilities of an AI system is called ________.
3. ________ expert system is used in the field of organic chemistry.
4. ________ expert system is used in the treatment of infectious diseases.
5. ________ expert system is used to produce art work.
6. The ability of an intelligent agent to control its own options is called ________.
7. Intelligence has ________ levels.
8. ________ performs the state change of the problem space.
9. The study of human reasoning processes is called ________.
10. The degree of autonomy given to an agent is called ________.

ANSWERS

1. Algorithm
2. Machine learning
3. Dendral
4. Mycin
5. AARON
6. Autonomy
7. 4
8. Operator
9. Cognitive Psychology
10. Agency

Choose the correct answers

1. ________ is not an expert system. [c]

   (a) Mycin (b) XCON

   (c) Mailbots (d) Teiresias.

2. Which among these is a characteristic of an artificial intelligence ? [a]

   (a) Inferencing (b) Dendral

   (c) Emycin (d) AARON.

3. Which among these is not a feature of intelligent agent ? [b]

   (a) Proactiveness (b) Symbolic processing

   (c) Mobility (d) Temporal continuity.

4. Web Watcher is a ________ agent. [d]

   (a) Learning agent (b) Search engine

   (c) Heuristic agent (d) Software agent.

5. ________ is not a component of an agent. [b]

   (a) Author (b) Learner

   (c) Subject description (d) Goal.

6. Which among these, is not a type of knowledge ? [c]

   (a) Inferential knowledge (b) Declarative knowledge

   (c) Affirmative knowledge (d) Procedural knowledge.

7. ________ agents perform tasks on behalf of their users. [a]

   (a) Personal (b) Public

   (c) Software (d) Organizational agent.

8. Which is not a characteristic of an intelligent agent ? [d]

   (a) Intelligence (b) Agency

   (c) Mobility (d) Symbolic processing.

9. E-mail agents are also known as . [b]

   (a) Watch Guard (b) Mailbots

   (c) Alertview (d) Inter AP.

10. ________ is a feature of expert system. [a]

   (a) Expertise (b) Mobility

   (c) Pattern recognition (d) Fuzzy logic.

UNIT - V

Fill in the Blanks

1. Data warehouse is a collection of ________ databases.
2. Operational data store performs ________ operations and data warehouse performs ________ activities.
3. Application messaging layer transmits information around ________
4. Virtual data warehouse is also known as ________
5. The three types of metadata are ________
6. Data warehouse architecture consists of ________ layers.
7. ________ is the process of converting numerical data into meaningful images.
8. The components of spatial data are ________
9. The specific approaches for conducting OCAP analysis are ________
10. The technologies for developing mining models are ________

ANSWERS

1. Integrated, subject-oriented
2. Day-to-day, managerial
3. Enterprise computing network
4. Point-to-point
5. Operational, extraction and transformational, end-user metadata.
6. 8
7. Data visualization
8. Points, lines, polygons
9. ROLAP, MOLAP
10. Neural network, decision trees, statistical analysis.

Choose the Correct Answers

1. Data mart is ________ system. [c]
   - (a) Executive information system
   - (b) Geographical information system
   - (c) Decision support systems
   - (d) Transaction processing system.

2. Data warehouse has ________ level of granularity. [a]
   (a) Low (b) High
   (c) Detailed (d) Abstract.

3. The data in data warehouse is ________ [c]
   (a) More normalized (b) Less normalized
   (c) Not normalized (d) Simply normalized.

4. Data mining techniques include, [d]
   (a) Indexing, sequencing, classification, clustering
   (b) Clustering, integrating, classification, summarization
   (c) Transformation, loading, cleansing, sequencing
   (d) Classification, association, sequencing and clustering.

5. The data marts are built using, [d]
   (a) Top-down approach (b) Bottom-up approach
   (c) Hybrid approach (d) All the above.

6. An example of association rule mining include, [b]
   (a) Fraud analysis (b) Market-basket analysis
   (c) Stock analysis (d) Weather analysis.

7. Data warehousing topologies include, [c]
   (a) Enterprise, distributed, datamart (b) Central, virtual, metadata
   (c) Virtual, central, distributed (d) None of the above.

8. Data mart have structure. [d]
   (a) Join (b) Fast constellation
   (c) Normalized (d) Star join.

9. ________ layer focuses on scheduling the tasks. [c]
   (a) Application messaging layer (b) Data staging layer
   (c) Process management layer (d) Information access layer.

10. Operational data store provides ________ flexibility. [a]
   (a) Limited (b) High
   (c) Low (d) No.

FACULTY OF MANAGEMENT

M.B.A II - Semester Examination, August - 2015

DECISION SUPPORT SYSTEMS

Time : 3 Hours] **[Max. Marks : 80**

Note : Answer **all** the questions

SECTION - A **(10 × 2 = 20 Marks)**

1. Write short notes on :

   a) Need for DSS

   b) Types of Decisions

   c) Group decision making process

   d) Architecture for DSS

   e) EIS components

   f) Artificial Intelligence

   g) Strategic model

   h) Structure of ES

   i) Data warehousing

   i) On Line Transactions

SECTION - B **(5 × 12 = 60 Marks)**

2. a) Discuss the merits and demerits of Decision Support System.

   OR

   b) Explain a suitable framework for Decision Support System.

3. a) Discuss the relevant approaches for DSS development.

   OR

   b) Examine the significant models for DSS.

4. a) Discuss the problems involved in group decision making and suggest remedial measures.

OR

b) Explain the prospects of EIS in a modern business world.

5. a) Discuss the relative merits and demerits of Natural and Artificial intelligence system.

OR

b) Explain the process of building and designing the expert system in an organization.

6. a) Explain the general architecture for Data warehousing.

OR

b) Discuss the merits and limitations of Data Mining.

ANSWERS TO AUGUST - 2015

SECTION - A **(10 × 2 = 20 Marks)**

1. a) **Need for DSS**

Ans :

Refer to Topic No. 1.3, page no. 3, Unit - I

b) **Types of Decisions**

Ans :

Refer to Topic No. 1.6, page no. 9, Unit - I

c) **Group decision making process**

Ans :

Refer to Topic No. 1.11, page no. 17, Unit - I

d) **Architecture for DSS**

Ans :

Refer to Short Notes - 1, page no. 127, Unit - II

e) **EIS components**

Ans :

Refer to Short Notes - 13, page no. 132, Unit - III

f) **Artificial Intelligence**

Ans :

Refer to Short Notes - 1, page no. 134, Unit - IV

g) **Strategic model**

Ans :

Refer to Topic No. 2.6, page no. 38, Unit - II

h) **Structure of ES**

Ans :

Refer to Topic No. 4.5, page no. 78, Unit - IV

i) **Data warehousing**

Ans :

Refer to Topic No. 5.2, page no. 97, Unit - V

j) **On Line Transactions**

Ans :

Refer to Topic No. 5.10, page no. 113, Unit - V

SECTION - B **(5 × 12 = 60 Marks)**

2. a) Discuss the merits and demerits of Decision Support System.

Ans :

Refer to Topic No. 1.3, page no. 3, Unit - I

b) Explain a suitable framework for Decision Support System.

Ans :

Refer to Topic No. 1.7, page no. 12, Unit - I

3. a) Discuss the relevant approaches for DSS development.

Ans :

Refer to Topic No. 2.4, page no. 31, Unit - II

b) Examine the significant models for DSS.

Ans :

Refer to Topic No. 2.6, 2.7, page no. 38 to 39, Unit - II

4. a) Discuss the problems involved in group decision making and suggest remedial measures.

Ans :

Refer to Topic No. 3.2, page no. 47, Unit - III

b) Explain the prospects of EIS in a modern business world.

Ans :

Refer to Topic No. 3.10, page no. 65, Unit - III

5. a) Discuss the relative merits and demerits of Natural and Artificial intelligence system.

Ans :

Refer to Topic No. 4.1, 4.2, page no. 73 to 75, Unit - IV

b) Explain the process of building and designing the expert system in an organization.

Ans :

Refer to Topic No. 4.4, 4.6, page no. 77, 79, Unit - IV

6. a) Explain the general architecture for Data warehousing.

Ans :

Refer to Topic No. 5.7, page no. 100, Unit - V

b) Discuss the merits and limitations of Data Mining.

Ans :

Refer to Topic No. 5.13, 5.14, page no. 120, 122, Unit - V

FACULTY OF MANAGEMENT

M.B.A II - Semester Examination, April / May-2015

DECISION SUPPORT SYSTEMS

Time : 3 Hours] **[Max. Marks : 80**

Note : Answer **all** the questions

SECTION - A **(10 × 2 = 20 Marks)**

1. Write short notes on :

   a) State the need for DSS.

   b) What is Decision Making process ?

   c) State Hardware tools for DSS

   d) Essential Software tools for DSS

   e) What is MDM ?

   f) State EIS components

   g) What is AI ?

   h) What is ES ?

   i) What is Data Mining ?

   j) What is Online system ?

SECTION - B **(5 × 12 = 60 Marks)**

2. a) What is Decision support system and state its advantages in business operations.

OR

   b) Explain a framework for DSS in an organization with suitable examples.

3. a) Discuss the relevant approaches for the development of DSS Architecture.

OR

   b) Discuss various models for DSS and state its relative merits.

4. a) Discuss the problems involved in group decision making and how to overcome it.

OR

b) Explain the significance of Executive Decision making system in an organization.

5. a) Distinguish between Artificial and Natural Intelligence systems.

OR

b) How to design and build up the Expert system in a multinational company?

6. a) Discuss the significance of Data Warehousing system.

OR

b) Explain various techniques for Data Mining.

ANSWERS TO APRIL/MAY - 2015

SECTION - A **(10 × 2 = 20 Marks)**

1. Write short notes on :

a) State the need for DSS.

Ans :

Refer to Topic No. 1.3, page no. 3, Unit - I

b) What is Decision Making process ?

Ans :

Refer to Topic No. 1.5, page no. 6, Unit - I

c) State Hardware tools for DSS

Ans :

Refer to Topic No. 2.2, page no. 23, Unit - II

d) Essential Software tools for DSS

Ans :

Refer to Topic No. 2.3, page no. 26, Unit - I

e) What is MDM ?

Ans :

Refer to Short Notes. 13, page no. 131, Unit - III

f) State EIS components

Ans :

Refer to Short Notes - 13, page no. 132, Unit - III

g) What is AI ?

Ans :

Refer to Short Notes. 1, page no. 134, Unit - IV

h) What is ES ?

Ans :

Refer to Topic No. 4.4, page no. 77, Unit - IV

i) What is Data Mining ?

Ans :

Refer to Topic No. 5.9, page no. 108, Unit - V

j) What is Online system ?

Ans :

Refer to Short Notes - 19, page no. 139, Unit - V

SECTION - B (5 × 12 = 60 Marks)

2. a) What is Decision support system and state its advantages in business operations.

Ans :

Refer to Topic No. 1.2, 1.3, page no. 2, 3, Unit - I

b) Explain a framework for DSS in an organization with suitable examples.

Ans :

Refer to Topic No. 1.7, page no. 12, Unit - I

3. a) Discuss the relevant approaches for the development of DSS Architecture.

Ans :

Refer to Topic No. 2.4, page no. 31, Unit - II

b) Discuss various models for DSS and state its relative merits.

Ans :

Refer to Topic No. 2.6, page no. 38, Unit - II

4. a) Discuss the problems involved in group decision making and how to overcome it.

Ans :

Refer to Topic No. 3.2, page no. 47, Unit - III

b) Explain the significance of Executive Decision making system in an organization.

Ans :

Refer to Topic No. 3.12, page no. 70, Unit - III

5. a) Distinguish between Artificial and Natural Intelligence systems.

Ans :

Refer to Topic No. 4.2, page no. 75, Unit - IV

b) How to design and build up the Expert system in a multinational company ?

Ans :

Refer to Topic No. 4.4, 4.5, 4.6, page no. 77 to 79, Unit - IV

6. a) Discuss the significance of Data Warehousing system.

Ans :

Refer to Topic No. 5.1, page no. 95, Unit - V

b) Explain various techniques for Data Mining.

Ans :

Refer to Topic No. 5.12, page no. 118, Unit - V

FACULTY OF MANAGEMENT

M.B.A II - Semester Examination, JULY - 2014

DECISION SUPPORT SYSTEMS

Time : 3 Hours] **[Max. Marks : 80**

Note : Answer **all** the questions

SECTION - A **(10 × 2 = 20 Marks)**

1. Write short notes on :

   a) Architecture of D.S.S.

   b) Resource pooling

   c) Muddling

   d) Synergy

   e) Drill Down

   f) Modes of EIS

   g) Inference Engine

   h) Knowledge Assets

   i) Data Mart

   j) Data Mining

SECTION - B **(5 × 12 = 60 Marks)**

2. a) Distinguish between structured and unstructured decisions. Explain the phases on the decision making process.

Or

   b) What do you mean by decision analysis approach? Explain the conceptual model of DSS.

3. a) Describe the hardware requirements of DSS. Discuss the model management component of DSS.

Or

   b) Explain DSS tools. Describe the activities in the implementation of DSS.

4. a) Discuss the distributed DSS technology and its functions.

Or

b) What is group decision support system? How distributed GDSS can enhance group decision making ?

5. a) What are the business benefits of using artificial intelligence technology? What are intelligent agents ?

Or

b) Distinguish between artificial intelligence and natural intelligence.

Ans :

6. a) Where data mining fits in with data warehousing? Describe the data visualization tools.

Or

b) What are the characteristics of data warehouse? Discuss the commonly used data mining techniques.

ANSWERS TO JULY - 2014

PART - A

1. a) Architecture of D.S.S.

Ans :

Refer to UNIT – II, Short Answer No. 1.

b) Resource pooling

Ans :

A resource pool is a set of resources available for assignment to project tasks. A resource pool can be assigned exclusively to a project or task or shared by several projects. One resource can be part of individual resource lists for multiple projects or the resource can be part of a single shared resource pool.

The kinds of services that can apply to a resource pooling strategy include data storage services, processing services and bandwidth provided services.

c) Muddling

Ans :

One way of illustrating the bounded rationality approach to decision making is the theory of “Muddling Through”. Muddling through describes decision makers unwillingness to make bold changes through their choices. Rather, they prefer minor changes that causes only incremental changes in their environment. So, while they select in concert with their goals decision makers do so for taking small steps in the appropriate decisions.

d) Synergy

Ans :

In general, synergy is the combined working together of two or more parts of a system so that the combined effect is greater than the sum of the efforts of the parts. In business and technology, the term describes a hoped-for or real effect resulting from different individuals, departments, or companies working together and stimulating new ideas that result in greater productivity.

In the context of organizational behavior, following the view that a cohesive group is more than the sum of its parts, synergy is the ability of a group to outperform even its best individual member.

If used in a business application, synergy means that teamwork will produce an overall better result than if each person within the group were working toward the same goal individually.

e) Drill Down

Ans :

In information technology, to move from summary information to detailed data by focusing in on something. To *drill down* through a series of folders, for example, on a desktop means to go through the hierarchy of folders to find a specific file or to click through drop-down menus in a GUI. To *drill down* through a database is to access information by starting with a general category and moving through the hierarchy of field to file to record.

f) Modes of EIS

Ans :

An executive information system (EIS) is a type of management information system that facilitates and supports senior executive information and decision-making needs. It provides easy access to internal and external information relevant to organizational goals.

There are two modes that EIS supports.

- Corporate Management
- Technical Information Dissemination.

g) Inference Engine

Ans :

An Inference Engine is a tool from artificial intelligence. The first inference engines were components of expert systems. The typical expert system consisted of a knowledge base and an inference engine. The knowledge base stored facts about the world. The inference engine applied logical rules to the knowledge base and deduced new knowledge. This process would iterate as each new fact in the knowledge base could trigger additional rules in the inference engine. Inference engines work primarily in one of two modes: forward chaining and backward chaining. Forward chaining starts with the known facts and asserts new facts. Backward chaining starts with goals, and works backward to determine what facts must be asserted so that the goals can be achieved.

h) Knowledge Assets

Ans :

A Knowledge Asset is a single set of documents, or a single document, containing compiled, structured and validated guidance on a specific area of practice. Knowledge Assets consist of guidelines, set within business context, enlivened by stories and quotes from experience, and linked to people and documents for further investigation. The role of knowledge assets in knowledge management is to provide the means by which one team or person can transfer their knowledge to many teams or people, separated in time and distance.

i) Data Mart

Ans :

Refer to UNIT – V, Short Answer No. 9.

j) Data Mining

Ans :

Data mining is the process of analyzing data from different perspectives and summarizing it into useful information - information that can be used to increase revenue, cuts costs, or both. Data mining software is one of a number of analytical tools for analyzing data. It allows users to analyze data from many different dimensions or angles, categorize it, and summarize the relationships identified. Technically, data mining is the process of finding correlations or patterns among dozens of fields in large relational databases.

PART - B

2. a) Distinguish between structured and unstructured decisions. Explain the phases on the decision making process.

Ans :

Refer to Topic No. 1.6 and 1.5 from UNIT – I.

b) What do you mean by decision analysis approach? Explain the conceptual model of DSS.

Ans :

Decision analysis is *identifying and analyzing key decisions in day-to-day business operations and capturing the decision logic used to support them.* Decision analysis should be a central focus of business analysis. It is a highly effective, business-oriented means to capture certain kinds of business rules.

A *decision* is a determination requiring know-how or guidance; the resolving of a question by reasoning.

An *outcome* is an answer to such a question; that is, some result from making a decision.

A *decision task* is a task or action in which some decision is made.

The end-product of decision analysis is decision logic in the form of decision structures, decision tables, and business rule statements. This decision logic is rendered in a form that is practicable (ready for deployment whether to staff or ultimately to machines), enterprise-robust, and business-friendly.

Conceptual Model of DSS

Refer to Topic No. 1.7 (A framework for DSS Support)

3. a) Describe the hardware requirements of DSS. Discuss the model management component of DSS.

Ans :

Refer to Topic No. 2.2 and 2.7, UNIT – 2

b) Explain DSS tools. Describe the activities in the implementation of DSS.

Ans :

Refer to Topic No. 2.3 and 2.5, UNIT – 2

4. a) Discuss the distributed DSS technology and its functions.

Ans :

Refer to Topic No. 3.5, UNIT – 3

b) What is group decision support system? How distributed GDSS can enhance group decision making ?

Ans :

Group decision-making is a situation faced when individuals collectively make a choice from the alternatives before them. The decision is then no longer attributable to any single individual who is a member of the group. This is because all the individuals and social group processes such as social influence contribute to the outcome. The decisions made by groups are often different from those made by individuals.

This decision requires the input from a number of different units within the organization, such as marketing, engineering, manufacturing, etc. Let's say the CEO of the company has set up a task force to develop a recommendation. Each unit in the organization is represented by one of its managers.

There are a number of ways for the group members to collaborate. They can have meetings to share information and discuss the decisions that need to be made. If meeting face-to-face is not practical, they can use a technology, like videoconferencing. They can also communicate with each other by e-mail to share ideas and provide updates.

How Distributed GDSS Can Enhance Group Decision-Making..

GDSS, or group decision support systems, are types of information systems whose purpose is to help a group of managers solve unstructured or semi-structured problems. Group decision support systems enhance the management decision-making process by providing groups with the technology to collaboratively generate ideas, organize ideas, set priorities, resolve conflicts, and arrive at solutions. Groupthink and destructive conflict miscommunication can be managed effectively through the use of GDSS. Originally designed to facilitate face-to-face group meetings, GDSS technology is now widely used in virtual space.

Identification

Knowledge-based software system that helps business end-users compile raw data, business models, and academic research to help recognize and solve problems individually. The focus of GDSS is on communication-driven group decision support systems. The development of GDSS was an important advance for organizations and has evolved to help many institutions solve controversial management issues through more direct and accurate communication in an open and collaborative setting.

Processes

General process steps of group decision support systems are group brainstorming, classification, prioritization, planning, assessment, documentation, and resolution. The process always involves a facilitator who designs the work space and guides the team. GDSS enhance group decision making through this general process and can then be customized to serve clients in ways that are unique to their businesses.

For example, in 1989 GroupSystems, the first company to offer GDSS software, developed a product based on the research of Dr. Jay Nunamaker. The developed software was tailored to specific needs of IBM and the U.S. Navy, in both cases giving a tangible structure for collaboration and enhancing group communication, which resolved issues related to peer dynamics and information flow.

Developments

Electronic GDSS has developed significantly since the 1980s, helping organizations like NASA, Intel, IBM and P&G to build better company communication networks and make decisions that enhance company services and growth. Advances in electronic infrastructure, processing, meeting space, and communication are just a few examples of how GDSS can improve organizational decision-making processes.

Considerations

Small businesses that are growing rapidly can benefit materially by using electronic GDSS technology. As a firm grows quickly and more employees are hired, a shift takes place in the organizational dynamics of the company and peer communication. Many new employees need access to information and to others within the company to make decisions related to their work. Implementing GDSS is important, as they can effectively rapidly facilitate communication among members of a growing group in a systematic, controllable and efficient manner.

5. a) What are the business benefits of using artificial intelligence technology? What are intelligent agents ?

Ans :

Artificial intelligence is the science of making machines do things that would require intelligence if done by men." AI is the construction and/or programming of computers to imitate human thought processes. Scientists are trying to design computers capable of processing natural languages and reasoning.

Business benefits of using AI :

AI is being used extensively in the business world, But the fact is the development of AI is still in the stages of development. Its applications cross a wide spectrum. For example, AI is being applied in management and administration, science, engineering, manufacturing, financial and legal areas, military and space endeavors, medicine, and diagnostics.

Some AI implementations include natural language processing, database retrieval, expert consulting systems, theorem proving, robotics, automatic programming, scheduling, and solving perceptual problems. Management is relying more and more on knowledge work systems, which are systems used to aid professionals such as architects, engineers, and medical technicians in the creation and dissemination of new knowledge and information.

One such system is in use at Square D, an electrical component manufacturer. A computer does the design work for giant units of electrical equipment. The units generally share the same basic elements but vary in required size, specifications, and features. However, as is the case with most AI-type systems, human intervention is still required. An engineer is needed to check the computer-produced drawing before the equipment is put into production.

Senior managers in many companies use AI-based strategic planning systems to assist in functions like competitive analysis, technology deployment, and resource allocation. They also use programs to assist in equipment configuration design, product distribution, regulatory-compliance advisement, and personnel assessment. AI is contributing heavily to management's organization, planning, and controlling operations, and will continue to do so with more frequency as programs are refined.

AI is also influential in science and engineering. The applications developed were used to organize and manipulate the ever-increasing amounts of information available to scientists and engineers. AI has been used in complex processes such as mass spectrometry analysis, biological classifications, and the creation of semiconductor circuits and automobile components. AI has been used with increasing frequency in diffraction and image analysis; power plant and space station design; and robot sensing, control, and programming. It is the increased use of robotics in business that is alarming many critics of artificial intelligence.

Robots are being utilized more frequently in the business world. In 1990, over 200,000 robots were in use in U.S. factories. Experts predict that by the year 2025 robots could potentially replace humans in almost all manufacturing jobs. This includes not only the mundane tasks, but also those requiring specialized skills. They will be performing jobs such as shearing sheep, scraping barnacles from the bottoms of ships, and sandblasting walls. However, there are jobs that robots will never be able to perform, such as surgery.

Of course, there will still be a need for individuals to design, build, and maintain robots. Yet, once scientists develop robots that can think, as well as act, there may be less of a need for human intervention. Thus, the social ramifications of AI is of major concern to people today.

Intelligent Agents

An intelligent agent is an agent capable of making decisions about how it acts based on experience. An autonomous intelligent agent is an intelligent agent that is free to choose between different actions. Typically, an agent program, using parameters you have provided, searches all or some part of the Internet, gathers information you're interested in, and presents it to you on a daily or other periodic basis. An agent is sometimes called a robot.

b) Distinguish between artificial intelligence and natural intelligence.

Ans :

Refer to Topic No. 4.2 , Unit – IV

6. a) Where data mining fits in with data warehousing? Describe the data visualization tools.

Ans :

Data mining plays an important role in the data warehouse environment. The initial value of a data warehouse comes from automating existing processes, such as putting reports online and giving existing applications a clean source of data. The biggest returns are the improved access to data that can spur innovation and creativity and these come from new ways of looking at and analyzing data. This is the role of data mining to provide the tools that improve under-standing and inspire creativity based on observations in the data.

A good data warehousing environment serves as a catalyst for data mining.

The two technologies work together as partners

- Data mining thrives on large amounts of data and the more detailed the data, the better data that comes from a data warehouse.
- Data mining thrives on clean and consistent data capitalizing on the investment in data cleansing tools.

- The data warehouse environment enables hypothesis testing and simplifies efforts to measure the effects of actions taken enabling the virtuous cycle of data mining.
- Scalable hardware and relational database software can offload the data processing parts of data mining.

However, there is a distinction between the way data mining looks at the world and the way data warehousing does. Normalized data warehouses can store data with time stamps, but it is difficult to do time-related manipulations such as determining what event happened just before some other event of interest.

OLAP introduces a time dimension. Data mining extends this even further by taking into account the notion of "before" and "after." Data mining learns from data with the purpose of applying these findings to the future. For this reason, data mining often puts a heavy load on data warehouses. These are complementary technologies, supporting each other as discussed in the next few sections.

Data Visualization Tools

Data visualization tools are used to create two-and three-dimensional pictures of business data sets. Some tools even allow you to animate the picture through one or more data dimensions. Simple visualization tools such as line, column., bar, and pie graphs have been used for centuries. Recently, with the advance of new visualization techniques, businesses are finding they can rapidly employ a few visualizations to replace hundreds of pages of tabular reports.

Other businesses use these visualizations to augment and summarize their traditional reports. Using visualization tools and techniques can lead to quicker deployment, result in faster business insights, and enable you to easily communicate those insights to others The data visualization tool used depends on the nature of the business data set and its underlying structure. Data visualization tools can be classified into two main categories :

- Multidimensional visualizations
- Specialized hierarchical and landscape visualizations.

b) What are the characteristics of data warehouse? Discuss the commonly used data mining techniques.

Ans :

Refer to Topic No. 5.1.1 and 5.12, UNIT – V.

FACULTY OF MANAGEMENT

M.B.A II - Semester Examination, December - 2013

DECISION SUPPORT SYSTEMS

Time : 3 Hours] **[Max. Marks : 80**

Note : Answer **all** the questions

PART - A **(10 × 2 = 20 Marks)**

1. Write short notes on the following:

   a) Define DSS

   b) Define EIS

   c) Define Data store

   d) What is data Visualization?

   e) What is an information system?

   f) What is the difference between Hardware and Software?

   g) What is a groupware?

   h) Implementation of DSS.

   i) How do you build an ES?

   j) What is natural Intelligence?

PART - B **(5 × 12 = 60 Marks)**

2. a) Explain in detail the decision-making process.

OR

   b) What are the types of DSS?

3. a) Explain the hardware and software required for DSS.

OR

   b) What are types of models of a DSS?

4. a) What is the difference between EIS and DSS?

OR

   b) Explain the future of executive decision making.

5. a) Explain the characteristics of Expert Systems.

OR

b) Differentiate between Artificial and Natural Intelligence.

6. a) Explain about the on-line transaction processing techniques used in order to mine data.

OR

b) Explain characteristics and Architecture of Data Warehouse.

Solutions to December - 2013

PART - A **(10 × 2 = 20 Marks)**

1. Write short notes on the following:

a) Define DSS

Ans :

Refer to Unit - I, Short Notes - 1.

b) Define EIS

Ans :

Refer to Unit - III, Short Notes - 13.

c) Define Data store

Ans :

Refer to Unit - V, Short Notes - 11.

d) What is data Visualization?

Ans :

Refer to Unit - V, Short Notes - 20.

e) What is an information system?

Ans :

An information system (IS) refers to a collection of multiple pieces of equipment involved in the dissemination of information. Hardware, software, computer system connections and information, information system users, and the system's housing are all part of an IS.

f) What is the difference between Hardware and Software?

Ans :

Computer hardware is any physical device, something that you are able to touch and software is a collection of instructions and code installed into the computer and cannot be touched. For example, the computer monitor you are using to read this text on and the mouse you are using to navigate this web page is computer hardware. The Internet browser that allowed you to visit this page and the operating system that the browser is running on is software.

g) What is a groupware?

Ans :

Refer to Unit - III, Short Notes - 9.

h) Implementation of DSS.

Ans :

Refer to Unit - II, Short Notes - 11.

i) How do you build an ES?

Ans :

Refer to Unit - IV, Page No. 79, Topic No. 4.6.

j) What is natural Intelligence?

Ans :

Natural intelligence (NI) is the opposite of artificial intelligence: it is all the systems of control present in biology. Normally when we think of NI we think about how animal or human brains function, but there is more to natural intelligence than neuroscience. Nature also demonstrates non-neural control in plants and protozoa, as well as distributed intelligence in colony species like ants, hyenas and humans. Our behaviour co-evolves with the rest of our bodies, and in response to our changing environment. Understanding natural intelligence requires understanding all of these influences on behaviour and their interactions.

PART - B **(5 × 12 = 60 Marks)**

2. a) Explain in detail the decision-making process.

Ans :

Refer to Unit - I, Page No. 6, Topic No. 1.5.

OR

b) What are the types of DSS?

Ans :

Refer to Unit - I, Page No. 14, Topic No. 1.9.

3. a) Explain the hardware and software required for DSS.

Ans :

Refer to Unit - II, Page No. 23, 26, Topic No. 2.2, 2.3.

OR

b) What are types of models of a DSS?

Ans :

Refer to Unit - II, Page No. 38, Topic No. 2.6.

4. a) What is the difference between EIS and DSS?

Ans :

Refer to Unit - I, Page No. 2 and 3, Topic No. 1.2, 1.3

Refer to Unit - III, Page No. 60 and 61, Topic No. 3.6, 3.7

OR

b) Explain the future of executive decision making.

Ans :

Refer to Unit - III, Page No. 70, Topic No. 3.12.

5. a) Explain the characteristics of Expert Systems.

Ans :

Refer to Unit - IV, Page No. 77, Topic No. 4.4 and 4.5

Characteristics of Expert Systems

High performance: They should perform at the level of a human expert.

Adequate response time: They should have the ability to respond in a reasonable amount of time. Time is crucial especially for real time systems.

Reliability: They must be reliable and should not crash.

Understandable: They should not be a black box instead it should be able explain the steps of the reasoning process. It should justify its conclusions in the same way a human expert explains why he arrived at particular conclusion.

OR

b) Differentiate between Artificial and Natural Intelligence.

Ans :

Refer to Unit - IV, Page No. 75, Topic No. 4.2.

6. a) Explain about the on-line transaction processing techniques used in order to mine data.

Ans :

Refer to Unit - V, Page No. 113, Topic No. 5.10.

OR

b) Explain characteristics and Architecture of Data Warehouse.

Ans :

Refer to Unit - V, Page No. 95, 100, Topic No. 5.1.1, 5.7.

FACULTY OF MANAGEMENT

M.B.A II - Semester Examination, August / September - 2013

DECISION SUPPORT SYSTEMS

Time : 3 Hours] **[Max. Marks : 80**

Note : Answer **all** the questions

PART - A **(10 × 2 = 20 Marks)**

1. Write short notes on the following at one place only.

   a) What is DSS?

   b) State decision making process.

   c) Hardware and Software

   d) Components of DSS

   e) What is EIS?

   f) Components in EIS.

   g) What is AI?

   h) What is Expert System?

   i) State features of Data warehouse.

   j) What is Data Mining?

PART - B **(5 × 12 = 60 Marks)**

2. a) Explain the significant features of various decisions in an organization.

OR

   b) Discuss a suitable framework for decision support system in a large organization.

3. a) Explain the Hardware and Software mechanism for Decision Support System.

OR

   b) Discuss the problems in the implementation of DSS models.

4. a) Explain the problems and merits in group decision making process.

OR

b) Discuss the problems and prospects of Executive Decision making in a complex organization.

5. a) Explain the relative merits and demerits of Artificial and Natural intelligence systems.

OR

b) Discuss the designing and building process for Expert System.

6. a) Explain the implementation process of Data warehouse.

OR

b) Discuss the limitations of Data Mining and Warehousing Systems.

Solutions to August/September - 2013

PART - A **(10 × 2 = 20 Marks)**

1. Write short notes on the following at one place only.

a) What is DSS?

Ans :

Refer to Unit - I, Short Notes - 1.

b) State decision making process.

Ans :

Refer to Unit - II, Short Notes - 2.

c) Hardware and Software

Ans :

Refer to December - 2013, Q.No. 1(f)

d) Components of DSS

Ans :

Components of the main decision-support system :

1. **Hardware :** a personal computer or computer network
2. **Software :** database programs , management programs
3. **HumanResource :** trained and experienced staff for the areas of operations research, decision support, analysis , statistical analysis, computer technology, networking and communications .
4. Procedures
5. The user interface: dialogue with the program
6. Database
7. Forms and models database

e) What is EIS?

Ans :

Refer to Unit - III, Short Notes - 13.

f) Components in EIS.

Ans :

Refer to Unit - III, Page No. 61, Topic No. 3.7

g) What is AI?

Ans :

Refer to Unit - IV, Short Notes - 2.

h) What is Expert System?

Ans :

Refer to Unit - IV, Page No. 77, Topic No. 4.4

i) State features of Data warehouse.

Ans :

Refer to Unit - IV, Short Notes - 2.

j) What is Data Mining?

Ans :

Data mining is the practice of automatically searching large stores of data to discover patterns and trends that go beyond simple analysis. Data mining uses sophisticated mathematical algorithms to segment the data and evaluate the probability of future events. Data mining is also known as Knowledge Discovery in Data (KDD).

The key properties of data mining are:

- Automatic discovery of patterns
- Prediction of likely outcomes
- Creation of actionable information
- Focus on large data sets and databases

Data mining can answer questions that cannot be addressed through simple query and reporting techniques.

PART - B **(5 × 12 = 60 Marks)**

2. a) Explain the significant features of various decisions in an organization.

Ans :

Refer to Unit - I, Page No. 2, 3, 5, Topic No. 1.2, 1.3, 1.4.

OR

b) Discuss a suitable framework for decision support system in a large organization.

Ans :

Refer to Unit - I, Page No. 12, Topic No. 1.7.

3. a) Explain the Hardware and Software mechanism for Decision Support System.

Ans :

Refer to Unit - II, Page No. 23, 26, Topic No. 2.2, 2.3.

OR

b) Discuss the problems in the implementation of DSS models.

Ans :

Refer to Unit - II, Page No. 35, Topic No. 2.5.

4. a) Explain the problems and merits in group decision making process.

Ans :

Refer to Unit - III, Page No. 45, Topic No. 3.1.3.

OR

b) Discuss the problems and prospects of Executive Decision making in a complex organization.

Ans :

Refer to Unit - III, Page No. 70, Topic No. 3.12.

5. a) Explain the relative merits and demerits of Artificial and Natural intelligence systems.

Ans :

Refer to Unit - IV, Page No. 73, 74, 75, Topic No. 4.1, 4.2, 4.3.

OR

b) Discuss the designing and building process for Expert System.

Ans :

Refer to Unit - IV, Page No. 78, 79, Topic No. 4.5, 4.6.

6. a) Explain the implementation process of Data warehouse.

Ans :

Refer to Unit - V, Page No. 104, Topic No. 5.8.

OR

b) Discuss the limitations of Data Mining and Warehousing Systems.

Ans :

Refer to Unit - V, Page No. 122, Topic No. 5.14.

Refer to Unit - VI, Short Notes - 6.

FACULTY OF MANAGEMENT

M.B.A II - Semester Examination, August - 2012

DECISION SUPPORT SYSTEMS

Time : 3 Hours] **[Max. Marks : 80**

Note : Answer **all** the questions

SECTION - A **(10 × 2 = 20 Marks)**

1. Write short notes on :
   - a) Programmable decisions
   - b) Closed Decision Systems
   - c) Flows charts
   - d) Abstract systems
   - e) KBES
   - f) Forward chaining
   - g) Semantic network
   - h) Entropy
   - i) Data mining
   - j) Artificial Intelligence

SECTION - B **(5 × 12 = 60 Marks)**

2. a) What is DSS ? Explain its business applications.

OR

b) Discuss various types of Decision Support Systems.

3. a) Discuss the salient features of DSS Architecture.

OCR

b) Discuss the various phases involved in the implementation of a typical DSS.

4. a) What is Group Decision making ? Discuss the problems involved in it.

OR

b) Discuss the problems and prospects of EIS.

5. a) What is an Expert System ? Explain the structure of a typical Expert System.

OR

b) What are Intelligent Software Agents ? Explain their importance in an Expert System.

6. a) What is data warehouse ? Explain its characteristics.

OR

b) Discuss the salient features of Data Warehouse Architecture.

Solutions to August - 2012

SECTION - A **(10 × 2 = 20 Marks)**

1. Write short notes on :

a) Programmable decisions

Ans :

Programmed decisions are decisions that managers have made in the past based on an identical situation. The idea is that the former solution would yield and identical result. These decisions generally aren't costly to make.

b) Closed Decision Systems

Ans :

If the manager operates in a known environment then it is called closed decision making system.

Conditions :

i) Manager knows the set of decision alternative and know their outcome in term of values.

ii) Manager has a model, by which decision alternatives can be generated, tested and ranked.

iii) The manager can choose one of them, based on some goal or objective.

c) Flows charts

Ans :

The flowchart is designed to determine applicability of the rule and provide the main standard citation and associated standard, monitoring, recordkeeping, reporting and testing requirements that are applicable to the emission unit. Thus, the flowchart will provide the same level of detail as the RES.

d) Abstract systems

Ans :

Every conceptual model is an abstract system, for example, traffic system models and computer programs are both types of modeled systems. They can be the product of identification, design or invention.

e) KBES

Ans :

KBES stands for Knowledge Based Expert System.

Knowledge based expert system makes use of human knowledge to compute problems which basically need human intelligence. In this system, the expertise knowledge is represented as data or rules within the computer. And therefore, when there is a need to solve problems, these rules and data are called.

f) Forward chaining

Ans :

A method of reasoning using inference rules. Forward chaining starts with the available data and uses inference rules to extract more data (from an end user for example) until an optimal goal is reached. An inference engine using forward chaining searches the inference rules until it finds one where the If clause is known to be true. When found it can conclude, or infer, the Then clause, resulting in the addition of new information to its dataset.

g) Semantic network

Ans :

A semantic network or net is a graph structure for representing knowledge in patterns of interconnected nodes and arcs. Computer implementations of semantic networks were first developed for artificial intelligence and machine translation, but earlier versions have long been used in philosophy, psychology, and linguistics.

h) Entropy

Ans :

System entropy is the state in which the system deteriorates due to lack of maintenance. For example, if software engineers are not trained in new technologies, tools and languages, the products developed by them can become outdated. In order to survive in the market, the organization must train their employees. Maintenance is a process of reducing system entropy and increasing its performance.

i) Data mining

Ans :

Refer to December - 2013, Q.No. 1(j)

j) Artificial Intelligence

Ans :

Refer to December - 2013, Q.No. 1(g)

SECTION - B **(5 × 12 = 60 Marks)**

2. a) What is DSS ? Explain its business applications.

Ans :

Refer to Unit - I, Page No. 2, 5, Topic No. 1.2, 1.4.

OR

b) Discuss various types of Decision Support Systems.

Ans :

Refer to Unit - I, Page No. 14, Topic No. 1.19.

3. a) Discuss the salient features of DSS Architecture.

Ans :

Refer to Unit - II, Page No. 19, Topic No. 2.1.

OR

b) Discuss the various phases involved in the implementation of a typical DSS.

Ans :

Refer to Unit - II, Page No. 35, Topic No. 2.5.

4. a) What is Group Decision making ? Discuss the problems involved in it.

Ans :

Refer to Unit - III, Page No. 43, 47, Topic No. 3.1, 3.2.

OR

b) Discuss the problems and prospects of EIS.

Ans :

Refer to Unit - III, Page No. 60, 63, 64, Topic No. 3.6, 3.8, 3.9.

5. a) What is an Expert System ? Explain the structure of a typical Expert System.

Ans :

Refer to Unit - IV, Page No. 77, 78, Topic No. 4.4, 4.5.

OR

b) What are Intelligent Software Agents ? Explain their importance in an Expert System.

Ans :

Refer to Unit - IV, Page No. 85, 82, Topic No. 4.9, 4.7.

6. a) What is data warehouse ? Explain its characteristics.

Ans :

Refer to Unit - V, Page No. 95, Topic No. 5.1, 5.1.1.

OR

b) Discuss the salient features of Data Warehouse Architecture.

Ans :

Refer to Unit - V, Page No. 100, Topic No. 5.7.

FACULTY OF MANAGEMENT

M.B.A II - Semester Examination, January - 2012

DECISION SUPPORT SYSTEMS

Time : 3 Hours] **[Max. Marks : 80**

Note : Answer **all** the questions

SECTION - A **(10 × 2 = 20 Marks)**

1. Write short notes on the following :

(a) Define DSS

(b) Types of DSS

(c) Components of DSS

(d) Hardware Required for DSS

(e) Software Tools for DSS

(f) Components of EIS

(g) Intelligent Software Agents

(h) Limitations of Data Mining

(i) Data mart

(j) Data Visualisation

SECTION - B **(5 × 12 = 60 Marks)**

2. (a) Discuss the need and benefits of decision support system.

OR

(b) Describe the decision making process by using DSS.

3. (a) Discuss the steps invalued in implementations of DSS.

OR

(b) Briefly explain various DSS models and their limitations.

4. (a) Define an executive information systems and state its advantages.

OR

(b) Describe the features of executive information systems.

5. (a) What is the structure of expert systems ? Explain the process of implementing ES.

OR

(b) What are the advantages and disadvantages of an expert systems ?

6. (a) What is data mining ? Discuss the techniques of data mining.

OR

(b) Discuss the functions and benefits of data warehouses.

Solutions to January - 2012

SECTION - A **(10 × 2 = 20 Marks)**

1. Write short notes on the following :

(a) Define DSS

Ans :

Refer to Unit - I, Short Notes - 1

(b) Types of DSS

Ans :

Refer to Unit - I, Short Notes - 10

(c) Components of DSS

Ans :

The basic components of DSS are :

1. DSS structure
2. User Interface
3. DSS software system

(d) Hardware Required for DSS

Ans :

Decision support system can run on several platforms. Here, the term platform refers to the hardware operating system environment that support DSS applications.

The platform on which DSS runs are :

1. The central corporate system
2. The client/server system
3. The system that obtains data from central system and provide it to users.
4. A stand-alone system

(e) Software Tools for DSS

Ans :

The specialized software used for helping DSS development process are :

1. DBMS packages
2. Information retrieval packages
3. Specialized modelling packages (spread sheets)
4. Forecasting packages
5. Forecasting packages
6. Graphing packages.

(f) Components of EIS

Ans :

Refer to Unit - III, Page No. 61, Topic No. 3.7

(g) Intelligent Software Agents

Ans :

Refer to Unit - IV, Page No. 85, Topic No. 4.9

(h) Limitations of Data Mining

Ans :

Refer to Unit - V, Page No. 122, Topic No. 5.14

(i) Data mart

Ans :

Refer to Unit - V, Page No. 99, Topic No. 5.4

(j) Data Visualisation

Ans :

Refer to Unit - V, Page No. 123, Topic No. 5.15

SECTION - B **(5 × 12 = 60 Marks)**

2. (a) Discuss the need and benefits of decision support system.

Ans :

Refer to Unit - I, Page No. 3, Topic No. 1.3.

OR

(b) Describe the decision making process by using DSS.

Ans :

Refer to Unit - I, Page No. 6, Topic No. 1.5.

3. (a) Discuss the steps invalued in implementations of DSS.

Ans :

Refer to Unit - II, Page No. 35, Topic No. 2.5.

OR

(b) Briefly explain various DSS models and their limitations.

Ans :

Refer to Unit - II, Page No. 38, Topic No. 2.6.

4. (a) Define an executive information systems and state its advantages.

Ans :

Refer to Unit - III, Page No. 60, 64, Topic No. 3.6, 3.9.

OR

(b) Describe the features of executive information systems.

Ans :

Executive support systems are intended to be used by the senior managers directly to provide support to non-programmed decisions in strategic management.

These information are often external,unstructured and even uncertain.Exact scope and context of such information is often not known beforehand.

This information is intelligence based:

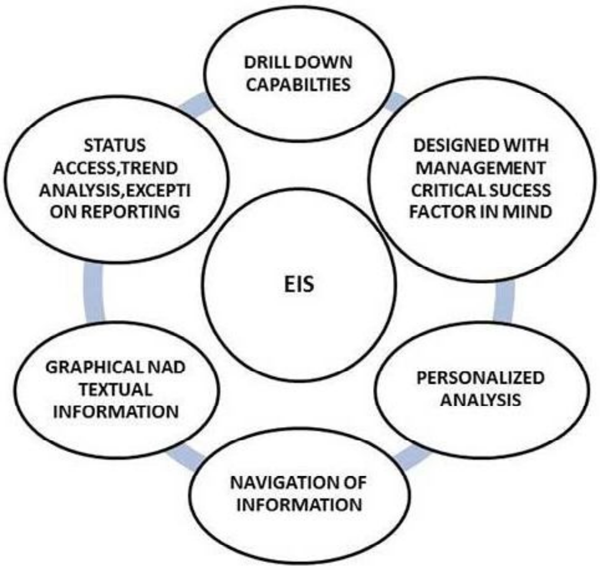
- Market intelligence
- Investment intelligence
- Technology intelligence

Examples of Intelligent Information

Following are some examples of intelligent information, which is often source of an ESS:

- External databases
- Technology reports like patent records etc.
- Technical reports from consultants
- Market reports
- Confidential information about competitors
- Speculative information like market conditions
- Government policies
- Financial reports and information

Features of Executive Information System



Advantages of ESS:

- Easy for upper level executive to use
- Ability to analyze trends
- Augmentation of managers' leadership capabilities
- Enhance personal thinking and decision making
- Contribution to strategic control flexibility
- Enhance organizational competitiveness in the market place
- Instruments of change
- Increased executive time horizons.
- Better reporting system
- Improved mental model of business executive
- Help improve consensus building and communication
- Improve office automation
- Reduce time for finding information
- Early identification of company performance
- Detail examination of critical success factor
- Better understanding
- Time management
- Increased communication capacity and quality

Disadvantage of ESS

- Functions are limited
- Hard to quantify benefits
- Executive may encounter information overload
- System may become slow
- Difficult to keep current data
- May lead to less reliable and insecure data
- Excessive cost for small company

5. (a) What is the structure of expert systems ? Explain the process of implementing ES.

Ans :

Refer to Unit - IV, Page No. 78, 79, Topic No. 4.5, 4.6.

OR

(b) What are the advantages and disadvantages of an expert systems ?

Ans :

Refer to Unit - IV, Page No. 82, Topic No. 4.7.

6. (a) What is data mining ? Discuss the techniques of data mining.

Ans :

Refer to Unit - V, Page No. 108, 118, Topic No. 5.9, 5.12.

OR

(b) Discuss the functions and benefits of data warehouses.

Ans :

Functions of Data Warehouse

The main purpose of data warehouse is to store data and information that is derived from many applications. The other functions of data warehouse are as follows:

1. It stores data in order to support the information reporting requirement of an organization.
2. It sorts and analyzes the consolidated information.
3. It maintains data such that it can be used easily and quickly.
4. It makes sure that every organizational area have same perspective regarding the stored data.
5. It displays meta data in technical and as well as in business perspective.
6. It enhances the ability of creating and updating the organizational data and applications.
7. It separates physical model from logical model.
8. It ensures both data consistency and quality techniques.

Benefits of Data Warehouse

1. Integrating data from multiple sources;
2. Performing new types of analyses; and
3. Reducing cost to access historical data.

Other benefits may include:

1. Standardizing data across the organization, a "single version of the truth";
2. Improving turnaround time for analysis and reporting;
3. Sharing data and allowing others to easily access data;
4. Supporting ad hoc reporting and inquiry;
5. Reducing the development burden on IS/IT; and
6. Removing informational processing load from transaction-oriented databases.

FACULTY OF MANAGEMENT

M.B.A II Semester (New) Examination, July - 2011

DECISION SUPPORT SYSTEMS

Time : 3 Hours] **[Max. Marks : 80**

Note : Answer **all** the questions

SECTION - A **(10 × 2 = 20 Marks)**

1. Write short notes on :
   a) Types of DSS.
   b) Goals of DSS
   c) DSS architecture
   d) Tools for DSS
   e) DSS technologies
   f) EIS components
   g) What is artificial intelligene ?
   h) Components of Expert Systems (ES).
   i) Data warehouse architecture
   j) Limitations of Data mining.

SECTION - B **(5 × 12 = 60 Marks)**

2. a) What is a Decision Support System ? How does it differs from Management Information Systems ?

   OR

   b) Describe various DSS models are state their advantages.

3. a) Explain about the hardware and software required for DSS.

   OR

   b) Discuss the problems encountered in implementations of DSS.

4. a) In what ways does an Executive Information System differ from the Traditional Information System ?

   OR

   b) Describe the features of Executive Information Systems.

5. a) Briefly describe Expert Systems. In which areas of an organisation expert systems can be used ?

   OR

   b) What are the benefits of Expert Systems ?

6. a) Define Data Warehousing. Explain its characteristics.

   OR

   b) What are Data Marts ? Explain its relationship with Data Warehouse.

Solutions to July - 2011

SECTION - A **(10 × 2 = 20 Marks)**

1. Write short notes on :

a) Types of DSS

Ans :

Refer to Unit-I, Short Notes - 1.

b) Goals of DSS

Ans :

The objective of the DSS are as stated below:

1. Provide assistance to decision makers in situations which are semi-structured.
2. Identify plans and potential actions to resolve problems.
3. Rank among the solutions identified, those which can be implemented and provide a list of viable alternatives.

c) DSS architecture

Ans :

Refer to Unit-II, Short Notes - 1.

d) Tools for DSS

Ans :

Class project Tools

- Expert System Shells
- Modeling
- Programming Languages
- Simulation Languages
- Simulation Tools

e) DSS technologies

Ans :

DSS technologies are classified into three levels,

(i) DSS Primary Tools : Primary tools are considered as the essential elements that help in developing DSS generator and Specific DSS.

(ii) DSS Integrated Tools : Integrated tools maintain a set of potentials that can easily create a specific DSS with minimal cost and time.

(iii) Specific DSS : Specific DSS is the DSS application that can successfully complete the intended task.

f) EIS components

Ans :

Refer to Unit - III, Page No. 61, Topic No. 3.7

g) What is artificial intelligene ?

Ans :

Refer to Unit-IV, Short Notes - 1.

h) Components of Expert Systems (ES).

Ans :

Refer to Unit - IV, Page No. 77, Topic No. 4.4

i) Data warehouse architecture

Ans :

Refer to Unit - V, Page No. 100, Topic No. 5.7

j) Limitations of Data mining.

Ans :

Refer to Unit - V, Page No. 122, Topic No. 5.14

SECTION - B **(5 × 12 = 60 Marks)**

2. a) What is a Decision Support System ? How does it differs from Management Information Systems ?

Ans :

Refer to Unit - I, Page No. 2, 13, Topic No. 1.2, 1.8.

OR

b) Describe various DSS models are state their advantages.

Ans :

Refer to Unit - II, Page No. 38, Topic No. 2.6.

3. a) Explain about the hardware and software required for DSS.

Ans :

Refer to Unit - II, Page No. 22, 26, Topic No. 2.2, 2.3.

OR

b) Discuss the problems encountered in implementations of DSS.

Ans :

Refer to Unit - I, Page No. 2, 13, Topic No. 1.2, 1.8.

4. a) In what ways does an Executive Information System differ from the Traditional Information System ?

Ans :

Refer to Unit - III, Page No. 60 and 63, Topic No. 3.6 and 3.8

OR

b) Describe the features of Executive Information Systems.

Ans :

Refer to January - 2012, Q.No. 4(b)

5. a) Briefly describe Expert Systems. In which areas of an organisation expert systems can be used ?

Ans :

Refer to Unit - IV, Page No. 77, 83, 87, Topic No. 4.4, 4.8, 4.11.

OR

b) What are the benefits of Expert Systems ?

Ans :

Refer to Unit - IV, Page No. 82, Topic No. 4.7.

6. a) Define Data Warehousing. Explain its characteristics.

Ans :

Refer to Unit - V, Page No. 95, Topic No. 5.1, 5.1.1.

OR

b) What are Data Marts ? Explain its relationship with Data Warehouse.

Ans :

Refer to Unit - V, Page No. 124, Topic No. 5.4, 5.16.