Information Systems for Managers (Session – 1 to 10)

IBS
BUSINESS SCHOOL

Information Systems for Managers

CHAPTER 1

Introduction to Information Systems

Source: http://www.imi-groups.com

SECTION 1

Basics of Information Systems

Video 1.1.1 : What is an Information System?

An Information System (IS) is a system that accepts inputs in the form of data resources, processes them and provides output in the form of information. Information systems are designed in such a way as to help the managers analyze data and to enable decision-making.

Need for Information Systems

Video 1.1.2: An Introduction to Business Information Systems

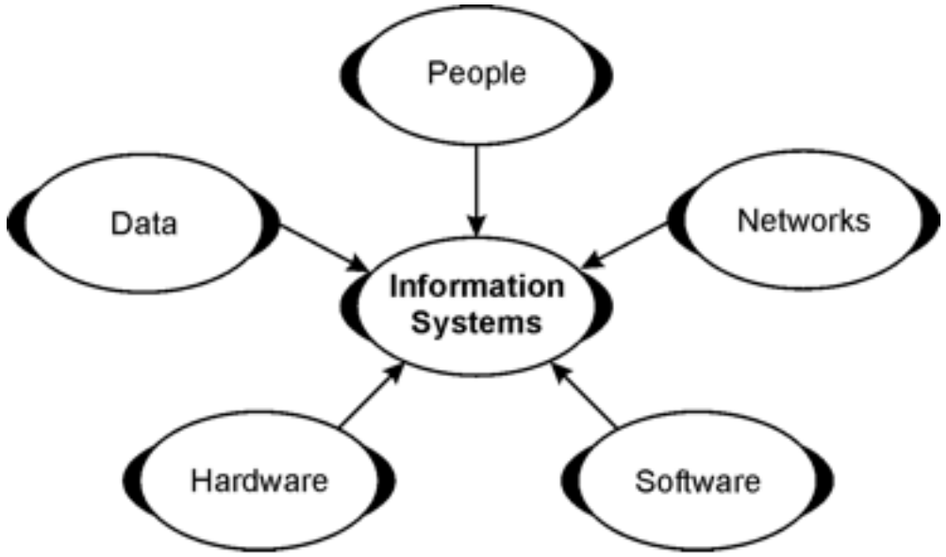
Information systems carry out certain functions that would help in data analysis and decision-making. Some of the important functions carried out by information systems are as follows:

- Accepting input in the form of data resources
- Processing the data resources into information products
- Storing the data resources
- Generating output
- Controlling the performance of the system components of Information Systems

The IS components include people resources (end users and IS specialists), equipment (hardware and software resources), data resources (data and knowledge bases) and network resources (communications media and network support). These resources carry out the input, processing, output, storage and control activities, and convert the data resources into information products. Figure 1.1.1 represents the various IS components. It provides an outline that focuses on the five basic resources of information systems namely – people, hardware, software, data and networks.

These resources have been briefly explained below:

Figure 1.1.1: Information System Components



Source: Jessup Leonard M. and Joseph S. Valacich. Information Systems Today. New Delhi: Prentice-Hall of India Private Limited, 2005. Pg 5.

Video 1.1.3 : Business Information Systems

Video 1.1.4 : How Systems Can Help Your Business

SECTION 2

Business Perspective of Information Systems

Video 1.2.1 : Business Perspective of IS - 1

Information systems are designed in a manner that helps managers analyze data and make decisions. Some of the important functions carried out by information systems are accepting input in the form of data resources, processing the data resources into information products, storing the data resources, generating output and controlling the performance of the system. Information systems help an organization perform various functions, solve *business* problems and pursue business opportunities.

BUSINESS PROCESSES AND ISs

Information systems can be used by businesses to achieve strategic advantages by improving production methods and by developing new products and services. Following are some of the strategic advantages that a company can gain through the use of information systems:

Video 1.2.2: Business Perspective of IS - 2

- Enhance the efficiency and effectiveness of business operations. Create entry barriers to other competitive firms. Encourage the suppliers to do business with it and attract customers to buy its products and/or services.

Source:http://img.ehowcdn.com/

- Strengthen the organization's relationships with the suppliers.
- Enhance the existing products and/or services, customize the products and/or services and develop innovative products and/or services on a regular basis.
- Maintain an information database about the customers. Target the customers based on their previous purchases and sell this information to other retailers.
- Global expansion.

Some of the other advantages that an organization can gain from using information systems are discussed in detail as follows:

Improvements in Business Processes

Information systems can be used to develop products, services and other competencies that will enable companies to achieve strategic advantages. The use of information systems helps in streamlining the operational and managerial processes. By improving their

Source: http://technosysint.com/

business processes, organizations can cut costs, improve quality and customer service, and develop innovative products. The manufacturing process can be automated; computers are used in design, production

and engineering, in addition to the management of resources. Organizations can use intranets, extranets, Internet and other networks to interact within and with the outside world (i.,e, distributors, customers, creditors, investors, etc). For example, information systems can be used for connecting manufacturers with dealers and suppliers. Improved business processes can enable manufacturers improve production, distribution, sales, etc.

SECTION 3

IT Infrastructure and Computer Networks

The field of computing and communication technologies has witnessed significant developments over the last couple of decades. With the advances in communication technologies, the need for information sharing and dissemination through computer networks is being widely recognized.

A computer network can be defined as an inter- connected collection of autonomous computers. In simplewords, a network links two or more computers and enables sharing of information between them. Computersare said to be interconnected if they are able to exchangeinformation. They may be connected through copper wires, fiber optic cables, microwaves, or communication satellites.

A major goal of networking is scalability. Scalability is the ability to increase system performance gradually as the workload increases. For example, a scalable network system would be one that can start with just a few nodes but can easily expand to thousands of nodes. Any device which is connected to the computer network can be termed as a node in this case. Nodes can be computers, printers, servers, routers, switches, cell phones, hubs, etc. A node has an address on the network and makes use of the computer network as a medium of communication.

Source: http://www.playgroundchildren.com

A computer network is a data communication system where two or more computers are linked in order to exchange data (documents, sheets, etc.) and share resources like (CD-ROM, printers, storage devices, etc.). The computers on the network can be linked through cables, radio waves, telephone lines, infrared light beams, or satellites. Depending on the usage networks can be classified into three categories:

1. Local Area Network (LAN)

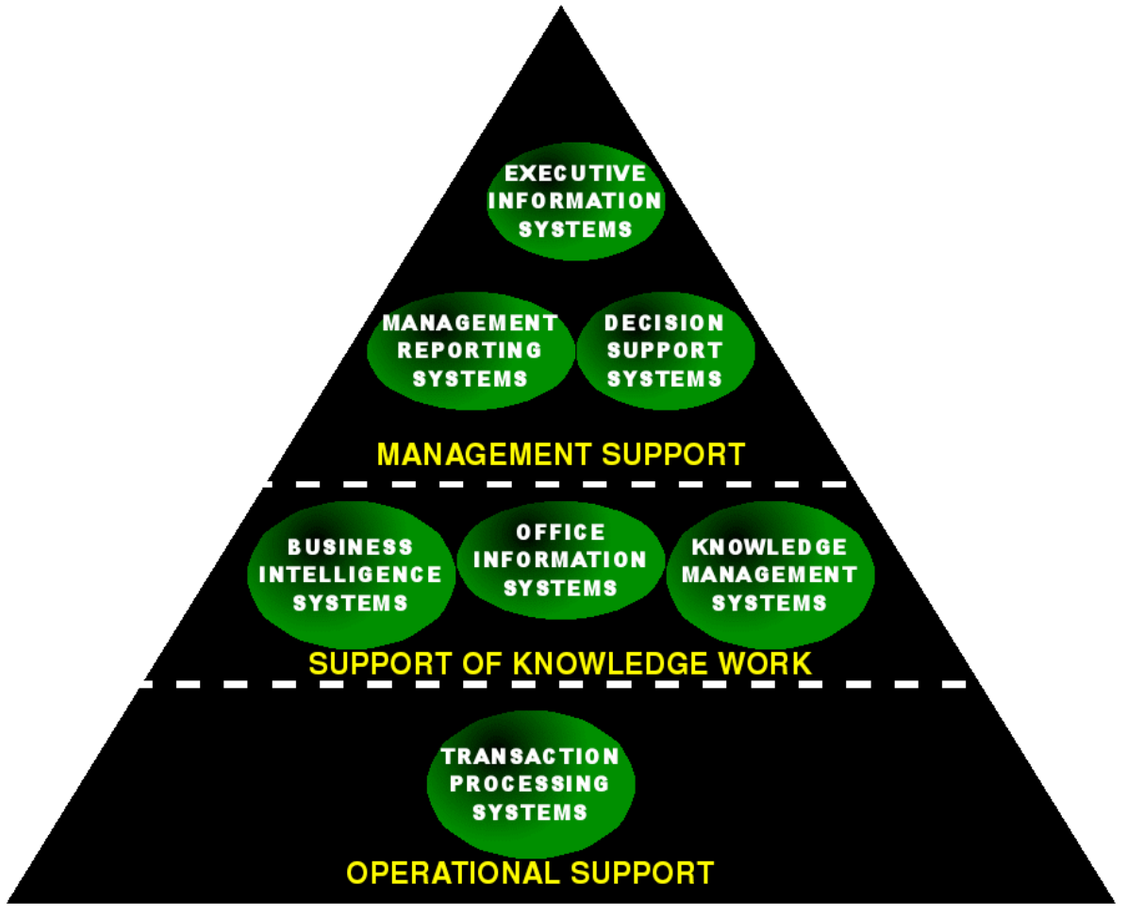
2. Metropolitan Area Network (MAN)

Video 1.3.1 : Computer Networking Tutorial -1

3. Wide Area Network (WAN)

Video 1.3.2 : Computer Networking Tutorial - 2

Different Types of Information Systems



Source:http://www.octium.eu/en/index.php/information-systems/what-is-an-information-system

SECTION 1

Classification of IS by Organizational Levels

Information requirements differ and depend on the various levels in the organization. Both information and organizational hierarchy are related to each other. Figure 2.1.1 depicts the relationship between information and organizational hierarchy.

Figure 2.1.1: Information at Various Organizational Levels

Source: Jawadekar W S. Management Information Systems. Second Edition. New Delhi: Tata McGrawHill, 2002. Pg 96.

Under the hierarchical classification of an organization, there are three levels namely, the operational, tactical and strategic levels. The nature of decisions made differ from one level to another. Therefore, the information requirements also differ from one level to another. Refer to Table 2.1.1 for informational requirements by various levels in the organization.

At the operational level, a large quantity of data needs to be processed. This data is usually generated by business transactions with the customers, suppliers, etc.

Video 2.1.1: Types of Information Systems

Table 2.1.1: Informational Requirements at Various Organizational Levels

MANAGEMENT LEVEL	TYPE OF PROBLEMS TACKLED	TIME FRAME	INFORMATION NEEDS
Senior Management	*Strategic,* e.g., "We want to be the best at customer service"	Months-years	Highly summarized
Middle Management	*Tactical*, e.g., "We will improve staff training."	Weeks-months	Summarized
Operational Management	*Operational,* e.g., "We will hire motivational speaker Fred Smith to talk to staff on Friday."	Hours-Days	Raw or slightly processed
Non-management workers	e.g., "We will set up the tables and chairs in the conference room."	Hours-Minutes	Basic

Source: http://www.mckinnonsc.vic.edu.au/la/it/ipmnotes/index.htm.

At the tactical level, the concern shifts from day-to-day decisions that have a short-term focus to those which have a medium-term impact on the performance of the organization. This level requires information in the form of consolidated reports pertaining to the performance of the various business units of the organization. At this level, the plans are compared with the actual performance and remedial measures are taken in case of any deviations.

At the strategic level, in addition to the information gathered from the internal sources, the decision makers would require information from the external environment. The decisions made at this level are taken in situations that are marked with a great deal of uncertainty.

Based on their application in business, information systems can be classified as Transaction Processing Systems (TPS), Management Information Systems (MIS), Decision Support Systems (DSS) and Executive Information Systems (EIS). Artificial Intelligence (AI) is also used by many organizations to improve precision in production/operation or decision-making.

With the increasing competition from domestic as well as foreign players, business organizations and their information needs have undergone a significant change. Organizations are increasingly using Information Technology (IT) to capture and disseminate information and enhance the performance ofthe business. This may involve improvements in the efficiencyof operations, in the quality of management processes and even in the way the business is conducted or organized.

Transaction processing is one of the fundamental activities of every organization. Although an information system has a very important role to play in supporting management,

ensuring control and undertaking other knowledge work, such an emphasis should in no way obscure its importance in transaction processing. Beyond such operational level processing of data, information systems have specific applications in the various functions of an organization like

Source: http://img.gawkerassets.com/post/17/2012/03/shutterstock_11609845.jpg

marketing, manufacturing, human resources, accounting, finance, etc.

Marketing information systems support marketing function like sales planning, advertising & promotion, and market research. Manufacturing information systems support production or operations function, which includes planning and control of processes by which goods and services are produced or delivered. Human resources information systems help in keeping track of the details of all employees working in the organization as well as those of new applicants. Accounting information systems record and report flow of funds and help produce financial statements such as balance sheets and income statements. Financial information systems help in allocating and controlling the financial resources within a business.

Management Information System (MIS) is a management support system that facilitates day to day operations in an organization. MIS makes use of computer-based systems for converting data into information. These systems can be classified into strategic,

Source: http://i.ehow.co.uk/images/a06/uq/b9/contributing-information-system-success-failure-1.1-800x800.jpg

tactical and operational information systems based on the nature of the information and the decision structure. MIS supports structured decision-making, i.e., those decisions which can be described in detail.

Decision Support Systems (DSS) are information systems that help the managers in decision-making. DSS are developed using analytical models, specialized databases, and the knowledge and experience of the decision makers. DSS generally supports decisions that are unstructured or semi-structured, i.e., those decisions that cannot be described or can be described only partially.

Executive Information Systems (EIS) enable online access to relevant information (related to the external environment) to the top management in a comprehensible

format. These systems provide timely,

accurate and relevant information to the management. The basic purpose of an EIS is to help executives learn about the organization, its work processes and its interaction with the external environment. These systems mostly help the top management in taking unstructured decisions.

Source: http://www.tech-faq.com/wp-content/uploads/2009/02/Decision-Support-System.jpg

Online Analytical Processing, popularly known as OLAP, is used for analyzing data stored in the database. OLAP includes data marts, data warehouses, data mining and multi-dimensional databases.

Information systems are used by business organizations in order to achieve strategic advantages such asimproving the business processes, reengineering it, becoming an agile competitor, creating virtual companies and knowledge management.

SECTION 2

Transaction Processing Systems & Functional Information Systems

Source: http://news.softpedia.com

Information systems that process data generated from business transactions are called transaction processing systems. In other words, the main job of a transaction processing system is to collect data generated from the transactions, store it, and, at times, control the decisions that are taken in the wake of the transactions. Such transactions can be in the form of purchases, sales, deposits, withdrawals, etc.

For instance, booking an airline ticket, withdrawing money from an ATM, depositing cash in the bank, etc., are all examples of transactions.

Generally, these transactions occur on a day-to-day-basis. A sale or purchase of an item triggers many other transactions like credit checks, billing, and changes in the inventory. Thus,

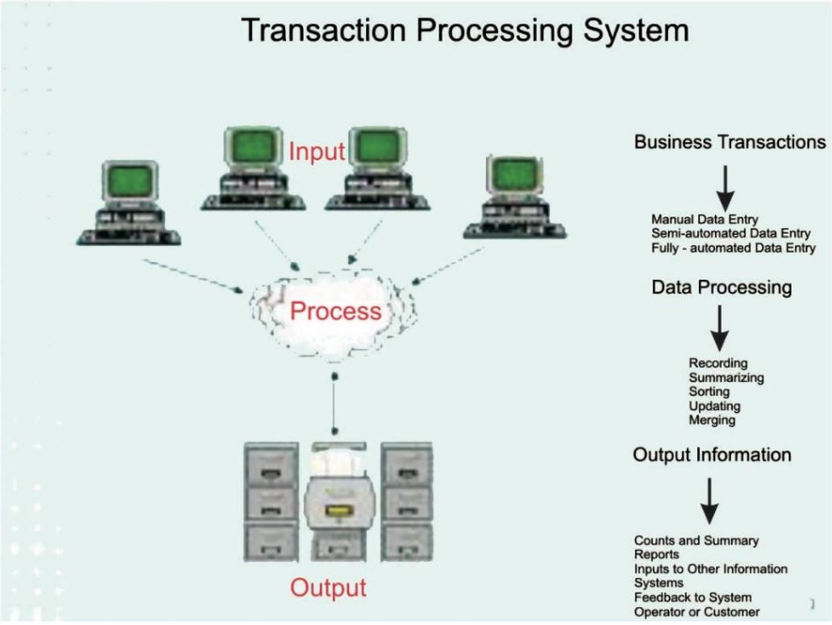
transactions generate additional data.

Following are the objectives of a transaction processing system:

- Carrying out the day-to-day transactions of the organization on a regular basis.
- Collecting, processing, editing, updating, storing the data, and generating the required reports or documents.
- Supplying the necessary information to the organization, which would enable proper functioning of the business.
- Providing reports and documents which would help in making timely decisions.
- Supplying data to other information systems.

Functional Information Systems - It is important for a business end user to under stand how information systems affect a particular function say, finance, or a particular industry say, banking. This section deals with information systems that support various business functions such as marketing, manufacturing, and finance. The objective here is to give the reader an idea of the range of business information systems, which can be used by organizations.

Architecture of TPS



SECTION 3

Management Information Systems

Video 2.3.1: Why Study MIS?

MIS can be defined as an integrated, user-machine system for providing information to support managerial, operational and decision-making functions in an organization.

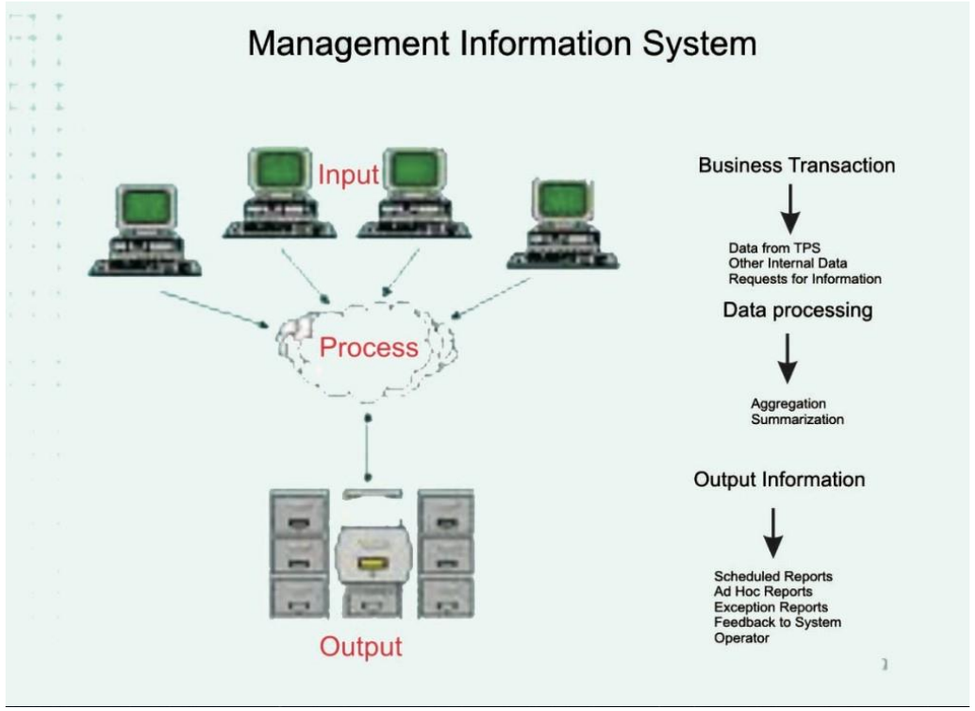
According to Barry E. Cushing, MIS is “a set of human and capital resources within an organization which is responsible for the collection and processing

of data to produce information which is useful to all levels of management in planning and controlling the activities of an organization.” For the purpose of analysis, planning, control and decision making, the system uses manual procedures, computer hardware and software, data models and a database.

Video 2.3.2: Management Information Systems

Information is needed at all levels within a business organization. However, its scope, content and presentation differ from one level to another. Based on the location at which information is used, it can be classified as operational,tactical and strategic information.

Architecture of MIS



SECTION 4

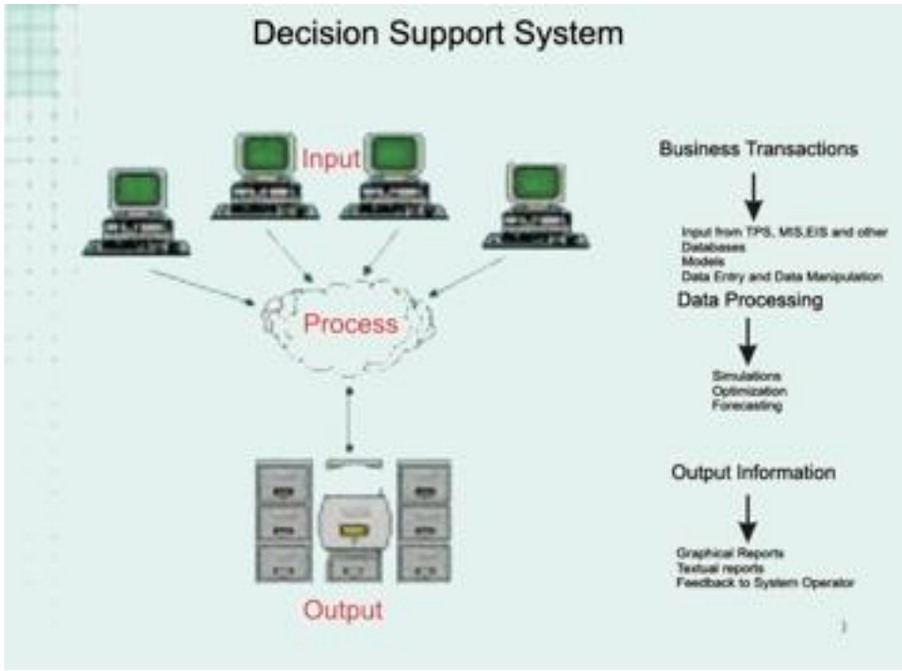
Decision Support Systems

Source: http://www.referenceforbusiness.com

Decision Support Systems (DSSs) are computer-based information systems that support the decision-making activities of the organization. These are interactive systems and subsystems that provide assistance to the decision-making team of the organization to effectively use organizational knowledge and various technologies to make decisions. The DSS provides access to all the information assets of the organization, compares the data figures, forecasts figures based on new data and hypotheses made and evaluates various decision alternatives considering the past experiences.

DSSs are widely used in business organizations to provide support in activities such as financial planning, forecasting, risk assessment, etc. To arrive at a rational solution, a DSS may make use of inquiry, analysis, models, or accounting systems. They are very useful when complex manipulations and different analysis techniques need to be used to find a solution. There are basically two types of decisions – programmable decisions and non- programmable decisions. Programmable decisions are those that are based on predetermined rules and can be computerized. Computerization is possible since the inputs, process methodology, analysis and choice of decisions are all predetermined. Non-programmable decisions are those that do not follow any fixed rules but are based on circumstances.

Architecture of DSS



Characteristics of a DSS

A DSS enables its users to solve a particular problem using the 'what-if' analysis. Using this analysis, one can make modifications to the data related to the problem and find out the effect of these changes on the results. Thus a DSS is used for analyzing the various possibilities and deriving an appropriate strategy for each situation. Following are the characteristics of a DSS:

- They are computerized information systems that are interactive in nature. These systems can be used by decision makers in order to control the order of operations performed.
- DSSs provide support to those decision-making activities or processes that are specific in nature. They facilitate support to the decision makers in the organization, but do not replace them.
- They can be independent systems or subsystems of a more integrated and larger information system. DSSs as independent systems can collect or reproduce data from other information systems.
- A DSS is flexible so that it supports semi-structured and unstructured information. This is an essential attribute of DSSs since decisions are always based on assumptions.
- Decision-making may require a lot of information. For meaningful information to be made available to

decision makers, it is necessary to store the information in databases from which data can be accessed easily and quickly.

Types of DSS

There are four basic types of DSS, namely data analysis systems, information analysis systems, accounting systems and status inquiry systems. These systems are described in brief here:

Data analysis systems

Data analysis systems are developed using simple data processing tools and business rules. These systems rely on comparative analysis, application of formula and use of algorithms. Such systems are generally used for conducting cash flow analysis and fund flow analysis.

Information analysis systems

Information available to the management needs to be analyzed to arrive at a result. The analyzed data is printed in the form of reports for the perusal of the decision maker. By going through these reports, the decision makers can take decisions. Such information analysis systems are used for generating sales analysis reports, market analysis reports, etc.

Accounting systems

Though accounting systems do not contribute directly to decision-making, they can be of great value in tracking

Source: http://s3.hubimg.com

regarding cash, inventory and personnel. In most of these systems, predetermined standards are used. A comparisonis made between the actuals and the standards. The results of such comparison help the management exercise control in the organization and arrive at a decision.

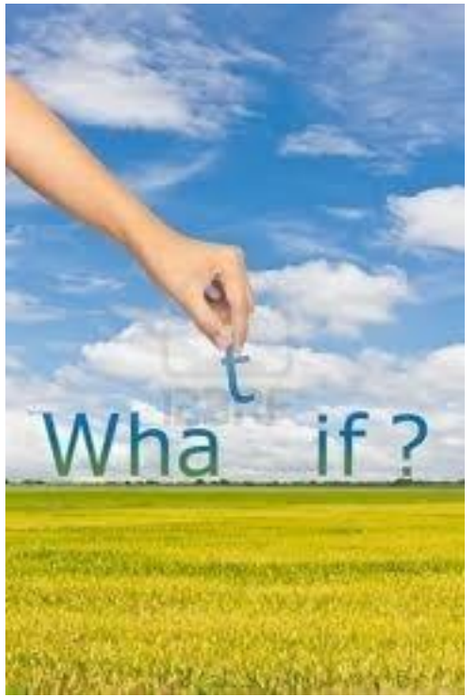
Status inquiry systems

business functions. These systems track information

Some decisions in the operational and middle management level do not require any elaborate computations, analysis, selection, etc. These decisions can be taken easily if the current status is known. Railwayreservation systems are an example of status inquiry systems. The system displays the status based on availability.

Applications of DSS

DSSs are very useful in analytical modeling. The four basictypes of analytical modeling supported by DSS are what-if analysis, goal seeking analysis, sensitivity analysis andoptimization analysis. These are discussed below:



Source: http://us.123rf.com

What-if analysis - End users can make use of what-if analysis to make changes in the variables or in the relationship amongst variables and observe the changes. The what-ifa nalysis is used for analyzing the various possibilities and derivingan appropriate strategy for e a ch situation. For example, the change in revenue can be studied by changing the tax rate. Managers generally use such an analysis to observe and evaluate changes. For instance, the what- if analysis is used for finding out the effect of a 5% reduction in advertising on sales.

Goal seeking analysis - Goal seeking analysis is the reverse of what-if-analysis. In goal-seek, the target is fixed and changes are made to the related variables so that the target achieved. For example, if the net profit is fixed at Rs. 100 million, changes can be made to the expenses and revenues in order to achieve the predetermined net profit. This is another important decision support tool. MS Excel is generally used for conducting goal seeking analysis.

Sensitivity analysis - Sensitivity analysis can be considered as a type of what-if analysis in which the effect of a repeated change in a single variable is examined. Using this analysis, one can find out the impact of a single variable on other variables. It is useful when the user is not sure about the value of a key variable. There are a few DSS packages that automatically and repeatedly make minor changes to the variables. For example, the tax rate can be changed repeatedly to observe how the revenues are affected.

Sensitivity analysis is used to find out how a continuous reduction in advertising expenditure affects sales. Scenario, a what-if analysis tool in MS Excel, is

Source: http://latestseoupdates.files.wordpress.com

Source:http://i.istockimg.com

is used for conducting sensitivity analysis.

Optimization analysis - Optimization analysis is a complex extension of goal-seeking. In optimization analysis, the target is not fixed. Rather, the target needs to be arrived at after taking into consideration the constraints involved in achieving the targets. In this analysis, one or more variables are changed after taking the constraints into account until the bestalternative or the optimal value is found. Optimization analysis would require special purpose software and techniques like linear programming. For instance, optimization analysis is used for finding out the optimum amount of advertising that could be used with the given constraints of budget and the media. Solver, a what-if analysis tool in MS Excel, is used for conducting optimization analysis.

SECTION 5

Executive Information Systems

Source: http://image.shutterstock.com

An Executive Information System (EIS) is a computerized information system which is designed to meet the informational requirements of the top executives of an organization. These information systems provide internal as well as external information that are significantly important for making decisions in order to meet the strategic objectives of the organization.

EIS combines the various features of the MIS and DSS. It can be considered a logical extension or form of decision support systems. Unlike DSS, Executive Information Systems are designed to draw inferences based on examples or make decisions based on predetermined logic or business rules. They were initially developed to serve the information requirements of the top management. These systems were aimed at supporting managerial learning about the organization, its work process and the impact of external environment. Information is mostly presented in graphical or diagrammatic form so that a user can understand it quickly. The format of presentation of information may also be predetermined so that reporting is standardized across the organization. The drill-down facility offered by these systems is useful when a manager wants to access details of previous analyses. EIS also helps the management focus its attention on critical issues or business problems.

EIS is being widely used in areas like crisis management, strategic planning, employee relations, internal and external monitoring of resources anddecision making at the executive level. It is used forproviding simplified information to executives and aids indecision-making.

For instance, most of the business organizations subscribe to the stock exchanges and other institutions to have access to stock market related data. Data provided by these institutions is complex and quite detailed. EIS can be used to generate reports which are simple and user-friendly. These systems take in only the information which is appropriate and then convert/ transform that information into a simpler and more user-friendly form which will aid executives in easy understanding and quick decision-making.

Exhibit 6.2

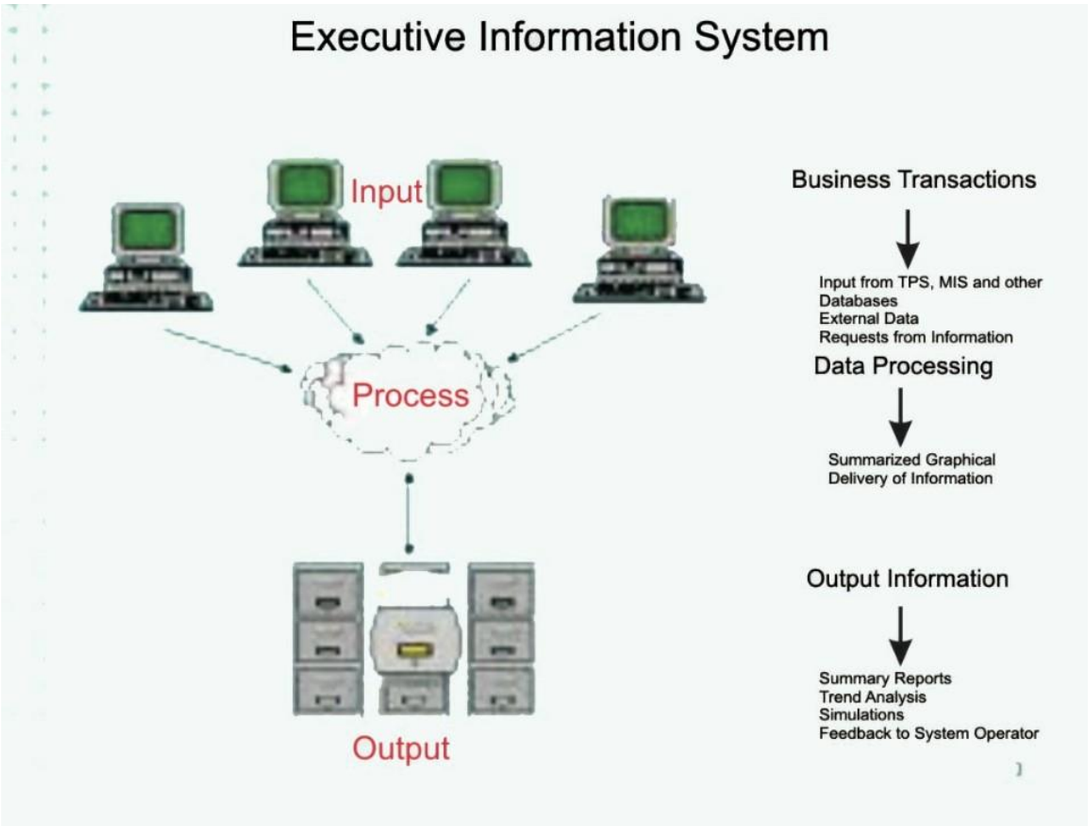
Mycin

An expert system in the field of medicine named Mycin was developed at Stanford University in the 1970s. The primary activity of this expert system was to diagnose and recommend treatment for some types of blood infections. Conventionally, it would take about 48 hours for doctors to properly diagnose a blood infection and by that time, most of the patients would die. Doctors, therefore, had to make quick guesses about the expected problems from the available data and use them to provide a covering treatment under which drugs which could deal with any problem would be given.

The development of Mycin was done partly to explore how experts made these rough but important guesses based on limited information. The use of an expert tool would help junior or non-specialized doctors in the process of providing more effective treatment. Mycin used various heuristics to control the search for a solution (or proof of some hypothesis). These were required both to make the reasoning efficient and to prevent the user being asked too many unnecessary questions. The performance of Mycin was extremely good. However, it was never practically implemented. This was due to the ethical and legal issues related to the use of computers in medicine. One of the questions asked for example, was who would be sued if the system made the wrong diagnosis.

Adapted from, “MYCIN: A Quick Case Study,” http://www.macs.hw.ac.uk/~alison/ai3notes/section2_5_5.html#SECTION00550000000000000000.

Architecture of EIS



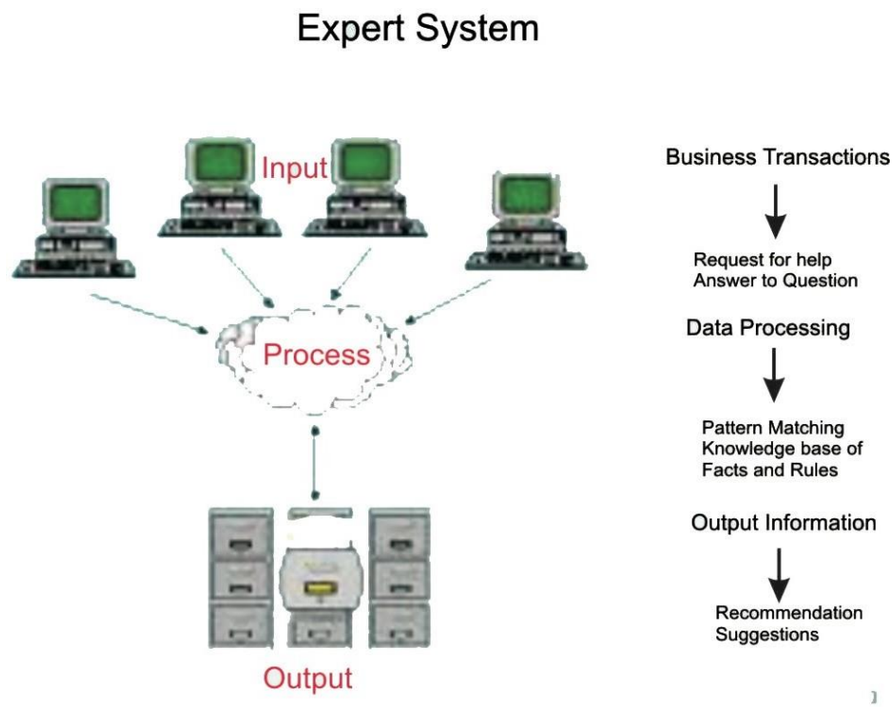
SECTION 6

Expert Systems

Expert systems are programs designed to provide users with the expertise of professionals in a particular field. These are knowledge-based information systems that use knowledge about a specific area to act as an expert consultant to the users. These systems gain knowledge from an expert and apply this knowledge to makedecisions. The knowledge base of the system consists of facts, procedural steps and rules that determine how the data is related to the solution and other relevant information. The rules are framed on the basis of the methods used by professionals for solving problems.

The expert system consists of an inference engine, which is a program that enables the system to evaluate the rules in the knowledge base. It determines the set of rules that will be invoked based on the nature of the problem. For example, an expert system can be used to gain knowledge about diagnosing a disease from a doctor and this knowledge can be incorporated in the form of software, which can be used by medical students. Refer to Exhibit 6.2 on an Expert System called Mycin, which was used for conducting medical diagnosis. The process in which the expert knowledge is acquired, documented and incorporated as software is called knowledge engineering.

Architecture of Expert System



SECTION 8

Enterprise IS - An Overview

Source: http://www.bournemouthwebsites.com

The world is witnessing an information and communication revolution. IT has changed the way people interact. The Internet has brought about a fundamental change in the way we work, shop, communicate, learn and play. Businesses have also benefited significantly through theuse of the Internet. The speed and efficiency of business transactions have improved drastically. Business deals that took months to finalize are now closed within hours. Besides, the Internet has helped streamline the business processes of organizations. The use of Internet technology for strategic advantage helps organizations improve efficiency and compete globally.

The Internet has also had an impact on customers, who have become more demanding as they now have more information about new products and services. The speed of the Internet has changed every aspect of business, be it interactions with customers, relationships with partners, or supply chain management.

IT helps organizations communicate, coordinate and collaborate both within and outside the organization. Systems that facilitate communication, coordination and collaboration to help people work together are known as enterprise

collaboration systems. The three main components of an enterprise collaboration system are electronic communication systems, electronic conferencing tools and collaborative work management tools. Workgroup support systems comprise

groupware that facilitates linking of workgroups located in different geographical regions. Multimedia is another popular tool for enterprise collaboration. It helps in making presentations more interactive and interesting.

Enterprise Communication Tools

Enterprise communication tools help in sharing documents, files and messages electronically with others. These include electronic mail, faxing, voice mail, instant messaging, web publishing, Internet phone and paging systems, and the Usenet. Through these tools, one can send data files, text, voice messages, or multimedia to others through computer networks.

Enterprise Conferencing Tools

Source:http://www.tnspl.in

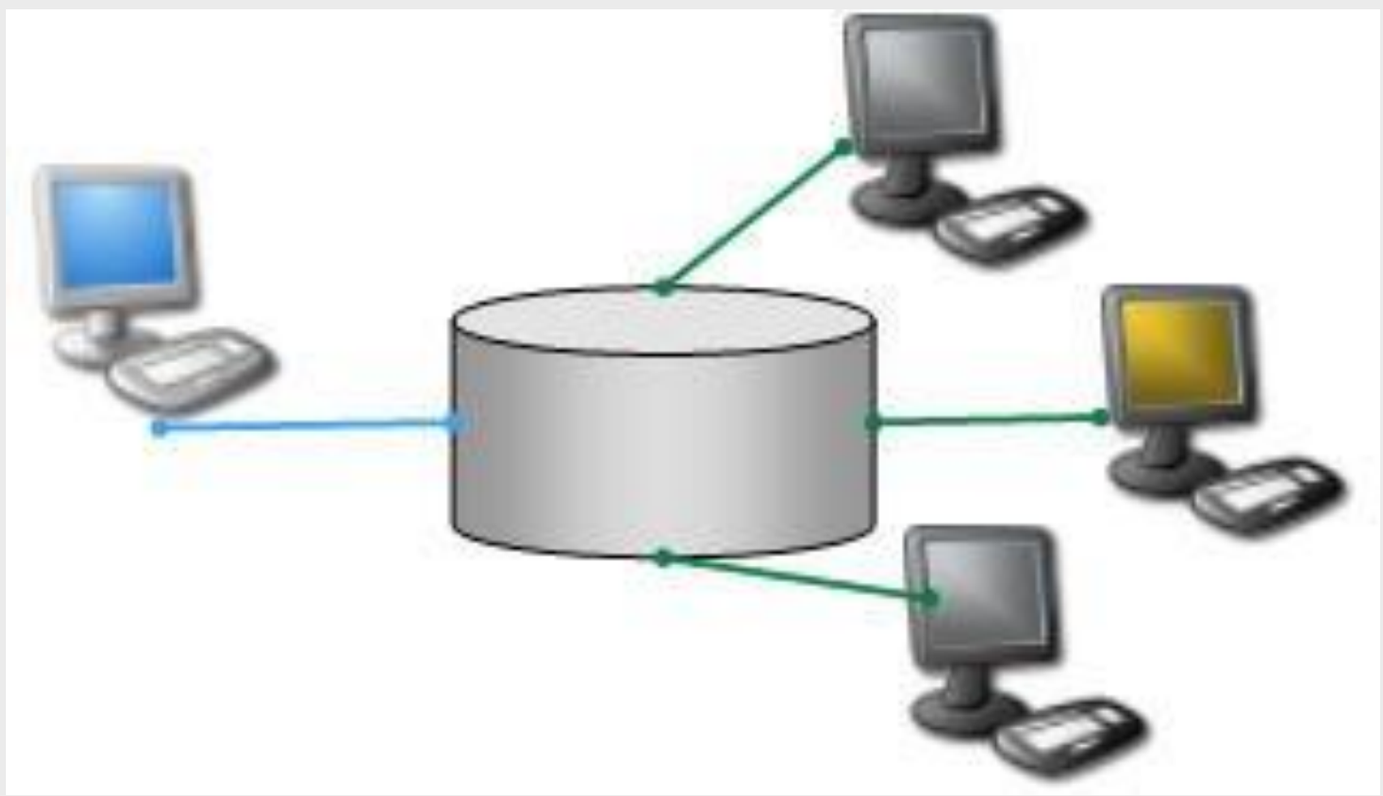
Enterprise conferencing tools enable people to share information in an interactive way. These tools include teleconferencing, discussion forums, chat systems and electronic meeting systems.

Video 2.7.1: CISCO Telepres-ence Magic - 1

Video 2.7.2 Telepresence (CISCO Video Conferencing) - 2

CHAPTER 4

Database Approaches to Data Management



Source: http://zone.ni.com

SECTION 1

Database Management Systems

Source: http://insidetech.monster.com

Data is a raw form of facts and is unformatted and unprocessed information. Data constitutes the building blocks of information. A database is a well-organized data in an integrated computer structure. It houses a collection of data of end-user and also metadata, which describes the data characteristics and the relationships between the different data sets. A database is a collection of related data that is organized to make access easier. Data management deals with proper generation, storage and retrieval of data. The database management system (DBMS) consists of interrelated data and a set of programs to access the data. DBMSs were first introduced during the 1960s and since then it has undergone a lot of changes. The primary goal of DBMS is to provide a convenient and efficient environment for storing and retrieving information in a database. The DBMS is a software that enables the programmer and administrators to create, delete, store, retrieve, organize, interrogate and maintain databases so as to enable instant and hassle-free access

to requisite information to the end users and their organizations. It involves the definition of structures for data storage and the provision for manipulation of data. It also ensures system security, preventing data loss due to system failure and unauthorized access. The DBMS software is responsible for the creation, maintenance and use of database systems in an organization. In the DBMSs, the data records are consolidated into databases that can be accessed by different application programs. The DBMS serves as an interface between users and the various databases. This helps the users access data easily. The most typical DBMS is a relational database management system (RDBMS). Microsoft Access is a popular example of a single or small-group user DBMS. Microsoft's SQL Server, Oracle, MySQL, etc., are examples of a DBMS that serves multiple-users.

Video 4.1.1: Database Management System

<u>How does a DBMS solve the problems of the traditional file environment:</u>

Prior to the advent of the Database Management System (DBMS), organizations stored data in a file- processing system, which followed electronic file processing approach to store and manipulate data. In a file-processing system, records are stored in various files. In order to extract, add, or delete records in aparticular file, various application programs need to be written. The file-processing system has certain disadvantages like difficulty in accessing data, duplication of data, large storage space being required and other security related problems. Since data wasstored on the tapes as long and sequential computer files, any slight modifications in the data had to be made in all the files that contained the data. These difficulties led to the development of the DBMS.

Table 4.1.1 Different Terms Used in Different Models:

E-R Model	Relational Model	Database	Traditional Programmer
Entity	Relation	Table	File
Entity Instance	Tuple	Row	Record
Attribute	Attribute	Column	Field
Identifier	Key	Key	Key (or link)

Source: http://cisnet.baruch.cuny.edu/holowczak/classes/4300/week4.html.

Entity-Relationship model is useful for database design and consists of entities, relationships and attributes as the basic elements or constructs. An entity consists of basic objects or concepts about which data is collected and stored. These may be places, people, objects, events, customers, orders, or something abstract like a loan or a holiday. Employees, invoices, projects, etc., are examples of entities. In the relational model, an entity is equivalent to a table. Entities can be classified based on whether they are independent or dependent. In certain

instances, they are also referred to as strong or weak. An independent entity is one which does not depend upon another entity for identification while a dependent entity depends upon another entity for identification. The occurrence of an entity, also known as the instance of an entity, is an individual occurrence of an entity. In the relational model, an occurrence is equivalent to a row while an attribute is equivalent to a column.

A relationship represents the association between two or more entities. It can be defined as the way in which data is shared between these entities. For example, an organization consists of many departments. Each department consists of anumber of employees. Each employee is identified with an employee identification number. Relationships are classified on the basis of degree, connectivity and cardinality, direction, type and existence. The degree of a relationship refers to the number of entities that are associated with the relationship. Binary relationships (relating two entities), ternary relationships (relating three entities), N-ary relationships (relating N number of entities), etc., are the different types of relationships classified on the basis of degree. When an entityis related to itself, the relationship is termed as a recursive relationship. Connectivity refers to the mapping of relatedentity occurrences in the relationship. These can be one or many. Cardinality refers to the actual number of associated instances for each of the two entities.

Three types of relationships based on connectivity take place between entities. These are one-to-one, one-to-many and many-to-many relationships. One-to-one or 1:1 relationships take place when one instance of an entity P is associated with one instance of another entity Q. For example, the employee name (P) is associated with the identification number (Q) of the employee. Also, the identification number of the employee can be used to identify the employee name. One-to-many or 1:N relationships take place when one instance of an entity P is associated with zero, one, or many instances of another entity Q. However, entity Q has an association with only one instance of entity P. For example, a department (P) consists of a number of employees (Q). All these employees (Q) belong to only one department (P). This relationship is also called the many-to-one or N:1 relationship. Many-to-many or M:N relationships take place when one instance of an entity P is associated with zero, one, or many instances of another entity Q. And, one instance of entity Q is associated with zero, one, or many instances of entity P. For example, in an organization, a single project (P) can be assigned to many employees (Q) and at the same time, a single employee (Q) can be assigned to many projects (P). This relationship is also called the N:M or non-specific relationship. The direction of a relationship indicates the flow of relationship from the originating entity to the terminating entity. In a relationship, the entity from which the relationship commences is called the parent entitywhile the entity at which the relationship concludes iscalled the child entity. The connectivity of a relationship decides the direction of the relationship. For example, in aone-to-one relationship, the direction flows from anindependent entity to a dependent entity. In one-to-many relationships, the direction always flows from one side to

many sides, only once to the parent entity. The direction will be an arbitrary one in situations where both the entities are independent or in case of

m a n y - t o - m a n y relationships.

Video 4.1.2 : Databases

Converting E-R model to a database model: The E-R model should be converted to a model which can be used directly in a database. Therefore, we need to convert the E-R model to a relational model. The relational model consists of relations, tuples and attributes. A relation is a two dimensional table which is made up of tuples. A tuple in therelational model is a row in a database. It is made up of oneor more attributes (or columns in the database model). Attribute is a characteristic or a property of the relationcontained in a tuple. Table 1 gives the different terms whichare used by different models.

In most of the E-R models, entities and weak entities get easily converted into relations. Each entity gets directly converted to a relation. The entity instances in the entity become tuples in the relation. The attributes in the entity become the attributes in the relation. The identifier in the entity becomes a key in the relation. If a weak entity is not dependent on the identifier (key), then it should be treated like any other.

The E-R model is based on various structures. These structures are formed out of the entities and they define the relationships between those entities. Refer to Figure 8.8 for the various structures.

For a database designer, the E-R model:

- Goes well with the relational model. The constructsused in the model (entities and relationships) can be transformed easily into relational tables.
- It is simple and can be easily understood by the end user.
- It requires minimal training.

- It can be used as a design plan for implementing adata model in database management.

SECTION 2

Relational DBMS and Its Operations

Earlier, databases were designed based on the network (collection of records that is organized as collections of arbitrary graphs) and the hierarchical (collection of records that is logically organized to conform to the upside-down tree structure) models. In 1970, Edgar F. Codd proposed the relational model. This model gained prominence over the years and began to dominate the data processing applications scenario in business organizations.

The Relational Database Model, also known as the Relational Database Management System (RDBMS), is based on the concept of tables or relations. In this model, the data is organized in the form of two-dimensional tables, representing data and relationships. Each row of a table corresponds to a record, while each column corresponds to a field. Unique keys or primary keys are used to access records in a table. The fields contain attributes like employee ID, employee name, age, etc.,while a row (also known as a tuple) identifies the details pertaining to a single instance like the details of a particular employee, say, Nikhil.

In relational databases, each row is distinctive and each column has a unique name. Each row has a key that identifies the row with the relation. Data records stored in tables can be accessed using a primary key. The primary key is a field in a record that is used to distinguish a record from other records in the table. For example, employee number will be the primary key in the employee table.Thus, relational databases allow the designating of certain fields as keys to facilitate specific field value search, i.e., when two different tables constitute the same field values,a single operation can be performed by matching the field values to select the related records in the two tables. At times, the fields will be referred to by the same name in both the tables. For instance, a table containing the personal details of the employees will have a field for employee ID. A table containing the official details of the employees will also have an employee ID field. This

employee ID field can be used as a medium for relating the two tables. Another example is linking a customer file and an accounts receivable file by using a common field, such as the customer account number field. The user can then request a report consisting of fields from both the customer and the accounts receivable records. This facility offered by relational databases can also be extended to relate multiple tables.

Relational databases also have keys called foreign keys. These keys are primary keys of one table which can be included in another table for relating or joining the data. For example, the social security numbers of the father and mother can be used to represent their child. In this example, the social security number of the father and/or the mother acts as a primary key in a table that represents them while it acts as a foreign key in the table which represents their child.

Relational database management systems like DB2, Microsoft SQL Server, Oracle, Informix, Sybase SQL Server, Ingres, SQLite, Access, etc., are based on the relational model.

Normalization of data: Normalization is a technique used for designing relational databases. It refers to the optimization of tables to remove any redundancy and scalability issues that might arise when the amount of data is increased. It is a two-step process which involves arranging the data in a tabular form after deleting the repeating groups and the duplicated data from relational tables.

The process of normalization is based on the concept of normal form. A relational table is said to be in a normal form if it satisfies a set of constraints. A database can be normalized up to six normal forms but most databases

Table 4.2.1(a): Table Not Complying with the Second Normal Form

Student ID	Course ID	Percentage Obtained	Course Title
111	223	70	Data Warehousing
112	224	60	SQL
113	225	85	RDBMS
114	226	75	C and C++
115	227	65	Java
116	225	55	RDBMS
117	224	56	SQL
118	223	87	Data Warehousing
119	226	62	C and C++
120	227	78	Java

are only up to the third normal form. To be in the first normal form, every table must have a primary key, which is a column (or set of columns) that uniquely identifies each row. Usually, each table contains only one primary key. Sometimes, there can be more than one primary key in a table. In such situations, one key is selected as the primary key; the others are called alternate keys.

To be in second normal form, the table should be in the first normal form and there should not be any partial dependency, i.e., all the non-key fields (fields that are not primary) should be functionally dependent on the full primary key. Refer to Table 4.2.1(a) for an example of a table that does not comply with the second normal form.

Table 4.2.1(b): Table Complying with the Second Normal form:

Student ID	Course ID	Percentage Obtained
111	223	70
112	224	60
113	225	85
114	226	75
115	227	65
116	225	55
117	224	56
118	223	87
119	226	62
120	227	78

Course ID	Course Title
223	Data Warehousing
224	SQL
225	RDBMS
226	C and C++
227	Java

In Table 4.2.1(a), student ID + course ID is the primary key on which the percentage and the course title are dependent. The course title functionally depends only on the course ID (part of the primary key) rather than on the full primary key. Therefore, this is a situation of a partial dependency. In order to convert the table into the second normal form, it should be split into two as given in table 2(b). One table would contain only the student ID, the course ID and the percentage obtained while another would contain the course ID and the course title.

Table 4.2.2(a) : Table not Complying with the third normal form:

Customer ID	Customer	Salesperson	Zone
653	James	Sally	South
256	Jewel	Tom	North
152	Harry	Sally	South
569	Helen	Jack	West
972	Scott	Howard	East

In Table 4.2.2(a), customer ID is the primary key onwhich the customer, salesperson and the zone are dependent. However, there is a transitive dependence between salesperson and the zone. For instance, the salesperson Sally is available in the Southern zone. Whenever, a customer calls from the Southern zone,Sally is the salesperson who attends to the call. In the given situation, James and Harry are customers who belong to the Southern zone and therefore Sally attends to their calls.

Table 4.2.2(b): Tables Complying with the Third Normal Form

Customer ID	Customer	Salesperson
653	James	Sally
256	Jewel	Tom
152	Harry	Sally
569	Helen	Jack
972	Scott	Howard

Salesperson	Zone
Sally	South
Tom	North
Jack	West
Howard	East

To convert the table into the third normal form, the tableshould be further split into two as given in Table 4.2.2(b). Onetable would have the customer ID, customer and thesalesperson while the other would have the salesperson and the zone.

SECTION 3

Capabilities of DBMS

Source: http://www.adroitglobalnetwork.com

DBMS reduces data redundancy and improves productivity and concurrency. In a DBMS, data is integrated and can be accessed by multiple programs and users. In a DBMS, simple queries can be used to obtain information. Therefore, there is no need to write programs. The DBMS approach reduces the costs involved in data maintenance. Managing data in databases augments maintenance through data independence. In a DBMS,data is stored in databases which are reliable and secure. Database management enhances the accessibility and responsiveness of the data. The DBMS approach enables better data sharing and avoids duplication.

The DBMS helps in effectively managing huge volumes of interrelated data. Any changes made in the data are reflected in every location at which the data is recorded. The DBMS also helps in preventing data redundancy. Different applications in banking, such as check processing, savings accounts, bank credit cards, automated teller systems and loan accounting require suchactivities to be done on a regular basis. The entire data related to the customers can be consolidated into a common customer database.

The DBMS enables frequent updation and maintenance of databases so that they reflect new business transactions. The DBMS supplies information to the end users through application programs. These programs share the data that are stored in the common databases. Also, the end users need not know where and how the data is physically stored. The DBMS provides inquiry and reporting capabilities to the end users.