

MANAGEMENT INFORMATION SYSTEM

I MBA – Semester - II					
Course Code	MANAGEMENT INFORMATION SYSTEM	L	T	P	C
22MBA126A			3	1	0
Course Educational Objectives:					
<p>CEO1 : To inculcate students with comprehensive knowledge of information system and information technology for the use in business.</p> <p>CEO2 : To enable students understand the role of information system in managerial decision making.</p> <p>CEO3 : To provide knowledge on systems design, development and implementation.</p> <p>CEO4 : To apply specific knowledge of information system in functional areas of business.</p> <p>CEO5 : To enable students to manage and protect information resources.</p>					
UNIT - I	Information and systems concepts	Lecture Hrs: 10			
Types of Information systems on organizations, Decision making process – Individual Vs. Organizational models, Managing H/W, S/W and Data Resources, I.T. Infrastructure for the organization and Digital Firm.					
UNIT - II	MIS Design	Lecture Hrs: 10			
Importance of MIS Design, Approaches for the MIS design: Traditional and Modern Approaches. MIS Growth Model.					
UNIT - III	Management support systems	Lecture Hrs:12			
Decision support systems, Expert systems. Concepts of Data mining, Data warehousing and OLAP.					
UNIT - IV	Functional Information Systems	Lecture Hrs:12			
Marketing, Manufacturing, Financial and Human resource Information Systems					
UNIT - V	Information Systems Security and Control:	Lecture Hrs:10			
Vulnerability and Abuse, Anti-Virus Packages and Systems Audit. Managing Global Information Systems					
Course Outcomes:					
On successful completion of the course the student will be able to,		POs & PSOs related to COs			
CO1	Employ the features of Information system and Information technology in decision making process	PO1, PO2, PO6, PSO1			
CO2	Appraise the management information system design models	PO1, PO2, PSO1			
CO3	Distinguish the application of various support systems to be put in appropriate practice	PO1, PO2, PSO1			
CO4	Use the concept of sub systems and data flows in the functional areas of management.	PO1, PO2, PO6, PO7, PO8, PSO1			

CO5	Apply the measures for safety and security of information system at organizational and global level.	PO4, PSO1, PSO2
Text Books:		
<ol style="list-style-type: none"> 1. Management Information Systems: Managing the Digital Firm, Kenneth C. Laudon, Jane Price Laudon, Pearson, 2020. 2. Management Information Systems, Kenneth C. Lauadon and Jane. P. Lauadon, Pearson Education, 2015. 		
Reference Books:		
<ol style="list-style-type: none"> 1. Management Information Systems, James A O 'Brien, Tata McGraw Hill, 2008. 2. Management Information Systems, Murthy CSV, Himalaya, 2013. 3. Management Information Systems, Giridhar Joshi, Oxford, 2005. 		
Online Learning Resources:		
https://repository.dinus.ac.id/docs/ajar/Kenneth_C.Laudon.Jane_P_.Laudon_-_Management_Information_Sysrem_13th_Edition_.pdf https://www.mbaknol.com/management-information-systems/case-study-on-mis-information-system-in-restaurant/ https://archive.nptel.ac.in/courses/110/105/110105148/		

COURSE OUTCOMES VS POs MAPPING (DETAILED; HIGH:3; MEDIUM:2; LOW:1):

Course	CO	PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PSO1	PSO2
C1206A : MANAGEMENT INFORMATION SYSTEM	C1206A.1	3	3	-	-	-	3	-	-	3	-
	C1206A.2	3	3	-	-	-	-	-	-	3	-
	C1206A.3	3	3	-	-	-	2	-	-	2.7	-
	C1206A.4	3	3	-	-	-	3	-	3	3	-
	C1206A.5	-	-	-	-	3	-	3	-	3	3
	C1206A	3	3	-	-	3	2.67	3	3	2.9	3

UNIT – I
INFORMATION SYSTEM AND
CONCEPTS

Management Information Systems (MIS), referred to as Information Management and Systems, is the discipline covering the application of people, technologies, and procedures collectively called information systems, to solving business problems.

“MIS’ is a planned system of collecting, storing and disseminating data in the form of information needed to carry out the functions of management.”

Academically, the term is commonly used to refer to the group of information management methods tied to the automation or support of human decision making, e.g. Decision Support Systems, Expert Systems, and Executive Information Systems.

Management : Management is art of getting things done through and with the people in formally organized groups. The basic functions performed by a manager in an organization are: Planning, controlling, staffing, organizing, and directing.

Information : Information is considered as valuable component of an organization. Information is data that is processed and is presented in a form which assists decision maker.

System : A system is defined as a set of elements which are joined together to achieve a common objective. The elements are interrelated and interdependent. Thus every system is said to be composed of subsystems. A system has one or multiple inputs, these inputs are processed through a transformation process to convert these input(s) to output.

1.1 MIS DEFINITION:

The Management Information System (MIS) is a concept of the last decade or two. It has been understood and described in a number ways. It is also known as the Information System, the Information and Decision System, the Computer- based information System.

The MIS has more than one definition, some of which are give below.

1. The MIS is defined as a system which provides information support for decision making in the organization.
2. The MIS is defined as an integrated system of man and machine for providing the information to support the operations, the management and the decision making function in the organization.
3. The MIS is defined as a system based on the database of the organization evolved for the purpose of providing information to the people in the organization.
4. The MIS is defined as a Computer based Information System.

In order to get a better grip on the activity of information processing, it is necessary to have a formal system which should take care of the following points:

- Handling of a voluminous data.
- Confirmation of the validity of data and transaction.
- Complex processing of data and multidimensional analysis.
- Quick search and retrieval.
- Mass storage.
- Communication of the information system to the user on time.
- Fulfilling the changing needs of the information.
- The management information system uses computers and communication technology to deal with these points of supreme importance.

1.2 Objectives of MIS :

1. Data Capturing : MIS capture data from various internal and external sources of organization. Data capturing may be manual or through computer terminals.

2. Processing of Data : The captured data is processed to convert into required information. Processing of data is done by such activities as calculating, sorting, classifying, and summarizing.

3. Storage of Information : MIS stores the processed or unprocessed data for future use. If any information is not immediately required, it is saved as an organization record, for later use.

4. Retrieval of Information : MIS retrieves information from its stores as and when required by various users.

5. Dissemination of Information : Information, which is a finished product of MIS, is disseminated to the users in the organization. It is periodic or online through computer terminal.

1.3 Characteristics of MIS :

1. Systems Approach : The information system follows a systems approach. Systems approach means taking a comprehensive view or a complete look at the interlocking sub-systems that operate within an organization.

2. Management Oriented : Management oriented characteristic of MIS implies that the management actively directs the system development efforts. For planning of MIS, top-down approach should be followed. Top down approach suggests that the system development starts from the determination of management's needs and overall business objective. To ensure that the implementation of system's policies meet the specification of the system, continued review and participation of the manager is necessary.

3. Need Based : MIS design should be as per the information needs of managers at different levels.

4. Exception Based : MIS should be developed on the exception based also, which means that in an abnormal situation, there should be immediate reporting about the exceptional situation to the decision –makers at the required level.

5. Future Oriented : MIS should not merely provide past of historical information; rather it should provide information, on the basis of future projections on the actions to be initiated.

6. Integrated : Integration is significant because of its ability to produce more meaningful information. Integration means taking a comprehensive view or looking at the complete picture of the interlocking subsystems that operate within the company.

7. Common Data Flow : Common data flow includes avoiding duplication, combining similar functions and simplifying operations wherever possible. The development of common data flow is an economically sound and logical concept, but it must be viewed from a practical angle.

8. Long Term Planning : MIS is developed over relatively long periods. A heavy element of planning should be involved.

9. Sub System Concept : The MIS should be viewed as a single entity, but it must be broken down into digestible sub-systems which are more meaningful.

10. Central database : In the MIS there should be common data base for whole system

1.4 ROLE OF THE MANAGEMENT INFORMATION SYSTEM:

The role of the MIS in an organization can be compared to the role of heart in the body.

(1) The system ensures that an appropriate data is collected from the various sources, processed, and sent further to all the needy destinations. The system is expected to fulfill the information needs of an individual, a group of individuals, the management functionaries: the managers and the top management.

(2) The MIS satisfies the diverse needs through a variety of systems such as Query Systems, Analysis Systems, Modeling Systems and Decision Support Systems the MIS helps in Strategic Planning, Management Control, Operational Control and Transaction Processing.

(3) The MIS helps the clerical personnel in the transaction processing and answers their queries on the data pertaining to the transaction, the status of a particular record and references on a variety of documents. The MIS helps the junior management personnel by providing the operational data for planning, scheduling and control, and helps them further in decision making at the operations level to correct an out of control situation.

(4) The MIS helps the middle management in short term planning, target setting and controlling the business functions. It is supported by the use of the management tools of planning and control. The MIS helps the top management in goal setting, strategic planning and evolving the business plans and their implementation.

(5) The MIS plays the role of information generation, communication, problem identification and helps in the process of decision making. The MIS, therefore, plays a vital role in the management, administration and operations of an organization.

INFORMATION CONCEPTS

The word .information. is used commonly in our day to day working. In MIS, information has a precise meaning and it is different from data. The information has a value in decision making while data does not have. Information brings clarity and creates an intelligent human response in the mind. In MIS a clear distinction is made between data and information. Data is like raw materials while the information is equivalent to the finished goods produced after processing the raw material. Information has certain characteristics. These are: Information

- Improves representation of an entity
- Updates the level of knowledge.
- Has a surprise value.
- Reduces uncertainty.
- Aids in decision making.

Characteristics of Information :

Following are the essential characteristic features :

(i) Timeliness : Timeliness means that information must reach the recipients within the prescribed timeframes. For effective decision-making, information must reach the decision-maker at the right time, i.e. recipients must get information when they need it. Delays destroys the value of information. The characteristic of timeliness, to be effective, should also include up-to-date, i.e. current information.

(ii) Accuracy : Information should be accurate. It means that information should be free from mistakes, errors &, clear Accuracy also means that the information is free from bias. Wrong information given to management would result in wrong decisions. As managers decisions are based on the information supplied in MIS reports, all managers need accurate information.

(iii) Relevance : Information is said to be relevant if it answers especially for the recipient what, why, where, when, who and why? In other words, the MIS should serve reports to managers which is useful and the information helps them to make decisions..

(iv) Adequacy : Adequacy means information must be sufficient in quantity, i.e. MIS must provide reports containing information which is required in the deciding processes of decision-making. The report should not give inadequate or for that matter, more than adequate information, which may create a difficult situation for the decision-maker. Whereas inadequacy of information leads to crises, information overload results in chaos.

(v) Completeness : The information which is given to a manager must be complete and should meet all his needs. Incomplete information may result in wrong decisions and thus may prove costly to the organization.

(vi) Explicitness : A report is said to be of good quality if it does not require further analysis by the recipients for decision making.

(vii) Impartiality: Impartial information contains no bias and has been collected without any distorted view of the situation. The partiality creeps in, if the data is collected with a preconceived view, a prejudice, and a pre-determined objective or a certain motive.

(viii) Validity: The validity of the information relates to the purpose of the information. In other words, it is the answer to the question-dose the information meet the purpose of decision making for

which it is being collected? The validity also depends on how the information is used.

(ix) Reliability: It is connected to the representation and the accuracy of what is being described. For example, if the organization collects the information on the product acceptance in the selected market segment, the size of the sample and the method of selection of the sample will decide the reliability. If the sample is small, the information may not give the correct and a complete picture and hence it is not reliable. The reliability is also affected from the right source.

(x) Consistency: The information is termed as inconsistent if it is derived form a data which dose not have a consistent pattern of period. Somewhere, the information must relate to a consistent base or a pattern. For example, you have collected the information on the quantity of production for the last twelve months to fix the production norms. If in this twelve months period, the factory has worked with variable shift production, the production statistics of the twelve months for comparison is inconsistent due to per shift production. The consistency can be brought in by

rationalizing the data to per shift production per month. The regularity in providing the information also helps in assessing the consistency in the information.

(xi)Age: If the information is old, it is not useful today. The currency of the information makes all the difference to the users. If the information is old then it does not meet any characteristics of the information viz., the update of knowledge, the element of surprise and the reduction of uncertainty, and the representation. Maintaining these parameters at a high degree always poses a number of problems.

System Concept

Definition of System :

"A system is an orderly grouping of interdependent components linked together according to a plan to achieve a specific objective".

Characteristics of a System:

- Organization
- Interaction
- Interdependence
- Integration
- Central Objective

i) Organization-It implies structure and order.

ii) Interaction-It refers to manner in which each component functions with other components of the system.

iii)Interdependence-Units/parts are dependent on each other.

iv)Integration-The parts of a system work together within the system even though each part performs a unique function.

v)Central Objective-Objective may be real or stated. All the components work together to achieve that particular objective.

Elements of a System

In most cases, systems analysts operate in a dynamic environment where change is a way of life. The environment may be a business firm, a business application, or a computer system. To reconstruct a system, the following key elements must be considered:

1. Outputs and inputs.
2. Processor(s).
3. Control.
4. Feedback.
5. Environment.
6. Boundaries and interface.

1) Outputs and Inputs : A major objective of a system is to produce an output that has value to its user. Whatever the nature of the output (goods, services, or information), it must be in line with the expectations of the intended user. Inputs are the elements (material, human resources, and information) that enter the system for processing. Output is the outcome of processing. A system feeds on input to produce output in much the same way that a business brings in human, financial, and material resources to produce goods and services. It is important to point out here that determining the output is a first step in specifying the nature, amount, and regularity of the input needed to operate a system. For

example, in systems analysis, the first concern is to determine the user's requirements of a proposed computer system – that is, specification of the output that the computer is expected to provide for meeting user requirements.

2) Processor(s) : The processor is the element of a system that involves the actual transformation of input into output. It is the operational component of a system. Processors may modify the input totally or partially, depending on the specifications of the output. This means that as the output specifications change so does the processing. In some cases, input is also modified to enable the processor to handle the transformation.

3) Control : The control element guides the system. It is the decision – making subsystem that controls the pattern of activities governing input, processing, and output. In an organizational context, management as a decision – making body controls the inflow, handling and outflow of activities that affect the welfare of the business. In a computer system, the operating system and accompanying software influence the behaviour of the system. Output specifications determine what and how much input is needed to keep the system in balance.

In systems analysis, knowing the attitudes of the individual who controls the area for which a computer is being considered can make a difference between the success and failure of the installation. Management support is required for securing control and supporting the objective of the proposed change.

4) Feedback: Control in a dynamic system is achieved by feedback. Feedback measures output against a standard in some form of cybernetic procedure that includes communication and control. Output information is fed back to the input and / or to management (Controller) for deliberation. After the output is compared against performance standards, changes can result in the input or processing and consequently, the output.

Feedback may be positive or negative, routing or informational. Positive feedback reinforces the performance of the system. It is routine in nature. Negative feedback generally provides the controller with information for action. In systems analysis, feedback is important in different ways. During analysis, the user may be told that the problems in a given application verify the initial concerns and justify the need for change.

Another form of feedback comes after the system is implemented. The user informs the analyst about the performance of the new installation. This feedback often results in enhancements to meet the user's requirements.

5) Environment

The environment is the “suprasystem” within which an organization operates. It is the source of external elements that impinge on the system. In fact, it often determines how a system must function. For example, the organization's environment, consisting of vendors, competitors, and others, may provide constraints and, consequently, influence the actual performance of the business.

6) Boundaries and interface

A system should be defined by its boundaries – the limits that identify its components, processes and interrelationship when it interfaces with another system. For example, a teller system in a commercial bank is restricted to the deposits, withdrawals and related activities of customers checking and savings accounts. It may exclude mortgage foreclosures, trust activities, and the like.

Each system has boundaries that determine its sphere of influence and control. For example, in an integrated banking – wide computer system design, a customer who has a mortgage and a checking account with the same bank may write a check through the “teller system” to pay the

premium that is later processed by the “mortgage loan system.” Recently, system design has been successful in allowing the automatic transfer of funds from a bank account to pay bills and other obligations to creditors, regardless of distance or location. This means that in systems analysis, knowledge of the boundaries of a given system is crucial in determining the nature of its interface with other systems for successful design.

Managing Database

Managing data Resources:

- An information system provides users with timely, accurate, and relevant information.
- The information is stored in computer files. When files are properly arranged and maintained, users can easily access and retrieve the information when they need.
- If the files are not properly managed, they can lead to chaos in information processing.
- Even if the hardware and software are excellent, the information system can be very inefficient because of poor file management.

File Organization Terms and Concepts

File Organization Terms and Concepts

- A computer system organizes data in a hierarchy that starts with the bit. Bit represents 0 or 1. 8 bits are grouped to form a byte. Each byte represents one character, number, or symbol.
- Bytes can be grouped to form a field. It can represent a person’s name or age.
- Related fields can be grouped to form a record. Related fields can be student’s name, course taken and the grade.
- Related records can be grouped to form a file.
- Related files can be grouped to form a database
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- There are mainly two ways to organize records: sequentially or randomly.
- In sequential file organization, data records must be retrieved in the same physical sequence in which they are stored.
- In direct or random file organization, data records can be accessed in any sequence as users desire, without regard to actual physical order on the storage media.
- Sequential file organization is the only file organization that can be used on magnetic tape. Example: Payroll
- Direct or random file organization is utilized with magnetic disk. Most computer applications utilize this method.

Database and Database Management System

- **Database** => A database is a collection of data organized to service many applications efficiently by centralizing the data and minimizing redundant data.
- **Database management System** => A database management system is a special software that permits an organization to centralize data, manage it efficiently, and provide access to the stored data by application programs.

- The Components of a DBMS
- The data definition language which is the formal language used by programmer to specify the content and structure of the database.
- The data manipulation language, which is used to manipulate the data in database. It contains commands that permit end-users and programming specialists to extract data from the database to satisfy information requests and develop applications.
- The data dictionary, which is an automated or manual file that stores definitions of data elements and data characteristics such as usage, physical representation, ownership and security.

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- Database Models

The principal database models are:

- Hierarchical database model
- Network data model
- Relational database model
- Object oriented database model

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- Hierarchical Database Model :

- The hierarchical database model stores data logically in a vertical hierarchy resembling a tree-like structure.
- An upper record is connected logically to a lower record in a parent-child relationship.
- A parent segment can have more than one child but a child can only have one parent.
- This model is good for treating one-to-many relationships.
- They can store large numbers of segments and process efficiently, but they can only deliver information if a request follows the linkages of the hierarchy.
- The disadvantages are their low user-friendliness, inflexibility, and complexity of programming .
- Advantages: They are good for high volume rapid response systems, such as airline reservation systems.

- Network Database Model:

- The network model stores data logically in a structure that permits many-to-many relationships.
- Through extensive use of pointers, child segment can have more than one parent.
- Network DBMS reduce redundancy and they process information efficiently.
- However, they are inflexible and very complex to maintain and program.

- Relational Database Model

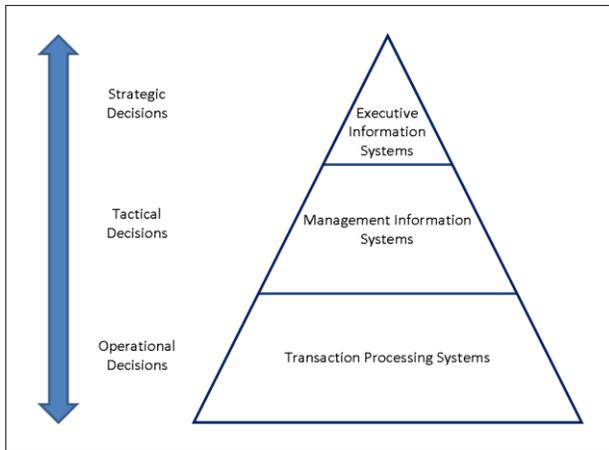
- The relational model overcomes many of the limitations of the previous models.
- Data are organized into two-dimensional tables, each of which can be considered a file.
- The relational model can relate any piece of information in one file to any piece in another file as long as the two tables share a common data element.
- For this reason, they are very flexible.
- Access paths to data are not predefined, so that they can easily respond to ad-hoc queries with less programming.

- The main problem with RDBMS is poor processing efficiency. Response time can be very slow if large number of accesses are required to select, join, and extract data from tables.
- Object-Oriented, Database model:
- Traditional databases store only homogeneous data that can be easily structured into predefined data fields and records. They are not well suited for handling other types of data such as procedures or graphics.
- For example, sales by item by department by store by region, in order to find patterns in the data.
- Such patterns are difficult to find with normal database methods.
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- Data Warehouse
- A data warehouse is a read-only analytical database that is used as the foundation of a decision support system.
- It is subject-oriented, integrated, nonvolatile, and time-variant
- Subject-oriented=> It is organized around the major subjects of the enterprise while operational world is designed around applications, functions, and process.
- Integrated=> Data from different sources is stored in data warehouse in a single, easy to understand, globally accepted fashion.
- Non-volatile=>Generally , updating is not done in data warehouse environment; update is done in operational environment.
- Time-variant=> It is a time variant collection of data. Time variant means that every unit of data in the warehouse is relevant to some moment of time.
- **Successful Database Environment**
- Data administration=> the policies, procedures, and tools for managing and planning for information as a corporate source.
- A data planning and modeling methodology from an enterprise-wide perspective.
- Users=> end users have a wide role with DBMS than in traditional systems and they must be trained.
- Database technology and management=> DBMS software maintained by firm's database administration group.
- A computer system organizes data in a hierarchy that starts with the bit.

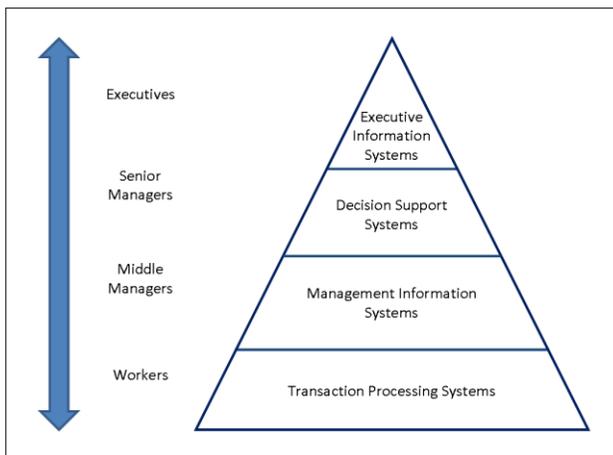
TYPES OF INFORMATION SYSTEM

The different types of information system that can be found are identified through a process of classification. . A 'type' or category of information system is simply a concept, an abstraction, which has been created as a way to simplify a complex problem through identifying areas of commonality between different things. One of the oldest and most widely used systems for classifying information systems is known as the pyramid model; this is described in more detail below.

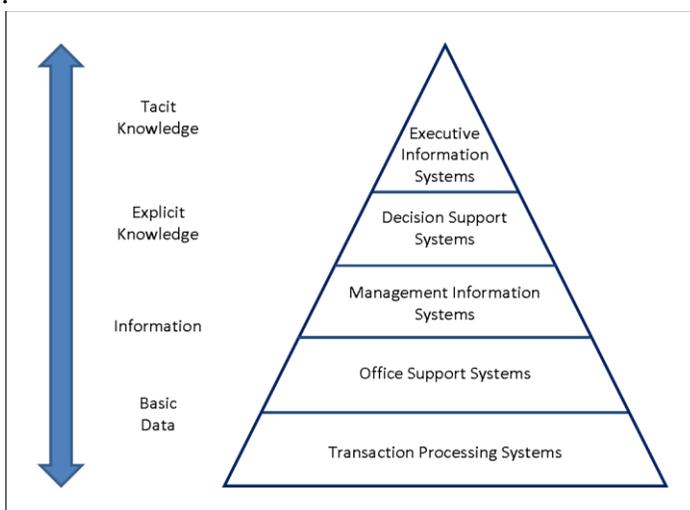
- A.** Three level pyramid model based on the type of decisions taken at different levels in the organization.



b. Four level pyramid model based on the different levels of hierarchy in the organization



C, Five level pyramid model based on the processing requirement of different levels in the organization



1. Transaction Processing Systems

Transaction Processing System are operational-level systems at the bottom of the pyramid. They are usually operated directly by shop floor workers or front line staff, which provide the key data required to support the management of operations. This data is usually obtained through the automated or semi-automated tracking of low-level activities and basic transactions.

Functions of a TPS

TPS are ultimately little more than simple data processing systems.

Functions of a TPS in terms of data processing requirements		
Inputs	Processing	Outputs
Transactions Events	Validation Sorting Listing Merging Updating Calculation	Lists Detail reports Action reports Summary reports?

Some examples of TPS

- Payroll systems
- Order processing systems
- Reservation systems
- Stock control systems
- Systems for payments and funds transfers
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2. Management Information Systems

For historical reasons, many of the different types of Information Systems found in commercial organizations are referred to as "Management Information Systems". However, within our pyramid model, Management Information Systems are management-level systems that are used by middle managers to help ensure the smooth running of the organization in the short to medium term. The highly structured information provided by these systems allows managers to evaluate an organization's performance by comparing current with previous outputs.

Functions of a MIS

MIS are built on the data provided by the TPS

Functions of a MIS in terms of data processing requirements		
Inputs	Processing	Outputs
Internal Transactions Internal Files Structured data	Sorting Merging Summarizing	Summary reports Action reports Detailed reports

Some examples of MIS

- Sales management systems
- Inventory control systems
- Budgeting systems
- Management Reporting Systems (MRS)
- Personnel (HRM) systems

3. Decision Support Systems

A Decision Support System can be seen as a knowledge based system, used by senior managers, which facilitates the creation of knowledge and allow its integration into the organization. These systems are often used to analyze existing structured information and allow managers to project the potential effects of their decisions into the future. Such systems are usually interactive and are used to solve ill structured problems. They offer access to databases, analytical tools, allow "what if" simulations, and may support the exchange of information within the organization.

Functions of a DSS

DSS manipulate and build upon the information from a MIS and/or TPS to generate insights and new information.

Functions of a DSS in terms of data processing requirements		
Inputs	Processing	Outputs
Internal Transactions Internal Files External Information?	Modelling Simulation Analysis Summarizing	Summary reports Forecasts Graphs / Plots

Some examples of DSS

- o Group Decision Support Systems (GDSS)
- o Computer Supported Co-operative work (CSCW)
- o Logistics systems
- o Financial Planning systems
- o Spreadsheet Models?
- o

4. Executive Information Systems

What is an EIS?

Executive Information Systems are strategic-level information systems that are found at the top of the Pyramid. They help executives and senior managers analyze the environment in which the organization operates, to identify long-term trends, and to plan appropriate courses of action. The information in such systems is often weakly structured and comes from both internal and external sources. Executive Information System are designed to be operated directly by executives without the need for intermediaries and easily tailored to the preferences of the individual using them.

Functions of an EIS

EIS organizes and presents data and information from both external data sources and internal MIS or TPS in order to support and extend the inherent capabilities of senior executives.

Functions of a EIS in terms of data processing requirements		
Inputs	Processing	Outputs
External Data Internal Files Pre-defined models	Summarizing Simulation "Drilling Down"	Summary reports Forecasts Graphs / Plots

Some examples of EIS

Executive Information Systems tend to be highly individualized and are often custom made for a particular client group; however, a number of off-the-shelf EIS packages do exist and many enterprise level systems offer a customizable EIS module.

5. Office Support System:

Office support system (OSS): a *system* designed to assist employees in accomplishing their day-to-day tasks and to improve communications

Office automation system includes formal and informal electronic systems primarily concerned with the communication of information to and from persons both inside and outside the firm. It supports data workers in an organization.

For Instance

- Word processing
- Desktop publishing
- Imaging & Web publishing
- Electronic calendars manager's appt. calendars
- Email
- Audio & video conferencing establishing communication between geographically dispersed persons

Decision making

DECISION-MAKING CONCEPT:

Individual and organizational decision making: Individual decision making is the process of choosing the best alternative by an individual may be for organizational purpose.

Organization decisions are group decision where several individuals are involved in decision making process.

A decision is choice out of several alternatives (options) made by the decision maker to achieve some objective s in a given situation. Business decisions are those, which are made in the process of conducting business to achieve its objective in a given environment. Managerial decision-making is a control point for every managerial activity may be planning, organizing, staffing, directing, controlling and communicating. Decision-making is the art of reasoned and judicious choice out of many alternatives. Once decision is taken, it implies commitment of resources.

The business managers have to take variety of decision. Some are routine and others are long-term implementation decision. Thus managerial decisions are grouped as:

- (a) Strategic decision
- (b) Tactical decision
- (c) Operation decision

1. Strategic Decision: these are known as major decision influence whole or major part of the organization. Such decisions contribute directly to the achievement of common goals of the organization; have long range effect upon the organization.

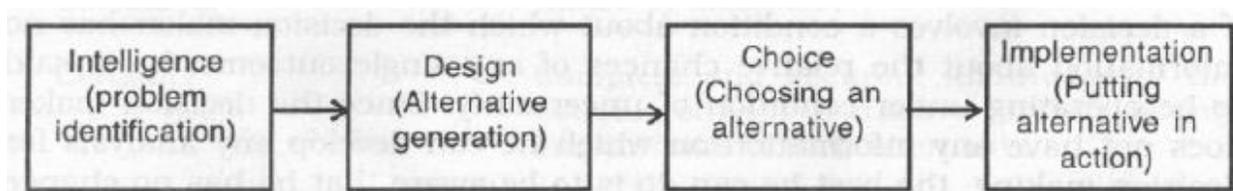
Generally, strategic decision is unstructured and thus, a manager has to apply his business judgment, evaluation and intuition into the definition of the problem. These decisions are based on partial knowledge of the environmental factors which are uncertain and dynamic, therefore such decision are taken at the higher level of management.

2. Tactical Decision: tactical decisions relate to the implementation of strategic decisions, directed towards developing divisional plans, structuring workflows, establishing distribution channels, acquisition of resources such as men, materials and money. These decisions are taken at the middle level of management.

3. **Operational Decision:** operational decisions relate to day-to-day operations of the enterprise having a short-term horizon and are always repeated. These decisions are based on facts regarding the events and do not require much of business judgments. Operational decisions are taken at lower level of management.

Organizational/Individual DECISION-MAKING PROCESS:

The phases of decision making as proposed by Simon will be taken in which the fourth phase of decision implementation is added because mere choice of an alternative does not complete decision-making process unless managers as decision makers commit resources for implementing a decision. Based on this, decision making process has been presented in Figure



(a) Intelligence Phase :

Intelligence phase of decision-making process involves searching the environment for conditions calling for decisions. This is related with the identification and formulation of the problem which is to be solved by the decision. A problem is the gap between present state of affairs and desired state of affairs on the subject-matter of decision.

When a problem is identified, it remains vague at the initial stage. In order to make it more clear and specific, problem formulation is required so that design and choice phases operate on the right problem. At this stage, the problem identified earlier, is defined more precisely and some complexity is reduced

b) Design Phase :

Design phase of decision making involves generation of possible alternatives through which the problem can be solved. A problem can be solved in several ways, however, all the ways cannot be equally satisfying. Further, if there is only one way of solving a problem, no question of decision arises. Therefore, the decision maker must try to find out the various alternatives available in order to get the most satisfactory result of a decision

A decision maker can use several sources for identifying alternatives his own past experience, practices followed by others, and using creative techniques. Past experience, applied in most cases of decision making, takes into account the actions taken by the decision maker in the past with obvious differences between the former challenges and the present one. The successful action of the past may become an alternative for the future. This is a very simple approach but has obvious limitations because there may be so much chances in the decision context that old

action becomes totally irrelevant. Copying from the experiences of others is another way of generating alternatives. Thus, alternatives used by successful decision makers can be thought of as alternatives of decision making. This is also practiced by many organizations after making suitable amendments in the light of changed decision context. Importing of technology from foreign countries with suitable changes is good example of this type of alternatives. The third method of generating alternatives is through creative process where various exercises are taken to generate entirely new ideas.

(c) Choice Phase :

Choice phase of decision making involves choice of an alternative which can be put into action to solve the problem. For choosing an alternative which aims at solving the problem in the most appropriate way in a given situation, the manager must evaluate all the alternatives generated at the design stage. However, all alternatives available for decision making will not be taken for detailed evaluation because of the obvious limitations of managers in evaluating all alternatives. The energy of managers is limited and psychologically most of them prefer to work on plans that have good prospect of being carried out. In narrowing down the number of alternatives, two approaches can be followed-constraint on alternatives and grouping of alternatives of similar nature. The decision maker develops a list of limits that must be met by a satisfactory solution. He may treat these limits as constraints, that is, he may check proposed alternatives against limits, and if an alternative does not meet them, he can discard it. In the second approach, various alternatives can be grouped into classes on some specific criteria important to decision making. A representative alternative from one group may be selected for further analysis. After identifying the group that shows up the best, decision maker can concentrate on alternatives within this group. This method is very helpful in decision making regarding the location of plant. Warehouse, etc.

(d) Implementation Phase :

Once an alternative is chosen. it is implemented, that is, it is put into action. Truly speaking, the actual process of decision making ends with the choice of an alternative through which the objectives can be achieved. However, decision making, being a continuous and ongoing process, must ensure that the problem has been solved and the objectives have been achieved by the chosen alternative. Unless this is done, managers will never know what way their choice has contributed. Therefore, the implementation of decision may be seen as an integral aspect of decision. Once the creative and analytical aspects of decision making through which an alternative has been chosen are over the managerial priority is one of converting the decision into something effective. This is the implementation aspect of decision making. The basic difference between decision making as an analytical process and implementation is that the former requires the use of conceptual skills since it translates the abstract ideas into reality. For example, suppose that there is a change in consumers tastes. This change is very abstract and cannot be seen unless some specific techniques and measurements are applied. How this change can provide opportunity to the organization is mostly a conceptual exercise requiring managers to interpret what changes are taking place and what products or services will be preferred in the changed situation. Implementation, on the other hand, relates to putting a decision into practice so that objectives of decision are achieved.

<i>Decision-making phase</i>	<i>Information required</i>	<i>Supporting information systems</i>
Intelligence	Exception reporting	Structured information systems
Design	Specified and directed information	Decision support systems and executive support systems
Choice	Information for evaluation	Large models of decision support systems
Implementation	Graphics and charts for monitoring	Integrated information systems, microcomputers and mainframe decision aids

Hardware

The term hardware refers to mechanical device that makes up computer. Computer hardware consists of interconnected electronic devices that we can use to control computer's operation, input and output. Examples of hardware are CPU, keyboard, mouse, hard disk, etc.

Software

A set of instructions that drives computer to do stipulated tasks is called a program. Software instructions are programmed in a computer language, translated into machine language, and executed by computer. Software can be categorized into two types –

- System software
- Application software

System Software

System software operates directly on hardware devices of computer. It provides a platform to run an application. It provides and supports user functionality. Examples of system software include operating systems such as Windows, Linux, Unix, etc.

Application Software

An application software is designed for benefit of users to perform one or more tasks. Examples of application software include Microsoft Word, Excel, PowerPoint

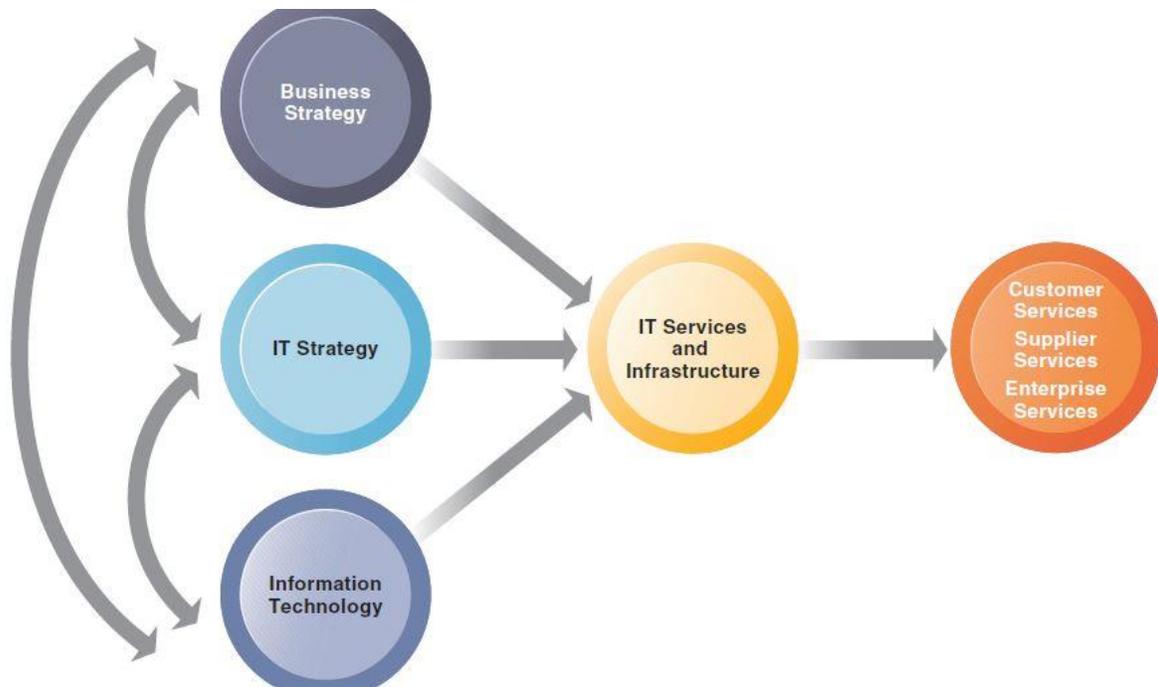
IT Infrastructure

Defining IT Infrastructure

An IT infrastructure consists of a set of physical devices and software applications that are required to operate the entire enterprise. But an IT infrastructure is also a set of firmwide services budgeted by management and comprising both human and technical capabilities. These services include the following:

- Computing platforms used to provide computing services that connect employees, customers, and suppliers into a coherent digital environment, including large mainframes, midrange computers, desktop and laptop computers, mobile handheld devices, and remote cloud computing services.
- Telecommunications services that provide data, voice, and video connectivity to employees, customers, and suppliers
- Data management services that store and manage corporate data and provide capabilities for analyzing the data
 - Application software services, including online software services, that provide enterprise-wide capabilities such as enterprise resource planning, customer relationship management, supply chain management, and knowledge management systems that are shared by all business units
- Physical facilities management services that develop and manage the physical installations required for computing, telecommunications, and data management services
- IT management services that plan and develop IT infrastructure, coordinate IT services for business units, manage accounting for IT expenditure, and provide project management services
- IT standards services that provide the firm and its business units with policies that determine which information technology will be used, when, how, and by whom
- IT education services that provide training in system use to employees and provide managers with training in how to plan for and manage IT investments
- IT research and development services that provide the firm with research on potential future IT projects and investments that could help the firm differentiate itself in the marketplace

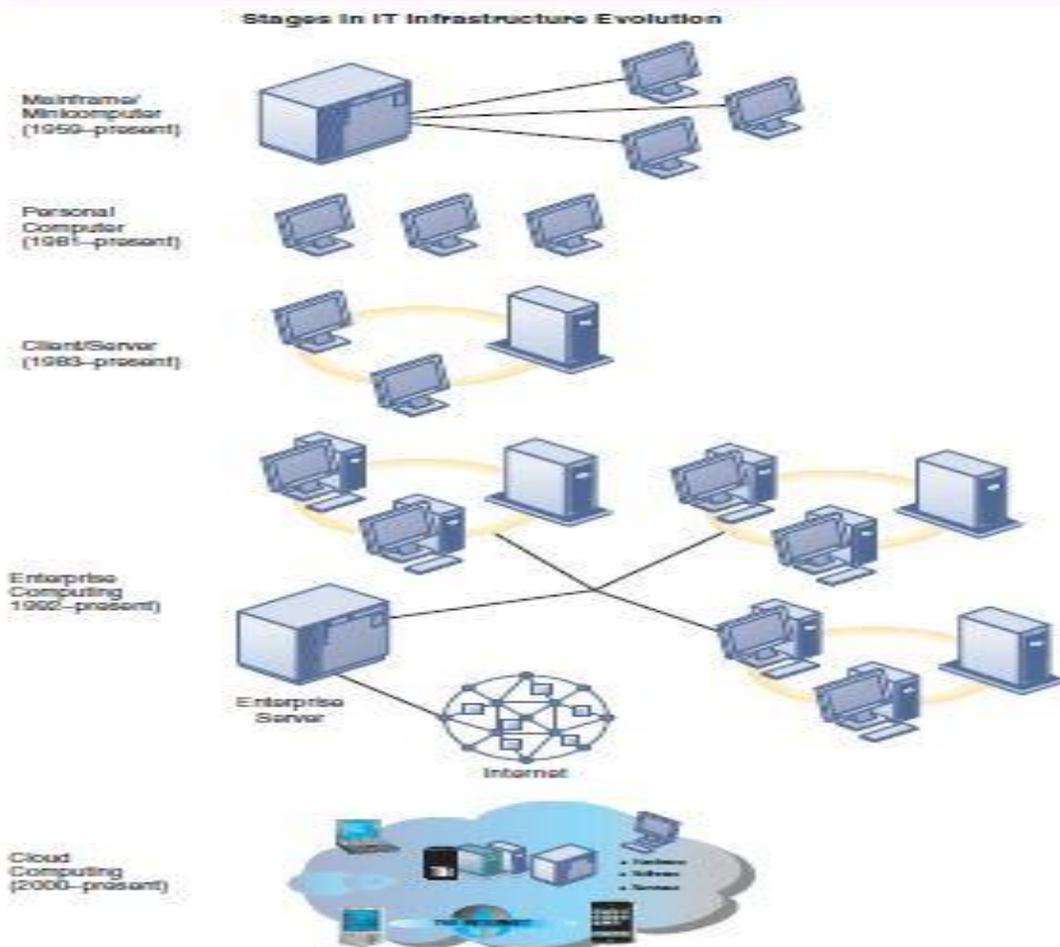
This “service platform” perspective makes it easier to understand the business value provided by infrastructure investments.



Evolution of IT Infrastructure

The IT infrastructure in organizations today is an outgrowth of more than 50 years of evolution in computing platforms. There have been five stages in this evolution, each representing a different configuration of computing power and infrastructure elements. The five eras are general-purpose mainframe and minicomputer computing, personal computers, client/server networks, enterprise computing, and cloud and mobile computing.

FIGURE 6.2 Eras In IT Infrastructure evolution.



General-Purpose Mainframe and Minicomputer Era (1959 to Present) The introduction of the IBM 1401 and 7090 transistorized machines in 1959 marked the beginning of widespread commercial use of **mainframe** computers. In 1965, the mainframe computer truly came into its own with the introduction of the IBM 360 series. The 360 was the first commercial computer with a powerful operating system that could provide time sharing, multitasking, and virtual memory in more advanced models. IBM has dominated mainframe computing from this point on. Mainframe computers became powerful enough to support thousands of online remote terminals connected to the centralized mainframe using proprietary communication protocols and proprietary data lines.

Personal Computer Era (1981 to Present) Although the first truly personal computers (PCs) appeared in the 1970s (the Xerox Alto, the MITS Altair 8800, and the Apple I and II, to name a few), these machines had only limited distribution to computer enthusiasts. The appearance of the IBM PC in 1981 is usually considered the beginning of the PC era because this machine was the first to be widely adopted by American businesses. At first using the DOS operating system, a text-based command language, and later the Microsoft Windows operating system, the **Wintel PC** computer (Windows operating system software on a computer with an Intel microprocessor) became the standard desktop personal computer. In 2012, there were an estimated 1.2 billion PCs

in the world, and 300 million new PCs are sold each year. Proliferation of PCs in the 1980s and early 1990s launched a spate of personal desktop productivity software tools—word processors, spreadsheets, electronic presentation software, and small data management programs—that were very valuable to both home and corporate users. These PCs were stand-alone systems until PC operating system software in the 1990s made it possible to link them into networks.

Client/Server Era (1983 to Present) In **client/server computing**, desktop or laptop computers called **clients** are networked to powerful **server** computers that provide the client computers with a variety of services and capabilities. Computer processing work is split between these two types of machines. The client is the user point of entry, while the server typically processes and stores shared data, serves up Web pages, or manages network activities. The term “server” refers to both the software application and the physical computer on which the network software runs. The server could be a mainframe, but today, server computers are typically more powerful versions of personal computers, based on inexpensive chips and often using multiple processors in a single computer box or in server racks.

The simplest client/server network consists of a client computer networked to a server computer, with processing split between the two types of machines. This is called a *two-tiered client/server architecture*.

Enterprise Computing Era (1992 to Present) In the early 1990s, firms turned to networking standards and software tools that could integrate disparate networks and applications throughout the firm into an enterprise-wide infrastructure. After 1995, as the Internet developed into a trusted communications environment, business firms began seriously using the *Transmission Control Protocol/Internet Protocol (TCP/IP)* networking standard to tie their disparate networks together.

Cloud and Mobile Computing Era (2000 to Present) The growing bandwidth power of the Internet has pushed the client/server model one step further, towards what is called the “Cloud Computing Model.” **Cloud computing** refers to a model of computing that provides access to a shared pool of computing resources (computers, storage, applications, and services) over a network, often the Internet. Hundreds of thousands of computers are located in cloud data centres, where they can be accessed by desktop computers, laptop computers, tablets, entertainment centres, smartphones, and other client machines linked to the Internet, with both personal and corporate computing increasingly moving to mobile platforms. IBM, HP, Dell, and Amazon operate huge, scalable cloud computing centres that provide computing power, data storage, and high-speed Internet connections to firms that want to maintain their IT infrastructures remotely. Software firms such as Google, Microsoft, SAP, Oracle, and Salesforce.com sell software applications as services delivered over the Internet. The Learning Tracks modules on the Companion Website for this text include a table titled Comparing Stages in IT Infrastructure Evolution, which compares each era on the infrastructure dimensions introduced.

Technology Drivers of Infrastructure Evolution

Moore’s Law and Microprocessing Power In 1965, Gordon Moore, the founder of Intel, the world’s largest chip manufacturer, wrote in *Electronics* magazine that, since the first microprocessor chip was introduced in 1959, the number of components on a chip with

the smallest manufacturing costs per component (generally transistors) had doubled each year. This assertion became the foundation of **Moore's Law**. Moore later reduced the rate of growth to a doubling every two years.

The Law of Mass Digital Storage A second technology driver of IT infrastructure change is the Law of Mass Digital Storage. The amount of digital information is roughly doubling every year (Gantz and Reinsel, 2011; Lyman and Varian, 2003). Fortunately, the cost of storing digital information is falling at an exponential rate of 100 percent a year. Figure 5.6 shows, from 1950 to the present, the number of megabytes that could be stored on magnetic media for \$1 roughly doubles every 15 months. In 2013, a 500 gigabyte hard disk drive sells at retail for about \$60.

Metcalfe's Law and Network Economics Moore's Law and the Law of Mass Storage help us understand why computing resources are now so readily available. But why do people
Nanotechnology

IT infrastructure for digital firms:

The Internet

- Rapidly becoming infrastructure of choice
- Universal, easy-to-use set of technologies and standards
- Web sites available 24/7
- Extended distribution channels
- Reduced transaction costs
- Reduced network and coordination costs

Internet Business Models

- Virtual storefront: Sells physical products directly to consumers or businesses.
- Information broker: Provides product pricing and availability information; generates revenue from advertising or directing buyers to sellers.
- Transaction Broker: Processes online sales transactions for fee.

Online Marketplace: Provides digital environment where buyers and sellers meet

- Content Provider: Provides digital content, such as news; revenue from fees or advertising sales
- Online Service Provider: Provides connectivity; revenue from fees, advertising, or marketing information

Virtual Community: Provides online meeting place for people of similar interests

- Portal: Provides initial point of entry to the Web, along with specialized content and services
- Business-to-consumer (B2C): Retailing products and services to individual shoppers
- Business-to-business (B2B): Sales of goods and services among businesses
 - Consumer-to-consumer (C2C): Consumers selling directly to consumers

Unit –II System Design

System Design:

System design is the process of defining the elements of a system such as the architecture, modules and components, the different interfaces of those components and the data that goes through that system. It is meant to satisfy specific needs and requirements of a business or organization.

Need/Importance of Systems Analysis and Design

User Requirements : Systems analysis and design, as performed by systems analysts, seeks to understand what humans need to analyze data input or data flow systematically, process or transform data, store data, and output information in the context of a particular organization or enterprise. By doing thorough analysis, analysts seek to identify and solve the right problems.

Computerization : Furthermore, systems analysis and design is used to analyze, design, and implement improvements in the support of users and the functioning of businesses that can be accomplished through the use of computerized information systems.

Costly process: Installing a system without proper planning leads to great user dissatisfaction and frequently causes the system to fall into disuse. Systems analysis and design lends structure to the analysis and design of information systems, a costly endeavor that might otherwise have been done in a haphazard way. It can be thought of as a series of processes systematically undertaken to improve a business through the use of computerized information systems. Systems analysis and design involves working with current and eventual users of information systems to support them in working with technologies in an organizational setting.

User Interface : User involvement throughout the systems project is critical to the successful development of computerized information systems. Systems analysts, whose roles in the organization are discussed next, are the other essential component in developing useful information systems. Users are moving to the forefront as software development teams become more international in their composition. This means that there is more emphasis on working with software users; on performing analysis of their business, problems, and objectives; and on communicating the analysis and design of the planned system to all involved.

New technology : New technologies also are driving the need for systems analysis. Ajax (Asynchronous JavaScript and XML) is not a new programming language, but a technique that uses existing languages to make Web pages function more like a traditional desktop application program. Building and redesigning Web pages that utilize Ajax technologies will be a task facing analysts. New programming languages, such as the open source Web framework, Ruby on Rails, which is a combination programming language and code generator for creating Web applications, will require more analysis.

APPROACHES TO SYSTEM DESIGN:

Traditional Approaches to System Design:

The traditional approaches include

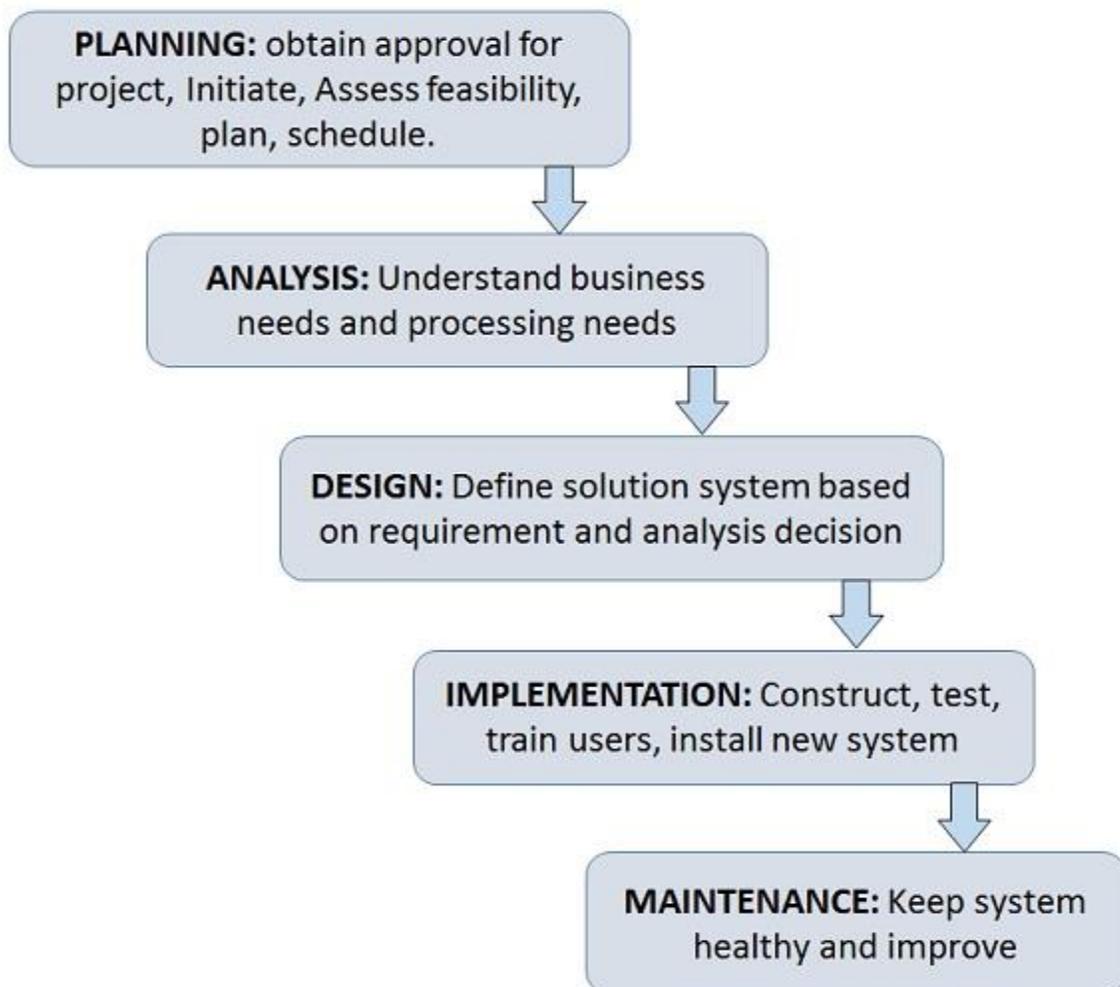
- a. System Development Life cycle Method
- b. Water fall Method

- a. System Development Life Cycle:

System Development Life Cycle (SDLC) is a conceptual model which includes policies and procedures for developing or altering systems throughout their life cycles.

Phases of SDLC

Systems Development Life Cycle is a systematic approach which explicitly breaks down the work into phases that are required to implement either new or modified Information System.



Feasibility Study or Planning

- Define the problem and scope of existing system.
- Overview the new system and determine its objectives.
- Confirm project feasibility and produce the project Schedule.
- During this phase, threats, constraints, integration and security of system are also considered.
- A feasibility report for the entire project is created at the end of this phase.

Analysis and Specification

- Gather, analyze, and validate the information.
- Define the requirements and prototypes for new system.
- Evaluate the alternatives and prioritize the requirements.
- Examine the information needs of end-user and enhances the system goal.
- A Software Requirement Specification (SRS) document, which specifies the software, hardware, functional, and network requirements of the system is prepared at the end of this phase.

System Design

- Includes the design of application, network, databases, user interfaces, and system interfaces.
- Transform the SRS document into logical structure, which contains detailed and complete set of specifications that can be implemented in a programming language.
- Create a contingency, training, maintenance, and operation plan.
- Review the proposed design. Ensure that the final design must meet the requirements stated in SRS document.
- Finally, prepare a design document which will be used during next phases.

Implementation

- Implement the design into source code through coding.
- Combine all the modules together into training environment that detects errors and defects.

- A test report which contains errors is prepared through test plan that includes test related tasks such as test case generation, testing criteria, and resource allocation for testing.
- Integrate the information system into its environment and install the new system.

Maintenance/Support

- Include all the activities such as phone support or physical on-site support for users that is required once the system is installing.
- Implement the changes that software might undergo over a period of time, or implement any new requirements after the software is deployed at the customer location.

b. Waterfall Method:

The waterfall Model illustrates the software development process in a linear sequential flow. This means that any phase in the development process begins only if the previous phase is complete. The waterfall approach does not define the process to go back to the previous phase to handle changes in requirement. Therefore, different projects may follow different approaches to handle such situations.

What is Waterfall methodology?

The waterfall approach is the earliest approach that was used for software development. Initially, most projects followed the waterfall approach because they did not focus on changing requirements.

Waterfall Approach Phases

1. Conception: Triggers when a problem is perceived. This phase involves identifying goals to be achieved after the problem is solved, estimating benefits in the new system over the current system, and identifying other areas that are affected by the solution. This phase also involves and developing the business case for the project. A business case provides the information that a manager needs to decide whether to support a proposed Project, before resources are committed to its development.



2.

2. Initiation: Involves a macro level study of the customer requirements. This phase also involves defining alternative solutions to the customer requirements and cost-benefit justification of these alternatives.

3. Analysis: Involves carrying out detailed study of the customer requirements and arriving at the exact requirements of the proposed system. The phase involves freezing the requirements before the design phase begins.

4. Design: Involves translating the identified requirements into a logical structure, called design that can be implemented in a programming logic.

5. Construction: Involves integrating and testing all the modules developed in the previous phase as a complete system.

6. Integration and Testing: Involves integrating and testing all the modules developed in the previous phase as a complete system.

7. Implementation and maintenance: Involves converting the new system design into operation. This may involve implementing the software system and training the operating staff before the software system is functional.

The waterfall approach assumes that requirements are stable and frozen across the project plan. However, this is usually not true in case of large projects where requirements may evolve across the development process.

Modern Methods of System Design:

- b. Structured System Analysis and Design**
- c. Rapid Application Method**
- d. Software Prototyping**
- e. Object Oriented System Design**

a. SSADM (STRUCTURED SYSTEMS ANALYSIS & DESIGN)

Structured systems analysis and design methodology (SSADM) is a set of standards for systems analysis and application design. It uses a formal methodical approach to the analysis and design of information systems.

Some of the important characteristics of SSADM are:

- Dividing a project into small modules with well defined objectives
- Useful during requirements specification and system design stage
- Diagrammatic representation and other useful modeling techniques
- Simple and easily understood by clients and developers
- Performing activities in a sequence

STRUCTURED ANALYSIS TOOLS

During Structured Analysis, various tools and techniques are used for system development.

They are –

- Data Flow Diagrams
- Data Dictionary
- Decision Trees

Data Flow Diagrams (DFD) or Bubble Chart

It is a technique developed by Larry Constantine to express the requirements of system in a graphical form.

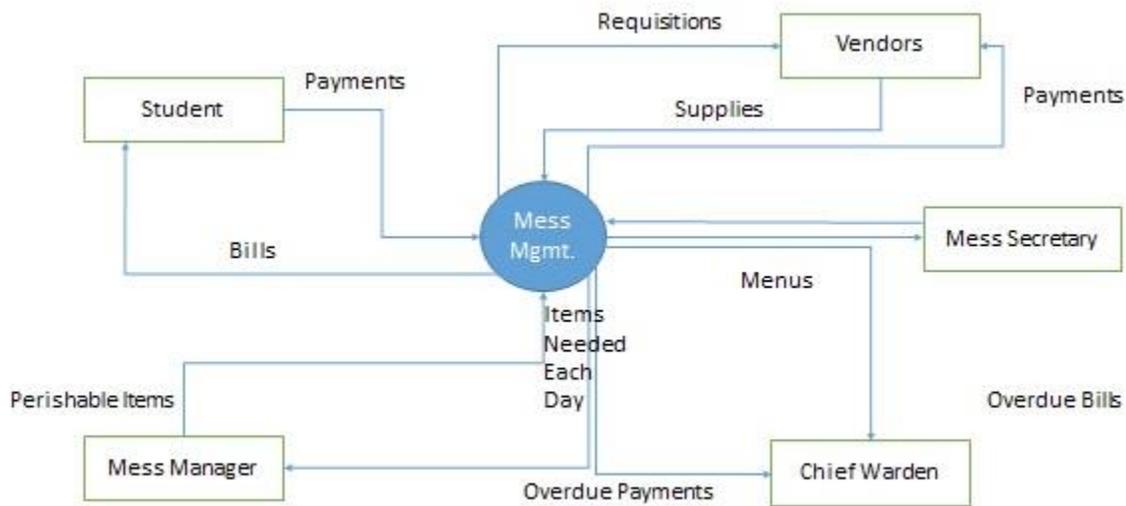
- It shows the flow of data between various functions of system and specifies how the current system is implemented.

Symbol Name	Symbol	Meaning
Square		Source or Destination of Data
Arrow		Data flow
Circle		Process transforming data flow
Open Rectangle		Data Store

Context Diagram

A context diagram helps in understanding the entire system by one DFD which gives the overview of a system. It starts with mentioning major processes with little details and then goes onto giving more details of the processes with the top-down approach.

The context diagram of mess management is shown below.



Data Dictionary

A data dictionary is a structured repository of data elements in the system. It stores the descriptions of all DFD data elements that is, details and definitions of data flows, data stores, data stored in data stores, and the processes.

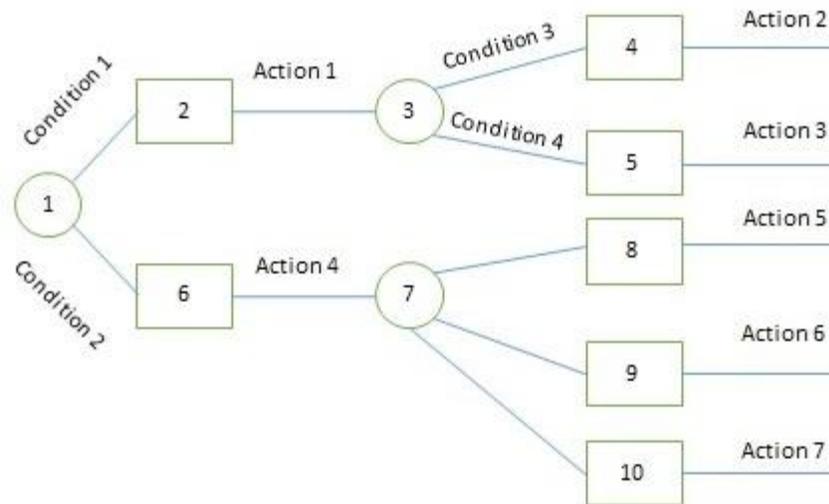
A data dictionary improves the communication between the analyst and the user. It plays an important role in building a database. Most DBMSs have a data dictionary as a standard feature. For example, refer the following table –

Sr.No.	Data Name	Description	No. of Characters
1	ISBN	ISBN Number	10
2	TITLE	title	60
3	SUB	Book Subjects	80
4	ANAME	Author Name	15

Decision Trees

Decision trees are a method for defining complex relationships by describing decisions and avoiding the problems in communication. A decision tree is a diagram that shows alternative actions and conditions within horizontal tree framework. Thus, it depicts which conditions to consider first, second, and so on.

Decision trees depict the relationship of each condition and their permissible actions. A square node indicates an action and a circle indicates a condition. It forces analysts to consider the sequence of decisions and identifies the actual decision that must be made.



b. THE RAD MODEL (RAPID APPLICATION DEVELOPMENT)

The RAD (Rapid Application Development) model is based on prototyping and iterative development with no specific planning involved. The process of writing the software itself involves the planning required for developing the product.

Rapid Application development focuses on gathering customer requirements through workshops or focus groups, early testing of the prototypes by the customer using iterative concept, reuse of the existing prototypes (components), continuous integration and rapid delivery.

What is RAD?

Rapid application development (RAD) is a software development methodology that uses minimal planning in favor of rapid prototyping. A prototype is a working model that is functionally equivalent to a component of the product.

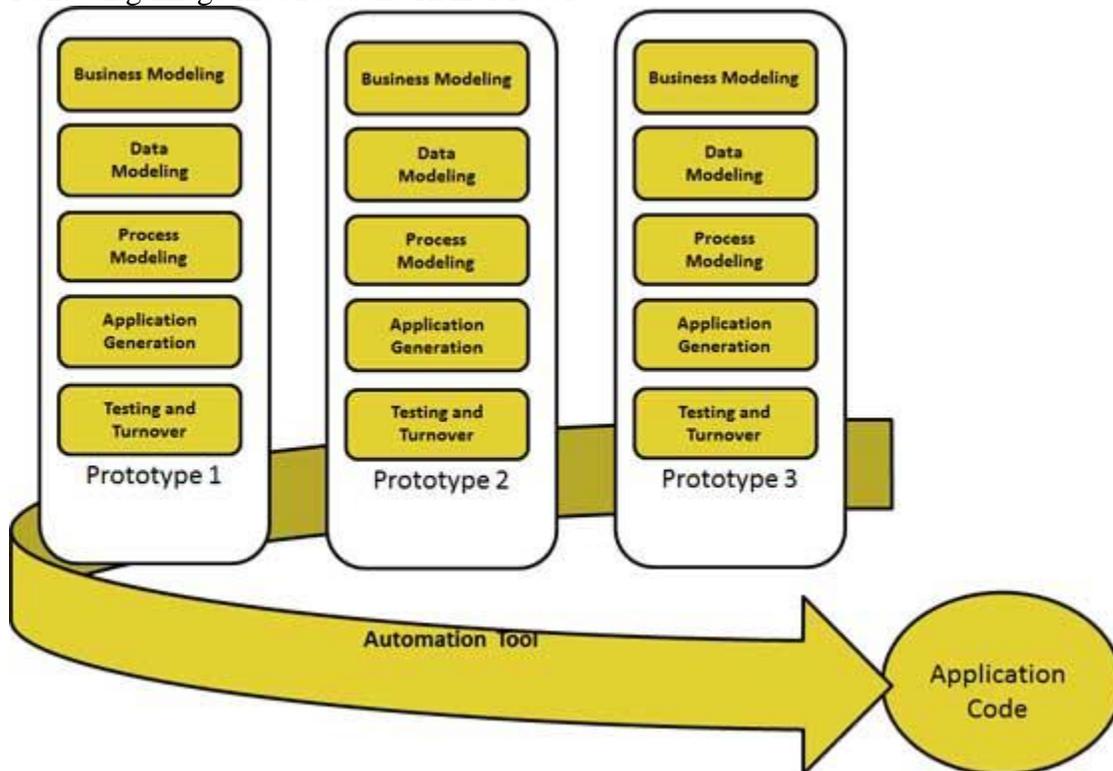
In RAD model the functional modules are developed in parallel as prototypes and are integrated to make the complete product for faster product delivery.

RAD Model Design

RAD model distributes the analysis, design, build, and test phases into a series of short, iterative development cycles. Following are the phases of RAD Model:

- **Business Modeling:** The business model for the product under development is designed in terms of flow of information and the distribution of information between various business channels. A complete business analysis is performed to find the vital information for business, how it can be obtained, how and when is the information processed and what are the factors driving successful flow of information.
- **Data Modeling:** The information gathered in the Business Modeling phase is reviewed and analyzed to form sets of data objects vital for the business. The attributes of all data sets is identified and defined. The relation between these data objects are established and defined in detail in relevance to the business model.
- **Process Modeling:** The data object sets defined in the Data Modeling phase are converted to establish the business information flow needed to achieve specific business objectives as per the business model. The process model for any changes or enhancements to the data object sets is defined in this phase. Process descriptions for adding , deleting, retrieving or modifying a data object are given.
- **Application Generation:** The actual system is built and coding is done by using automation tools to convert process and data models into actual prototypes.
- **Testing and Turnover:** The overall testing time is reduced in RAD model as the prototypes are independently tested during every iteration. However the data flow and the interfaces between all the components need to be thoroughly tested with complete test coverage. Since most of the programming components have already been tested, it reduces the risk of any major issues.

Following image illustrates the RAD Model:



RAD Model Pros and Cons

RAD model enables rapid delivery as it reduces the overall development time due to reusability of the components and parallel development.

RAD works well only if high skilled engineers are available and the customer is also committed to achieve the targeted prototype in the given time frame. If there is commitment lacking on either side the model may fail.

Following table lists out the pros and cons of RAD Model:

Pros	Cons
<ul style="list-style-type: none">• Changing requirements can be accommodated.• Progress can be measured.• Iteration time can be short with use of powerful RAD tools.• Productivity with fewer people in short time.• Reduced development time.• Increases reusability of components• Quick initial reviews occur• Encourages customer feedback• Integration from very beginning solves a lot of integration issues.	<ul style="list-style-type: none">• Dependency on technically strong team members for identifying business requirements.• Only system that can be modularized can be built using RAD.• Requires highly skilled developers/designers.• High dependency on modeling skills.• Inapplicable to cheaper projects as cost of modeling and automated code generation is very high.• Management complexity is more.• Suitable for systems that are component based and scalable.• Requires user involvement throughout the life cycle.

c. SOFTWARE PROTOTYPING

The Software Prototyping refers to building software application prototypes which display the functionality of the product under development but may not actually hold the exact logic of the original software.

Software prototyping is becoming very popular as a software development model, as it enables to understand customer requirements at an early stage of development. It helps get valuable feedback from the customer and helps software designers and developers understand about what exactly is expected from the product under development.

- Prototype is a working model of software with some limited functionality.
- The prototype does not always hold the exact logic used in the actual software application and is an extra effort to be considered under effort estimation.
- Prototyping is used to allow the users evaluate developer proposals and try them out before implementation.

- It also helps understand the requirements which are user specific and may not have been considered by the developer during product design.

Following is the stepwise approach to design a software prototype:

- **Basic Requirement Identification:** This step involves understanding the very basics product requirements especially in terms of user interface. The more intricate details of the internal design and external aspects like performance and security can be ignored at this stage.
- **Developing the initial Prototype:** The initial Prototype is developed in this stage, where the very basic requirements are showcased and user interfaces are provided. These features may not exactly work in the same manner internally in the actual software developed and the workarounds are used to give the same look and feel to the customer in the prototype developed.
- **Review of the Prototype:** The prototype developed is then presented to the customer and the other important stakeholders in the project. The feedback is collected in an organized manner and used for further enhancements in the product under development.
- **Revise and enhance the Prototype:** The feedback and the review comments are discussed during this stage and some negotiations happen with the customer based on factors like , time and budget constraints and technical feasibility of actual implementation. The changes accepted are again incorporated in the new Prototype developed and the cycle repeats until customer expectations are met.

d.OBJECT ORIENTED SOLUTION ARCHITECTURE AND DESIGN (OOSAD) DEVELOPMENT LIFE CYCLE.

Object-oriented analysis and design (OOAD) is a popular technical approach to analyzing, designing an application, system, or business by applying the [object-oriented paradigm](#) and visual modeling throughout the [development life cycles](#) to foster better stakeholder communication and product quality.

The main difference between object-oriented analysis and other forms of analysis is that by the object-oriented approach we organize requirements around objects, which integrate both behaviors (processes) and states (data) modeled after real world objects that the system interacts with. In other or traditional analysis methodologies, the two aspects: processes and data are

considered separately. For example, data may be modeled by [ER diagrams](#), and behaviors by [flow charts](#) or [structure charts](#). The objects may be graphs, charts, audio, video or graphics.

The primary tasks in object-oriented analysis (OOA) are:

- Find the objects
- Organize the objects
- Describe how the objects interact
- Define the behavior of the objects
- Define the internals of the objects

MIS Growth model:

[Nolan's Six-stage Model](#)

Information systems cannot deliver value from the first day in an organization. The organization needs time and maturity to be able to leverage the [information](#) system. Various organizations are at different levels of maturity in dealing with information systems. Nolan has provided a model for such information systems using maturity in organizations. However, empirical evidence is not available in favor of such models but intuitively, it seems correct. To leverage the benefits of information, an organization has to first appreciate the usefulness of information. This requires a change in the mindset and way of working. Organization culture needs to change to accommodate this kind of information-based working. Changing organizations takes time and hence, organizations pass through stages of maturity in dealing with information systems.

Nolan's Six-stage Model

One of the stages of growth model, helping in the understanding of the role of information systems, in an organization's strategy and its maturity. Earlier, in a similar model called the four-stage growth model the maturity of an organization was captured in terms of use of information systems. The stages are,

1. **Initiation**-in which the primary focus is cost reduction and only specialized applications are run with a specialized staff. Management is not very keen on monitoring the information system.
2. **Expansion**-in which application increase rapidly. Specialization of staff and applications is the order of the day. Management begins to take note of the new way of doing things.
3. **Formalization**-in which emphasis is laid on control and specialization, is built around control. Management controls information systems.
4. **Maturity**-in which [database](#) oriented applications proliferate. Information is used as a resource.

Nolan's Stages of Growth Model

I	II	III	IV	V	VI
<p>INITIATIONS</p> <ul style="list-style-type: none"> • Users are "hands off" in approach • Extensive IT/IS planning • Cost reduction primary focus • Functional application is in focus • MIS dept/IS dept is not under strict management control 	<p>CONTAGION</p> <ul style="list-style-type: none"> • Proliferation of applications • Little management control • Huge allocation of financial resources • Rapid growth of fundamental use of IT • IS/IT performance below importation and several crisis occur 	<p>CONTROL</p> <ul style="list-style-type: none"> • IT/IS is considered as an important function • Centralized controls are applied for IT/IS • No reduction in IT/IS use • Applications are often incompatible • Unhappy users • Use of database but with unsatisfactory outcome 	<p>INTEGRATION</p> <ul style="list-style-type: none"> • Greater use of database • Greater IT/IS budget • IT/IS dept now works on a professional utility model • Formal planning and control within IT/IS dept • Steering committees are widely used for application development. 	<p>DATA ADMIN</p> <ul style="list-style-type: none"> • Data in administration • Applications are in sync with the organization • Shift from IT/IS booking after DP to holistic information management 	<p>MATURITY</p> <ul style="list-style-type: none"> • IT/IS dept becomes partners of users in data management • Applications reflect real information needs • Strategic planning of IT/IS becomes important • Managers of IT/IS dept considered at par with other dept

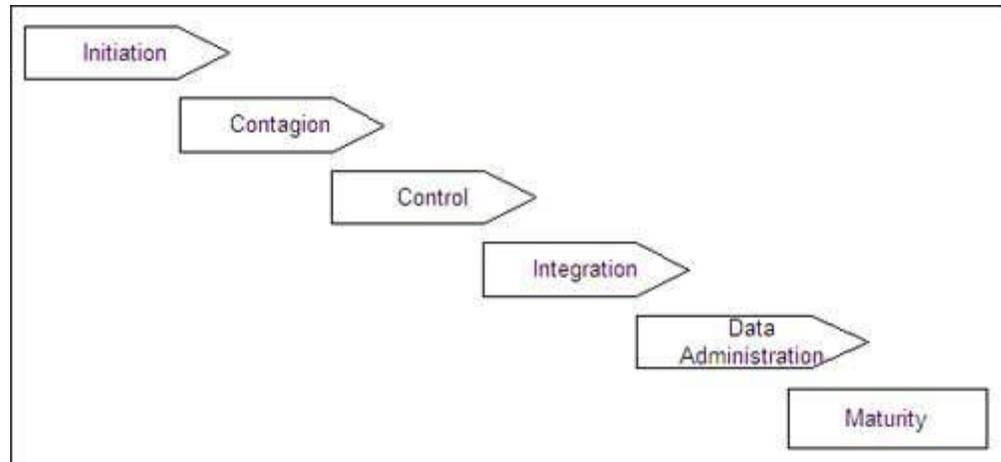
Nolan (1979) indicated that there are six stages in the information system evolutionary process. It is an improvement over the four-stage model. The stages are:

1. **Initiation**- in which the organization has an operational focus and tries to get operational efficiency and thereby limited value from the information systems.
2. **Contagion**-in which the organization moves towards online systems after having tasted success in the initiation stage. More users are added.
3. **Control**-in which the management exercises control and makes a cost-benefit type of assessment.
4. **Integration**-in which the organization moves away from an ad hoc isolated solutions based on information system to a service based information system. This is the stage when the organization transitions from a data processing outlook about information systems to more holistic information-based decision-making approach towards information systems. A more comprehensive approach towards information systems results in changes in the organization's

behavior towards information systems and initiates a new appreciation for data and information.

5. **Data administration**-in which the organization begins to appreciate the value of information and makes efforts to centralize the data management to take advantage of the benefits of information based decision-making.
6. **Maturity**-in which the organization creates synergies in its corporate objectives and information systems planning so that the two can work in a synchronized manner.

These are the stages as Nolan has described in this research. However, no empirical proof exists of this stage growth model of information system maturity.



Unit-III Management Support System

6. Decision Support Systems

A Decision Support System can be seen as a knowledge based system, used by senior managers, which facilitates the creation of knowledge and allow its integration into the organization. These systems are often used to analyze existing structured information and allow managers to project the potential effects of their decisions into the future. Such systems are usually interactive and are used to solve ill structured problems. They offer access to databases, analytical tools, allow "what if" simulations, and may support the exchange of information within the organization.

Functions of a DSS

DSS manipulate and build upon the information from a MIS and/or TPS to generate insights and new information.

Functions of a DSS in terms of data processing requirements

Inputs	Processing	Outputs
Internal Internal External Information?	Transactions Files Modelling Simulation Analysis Summarizing	Summary Forecasts Graphs / Plots reports

Some examples of DSS

- Group Decision Support Systems (GDSS)
- Computer Supported Co-operative work (CSCW)
- Logistics systems
- Financial Planning systems

Spreadsheet Models

Components of a Decision Support System

The three main components of a DSS framework are:

1. Model Based System

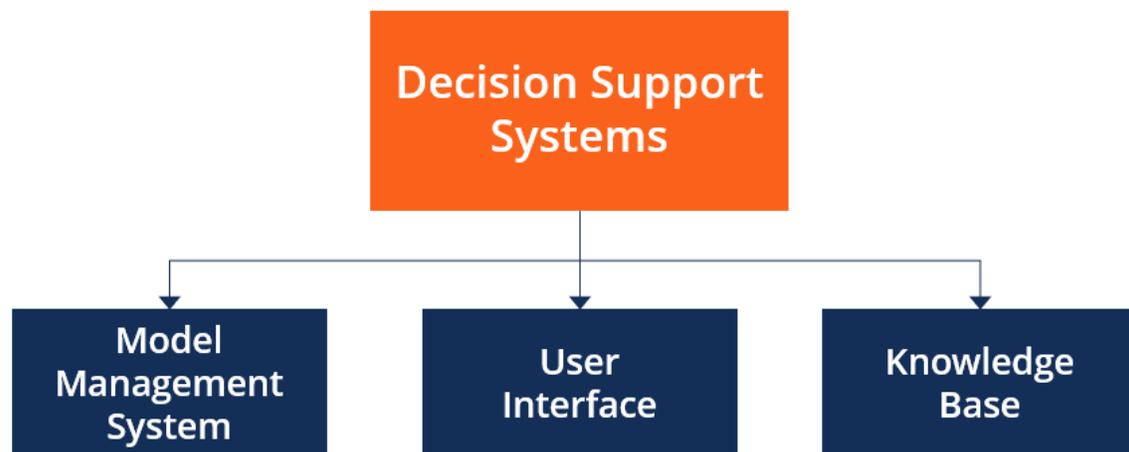
The model management system S=stores models that managers can use in their decision-making. The models are used in decision-making regarding the financial health of the organization and forecasting demand for a good or service.

2. User Interface

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

3. Knowledge Base

The knowledge base includes information from internal sources (information collected in a transaction process system) and external sources (newspapers and online databases).



Types of Decision Support Systems

Communication-based: Allows companies to support tasks that require more than one person to work on the task. It includes integrated tools such as Microsoft SharePoint Workspace and Google Docs.

Model-based: Allows access to and the management of financial, organizational, and statistical models. Data is collected, and parameters are determined using the information provided by users. The information is created into a decision-making model to analyze situations. An example of a model-driven DSS is Dicosess – an open-source model-driven DSS.

Knowledge-based: Provides factual and specialized solutions to situations using stored facts, procedures, rules, or interactive decision-making structures like [flowcharts](#).

Document-based: Manages unstructured information in different electronic formats.

Data-based: Helps companies to store and analyze internal and external data.

Advantages of a Decision Support System

A decision support system increases the speed and efficiency of decision-making activities. It is possible, as a DSS can collect and analyze real-time data.

It promotes training within the organization, as specific skills must be developed to implement and run a DSS within an organization.

It automates monotonous managerial processes, which means more of the manager's time can be spent on decision-making.

It improves [interpersonal communication](#) within the organization.

Disadvantages of a Decision Support System

The cost to develop and implement a DSS is a huge capital investment, which makes it less accessible to smaller organizations.

A company can develop a dependence on a DSS, as it is integrated into daily decision-making processes to improve efficiency and speed. However, managers tend to rely on the system too much, which takes away the subjectivity aspect of decision-making.

A DSS may lead to [information overload](#) because an information system tends to consider all aspects of a problem. It creates a dilemma for end-users, as they are left with multiple choices.

Implementation of a DSS can cause fear and backlash from lower-level employees. Many of them are not comfortable with new technology and are afraid of losing their jobs to technology.

Group decision support system

GDSS refers to a system of decision making by group of people with the help of technology. More and more, companies are turning to groups and teams to get work done. Hours upon hours are spent in meetings, in group collaboration, in communicating with many people. To help groups make decisions, a new category of systems was developed—the group decision-support system (GDSS).

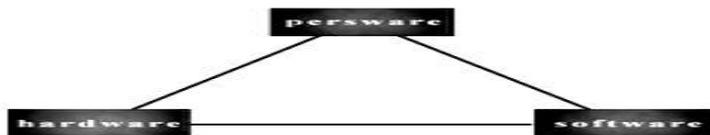
Elements of GDSS:

The elements of GDSS are

- Preplanning:** A clear-cut agenda of the topics for the meeting.
- Open, collaborative meeting atmosphere:** Free flow of ideas and communications without any of the attendees feeling shy about contributing
- Evaluation objectivity:** Reduces “office politics” and the chance that ideas will be dismissed because of who presented them instead of what was presented
- Documentation:** Clear communication about what took place and what decisions were made by the group
- Preservation of “organizational memory”:** Even those unable to attend the meeting will know what took place; great for geographically separated team members.

GDSS Characteristics and Software Tools

GDSS characteristics :



Hardware :In GDSS the hardware includes more than just computers and peripheral equipment. It also includes the conference facilities, audiovisual equipment, and networking equipment that connect everyone.

Persware: The persware extends to the meeting facilitators and the staff that keeps the hardware operating correctly. As the hardware becomes more sophisticated and widely available, many companies are bypassing specially equipped rooms in favor of having the group participants “attend” the meeting through their individual desktop computers.

Software :Many of the software tools and programs are used in GDSS. Groupware, can also be used to support GDSS. Some of these software tools are being reworked to allow people to attend meetings through Intranets or Extranets.

Software Tools:

- Electronic questionnaires:** Set an agenda and plan ahead for the meeting
- Electronic brainstorming:** Allows all users to participate without fear of reprisal or criticism
- Questionnaire tools:** Gather information even before the meeting begins, so facts and information are readily available
- Stakeholder identification:** Determines the impact of the group’s decision
- Group dictionaries:** Reduce the problem of different interpretations

Process of GDSS:

GDSS works as an Electronic meeting systems.. The following figure shows thesequence of activities at a typical EMS meeting.



- a. Session Planning: The session manager for the group decision will make a plan of session. The timing, tools, agenda of the session are pre decided.
- b. Idea Generation: Idea generation is the first stage in GDSS which includes brainstorming. Brain storming is the process of generating ideas without any criticisms from a group of people. The topic is provided to the participants and ideas are generated.
- c. Idea organization: The ideas are organized according to various categories and the participants in this stage are idea organizer, issue analyzer, group writer.
- d. Prioritizing: The ideas are ranked and arranged as per the priority. It may be based on voting or questionnaire evaluation.
- e. Policy development: The selected idea is converted into policy along with the identification of the stakeholder.
- f. Organizational memory: The whole process of GDSS is stored. Group dictionary and brief case are created to store the information for future purpose.

Executive Support System/ Expert System:

The components of an expert system include a knowledge base and software modules that perform inferences on the knowledge in the knowledge base and communicate answers to a user's questions.

The knowledge base of an expert system contains Facts about a specific area, Heuristics (thumbs of rule) that express the reasoning procedures of an expert on the subject. There are many ways that knowledge is represented in expert systems:-

- **Case-based reasoning:** Representing knowledge in an expert system's knowledge base in the form of cases.
- **Frame-based knowledge:** Knowledge represented in the form of a hierarchy or network of frames. A frame is a collection of knowledge about an entity consisting of a complex package of data values describing its attributes.
- **Object-based knowledge:** Knowledge represented as a network of objects. An object is a data element that includes both data and the methods or processes that act on those data.
- **Rule-based knowledge:** Knowledge represented in the form of rules and statements of fact. Rules are statements that typically take the form of a premise and a conclusion such as: IF (condition), Then (conclusion).
- **Software resources:** An expert system software package contains an inference engine and other programs for refining knowledge and communicating with users. The inference engine program processes the knowledge (such as rules and facts) related to a specific problem. It then makes associations and inferences resulting in recommended courses of action for a user. User interface programs for communicating with end-users are also needed, including an explanation program to explain the reasoning process to a user if requested.

Executive Support System

Executive Support Systems (ESS) supply the necessary tools to senior management. The decisions at this level of the company are usually never structured and could be described as "educated guesses." Executives rely as much, if not more so, on external data than they do on data internal to their organization. Decisions must be made in the context of the world outside the organization. The problems and situations senior executives face are very fluid, always changing, so the system must be flexible and easy to manipulate.

Basically manager's role is divided into 3 categories

1. Interpersonal Role - Roles like figurehead, leader, and liaison
2. Informational roles - Roles of monitor, disseminator, spokesperson
3. Decisional roles - Entrepreneur, disturbance handler, resource alligator, negotiator.

Advantages

- Simple for high-level executives to use Operations do not require extensive computer experience
- Provides timely delivery of company summary information
- Provides better understanding of information
- Filters data for better time management
- Provides system for improvement in information tracking

Disadvantages

- Computer skills required to obtain results
- Requires preparation and analysis time to get desired information
- Detail oriented Provides detailed analysis of a situation
- Difficult to quantify benefits
- Difficult to maintain database integrity
- Provides only moderate support of external data and graphics capabilities

Characteristics of ESS

An ESS has many distinct characteristics that differentiate it from other applications software. A list of these features is presented in table below

Characteristics	Description
Degree of use	High, consistent, without need of technical assistance
Computer skills required	Very low - must be easy to learn and use
Flexibility	High - must fit executive decision making style
Principle use	Tracking, control
Decisions supported	Upper level management, unstructured
Data supported	Company internal and external
Output capabilities	Text, tabular, graphical, trend toward audio/video in future
Graphic concentration	High, presentation style
Data access speed	Must be high, fast response

ESS: A Better Example

We know that car industry is characterized by tough competition and fast-shifting opportunities. One of such car industry was Hertz that needs to compete against dozens of competitors in hundreds of locations. Now the company's key to success is marketing. Several marketing decision must be made instantaneously.

Some of such decisions can be

- Whether to give discount on product seeing other company's strategy. . Whether to give some attractive gift with the product or not
- Whether to give free servicing for one year, free accessories or not. Whether to give insurance policy or not

ESS helped to identify that real problem was due to following reason

- The assistant staff is not always available
- The assistant recommended competitors cars.

Solution : Exclusive show rooms throughout the market

Data warehouse and Data mining

The term "Data Warehouse" was first coined by Bill Inmon in 1990. According to Inmon, a data warehouse is a subject oriented, integrated, time-variant, and non-volatile collection of data. This data helps analysts to take informed decisions in an organization.

Data mining functions such as association, clustering, classification, prediction can be integrated with OLAP operations to enhance the interactive mining of knowledge at multiple level of abstraction. That's why data warehouse has now become an important platform for data analysis and online analytical processing.

Data Warehouse Features

The key features of a data warehouse are discussed below –

- **Subject Oriented** – A data warehouse is subject oriented because it provides information around a subject rather than the organization's ongoing operations. These subjects can be product, customers, suppliers, sales, revenue, etc. A data warehouse does not focus on the ongoing operations, rather it focuses on modelling and analysis of data for decision making.
- **Integrated** – A data warehouse is constructed by integrating data from heterogeneous sources such as relational databases, flat files, etc. This integration enhances the effective analysis of data.
- **Time Variant** – The data collected in a data warehouse is identified with a particular time period. The data in a data warehouse provides information from the historical point of view.
- **Non-volatile** – Non-volatile means the previous data is not erased when new data is added to it. A data warehouse is kept separate from the operational database and therefore frequent changes in operational database is not reflected in the data warehouse.

Note – A data warehouse does not require transaction processing, recovery, and concurrency controls, because it is physically stored and separate from the operational database.

Data Warehouse Applications

As discussed before, a data warehouse helps business executives to organize, analyze, and use their data for decision making. A data warehouse serves as a sole part of a plan-execute-assess "closed-loop" feedback system for the enterprise management. Data warehouses are widely used in the following fields –

- Financial services
- Banking services
- Consumer goods
- Retail sectors
- Controlled manufacturing

Types of Data Warehouse

Information processing, analytical processing, and data mining are the three types of data warehouse applications that are discussed below –

- **Information Processing** – A data warehouse allows to process the data stored in it. The data can be processed by means of querying, basic statistical analysis, reporting using crosstabs, tables, charts, or graphs.
- **Analytical Processing** – A data warehouse supports analytical processing of the information stored in it. The data can be analyzed by means of basic OLAP operations, including slice-and-dice, drill down, drill up, and pivoting.
- **Data Mining** – Data mining supports knowledge discovery by finding hidden patterns and associations, constructing analytical models, performing classification and prediction. These mining results can be presented using the visualization tools.

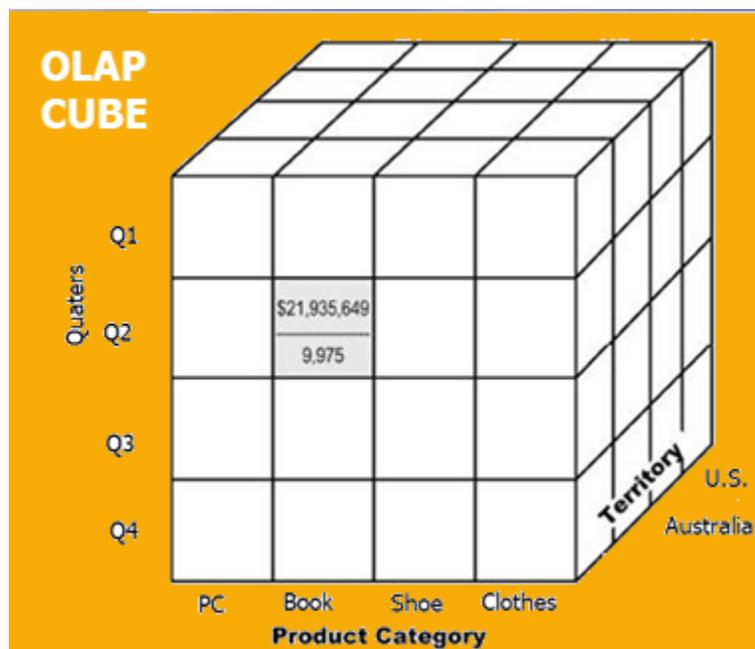
Online Analytical Processing

OLAP is a category of software that allows users to analyze information from multiple database systems at the same time. It is a technology that enables analysts to extract and view business data from different points of view. OLAP stands for Online Analytical Processing.

Analysts frequently need to group, aggregate and join data. These operations in relational databases are resource intensive. With OLAP data can be pre-calculated and pre-aggregated, making analysis faster.

OLAP databases are divided into one or more cubes. The cubes are designed in such a way that creating and viewing reports become easy.

OLAP cube:



At the core of the OLAP, concept is an OLAP Cube. The OLAP cube is a data structure optimized for very quick data analysis.

The OLAP Cube consists of numeric facts called measures which are categorized by dimensions. OLAP Cube is also called the **hypercube**.

Usually, data operations and analysis are performed using the simple spreadsheet, where data values are arranged in row and column format. This

is ideal for two-dimensional data. However, OLAP contains multidimensional data, with data usually obtained from a different and unrelated source. Using a spreadsheet is not an optimal option. The cube can store and analyze multidimensional data in a logical and orderly manner.

How does it work?

A Data warehouse would extract information from multiple data sources and formats like text files, excel sheet, multimedia files, etc.

The extracted data is cleaned and transformed. Data is loaded into an OLAP server (or OLAP cube) where information is pre-calculated in advance for further analysis.

Basic analytical operations of OLAP

Four types of analytical operations in OLAP are:

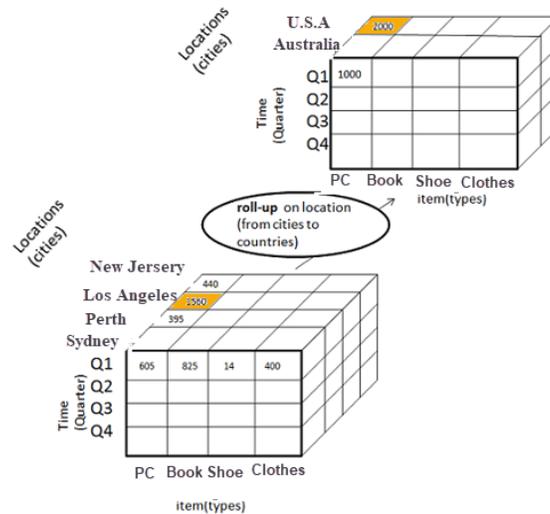
1. Roll-up
2. Drill-down
3. Slice and dice
4. Pivot (rotate)

1) Roll-up:

Roll-up is also known as "consolidation" or "aggregation." The Roll-up operation can be performed in 2 ways

1. Reducing dimensions
2. Climbing up concept hierarchy. Concept hierarchy is a system of grouping things based on their order or level.

Consider the following diagram



- In this example, cities New Jersey and Los Angeles are rolled up into country USA
- The sales figure of New Jersey and Los Angeles are 440 and 1560 respectively. They become 2000 after roll-up
- In this aggregation process, data location hierarchy moves up from city to the country.
- In the roll-up process at least one or more dimensions need to be removed. In this example, Quarter dimension is removed.

2) Drill-down

In drill-down data is fragmented into smaller parts. It is the opposite of the rollup process. It can be done via

- Moving down the concept hierarchy
- Increasing a dimension

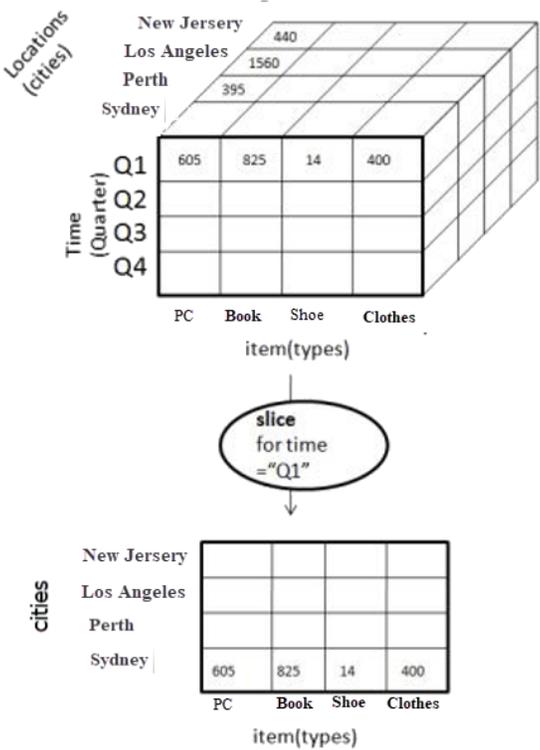
Consider the diagram above

- Quarter Q1 is drilled down to months January, February, and March. Corresponding sales are also registers.
- In this example, dimension months are added.

3) Slice:

Here, one dimension is selected, and a new sub-cube is created.

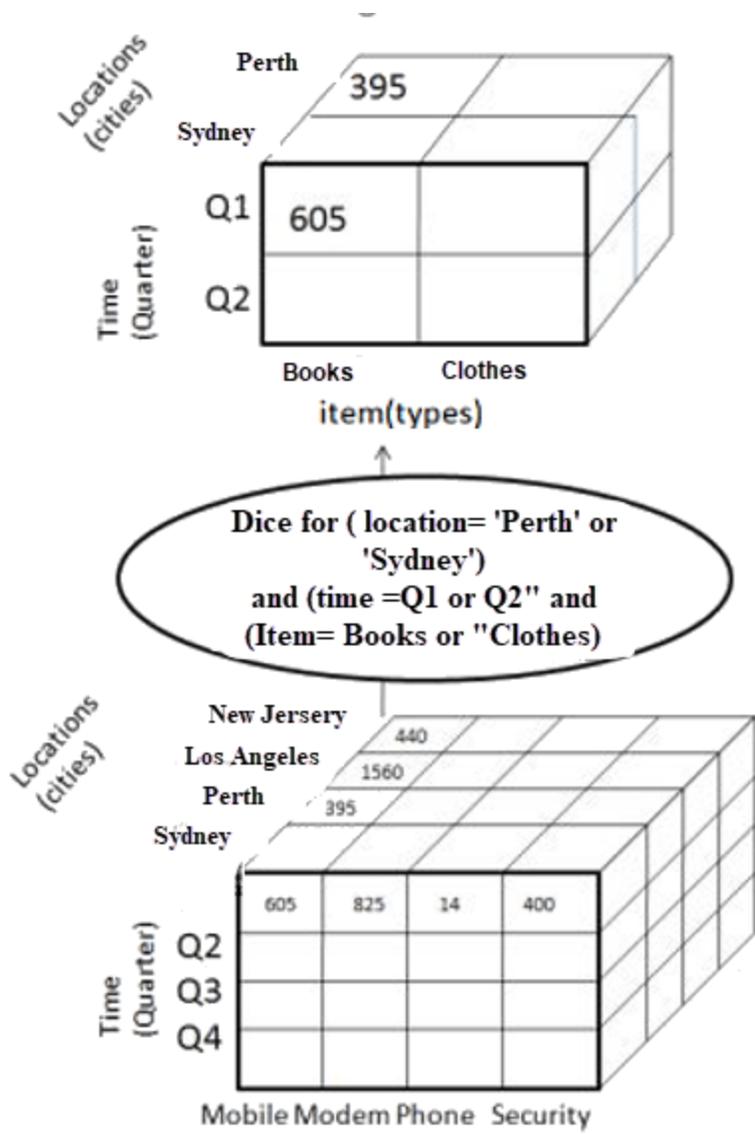
Following diagram explain how slice operation performed:



- Dimension Time is Sliced with Q1 as the filter.
- A new cube is created altogether.

Dice:

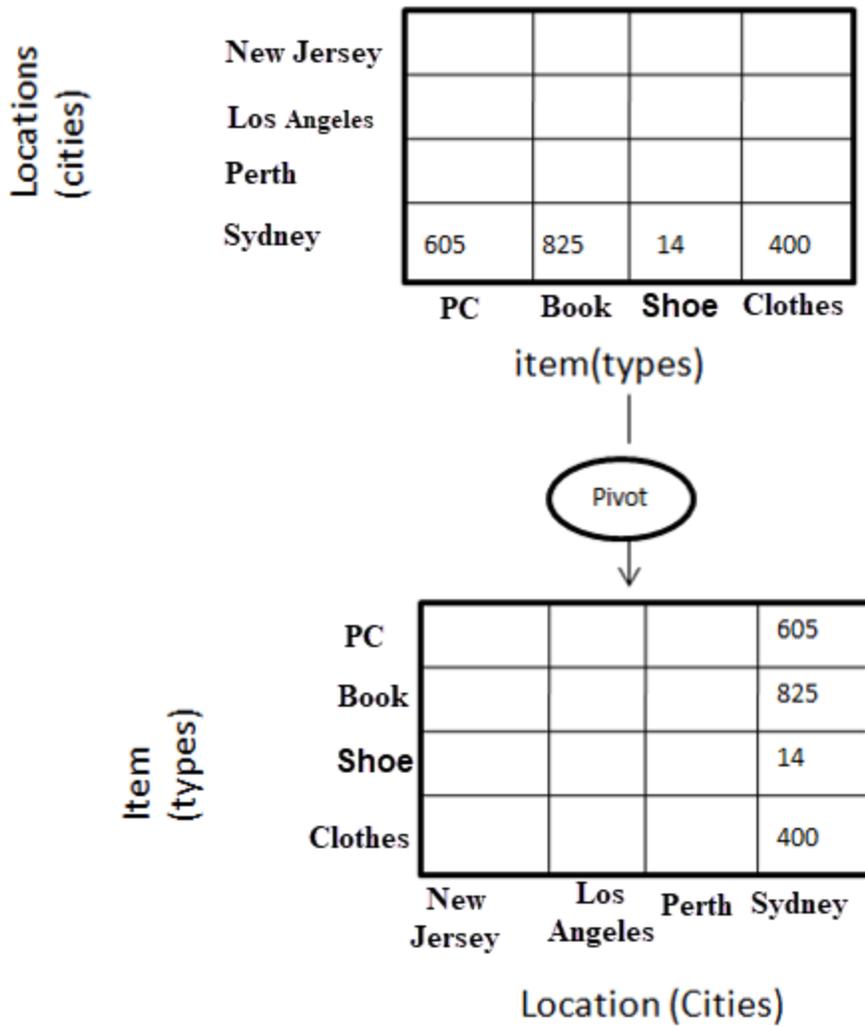
This operation is similar to a slice. The difference in dice is you select 2 or more dimensions that result in the creation of a sub-cube.



4) Pivot

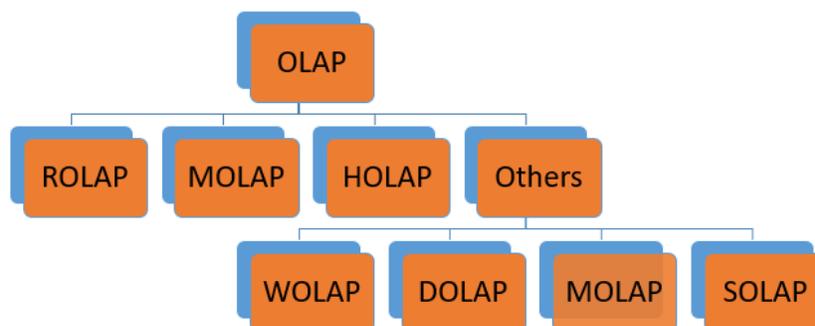
In Pivot, you rotate the data axes to provide a substitute presentation of data.

In the following example, the pivot is based on item types.



Types of OLAP systems

OLAP Hierarchical Structure



Type of OLAP	Explanation
Relational OLAP(ROLAP):	ROLAP is an extended RDBMS along with multidimensional data mapping to perform the standard relational operation.
Multidimensional OLAP (MOLAP)	MOLAP Implements operation in multidimensional data.
Hybrid OnlineAnalytical Processing (HOLAP)	In HOLAP approach the aggregated totals are stored in a multidimensional database while the detailed data is stored in the relational database. This offers both data efficiency of the ROLAP model and the performance of the MOLAP model.
Desktop OLAP (DOLAP)	<p>In Desktop OLAP, a user downloads a part of the data from the database locally, or on their desktop and analyze it.</p> <p>DOLAP is relatively cheaper to deploy as it offers very few functionalities compares to other OLAP systems.</p>
Web OLAP (WOLAP)	Web OLAP which is OLAP system accessible via the web browser. WOLAP is a three-tiered architecture. It consists of three components: client, middleware, and a database server.
Mobile OLAP:	Mobile OLAP helps users to access and analyze OLAP data using their

mobile devices

Spatial OLAP :

SOLAP is created to facilitate management of both spatial and non-spatial data in a Geographic Information system (GIS)

UNIT- IV

Functional information system

Functional business systems are composed of a variety of types of information systems (transaction processing,

Management information, decision support, etc) that support the business functions of:

- Accounting and Finance
- Marketing
- Productions/operations or Manufacturing
- Human resource management

Financial Information Systems

Typically, the first applications that organizations computerize are financial accounting systems. Financial accounting information systems are typically task oriented. They focus on processing financial transactions to produce the routine, repetitive information outputs that every organization finds necessary.

Financial Accounting System is divided into

- a. Operational level Financial Accounting Systems
- b. Tactical level Financial Accounting Systems
- c. Strategic level Financial Accounting System

Operational Financial Accounting Systems

The heart of an organization's operational financial information system is its financial accounting system. A computerized financial accounting system is composed of a series of software modules or subsystems that may be used separately or in an integrated fashion. The system modules typically include

- General ledger
- Fixed assets
- Sales order processing
- Accounts receivable
- Accounts payable
- Inventory control
- Purchase order processing
- Pay roll

General Ledger System provides managers with periodic accounting reports and statements such as the income statement and balance sheet.

Fixed Assets System maintains records of equipment, property, and other long--term assets that an organization Owns. The records include the original cost of the as-sets, their depreciation rates, the accumulated depreciation to date, and the book value of the assets, or the original cost less accumulated depreciation.

Sales Order Processing System or order-entry system, routinely records sales orders and also provides data to other Systems that fill those orders, maintain inventory levels, and bill the customer. This system provides sales tax data to the general ledger system for posting to taxing agency accounts, stock data to the inventory sys-tem for updating inventory balances, and sales data to the accounts receivable system for posting to customer accounts.

Accounts Receivables System allows you to enter, update, and delete customer information such as sales made on account, credit terms, and cash payments received, credit memorandums, and account balances. Inputs to the accounts receivable system include sales invoices, credit

memorandums, and cash received from customers. Typical outputs of this system are monthly customer statements of account and a schedule of accounts receivable listing each account and its balance.

Accounts Payable System processes much the same routine, repetitive information as the accounts receivable system, except that in this case the information is about the organization's creditors rather than about its customers.

Inventory Control System provides input to the general ledger system and receives input from the purchase order and the sales order systems. The basic purpose of the system is to keep track of inventory levels and inventory costs. The system maintains information about each stock item, such as stock numbers and stock descriptions, receipts and issues of stock, stock damage, and stock balances.

Purchase Order Processing System processes purchase orders and tracks which purchase orders have been filled, which stock items ordered are on backorder, which stock items have been damaged or do not meet the specifications of the original order, and which orders are still on order and when those orders are expected to arrive. The purchase order system provides information to the accounts payable and inventory systems. The system produces a variety of reports, including a list of all stock on backorder and an open-order report that lists all purchase orders not yet received and their expected arrival dates.

Payroll System processes wage and salary information such as payments to employees; deductions from employee paychecks; and payments to federal, state, and other taxing agencies for taxes used. The payroll system produces such reports as the weekly payroll summary report, overtime reports, forms for taxing agencies such as wage and tax statements, payroll checks, and checks for payroll taxes owed to taxing agencies.

Tactical Accounting and Financial Information Systems

Budgeting Systems permits managers to track actual revenues and expenses and compare these amounts to expected revenues and expenses. It also allows managers to compare current budget amounts to those of prior fiscal periods, other divisions, and other departments—even to industry-wide data. Comparisons of budget data against such standards allow Managers to assess how they use their resources to achieve their goals. For example, a manager may view the budget to find the amount of money actually spent in the purchasing department on supervisory versus clerical staff. The manager may then compare those amounts to the amounts spent by other purchasing departments in the organization or in the industry.

For example, the general ledger system of a financial accounting system may provide these reports:

1. Current budget allocations, expenditures, and variances by budget line item.
2. Current budget allocations compared to the previous year's allocations.
3. Current revenues and expenditures compared to the previous year's revenues and expenditures.
4. Current revenues and expenditures compared to the average of the other units or divisions of the organization.
5. Projected expenditures and variances for each budget line item for the entire year based on the expenditures incurred to date.

Cash Management Systems

A **cash flow report** shows the estimated amount of cash that will be received and spent each month. The report shows which months will have excess funds that might be put to use and

which months will have insufficient funds, which may require the organization to borrow cash to meet its working capital or fixed asset acquisition needs.

Capital Budgeting Systems

A **capital budget** contains information about the planned acquisition or disposal of major plant assets during the current year. The manager may compare the various capital spending plans using three commonly used evaluation tools: net present value, internal rate of return, and payback period. Before the plant asset is acquired, the manager should compare and evaluate various plans for its acquisition using some financial software tool, such as an electronic spreadsheet.

For example, suppose a manager is considering acquiring a large electronic printer and estimates that her firm will keep the machine for five years. The printer may be purchased or leased. Each method requires the manager to spend different amounts of money over different periods of time. The manager can improve the decision to buy or lease by evaluating the present value of the funds each method requires.

Investment Management Systems

Investment management-overseeing the organization's investments in stocks, bonds, and other securities-is an important part of cash management. Managing investments is also an important part of managing the organization's pension plan. Whatever their source of investment funds, most organizations invest money in securities of one kind or another. Careful management of these investments is necessary to ensure the achievement of organization goals.

Strategic Accounting and Financial Information Systems

Strategic accounting and financial information systems typically include several types of information flows:

1. Internally generated financial condition analysis data, describing the status of the organization.
2. Externally generated economic, demographic, and social data describing the present and future environments for the Organization.
3. Forecasts of the future of that organization in those environments.

Financial Condition Analysis Systems

Computerized accounting systems provide the user with many reports to which conditions and analysis tools may be applied. For example, the manager may use a variety, analysis tools, on the data reported on the income statement and balance sheet. Many computerized accounting systems supp reports that automatically calculate and present the results of these tools and ratio Along with the data and reports, these tools and ratios make up the organization **financial condition analysis system**. This system provides management with variety of measures of the soundness of the organization and makes it possible to explore ways of improving the organizations financial condition.

Commonly used financial ratios

Current ratio

Working Capital

Inventory turnover

Debt-to-equity ratio

Rate earned on stockholder's equity

Earnings per share

Current assets \square \square current liabilities

Long-Range Forecasting Systems

Strategic planners demand forecasts on a variety of factors that will affect organization performance in the future. Some Forecasts may involve the use of internally generated data. For example, past sales data may be used to project future sales. Other forecasts may use only external data or both internal and external data

Marketing Information System:

The marketing function occurs in all organizations, including profit and not-for-profit, manufacturing, agricultural, financial, educational, and service organizations. The basic goal of the marketing function in any organization is to satisfy the needs and wants of its customers. To achieve that goal, marketing personnel engage in activities such as planning and developing new products; advertising, promoting, selling, storing, and distributing goods and services; providing financing and credit to customers' and conducting market research All these functions are facilitated through marketing information system.

The marketing information system is classified into

- a. Operational level marketing information system
- b. Tactical level marketing information system
- c. Strategic level marketing information system

Operational Marketing Information Systems

. Operational marketing information systems include systems such as sales systems, advertising systems, sales promotion systems, warehousing systems, and pricing systems. The systems collect data that describe marketing operations, process those data, and make marketing information available to marketing managers to help them make decisions. To be effective, marketing information systems must be coordinated with other organizational information systems, such as purchasing systems, production systems, inventory systems, accounts receivable systems, credit systems, and order-entry systems.

Sales Force Automation Systems are designed to increase the productivity of sales-people. Bread-and-butter sales activities usually include identifying potential or prospective customer contacting customers, calling on customers, making sales pitches, closing the sale, and following up on sales. Typically, automating a sales force involves equipping salespeople with notebook computers and software to support their activities

Prospect information systems: Locating potential customers are often a time- consuming and frustrating part of the

Salesperson's work. The sources of information used to obtain sales leads are diverse and may include other customers, other vendors who sell supporting or ancillary products, newspaper notices, telephone directories, and customer inquiries. Searching directories and other customer lists may take a lot of time and yield few actual customers

Contact management systems: Provide information to the sales force pertaining to customers, their product or service preferences, sales history data, and a historical record of sales calls and/or visits. One output of these systems may be a call report showing the number of sales calls

made by a salesperson categorized by size of organization, previous sales, or some other characteristic, and the number or amount of sales made per customer, per visit, and/or per category.

Other sales force automation systems: May also provide support for many other routine, repetitive salesperson activities, for example, travel expense reports, appointment calendars, telephone and address rolodexes, sales letter creation and distribution, e-mail, and fax. Internet access may also be provided so that salespeople can keep current on business news at any hour, especially news about the industry, competitors, and customers.

Micromarketing and Data Warehouse Systems: Pitching sales or advertising campaigns to very narrowly defined

Customer targets are called **micromarketing**.

Telemarketing systems: Usually include support for the automatic dialing of parties and/or delivering voice messages to the answering party under the control of a computer system. Some systems allow you to make notes about the calls, to generate follow-up letters, and to view a customer file while a call to that customer is in progress.

Direct Mail Advertising Systems: Many organizations generate sales by mailing sales brochures and catalogs directly to customers using direct mail advertising systems. To distribute sales documents rapidly to large numbers of potential customers, most marketing departments maintain customer mailing lists that are used for mass mailings. The lists may be drawn from customer files; accounts receivable records; prospect files; commercial databases of households, businesses, and organizations; or they can be purchased from other firms.

Point of Sale System: Systems provide immediate updates to sales and inventory systems and allow firms to monitor sales trends minute by minute. They also allow firms to capture customer data and preferences and add the information to their data warehouses.

Delivery Tracking and Routine Systems: Customers like to receive their merchandise on time. In a manual system, customers called in to a customer representative to check on the delivery of their merchandise. The customer rep would then have to call the delivery vehicle driver who uses a cell phone to tell the rep where he or she is and how soon the merchandise might be delivered. That process took time, frequently frustrated the customer, and cost the firm money to support.

Electronic Shopping and Advertising: Firms have been able to advertise and customers to shop via TV; radio, and the telephone for many years. The computer age, however, has made other avenues for shopping and advertising available, the most dramatic of which is clearly the Internet

Virtual shopping: When people view, select, and purchase products and services from a store in another location using Electronic means, they are virtually shopping at that store. Virtual shopping, or electronic shopping, allows organizations to present information about goods and services to potential customers who are connected to their electronic “store.”

Selecting and buying goods using an electronic kiosk (described in the next section), from an organization’s Internet site, and from a “virtual mall” of Internet Web “stores” are all examples of virtual or electronic shopping.

Tactical Marketing Information Systems

Tactical marketing information systems differ from operational marketing information systems because in addition to producing information on a regular basis, they also generate ad hoc reports, create unexpected as well as expected output, produce comparative as well as descriptive information. It includes

Sales Management Systems

Sales management systems enable marketing managers to assess the productivity of the sales force; the fertility of sales territories; and the success of products by salesperson, territory, and customer type. Sales management systems keep track of salesperson call activities, sales orders, and customer activity. The systems allow the manager to identify weak territories or weak products in a territory; to compare salesperson performance by product and customer type; to compare salesperson performance against salesperson goals; to analyze salesperson calls within territories or by customer type; to identify trends in customer purchases; to identify potential shortages or excess stock in inventory; and to perform other planning, controlling, and organizing tasks with ease and speed.

Advertising and Promotion Systems

Marketing managers also need to develop advertising and promotional tactics to implement strategic sales goals set by top management. Managers must decide which advertising media and promotional devices to use to reach the selected market segments, when to use these media and devices, and what overall mix of promotional activities to deploy to achieve sales goals. Advertising and promotion systems assist managers in these tasks.

Pricing Systems

Pricing systems provide information to managers that helps them set prices for their products and services. These information systems are important because the price of a product or service affects the sales volume and profitability of the organization.

Distribution Channel Systems

To support the marketing manager, the marketing information system should provide distribution channel decision-support systems. These systems should provide information on the costs of using the various distribution channels, the time lags caused by the various channels, the reliability of the various channels in delivering the products and services, and the market segment situation provided by the channels. The systems should also track the demand and inventory at all levels of the distribution channels so that the manager may anticipate excess inventories and shortfalls.

Competitive Tracking Systems

To ensure that your organization's marketing mix will continue to satisfy customers, you must keep abreast of major competitors and their activities. In the end, market share is likely to be greatest for the organization that provides the marketing mix most closely matching a given market segment's needs and wants. Competitive Intelligence, or knowledge of the competitor prices, products, sales, advertising, and promotions, must be gathered if the organization is to avoid falling behind the competition in the eyes of the customers. Gathering competitive intelligence is carried out through competitive tracking systems. It should be noted that data about competitors can be used both tactically and strategically by managers.

Strategic Marketing Information Systems

The strategic activities may include segmenting the market into target groups of potential customers based on common characteristics, needs, or wants; selecting those market segments the organization wishes to reach; planning products and services to meet those. Customers' needs; and forecasting sales for the market segments and products

It includes

Sales Forecasting Systems

Strategic sales forecasting systems usually include several varieties of forecasts: forecasts of sales for the industry as a whole, forecasts of sales for the entire organization, forecasts of sales for each product or service, forecasts of sales for a new product or service, and forecasts for market segments. The results of these sales forecasts are often further categorized by sales territory and sales division. Regardless of type, sales forecasts are usually based on more than historical data; they are not merely projections of past trends. Sales forecasts are also based on assumptions about the activities of the competition, governmental action, shifting customer demand, economic trends, demographic trends, and a variety of other pertinent factors, including even the weather.

Marketing Research Systems

In large organizations, research departments conduct and manage marketing re-search. In smaller companies, marketing

Research may be completed by outside consultants or by personnel who must wear several hats. Regardless of how the

function is completed, the results of marketing research provide important input to both tactical and strategic decision making. These following activities are typical of a marketing research department.

1. Conducting trend analyses of industry sales of products and services identical or similar to those offered by the organization to identify products or services that are on the ascent or descent.
2. Analyzing population and target group characteristics, especially for trends or changes in data that could affect the organization.
3. Analyzing and identifying consumer preferences, including testing products and services.
4. Determining and analyzing customer satisfaction with the organization's existing products and services.
5. Estimating market share for all of each product and service offered.

Product planning and development systems

The major objective of **product planning and development systems** is to make information about consumer preferences obtained from the marketing research system and from customer inquiries available for the development of new products. The primary output of planning and development activities is a set of product specifications. In a manufacturing organization, these specifications would be given to the engineering department, which would try to design a product to meet them. Similar activities occur in service organizations. For example, a survey Of bank customers may indicate that customers would like a checking account that also acts like a savings account-an account in which they could place all their money, maximize the amount of cash earning interest, avoid multiple statements, and avoid the need to shift funds between savings and checking accounts.

Production/Operations/Manufacturing Information system:

The purpose of the production system is to acquire the raw materials and purchased parts; test the materials for quality; acquire the appropriate human resources, work space, and equipment; fabricate the products or services; test the product or service outputs; and monitor and control the use and costs of the resources involved.

It is further classified into

- a. Operational level production information system

- b. Tactical level production information system
- c. Strategic level production information system.

Operational Production Information Systems

Operational production systems are diverse; they include continuous flow production, mass production, and job order Production, and project production. In addition, operational production systems include the production of services as well as hard goods.

It includes

Purchasing Systems: To produce goods and services, you must have the right quantity of raw materials and production supplies on hand. Furthermore, you will want to procure these materials and supplies at the lowest cost and have them delivered at the right time. To assist in this function, the purchasing system has to maintain data on all phases of the acquisition of raw materials and purchased parts used in production.

Receiving Systems: When shipments of purchased goods and supplies are received, they must usually be opened, inspected, and verified against purchase orders, and the information about their status passed to the accounts payable, inventory, and production departments. Delivery dates should also be noted for several reasons, including collecting data on the delivery-time reliability of suppliers. This type of information is supplied by receiving systems

Quality Control Systems provide information about the status of production goods as they move from the raw materials state, through goods in process, to finished goods. Quality control systems ensure that raw materials or parts purchased for use in the production processes meet the standards set for those materials. The systems also monitor quality during the production cycle.

Cost Accounting Systems: Many operational-level financial accounting systems collect and report information about the resources that are used in the production processes so that managers can obtain accurate costs of production on products and services. Cost accounting systems monitor the three major resources used in production: human resources, materials, and equipment and facilities.

Materials management systems provide information on current inventory levels of production materials, use of these Materials in the production processes and their locations, and specifications of how these materials are employed in products. The latter system is usually called a bill-of-materials (BOM) system. A bill-of-materials system produces a list of the raw materials, subassemblies, and component parts needed to complete each product. It provides, in essence, a list of ingredients for the end product

Inventory Control System: Maintaining inventories at their proper levels eliminates production shutdowns from lack of raw materials and lost sales from lack of finished goods. However, maintaining inventories also represents a number of costs to the organization, including the costs of procuring and carrying the inventory, and stock out costs, or those costs that result when the right amount of the right item is not on hand at the right time.

Automated Material Handling Systems track, control, and otherwise support the movement of raw materials, work-in process and finished goods from the receiving docks to the shipping docks.

Computer Aided Design and Manufacturing Systems are aiding product engineers design new products and improve old products.

Image Management Systems are designed to manage the storage and retrieval of engineering and architectural drawings using optical disk storage media.

Material Selection Systems aid in choosing the materials for the product under design.

Shop-Floor Scheduling Systems help in scheduling production jobs. The tasks include scheduling the time, building and rooms, tools and equipment, inventory, and personnel to complete factory orders. space, and equipment; schedule the materials, human resources,

Tactical Production Information Systems

Production systems encompass all the activities necessary to ensure the manufacture of products or services. To perform its functions, the production system must locate production sites, plan the layout of those sites, and produce a production plan. The production system has to acquire the raw materials, parts, and subassemblies needed to produce the products or services described in the plan and to identify how many workers of each type are required.

Materials Requirements Planning Systems

Inventory management can be taken a step further so that the system automatically produces purchase orders for stock that needs to be reordered. Materials requirement planning (MRP) software is basically a set of programs that use data from master production schedule, inventory files, and bill-of-materials systems or list raw materials and components needed to create each product to help manage production and inventory. MRP systems perform a great deal of calculation and record keeping. When quantities of raw materials and parts are large, the calculations and record keeping become too time-consuming to complete manually, except at high costs. The computer, however, has made such calculations and purchase-order preparation possible for all organizations, and in recent years, software to implement materials requirements planning has become abundant.

Just-in-Time Systems

The just-in-time (JIT) system is not a tactical information system, but a tactical approach to production. The just-in-time approach was created by the Toyota Motor Company of Japan and has generated many advantages to organizations, especially those that do repetitive production. The purpose of the approach is to eliminate waste in the use of equipment, parts, space, workers' time, and materials, including the resources devoted to inventories. The basic philosophy of JIT is that operations should occur just when they are required to maintain the production schedule. To assure a smooth flow of operations in that environment, sources of problems must be eradicated. That means that quality must be emphasized because quality problems interfere with the even flow of work. For inventory management, JIT translates into having just as much inventory on hand as is absolutely needed, which is achieved by developing efficient and effective production controls.

Capacity Planning Systems

In addition to ensuring that enough raw materials will be on hand for planned production, the production manager must also see to it that enough production capacity will be available to meet production goals. The purpose of capacity planning is to make certain that sufficient personnel, space, machines, and other production facilities are available at the right time to meet the organization's planned production. Managers also utilize capacity planning to minimize excess production capacity. Capacity planning decisions are tactical production decisions and include allocating personnel and production facilities. Selecting sites for constructing plant facilities, acquiring plant facilities, and planning those facilities to meet long-term production goals are usually categorized as strategic production

Production Scheduling Systems

The purpose of the production schedule is to allocate the use of specific production facilities for the production of finished goods to meet the master production schedule. To manage the

scheduling process, a number of scheduling tools have been developed. Two of these tools are Gantt and PERT (Program Evaluation and Reporting Technique) charts. These tools allow managers to control projects and project completion times and also to determine the impact problems will have on project completion dates.

Product Design and Development Systems

Many tactical decisions must be made to design and develop a product, especially a new product. The design engineering team usually depends on product specification information derived from customer surveys, target population analysis, or other marketing research systems.

Manufacturing Resource Planning Systems

More recently, software that provides for manufacturing resource planning (MRP-II) has become available. MRP-II software extends the production information system to finance, marketing, human resource management, and other organizational functions. A fully developed MRP-II system includes modules that provide material requirements planning, shop floor control, inventory management, and capacity planning. The system also accesses cost accounting data through integration with the financial accounting system. MRP-II systems usually accept data from a wide range of shop-floor data collection equipment, including voice recognition equipment, factory robots, production-line sensors, process control systems, bar code readers, and CAD workstations.

Computer-Integrated Manufacturing Systems

Many production professionals envision a day when factory and product planning control, design, and operation will be totally integrated and almost totally computerized. Some software and hardware firms that provide MSP, MRP, MRP-II, CAD, CAM, robotics, and related information systems are joining forces through mergers, acquisitions, and joint projects to integrate current production hardware and software products into systems that provide computer integrated manufacturing (CIM). A growing number of manufacturers are utilizing CIM -or at least a great many components of CIM-to run their factories. Implementing CIM can lead to considerable cost savings, improvement in quality, and more flexible responses to customer. more flexible responses to customer.

Strategic Production Information Systems

Strategic production information systems provide support for top-management-level production decisions such as:

- Selecting a plant site.
- Constructing a plant addition.
- Building a new plant.
- Designing and laying out a production facility.
- Choosing the technologies that will be used in the production processes.
- Choosing responsibility for production processes-deciding basic policies on vertical integration and outsourcing.

Decisions of this magnitude require the commitment of a large amount of capital and other resources over a long period of time and thus are strategic in nature. Clearly, such decisions must not be made lightly.

Site Planning and Selection Systems

Site planning systems usually rely on a variety of internal and external sources. Some of the external information needed is relatively objective and quantitative, such as the availability and cost of trained or experienced labor and the degree to which it is unionized, the availability and

cost of transportation for raw materials and finished goods, the availability of suitable sites, the cost of land, the proximity of raw materials suppliers and finished goods customers, the availability and costs of power, and the rate of property and income taxation.

Technology Planning and Assessment Systems

Having access to information on new; production technologies allows top management to make better and more informed decisions about which production technologies to use for a product or service. **Technology assessment systems**, which identify new technologies and assess them for their strategic advantage, can help top management in many areas, not merely production. Like site planning, technology in-formation systems may include CD-ROM databases, traditional library resources, Internet sites, and on-line databases maintained by government agencies, industry groups, private research groups, and consulting organizations. They may also include technology assessment groups within the production or engineering arms of the organization.

Process Positioning Systems

An important part of any organization's strategic production plan is the span of production processes it decides to perform for any given product or product line. Decisions of this nature are called **process positioning**, or vertical integration. An organization might purchase raw materials, fabricate parts, assemble; parts into subassemblies, and then assemble and test the complete product. It may, on the other hand, decide to purchase already constructed subassemblies and parts from others and limit its internal span of production processes to assembling and testing the plant Design Systems completed product. Outsourcing subassemblies, for example, to production facilities in third world countries, may allow the organization to gain a competitive advantage by being a low-cost leader for its products.

Plant Design Systems

Designing and laying out a manufacturing plant requires large amounts of diverse in-formation about the proposed plant, including engineering data on the proposed site, proposed production technologies, the number and duties of plant personnel, the expected schedule for the use of the facility, the area transportation system, choices of water and power systems and their costs, the cost and availability of construction materials, the plans for shop-floor information systems, and the need for physical security. Much of this information is available to the **plant design system** from the site planning, technology assessment, and process positioning decision processes

Human Resource Information System: Human resource departments are responsible for many facets to human resource management, including recruiting, assessment, selection, placement, training, performance appraisal, compensation and benefit management, promotion, termination, occupational health and safety, employee services, complaints with legal constraints, helping managers with human resource problems, and providing top management with information for strategic planning.

It is further classified into

- a. Operational level Human Resource Information System
- b. Tactical level Human Resource Information System
- c. Strategic level Human Resource Information System
- d.

Operational Human Resource Information Systems

Operational Human Resource Information Systems provide managers with data to support the routine, repetitive human

resource decisions that occur regularly in the management of organization's human resources. There are many operational level human resource information systems including systems that help managers keep track of the organisation's positions and employees, conduct performance evaluation, provide alternative or flexible scheduling, recruit new employees, place employees, train employees, relocate employees, terminate employees, provide employment benefits and provide reports to governmental agencies. Let us see some of the important sub systems of operational

human resource information systems and their benefits as follows:

Position Control Systems is to identify each position in the organization, the job title in which the position is classified, and the employee currently assigned to the position. Reference to the position control systems allows a human resource manager to identify the details about unfilled positions.

Employee Information Systems is a set of employee profile records, or employee inventory. An employee profile usually contains personal and organization-related information, such as name, address, sex, minority status, marital status, citizenship, years of service or seniority data, education and training, previous experience, employment history within the organization, salary rate, salary or wage grade, and recruitment and health plan choices. Employee Skills Inventory contains information about every employee's work experience, work preferences, test scores, Interests, and special skills or proficiencies.

Performance Management Systems: Many organizations review the work of employees on a regular basis to make

decisions regarding merit pay, pay increases, transfer or promotion. Typically, a new employee is evaluated at the end of the first six months of employment, and other employees are evaluated annually. These reviews are often called performance appraisals. The data for performance appraisals are frequently collected by asking each employee's immediate superior to complete an employee appraisal form. The form may be also given to peers, the employees themselves, and even customers or clients.

Government Reporting Systems: Data Secures from the payroll, position control, employee profiles, performance

management, and other human resource information systems can be used to produce reports required by myriad governmental laws and regulations, including affirmative action and equal employment opportunity laws and regulations.

Applicant Selection and Placement Systems After jobs and the employee requirements for those jobs have been identified and after a pool of suitable job candidates has been recruited, candidates must be screened, evaluated, selected, and placed in the positions that are open. The primary purpose of the application selection and placement system is to assist the human resources staff in these tasks.

Training Systems: A great deal of software available today providing on-line training for employees, including management training software, sale training software, microcomputer training software, and word processing software.

Tactical Human Resource Information Systems

. Tactical HRIS include job analysis and design, recruitment, training and development, and employee compensation. Strategic HRIS include information systems that support workforce planning and labor negotiation.

Job Analysis and Design Systems

Job analysis and design includes describing the jobs needed in an organization and the qualities of the workers needed to fill those jobs. These tasks involve the development of job descriptions for every type of position in an organization. Each job description specifies the purposes, tasks, duties, and responsibilities of each job and the conditions and performance standards under which those duties and responsibilities must be carried out. Job analysis and design also includes the development of job specifications for each type of job. A job specification describes the skills, knowledge, experience, and other personal characteristics required to perform the jobs that are listed in job descriptions. In short, job descriptions describe the jobs, and job specifications describe the workers needed to fill those jobs.

Recruiting Systems

A **recruiting system** should provide the organization with a bank of qualified applicants from which it may fill vacant positions identified through the position control system and described by the job analysis and design information system. The recruiting function should also ensure that the organization is in compliance with various federal, state, and local statutes and contract regulations for affirmative action and equal employment opportunity.

Compensation and Benefits Systems

To help human resource managers control their compensation and benefit plans, organizations must keep and maintain information describing the various pay plans and fringe benefits as well as the choices of each employee. The **compensation and benefits system** may support a variety of tactical human resource decisions, especially when compensation and benefits information is related to information from internal and external sources. For example, you may wish to relate the pay received by employees with the same job duties or job titles to identify employees who are paid more or less than they should be for the skills they have and the duties they must complete.

Succession Planning Systems

An important role of human resource departments is to make certain that replacements for key organizational personnel are available when the positions key personnel occupy become vacant because of death, injury, retirement, or other reasons. Planning for the succession of these key people means identifying replacement employee.

Strategic Human Resource Information Systems

Human resource planning ensures that the organization has the right kinds and the right numbers of people at the right places at the right time to achieve its objectives. Several types of human resource planning are strategic in nature, including workforce planning and labor negotiations.

Workforce Planning Systems

Organizations involved in long-term strategic planning, such as those planning to expand into new market areas, construct factories or offices in new locations, or add new products, will need information about the quantity and quality of the available workforce to achieve their goals. Forecasting human resource needs requires information to answer a number of planning questions, including the following:

1. What should be the labor force of the organization look like to meet the strategic plan? What skills, experiences, Knowledge, and other qualities should be organization's human resource process? In other words, what job descriptions and specializations does the strategic plan require?

2. What quantities of human resources with the qualities already identified are needed to carry out the strategic plan? In other words, how many positions for each job title does the strategic plan need?
3. What are the current human resources of the organization and how well do they satisfy the organization's strategic needs for human resources?

Information Systems Supporting Labor Negotiations

Negotiating with craft, maintenance, office, and factory unions requires information gathered from many of the human Resource information systems already discussed. In addition, negotiators need information from the financial accounting System and from external sources, including competitor wage agreements and appropriate economic data for the industry, employee group, and geographical region. The human resource team completing the negotiating needs to be able to obtain numerous ad hoc reports that analyze the organization's and union's positions within the framework of both the industry and the current economic situation. The negotiating team must receive these ad hoc reports on a very timely basis because additional questions and tactics will occur to the team while they are negotiating.

Unit-V

INFORMATION SYSTEMS SECURITY AND CONTROL

Security and control

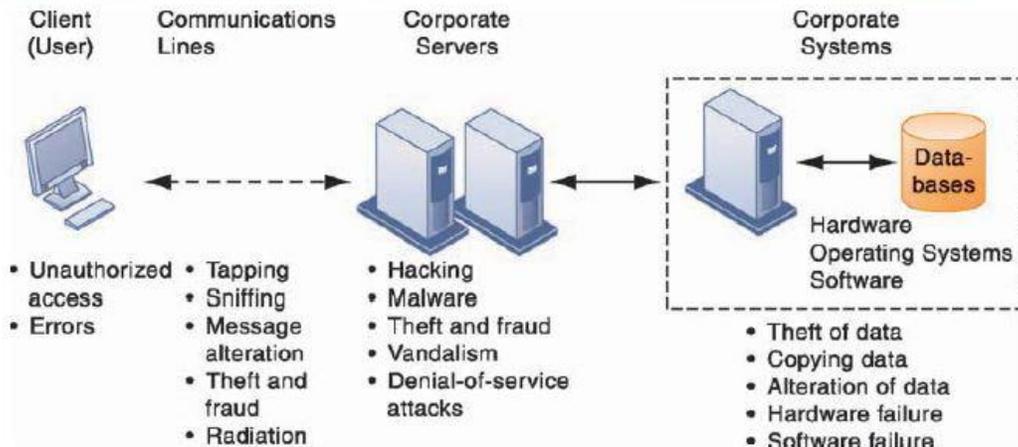
Security refers to the policies, procedures, and technical measures used to prevent unauthorized access, alteration, theft, or physical damage to information systems.

Controls are methods, policies, and organizational procedures that ensure the safety of the organization's assets, the accuracy and reliability of its records, and operational adherence to management standards.

Vulnerability of the System and its abuse:

When large amounts of data are stored in electronic form, they are vulnerable to many more kinds of threats than when they existed in manual form. Through communications networks, information systems in different locations are interconnected.

FIGURE CONTEMPORARY SECURITY CHALLENGES AND VULNERABILITIES



The architecture of a Web-based application typically includes a Web client, a server, and corporate information systems linked to databases. Each of these components presents security challenges and vulnerabilities. Floods, fires, power failures, and other electrical problems can cause disruptions at any point in the network.

Client:

Users at the client layer can cause harm by introducing errors or by accessing systems without authorization.

Communication lines:

It is possible to access data flowing over networks, steal valuable data during transmission, or alter messages without authorization. Radiation may disrupt a network at various points as well. Intruders can launch denial of service attacks or malicious software to disrupt the operation of Web sites.

Corporate server:

Those capable of penetrating corporate systems can destroy or alter corporate data stored in databases or files.

Corporate systems

Systems malfunction if computer hardware breaks down, is not configured properly, or is damaged by improper use or criminal acts. Errors in programming, improper installation, or unauthorized changes cause computer software to fail. Power failures, floods, fires, or other natural disasters can also disrupt computer systems.

Domestic or offshore partnering with another company adds to system vulnerability if valuable information resides on networks and computers outside the organization's control. Without strong safeguards, valuable data could be lost, destroyed, or could fall into the wrong hands, revealing important trade secrets or information that violates personal privacy.

Mobile phones:

The popularity of handheld mobile devices for business computing adds to these woes. Portability makes cell phones, smartphones, and tablet computers easy to lose or steal. Smartphones share the same security weaknesses as other Internet devices, and are vulnerable to malicious software and penetration from outsiders. Smartphones used by corporate employees often contain sensitive data such as sales figures, customer names, phone numbers, and e-mail addresses. Intruders may be able to access internal corporate systems through these devices.

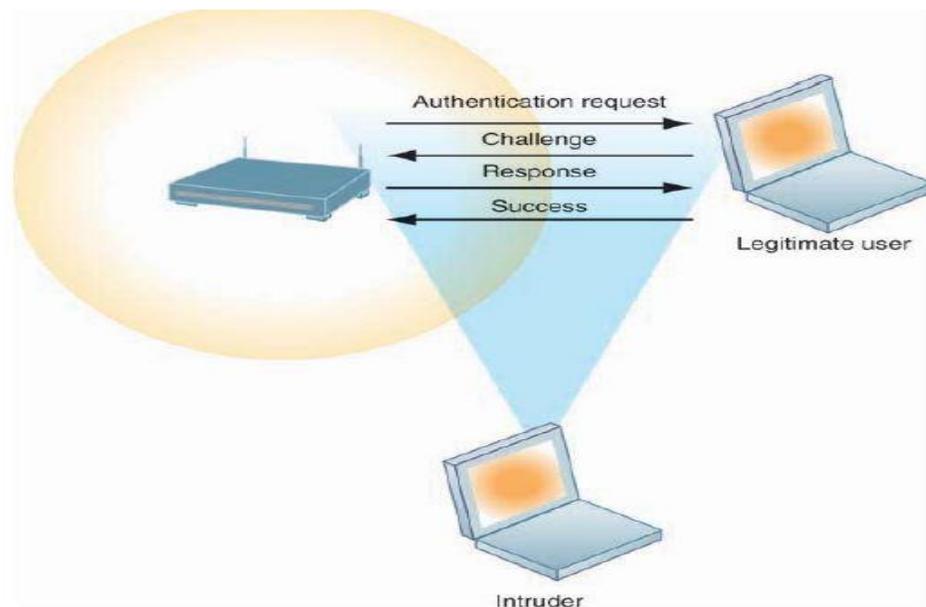
Internet Vulnerabilities

Large public networks, such as the Internet, are more vulnerable than internal networks because they are virtually open to anyone. The Internet is so huge that when abuses do occur, they can have an enormously widespread impact. When the Internet becomes part of the corporate network, the organization's information systems are even more vulnerable to actions from outsiders.

Wireless Security Challenges

Bluetooth and Wi-Fi networks are susceptible to hacking by eavesdroppers. Local area networks can be easily penetrated by outsiders armed with laptops, wireless cards, external antennae, and hacking software. Hackers use these tools to detect unprotected networks, monitor network traffic, and, in some cases, gain access to the Internet or to corporate networks.

FIGURE 8.2 WI-FI SECURITY CHALLENGES



MALICIOUS SOFTWARE: VIRUSES, WORMS, TROJAN HORSES, AND SPYWARE

Malicious software programs are referred to as **malware** and include a variety of threats, such as computer viruses, worms, and Trojan horses.

Virus: A **computer virus** is a rogue software program that attaches itself to other software programs or data files in order to be executed, usually without user knowledge or permission. Most computer viruses deliver a "payload." The payload may be relatively benign, such as

instructions to display a message or image, or it may be highly destructive—destroying programs or data, clogging computer memory, reformatting a computer’s hard drive, or causing programs to run improperly. Viruses typically spread from computer to computer when humans take an action, such as sending an e-mail attachment or copying an infected file.

Worm: Most recent attacks have come from **worms**, which are independent computer programs that copy themselves from one computer to other computers over a network. Unlike viruses, worms can operate on their own without attaching to other computer program files and rely less on human behavior in order to spread from computer to computer. This explains why computer worms spread much more rapidly than computer viruses. Worms destroy data and programs as well as disrupt or even halt the operation of computer networks.

Sources of worms and viruses:

Worms and viruses are often spread over the Internet from files of downloaded software, from files attached to e-mail transmissions, or from compromised e-mail messages, online ads, or instant messaging. Viruses have also invaded computerized information systems from “infected” disks

or infected machines. Especially prevalent today are **drive-by downloads**, consisting of malware that comes with a downloaded file that a user intentionally or unintentionally requests. Hackers can do to a smartphone just about anything they can do to any Internet device: request malicious files without user intervention, delete files, transmit files, install programs running in the background to monitor user actions, and potentially convert the smartphone into a robot in a botnet to send e-mail and text messages to anyone. With smartphones starting to outsell PCs, and smartphones increasingly used as payment devices, they are becoming a major avenue for malware.

Malware targeting mobile devices is not yet as extensive as that targeting larger computers, but nonetheless is spreading using e-mail, text messages, Bluetooth, and file downloads from the Web via Wi-Fi or cellular networks.

Blogs, wikis, and social networking sites such as Facebook have emerged as new conduits for malware or spyware. These applications allow users to post software code as part of the permissible content, and such code can be launched automatically as soon as a Web page is viewed. On July 4, 2011, hackers broke into the “Fox News Politics” Twitter account, sending fake messages about President Barack Obama. The hackers changed the account's password, preventing Fox from correcting the messages for hours

Trojan Horse:

A **Trojan horse** is a software program that appears to be benign but then does something other than expected. The Trojan horse is not itself a virus because it does not replicate, but it is often a way for viruses or other malicious code to be introduced into a computer system. The term *Trojan horse* is based on the huge wooden horse used by the Greeks to trick the Trojans into opening the gates to their fortified city during the Trojan War. Once inside the city walls, Greek soldiers hidden in the horse revealed themselves and captured the city. An example of a modern-day Trojan horse is the MMarketPay.A Trojan for Android phones. This Trojan is hidden in several apps that appear to be legitimate, including travel and weather apps. It places orders for

applications and movies automatically without the user's permission, potentially causing users to be hit with unexpectedly high phone bills. .

SQL injection attacks have become a major malware threat. SQL injection attacks take advantage of vulnerabilities in poorly coded Web application software to introduce malicious program code into a company's systems and networks. These vulnerabilities occur when a Web application fails to properly validate or filter data entered by a user on a Web page, which might occur when ordering something online.

Spyware:

Some types of spyware also act as malicious software. These small programs install themselves surreptitiously on computers to monitor user Web surfing activity and serve up advertising. Thousands of forms of spyware have been documented.

Many users find such **spyware** annoying, and some critics worry about its infringement on computer users' privacy. Some forms of spyware are especially nefarious. **Keyloggers** record every keystroke made on a computer to steal serial numbers for software, to launch Internet attacks, to gain access to e-mail accounts, to obtain passwords to protected computer systems, or to pick up personal information such as credit card numbers.

For example, the Zeus Trojan stole financial and personal data from online banking and social networking sites by surreptitiously tracking users' keystrokes as they entered data into their computers. Other spyware programs reset Web browser home pages, redirect search requests, or slow performance by taking up too much memory.

Computer Crime

Most hacker activities are criminal offenses, and the vulnerabilities of systems we have just described make them targets for other types of **computer crime** as well.

a. Hackers And Computer Crime

A **hacker** is an individual who intends to gain unauthorized access to a computer system. Within the hacking community, the term *cracker* is typically used to denote a hacker with criminal intent, although in the public press,

b. Spoofing and Sniffing

Hackers attempting to hide their true identities often spoof, or misrepresent, themselves by using fake e-mail addresses or masquerading as someone else.

Spoofing also may involve redirecting a Web link to an address different from the intended one, with the site masquerading as the intended destination. For example, if hackers redirect customers to a fake Web site that looks almost exactly like the true site, they can then collect and process orders, effectively stealing business as well as sensitive customer information from the true site. We provide

more detail on other forms of spoofing in our discussion of computer crime.

A **sniffer** is a type of eavesdropping program that monitors information traveling over a network. When used legitimately, sniffers help identify potential network trouble spots or criminal activity on networks, but when used for criminal purposes, they can be damaging and very difficult to detect.

Sniffers enable hackers to steal proprietary information from anywhere on a network, including e-mail messages, company files, and confidential reports.

c. Denial-of-Service Attacks

In a **denial-of-service (DoS) attack**, hackers flood a network server or Web server with many thousands of false communications or requests for services to crash the network. The network receives so many queries that it cannot keep up with them and is thus unavailable to service legitimate requests.

d. Identity Theft

With the growth of the Internet and electronic commerce, identity theft has become especially troubling. **Identity theft** is a crime in which an imposter obtains key pieces of personal information, such as social security identification numbers, driver's license numbers, or credit card numbers, to impersonate someone else. The information may be used to obtain credit, merchandise, or services in the name of the victim or to provide the thief with false credentials.

TABLE 8.2 EXAMPLES OF COMPUTER CRIME

COMPUTERS AS TARGETS OF CRIME
Breaching the confidentiality of protected computerized data
Accessing a computer system without authority
Knowingly accessing a protected computer to commit fraud
Intentionally accessing a protected computer and causing damage, negligently or deliberately
Knowingly transmitting a program, program code, or command that intentionally causes damage to a protected computer
Threatening to cause damage to a protected computer
COMPUTERS AS INSTRUMENTS OF CRIME
Theft of trade secrets
Unauthorized copying of software or copyrighted intellectual property, such as articles, books, music, and video
Schemes to defraud
Using e-mail for threats or harassment
Intentionally attempting to intercept electronic communication
Illegally accessing stored electronic communications, including e-mail and voice mail
Transmitting or possessing child pornography using a computer

e. **phishing**: Phishing involves setting up fake Web sites or sending e-mail messages that look like those of legitimate businesses to ask users for confidential personal data. The e-mail message instructs recipients to update or confirm records by providing social security numbers, bank and credit card information, and other confidential data either by responding to the e-mail message, by entering the information at a bogus Web site, or by calling a telephone number. EBay, PayPal, Amazon.com, Walmart, and a variety of banks are among the top spoofed companies.

f. **Pharming** redirects users to a bogus Web page, even when the individual types the correct Web page address into his or her browser. This is possible if pharming perpetrators gain access to the Internet address information stored by Internet service providers to speed up Web browsing and the ISP companies have flawed software on their servers that allows the fraudsters to hack in and change those addresses.

g. Click Fraud

When you click on an ad displayed by a search engine, the advertiser typically pays a fee for each click, which is supposed to direct potential buyers to its products. **Click fraud** occurs when an individual or computer program fraudulently clicks on an online ad without any intention of learning more about the advertiser or making a purchase. Click fraud has become a serious problem at Google and other Web sites that feature pay-per-click online advertising.

Global Threats: Cyberterrorism and Cyberwarfare

The cyber criminal activities we have described—launching malware, denial-of-service attacks, and phishing probes—are borderless. China, the United States, South Korea, Russia, and Taiwan are currently the sources of most of the world’s malware (King, 2012). The global nature of the Internet makes it possible for cybercriminals to operate—and to do harm—anywhere in the world.

Internet vulnerabilities have also turned individuals and even entire nation states into easy targets for politically-motivated hacking to conduct sabotage and espionage. **Cyberwarfare** is a state-sponsored activity designed to cripple and defeat another state or nation by penetrating its computers or networks for the purposes of causing damage and disruption.

TABLE 8.3 THE FIVE MOST EXPENSIVE DATA BREACHES

DATA BREACH	DESCRIPTION
U.S. Veterans Affairs Department	In 2006, the names, birth dates, and social security numbers of 17.5 million military veterans and personnel were stolen from a laptop that a Department of Veterans Affairs employee had taken home. The VA spent at least \$25 million to run call centers, send out mailings, and pay for a year of a credit-monitoring service for victims.
Heartland Payment Systems	In 2008, criminals led by Miami hacker Albert Gonzales installed spying software on the computer network of Heartland Payment Systems, a payment processor based in Princeton, NJ, and stole the numbers of as many as 100 million credit and debit cards. Gonzales was sentenced in 2010 to 20 years in federal prison, and Heartland paid about \$140 million in fines and settlements.
TJX	A 2007 data breach at TJX, the retailer that owns national chains including TJ Maxx and Marshalls, cost at least \$250 million. Cyber criminals took more than 45 million credit and debit card numbers, some of which were used later to buy millions of dollars in electronics from Walmart and elsewhere. Albert Gonzales, who played a major role in the Heartland hack, was linked to this cyberattack as well.
Epsilon	In March 2011, hackers stole millions of names and e-mail addresses from the Epsilon e-mail marketing firm, which handles e-mail lists for major retailers and banks like Best Buy, JPMorgan, TiVo, and Walgreens. Costs could range from \$100 million to \$4 billion, depending on what happens to the stolen data, with most of the costs from losing customers due to a damaged reputation.
Sony	In April 2011, hackers obtained personal information, including credit, debit, and bank account numbers, from over 100 million PlayStation Network users and Sony Online Entertainment users. The breach could cost Sony and credit card issuers up to a total of \$2 billion.

INTERNAL THREATS: EMPLOYEES

The company insiders pose serious security problems. Employees have access to privileged information, and in the presence of sloppy internal security procedures, they are often able to roam throughout an organization’s systems without leaving a trace.

Studies have found that user lack of knowledge is the single greatest cause of network security breaches. Many employees forget their passwords to access computer systems or allow co-workers to use them, which compromises the system. Malicious intruders seeking system access sometimes trick employees into revealing their passwords by pretending to be legitimate members of the company in need of information. This practice is called **social engineering**.

Both end users and information systems specialists are also a major source of errors introduced into information systems. End users introduce errors by entering faulty data or by not following the proper instructions for processing data and using computer equipment. Information systems specialists may create software errors as they design and develop new software or maintain existing programs.

SOFTWARE VULNERABILITY

Software errors pose a constant threat to information systems, causing untold losses in productivity. Growing complexity and size of software programs, coupled with demands for timely delivery to markets, have contributed to an increase in software flaws or vulnerabilities. For example, a software error in an iPad app for paying bills caused Citibank to double the charge for customer payments between July and December 2011.

A major problem with software is the presence of hidden **bugs** or program code defects. Studies have shown that it is virtually impossible to eliminate all bugs from large programs. The main source of bugs is the complexity of decision-making code.

Security Control Measures:

INFORMATION SYSTEMS CONTROLS

Information systems controls are both manual and automated and consist of general and application controls.

General controls govern the design, security, and use of computer programs and the security of data files in general throughout the organization's information technology infrastructure. On the whole, general controls apply to all computerized applications and consist of a combination of hardware, software, and manual procedures that create an overall control environment.

General controls include software controls, physical hardware controls, computer operations controls, data security controls, controls over implementation of system processes, and administrative controls. The following table describes the functions of each of these controls.

Application controls are specific controls unique to each computerized application, such as payroll or order processing. They include both automated and manual procedures that ensure that only authorized data are completely and accurately processed by that application. Application controls can be classified as

- (1) input controls,
- (2) processing controls, and
- (3) output controls.

Input controls check data for accuracy and completeness when they enter the system. There are specific input controls for input authorization, data conversion, data editing, and error handling.

Processing controls establish that data are complete and accurate during updating. *Output controls* ensure that the results of computer processing are accurate, complete, and properly distributed.

TABLE 8.4 GENERAL CONTROLS

TYPE OF GENERAL CONTROL	DESCRIPTION
Software controls	Monitor the use of system software and prevent unauthorized access of software programs, system software, and computer programs.
Hardware controls	Ensure that computer hardware is physically secure, and check for equipment malfunction. Organizations that are critically dependent on their computers also must make provisions for backup or continued operation to maintain constant service.
Computer operations controls	Oversee the work of the computer department to ensure that programmed procedures are consistently and correctly applied to the storage and processing of data. They include controls over the setup of computer processing jobs and backup and recovery procedures for processing that ends abnormally.
Data security controls	Ensure that valuable business data files on either disk or tape are not subject to unauthorized access, change, or destruction while they are in use or in storage.
Implementation controls	Audit the systems development process at various points to ensure that the process is properly controlled and managed.
Administrative controls	Formalize standards, rules, procedures, and control disciplines to ensure that the organization's general and application controls are properly executed and enforced.

Other Control measures:

1.ELECTRONIC EVIDENCE AND COMPUTER FORENSICS: Security, control, and electronic records management have become essential for responding to legal actions. Much of the evidence today for stock fraud, embezzlement, theft of company trade secrets, computer crime, and many civil cases is in digital form. In addition to information from printed or typewritten

pages, legal cases today increasingly rely on evidence represented as digital data stored on portable storage devices, CDs, and computer hard disk drives, as well as in e-mail, instant messages, and e-commerce transactions over the Internet. E-mail is currently the most common type of electronic evidence.

Computer forensics is the scientific collection, examination, authentication, preservation, and analysis of data held on or retrieved from computer storage media in such a way that the information can be used as evidence in a court of law. It deals with the following problems:

- Recovering data from computers while preserving evidential integrity
- Securely storing and handling recovered electronic data
- Finding significant information in a large volume of electronic data
- Presenting the information to a court of law

A **risk assessment** determines the level of risk to the firm if a specific activity or process is not properly controlled. Not all risks can be anticipated and measured, but most businesses will be able to acquire some understanding of the risks they face.

2.SECURITY POLICY

Once you've identified the main risks to your systems, your company will need to develop a security policy for protecting the company's assets. A **security policy** consists of statements ranking information risks, identifying acceptable security goals, and identifying the mechanisms for achieving these goals.

Security policy also includes provisions for identity management.

3. Identity management consists of business processes and software tools for identifying the valid users of a system and controlling their access to system resources. It includes policies for

identifying and authorizing different categories of system users, specifying what systems or portions of systems each user is allowed to access, and the processes and technologies for authenticating users and protecting their identities.

TECHNOLOGIES AND TOOLS FOR PROTECTING INFORMATION RESOURCES

Businesses have an array of technologies for protecting their information resources. They include tools for managing user identities, preventing unauthorized access to systems and data, ensuring system availability, and ensuring software quality.

IDENTITY MANAGEMENT AND AUTHENTICATION

Authentication refers to the ability to know that a person is who he or she claims to be. Authentication is often established by using **passwords** known only to authorized users. An end user uses a password to log on to a computer system and may also use passwords for accessing specific systems and files.

New authentication technologies, such as tokens, smart cards, and biometric authentication, overcome some of these problems.

A **token** is a physical device, similar to an identification card, that is designed to prove the identity of a single user. Tokens are small gadgets that typically fit on key rings and display passcodes that change frequently.

A **smart card** is a device about the size of a credit card that contains a chip formatted with access permission and other data. (Smart cards are also used in electronic payment systems.) A reader

device interprets the data on the smart card and allows or denies access.

Biometric authentication uses systems that read and interpret individual human traits, such as fingerprints, irises, and voices, in order to grant or deny access. Biometric authentication is based on the measurement of a physical or behavioral trait that makes each individual unique. It compares a person's unique characteristics, such as the fingerprints, face, or retinal image, against a stored profile of these characteristics to determine whether there are any differences between these characteristics and the stored profile. If the two profiles match, access is granted. Fingerprint and facial recognition technologies are just beginning to be used for security applications,

FIREWALLS, INTRUSION DETECTION SYSTEMS, AND ANTIVIRUS SOFTWARE

Without protection against malware and intruders, connecting to the Internet would be very dangerous. Firewalls, intrusion detection systems, and antivirus software have become essential business tools.

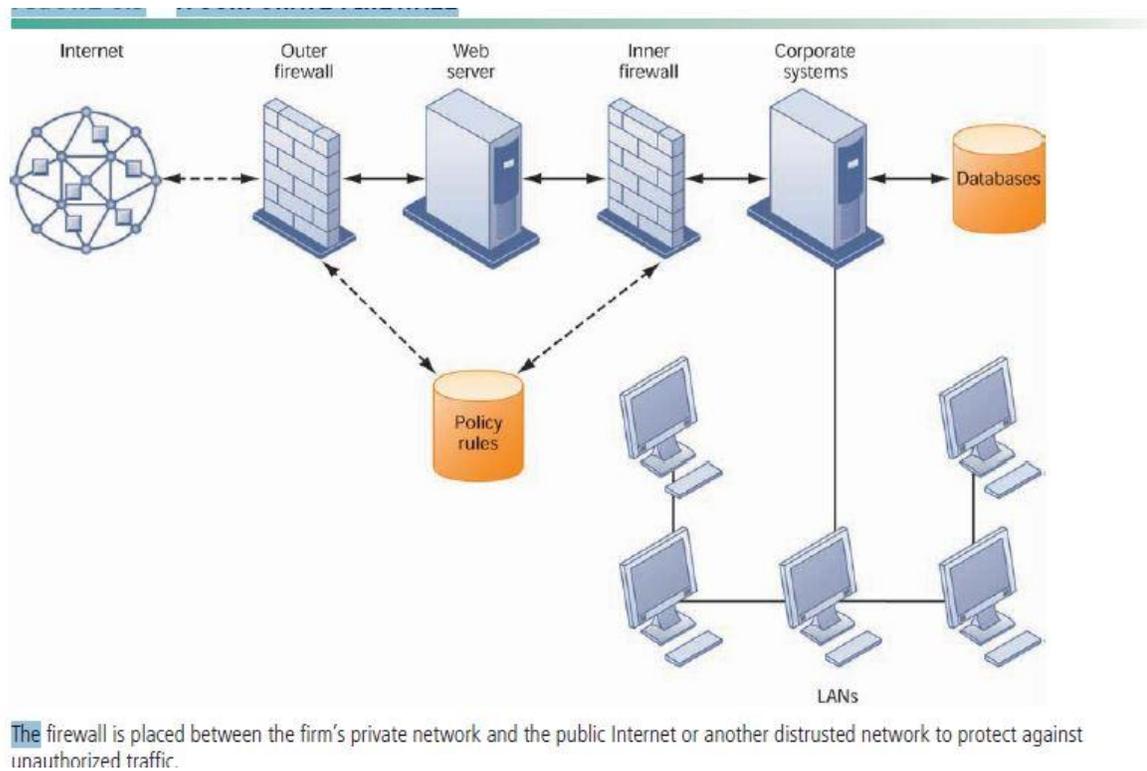
Firewalls

Firewalls prevent unauthorized users from accessing private networks. A firewall is a combination of hardware and software that controls the flow of incoming and outgoing network traffic. It is generally placed between the organization's private internal networks and distrusted external networks, such as the Internet, although firewalls can also be used to protect one part of a company's network from the rest of the network

The firewall acts like a gatekeeper who examines each user's credentials before access is granted to a network. The firewall identifies names, IP addresses, applications, and other characteristics of incoming traffic. It checks this information against the access rules that have been

programmed into the system by the network administrator. The firewall prevents unauthorized communication into and out of the network.

FIGURE 8.5 A CORPORATE FIREWALL



Antivirus and Antispyware Software

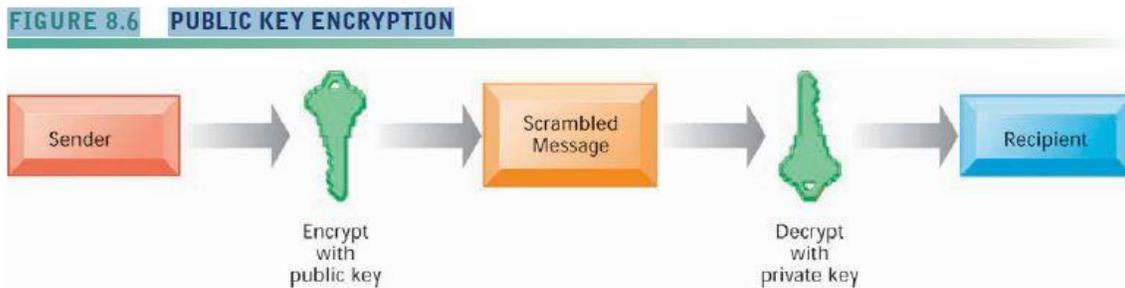
Defensive technology plans for both individuals and businesses must include anti-malware protection for every computer. **Antivirus software** prevents, detects, and removes malware, including computer viruses, computer worms, Trojan horses, spyware, and adware. However, most antivirus software is effective only against malware already known when the software was written. To remain effective, the antivirus software must be continually updated.

ENCRYPTION AND PUBLIC KEY INFRASTRUCTURE

Many businesses use encryption to protect digital information that they store, physically transfer, or send over the Internet. **Encryption** is the process of transforming plain text or data into cipher text that cannot be read by anyone other than the sender and the intended receiver. Data are encrypted by using a secret numerical code, called an encryption key, that transforms plain data into cipher text. The message must be decrypted by the receiver.

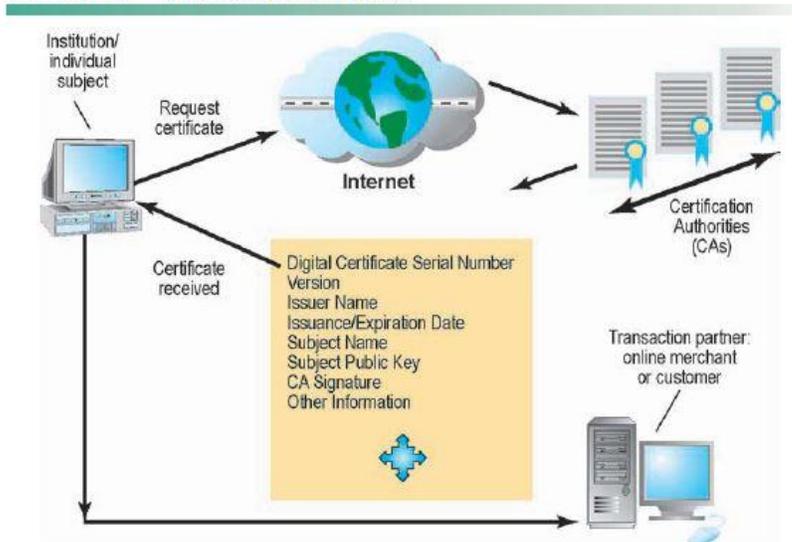
A more secure form of encryption called **public key encryption** uses two keys: one shared (or public) and one totally private

FIGURE 8.6 PUBLIC KEY ENCRYPTION



Digital certificates are data files used to establish the identity of users and electronic assets for protection of online transactions. A digital certificate system uses a trusted third party, known as a certificate authority (CA, or certification authority), to validate a user's identity. There are many CAs in the United States and around the world, including Symantec, GoDaddy, and Comodo.

FIGURE 8.7 DIGITAL CERTIFICATES



Digital certificates help establish the identity of people or electronic assets. They protect online transactions by providing secure, encrypted, online communication.

Security in the Cloud

When processing takes place in the cloud, accountability and responsibility for protection of sensitive data still reside with the company owning that data.

Cloud users need to confirm that regardless of where their data are stored, they are protected at a level that meets their corporate requirements. They should stipulate that the cloud provider store and process data in specific jurisdictions according to the privacy rules of those jurisdictions. Cloud clients should find how the cloud provider segregates their corporate data from those of other companies and ask for proof that encryption mechanisms are sound.

Securing Mobile Platforms

If mobile devices are performing many of the functions of computers, they need to be secured like desktops and laptops against malware, theft, accidental loss, unauthorized access, and hacking attempts.

Mobile devices accessing corporate systems and data require special protection. Companies should make sure that their corporate security policy includes mobile devices, with additional details on how mobile devices should be supported, protected, and used.

ENSURING SOFTWARE QUALITY

In addition to implementing effective security and controls, organizations can improve system quality and reliability by employing software metrics and rigorous software testing. Software metrics are objective assessments of the system in the form of quantified measurements. Ongoing use of metrics allows the information systems department and end users to jointly measure the performance of the system and identify problems as they occur.

Information system audit

An information system (IS) audit or information technology(IT) audit is an examination of the controls within an entity's Information technology infrastructure. These reviews may be performed in conjunction with a financial statement audit, internal audit, or other form of attestation engagement. It is the process of collecting and evaluating evidence of an organization's information systems, practices, and operations. Obtained evidence evaluation can ensure whether the organization's information systems safeguard assets, maintains data integrity, and are operating effectively and efficiently to achieve the organization's goals or objectives.

An IS audit is not entirely similar to a financial statement audit. An evaluation of internal controls may or may not take place in an IS audit. Reliance on internal controls is a unique characteristic of a financial audit. An evaluation of internal controls is necessary in a financial audit, in order to allow the auditor to place reliance on the internal controls, and therefore, substantially reduce the amount of testing necessary to form an opinion regarding the financial statements of the company. An IS audit, on the other hand, tends to focus on determining risks that are relevant to information assets, and in assessing controls in order to reduce or mitigate these risks. An IT audit may take the form of a "general control review" or an "specific control review". Regarding the protection of information assets, one purpose of an IS audit is to review and evaluate an organization's information system's availability, confidentiality, and integrity by answering the following questions:

1. Will the organization's computerized systems be available for the business at all times when required? (Availability)

2. Will the information in the systems be disclosed only to authorized users?
(Confidentiality)
3. Will the information provided by the system always be accurate, reliable, and timely?
(Integrity).

The performance of an IS Audit covers several facets of the financial and organizational functions of our Clients. The diagram to the right gives you an overview of the Information Systems Audit flow: From Financial Statements to the Control Environment and Information Systems Platforms.

Information Systems Audit Methodology

PHASE 1: Audit Planning

In this phase we plan the information system coverage to comply with the audit objectives specified by the Client and ensure compliance to all Laws and Professional Standards. The first thing is to obtain an Audit Charter from the Client detailing the purpose of the audit, the management responsibility, authority and accountability of the Information Systems Audit function as follows:

1. Responsibility: The Audit Charter should define the mission, aims, goals and objectives of the Information System Audit. At this stage we also define the Key Performance Indicators and an Audit Evaluation process;
2. Authority: The Audit Charter should clearly specify the Authority assigned to the Information Systems Auditors with relation to the Risk Assessment work that will be carried out, right to access the Client's information, the scope and/or limitations to the scope, the Client's functions to be audited and the auditee expectations; and
3. Accountability: The Audit Charter should clearly define reporting lines, appraisals, assessment of compliance and agreed actions.

The Audit Charter should be approved and agreed upon by an appropriate level within the Client's Organization.

See Template for an Audit Charter/ Engagement Letter [here](#).

In addition to the Audit Charter, we should be able to obtain a written representation ("Letter of Representation") from the Client's Management acknowledging:

1. Their responsibility for the design and implementation of the Internal Control Systems affecting the IT Systems and processes
2. Their willingness to disclose to the Information Systems Auditor their knowledge of irregularities and/or illegal acts affecting their organisation pertaining to management and employees with significant roles within the internal audit department.

3. Their willingness to disclose to the IS Auditor the results of any risk assessment that a material misstatement may have occurred

See a Template for a Letter of Representation here.

PHASE 2 – Risk Assessment and Business Process Analysis

Risk is the possibility of an act or event occurring that would have an adverse effect on the organisation and its information systems. Risk can also be the potential that a given threat will exploit vulnerabilities of an asset or group of assets to cause loss of, or damage to, the assets. It is ordinarily measured by a combination of effect and likelihood of occurrence.

More and more organisations are moving to a risk-based audit approach that can be adapted to develop and improve the continuous audit process. This approach is used to assess risk and to assist an IS auditor's decision to do either compliance testing or substantive testing. In a risk based audit approach, IS auditors are not just relying on risk. They are also relying on internal and operational controls as well as knowledge of the organisation. This type of risk assessment decision can help relate the cost/benefit analysis of the control to the known risk, allowing practical choices.

The process of quantifying risk is called Risk Assessment. Risk Assessment is useful in making decisions such as:

1. The area/business function to be audited
2. The nature, extent and timing of audit procedures
3. The amount of resources to be allocated to an audit

A detailed IS control is a control over acquisition, implementation, delivery and support of IS systems and services. The IS auditor should consider, to the level appropriate for the audit area in question:

- The findings from and date of previous audits in this area
- The complexity of the systems involved
- The level of manual intervention required
- The susceptibility to loss or misappropriation of the assets controlled by the system (e.g., inventory, and payroll)
- The likelihood of activity peaks at certain times in the audit period
- Activities outside the day-to-day routine of IS processing (e.g., the use of operating system utilities to amend data)
- The integrity, experience and skills of the management and staff involved in applying the IS controls

PHASE 3 – Performance of Audit Work

In the performance of Audit Work the Information Systems Audit Standards require us to provide supervision, gather audit evidence and document our audit work. We achieve this objective through:

- Establishing an Internal Review Process where the work of one person is reviewed by another, preferably a more senior person.
- We obtain sufficient, reliable and relevant evidence to be obtained through Inspection, Observation, Inquiry, Confirmation and recomputation of calculations
- Documentation of audit work done and audit evidence gathered to support the auditors' findings.

Based on our risk assessment and upon the identification of the risky areas, we move ahead to develop an Audit Plan and Audit Program. The Audit Plan will detail the nature, objectives, timing and the extent of the resources required in the audit.

PHASE 4: Reporting

Upon the performance of the audit test, the Information Systems Auditor is required to produce an appropriate report communicating the results of the IS Audit. An IS Audit report should:

1. Identify an organization, intended recipients and any restrictions on circulation
2. State the scope, objectives, period of coverage, nature, timing and the extent of the audit work
3. State findings, conclusions, recommendations and any reservations, qualifications and limitations
4. Provide audit evidence

Global management of information system

DEVELOPING AN INTERNATIONAL INFORMATION SYSTEMS ARCHITECTURE

. An **international information systems architecture** consists of the basic information systems required by organizations to coordinate worldwide trade and other activities.

INTERNATIONAL INFORMATION SYSTEMS ARCHITECTURE



Stage 1: THE GLOBAL ENVIRONMENT: BUSINESS DRIVERS AND CHALLENGES

The global business drivers can be divided into two groups: general cultural factors and specific business factors. Easily recognized general cultural factors have driven internationalization since World War II. Information, communication, and transportation technologies have created a *global village* in which communication (by telephone, television, radio, or computer network) around

the globe is no more difficult and not much more expensive than communication down the block. The cost of moving goods and services to and from geographically dispersed locations has fallen dramatically.

The development of global communications has created a global village in a second sense: A **global culture** created by television, the Internet, and other globally share media.

TABLE 15-1 THE GLOBAL ENVIRONMENT: BUSINESS DRIVERS AND CHALLENGES

GENERAL CULTURAL FACTORS	SPECIFIC BUSINESS FACTORS
Global communication and transportation technologies	Global markets
Development of global culture	Global production and operations
Emergence of global social norms	Global coordination
Political stability	Global workforce
Global knowledge base	Global economies of scale

- Cultural and political differences profoundly affect organizations' business processes and applications of information technology.
- Language remains a significant barrier. Although English has become a kind of standard business language, this is truer at higher levels of companies and not throughout the middle and lower ranks. Software may have to be built with local language interfaces before a new information system can be successfully implemented.
- Currency fluctuations can play havoc with planning models and projections.

Stage 2: GLOBAL STRATEGIES AND BUSINESS ORGANIZATION:

Four main global strategies form the basis for global firms' organizational structure. These are domestic exporter, multinational, franchiser, and transnational.

The **domestic exporter** strategy is characterized by heavy centralization of corporate activities in the home country of origin. Nearly all international companies begin this way, and some move on to other forms. Production, finance/accounting, sales/marketing, human resources, and strategic management are set up to optimize resources in the home country. International sales are sometimes dispersed using agency agreements or subsidiaries, but even here, foreign marketing relies on the domestic home base for marketing themes and strategies. Caterpillar Corporation and other heavy capital-equipment manufacturers fall into this category of firm.

The **multinational** strategy concentrates financial management and control out of a central home base while decentralizing production, sales, and marketing operations to units in other countries. The products and services on sale in different countries are adapted to suit local market conditions. The organization becomes a far-flung confederation of production and marketing facilities in different countries. Many financial service firms, along with a host of manufacturers, such as General Motors, Chrysler, and Intel, fit this pattern.

Franchisers are an interesting mix of old and new. On the one hand, the product is created, designed, financed, and initially produced in the home country, but for product-specific reasons must rely heavily on foreign personnel for further production, marketing, and human resources. Food franchisers such Information technology and improvements in global telecommunications are giving international firms more flexibility to shape their global strategies. The configuration, management, and development of systems tend to follow the global strategy chosen

TABLE 15-3 GLOBAL BUSINESS STRATEGY AND STRUCTURE

BUSINESS FUNCTION	DOMESTIC EXPORTER	MULTINATIONAL	FRANCHISER	TRANSNATIONAL
Production	Centralized	Dispersed	Coordinated	Coordinated
Finance/Accounting	Centralized	Centralized	Centralized	Coordinated
Sales/Marketing	Mixed	Dispersed	Coordinated	Coordinated
Human Resources	Centralized	Centralized	Coordinated	Coordinated
Strategic Management	Centralized	Centralized	Centralized	Coordinated

Stage 3: REORGANIZING THE BUSINESS

To develop a global company and information systems support structure, a firm needs to follow these principles:

1. Organize value-adding activities along lines of comparative advantage. For instance, marketing/sales functions should be located where they can best be performed, for least cost and maximum impact; likewise with production, finance, human resources, and information systems.
2. Develop and operate systems units at each level of corporate activity— regional, national, and international. To serve local needs, there should be *host country systems units* of some magnitude.
3. Establish at world headquarters a single office responsible for development of international systems—a global chief information officer (CIO) position.



Stage 4: Managing Global Business process

THE MANAGEMENT SOLUTION: IMPLEMENTATION

1. Agreeing on Common User Requirements

Establishing a short list of the core business processes and core support systems will begin a process of rational comparison across the many divisions of the company, develop a common language for discussing the business, and naturally lead to an understanding of common elements (as well as the unique qualities that must remain local).

2. Introducing Changes in Business Processes

Involving people in change assuring them that change is in the best interests of the company and their local units, is a key tactic.

3. Coordinating Applications Development

. It is far easier to coordinate change by making small incremental steps toward a larger vision. Imagine a five-year plan of action rather than a two-year plan of action, and reduce the set of transnational systems to a bare minimum to reduce coordination costs.

4. Coordinating Software Releases

Firms can institute procedures to ensure that all operating units convert to new software updates at the same time so that everyone's software is compatible.

Stage 5: Technology

Once firms have defined a global business model and systems strategy, they must select hardware, software, and networking standards along with key system applications to support global business processes. Hardware, software, and networking pose special technical challenges in an international setting.

One major challenge is finding some way to standardize a global computing platform when there is so much variation from operating unit to operating unit and from country to country.

Another major challenge is finding specific software applications that are user friendly and that truly enhance the productivity of international work teams.

a. COMPUTING PLATFORMS AND SYSTEMS INTEGRATION

The development of a transnational information systems architecture based on the concept of core systems raises questions about how the new core systems will fit in with the existing suite of applications developed around the globe by different divisions, different people, and for different kinds of computing hardware.

b. CONNECTIVITY

Truly integrated global systems must have connectivity—the ability to link together the systems and people of a global firm into a single integrated network just like the phone system but capable of voice, data, and image transmissions.

c. SOFTWARE LOCALIZATION

. If new software must be created, another challenge is to build software that can be realistically used by multiple business units from different countries given that business units are accustomed to their unique business processes and definitions of data.

Types of Virus & Anti-virus

Computer virus is a harmful software program written intentionally to enter a computer without the user's permission or knowledge. It has the ability to replicate itself, thus continuing to spread. Some viruses do little but replicate, while others can cause severe harm or adversely affect the

program and performance of the system. A virus should never be assumed harmless and left on a system.—Computer virus is a software program written with malicious intentions. —

Types of Computer Viruses

- **Memory Resident Virus** Examples: Randex, CMJ, Meve, and MrKlunky— This type of virus hides in the RAM and stays there even after the malicious code is executed. These viruses fix themselves in the computer memory and get activated whenever the OS runs and infects all the files that are then opened. —
- **Direct Action Viruses** Examples: Vienna virus— Target: It can corrupt files. Basically, it is a file-infector virus. — The viruses keep changing their location into new files whenever the code is executed, but are generally found in the hard disk's root directory.
- **Overwrite Viruses** Examples: Way, Trj.Reboot, Trivial.88.D— The virus replaces the file content. However, it does not change the file size. — A virus of this kind is characterized by the fact that it deletes the information contained in the files that it infects, totally useless once they have been infected. —
- **–Boot Sector Virus** Examples: Polyboot.B, AntiEXE— It hides in the memory until DOS accesses the floppy disk, and whichever boot data is accessed, the virus infects it.
- **Macro Virus** Examples: Relax, Melissa.A, Bablas, O97M/Y2K— These hide in documents that are shared via e-mail or networks. — Macro viruses infect files that are created using certain applications or programs that contain macros, like .doc, .xls, .pps, .mdb, etc.
- **Directory Virus** Examples: Dir-2 virus— It is usually located in only one location of the disk, but infects the entire program in the directory. — Directory viruses (also called Cluster Virus/File System Virus) infect the directory of your computer by changing the path that indicates the location of a file.
- **Polymorphic Virus** Examples: Elkern, Marburg, Satan Bug and Tuareg— Polymorphic viruses encrypt or encode themselves in a different way (using different algorithms and encryption keys) every time they infect a system. This makes it impossible for antivirus software to find them using string or signature searches (because they are different in each encryption). The virus then goes on to create a large number of copies. —
- **Companion Viruses** Examples: Stator, Asimov.1539 and Terrax.1069— These generally use the same filename and create a different extension of it. For example: If there is a file "Me.exe", the virus creates another file named "Me.com" and hides in the new file. When the system calls the filename "Me", the ".com" file gets executed (as ".com" has higher priority than ".exe"), thus infecting the system.
- **FAT Virus** Examples: Link Virus— ge caused can result in loss of information from individual files or even entire directories. — FAT virus attacks the FAT section and may damage crucial hardware—
- **Web Scripting Virus** Examples: JS.Fortnight is a virus that spreads through malicious e-mails.— The main sources of web scripting viruses are the web browsers or infected

web pages. → Many web pages include complex codes in order to create an interesting and interactive content. This code is often exploited to bring about certain undesirable actions. →

Effects of Virus:

- ♣ Damage software
- ♣ Damage data
 - ♣ Display false message every few times
- ♣ Modify files dates and extensions
 - ♣ Copy, rename and delete files
- ♣ Format hard disk
 - ♣ Files mysteriously disappear
- ♣ Error messages on regular basis
 - ♣ New windows open up at an alarming rate
- ♣ System memory and disk space is reduced
 - ♣ Icons change in appearance
 - ♣ Unknown and uninstalled icons on desktop
- ♣ Random restarts
- ♣ Computer runs slowly

There are certain types of anti-viruses. →

Computer Anti-Virus : Antivirus software is a computer program that detects, prevents, and takes action to disarm or remove malicious software programs, such as viruses and worms. →

List of all Anti-Viruses

- Avira Antivirus
- Avast Antivirus
- AVG Antivirus
- Immunet Protect
- Emsisoft Antimalware
- Digital Patrol
- K7 Antivirus
- eScan Antivirus
- Comodo Antivirus
- Dr.Web Antivirus
- Digital Defender Antivirus
- Norman Antivirus
- Clam Antivirus
- F-Prot Antivirus

- Kaspersky Antivirus
- Vipre Antivirus
- Trend Micro Antivirus
- Sophos Antivirus
- Panda Cloud Antivirus
- Tizer Secure
- FortiClient Antivirus
- Solo Antivirus
- Twister Antivirus
- Ad-Aware Internet Security
- Quick Heal Antivirus
- Rising Antivirus
- Kingsoft Antivirus
- Vexira Antivirus
- nProtect Antivirus
- Norton Antivirus
- Coranti Antivirus
- Ashampoo Anti-malware
- McAfee Antivirus
- Trustport Antivirus
- Webroot Antivirus
- My Free Antivirus
- F-Secure Antivirus
- Bullguard Antivirus •
- Cyber Defender
- Protector Plus
- G Data Antivirus • Max Secure Antivirus
- Spyware Doctor •
- BitDefender Antivirus

♣ Advantages of Anti-Virus

Protecting Personal Information . Hackers and viruses go hand in hand. A good anti-virus program will protect you while you surf the Internet, preventing hackers from gaining access to personal things such—Advantages of Anti-Virus as credit card information and bank account access. The firewall feature included with most anti-virus software will block any unauthorized incoming connections to your network or computer, preventing hackers from digging their hooks into your life and your computer.