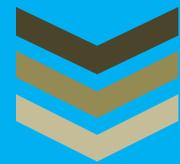


Referencer for Quick Revision



Intermediate Course Paper-7 Sec-A: Information Technology

A compendium of subject-wise capsules published in the
monthly journal "The Chartered Accountant Student"



**Board of Studies
(Academic)
ICAI**

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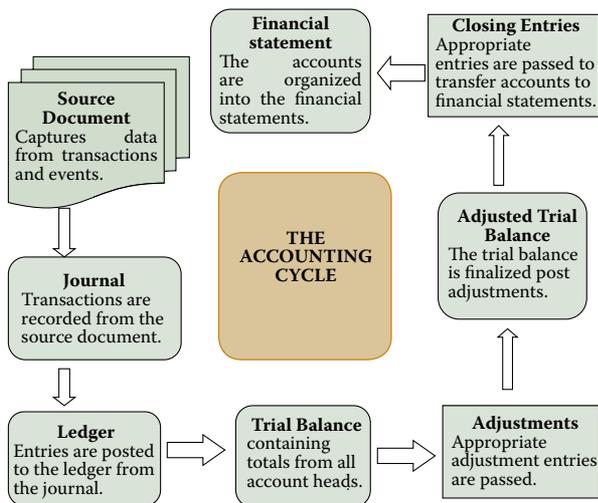
Page No.	Edition of Students' Journal	Topics
<i>1-7</i>	<i>December 2019</i>	<i>Business Process Management & IT</i>
<i>7-13</i>	<i>December 2019</i>	<i>Information Systems and IT Fundamentals</i>
<i>14-18</i>	<i>March 2020</i>	<i>Telecommunication and Network</i>
<i>18-22</i>	<i>March 2020</i>	<i>Business Information Systems</i>
<i>22-25</i>	<i>March 2020</i>	<i>Business Process Automation through Application Software</i>

The capsule on IIPC (old) Paper 7A: Information Technology that covers Chapter 1 “Business Process Management & IT” and Chapter 2 “Information Systems and IT Fundamentals” of subject is another step of Board of Studies in its endeavour to provide quality academic inputs to IIPC students of Chartered Accountancy course. This capsule intends to assist students in their quick revision of Chapters 1 and 2 and should not be taken as a substitute for the detailed study of these chapters. Students are advised to refer to the relevant study material and Revision Test Paper for comprehensive study and revision.

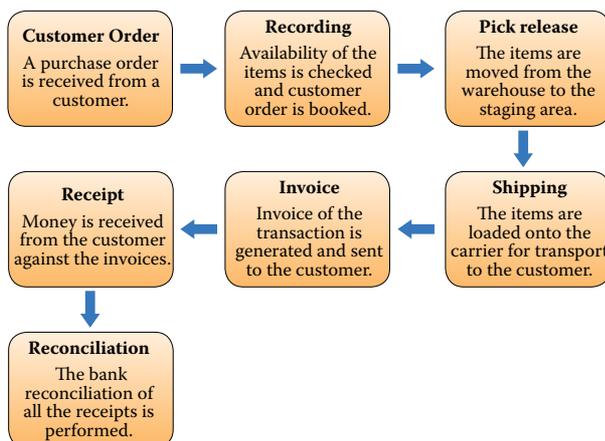
CHAPTER 1: BUSINESS PROCESS MANAGEMENT & IT

This chapter deals with the basic concepts of Business Process Management, Business Process Reengineering; different approaches used in mapping business system and the significance of each approach; benefits and risks associated with implementation of BPM and BPR Project.

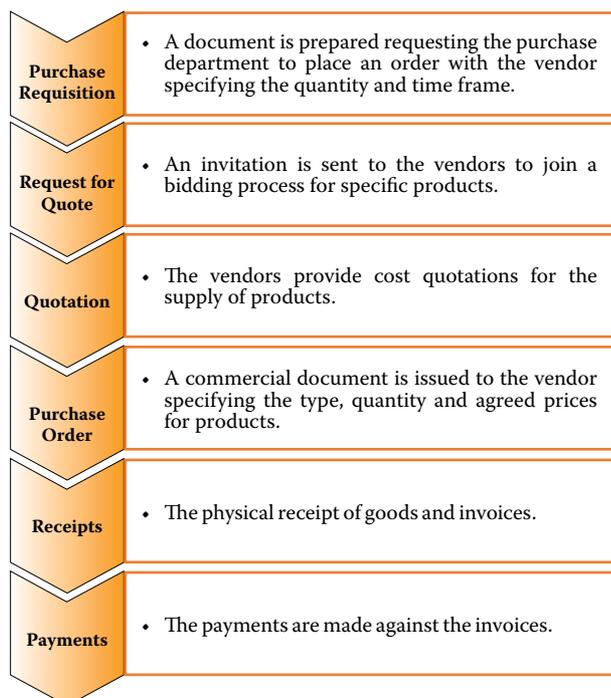
Business Process Flow- A Business Process is a prescribed sequence of work steps performed in order to produce a desired result for the organization. A business process is initiated by a particular kind of event, has a well-defined beginning and end, and is usually completed in a relatively short period. Examples of Business Processes are: Accounting, Sales and Purchase.



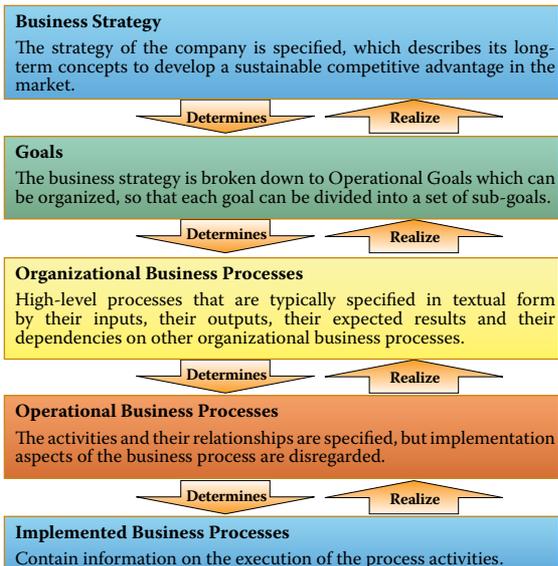
Order to Cash Process (O2C) Flow Cycle



Purchase to Pay (P2P) Cycle



Classification of Business Processes



Business Process Management (BPM) - "The achievement of an organization's objectives through the improvement, management and control of essential business processes".

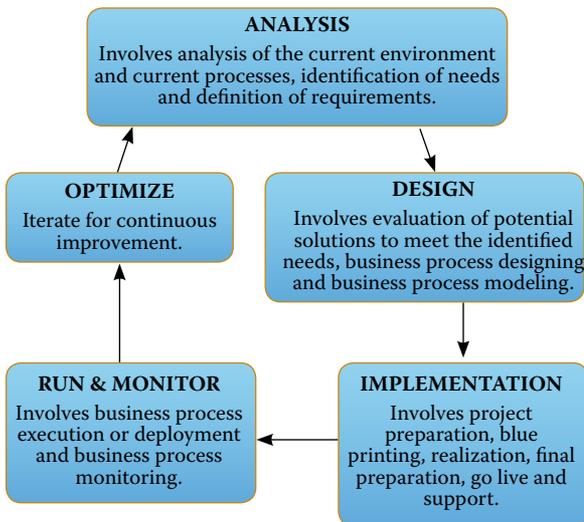
BPM's Principles

- Business processes are organizational assets that are central to creating value for customers;
- By measuring, monitoring, controlling, and analyzing business processes, a company can deliver consistent value to customers;
- As the basis for process improvement - business processes should be continuously improved; and
- Information technology is an essential enabler for BPM.

BPM's Practices

- Strive for process-oriented organizational structure;
- Appoint process owners;
- Senior management needs to commit and drive BPM and execution of BPM process improvements should take a bottom-up approach;
- Put in place information technology systems to monitor, control, analyze, and improve processes;
- Work collaboratively with business partners on cross-organizational business processes;
- Continuously train the workforce and continuously improve business processes;
- Align employee bonuses and rewards to business process performance;
- Utilize both incremental (e.g., Six Sigma) and more radical (e.g., BPR) methodologies to implement process improvement.

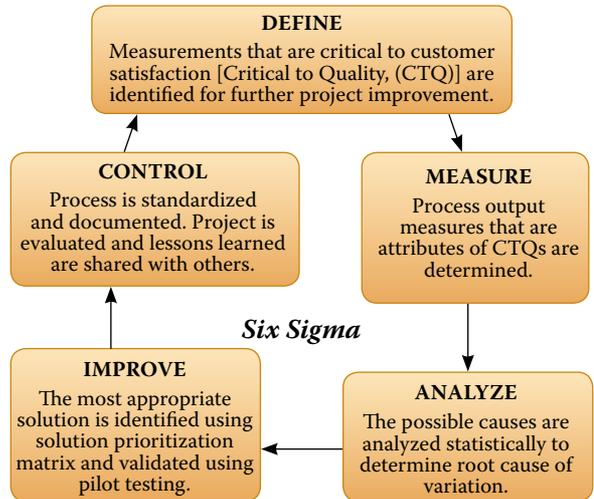
Business Process Management Life Cycle (BPM - L Cycle)



Theories of Process Management

Under the BPM framework, **Business Process Re-engineering (BPR)** and incremental process improvement methodologies (i.e., **Six Sigma**, **TQM**, etc.) are tools that organizations can use to implement process improvement.

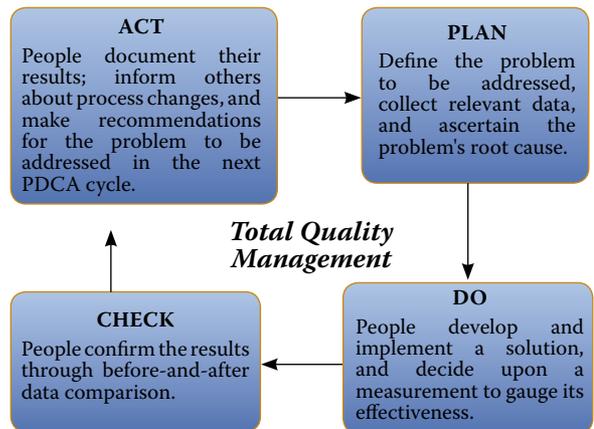
Six Sigma - A set of strategies, techniques, and tools for process improvement. It follows a life-cycle having phases: **Define, Measure, Analyze, Improve** and **Control** (or **DMAIC**).



Six Sigma

- "BPR is the fundamental rethinking and radical redesign of processes to achieve dramatic improvement, in critical, contemporary measures of performance such as cost, quality, service and speed".
- **Business Process Reengineering** is based on the understanding that the products and services a company offers to the market are provided through business processes, and a radical redesign of these processes is the road to success.

Total Quality Management (TQM) is a comprehensive and structured approach to organizational management that seeks to improve the quality of products and services through ongoing refinements in response to continuous feedback. TQM processes are divided into four sequential categories: **Plan, Do, Check, and Act** (the **PDCA cycle**).



Total Quality Management

Control refers to the policies, procedures, practices and organization structures that are designed to provide reasonable assurance that business objectives are achieved and undesired events are prevented, detected or corrected.

BPR Success factors: BPR implies not just change but dramatic change in the way a business functions. Research has identified some key factors for BPR projects to succeed. These factors are as follows:

- **Organization wide commitment:** Changes to business processes would have a direct impact on processes, organizational structures, work culture, information flows, infrastructure & technologies and job competencies. This requires strong leadership, support and sponsorship from the top management.

- **BPR team composition:** A BPR team is formed which would be responsible to take the BPR project forward and make key decisions and recommendations. The BPR team would include active representatives from top management, business process owners, technical experts and users.
- **Business needs analysis:** It is important to identify exactly what current processes need reengineering. A series of sessions are held with the process owners and stakeholders and all the ideas would be evaluated to outline and conceptualize the desired business process.
- **Adequate IT infrastructure:** Adequate investment in IT infrastructure in line is of vital importance to successful BPR implementation. An IT infrastructure is a set of hardware, software, networks, facilities, etc. in order to develop, test, deliver, monitor, control or support IT services.
- **Effective change management:** BPR involves changes in people behavior and culture, processes and technologies. An effective change management process would consider the current culture to foster a change in the prevailing beliefs, attitudes and behaviors effectively.
- **Ongoing continuous improvement:** BPR is an ongoing process hence innovation and continuous improvement are key to the successful implementation of BPR.

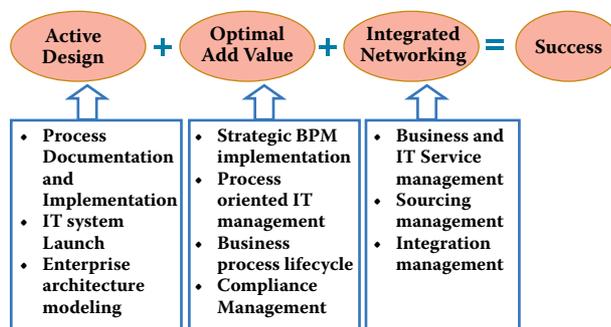
BPM Implementation

- BPM is actually paper-based standard operating procedures taken to their most productive level – throughout the initiation of increasingly business-centric technological advances.
- The key to a successful BPM implementation is to consider it not just as an improvement programs but make it an integral part of business strategy.
- An effective BPM implementation has to result in the institutionalization of process improvement as a fundamental management practice. This can be effectively achieved through proactive and predictive management of relevant business processes.

Key factors and related considerations in implementing BPM

Factors	Key Considerations
Scope	A single process, a department, the entire company
Goals	Process understanding, improvement, automation, re-engineering, optimization
Methods to be used	Six Sigma, BPM Life Cycle Method, TQM, Informal methods
Skills Required	Consultants, Train Employees, Formal Certification, Basic Education, Existing Skill sets
Tools to be used	White-Boards, Sticky Notes, Software For Mapping, Documenting, Software for Simulation, Comprehensive BPMS
Investments to Make	Training, Tools, Time
Sponsorship/ Buy-in Needed	Executive Level, Department Level, Process Owner Level, Employee Level

Need for BPM Implementation



Business Process Automation (BPA) is a strategy that is used to optimize and streamline the essential business processes, using the latest technology to automate the functions involved in carrying them out.

Benefits

Saving on costs	Automation leads to saving in time and labor costs.
Staying ahead in competition	Today, in order to survive, businesses need to adopt automation.
Fast service to customers	This was not the initial reason for adoption of BPA but gradually business managers realized that automation could help them to serve their customers faster and better.

Risks

Risk to jobs	Jobs that were earlier performed manually by several employees would post-automation would be mechanized, thereby posing a threat to jobs.
False sense of security	Automating poor processes will not gain better business practices.

BPM Technology

BPM Technology can complement existing (and future) investments in applications and give organizations the ability to implement a real – time process improvement without the extensive process conversion efforts as the original business processes already exist.

The process architecture of BPM contains four layers:

- The **Database layer** physically contains data;
- **Application Layer** contains applications and process logic;
- **Presentation Layer** is what users see;
- **Process Layer** is an independent layer linking various independent applications needed to execute a single end to end business process.

Value Chain Automation

Value chain refers to separate activities which are necessary to strengthen an organization's strategies and are linked together both inside and outside the organization. The idea of the Value Chain is based on the process view of organizations, the idea of seeing a manufacturing (or service) organization as a system, made up of subsystems each with inputs, transformation processes and outputs.

Six business functions of the value chain are as follows:

- Research and development
- Design of products, services, or processes
- Production
- Marketing and sales
- Distribution
- Customer service

Accounting Systems Automation

An **Accounting Information System (AIS)** is defined as a system of collection, storage and processing of financial and accounting data that is used by decision makers.

Accountants and Auditors must study and understand AIS and related concepts so that they can accomplish the functions of accounting, general accounting reports and using accounting reports. The Accounting Information System is the mechanism that allows accountants to perform their accounting functions and tasks. **Basic Functions of an Accounting Information System.**

1	Collect and store data	Collect and store data about organization's business activities and transactions by capturing transaction data from source documents and posting data from journals to ledgers.
2	Record transaction	Record transactions data into journals. These journals present a chronological record of what occurred and provide management with information useful for decision making.
3	Safeguard organisational assets	Provide adequate controls to ensure that data are recorded and processed accurately by safeguarding organizational assets (data and systems).

- **Processing Cycles of an Accounts BPM:** These are namely **Financing Cycle, Revenue Cycle, Expenditure Cycle, Human Resource Cycle, and Production Cycle.**

Financing Cycle	The cycle consists of a set of transactions leading to the recognition of a major economic event on the financial statements.
Revenue Cycle	It includes transactions surrounding the recognition of revenue involving accounts like Sales, Accounts Receivable, Inventory and General Ledger.
Expenditure Cycle	It includes transactions surrounding the recognition of expenditures involving accounts like Purchases, Accounts Payable, Cash Disbursements, Inventory and General Ledger, preparation and recording of purchase orders; receipt of goods and the recording of the cost of inventory; receipt of vendor invoices; recording of accounts payable and preparation and recording of cash disbursements.
Human Resource Cycle	This involves activities of hiring and paying employees.
Production Cycle	This involves the recurring set of business activities and related data processing operations associated with the manufacturer of products including activities like converting raw materials and labor into finished goods.

- **General Ledger & Reporting System:** The information processing operations involved in updating the general ledger and preparing reports, summarize the results of an organization's activities. An important function of the AIS is to efficiently and effectively collect and process the data about a company's transactions.

- **Data Processing Cycle:** In the data processing cycle, the processes of business activities about which data must be collected and processed are identified. Further, the activities, resources affected by that event, the agents who participate in that event and the event of interest could be the input, output, processing, storage, alerts, controls and feedback.

Data Processing Cycle

The **Data Processing Cycle** consists of following basic steps with alerts, controls and feedback at each step.

Data Input	Involves the activities like capturing the data, implementing control procedures, recording in journals, posting to ledgers and preparation of reports.
Data Storage	Involves organizing the data in master file or reference file of an automated system for easy and efficient access.
Data Processing	Involves addition, deletion and updating of the data in the transaction file, master file or reference file.
Information Output	Involves generation of documents and managerial reports in printable or electronic form for addressing queries.

Benefits of BPMS

Automating repetitive business processes

- Processes such as report creation and distribution or the monitoring of or reporting on company's Key Performance Indicators (KPI) reduces the manual operational costs and helps employees to concentrate on activities that are important to the success of business.

BPMS works by 'loosely coupling' with a company's existing applications

- Enables to monitor, extract, format and distribute information to systems and people; in line with business events or rules.

Operational savings

- BPM focuses on optimization of processes. The processes that are repetitive are optimized and lead to reduced expenses which translate to immediate cost savings.

Reduction in the administration involved in compliance and ISO activities

- The BPM is ideally suited to support companies in their quest for process improvement and compliance/governance certification.
- It gives full control over process and document change, clarity of inherent risks, and ease with which process knowledge is communicated across the company.

Freeing-up of employee time

- There is a hard cost associated with employee time as well as soft costs associated with losing business or lowered productivity.
- Another area where time comes into play is in opportunity costs.

Business Risks of failure of IT

Reasons for failure of BPMS

- Superficial or deficient executive involvement;
- Deficient project management;
- Breakdown in gap analysis;
- Limited options for customization of the BPM software is required;
- Not flexible enough or too complicated to be customized to meet the precise workflow and business process;
- Failure to identify future business needs;
- Inadequate assessment of the need for change management;
- Persistent compatibility problems with the diverse legacy systems of the partners;
- Resources not available when desirable;
- Software fails to meet business needs;
- System may be over-engineered when compared to the actual requirements; and
- Technological obsolescence.

Information as a Business Asset

Information becomes an asset for an organization if it is useful, digital, accessible, relevant, accurate, trust-worthy, searchable, understandable, spatially enabled and shareable at the time when required. Information can be treated as a valuable commodity if it can be used effectively.

Information that is accurate and encompassing will allow decision-makers to better an organization's performance. Without reliable information, the decision-making process can be badly hampered and an informed decision impossible to make.

To achieve operational performance, it is important to ensure that Information Technology infrastructure is tailored to an organization that is able to meet an organization's needs for Customer Relationship Management (CRM), Enterprise Resource Planning (ERP), Business Intelligence (BI), Data Warehousing, Data Migration and Replication.

Approaches to Mapping Systems

Approaches to Mapping systems- Documentation includes the flowcharts, narratives and other written communications that describe the inputs, processing and outputs of an Accounting Information System. Documentation also describes the logical flow of data within a computer system and the procedures that employees must follow to accomplish application tasks.

Reasons why documentation is important to Information Systems

• Depicting how the system works

- Documentation is required to help employees understand how a system works, assist accountants in designing controls for it, demonstrates to managers that it will meet their information needs, and assists auditors in understanding the systems that they test and evaluate.

• Training users

- Documentation also includes user guides, manuals, and similar operating instructions that help people learn how an Information System operates.

• Designing new systems

- Documentation helps system designers develop new systems in much the same way that blueprints help architects design building.

• Controlling system development and gap maintenance costs

- Helps system designers develop object-oriented software, which is software that contains modular, reusable code that further avoid writing duplicate programs and facilitate changes when programs must be modified later.

• Standardizing communications with others

- Documentation aids such as E-R Diagrams, System Flowcharts, and Data Flow Diagrams are more standardized tools and they are more likely to be interpreted the same way by all parties viewing them.

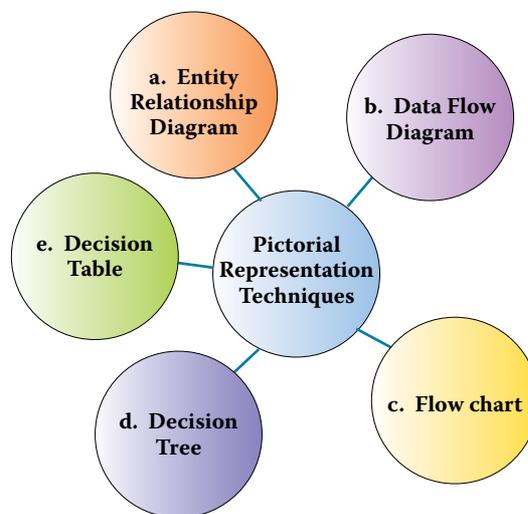
• Auditing information systems

- Documentation helps depict audit trails, documentation helps auditors determine the strengths and weaknesses of a system's controls.

• Documenting business processes

- Documentation helps managers better understand how their businesses operate what controls are involved or missing from critical organizational activities, and how to improve core business activities.

Pictorial Representation for Mapping Business Processes

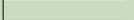
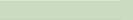


a. ER Diagram: An Entity-Relationship (ER) diagram is a data modeling technique that creates a graphical representation of the entities, and the relationships between entities, within an information system.

Shapes	Type of Relationship
Boxes are commonly used to represent entities .	One-to-One relationship (1:1)
Diamonds are normally used to represent relationships .	One-to-Many relationship (1:N)
Ovals are used to represent attributes .	Many-to-One relationship (M:1)
	Many-to-Many relationships (M:N)
Advantages	Limitations
<ul style="list-style-type: none"> • ER Modeling is simple and easily understandable. It is represented in business users' language and it can be understood by non-technical specialist. • Intuitive and helps in Physical Database creation. • Can be generalized and specialized based on needs. • Can help in database design. • Gives a higher level description of the system. 	<ul style="list-style-type: none"> • Physical design derived from E-R Model may have some amount of ambiguities or inconsistency. • Sometime diagrams may lead to misinterpretations.

b. Data Flow Diagram (DFD) is a graphical representation of the flow of data through an information system. The major DFD component's symbols are as follows:

Entity	An entity is the source or destination of data. Entities are often represented as rectangles.
Process	The process is the manipulation or work that transforms data, performing computations, making decisions (logic flow), or directing data flows based on business rules.
Data Store	A data store is where a process stores data between processes for later retrieval by that same process or another one.
Data Flow	Data flow is the movement of data between the entity, the process and the data store. Data flow portrays the interface between the components of the DFD.

Meaning	Symbols
Process	 or 
Data Store	 or 
Entity	
Data Flow	

Types of DFD

Logical Data Flow Diagram A logical DFD focuses on the business and how the business operates. It describes the business events that take place and the data required and produced by each event. The logical model reflects the business.

Physical Data Flow Diagram A physical DFD shows how the system will be implemented. The physical model depicts the system.

Advantages of DFD	Limitations of DFD
<ul style="list-style-type: none"> It aids in describing the boundaries of the system. It is beneficial for communicating existing system knowledge to the users. A straightforward graphical technique which is easy to recognize. DFDs can provide a detailed representation of system components. It is used as the part of system documentation file. DFDs are easier to understand by technical and nontechnical audiences. It supports the logic behind the data flow within the system. 	<ul style="list-style-type: none"> It make the programmers little confusing concerning the system. The biggest drawback of the DFD is that it simply takes a long time to create, so long that the analyst may not receive support from management to complete it. Physical considerations are left out.

c. Flow Chart is a type of diagram that represents an algorithm, workflow or process, showing the steps as boxes of various kinds, and their order by connecting them with arrows.

It allows the programmer to compare different approaches and alternatives on paper and often shows interrelationships that are not immediately apparent.

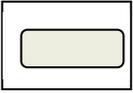
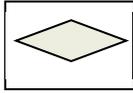
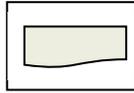
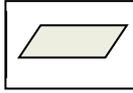
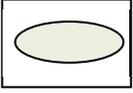
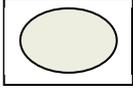
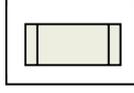
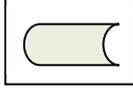
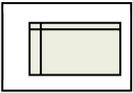
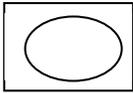
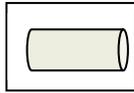
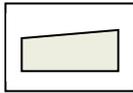
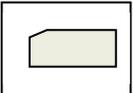
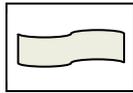
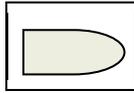
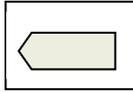
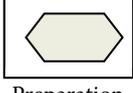
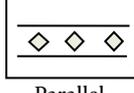
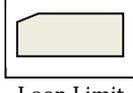
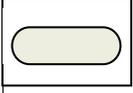
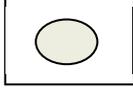
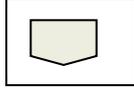
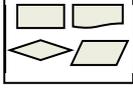
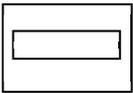
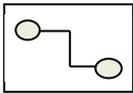
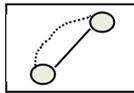
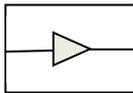
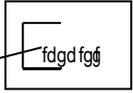
Advantages of using Flowchart

- Quicker grasp of relationships
- Effective Analysis
- Communication
- Documentation
- Efficient coding
- Orderly check out of problem
- Efficient program maintenance

Limitations of using Flowchart

- Complex logic
- Modification
- Reproduction
- Link between conditions and actions
- Standardization

Basic Flowchart Shapes

			
Process	Decision	Document	Data
			
Start 1	Start 2	Pre-defined Process	Stored Data
			
Internal Storage	Sequential Data	Direct Data	Manual Input
			
Card	Paper Tape	Delay	Display
			
Manual Operation	Preparation	Parallel Mode	Loop Limit
			
Terminator	On-page Reference	Off-page Reference	Flowchart shapes
			
Auto height Text	Dynamic Connector	Line curve Connector	Control Transfer
			
Annotation			

d. A Decision Tree also termed as an **Inference** or **Logical tree** is a collection of a basis (condition) and a conclusion (action).

- A decision tree is a decision support tool that uses a tree-like graph or model of decisions and their possible consequences, including chance event outcomes, resource costs, and utility.
- Decision Trees are measured to be one of the most accepted approaches for representing classifier.

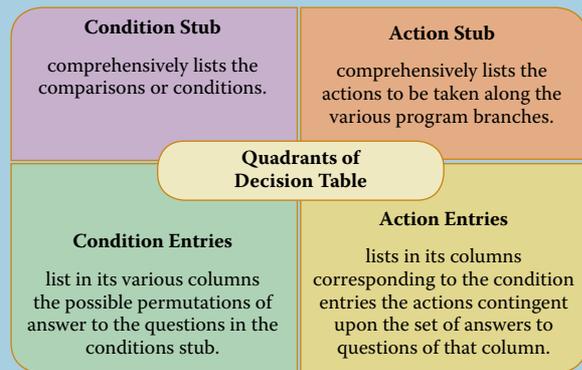
Advantages of using Decision Tree

- Are simple to understand and interpret. People are able to understand decision tree models after a brief explanation.
- Possible scenarios can be added.
- Worst, best and expected values can be determined for different scenarios.

Limitations of using Decision Tree

- For data including categorical variables with different number of levels, information gain in decision trees are biased in favor of those attributes with more levels.
- Calculations can get very complex particularly if many values are uncertain and/or if many outcomes are linked.

e. A **Decision Table** is a table which may accompany a flowchart, defining the possible contingencies that may be considered within the program and the appropriate course of action for each contingency.



Advantages of using Decision Table

- **Easy to Draw** – Decision Tables are easy to draw and modify as compared to flowcharts.
- **Compact Documentation** – The documentation in the form of decision tables is compact since one decision table may replace few pages of a flowchart.
- **Simplicity** – It is easier to follow a particular path in one column of a decision table than it is to go through several pages of the flowcharts.
- **Direct Codification** - The decision tables can be directly coded into a program.
- **Better Analysis** – A decision table shows various alternatives and their respective outcomes side by side for better analysis of the problem.
- **Modularity** – The complex problems would require complex decision tables which can be easily broken down to micro-decision tables.
- **Non-technical** – No knowledge of computer language or CPU working is necessary for drawing decision tables.

Limitations of using Decision Table

- All programmers may not be familiar with Decision Tables and therefore flow charts are more common.
- Flowcharts can better represent a simple logic of the system rather than a decision table.
- The decision tables do not express the total sequence of the events needed to solve the problem.

CHAPTER 2: INFORMATION SYSTEMS AND IT FUNDAMENTALS

This chapter deals with importance and impact of IT in auditing; Information System Layers; Information System Life Cycle; and various computing technologies.

Need for Information Technology

- Communication Capabilities**
 - Enterprises can now integrate their business functions and segments spread across different geographical areas.
 - Enterprises equipped with **email, video conferencing equipment and internal chat rooms** provide an efficient way to communicate and conduct business.
 - **VOIP** service allows people across the world to make free, unlimited, superior quality voice calls via its innovative peer-to-peer software. Example - Skype.
 - **WhatsApp Messenger** is a cross-platform mobile messaging application which allows us to exchange messages without having to pay for SMS. It is available for: iPhone, BlackBerry, Android, Windows phone etc.
 - **Team-ware, Collaboration Software or Groupware software** allow collective and collaborative working of teams from different geographical locations on an online and real-time basis.
- Data and Information Management**
 - Most enterprises store digital versions of documents on servers, storage devices and on cloud economically and employees benefit from immediate access to the documents they need regardless of their geographical location.
- Automated Processes**
 - Used to optimize and streamline the essential business processes, using the latest technology to automate the functions involved in carrying them out.
 - Allows the organizations to extract maximum benefit by using the available resources to their best advantage, while keeping the operational cost as low as possible.

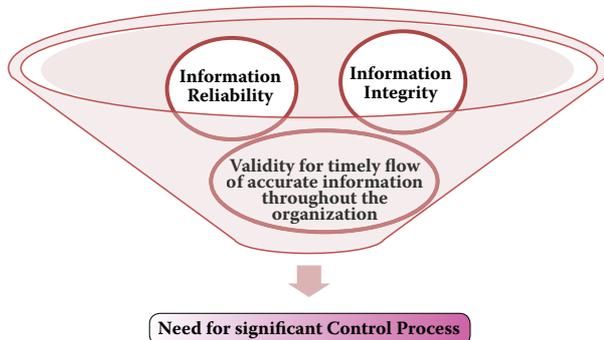
AUDIT OBJECTIVES

- EXISTENCE**
 - Verify that the assets, liabilities, ownership, and/or activities are real.
- AUTHORIZATION**
 - Verify that events have occurred in accordance with management's intent.
- VALUATION**
 - Verify that the accounting values fairly present items worth.
- CUTOFF**
 - Verify that the transaction is re-coded in the proper accounting period.
- COMPLIANCE**
 - Verify that the processing is in compliance with governmental laws and regulations, generally accepted accounting procedures, and organization's policies and procedures.
- OPERATIONAL**
 - Verify that the program, area, or activity is performed economically, efficiently, and effectively;
 - Assisting management in finding ways to implementing internal control recommendations;
 - Participating in specifying and designing computer control and other features for systems to be installed;
 - Determining whether efficient use is made of the organization's Computer resources; and
 - Determining whether Computer system used accomplishes the business objectives and goals.

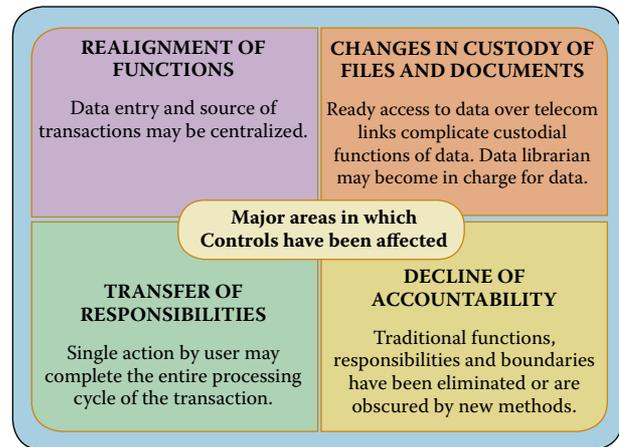
AUDIT PROCEDURES

Study Technical Aspects	<ul style="list-style-type: none"> Gather evidential matter relating to technical aspects of systems under study, including all relevant documentation describing the computer facility, application programs, operating procedures, security procedures and so on.
Use Unique Techniques	<ul style="list-style-type: none"> Require application of unique techniques to these efforts. For example, the audit planning step includes review of technical documentation and interviewing technical specialists. The auditor must understand the procedures for testing and evaluating Computer Controls.
Audit Software Usage	<ul style="list-style-type: none"> These procedures include the use of generalized audit software to survey the contents of data files, the use of specialized software to assess the contents of operating system parameter files and flow-charting techniques for documenting the automated applications.

Need for Controls in Information Systems



<p>Safeguarding assets to maintain data integrity to achieve system effectiveness and efficiency is a significant control process.</p> <p>Information Systems Control Procedure may include</p> <ul style="list-style-type: none"> Strategy and Direction; General Organization and Management; Access to IT resources, including data and programs; System development methodologies and change control; Operation procedures; System Programming and Technical support functions; Quality Assurance Procedures; Physical Access Controls; Business Continuity Planning (BCP) and Disaster Recovery Planning (DRP); Network and Communication; Database Administration; and Protective and detective mechanisms against internal and external attacks.



From IT perspective, various IT processes that are usually involved in a typical business enterprise:

Database access and changes	Provides access to data via ODBC (Open DataBase Connectivity) connections, data updates, and file transfers.
File replication and Data backup	Protects valuable data by backing up databases and key systems.
Systems and Event Log monitoring	Reviews and analyzes the event log and critical systems, and create multistep corrective action, such as restarting a server service. With BPA, these processes run automatically when certain events occur.
Job Scheduling	Automates processes that perform a variety of daily or unscheduled tasks.
Application Integration	Automates IT and business processes by combining applications that drive business. Complex processes such as database queries, data transformation and spreadsheet integration can be automated.
File Transfers	Can be automated to deliver and retrieve data on set schedules.
Printing	Automated to simplify print jobs.

Business Process Automation - Critical pillars		
INTEGRATION	ORCHESTRATION	AUTOMATION
Allows applications and operating systems not only to read data that the systems produce, but also to pass data between the component applications of the business process and to modify the data as necessary.	Enables the ability to bring tasks that exist across multiple computers and different business departments or branches under one umbrella that is the business process itself.	Orchestration and integration unite with automation to deliver the capability to provide a rules-based process of automatic execution that can span multiple systems and enable a more effective, nimble and efficient business process.

Steps involved in implementing Business Process Automation (BPA)	
Step 1: Define why we plan to implement BPA?	The answer to this question will provide justification for implementing BPA.
Step 2: Understand rules/ regulation under which it needs to comply with?	The underlying issue is that any BPA created needs to comply with applicable laws and regulations.
Step 3: Document the process, we wish to automate.	The current processes which are planned to be automated need to be correctly and completely documented at this step.
Step 4: Define the objectives/goals to be achieved by implementing BPA.	This enables the developer and user to understand the reasons for going for BPA. The goals need to be precise and clear.
Step 5: Engage business process consultant.	Once the entity has been able to define the above, the entity needs to appoint an expert, who can implement it for the entity.
Step 6: Calculate the ROI for project.	The answer to this question can be used for convincing top management to say 'yes' to the BPA exercise.
Step 7: Development of BPA.	Once the top management grant their approval, the right business solution has to be procured and implemented or developed and implemented covering necessary BPA.
Step 8: Testing the BPA.	Before making the process live, the BPA solutions should be fully tested.

Computing Technologies

Servers: Servers are often dedicated, meaning that they perform no other tasks besides their server tasks.

- From a **hardware perspective**, a **Server** is a computer (Hardware) or device on a network dedicated to run one or more services (as a host), to serve the needs of the users of other computers on a network.
- In the context of **client-server architecture**, a **Server** is a computer program running to serve the requests of other programs, the "clients".

Types of Servers

File Server	A computer and storage device dedicated to storing files. Any user on the network can store files on the server.
Print Server	A computer that manages one or more printers.
Network Server	A computer that manages network traffic.
Database Server	A computer system that processes database queries.
Application Server	A program that handles all application operations between users and an enterprise's backend business applications or databases.

Web Server

A computer that delivers (serves up) web pages. Every web server has an IP address and possibly a domain name.

Mail Server

Mail server moves/stores mail over corporate networks.

INSTRUCTION SET

Instruction set is the set of machine code instructions that the processor can carry out. CPU (Processor), the center piece of the computer's architecture, is in charge of executing the instructions of the currently loaded program.

Instruction Set Architecture (ISA) is related to the programming of a computer – that is, how the computer understands what each element in its basic language means, what instructions are to be carried out and in what order, etc.

The instructions may be Data Movement Instructions, Transfer of Control, Arithmetic/Logical Instructions; Input/Output and some miscellaneous instructions that handle interrupts and activities.

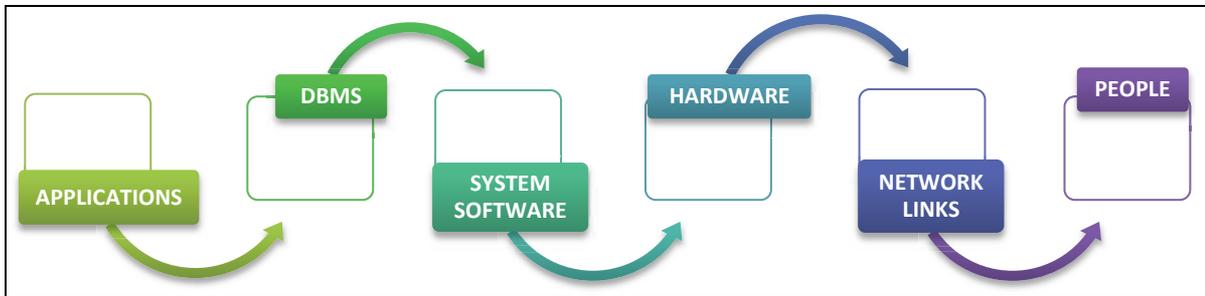
Types of instructions are as follows:

Fixed Length Instructions	Variable Length Instructions
Fixed - length instructions are commonly used with RISC processors.	Variable - length instructions are commonly used on CISC machines.
All machine code instructions are of the same length i.e. fixed length.	Each instruction uses exactly the amount of space it requires.
Since each instruction occupies the same amount of space, memory space is wasted by this form of instruction.	The variable length instructions reduce the amount of memory space required for a program.
They make the job of fetching and decoding instructions easier and more efficient, i.e. they can be executed in less time than the corresponding variable length instructions.	These instructions take relatively more time for execution.

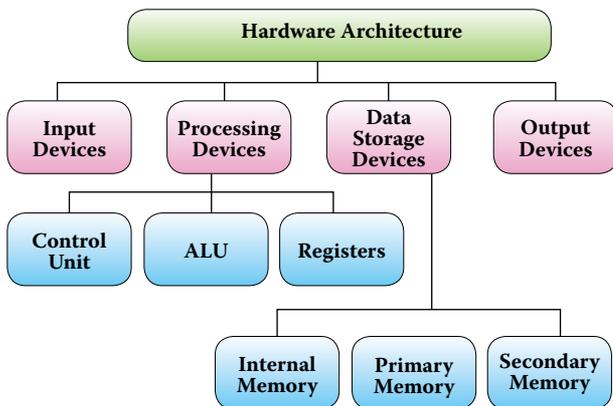
Classification of Instruction Set: An important aspect of computer architecture is the design of the instruction set for the processor, which is of two types:

- **Complex Instruction Set Computer (CISC):** If the control unit contains a number of micro-electronic circuitry to generate a set of control signals and each micro-circuitry is activated by a micro-code, this design approach is called **CISC design**. Examples of CISC processors are: Intel 386, 486, Pentium, Pentium Pro, Pentium II, Pentium III processors etc.
- **Reduced Instruction Set Computer (RISC):** To execute each instruction, if there is separate electronic circuitry in the control unit, which produces all the necessary signals, this approach of the design of the control section of the processor is called **RISC design**. It is also called hard-wired approach. Examples of RISC processors: IBM RS6000, MC88100 processors etc.

INFORMATION SYSTEM LAYERS



Hardware is the tangible portion of our computer systems; something we can touch and see.



Application Software: This includes all that computer software that cause a computer to perform useful tasks beyond the running of the computer itself. The different types of application software are as follows:

- Application Suite** { Has multiple applications bundled together. Related functions, features and user interfaces interact with each other. E.g. MS Office 2010 which has MS Word, MS Excel, MS Access etc.
- Enterprise Software** { Addresses an enterprise's needs and data flow in a huge distributed environment. E.g. ERP Applications like SAP.
- Enterprise Infrastructure Software** { Provides capabilities required to support enterprise software systems. E.g. email servers, Security software.
- Information Worker Software** { Addresses individual needs required to manage and create information for individual projects within departments. E.g. Spreadsheets, CAAT (Computer Assisted Audit Tools) etc.
- Content Access Software** { Used to access contents and addresses a desire for published digital content & entertainment. E.g. Media Players, Adobe Digital etc.

Educational Software

Holds contents adopted for use by students. E.g. Examination Test CDs.

Media Development Software

Addresses individual needs to generate and print electronic media for others to consume. E.g. Desktop Publishing, Video Editing etc.

Advantages of Application software

- **Addressing User needs:** It meets the exact needs of the user.
- **Less threat from virus:** The threat of viruses invading custom-made applications is very small.
- **Regular updates:** Licensed application software gets regular updates from the developer for security reasons.

Disadvantages of Application software

- Development is costly.
- Infection from Malware.

System Software is computer software that is designed to operate the computer hardware and to give and maintain a platform for running application software. One of the most important and widely used system software is computer operating systems.

An **Operating System (O/S)** is a set of computer programs that manages computer hardware resources and acts as an interface with computer applications programs.

Variety of Activities performed by O/S

Performing Hardware functions

- Acts as an intermediary between the application program and the hardware.

User Interfaces

- Provides user interface by accessing how we interface with our system.

Hardware Independence

- Provides Application Program Interfaces (API), which can be used by application developers to create application software, thus obviating the need to understand the inner workings of OS and hardware. Thus, OS gives us hardware independence.

INFORMATION TECHNOLOGY ||

Memory Management

- Allows controlling how memory is accessed and maximize available memory & storage.

Task Management

- Facilitates a user to work with more than one application at a time i.e. multitasking and also allows more than one user to use the system i.e. timesharing.

Networking Capability

- Provides systems with features & capabilities to help connect computer networks.

Logical Access Security

- Provides logical security by establishing a procedure for identification & authentication using a User ID and Password.

File Management

- Keeps a track of where each file is stored and who can access it, based on which it provides the file retrieval.

Network Links: Computer Network is a collection of computers and other hardware interconnected by communication channels that allow sharing of resources and information. Each component, namely the computer in a computer network is called a 'Node'.

Benefits of Computer Network

Distributed nature of information

Resource Sharing

Computational Power

Reliability

User communication

Types of Computer Network

Connection Oriented Networks

- Wherein a connection is first established and then data is exchanged, like it happens in case of telephone networks.

Connectionless Networks

- Where no prior connection is made before data exchanges. Data which is being exchanged in fact has a complete contact information of recipient and at each intermediate destination, it is decided how to proceed further, like it happens in case of postal networks.

Important Definitions in Networking

Routing

Refers to the process of deciding on how to communicate the data from source to destination in a network.

Bandwidth

Refers to the amount of data which can be sent across a network in given time.

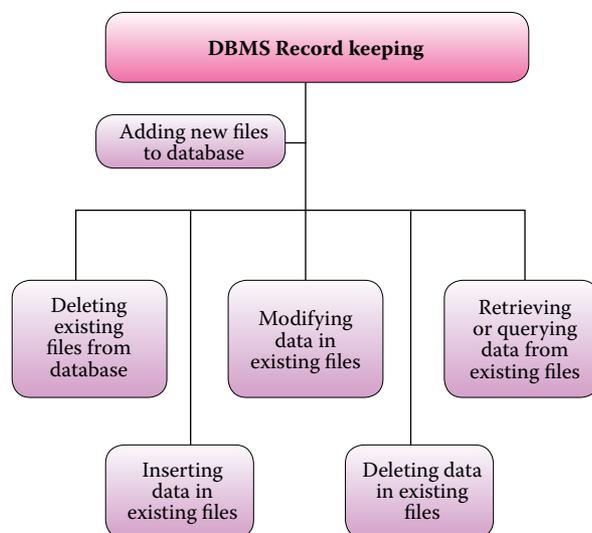
Resilience

Refers to the ability of a network to recover from any kind of error like connection failure, loss of data etc.

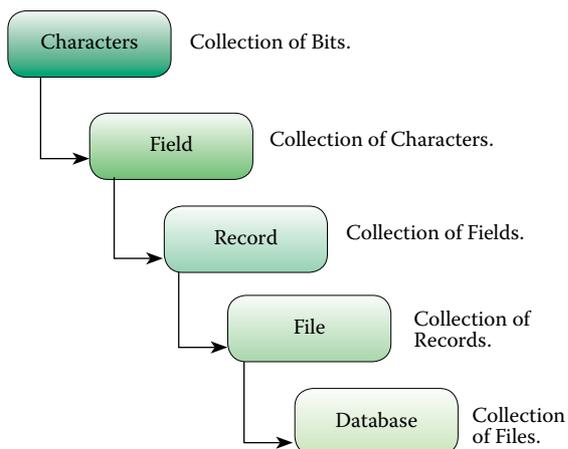
Contention

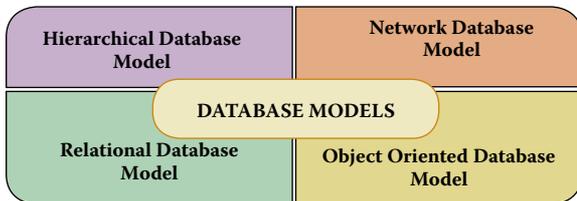
Refers to the situation that arises when there is a conflict for some common resource in a network.

Database Management Systems (DBMS)



DBMS - Basic Concepts





Advantages of DBMS

Permitting data sharing

- In DBMS, the same information can be made available to different users.

Minimizing Data Redundancy

- In a DBMS, duplication of information or redundancy is, if not eliminated, carefully controlled or reduced.

Integrity can be maintained

- Data integrity is maintained by having accurate, consistent, and up-to-date data. Updates and changes to the data only have to be made in one place in DBMS ensuring Integrity.

Program and file consistency

- The file formats and programs are standardized. This makes the data files easier to maintain because the same rules and guidelines apply across all types of data.

User-friendly

- DBMS makes the data access and manipulation easier for the user and also reduces the reliance of users on computer experts to meet their data needs.

Improved security

- DBMS allows multiple users to access the same data resources which could lead to risk to an enterprise if not controlled. Security constraints can be defined.

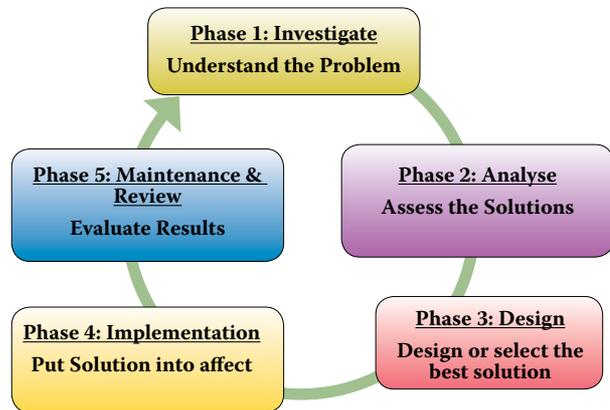
Achieving program/data independence

- In a DBMS, data does not reside in applications but data bases program & data are independent of each other.

Faster application development

- In the case of deployment of DBMS, the data is already therein databases, application developer has to think of only the logic required to retrieve the data in the way a user needs.

Information System Life Cycle



Phase 1: System Investigation - Examines 'What is the problem and is it worth solving?'

- Technical feasibility:** Does the technology exist to implement the proposed system or is it a practical proposition?
- Economic feasibility:** Is proposed system cost-effective: if benefits do not outweigh costs, it's not worth going ahead?
- Legal feasibility:** Is there any conflict between the proposed system and legal requirements?
- Operational feasibility:** Are the current work practices and procedures adequate to support the new system?
- Schedule feasibility:** How long will the system take to develop, or can it be done in a desired time-frame?

Phase 2: System Analysis - Examines 'What must the Information System do to solve the problem?'

- Interviewing staff:** at different levels from end-users to senior management;
- Examine current business:** systems documents and output including current order documents, computer system procedures and reports used by operations and senior management;
- Sending out questionnaires:** that have to be carefully constructed to elicit unambiguous answers; and
- Observation of current procedures:** by spending time in various departments. A time and motion study can show where procedures could be more efficient or to detect bottlenecks.

Phase 3: System Designing - Examines 'How will the Information System do, that it must do to obtain the solution to the problem?'

- Hardware platform:** Computer, network capabilities, input, storage and output devices;
- Software:** Programming language, package and database;
- Outputs:** Report layouts and screen designs;
- Inputs:** Documents, screen layouts and validation procedures;
- User interface:** How users will interact with the computer system;
- Modular design:** Of each program in the application;
- Test plan:** Develop test data;
- Conversion plan:** How the new system is to be implemented; and
- Documentation:** Including systems and operations documentation. Later, a user manual will be produced.

Phase 4: System Implementation - Examines 'How will the Solution be put into effect?'

Implementation can be put in place either through **Installation** or **Conversion**.

Installation involves following major activities:

- Installing the new hardware, which may involve extensive re-cabling and changes in office layouts;
- Training the users on the new system; and
- Conversion of master files to the new system or creation of new master files.

Conversion involves following activities:

- **Direct Changeover:** The user stops using the old system one particular day and starts using the new system from thereon, usually over a weekend or during a slack period.
- **Parallel Conversion:** The old system continues alongside the new system for a few weeks or months.
- **Phased Conversion:** Used with larger systems that can be broken down into individual modules which can be implemented separately at different times.
- **Pilot Conversion:** New system will first be used by only a portion of the enterprise, for example at one branch or factory.

Phase 5: System Maintenance and Review - Evaluates results of solution and modifies the system to meet the changing needs.

Perfective Maintenance This implies that while the system runs satisfactorily, there is still room for improvement.

Adaptive Maintenance All systems will need to adapt to changing needs within a company.

Corrective Maintenance Problems frequently surface after a system has been in use for a short time, however thoroughly it was tested. Any errors must be corrected.

CLLOUD COMPUTING

Cloud Computing is defined as the use of various services, such as software development platforms, servers, storage, and software, over the Internet, often referred to as the "Cloud." Cloud Computing Environment involves the following:

PUBLIC CLOUD: Composition of two or more private, community or public clouds that remain unique entities but are bound together, offering the benefits of multiple deployment models, is internally & externally hosted.

COMMUNITY CLOUD: Shared by several organizations; externally hosted, but may be internally hosted by one of the organizations.

PRIVATE CLOUD: Used for a single organization; can be internally or externally hosted.

HYBRID CLOUD: Provisioned for open use for the public by a particular organization who also hosts the service.

Cloud Computing Architecture refers to the components and subcomponents that typically consist of a Front end platform (fat client, thin client, mobile device), Back end platforms (servers, storage), a cloud based delivery, and a network (Internet, Intranet, Intercloud).

Front End	Back End
The Front End of the cloud computing system comprises of the client's devices (or it may be a computer network) and some applications are needed for accessing the cloud computing system. Existing web browsers such as Firefox, Microsoft's internet explorer or Apple's Safari.	In cloud computing, the Back End is cloud itself which may encompass various computer machines, data storage systems and servers.

Service Models of Cloud Computing

Infrastructure as a Service (IaaS)
Provides clients with access to server hardware, storage, bandwidth and other fundamental computing resources.

Software as a Service (SaaS)
In this, an application is hosted as a service provided to customers across the Internet by removing the need to install and run an application on a user's own computer.

Platform as a Service (PaaS)
Provides clients with access to the basic operating software and optional services to develop and use software applications without the need to buy and manage the underlying computing infrastructure.

Network as a Service (NaaS)
Involves optimization of resource allocation by considering network and computing resources as a whole. Example - VPN, Mobile N/w Virtualization.

Communication as a Service (CaaS)
Allows businesses to selectively deploy communication devices and modes on a pay-as-you-go, as-needed basis. This approach eliminates the large capital investments. Examples are: Voice over IP (VoIP), Instant Messaging (IM), Collaboration and Videoconferencing.

MOBILE COMPUTING

Mobile Computing: Defined as the use of portable computing devices like laptop/handheld computers in conjunction with mobile communications technologies to enable users to access Internet and data on their home/ work computers from anywhere in the world.

Its components are:

Mobile Communication	Mobile Hardware	Mobile Software
Refers to the infrastructure put in place to ensure that seamless and reliable communication goes on.	Includes mobile devices or device components that receive or access the service of mobility.	It is the actual program that runs on the mobile hardware.
These would include devices such as Protocols, Services, Bandwidth and Portals necessary to facilitate and support the stated services.	They would range from Portable laptops, Smart phones, Tablet PC's to Personal Digital Assistants.	This is the engine of that mobile device. In other terms, it is the operating system of that appliance.

INFORMATION TECHNOLOGY

The Capsule on IIPC(Old) Paper 7A: Information Technology incorporates Chapter 3: Telecommunication and Network, Chapter 4: Business Information Systems and Chapter 5: Business Process Automation Through Application Software. This capsule intends to assist students in their Quick revision and should not be taken as a substitute for the detailed study of these chapters. Students are advised to refer to the relevant study material and Revision Test Paper for comprehensive study and revision.

CHAPTER 3: TELECOMMUNICATION AND NETWORK

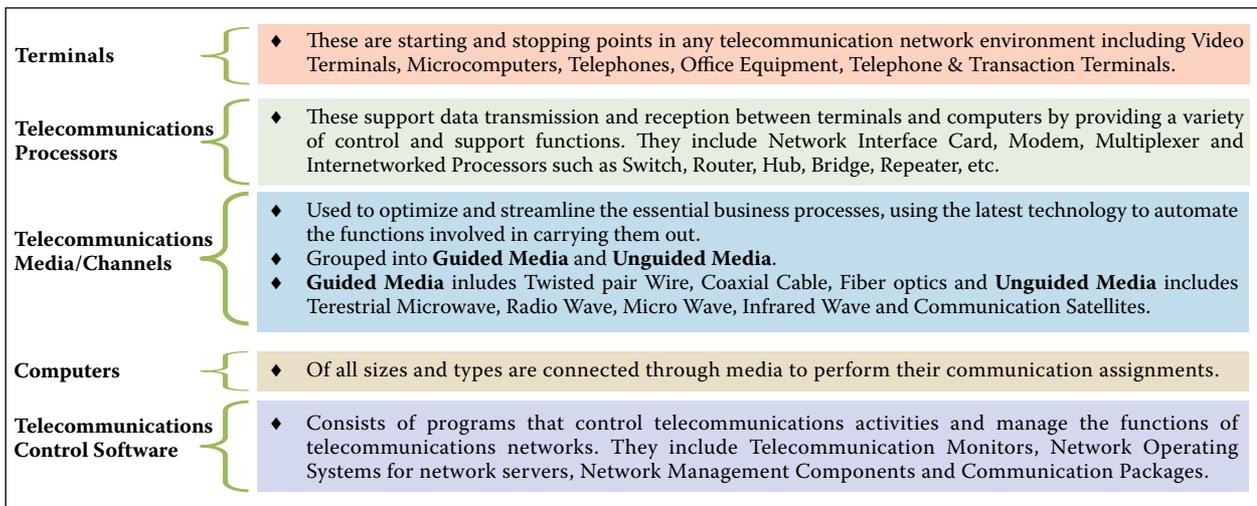
NETWORKING AN ENTERPRISE

Businesses are installing and extending intranets throughout their organizations to improve communications and collaboration among individuals and teams within the enterprise. Major generic components of any telecommunications network are terminals, telecommunications processors, communication channels, computers, and telecommunications s/w. Telecommunications processors include modems, multiplexers, and internetworked processors. Internet and Internet-like networks inside an enterprise are called **Intranets**, between an enterprise and its trading partners are called **Extranets**.

Advantages of a computer network in an organization

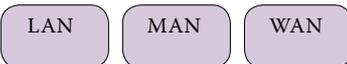
<ul style="list-style-type: none"> ◆ File Sharing ◆ Resource Sharing 	<ul style="list-style-type: none"> ◆ Remote Access ◆ Shared Databases 	<ul style="list-style-type: none"> ◆ Fault Tolerance ◆ Internet Access and Security
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TELECOMMUNICATION NETWORK MODEL

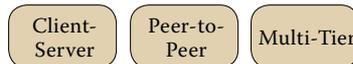


CLASSIFICATION OF TELECOMMUNICATION NETWORKS

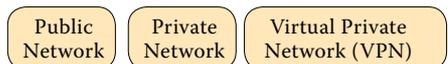
Area Coverage Based Classification



Functional Based Classification



Ownership Based Classification



LOCAL AREA NETWORKS (LAN)

The **Local Area Networks** are telecommunications networks that connect information-processing devices within a limited physical area. It has following characteristics:

◆ Security	◆ Expanded PC usage through inexpensive workstation
◆ Distributed processing	◆ Electronic mail and Message Broadcasting
◆ Organizational Benefits	◆ Data management benefits

METROPOLITAN AREA NETWORK (MAN)

A **Metropolitan Area Network** is somewhere between a LAN and a WAN. A MAN can support both data and voice. Cable television networks are examples of MANs that distribute television signals. A MAN just has one or two cables and does not contain switching elements.

WIDE AREA NETWORKS (WAN)

Wide Area Networks are telecommunications networks that cover large geographic areas with various communication facilities such as long distance telephone service, satellite transmission, and under-sea cables. These networks cover areas such as large city or metropolitan area; Whole country or many countries and continents.

CLIENT SERVER (C/S) NETWORK

Client/Server network is a computer network in which one centralized powerful computer (called Server) is connected to many less powerful PCs or workstations (called Clients). A **Client** is a single-user workstation that provides a presentation services and the appropriate computing, connectivity and the database services relevant to the business need. A **Server** is one or more multi-user processors with shared memory providing computing, connectivity and the database services and the interfaces relevant to the business need. Different types of Clients are - **Fat/Thick Client, Thin Client and Hybrid Client.**

Prominent characteristics of C/S architecture are as follows:

- **Service:** The server process is a provider of services and the client is a consumer of services.
- **Shared Resources:** A server can service many clients at the same time and regulate their access to the shared resources.
- **Transparency of Location:** C/S software usually masks the location of the server from the clients by redirecting the service calls when needed.
- **Mix-and-Match:** The ideal C/S software is independent of h/w or O/S software platforms.
- **Scalability:** Client workstations can either be added or removed and the server load can be distributed across multiple servers.
- **Integrity:** Server code & data are centrally managed, which results in cheaper maintenance and the guarding of shared data integrity.

Issues in Client/Server Network are as follows:

- When the server goes down or crashes, all the computers connected to it become unavailable to use.
- Simultaneous access to data and services by the user takes little more time for server to process the task.

PEER TO PEER NETWORKING (P2P)

- It is created with two or more PCs connected together and share resources without going through a separate server computer.
- The prime goal of a P2P file-sharing network is that many computers come together and pool their resources to form a content distribution system. Configured computers in P2P workgroups allow sharing of files, printers across all the devices.

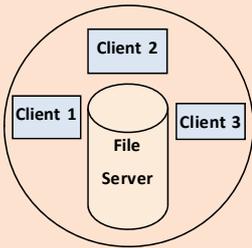
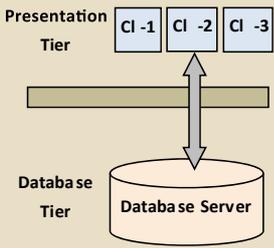
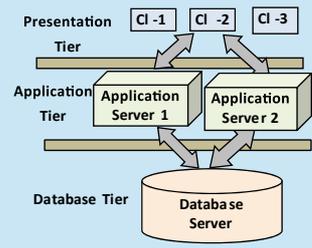
Advantages

- These are easy and simple to set up and only require a Hub or a Switch to connect all the computers together.
- If one computer fails, all other computers connected to it continue to work.

Disadvantages

- There can be problem in accessing files if computers are not connected properly.
- Does not support connections with too many computers as the performance gets degraded in case of high network size.
- The data security is very poor in this architecture.

MULTI-TIER ARCHITECTURE

Single Tier Architecture	Two Tier Architecture	n-Tier Architecture
Involves putting all the required components for a software application or technology on a single server or platform.	A software architecture in which a presentation layer or interface runs on a client, and a data layer or data structure gets stored on a server.	It is a client-server architecture in which presentation, application processing, and data management functions are logically separated.
		
<p>Advantages</p> <ul style="list-style-type: none"> ■ This system requires only one stand-alone computer and installation of proprietary software which makes it most cost-effective system. 	<p>Advantages</p> <ul style="list-style-type: none"> ■ System performance is higher because business logic and database are physically close. ■ More users could interact with system. 	<p>Advantages</p> <ul style="list-style-type: none"> ■ Clear separation of user-interface control & data presentation from application-logic; Dynamic load balancing & change management.
<p>Disadvantages</p> <ul style="list-style-type: none"> ■ Can be used by only one user at a time. ■ It is impractical for an organization which requires two or more users to interact with the organizational data stores at the same time. 	<p>Disadvantages</p> <ul style="list-style-type: none"> ■ Performance deteriorates if number of users increases. ■ There is restricted flexibility and choice of DBMS, since data language used in server is proprietary to each vendor. 	<p>Disadvantages</p> <ul style="list-style-type: none"> ■ Creates an increased need for network traffic management, server load balancing, and fault tolerance. ■ Current maintenance tools are relatively immature, inadequate and more complex.

OWNERSHIP BASED CLASSIFICATION

Public Data Network	Private Data Network	Virtual Private Networks (VPN)
A network established and operated by a telecommunications administration, or a recognized private operating agency, for the specific purpose of providing data transmission services for the public.	Enables the ability to bring tasks that exist across multiple computers and different business departments or branches under one umbrella that is the business process itself.	These are overlay networks on top of public networks but with most of the properties of private networks. They are called 'virtual' because they are merely an illusion, just as virtual. It is a private network that uses a public network (usually the Internet) to connect remote sites or users together.

NETWORK COMPUTING

The growing reliance on the computer hardware, software, and data resources of the Internet, Intranets, extranets, and other networks has emphasized that for many users “the network is the computer”.

Features of Network Computing are as follows:

- Network computers & other thin clients provide a browser-based user-interface for processing small application programs (applets).
- These are microcomputers without floppy or hard disk drives that are designed as low-cost networking computing devices.
- Application and database servers provide the operating system, application software, applets, databases, and database management software needed by end users in network.

MODELS OF COMPUTING

Centralized Computing - It is done at a central location, using terminals attached to a central computer. The computer itself may control all the peripherals directly, or they may be attached via a terminal server.

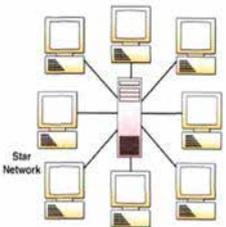
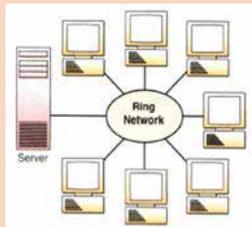
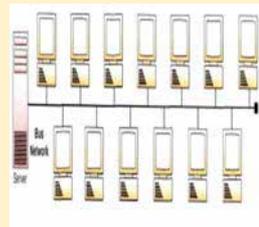
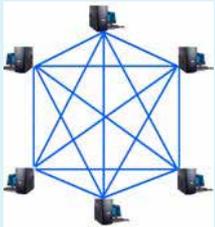
Decentralized Computing - Decentralized computing is the allocation of resources, both hardware and software, to each individual workstation, or office location. Decentralized systems enable file sharing and all computers can share peripherals.

Advantages - It offers greater security over decentralized systems because all the processing is controlled in a central location.

Advantages - These can run independently of each other and enable file sharing and all computers can share peripherals such as printers & scanners, allowing all the computers in the network to connect to the internet.

NETWORK TOPOLOGY

“**Topology**” defines the physical or logical arrangement of links in a network. It is the geometric representation of the relationship of all the links and linking devices (usually called Nodes) to each other.

Star Network	Ring Network	Bus Network	Mesh Network
The central unit (server) in the network acts as the traffic controller among all the other computers tied to it.	Local computer processors are tied together sequentially in a ring with each device being connected to two other devices under a decentralized approach.	A single length of wire, cable, or optical fiber connects number of computers.	Each node is connected by a dedicated point to point link to every node.
			
A node failure does not bring down the entire network. Failure of server affects whole network.	Failure of one computer on the network can affect the whole network.	If one of the microcomputer fails, it will not affect the entire network.	If one of node fails, the network traffic can be redirected to another node.
New nodes can be added easily without affecting rest of the network.	It is considered to be inefficient as data can only travel in one route to reach its destination.	It is easy to install, easily extendable and inexpensive.	It is the best choice for fault tolerance, however, it is very difficult to setup and maintain.

Data Transmission (The transmission of binary data across a link)

Parallel

Serial

Asynchronous

Synchronous

SERIAL MODE	PARALLEL MODE
In this, the data bits are transmitted serially one after another.	In this, the data bits are transmitted simultaneously.
Data is transmitted over a single wire.	Data is transmitted over 8 different wires.
It is a cheaper mode of transferring data.	It is relatively expensive mode of transferring data.
It is useful for long distance data transmissions.	Not practical for long distance communications as it uses parallel paths, so cross talk may occur.
It is relatively slower.	It is relatively faster.

TRANSMISSION MODE USED TO DEFINE DIRECTION OF SIGNAL FLOW BETWEEN TWO LINKED DEVICES

Simplex Connection	Half-Duplex Connection	Full Duplex Connection
Data flows in only one direction.	Data flows in one direction or the other, but not both at the same time.	Data flows in both directions simultaneously.
Terminal A → Terminal B	Terminal A ↔ Terminal B	Terminal A ↔ Terminal B
Example – Data from user's computer to the printer.	Example – Walkie-Talkie.	Example – Mobile Phones.

INFORMATION TECHNOLOGY

Transmission Techniques

- Based on techniques used to transfer data, communication networks can be categorized into the following:
- ◆ **Broadcast Networks:** Data transmitted by one node is received by many, sometimes all, of the other nodes. This refers to a method of transferring a message to all recipients simultaneously.
 - ◆ **Switched Networks:** Data transferred from source to destination is routed through the switch nodes. The way in which the nodes switch data from one link to another, as it is transmitted from source to destination node, is referred to as a switching technique. Three common switching techniques are **Circuit Switching, Packet Switching and Message Switching.**

NETWORK ARCHITECTURE

- ◆ It refers to the layout of the network consisting of the hardware, software, connectivity, communication protocols and mode of transmission, such as wired or wireless and its goal is to promote an open, simple, flexible, and efficient telecommunications environment. It includes hardware components used for communication, cabling and device types, network layout and topologies, physical and wireless connections, implemented areas and future plans.

PROTOCOLS

- ◆ **Protocols** are software that performs a variety of actions necessary for data transmission between computers. These are a set of rules for inter-computer communication that have been agreed upon and implemented by many vendors, users and standards bodies to ensure that the information being exchanged between the two parties is received and interpreted correctly.

The OSI Model: The **International Standards Organization (ISO)** developed a seven-layer Open Systems Interconnection (OSI) model to serve as a standard model for network architectures.

TCP/IP	The OSI Model	Functions
Application or Process Layer	Application Layer	Provides communications services for end user applications.
	Presentation Layer	Provides appropriate data transmission formats and codes.
Host-to-Host Transport Layer	Session Layer	Supports the accomplishment of telecommunication sessions.
	Transport Layer	Supports the organization and transfer of data between nodes in the network.
Internet Protocol (IP)	Network Layer	Provides appropriate routing by establishing connections among network links.
Network Interface	Data Link Layer	Supports error-free organization and transmission of data in the network.
Physical Layer	Physical Layer	Provides physical transmission of data on the telecommunication media in the network.

THREATS

Unstructured Threats

- ◆ These originate mostly from inexperienced individuals using easily available hacking tools from the Internet.
- ◆ These include port-scanning tools, address-sweeping tools, and many others.

Structured Threats

- ◆ These originate from individuals who are highly motivated and technically competent and usually understand network systems design and the vulnerabilities of those systems.

External Threats

- ◆ These originate from individuals or organizations working outside an organization, which does not have authorized access to organization's computer systems or network.

Internal Threats

- ◆ These threats originate from individuals who have authorized access to the network. These users either have an account on a server or physical access to the network.

VULNERABILITY

Vulnerability is an inherent weakness in the design, configuration, or implementation of a network or system that renders it susceptible to a threat. The following facts are responsible for occurrence of vulnerabilities in the software:

- **Software Bugs** - Software bugs are so common that users have developed techniques to work around the consequences, and bugs that make saving work necessary every half an hour or crash the computer every so often are considered to be a normal part of computing.
- **Timing Windows** - This problem may occur when a temporary file is exploited by an intruder to gain access to the file, overwrite important data, and use the file as a gateway for advancing further into the system.
- **Insecure default configurations** - Insecure default configurations occur when vendors use known default passwords to make it as easy as possible for consumers to set up new systems.
- **Trusting Untrustworthy information** - This is a problem that affects routers, or those computers that connect one network to another.
- **End users** - Generally, users of computer systems are not professionals and are not always security conscious.

NETWORK SECURITY

It is based on the increasing demand and expectations, the security involves four aspects: **Privacy (Confidentiality), Message Authentication, Message Integrity and Non-repudiation.**

Privacy	Authentication	Integrity	Non-Repudiation
<ul style="list-style-type: none"> • This means that sender and receiver expect confidentiality. The transmitted message should make sense to only intended receiver and the message should be unintelligible to unauthorized users. 	<ul style="list-style-type: none"> • The receiver is sure of the sender's identity and that an imposter has not sent the message. 	<ul style="list-style-type: none"> • This means that the data must arrive at the receiver exactly as it was sent. There must not be any changes during the transmission – either accidental or malicious. 	<ul style="list-style-type: none"> • This means that a receiver must be able to prove that a received message came from a specific sender and the sender must not be able to deny sending it.

Secure Socket Layer - It provides a secure channel between two machines operating over the Internet or an internal network.	SSH File Transfer Protocol - A computing network protocol for accessing and managing files on remote file systems.
NETWORK SECURITY PROTOCOLS	
HyperText Transfer Protocol Secure - A protocol for secure communication over a computer network, with especially wide deployment on the Internet.	Secure Shell (SSH) - A program to log into another computer over a network, execute commands in a remote machine and move files from one machine to another.

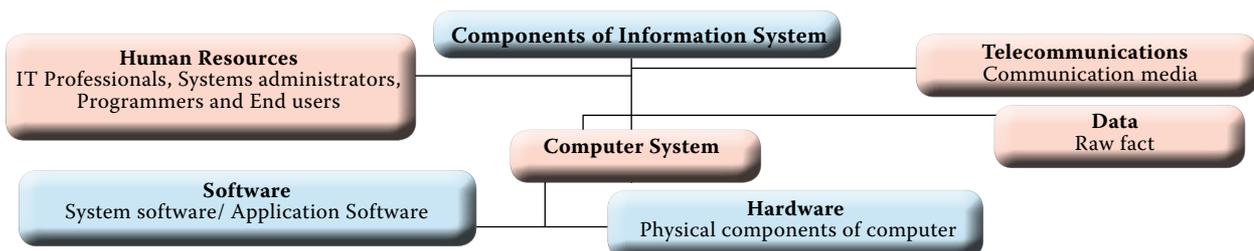
NETWORK SECURITY TECHNIQUES	
These are the tools/techniques to protect information and systems against compromise, intrusion, or misuse.	
1. Intrusion Detection System (IDS): An Intrusion Detection System is a device or software application that monitors network or system activities for malicious activities or policy violations and produces reports to a Management Station. Intrusion Detection System are primarily of following types: Network Intrusion Detection (NID), Host-based Intrusion Detection (HID), and Hybrid Intrusion Detection.	
2. Firewall: Forms a barrier between a secure and an open environment when the latter environment is usually considered hostile.	
3. Network Access Control: Enforces security policy by granting only security policy-compliant devices access to network assets.	
4. Anti – Malware: It is an umbrella term used to refer to a variety of forms of hostile or intrusive software, including computer viruses, worms, trojan horses etc. and other malicious programs.	
5. Site Blocking: It is a software-based approach that prohibits access to certain Web sites that are deemed inappropriate by management.	

NETWORK ADMINISTRATION AND MANAGEMENT	
Network Management refers to the activities, methods, procedures, and tools that pertain to the Operation, Administration, Maintenance, and Provisioning of networked systems.	
Operation	Deals with keeping network and services that the network provides up and running smoothly.
Administration	Deals with keeping track of resources in the network and how they are assigned.
Maintenance	Concerned with performing repairs and upgrades.
Provisioning	Concerned with configuring resources in the network to support a given service.

E-COMMERCE / M-COMMERCE	
Electronic Commerce (e-Commerce) is a sophisticated combination of technologies and consumer-based services integrated to form a new paradigm in business transaction processing. It refers to the use of technology to enhance the processing of commercial transactions between a company, its customers and its business partners.	
Benefits of e-Commerce Application and Implementation are as follows:	
<ul style="list-style-type: none"> Reduction in costs to buyers and suppliers by electronically accessing on-line databases; errors, time, and overhead costs in information processing; time to complete business transactions; inventories and reduction of risk of obsolete inventories; overhead and advertising costs; use of ecologically damaging materials. Easier entry into new markets, especially geographically remote markets, for enterprises regardless of size and location. Optimization of resource selection as businesses form cooperative teams. 	
Risks involved in e-Commerce are Problem of anonymity, Repudiation of contract, Lack of authenticity of transactions, Data Loss or theft or duplication, Attack from hackers, Denial of Service, Non-recognition of electronic transactions, Lack of audit trails and Problem of piracy.	
Types of e-Commerce are as follows:	
(a) Business-to-Business (B2B) e-Commerce	(c) Consumer-to-Business (C2B) e-Commerce
(b) Business-to-Consumer (B2C) e-Commerce	(d) Consumer-to-Consumer (C2C) e-Commerce
(e) Business-to-Government (B2G) e-Commerce	(f) Business-to-Employee (B2E) e-Commerce
M-commerce (Mobile commerce) is the buying and selling of goods and services through wireless handheld devices such as cellular telephone and personal digital assistants (PDAs), known as next-generation e-commerce; enables users to access the Internet without needing to find a place to plug in. The industries affected by m-commerce include Financial services, Telecommunications, Service/retail, etc.	

CHAPTER 4: BUSINESS INFORMATION SYSTEMS

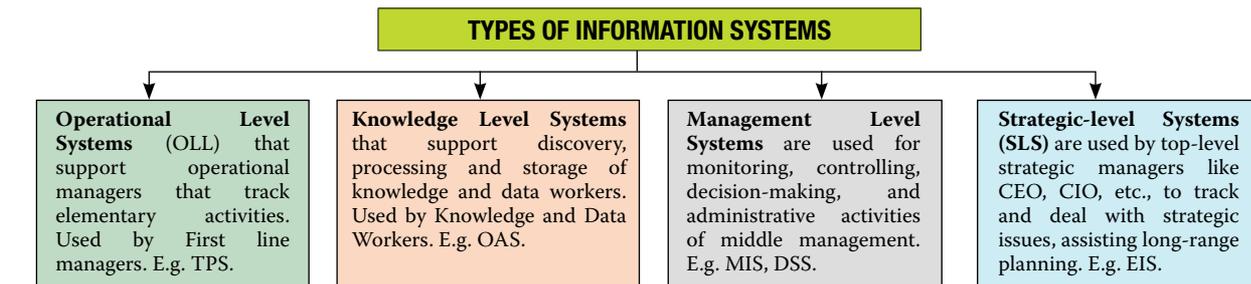
Information System is defined as a combination of people, hardware, software, communication devices, network and data resources that processes data and information for a specific purpose. The system needs inputs from user which will then be processed using technology devices such as computers, and produce output (printing reports, displaying results) that will be sent to another user or other system via a network and a feedback method that controls the operation.



INFORMATION TECHNOLOGY

Business Information System (BIS): Defined as systems integrating information technology, people and business. BIS bring business functions and information modules together for establishing effective communication channels which are useful for making timely and accurate decisions and in turn contribute to organizational productivity and competitiveness.

A Business Process: It is an activity or set of activities that will accomplish a specific organization goal. Has a goal, specific inputs and outputs, several activities that are performed in some order. It uses resources, may affect more than one organisational unit and creates value of some kind for the customer.



	Introduction	TPS Cycle	TPS Attributes	Pre-requisites of ACID Test
Transaction Processing System (TPS)	TPS is the lowest level of OLL level system that collects, stores, modifies and retrieves the day-to-day data transactions of an enterprise. Examples are Airline Reservation Systems, Railway reservation System etc.	<ul style="list-style-type: none"> • Data Entry: Recording/editing of data to be quickly/correctly captured for its proper processing. • Transaction processing: As Batch/Real-time processing. • Database Maintenance: Correct/up-to date. • Document & Report Generation: purchase orders, pay-checks, sales receipts, invoices, and customer statements. 	<ul style="list-style-type: none"> • Access Control: people who are not authorized to use the system are not permissible to influence or transform the transaction process. • Equivalence: Transactions are processed in the similar format every time to ensure that full effectiveness is achieved. • High Volume Rapid Processing: instantaneous processing of transactions is noteworthy to the success of certain industry such as banking. • Trustworthiness: designed to be robust and trustworthy. 	<ul style="list-style-type: none"> • Atomicity: means that a transaction is either completed in full or not at all. TPS systems ensure that transactions take place in their entirety. • Consistency: TPS systems exist within a set of operating rules. • Isolation: Transactions must appear to take place in seclusion. • Durability: Once transactions are completed, they cannot be undone.

Office Automation Systems (OAS) is an amalgamation of hardware, software, and other resources used to smooth the progress of communications and augment efficiency. Its basic activities include – Exchange of information; management of administrative documents; handling of numerical data; and meeting, planning and management of work schedules.

Applications	Description
Word Processing	Use of a computer to perform automatically many of the tasks necessary to prepare typed or printed documents.
Electronic mail	Use of a computer network that allows users to send, store & retrieve messages using terminals & storage devices.
Voice Mail	Requires computers with an ability to store audio messages digitally and convert them back upon retrieval.
Video Conferencing	Use of television equipment to link geographically dispersed conference participants.

Knowledge Management Systems (KMS) refer to any kind of IT system that stores and retrieves knowledge, improves collaboration, locates knowledge sources, mines repositories for hidden knowledge, captures and uses knowledge, or in some other way enhances the KM process. There are two broad types of knowledge—**Explicit and Tacit**.

Explicit Knowledge: It can be formalized easily and is easily available across the organization. It is articulated, and represented as spoken words, written material and compiled data. It is codified, easy to document, transfer and reproduce. For example – Online tutorials, Policy and procedural manuals.	Tacit Knowledge: It is unarticulated and represented as intuition, perspective, beliefs, and values that individuals form based on their experiences. It is personal, experimental and context specific. It is difficult to document and communicate the tacit knowledge. For example – hand-on skills, special know-how, employee experiences.
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Management Information System (MIS) refers to the data, equipment and computer programs that are used to develop information for managerial use.

- **Management:** Comprises the process and activity that a manager does in the operation of their organization, i.e., to plan, organize, direct and control operations.
- **Information:** Information simply means processed data or in the layman language, data which can be converted into meaningful and useful form for a specific user.
- **System:** Defined as a group of interrelated components working together towards a common goal by accepting input and producing output in an organized transformation process.
- **Some Examples of MIS** - Airline reservations (seat, booking, payment, schedules, boarding list, special needs, etc.); Bank operations (deposit, transfer, withdrawal) electronically with a distinguish payment gateways; and Integration of department with the help of contemporary software's like ERP.

Decision Support System (DSS) is a type of computerized information system that supports business and organizational decision – making activities. Planning languages commonly used in DSS are **General-purpose planning languages and Special-purpose planning languages**. DSS components are as follows:

The user: Usually a manager with an unstructured or semi-structured problem to solve at management - level of an organization.	One or more databases: Databases contain both routine and non-routine data from both internal and external sources.	Model Base: It is the brain of DSS that performs data manipulations & computations with the data provided to it by user & database. The planning language in DSS allows user to maintain a dialogue with model base.
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Executive Information Systems (EIS) sometimes referred to as an Executive Support System (ESS) serves the strategic level i.e. top-level managers of the organization.

Components	Description
Hardware	Includes Input data-entry devices, CPU, Data Storage files and Output Devices.
Software	Includes Text base software, Database, and Graphic types such as time series charts, scatter diagrams, maps, motion graphics, sequence charts, and comparison-oriented graphs (i.e., bar charts) Model base.
User Interface	Includes hardware (physical) and software (logical) components by which people (users) interact with a machine. Several types of interfaces can be available to the EIS structure, such as scheduled reports, questions/answers, menu driven, command language, natural language, and input/output.
Telecommunication	Involves transmitting data from one place to another in a reliable networked system.

SPECIALISED SYSTEMS

Customer Relationship Management (CRM) may be defined as a business process in which client relationships; customer loyalty and brand value are built through marketing strategies & activities. It allows businesses to develop long-term relationships with established and new customers while helping modernize corporate performance, incorporates commercial and client-specific strategies via employee training, marketing planning, relationship building , etc.

Benefits of CRM

- ◆ Generates customer loyalty, raising a market intelligence enterprise, and an integrated relationship.
- ◆ Preserves existing customers/provides enhanced services to accomplish loyalty.
- ◆ Smoothens the progress to capture, consolidate, analysis, and enterprise-wide dissemination of data from existing and potential customers.

Supply Chain Management (SCM) may be defined as the process of planning, implementing and controlling the operations of the supply chain with the purpose of satisfying the customer's requirement as efficiently as possible. Core Elements of SCM are as follows:

DISTRIBUTION	INTEGRATION	PURCHASING	OPERATIONS
<ul style="list-style-type: none"> ■ Transportation ■ CRM ■ Logistics Parties 	<ul style="list-style-type: none"> ■ Coordination ■ Management ■ Control 	<ul style="list-style-type: none"> ■ Supplier Selection ■ Recruitment ■ Payroll Management 	<ul style="list-style-type: none"> ■ Inventory ■ Control ■ Quality

Human Resource Management System refers to the systems and processes at the intersection between Human Resource Management (HRM) and Information Technology.

- ◆ **Workforce Management** provides powerful tools to effectively manage labor rules, ensure compliance, and control labor costs and expenses.
- ◆ **Time and Attendance** module gathers standardized time and work related efforts, data collection methods, labor distribution capabilities and data analysis.
- ◆ **Payroll Management** facilitates salary, deductions, calculations, eliminates errors, free up HR staff etc.
- ◆ **Training Management** tracks the trainer or training organization, costs associated with training schedule, training locations, required supplies and equipment and registered attendees.
- ◆ **Compensation Management** requires integrating employee processes, information and programs with organizational processes and strategies to achieve optimal organizational results.
- ◆ **Recruitment Management** includes processes for managing open positions/requisitions, applicant screening, assessments, selection and hiring, correspondence, reporting and cost analysis.
- ◆ **Personnel Management** comprises of HR master-data, personnel administration, recruitment and salary administration.
- ◆ **Organizational Management** includes organizational structure, staffing schedules and job description.
- ◆ **Employee Self Service (ESS)** allows employees to query HR related data and perform some HR transactions over the system.
- ◆ **Analytics** enables organizations to extend the value of an HRMS implementation by extracting HR related data for use with other business intelligence platforms.

INFORMATION TECHNOLOGY ||

Core Banking Systems (CBS) may be defined as a back-end system that processes daily banking transactions, and posts updates to accounts and other financial records. Examples of core banking products include Infosys' Finacle, Nucleus FinnOne and Oracle's Flexcube application (from their acquisition of Indian IT vendor i-flex). **Elements of CBS are as follows:**

<ul style="list-style-type: none"> ◆ Making and servicing loans. ◆ Processing cash deposits and withdrawals. ◆ Calculating interest. ◆ Establishing criteria for minimum balances, interest rates, number of withdrawals allowed and so on. 	<ul style="list-style-type: none"> ◆ Opening new accounts. ◆ Processing payments and cheques. ◆ Customer Relationship Management activities. ◆ Establishing interest rates. ◆ Maintaining records for all the bank's transactions.
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Accounting Information System (AIS) is defined as a system of collection, storage and processing of financial and accounting data that is used by decision makers. **Its key components are as follows:**

People	AIS helps various system users that include accountants, consultants, business analysts, managers, chief financial officers and auditors etc. from different departments within a company to work together.
Procedure & Instructions	These include both manual and automated methods for collecting, storing, retrieving and processing data.
Data	Refers to the information pertinent to the organization's business practices that may include sales orders, customer billing statements, sales analysis reports etc., which can then be used to prepare accounting statements and reports.
Software	These are the computer programs that provide quality, reliability and security to the company's financial data that may be stored, retrieved, processed and analyzed. Managers rely on the information it outputs to make decisions for the company, and they need high-quality information to make sound decisions.
IT Infrastructure	This include hardware such as personal computers, servers, printers, surge protectors, routers, storage media, and possibly a backup power supply used to operate the system.
Internal Controls	These are the security measures such as passwords or as complex as biometric identification to protect sensitive data against unauthorized computer access and to limit access to authorized users. Internal controls also protect against computer viruses, hackers and other internal and external threats to network security.

Expert System (ES) Definition

A computerized information system that allows non-experts to make decisions comparable to those of an expert.

Expert Systems Components

- ◆ **Knowledge Base:** Includes the data, knowledge, relationships, rules of thumb (heuristics), and decision trees used by experts to solve a particular problem.
- ◆ **Inference Engine:** Contains the logic and reasoning mechanisms that simulate the expert logic process and deliver advice.
- ◆ **User Interface:** Allows the user to design, create, update, use and communicate with ES.
- ◆ **Explanation facility:** Provides user with an explanation of the logic the ES used to arrive at its conclusion.

Business Intelligence (BI) is the delivery of accurate, useful information to the appropriate decision makers within the necessary time frame to support effective decision making for business processes.

Business Intelligence Tools are a type of software that is designed to retrieve, analyze and report data.

Simple Reporting and Querying	This involves using the data warehouse that provides the perfect architecture to combine all the data dispersed throughout the enterprise in different applications in a variety of formats, on a range of hardware, which could be anywhere to be cleaned up, summarized, converted and integrated into one common format and available centrally for further processing.
Business Analysis	Business analysis refers to presenting visualizing data in a multidimensional manner. This allows the user to plot data in row and column coordinates to further understand the intersecting points. ETL (Extract, Transform, Load) tools bring in data from outside sources, transform it to meet business specified operational needs, and then load the results into the company database
Dashboards	Are flexible tools that can be bent into as many different shapes as per user requirements. It includes a collection of graphs, reports, and KPIs that help monitor business activities as progress on a specific initiative.
Scorecards	This involves providing a visual representation of the enterprise strategy by taking critical metrics and mapping them to strategic goals throughout the enterprise. A scorecard has a graphical list of specific, attainable strategic milestones, combined with metrics that serve as benchmarks.
Data Mining or Statistical Analysis	This involves using statistical, artificial intelligence, and related techniques to mine through large volumes of data and providing knowledge without users even having to ask specific questions. The objective is to provide interesting and useful information to users by design even without their querying.

Business Reports are a type task which facilitates in scrutinizing a situation and pertain to business theories to fabricate a variety of suggestions for development. Business reports are routinely assigned to facilitate us to:

- Accomplish conclusions about a trouble or issue.
- Demonstrate short and apparent communication skills.
- Endow with recommendations for upcoming accomplishing.
- Exhibit our analytical, reasoning, and evaluation skills in identifying and weighing-up potential solutions and outcomes.
- Pertain business and management theory to a practical situation.
- Scrutinize obtainable and potential solutions to a problem, situation, or question.

IMPORTANCE OF ACCESS AND PRIVILEGE CONTROLS

In order to safeguard software systems, procedures are developed and implemented for protecting them from unauthorized modification, disclosure or destruction to ensure that information remains accurate, confidential, and is available when required. Access controls help us to restrict whom and what accesses our information resources, and they possess four general functions: **Identity Verification, Authentication, Authorization and Accountability.**

Approaches to Access Control are as follows:

Role-based Access Control (RBAC) enforces static constraints based on a user's role that largely eliminates discretion when providing access to objects. RBAC, for example, enforces static constraints based on a user's role.

Rules-based Access Control (RAC) is largely context-based that considers the data affected, the identity attempting to perform a task, and other triggers governed by business rules.

Principle of Least Privilege

This is a fundamental principle of information security, which refers to give only those privileges to a user account, which are essential to that user's work. For example, a backup user does not need to install software; hence, the backup user has rights only to run backup and backup-related applications. Any other privileges, such as installing new software, should be blocked.

CHAPTER 5: BUSINESS PROCESS AUTOMATION THROUGH APPLICATION SOFTWARE

BUSINESS APPLICATION

- **Business** is defined as a person's regular occupation or commercial activity, a person's concern.
- **Application**, in terms of computers, is defined as a computer program to fulfill a particular purpose.
- **Business Application** as a computer program used to fulfill a person's need for regular.

APPLICATIONS BASED ON NATURE OF PROCESSING

Batch Processing	Online Processing	Real-Time Processing
It is defined as a processing of large set of data in a specific way, automatically, without needing any user intervention. The data is first collected, during a work day, for example, and then batch-processed, so all the collected data is processed in one go.	Data is processed immediately while it is entered, the user usually only has to wait a short time for a response. Interactive or online processing requires a user to supply an input.	Real time processing is a subset of interactive or online processing. This system doesn't need a user to control it, it works automatically. Real time processing is used in warning systems on aircraft, alarm systems in hazardous zones, burglar alarms etc.

APPLICATIONS BASED ON SIZE AND COMPLEXITY OF BUSINESS

Small and Medium Enterprise (SME) Business	Large Business
The best software for small and medium businesses is software designed to help them to run their operations better, cut costs and replace paper processes.	When it comes to other sorts of business software, designed for the larger or more ambitious businesses, a business application being used by many small business establishments in India may not be effective for large business organizations.

BUSINESS APPLICATIONS BASED ON NATURE OF APPLICATION

Accounting Applications	These are used by business entities for the purpose of day-to-day transactions of accounting and generating financial information such as balance sheet, profit and loss account and cash flow statements.
Office Mgt. S/w	These applications help entities to manage their office requirements like word processors (MS Word), electronic spreadsheets (MS Excel), presentation software (PowerPoint), file sharing systems, etc.
Compliance Applications	Enterprises need to comply with applicable laws and regulations. A separate class of business application are available that facilitate meeting the compliance requirements.
CRM S/w	These are specialized applications catering to the need of organizations largely in FMCG categories.
Management Support S/w	These are applications catering to decision-making needs of the management. They may be further classified based on the level of management using them.
ERP S/w	These applications called as Enterprise Resource Planning software, which are used by entities to manage resources optimally and to maximize the three Es i.e. Economy, Efficiency and Effectiveness of business operations.
Product Lifecycle Mgt. S/w	These applications are used by enterprises that are involved in development or launch of new products and are involved in development of new products.
Logistics Mgt. S/w	For large logistics managing companies, these are key business applications.
Legal Mgt. S/w	Government of India is keen to reduce the pendency in courts. As this process goes, on legal profession in India shall need such systems.
Industry Specific Applications	These are industry specific applications focused on a specific industry sector.

BUSINESS PROCESS AUTOMATION (BPA)

It is a strategy that is used to optimize and streamline the essential business processes, using the latest technology to automate the functions involved in carrying them out. The objectives of BPA are given below:

Confidentiality	To ensure that data is only available to persons who have right to see the same.
Integrity	To ensure that no un-authorized amendments can be made in the data.
Availability	To ensure that data is available when asked for.
Timeliness	To ensure that data is made available in at the right time.

APPLICATIONS THAT HELP ENTITY TO ACHIEVE BPA

Applications that help entity to achieve BPA are: TALLY, SAP R/3, MS Office Applications, Attendance Systems, Vehicle Tracking System, Automated Toll Collection Systems, Department Stores Systems, Travel Management Systems, Educational Institute Management Systems, etc.

Why BPA should be implemented?

Reducing the Impact of Human Error

- ◆ BPA removes human participation in the process, which is the source of many errors.

Transforming Data into Information

- ◆ BPA can, apart from collecting and storing data also analyze data and make it available in a form that is useful for decision-making.

Improving performance and process effectiveness

- ◆ In many cases, tasks that must be done manually are the bottleneck in the process. Automating those manual tasks speeds up the effective throughput of the application.

Making users more efficient and effective

- ◆ People can focus their energies on the tasks they do best, allowing the computers to handle those that machines are best suited for.

Making the business more responsive

- ◆ Enterprises can easily automate new applications and

processes as they are introduced that provide greater control over business and IT processes.

Improving Collaboration and Information Sharing

- ◆ Business processes designed through a collaborative interface mean IT can integrate its processes with the business-side logic that drives day-to-day operations.

Cost Saving

- ◆ Automation leads to saving in time and labor costs through higher efficiency and better management of the people involved.

To remain competitive

- ◆ To provide the level of products and services as offered by competition.

Fast service to customers

- ◆ Automation shortens cycle times in the execution of processes through improved and refined business workflows and help enterprises to serve their customers faster and better.

Information may be defined as processed data, which is of value to the user. Information is necessary for decision making and survival of an entity as success of business depends upon making right decisions at the right time based on the right information available. The effort to create information from raw data is known as Information Processing.

Classification of information based on level of human/computer intervention is as follows:

Manual Information Processing Cycle	These are the systems where the level of manual intervention is very high. Components of manual information processing cycle include: <ul style="list-style-type: none"> ◆ Input: Put details in register. ◆ Process: Summarize the information. ◆ Output: Present information to management in the form of reports.
Computerized Information Processing Cycle	These are systems where computers are used at every stage of transaction processing. The components of a computerized information processing cycle include: <ul style="list-style-type: none"> ◆ Input: Entering data into the computer; ◆ Processing: Performing operations on the data; ◆ Storage: Saving data, programs, or output for future use; and ◆ Output: Presenting the results.

- **Control** is defined as policies, procedures, practices and organization structure that are designed to provide reasonable assurance that business objectives are achieved and undesired events are prevented or detected and corrected. Major control objectives are as follows:

Authorization

Ensures that all transactions are approved by responsible personnel in accordance with their specific or general authority before the transaction is recorded.

Completeness

Ensures that no valid transactions have been omitted from the accounting records.

Accuracy

Ensures that all valid transactions are accurate, consistent with the originating transaction data, and information is recorded in a timely manner.

Validity

Ensures that all recorded transactions fairly represent the economic events that actually occurred, are lawful in nature, and have been executed in accordance with management's general authorization.

Physical Safeguards and Security

Ensures that access to physical assets and information systems are controlled and properly restricted to authorized personnel.

Error Handling

Ensures that errors detected at any stage of processing receive prompt corrective action and are reported to the appropriate level of management.

Segregation of Duties

Ensures that duties are assigned to individuals in a manner that ensures that no one individual can control both the recording function and the procedures relative to processing a transaction.

INFORMATION SYSTEMS' (IS) CONTROLS

Auditors need guidelines that will direct them toward those aspects of the information systems function in which material losses or account misstatements are most likely to occur. Controls reduce expected losses from unlawful events by either decreasing the probability of the event occurring in the first place or limiting the losses that arise if the event occurs.

A. Managerial Controls: These controls provide a stable infrastructure in which information systems can be built, operated, and maintained on a day-to-day basis. These are as follows:

Management Subsystem	Description of Subsystem
Top Mgt.	Responsible primarily for long – run policy decisions on how IS will be used in the organization.
Information Systems Mgt.	Provides advice to top mgt. in relation to long-run policy decision making & translates long-run policies into short-run goals & objectives.
Systems Development Mgt.	Responsible for the design, implementation, and maintenance of application systems.
Programming Management	Responsible for programming new system; maintain old ones and providing general systems support s/w.
Data Administration	Responsible for addressing planning and control issues in relation to use of an organization's data.
Quality Assurance Management	Responsible for ensuring IS development; implementation, operation, and maintenance conform to established quality standards.
Security Administration	Responsible for access controls and physical security over the information systems function.
Operations Management	Responsible for planning and control of the day-to-day operations of information systems.

B. Application Controls: It will examine the application functions that need to be in place to accomplish reliable information processing.

Application Subsystem	Description of Subsystem
Boundary	Comprises components that establish interface between user and system.
Input	Comprises components that capture, prepare, and enter commands and data into system.
Communication	Comprises components that transmit data among subsystems and systems.
Processing	Comprises the components that perform decision making, computation, classification, ordering, and summarization of data in the system.
Output	Comprises components that retrieve and present data to users of the system.
Database	Comprises the components that define, add, access, modify, and delete data in the system.

MANAGERIAL FUNCTIONS BASED CONTROLS

1. Top Management and Information Systems Management Controls: The senior managers who take responsibility for IS function in an organization perform many functions that involves following:

- ◆ **Planning:** Determining the goals of the information systems function and the means of achieving these goals;
- ◆ **Organizing:** Gathering, allocating, and coordinating resources needed to accomplish goals;
- ◆ **Leading:** Motivating, guiding, and communicating with personnel; and
- ◆ **Controlling:** Comparing actual performance with planned performance as a basis for taking any corrective actions that are needed.

2. Systems Development Management Controls: These have the responsibility for the functions concerned with analyzing, designing, building, implementing, and maintaining information systems.

- ◆ **Concurrent Audit:** Auditors are members of the system development team. They assist the team in improving the quality of systems development for the specific system they are building and implementing.
- ◆ **Post-implementation Audit:** Auditors seek to help an organization learn from its experiences in the development of a specific application system.
- ◆ **General Audit :** Auditors evaluate systems development controls overall.

3. Programming Management Controls: Program development and implementation is a major phase within the systems development life cycle containing following six phases:

- ◆ **Planning:** Techniques like Work Breakdown Structures (WBS), Gantt Charts and PERT (Program Evaluation and Review Technique) Charts can be used to monitor progress against plan.
- ◆ **Design:** A systematic approach to program design, such as any of the structured design approaches or object-oriented design is adopted.
- ◆ **Coding:** Programmers must choose a module implementation and integration strategy, a coding strategy, and a documentation strategy .
- ◆ **Testing:** Three types of testing are to ensure that a developed or acquired program achieves its specified requirements.
- ◆ **Operation and Maintenance:** Management establishes formal mechanisms to monitor the status of operational programs so maintenance needs can be identified on a timely basis.

4. Data Resource Management Controls: Data is a critical resource that must be managed properly and therefore, accordingly, centralized planning and control are implemented.

- ◆ For data to be managed better users must be able to share data, data must be available to users when it is needed, in the location where it is needed, and in the form in which it is needed.
- ◆ It must be controlled carefully, however, because consequences are serious if data definition is compromised or destroyed.

5. Quality Assurance Management Controls

- ◆ Organizations are increasingly producing safety-critical systems and users are becoming more demanding in terms of the quality of the software they employ to undertake their work.

6. Security Management Controls

- Information security administrators are responsible for ensuring that information systems assets are secure. The major threats to the security of information systems and their controls are as given below:
- ◆ **Fire:** Well-designed, reliable fire-protection systems must be implemented.
 - ◆ **Water:** Facilities must be designed and sited to mitigate losses from water damage.
 - ◆ **Energy Variations:** Voltage regulators, circuit breakers, and uninterruptible power supplies can be used.
 - ◆ **Structural Damage:** Facilities must be designed to withstand structural damage.
 - ◆ **Pollution:** Regular cleaning of facilities and equipment should occur.
 - ◆ **Unauthorized Intrusion:** Physical access controls can be used.
 - ◆ **Viruses and Worms:** Controls to prevent use of virus-infected programs and to close security loopholes that allow worms to propagate.
 - ◆ **Misuse of software, data and services:** Code of conduct to govern the actions of IS employees.
 - ◆ **Hackers:** Strong, logical access controls to mitigate losses from the activities of hackers.

7. Operations Management Controls

- ◆ These must continuously monitor the performance of hardware/software platform to ensure that systems are executing efficiently, an acceptable response time or turnaround time is being achieved, and an acceptable level of uptime is occurring.

APPLICATION FUNCTIONS BASED CONTROLS

Boundary Controls

- ◆ **Cryptographic Controls:** These are designed to protect the privacy of data and to prevent unauthorized modifications of data.
- ◆ **Access Controls:** These restrict use of computer system resources to authorized users, limit actions authorized users can take with these resources, and ensure that users obtain only authentic computer system resources.
- ◆ **Personal Identification Numbers (PIN):** It is similar to a password assigned to a user by an institution based on the user characteristics and encrypted using a cryptographic algorithm.
- ◆ **Digital Signatures:** These establish the authenticity of persons & prevent denial of messages or contracts when data is exchanged electronically.
- ◆ **Plastic Cards:** These are used to identify a user need to go through procedural controls like application for a card, preparation of the card, issue of card, use of the card and return of the card or card termination phases.

Input Controls

- ◆ **Source Document Control:** These facilitate data entry into a computer system & reference checking.
- ◆ **Data Coding Controls:** These are put in place to reduce user error during data feeding.
- ◆ **Batch Controls:** These are put in place at locations where batch processing is being used.
- ◆ **Validation Controls:** These are intended to detect errors in transaction data before the data are processed.

Communication Controls

- ◆ **Physical Component Controls:** One way to reduce expected losses in the communication subsystem is to choose physical components that have characteristics that make them reliable and that incorporate features or provide controls that mitigate the possible effects of exposures.
- ◆ **Line Error Controls:** Whenever data is transmitted over a communication line, it can be received in error because of attenuation, distortion, or noise that occurs on the line.
- ◆ **Flow Controls:** These are needed because two nodes in a network can differ in terms of the rate at which they can send receive and process data.
- ◆ **Link Controls:** This involves two common protocols – HDLC (Higher Level Data Control) and SDLC (Synchronous Data Link Control)
- ◆ **Topological Controls:** Specifies the location of nodes within a network, the ways in which these nodes will be linked, and the data transmission capabilities of the links between the nodes.
- ◆ **Channel Access Controls:** Two different nodes in a network can compete to use a communication channel. Whenever the possibility of contention for the channel exists, some type of channel access control technique must be used.
- ◆ **Internetworking Controls:** Internetworking is the process of connecting two or more communication networks together to allow the users of one network to communicate with the users of other networks.

Processing Controls

- ◆ **Run-to-Run Totals:** These help in verifying data that is subject to process through different stages.
- ◆ **Reasonableness Verification:** Two or more fields can be compared/cross verified to ensure their correctness.
- ◆ **Edit Checks:** Edit checks similar to the data validation controls can also be used at the processing stage to verify accuracy and completeness of data.
- ◆ **Field Initialization:** Data overflow can occur, if records are constantly added to a table or if fields are added to a record without initializing it, i.e., setting all values to zero before inserting the field or record.
- ◆ **Exception Reports:** Exception reports are generated to identify errors in data processed.
- ◆ **Existence/Recovery Controls:** The check-point/restart logs, facility is a short-term backup and recovery control that enables a system to be recovered if failure is temporary and localized.

Output Controls

- ◆ **Storage and Logging of Sensitive and Critical Forms:** Pre-printed stationery should be stored securely to prevent unauthorized destruction or removal and usage.
- ◆ **Logging of Output Program Executions:** When programs used for output of data are executed, they should be logged and monitored.
- ◆ **Controls over Printing:** This ensures that unauthorized disclosure of information printed is prevented.
- ◆ **Report Distribution and Collection Controls:** Distribution of reports should be in a secure way to avoid unauthorized disclosure of data.
- ◆ **Retention Controls:** These consider duration for which outputs should be retained before being destroyed.
- ◆ **Existence/Recovery Controls:** These are needed to recover output in the event that it is lost or destroyed.

Database Controls

- ◆ **Sequence Check Transaction and Master Files:** Synchronization and correct sequence of processing between the master file and transaction file is critical to maintain integrity of updation, insertion or deletion of records in the master file with respect to the transaction records.
- ◆ **Ensure all records on files are processed:** While processing transaction file records mapped to respective master file end-of-file of transaction file with respect to the end-of-file of the master file is to be ensured.
- ◆ **Process multiple transactions for a single record in the correct order:** Multiple transactions can occur based on a single master record.