CA – IPCE

Paper 7A: Information Technology

Free Revisionary Notes

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Suggested Study Pattern

Paper 7: IT / SM

On 13th May	Flow Charts, Chapter 1 & 2 of IT (Along with its RTP)
On 14th May –	
Pre Lunch	Chapter 4 & 5 of IT, Chapter 1,2 & 3 of SM
Post Lunch	Chapter 4,5,6,7 of SM
Late Night	Chapter 3 of IT
On 15th May – (Exam Day)	Distinguish between...., Important Terms, Remaining Questions of RTP of Nov.2015 attempt & May 2016 attempt & Recent Mock Papers

CA – IPCE

Paper 7A: Information Technology

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Revisionary Notes contains all the Important Provisions relevant from Exam Point of View.
However, these Notes are meant for REVISION ONLY.

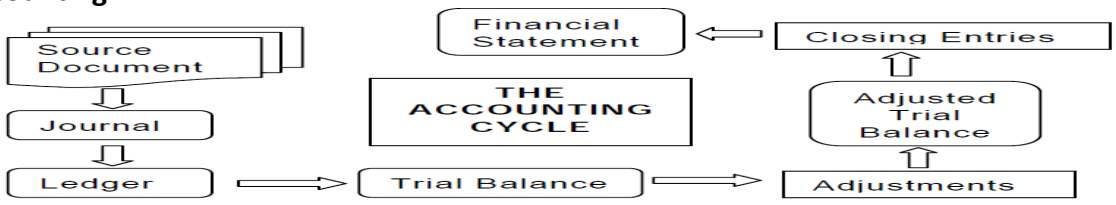
Unit 1: Business Process Management & IT

From a business perspective,
- A process is a coordinated and standardized flow of activities,
- Performed by people or machines,
- Which can traverse functional boundaries to achieve a business objective and
- Creates value for internal or external customers.

To manage a process-
(i) **Define** it and map the tasks to the roles involved.
(ii) **Performance measures** can be established.
(iii) Describe the **organizational setup** that enables the standardization of the process throughout the organization.

	Functional Organization	**Process Organization**
Work Unit	Department	Team
Key Figure	Functional Executive	Process Owner
Benefits	(i) Functional excellence. (ii) Easier to implement work balancing. (iii) Clear management direction.	(i) Responsive to market requirements. (ii) Improved communication and collaboration between different functional tasks. (iii) Performance measurements aligned with process goals.
Weaknesses	(i) Barrier to communication between different functions. (ii) Poor handover between functions that affects customer service.	(i) Duplication of functional expertise. (ii) Increased operational complexity.

Business Process Flow:
(1) Accounting:



(2) Sales: (Order to Cash)
(i) Customer Order (ii) Recording (Checking availability) (iii) Pick release
(iv) Shipping (v) Invoice (vi) Receipt (vii) Reconciliation

(3) Purchase: (Procure to Pay)
(a) Purchase requisition (b) Request for quote (c) Quotation
(d) Purchase order (e) Receipts (f) Payments

(4) Finances:

Classification of Business Processes:

A. Business Strategy: (Highest Level):

Describes long-term concepts to develop a sustainable competitive advantage

B. Goals: (Second Level):

Business strategy is broken down to Operational Goals.

C. Organizational Business Processes:

High-level processes that are specified in textual form by their inputs, outputs, expected results and dependencies on other organizational business processes

D. Operational Business Processes:

The activities and their relationships are specified

E. Implemented Business Processes:

Contain information on the execution of the process activities.

Business Process Management (BPM):

"The achievement of an organization's objectives through the improvement, management and control of essential business processes"

Business Process Management System (BPMS):

- A generic software system
- that is driven by process representations
- to coordinate the enactment of business processes.

The primary benefits of using technology for BPM are:

(i) Effectiveness gains - Automated coordination of activities;
(ii) Distribution of tasks to process participants;
(iii) Amalgamation of applications;
(iv) Ability to process more with less effort and higher quality.

BPM's Principles:

1. **Processes are assets** that create value for customers.
2. Management of processes - **Measuring, monitoring, controlling, and analyzing business processes.**
3. **Continuous improvement** of processes.
4. **Information technology** is an essential enabler for BPM.

BPM's Practices:

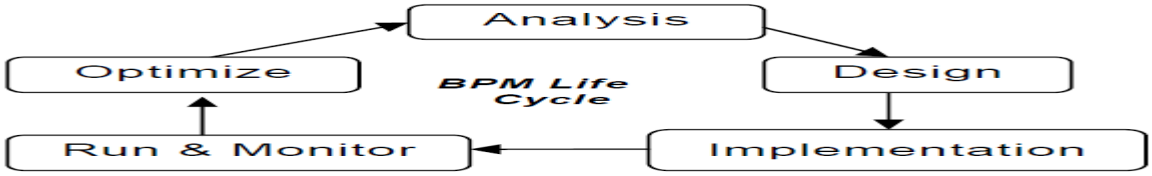
1. Process-oriented organizational structure:

(a) Process Organization
(b) Case management organization (Case Managers)
(c) Horizontal process management organization (Process owner for core process)

2. Appoint Process Owners:
- Responsible for influencing functional workers and functional heads
- Should be a senior member of the organization

3. Top-Down Commitment, Bottom - Up Execution
4. Use Information Technology (IT) to Manage Processes
5. Collaborate with Business Partners
6. Continuous Learning and Process Improvement
7. Align Employee Rewards to Process Performance
8. Utilize Six Sigma, BPR, TQM and Other Process Improvement Tools

Business Process Management Life Cycle (BPM-L Cycle):



Theories of Process Management:
(I) Six Sigma:
Six Sigma is a set of strategies and tools for process improvement. It seeks to improve the quality of process outputs by identifying and removing the causes of defects.
Phases: (DMAIC)
(i) Define: Measurements that are critical to customer satisfaction
(ii) Measure: Variances of output
(iii) Analyze: Possible causes are analyzed statistically to determine root cause of variation
(iv) Improve: Solution alternatives are generated to fix the root cause. The most appropriate solution is identified.
(v) Control: Process is standardized and documented

(II) Total Quality Management (TQM):
TQM is a management mechanism designed to improve the quality of the product or process by engaging every stakeholder as well as the customers.
TQM processes are divided into four sequential categories:
(i) Plan: Define the problem, collect data, and ascertain root cause;
(ii) Do: Develop and implement a solution;
(iii) Check: Confirm the results through before-and-after data comparison;
(iv) Act: Document results, inform others about changes, and make recommendations

(III) Business Process Reengineering (BPR):
BPR is the fundamental rethinking and radical redesign of processes, to achieve dramatic improvement, in critical measures of performance such as cost, quality, service and speed.
• **Dramatic achievement** means to achieve 80% or 90% reduction and not just 5%, 10%. Possible only by making major improvements and breakthroughs
• **Radical redesign** means reinventing and not improving. **"Clean slate approach"**
• **Fundamental rethinking** means asking the question "why do you do what you do", thereby eliminating business processes altogether if it does not add any value to the customer.

BPR Success factors:

(i) Organization wide commitment: Top management has to convince every affected group about the potential benefits to the organization as a whole and secure their commitment.

(ii) BPR team composition: BPR team should include representatives from top management, business process owners, technical experts and users. (Manageable size)

(iii) Business needs analysis: Identify exactly the processes that need reengineering.

(iv) Adequate IT infrastructure: Set of hardware, software, networks, facilities, etc.

(v) Effective change management: BPR involves changes in people behavior and culture, processes and technologies. The success of BPR depends on how effectively management conveys the need for change to the people.

(vi) Ongoing continuous improvement: Innovation and continuous improvement are key to the successful implementation of BPR.

BPM Implementation: Key factors to consider in implementing BPM:

Factors	Key Considerations
Scope	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, Trained Employees, Basic Education
Tools to be used	White-Boards, Sticky Notes, Software For Mapping, BPMS
Investments to Make	Training, Tools, Time, Capital

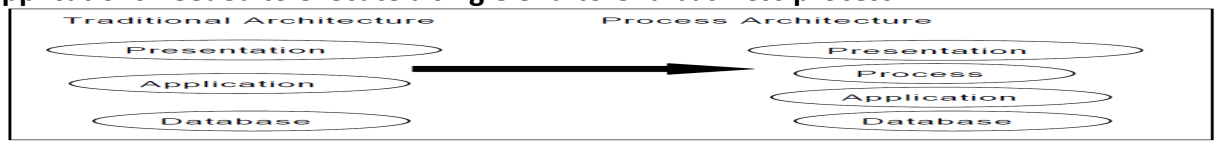
Challenges in implementing BPA:

- The number of interfaces with the customers is growing (e.g. phone, email, sms, etc.)
- The product, service and price options have increased
- Budgets are being cut.

BPM Technology:

(i) BPM technology can give organizations the ability to implement a real – time process improvement without the extensive process conversion efforts.

(ii) BPM provides an independent process layer, **linking the various independent applications needed to execute a single end-to-end business process**.



Value Chain Automation:

(i) Value chain is defined as a chain of activities that a firm operating in a specific industry performs in order to deliver a valuable product or service for the market.

(ii) The idea of the Value Chain is based on the process view of organizations.

(iii) Six business functions of the value chain:

- R&D
- Design of products, services, or processes
- Production
- Marketing and sales
- Distribution
- Customer service

(iv) "IT" helps us identify the ways in which we create value for our customers and then helps us think through how we can maximize this value.

Accounting Information Systems:
(i) It is defined as a system of collection, storage and processing of financial and accounting data that is used by decision makers.
(ii) It is computer-based method for tracking accounting activity.

Basic Functions of an Accounting Information System (AIS):
(i) Collect and store data: Capturing transaction data from source documents
(ii) Record transaction: Record transactions data into journals.
(iii) Safeguard organizational assets (data and systems): Provide adequate controls to ensure that data are recorded and processed accurately.

Processing Cycles of Accounts BPM:
(i) Financing Cycle
(ii) Revenue Cycle
(iii) Expenditure Cycle
(iv) Human Resource Cycle
(v) Production Cycle
(vi) Data Processing Cycle

The Data Processing Cycle consists of following basic steps:
• **Data input –** Capturing the data, implementing controls, recording in journals, posting to ledgers and preparation of reports.
• **Data storage -** Organizing the data in master file for easy access.
• **Data processing -** Addition, deletion and updating of the data in the transaction file & master file.
• **Information output -** Involves generation of documents and managerial reports and help the management in decision making.

Organizations that utilize BPM systems to accomplish IT enabled business process change, gain from the following capabilities:
• Closer business involvement in designing IT enabled business processes,
• Ability to integrate people and systems in business processes,
• Ability to simulate business processes to design the most optimal processes for implementation,
• Ability to monitor, control, and improve business processes in real time, and
• Ability to effect change on existing business processes in real time without an elaborate process conversion effort.

Benefits of BPMS:
(a) Automating repetitive business processes: (E.g. Processes such as report creation)
(b) Operational cost Savings
(c) Decrease in administration involved in Compliance activities
(d) Freeing-up of employee time

Business Risks of failure of IT:
- Inadequate investment in training for involved personnel,
- Lack of corporate policy protecting the integrity of the data in the BPM systems.

Some of the other reasons for failure of BPMS include the following:

- Superficial executive involvement
- Deficient project management
- Not flexible enough or too complicated
- Failure to identify future business needs
- Persistent compatibility problems with systems of the partners.
- Resources not available when desirable
- Technological obsolescence.

Information as a Business Asset:

(i) If it is useful, digital, relevant, accurate, trust-worthy, searchable, understandable, and shareable.

(ii) Information - accurate, then decision-makers - better an organization's performance. Without reliable information - the decision-making process can be badly hampered.

(iii) Without effectively management of information the result can be information chaos.

Documentation (Mapping IS): Some of the reasons why documentation is important:

(a) Depicting how the system works
(b) Training users
(c) Designing new systems
(d) Controlling system development and maintenance costs
(e) Standardizing communications with others
(f) Auditing Information Systems
(g) Understanding business processes

Entity Relationship Diagram:

(i) 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 IS.

(ii) Boxes (**Rectangles** labeled with nouns) are commonly used to represent **entities**. ('Physical object' or 'Event' or 'Concept')

(iv) **Diamonds** are normally used to represent **relationships.**

(v) **Ovals** are used to represent **attributes**.

Types of Relationships:

(i) One-to-One relationship (1:1): A student has one and only one Report card. Each report card is owned by one and only one student.

(ii) One-to-Many relationships (1:N): ["crow's foot" symbol denoting the 'many']

A student may borrow some books from library. A book in library may be borrowed by at most a student.

(iii) Many-to-One relationships (M:1): Reverse of One-to-Many relationship.

When three administrators in a small town report to one minister

(iv) Many-to-Many relationships (M:N): ['crow's foot' symbols at both ends]

A student enrolls in atleast one course. A course is enrolled by at least one student.

Advantages of using E-R Diagram:
• ER Modeling is **simple & easy to understand**. (Business users' language + understood by non-technical specialist)
• Intuitive and helps in **Database creation**.
• Can be **generalized or specialized** based on needs.
• Gives a **higher level description** of the system.

Limitations of using E-R Diagram:
• Physical design derived from E-R Model may have some **ambiguities or inconsistency**.
• Sometime diagrams may lead to **misinterpretations**.

(2) Data Flow Diagram:
(i) Graphical representation of the **flow of data through an information system**.
(ii) **Illustrates technical or business processes** (with the help of the external data stored + the data flowing from one process to another + results)
(iii) DFDs may be **partitioned into levels** that represent increasing information flow and functional detail.

The four major DFD component's symbols are:
(a) Entity: The source or destination of data. (Rectangles)
(b) Process: Process names usually describe the transformation (Submit payment). (Circles or a segmented rectangle with process name and process number)
(c) Data Store: Where a process stores data between processes for later retrieval. Data store names = Simple but meaningful, E.g. "Customers" (Rectangle - Right hand side missing)
(d) Data Flow: Movement of data between entity, process and data store. Interface between the components of the DFD. Named to reflect the nature of the data used (Arrow)

Logical Data Flow Diagram: Focuses on how the business operates. It describes the business events that take place and the data required and produced by each event.

Physical Data Flow Diagram: Shows how the system will be implemented. (Depicts system)

Advantages of using Data Flow Diagram:
• It aids in **describing the boundaries** of the system.
• It is beneficial for **communicating existing system knowledge** to the users.
• **Easy to recognize & understand** (Even by non technical person)
• Provides a **detailed representation of system** components.
• It is used as the part of **system documentation file**.
• **Explains the logic** behind the data flow within the system.

Limitations of using Data Flow Diagram:
• It makes the programmers little **confusing**.
• It **takes a long time** to create (Analyst may not receive support to complete it)
• **Physical considerations are left out**.

(3) Flowchart:
(i) Diagram **prepared by programmer, that shows sequence of steps** in solving a problem
(ii) **Illustrates the logic** followed in the program

(iii) It allows the programmer to **compare different alternatives on paper**
(iv) Helps the programmer **avoid fuzzy thinking and accidental omissions**

Types of Flowchart:
(i) Document Flowchart: Traces the physical flow of documents through an organization
(ii) System Flowchart: Depicts electronic flow of data & processing in an IS.
(iii) Program Flowchart: It is most detailed and is concerned with the logical/arithmetic operations on data within the CPU and the flow of data between the CPU and the input/output peripherals.

Advantages of using Flowchart:
(i) Quicker grasp of relationships
(ii) Effective Analysis
(iii) Aid in Communication
(iv) Serves as good documentation
(v) Efficient coding.
(vi) Orderly check out of problem
(vii) Efficient program maintenance

Limitations of using Flowchart:
(i) Complex logic
(ii) Modification (Re-drawing)
(iii) Reproduction (cannot be typed)
(iv) Link between conditions and actions (difficult to establish)
(v) Standardization (Neither a natural way of expressing procedures nor easy to put into Programming language)

(4) Decision Tree: (Inference or Logical tree)
(i) It is a collection of conditions and actions.
(ii) It is tree-like representation + conditions & actions are shown as nodes + branches of the tree connect them.
(iii) Logical operators "AND" & "OR" are used to replicate the structure of the if-then rules.
(iv) Powerful form of multiple variable analyses.

Advantages of using Decision Tree:
- Simple to understand and interpret.
- Possible scenarios can be added.
- Worst, best and expected values can be determined.

Limitations of using Decision Tree:
- Information in decision trees are biased in favor of those attributes with more levels.
- Becomes complex if many values are uncertain and/or if many outcomes are linked.

Decision Table:

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

A Decision Table is divided into four parts:

i. **Condition Stub** - Comprehensively lists the conditions;

ii. **Action Stub-** Comprehensively lists the actions;

iii. **Condition Entries** - lists the possible permutations of answer to the questions in the conditions stub; and

iv. **Action Entries -** lists, actions contingent upon the set of answers to questions of that column.

Advantages of using Decision Table:

(i) Easy to Draw
(ii) Compact Documentation
(iii) Simple to understand
(iv) Direct Codification
(v) Better Analysis
(vi) Modularity

Limitations of using Decision Table:

(i) All programmers may not be familiar with Decision Tables
(ii) Flowcharts can better represent a simple logic of the system rather than a decision table
(iii) The decision tables do not express the sequence of the events needed to solve problem

Unit 2: Information Systems and IT Fundamentals

Audit Objectives: General objectives of auditing in a computerized environment could include the following objectives:

- Existence
- Valuation
- Compliance
- Assisting management
- Check resource efficiency
- Authorization
- Cutoff
- Operational
- Control Design
- Goal

IT processes usually involved in a typical business enterprise:

- Database access and changes
- File replication and data backup
- Systems and event log monitoring
- Job scheduling
- Application integration
- File transfers
- Printing

BPA solutions - three critical pillars:

- Integration
- Orchestration
- Automation

Five sub-disciplines of the computing field:

(a) Computer Science: It refers to the scientific and practical approach to computation and its applications.

(b) Computer Engineering: It refers to the discipline that integrates several fields of electrical engineering and computer science required to develop computer hardware and software.

(c) Information System (IS): It refers to the study of complementary networks of hardware and software that enterprises, employees or individuals use to collect, process, create, store and distribute data.

(d) Information Technology (IT): Information Technology is defined as "the study, design, development, application, implementation, support or management of Computer-Based Information Systems"

(e) Software Engineering: It refers to the application of a systematic, disciplined approach to the design, development, operation, and maintenance of software.

Server: From a hardware perspective, a server is a computer on a network dedicated to run one or more services (as a host), to serve the needs of the users of other computers. A server can also be a computer program running to serve the requests of other programs.

Types of Servers:

- **File server:** (Storage device)
- **Print server:** (Manages one or more printers)
- **Network server:** (Manages network traffic)
- **Database server:** (Processes database queries)
- **Application Server:** (Handles all application operations between users and an enterprise's backend business applications)
- **Web Servers:** Web servers are computers that deliver (serves up) web pages. Every web server has an IP address and possibly a domain name.
- **Mail Server**: (Move and store mail over corporate networks)

Computing Architecture: Computer Architecture can be defined as the science and art of selecting and interconnecting hardware components to create computers that meet functional, performance and cost goals.

(1) Instruction Set Architecture (ISA): Instruction set is the set of machine code instructions that the processor can carry out. These instruction set tells the processor to carry out various calculations, to read and write values from and into the memory

- **Complex Instruction Set Computer (CISC**):

(i) 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. (Pentium processors)

(ii) CISC chips have a large, variable length and complex instructions and generally make use of complex addressing modes.

- **Reduced Instruction Set Computer (RISC):**

(i) 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. (IBM RS6000 processor)

(ii) RISC processors use a small and limited number of instructions of fixed length. These consume less power and are having high performance.

(2) Micro Architecture: Micro Architecture (Computer Organization) is a lower level detailed description of the system that is sufficient for completely describing the operation of all parts of the computing system, and how they are inter-connected and inter-operate. It's how everything is ultimately organized on the chip or processor.

- **Computer buses and switches:** Computer Bus is a communication system that transfers data between components inside a computer, or between computers that covers all related hardware components (wire, optical fiber, etc.) and software, including communication protocol.
- **Memory controllers and hierarchies:** The Memory Controller is a digital circuit which manages the flow of data going to and from the main memory and can be a separate chip or integrated into another chip.
- **CPU off-loads mechanisms - Direct Memory Access (DMA):** Direct Memory Access (DMA) is a feature of modern computers that allows certain hardware subsystems within the computer to access system memory independently of the central processing unit (CPU).

• **Multiprocessing** is the use of two or more Central Processing Units (CPUs) within a single computer system to allocate tasks between them.
• **Hardware Virtualization** or Platform Virtualization refers to the creation of a virtual machine that acts like a real computer with an operating system. Software executed on these virtual machines is separated from the underlying hardware resources.

Cloud computing: Cloud computing is the use of various services, such as servers, storage, and software, over the Internet, often referred to as the "cloud"
•**Public Clouds:** The public cloud is made available to the general public. They are administrated by third parties or vendors over the Internet, and services are offered on pay-per-use basis.
•**Private Clouds:** This cloud computing environment resides within the boundaries of an organization and is used exclusively for the organization's benefits. These are also called internal clouds.
•**Community Clouds:** This is the sharing of computing infrastructure in between organizations of the same community.
• **Hybrid Clouds:** It is maintained by both internal and external providers. It is a composition of two or more clouds (Private, Community or Public).

Cloud Computing Architectural Considerations: 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).

Service Models of Cloud Computing:
• **Infrastructure as a Service (IaaS):** It provides clients with access to server hardware, storage, bandwidth and other fundamental computing resources.
• **Software as a Service (SaaS**): It includes a complete software offering on the cloud.
• **Platform as a Service (PaaS):** It provides clients with access to the basic operating software and optional services to develop and use software applications
• **Network as a Service (NaaS):** It is a category of cloud services where the capability provided to the cloud service user is to use network/transport connecting services.
• **Communication as a Service (CaaS):** CaaS has evolved in the same lines as SaaS. CaaS is an outsourced enterprise communication solution that can be leased from a single vender.

Mobile Computing: Mobile Computing, is the use of portable computing devices (such as laptop and handheld computers) in conjunction with mobile communications technologies to enable users to access the Internet and data on their home or work computers from anywhere in the world.
• **Mobile Communication:** Mobile Communication refers to the infrastructure put in place to ensure that seamless and reliable communication goes on.
• **Mobile Hardware:** Mobile Hardware includes mobile devices or device components that receive or access the service of mobility.
• **Mobile Software:** Mobile Software is the actual program that runs on the mobile hardware.

Business Applications of Mobile Computing: Mobile devices provide the capability to conduct business anywhere and enable users to seamless communicate and access information whether they are in the office or anywhere.

- There is increase in workforce productivity
- Customer service can be improved
- Incident management can be improved
- Business processes can be transformed
- Enterprises can dynamically modify and update their offerings
- Mobile computing gives users the freedom to roam

Mobile Computing Concerns:

Major concerns relating to mobile computing are given as follows:

- Security concerns
- Dangers of misrepresentation
- Power consumption
- Potential health hazards

Layers of information system:

(1) Application Software: Application software includes all those computer software that cause a computer to perform useful tasks beyond the running of the computer itself.

- **Application Suite**: Has multiple applications bundled together. E.g. MS Office 2010
- **Enterprise Software:** Addresses enterprise's needs in a distributed environment. E.g. SAP.
- **Enterprise Infrastructure Software:** Provides capabilities required to support enterprise software systems. E.g. Email servers, Security software.
- **Information Worker Software (Customized Software)**: Addresses individual needs within departments. E.g. Spreadsheets
- **Content Access Software**: Used to access contents. E.g. Media Players, Adobe Digital etc
- **Educational Software:** Holds contents adopted for use by students. E.g. Examination Test
- **Media Development Software:** Addresses individual needs to generate and print electronic media for others to consume. E.g. Desktop Publishing, Video Editing etc

Benefits:

- Addressing User needs
- Less threat from virus
- Regular updates

Disadvantages:

- Development is costly
- Infection from Malware

(2) Hardware: Hardware is the tangible portion of our computer systems; something we can touch and see. It basically consists of devices that perform the functions of input, processing, data storage and output activities of the computer.

(i) Input devices

(ii) Processing devices: Include computer chips that contain the Central Processing Unit and main memory. **It consists of three functional units:**

- **Control Unit (CU):** Controls the flow of data and instruction to and from memory, and controls which tasks to execute and when.

• **Arithmetic and Logical Unit (ALU):** Performs arithmetic operations & logical comparison
• **Registers**: High speed memory units for storing small amount of data (32/64 bits).
Registers could be:
Accumulators: They can keep running totals of arithmetic values.
 # Address Registers: They can store memory addresses
 # Storage Registers: They can temporarily store data that is being sent or coming.
 # Miscellaneous: These are used for several functions for general purpose.

(iii) Data Storage Devices:
(a) Internal memory: Registers are internal memory within CPU, (very fast and very small)
(b) Primary Memory: These are devices in which any location can be accessed in any order.
These are primarily of two types:
Random Access Memory (RAM)
- ✓ This is Read Write memory.
- ✓ Information can be read as well as modified.
- ✓ Volatile in nature means Information is lost as soon as power is turned off.

Read Only Memory (ROM)
- ✓ This is non volatile in nature (contents remain even in absence of power).
- ✓ These are used to store small amount of information for quick reference by CPU.
- ✓ Information can be read not modified.
- ✓ Generally used by manufacturers to store data & programs

(c) Cache Memory: There is a huge speed difference between Registers and Primary Memory. In order to bridge these speed differences, we have cache memory.
(d) Virtual Memory: Virtual Memory is in fact not a separate device but an imaginary memory area supported by some operating systems. If a computer lacks the Random Access Memory (RAM) needed to run a program or operation, Windows uses virtual memory to compensate. When RAM runs low, virtual memory moves data from RAM to a space called a paging file (temporary space on the hard disk
(e) Secondary Memory: Non- volatility (Contents are permanent in nature),
Greater capacity (they are available in large size),
Greater economy (the cost of these is lesser compared to register and RAMs)
Slow speed (Slower in speed compared to register or primary storage).

(iv) Output Devices: Computers systems provide output to decision makers at all levels in an enterprise to solve business problems, which may be in visual, audio or digital forms.
• Cathode-Ray Tube (CRT)
• Liquid Crystal Display (LCDs)
• Laser Printer
• Ink-jet Printer
• Plotter
• Speakers

(3) System Software: System software is computer software that is designed to operate the computer hardware and to give and maintain a platform for running application software.
Example: Computer Operating Systems.

An Operating System (OS): It is a set of computer programs that manages computer hardware resources and acts as an interface with computer applications programs. Example: Windows 7, Windows 8, Linux, UNIX, etc.

A variety of activities are executed by Operating systems which include:

- Performing hardware functions
- User Interfaces
- Hardware Independence
- Memory Management
- Task Management
- Networking Capability
- Logical access security
- File management

(4) Network Links:

Each of these networks is modeled to address the following basic issues:

- **Routing:** Process of deciding how to communicate data from source to destination.
- **Bandwidth:** Amount of data which can be sent across a network in given time.
- **Resilience:** Ability of a network to recover from any kind of error like connection failure
- **Contention:** Situation that arises when there is a conflict for some common resource.

Important benefits of a computer network:

- Distributed nature of information
- Resource Sharing
- Computational Power
- Reliability
- User communication

(5) Database Management Systems (DBMS): Every enterprise needs to manage its information in an appropriate and desired manner. DBMS are software that aid in organizing, controlling and using the data needed by the application program. (Oracle, SQL)

Database Model Hierarchy:

- **Database:** This is a collection of Files.
- **File:** This is a collection of Records
- **Record:** This is a collection of Fields.
- **Field**: This is a collection of Characters.
- **Characters:** These are a collection of Bits.

Hierarchical Database Model: Records are logically organized into a hierarchy of relationships in an inverted tree pattern. All records in hierarchy are called nodes and are related to the others in a parent-child relationship. Each parent record may have one or more child records, but no child record may have more than one parent record. The top parent record in the hierarchy is called the root record.

Network Database Model: It is built on the concept of multiple branches emanating from one or more nodes. It views all records in sets. Each set is composed of an owner record and one or more member records. However, the network model also permits a record to be a member of more than one set at one time.

Relational Database Model: A relational database allows the definition of data and their structures, storage and retrieval operations and integrity constraints that can be organized in a table structure. A table is a collection of records and each record in a table contains the same fields.

Three key terms are used extensively in relational database models:

Relations: A relation is a table with columns and rows

Attributes: The named columns of the relation are called attributes

Domains: The set of values the attributes are allowed to take.

Some basic rules to qualify as relations:

1. The ordering of columns is immaterial in a table
2. There can't be identical record in a table.
3. Each record will contain a single value for each of its attributes

Object Oriented Data Base Model: In these databases, the data is modeled and created as objects. It is based on the concept that the world can be modeled in terms of objects and their interactions. An Object-oriented database provides a mechanism to store complex data such as images, audio and video, etc. An **object-oriented database management system (OODBMS)** helps programmers make objects created in a programming language behave as a database object.

Advantages of a DBMS:

- Permitting data sharing
- Minimizing Data Redundancy
- Integrity can be maintained
- Program and file consistency
- User-friendly
- Improved security
- Achieving program/data independence
- Faster application development

Disadvantages of a DBMS:

- Cost
- Security

Information System Life Cycle: This is commonly referred as Software/System Development Life Cycle (SDLC), which is a methodology used to describe the process of building information systems.

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

- Technical Feasibility
- Economical Feasibility
- Legal Feasibility
- Operational Feasibility
- Schedule feasibility

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

The Systems Analyst will (Role):
• Examine data and information flows in the enterprise using data flow diagrams;
• Establish what the proposed system will actually do (not how it will do it);
• Analyze costs and benefits;
• Outline system implementation options. (e.g. in-house or using consultants);
• Consider possible hardware configurations; and
• Make recommendations.

Phase 3: System Designing: Examines **'How will the Information System do what it must do to obtain the solution to the problem'?**
This phase specifies the technical aspects of a proposed system in terms of:
•Hardware platform
•Software
•Outputs
•Inputs
•User interface
•Modular design
•Test plan
•Conversion plan
•Documentation

Phase 4: System Implementation: Examines **'How will the Solution be put into effect'?**
This phase involves the following steps:
• Coding and testing of the system;
• Acquisition of hardware and software; and
• Either installation of the new system or conversion of the old system to the new one.

Phase 5: System Maintenance and Review: Evaluates results of solution and modifies the system to meet the changing needs.
System maintenance could be with following different objectives:
• **Perfective Maintenance**
• **Adaptive Maintenance**
• **Corrective Maintenance**

Recent Technologies/Devices:
(1) Bluetooth
(2) Wi-Fi
(3) Laptop: Notebook
(4) Tablet Computer or Tablet
(5) Smart Phone
(6) Touchpad
(7) iPad
(8) iPod
(9) Ultra-Mobile PC (UMPC)
(10) Android

Unit 3: Telecommunication and Networks

The Business Value of Telecommunications: (Strategic capabilities of Internet)

- ♦ Overcome geographic barriers
- ♦ Overcome time barriers
- ♦ Overcome cost barriers
- ♦ Overcome structural barriers

Telecommunication Network:

A Telecommunication Network is a collection of terminal nodes, intermediate terminal nodes & links which are connected so as to enable telecommunication between the terminals.

The advantages (benefits) of a computer network in an organization:

(i) File Sharing
(ii) Resource Sharing
(iii) Remote Access
(iv) Shared Databases
(v) Fault Tolerance
(vi) Internet Access and Security

Telecommunication Network Model:

(A) Terminals: (Starting and stopping points) Input or output device that is used to transmit or receive data can be classified as a terminal component.

(B) Telecommunication Processors: Support data transmission and reception (Provide a variety of control and support functions). They include:

(i) Network Interface Card (NIC): Computer hardware component that connects a computer to a computer network. It has additional memory for buffering incoming and outgoing data packets, thus improving the network throughput.

(ii) Modems: Device that converts a digital computer signal into an analog telephone signal (i.e. it modulates the signal) and converts an analog telephone signal into a digital computer signal (i.e. it demodulates the signal) in a data communication system.

(iii) Multiplexers: Allows a single communications channel to carry simultaneous data transmissions from many terminals. (Merges & separate)

(iv) Internetwork Processors: Telecommunications networks are interconnected by special - purpose communications processors called internetwork processors.

- **Switch:** Makes connections between telecommunications circuits in a network so that a telecommunications message can reach its intended destination.
- **Router**: Interconnects networks based on different rules or protocols, so that a telecommunications message can be routed to its destination.
- **Hub:** (Port-switching communications processor) Allows for the sharing of the network resources such as servers, LAN workstations, printers, etc.
- **Bridge:** Connects numerous LANs. It magnifies the data transmission signal while passing data from one LAN to another.
- **Repeater:** Boosts or amplifies the signal before passing it to the next section of cable.
- **Gateway**: Connects networks that use different communication architectures.

(C) Telecommunication Media/Channel: Connects message source with message receiver

(i) Guided Media/Bound Media: Uses a "cabling" system that guides the data signals along a specific path.

• **Twisted-Pair Wire:** Ordinary telephone wire, consisting of copper wire twisted into pairs.

- It is the most widely used media for telecommunications (voice and data transmissions)

Disadvantages: Susceptible to electrical interference. Signals must be "refreshed" every 1 to 2 miles through the use of repeaters, which are expensive and does not offer security.

• **Coaxial Cable:** Consists of copper or aluminum wire wrapped with spacers to insulate and protect it.

- Insulation minimizes interference of the signals.
- Carry a large volume of data and allows high-speed data transmission
- It is used extensively in office buildings for local area networks.
- The only disadvantage of coaxial cable is that it is more expensive than twisted pair.

• **Fiber Optics:**

- Consists of one or more hair-thin filaments of glass fiber wrapped in a protective jacket.
- Signals are converted to light form and fired by laser in bursts.
- Optical fibers can carry digital as well as analog signals and provides increased speed and greater carrying capacity than coaxial cable and twisted-pair lines.
- It is not affected by electromagnetic radiation/electronic noise and so it has much lower error rates than twisted-pair and coaxial cable.
- Speed of communications is 10,000 times faster than that of microwave and satellite.
- Disadvantage of using fiber optic cable is that installation can be difficult and costly.

(ii) Unguided Media/Unbound Media: Consists of a means for the data signals to travel but nothing to guide them along a specific path.

• **Terrestrial Microwave:** Transmit high-speed radio signals in a line-of-sight path between relay stations spaced approximately 30 miles apart using the atmosphere as the medium

- Used extensively for high-volume/long-distance communication of both data and voice.
- Disadvantage: it cannot bend around the curvature of the earth.

• **Radio Waves:** Invisible form of electromagnetic radiation that varies in wavelength from around a millimeter to 100,000 km (widest ranges). Radio waves are most commonly used transmission media in the wireless Local Area Networks.

• **Micro Waves:** Radio waves with wavelengths ranging from as long as one meter to as short as one millimeter, with frequencies between 300 MHz and 300 GHz.

• **Infrared Waves:** Used in industrial, scientific, and medical applications.

- Night-vision devices using infrared illumination allow people or animals to be observed without the observer being detected.
- Infrared tracking, **(Infrared Homing)** refers to a passive missile guidance system.

• **Communication Satellites:**

- A satellite is some solar-powered electronic device that receives, amplifies, and retransmits signals using atmosphere; the satellite acts as a relay station between satellite transmissions stations on the ground.
- Cost effective method for high-volume + long-distance communication (data and voice)
- Very expensive to develop and place in orbit and have an age limit of 7-10 years.
- Signals weaken over long distances + weather conditions & solar activity = noise interference.
- Anyone can listen in on satellite signals, so sensitive data must be sent in encrypted, form.

(D) Computers: They include Host Computers (mainframes), Front-End Processors (minicomputers) and Network Servers (microcomputers).

(E) Telecommunication Control Software: Programs that control telecommunications activities and manage the functions of telecommunications networks.
Examples of major network management functions include:
(a) Traffic management
(b) Security
(c) Network monitoring
(d) Capacity planning

Classification of Telecommunication Networks:
(I) Area Coverage Based Classification:
(A) Local Area Network: Telecommunications networks that connect information-processing devices within a limited physical area such as Offices, Classrooms, Buildings, etc.
- Provides high speed data transfer and is relatively inexpensive.
Characteristics of LANs include the following:
- LANs **use a variety of telecommunications media**
- To **communicate** over the network, a PC uses a **network interface card**.
- Most LANs **use powerful microcomputer** with large disk capacity as file or network server.
- **Allow end users in a workgroup to communicate** electronically; share hardware, software, and data resources; and pool their efforts when working on group projects.
Services LAN provides:
(i) Security
(ii) Expanded PC usage through inexpensive workstation
(iii) Distributed processing (Share load)
(iv) Electronic mail and Message Broadcasting
(v) Organizational Benefits (Reduce Cost)
(vi) Data management benefits
(vii) Software cost reduction and easy up-gradation

(B) Metropolitan Area Network (MAN): Used to refer to networks which connect local area networks within a metropolitan area (roughly 40 km). (Cable television networks)

(C) Wide Area Network (WAN): Telecommunications networks that cover large geographic areas with various communication facilities such as long distance telephone service, satellite transmission, and under-sea cables. Although sometimes it might be confined within the bounds of a state or country. Examples: Interstate banking networks and airline reservation systems. The Internet is an example of a world-wide public WAN.

(II) Functional Based Classification:
(A) Client-Server Networking: This partitions tasks or workloads between the providers of a resource or service, called servers, and service requesters, called clients.
- Computer network in which one centralized powerful computer (called Server) is connected to many less powerful PCs (called Clients)
- The clients run programs and access data that are stored on the server.

Client: Single-user workstation that provides a presentation services and the appropriate computing, connectivity and the database services relevant to the business need.
(i) Fat / Thick Client: A fat client is a client that performs the bulk of any data processing operations itself, and the server is accessed primarily for storage purposes.
- Fat clients often are not well-suited for public environments
- Example of fat client – Personal Computer.
(ii) Thin Client: Generally only presents processed data provided by an application server
- There is little hardware and software installed on the user's machine (Clients).
- A device using web application (such as Office Web Apps) is a thin client.
(iii) Hybrid Client: Mixture of the above two client models.
- This approach offers features from both the fat client (multimedia support, high performance) and the thin client (high flexibility).
- Hybrid clients are well suited for video gaming.
Server: A server is one or more multi-user processors with shared memory providing computing, connectivity and the database services relevant to the business need.
Middleware: Middleware is the software needed to for clients & servers to interact. (Helps in Communication, directory services, queuing, distributed file sharing, and printing)

Characteristics of C/S architecture are as follows:
• Service
• Shared Resources
• Transparency of Location
• Mix and Match (Independent of hardware or operating system software platform)
• Scalability
• Integrity

Issues in Client / Server Network:
(i) When the server crashes, all the computers connected to it become unavailable to use.
(ii) Simultaneous access to services by the user takes more time for server to process.

(B) 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 computers are called peers because each one can alternately act as a client to another peer, fetching its content, and as a server, providing content to other peers.
- P2P networks handle a very high volume of file sharing traffic by distributing the load.
Advantages:
(i) Easy and simple to set up and only require a Hub or a Switch
(ii) Cost effective.
(iii) If one computer fails to work, all other computers connected to it continue to work.
Disadvantages:
(i) There can be problem in accessing files if computers are not connected properly.
(ii) It does not support connections with too many computers as the performance gets degraded in case of high network size.
(iii) The data security is very poor in this architecture.

(C) Multi-Tier Architecture:

(a) Single Tier Systems/ One-Tier Architecture: A single computer that contains a database and a front-end (GUI) to access the database.

Advantages:

- Requires only one stand-alone computer.
- It also requires only one installation of proprietary software (cost- effective)

Disadvantages:

- It can be used by only one user at a time.
- Impractical for an organization which requires two or more users to interact with the organizational data stores at the same time.

(b) Two Tier Systems/ Two Tier Architecture: Consists of a client and a server (database is stored on the server, and the interface used to access the database is installed on the client)

Advantages:

- Performance is higher because business logic and database are physically close.
- Since processing is shared between client & server, more users could interact with system.

Disadvantages:

- Performance deteriorates if number of users increases.
- There is restricted flexibility and choice of DBMS

(c) Three Tier Architecture:

i. Presentation Tier: Occupies the top level and displays information.

ii. Application Tier: Also called the middle tier / logic tier. Performs detailed processing

iii. Database Tier: Houses the database servers where information is stored and retrieved.

Advantages:

• Clear separation of user-interface-control and data presentation from application-logic
• Dynamic load balancing
• Change management

Disadvantages:

• Increased need for network traffic management, server load balancing and fault tolerance.
• Current tools are relatively immature and are more complex.
• Maintenance tools are currently inadequate for maintaining server libraries.

(III) Ownership-based Classification

(A) Public Data Network: Network shared and accessed by users not belonging to a single organization. It is a network established and operated by recognized private operating agency, for providing data transmission services for the public.

- The Internet is an example of a Public Data Network.

(B) Private Data Network: Provide a dedicated network to continuously receive and transmit critical data. Private networks work fine and are very secure. Intruders have to physically wiretap the lines to break in, which is not easy to do. But it is too expensive.

(C) Virtual Private Networks (VPN): A VPN is a private network that uses a public network (usually the Internet) to connect remote sites or users together.

- They 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.
- By using a VPN, businesses ensure security – anyone intercepting the encrypted data can't read it.

Centralized Computing: Computing done at a central location. If one terminal breaks down, the user can go to another terminal and log in again, and all of their files will be accessible.

Advantages:

♦ Ease of management
♦ Enhanced security
♦ Ease of control
♦ Reduced cost of ownership

Disadvantages:

♦ In case of failure of central computer, the entire system will go down.
♦ Empowerment of the central computer should be adequate, else the usage suffers

Decentralized Computing: Allocation of resources, both hardware and software, to each individual workstation, which are capable of running independently of each other. Enable file sharing, peripherals sharing.

Advantages are as follows:

♦ Utilizes the potential of desktop systems to maximize the potential performance.

Disadvantages are as follows:

♦ All computers have to be updated individually with new software.

Network Topology: Physical or logical arrangement of links in a network. It is the geometric representation of the relationship of all the links and linking devices.

(A) Star network: Involves a central unit that has a number of terminals tied into it.
The central unit in the star network acts as the traffic controller.
The central computer is usually a mainframe (host), which acts as the file server.
Suited to companies with one large data processing facility shared by a no. of departments

Advantages:

♦ Several users can use the central unit at the same time.
♦ It is easy to add new nodes and remove existing nodes.
♦ A node failure does not bring down the entire network.
♦ It is easier to diagnose network problems through a central hub.

Disadvantages:

♦ The whole network is affected if the main unit “goes down”.
♦ Considered less reliable than a ring network
♦ Cost of cabling the central system and points of the star network together are very high.

(B) Ring Topology: Local computer processors are tied together sequentially in a ring with each device being connected to two other devices.
A ring network has a decentralized approach.
When one computer needs data from another computer, the data is passed along the ring.
Considered more reliable and less costly than star networks

Advantages are as follows:

♦ Neither require a central computer to control activity nor does it need a file server.
♦ Each computer connected to the network can communicate directly with the other.
♦ Ring networks offer high performance for a small number of workstations or for larger networks where each station has a similar workload.
♦ Ring networks can span longer distances than other types of networks.

Disadvantages are as follows:
♦ Relatively expensive and difficult to install.
♦ Failure of one computer on the network can affect the whole network.
♦ It is difficult to troubleshoot a ring network.
♦ Adding or removing computers can disrupt the network.

(C) Bus Network: A single length of cable connects a number of computers. All communications travel along this cable, called bus. They have a decentralized approach.
Advantages:
♦ There is no host computer which makes bus network reliable, easy to use and understand.
♦ If one of the microcomputers fails, it will not affect the entire network.
♦ Requires the least amount of cable and therefore is less expensive.
♦ Is easy to extend. A repeater can also be used to extend a bus configuration.
Disadvantages are as follows:
♦ Heavy network traffic can slow a bus considerably as networks do not coordinate when information is sent. Computers interrupting each other can use a lot of bandwidth.
♦ Each connection between two cables weakens the electrical signal.
♦ Can be difficult to troubleshoot.

(D) Mesh Topology: Random connection of nodes using communication links.
- In fully interconnected topology, each node is connected by a dedicated point to point link.
- The reliability is very high as there are always alternate paths available.
- Fully connected networks are not very common because of the high cost.
- Military installations, which need high degree of redundancy, may have such networks.

Advantages are as follows:
♦ Greatest redundancy: If one nodes fails, the network traffic can be redirected to another.
♦ Network problems are easier to diagnose.
Disadvantages are as follows:
♦ Installation and maintenance cost is very high.

Digital Data Transmission: A given transmission of data on a communication channel between two machines can be accomplished either in **Parallel mode** or **Serial mode**.

	Serial Transmission	Parallel Transmission
1	Data bits are transmitted serially one after another.	Data bits are transmitted simultaneously.
2	Data is transmitted over a single wire.	Data is transmitted over 8 different wires.
3	It is a cheaper mode of transferring data.	It is relatively expensive mode of transferring data.
4	It is useful for long distance data transmissions.	Not practical for long distance communications as cross talk may occur.
5	It is relatively slower.	It is relatively faster.

There are two basic ways of transmitting serial binary data that addresses the problem of sequencing and re-arranging of data at receiver end:

	ASYNCHRONOUS TRANSMISSION	SYNCHRONOUS TRANSMISSION
1	Each data word is accompanied by Start and Stop bits.	Allows characters to be sent down the line without Start-Stop bits.
2	Extra Start and Stop bits slow down the transmission process relatively.	Transmission is faster as in absence of Start and Stop bits, many data words can be transmitted per second.
3	It is relatively cheaper as it requires less hardware.	The synchronous device is more expensive to build as it must be smart enough to differentiate between the actual data and the special synchronous characters.
4	More reliable	Chances of data loss are relatively higher.
5	It is less efficient as it is relatively more complex.	It is more efficient and has greater throughput.

Transmission Mode: Used to define the direction of signal flow between two linked devices.

♦ **Simplex:** The data flows in only one direction (ie.. unidirectional) from the transmitter to the receiver. For example, Keyboards can only introduce input

♦ **Half-Duplex:** The data flows in one direction or the other, but not both at the same time. For example: Walkie Talkie. The entire capacity of a channel is taken over by whichever of the two devices transmitting data at the time.

♦ **Full-Duplex:** The data flow in both directions simultaneously, which means that the bandwidth is divided in two for each direction of data transmission if the same transmission medium is used for both directions of transmission. For example: Mobile Phone.

Transmission Techniques:

♦ **Broadcast Networks:** Data transmitted by one node is received by many, sometimes all.

- Method of transferring message to all recipients simultaneously. Example – Live television

♦ **Switched Networks:** The 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.**

♦ **Circuit Switching:** Establishes a fixed bandwidth circuit between nodes and terminals before the users may communicate. The route is dedicated and exclusive and released only when the communication session terminates. (Home phones). Three phases: Establish a Circuit, Transfer of data and Disconnect the Circuit.

♦ **Packet Switching:** The entire message is broken down into smaller transmission units called packets. The switching information is added in the header of each packet and transmitted independently. It is easier for intermediate networking devices to store smaller size packets. Since, there is no fixed path, different packets can follow different path and thus they may reach to destination out of order. Eg Text Message

♦ **Message Switching/ Store-and-Forward:** As a message is routed from its source to its destination, each intermediate switch within the network stores the entire message, providing a very reliable service. Therefore, each intermediary node within the network must store all messages before retransmitting them one at a time as proper resources become available. (Electronic mail)

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.

Protocols: Protocols 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. Allows heterogeneous computers to talk to each other

- At the most basic level, protocols define the physical aspects of communication (Voltage)
- At higher levels, protocols define the way that data will be transferred
- At still higher levels, protocols can standardize the way data itself is encoded

A protocol defines the following three aspects of digital communication:

(a) Syntax: The format of data being exchanged

(b) Semantics: Type and order of messages used

(c) Timing: Defines data rate selection

OSI Model: ISO developed OSI model as a standard model for network architectures

♦ **Layer 7 or Application Layer:** This layer is closest to the end user and interacts with software applications and provides user services by file transfer, file sharing, etc.

♦ **Layer 6 or Presentation Layer:** Also referred as Syntax Layer, this layer is usually a part of an operating system that converts incoming and outgoing data from one presentation format to another.

♦ **Layer 5 or Session Layer:** This layer sets up, coordinates, and terminates conversations; exchanges and dialogs between the applications at each end.

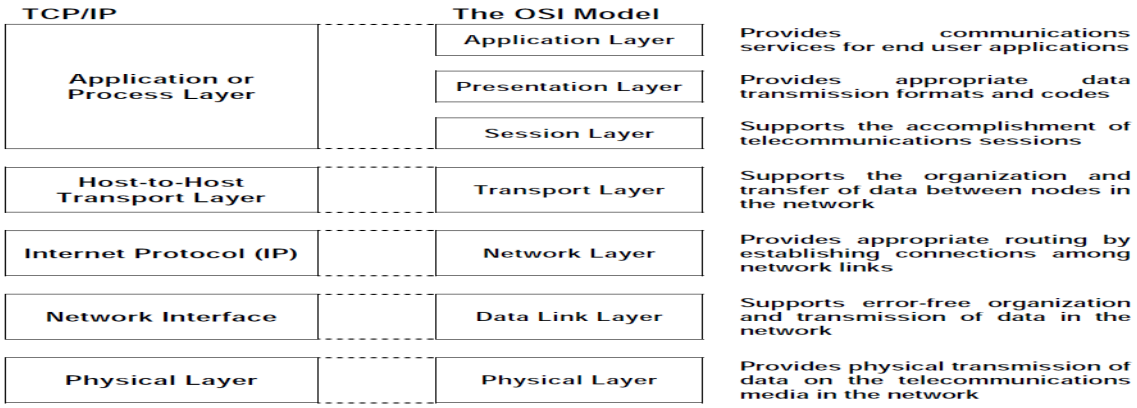
♦ **Layer 4 or Transport Layer:** This layer ensures reliable and transparent transfer of data between user processes

♦ **Layer 3 or Network Layer:** The Network Layer provides the functional and procedural means of transferring variable length data from a source to a destination via one or more networks, while maintaining the quality of service requested by the Transport Layer.

♦ **Layer 2 or Data Link Layer:** The Data Link Layer responds to service requests from the Network Layer and issues service requests to the Physical Layer.

♦ **Layer 1 or Physical Layer:** The Physical Layer is a hardware layer which specifies mechanical features as well as electromagnetic features of the connection between the devices and the transmission.

Internet's TCP/IP: The Internet uses a system of telecommunications protocols that has become so widely used that it is equivalent to network architecture. TCP/IP is used by the Internet and by all Intranets and extranets.



Threat: A Threat is a possible danger that can disrupt the operation, functioning, integrity, or availability of a network or system.

♦ **Unstructured Threats:** (Originate from inexperienced individuals more out of curiosity than with a malicious intent in mind)

♦ **Structured Threats:** (Originate from individuals who are highly motivated and technically competent)

♦ **External Threats**

♦ **Internal Threats**

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

♦ Timing Windows: (Temporary file)

♦ Insecure default configurations

♦ Trusting Untrustworthy information:

♦ End users

Security programs involve the following eight steps –

(i) Preparing project plan for enforcing security

(ii) Asset identification

(iii) Asset valuation

(iv) Threat identification:

(v) Threats probability of occurrence assessment

(vi) Exposure analysis:

(vii) Controls adjustment

(viii) Report generation outlining the levels of security to be provided for individual systems, end user, etc

Privacy: This means that the sender and the receiver expect confidentiality. The transmitted message should make sense to only the intended receiver. This is achieved by cryptography and encryption techniques

Cryptography: Cryptography is the practice and study of techniques for secure communication in the presence of third parties (called Adversaries).

Encryption: In Cryptography, encryption is the process of encoding messages (or information) in such a way that eavesdroppers or hackers cannot read it, but only authorized parties can. Decryption is defined as the recovery of the original message from the encrypted data.

Plaintext: It is the message that is to be encrypted.

CipherText: It is the output of the encryption process.

Network Security Protocols: ♦ **SSH:** Secure Shell is a program to log into another computer over a network, to execute commands in a remote machine. It provides strong authentication and secure communications over insecure channels. During SSH login, the entire login session, including transmission of password, is encrypted; therefore it is almost impossible for an outsider to collect passwords.

♦ **SFTP:** The SSH File Transfer Protocol is a computing network protocol for accessing and managing files on remote file systems.
♦ **HTTPS:** HyperText Transfer Protocol Secure (HTTPS) is a communications protocol for secure communication over a computer network, with especially wide deployment on the Internet. The security of HTTPS uses long term public and secret keys to exchange a short term session key to encrypt the data flow between client and server.
♦ **SSL:** (Secure Socket Layer) It is a protocol that provides a secure channel between two machines operating over the Internet or an internal network. SSL is used to secure online credit card transactions system logins, any sensitive information exchanged online etc.

Network Security Techniques:
1. Intrusion Detection System (IDS): Monitors network or system activities for malicious activities and report to Management. Goal: To detect anomalous behavior & misuse.
(i) Network Intrusion Detection (NID): Network Intrusion Detection System is placed on a network to analyze traffic in search of unwanted or malicious events on the wire between hosts.
(ii) Host-based Intrusion Detection (HID): Host-based Intrusion Detection systems are designed to monitor, detect, and respond to user and system activity and attacks on a given host.
(iii) Hybrid Intrusion Detection: Hybrid Intrusion Detection systems offer alert notification from both network and host-based intrusion detection devices.
2. Firewall: Firewall is a device that forms a barrier between a secure and an open environment & enforces a boundary between more than one networks.
3. Network Access Control: Network Access Control (NAC) products enforce security policy by granting only security policy–compliant devices access to network assets.
4. Anti – Malware: Anti-malware network tools help administrators identify block and remove malware.
5. Site Blocking: It is a software-based approach that prohibits access to certain Web sites that are deemed inappropriate by management.

Network Management: Network Management refers to the activities, methods, procedures, and tools that pertain to the Operation, Administration, Maintenance, and Provisioning of networked systems.
Activities of Network Management:
♦ **Operation:** Deals with keeping the network up and running smoothly.
♦ **Administration:** Deals with keeping track of resources in the network and how they are assigned.
♦ **Maintenance:** Is concerned with performing repairs and upgrades.
♦ **Provisioning:** It is concerned with configuring resources in the network to support a given service.

FCAPS model of network management: FCAPS is the ISO Telecommunications Management Network model and framework for network management.
(i) Fault Management (ii) Configuration Management
(iii) Accounting Management (iv) Performance Management
(v) Security Management

Internet: The **Internet** is the global computer network, or "information super-high way".
- The Internet developed from a variety of university and government–sponsored computer networks that have evolved and are made up of millions and millions of computers and sub networks throughout the world.
- The Internet is the network that serves as the backbone for the World Wide Web (WWW).
- It has numerous information resources and services.

Intranet: An **Intranet** is a network inside an organization that uses Internet technologies such as web browsers and servers, TCP/IP network protocols, HTML hypermedia document publishing and databases, and so on.

Extranet: Extranets are network links that use Internet technologies to interconnect the intranet of a business with the intranets of its customers, suppliers, or other business partners.

♦ **DSL (Digital Subscriber Line):** DSL reuses the telephone line that connects to our house for digital data transmission. The computer is connected to a device called a DSL modem that converts between digital packets and analog signals, which can pass over the telephone line.

Electronic Commerce: E-Commerce is the process of doing business electronically. It involves the automation of a variety of business-to-business and business-to-consumer transactions through reliable and secure connections.

Benefits of e-Commerce Application and Implementation:
- Reduction in costs to buyers
- Reduction in errors
- Reduction in costs to suppliers
- Reduction in time to complete business transactions
- Creation of new markets
- Faster time to market
- Reduction in inventories and reduction of risk
- Reduction in overhead costs
- Reduction in use of ecologically damaging materials
- Reduction in advertising costs.

Risks involved in e-Commerce:
- Problem of anonymity (Identity)
- 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
- Problem of piracy

Types of e-Commerce:

(a) Business-to-Business (B2B) e-Commerce: B2B refers to the exchange of services, information and/or products from one business to another.

(b) Business-to-Consumer (B2C) e-Commerce: It is defined as the exchange of services, information and/or products from a business to a consumer, as opposed to between one business and another.

Advantages:

(i) Shopping can be faster and more convenient.
(ii) Offerings and prices can change instantaneously.
(iii) Call centers can be integrated with the website.

(c) Consumer-to-Business (C2B) e-Commerce: In C2B e-Commerce model, consumers directly contact with business vendors by posting their project work online so that the needy companies review it and contact the consumer directly with bid.

(d) Consumer-to-Consumer (C2C) e-Commerce: C2C e-Commerce is an Internet-facilitated form of commerce that has existed for the span of history in the form of barte. C2C e-Commerce sites provide a virtual environment in which consumers can sell to one another through a third-party intermediary.

(e) Business-to-Government (B2G) e-Commerce: B2G e-Commerce, also known as e-Government, refers to the use of information and communication technologies to build and strengthen relationships between government and employees, citizens, businesses, non-profit organizations, and other government agencies.

(f) Business-to-Employee (B2E) e-Commerce: B2E e-Commerce, from an intra-organizational perspective, has provided the means for a business to offer online products and services to its employees.

Mobile Commerce: Mobile Commerce or m-Commerce is about the explosion of applications and services that are becoming accessible from Internet-enabled mobile devices. Mobile phones impose very different constraints than desktop computers but they also offer new applications and services.

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)

The industries affected by m-commerce include:

- Financial services
- Telecommunications
- Service/retail
- Information services

Electronic Fund Transfer: Electronic Funds Transfer (EFT) represents the way the business can receive direct deposit of all payments to the company bank account.

- EFT is fast, safe, & Paperless.

These are some examples of EFT systems in operation:

(i) Automated Teller Machines (ATMs)
(ii) Point-of-Sale (PoS) Transactions
(iii) Preauthorized Transfers
(iv) Telephone Transfers

[Also see business value of Internet, Intranet & Extranet]

Unit 4: Business Information Systems

Data v/s Information:

Data is raw and unorganized fact that needs to be processed.	When data is processed, organized, structured or presented in a context so as to make it useful, it is called Information.

System: A group of mutually related & co- operating elements, with a defined boundary, working on reaching a common goal, by taking inputs and producing outputs, in organized transformation process.

Information System: Information System (IS) is a combination of people, hardware, software, communication devices, network and data resources that processes data and information for a specific purpose. The main aim and purpose of each Information System is to convert the data into information which is useful and meaningful, to support operations, management and decision-making.

Four major concepts that can be applied to all types of information systems:
(i) People, hardware, software, and data are four basic resources of information systems;
(ii) Human resources consist of end users and IT specialists; hardware resources involve machines and media; software resources consist of programs and procedures; and data resources include data and knowledge base; and network resources include communications media and networks.
(iii) A process is used to convert data into information for end users;
(iv) Information processes consist of input, processing, output, storage, and control processes.

Business Information System: Business Information Systems (BIS) may be defined as systems integrating information technology, people and business.

Transaction Processing System (TPS): It may be defined as a type of information system that collects, stores, modifies and retrieves the day-to-day data transactions of an enterprise. Examples of such systems would be used in an Airline Reservation Systems.
Transaction Processing Cycle:
(i) Data Entry
(ii) Transaction Processing
(a) Batch processing (b) Real-time processing
(iii) Database Maintenance
(iv) Document and Report Generation
Attributes of TPS:
- Access Control
- Equivalence
- High Volume Rapid Processing
- Trustworthiness

Transactions Processing Qualifiers: In order to qualify as a TPS, transactions made by the system must pass the ACID Test – Atomicity, Consistency, Isolation, Durability

Office Automation Systems (OAS): It is an amalgamation of hardware, software, and other resources used to smooth the progress of communication and augment efficiency. Examples: Word Processing, Electronic mail, Voice Mail, Electronic Calendaring, Video Conferencing, FAX, Imaging

Knowledge Management System (KMS): It refers to any kind of IT system that stores and retrieves knowledge, 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 knowledge:** Explicit knowledge is that which can be formalized easily and as a consequence is easily available across the organization. This type of knowledge is easy to document, transfer and reproduce. Example: Online tutorials, Policy & procedural manuals.
- **Tacit knowledge:** Tacit knowledge, on the other hand, resides in a few often-in just one person and hasn't been captured by the organization or made available to others. It is personal, experimental & context- specific. Example: Hand-on skills, employee experiences.

Information	Knowledge
Information is piecemeal, fragmented and particular.	Knowledge is structured, coherent, and often universal.
Information is timely, transitory, and may even be short-lived.	Knowledge is of enduring significance.
Information is a flow of messages.	Knowledge is a stock, largely resulting from the flow, in the sense that the "input" of information may affect the stock of knowledge by adding to it, restructuring it, or changing it in any way.
Information is acquired by being told.	Knowledge can be acquired by thinking. Thus, new knowledge can be acquired without new information being received.

Management Information System (MIS): It refers to the data, equipment and computer programs that are used to develop information for managerial use. MIS provide decision-makers with preselected types of information generated from data obtained from transaction processing systems.

Decision Support Systems (DSS): It is a computer-based information system that supports business or organizational decision-making activities. A properly designed DSS may be defined as an interactive software-based system intended to help decision makers compile useful information from raw data, documents, personal knowledge & business models to identify and solve problems and make decisions. DSS are there to facilitate a manager in making operational decisions, but the ultimate burden of responsibility lies with the manger.

DSS has four basic components:

(a) The user
(b) One or more databases
(c) Planning languages
(d) Model Base

Executive Information System (EIS): An Executive Information System (EIS) is the nature of Information System used by executives to access and administer the data they entail to make informed business decisions. The EIS in itself is not an instrument, but rather, an infrastructure within a company. It may be defined as just not as a piece of hardware or software, but an infrastructure that supplies to a firm's executives the up-to-the-minute operational data, gathered and sifted from various databases.
Components of an EIS: Hardware, Software, User Interface, Telecommunication

Enterprise Resource Planning (ERP): ERP systems integrate internal and external management information across an entire organization, taking on finance/accounting, manufacturing, sales and service, customer relationship management, etc.
- ERP systems automate this activity with an integrated software application.
- The rationale of ERP is to make easy the flow of information between all business functions in the interior boundaries of the organization and control the connections to exterior stakeholders.

Customer Relationship Management (CRM): CRM may be defined as a business process in which client relationships; customer loyalty and brand value are built through marketing strategies and activities.
- CRM allows businesses to develop long-term relationships with established and new customers while helping modernize corporate performance.
- The main objective is to retain as much loyal customers as one can.

Supply Chain Management (SCM): SCM is a chain that starts with customers and ends with customers. Supply Chain Management 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.
- Supply Chain spans all movement and storage of raw materials, work-in-process, inventory and finished goods from the point of origin to the point of consumption.

Components of SCM:

(a) Procurement/Purchasing	(b) Operations
(c) Distribution	(d) Integration

Human Resource Management Systems (HRMS): It is a software application that merges many human resources functions together with benefits like administration, payroll, recruiting and training, performance analysis and assessment into one parcel.

Key Modules of HRMS are as follows

♦ Workforce Management	♦ Time and Attendance Management
♦ Payroll Management	♦ Training Management
♦ Compensation Management	♦ Recruitment Management
♦ Personnel Management	♦ Organizational Management
♦ Employee Self Service (ESS)	♦ Analytics

Core Banking System (CBS): It may be defined as the set of basic software components that manage the services provided by a bank to its customers through its branches.
- The absolute bank's branches access applications from centralized data centers. All transactions budge through core systems, which, at an absolute minimum, must remain running and responsive during business hours.
- Increasingly, these systems are running 24x7 to support Internet banking, global operations, and real time transactions via ATM, Internet, phone, and debit card.
- Examples of major core banking products include Infosys' Finacle, Nucleus FinnOne and Oracle's Flexcube application.

Accounting Information System (AIS): AIS is defined as a system of collection, storage and processing of financial and accounting data that is used by decision makers. AIS is generally a computer-based method for tracking accounting activity in conjunction with information technology resources.
The key elements that compose the typical Accounting Information System are as follows:
(i) People
(ii) Procedure and Instructions
(iii) Data
(iv) Software
(v) Information Technology Infrastructure
(vi) Internal Controls

Artificial Intelligence: Artificial Intelligence (AI) is the vicinity of computer science focusing on creating machines that can fit into place on behaviors that humans regard as intelligent.
- It is a research field that studies how to comprehend the intelligent human behaviors on a computer.
Some of the commercial applications of AI are as follows:
Decision Support
Information Retrieval
Virtual Reality
Robotics

Expert Systems: ES is a computerized information system that allows non-experts to make decisions comparable to those of an expert.
- The aim of the expert system is to have a team of seasoned specialists holding industry-wide experience who further spread across implementation in field of Defence, Government, Finance, Telecom, and Engineering sectors. **Components of an Expert System:**
(a) Knowledge Base: This includes the data, knowledge, relationships, rules of thumb (heuristics), and decision trees used by experts to solve a particular problem. The knowledge base of expert system encloses both realistic and heuristic knowledge.
(b) Database of Facts: This holds the user's input about the current problem.
(c) Inference Engine: This program contains the logic and reasoning mechanisms that simulate the expert logic process and deliver advice.
(d) Explanation facility: This facility provides the user with an explanation of the logic the Expert System used to arrive at its conclusion.
(e) User Interface: This program allows the user to design, create, update, use and communicate with the expert system.

Business Intelligence:

- Business Intelligence (BI), in simple words, refers to the process of collecting and refining information from many sources, analyzing and presenting the information in useful ways so that users can make better business decisions.
- BI enables managers to see things with more clarity, and empowers them to peek into the possible future.
- Business intelligence systems provide useful information to the user who need it, when they need it.
- BI is comprised of information that contains patterns, relationships, and trends about customers, suppliers, business partners and employees.
- BI can handle large amounts of information to help identify and develop new opportunities.

Business Intelligence Tools:

Business Intelligence tools are a type of software that is designed to retrieve, analyze and report data. Some of the key Business Intelligence tools are given as follows:

- **Simple Reporting and Querying:** This involves using the data warehouse to get response to the query: "Tell me what happened."
- **Business Analysis:** This involves using the data to get response to the query: "Tell me what happened and why."
- **Dashboards:** This involves using the information gathered from the data warehouse and making it available to users as snapshots of many different things with the objective of getting response to the query: "Tell me a lot of things, but without too much effort".
- **Scorecards:** This involves providing a visual representation of the enterprise strategy by taking critical metrics and mapping them to strategic goals throughout the enterprise.
- **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.

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.

These are discussed as follows:

- Identity Management
- Authentication
- Authorization
- Accountability

Approaches to Access Control:

- **Role-based Access Control (RBAC):**

- RBAC largely eliminates discretion when providing access to objects.
- Instead, administrators or automated systems place subjects into roles. Subjects receive only the rights and permissions assigned to those roles.
- When an employee changes jobs, all previous access is removed, and the rights and permissions of the new role are assigned.

• **Rules-based Access Control (RAC):**
- RAC differs from RBAC methods because it is largely context-based.
- RAC, however, also takes into account the data affected, the identity attempting to perform a task, and other triggers governed by business rules.
- A manager, for example, has the ability to approve his/her employees' hours worked.
- However, when s/he attempts to approve his/her own hours, a rule built into the application compares the employee record and the user, sees they are the same, and temporarily removes approval privilege.
- Note that this is dynamic and occurs at the time a transaction is attempted. This also sometimes called dynamic RBAC.

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.

Payment Mechanisms:
A. Credit Cards:
How a Credit Card is processed?
Step 1: Authorization
Step 2: Batching
Step 3: Clearing
Step 4: Funding
To address these growing security concerns and pave the way for uninhibited growth of electronic commerce on the net, the two leading credit card brands, Visa and MasterCard, teamed up some years ago to develop a common standard to process card transactions on the Internet, called the **Secure Electronic Transaction (SET) standard.**

B. Electronic Cheques

C. Smart Cards: Smart cards have an embedded microchip instead of magnetic strip. The chip contains all the information a magnetic strip contains but offers the possibility of manipulating the data and executing applications on the card.
♦ **Contact Cards –** Smart cards that need to insert into a reader in order to work, such as a smart card reader or automatic teller machines.
♦ **Contactless Cards** – Contactless smart cards don't need to be inserted into a reader. Just waving them near a reader is just sufficient for the card to exchange data. This type of cards is used for opening doors.
♦ **Combi/Hybrid Cards –** Combi cards contain both technologies and allow a wider range of applications.

D. Electronic Purses:
- It is very similar to a pre- paid card.

Unit 5: Business Process Automation through Application Software

Applications based on Nature of Processing:
(a) Batch 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.
(b) Online Processing: Data is processed immediately while it is entered, the user usually only has to wait a short time for a response. Example: Games, booking systems
(c) Real-time Processing: Real time processing is a subset of interactive or online processing. Input is continuously, automatically acquired from sensors, which is processed immediately in order to respond to the input in as little time as possible. After the system is finished responding, it reads the next set of input data immediately to process that. This system doesn't need a user to control it, it works automatically. Burglar alarms etc.

Applications based on Source of Application:
(a) Custom-built Application
(b) Packaged Software
(c) Leased application

Applications based on Size and Complexity of Business:
(a) Small and Medium Enterprise (SME) business
(b) Large Business:

Business applications based on Nature of Application:
Accounting Applications
Office Management Software
Compliance Applications
Customer Relationship Management Software
Management Support Software
ERP Software
Product Lifecycle Management Software
Logistics Management Software
Legal Management Software
Industry Specific Applications

Business Process Automation:
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. The idea behind BPA is to allow the organizations to extract maximum benefit by using the available resources to their best advantage, while keeping the operational cost as low as possible.

Objectives of BPA:

- Confidentiality
- Integrity
- Availability
- Timeliness

Benefits of BPA:

- Reducing the Impact of Human Error
- Transforming Data into Information
- Improving performance and process effectiveness
- Making users more efficient and effective
- Making the business more responsive
- Improving Collaboration and Information Sharing
- Cost Saving
- To remain competitive
- Fast service to customers

How to go about BPA?

The steps to go about implementing business process automation are:

Step 1: Define why we plan to implement BPA?	• The answer to this question will provide justification for implementing BPA.
Step 2: Understand the 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 the 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 the necessary BPA.
Step 8: Testing the BPA.	• Before making the process live, the BPA solutions should be fully tested.

A list of generic reasons for going for BPA may include any or combination of the following:

- Errors in manual processes leading to higher costs.
- Payment processes not streamlined, due to duplicate or late payments, missing early pay discounts, and losing revenue.
- Poor debtor management leading to high invoice aging and poor cash flow.
- Not being able to find documents quickly during an audit or lawsuit
- Lack of management understanding of business processes.
- Poor customer service.

Objectives/goals to be achieved by implementing BPA:
When determining goals, remember that goals need to be SMART:
• **Specific:** Clearly defined,
• **Measurable:** Easily quantifiable in monetary terms,
• **Attainable:** Achievable through best efforts,
• **Relevant:** Entity must be in need of these, and
• **Timely:** Achieved within a given time frame.

To decide as to which company/ consultant to partner with, depends upon the following:
• Objectivity of consultant in understanding/evaluating entity situation.
• Does the consultant have experience with entity business process?
• Is the consultant experienced in resolving critical business issues?
• Whether the consultant is capable of recommending and implementing a combination of hardware, software and services as appropriate to meeting enterprise BPA requirements?
• Does the consultant have the required expertise to clearly articulate the business value of every aspect of the proposed solution?

Some of the methods for justification of a BPA proposal may include:
• Cost Savings, being clearly computed and demonstrated.
• How BPA could lead to reduction in required manpower leading to no new recruits need to be hired and how existing employees can be re-deployed or used for further expansion.
• The cost of space regained from paper, file cabinets, reduced.
• Eliminating fines to be paid by entity due to delays being avoided.
• Reducing the cost of audits and lawsuits.
• Taking advantage of early payment discounts and eliminating duplicate payments.
• Ensuring complete documentation for all new accounts.
• New revenue generation opportunities.
• Collecting accounts receivable faster and improving cash flow.
• Building business by providing superior levels of customer service.

Applications that help entity to achieve BPA:
• **TALLY:** It is an accounting application that helps entity to automate processes relating to accounting of transactions. It also helps to achieve automation of few processes in inventory management. The latest version has been upgraded to help user achieve TAX compliances.
• **SAP R/3:** It is ERP software, which allows an entity to integrate its business processes. This is used by most of the large enterprises and covers enterprise automation end-to-end.
• **MS Office Applications:** These are various office automation systems made available by Microsoft Corporation which include MS Word, MS Excel, MS PowerPoint, MS Access, etc. Each of these software help to achieve automation of various tasks in the office.
• **Attendance Systems:** This application helps entity to automate the process of attendance tracking and report generation.
• **Vehicle Tracking System:** A lot of applications have been developed that allow entity to track their goods while in transit. It has features such as GPS based location, GPRS connection based real-time online data-logging and reporting.
• **Automated Toll Collection Systems:** Many toll booths allow users to buy pre-paid cards, where user need not stop in lane to pay toll charges, but just swipe / wave the card in front of a scanner.

• **Department Stores Systems:** Two critical elements for managing departmental stores have been automated in India; they include the billing processes and inventory management.
• **Travel Management Systems:** Many business processes specific to this industry have been automated, including ticket booking for air, bus, train, hotel, etc.
• **Educational Institute Management Systems:** A lot of automation has been achieved, including student tracking and record keeping. ICAI, itself is a good example of this automation.
• **File Management System:** These allow office records to be kept in soft copy and easy tracking of the same.
• **Other Systems:**
The banking systems, the railway reservations systems and stock exchange systems are good examples of business process automations achieved.

Information Processing: The effort to create information from raw data is known as Information Processing.

Manual Information Processing Cycle	**Computerized Information Processing Cycle**
Systems where the level of manual intervention is very high. For example- Evaluation of exam papers, teaching and operations in operation theatres.	Systems where computers are used at every stage of transaction processing and human intervention are minimal.
Include following components:	Include following components:
• Input: Put details in register. • Process: Summarize the information; • Output: Present information to management in the form of reports	• Input: Entering data into the computer; • Process: Performing operations on the data; • Storage: Saving data, programs, or output for future use; and • Output: Presenting the results.

Delivery Channels: Delivery channels refer to the mode through which information or products are delivered to users.

Delivery channels for information include:
• Intranet
• E-mail
• Internal newsletters and magazines;
• Staff briefings, meetings and other face-to-face communications methods;
• Notice boards in communal areas;
• Manuals, guides and other printed resources;
• Hand-held devices; and
• Social networking sites, like Facebook, WhatsApp, etc.
Delivery channels for products include:
• Traditional models, brick and mortar type;
• Buying from a shop;
• Home delivery of products;
• Buying from a departmental store; and
• Buying online, getting home delivery and making cash payment on delivery.

Information Delivery Channel: How to choose one?
• More than just the Intranet
• Understand staff needs & environment
• Traditional Channel need to be formalized

Product Delivery Channels: How to choose one?
- The way customer response is changing the way business operates.
- Customers while going for online shopping find wide range of products.
- The change is so drastic that physical brick and mortar sellers have to bring themselves on internet. The change is other way round also.
- Many online travel sites have opened brick and mortar office in cities and towns, to meet their customers.
- The key words are "convincing" and "capturing" the customer.
- So, any delivery channel shall work till it convinces customer.

Controls in BPA: To ensure that all information that is generated from system is accurate, complete and reliable for decision making, there is a requirement for proper controls.

Control Objectives:
• Authorization
• Completeness
• Accuracy
• Validity
• Physical Safeguards and Security
• Error Handling
• Segregation of Duties

• **Preventive Control:** Which prevent occurrence of an error/fraud, say security guards.
• **Detective Control:** Which capture an error, say audit trail.
• **Corrective Control:** Which correct an error or reduce the loss due to error, say insurance.

The major functions that a senior manager must perform are as follows:
• **Planning:** Determining the goals of the IS 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

Major threats and their control measures:

Threat	Control
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 information systems employees.
Hackers	Strong, logical access controls to mitigate losses from the activities of hackers.

Boundary control techniques include the following:

- Cryptography
- Personal Identification Numbers (PIN)
- Digital Signatures
- Passwords
- Identification Cards (Plastic Cards)
- **Access Controls (Amendment)**

Input Controls:

- Source Document Control
- Batch Controls
- Data Coding Controls
- Validation Controls

Process Controls:

- Run-to-Run Totals
- Reasonableness Verification
- Edit Checks
- Exception Reports
- Existence/Recovery Controls

Output Controls:

- Storage and Logging of Sensitive and Critical Forms
- Logging of Output Program Executions
- Controls over Printing
- Report Distribution and Collection Controls
- Retention Controls
- Existence/Recovery Controls

Database Controls:

- Sequence Check Transaction and Master Files
- Ensure all records on files are processed
- Process multiple transactions for a single record in the correct order

Cloud Computing:
Cloud Computing is the use of various services, such as servers, storage, and software, over the different networks, often referred to as the "cloud."

Characteristics of Cloud Computing:

- Elasticity and Scalability
- On-demand
- Multi Tenancy
- Pay-per-Use
- Resiliency
- Workload Movement

Advantage of Cloud Computing:

- Cost Efficient
- Almost Unlimited Storage
- Backup and Recovery
- Automatic Software Integration
- Easy Access to Information
- Quick Deployment

Disadvantages of Cloud Computing:

- Technical Issues
- Security in the Cloud
- Prone to Attack

Amendments

Access Controls:

- These controls restrict use of computer system resources to authorized users,
- Limit the actions authorized users can take with these resources, and
- Ensure that users obtain only authentic computer system resources.

Auditors concerns about access controls:

- They need to determine how well any access control mechanism safeguards assets and preserves data integrity and
- Given the capabilities of the access control mechanism that are available for any particular application system; auditors must determine whether the access controls chosen for that system suffice.

An access control mechanism processes users' requests for resources in three steps:

Identification: First users identify themselves to the mechanism, thereby indicating their intent to request system resources.

Authentication: It is a two way process wherein users must authenticate themselves, and the mechanism in turn must authenticate itself. That means, not only must the mechanism be sure it has a valid user, users must also be sure that they have a valid mechanism.

Authorization: Users must request specific resources and specify the actions they intend to take with the resources.

Communication Controls:

Components in the communication subsystem are responsible for transporting data among all the other subsystems within a system

Three types of exposure:

(a) As data is transported across a communication subsystem, it can be impaired through delay, distortion, and noise.

(b) The hardware and software components in a communication subsystem can fail.

(c) The communication subsystem can be subjected to passive or active subversive attacks.

Physical Component Controls:

- One way to reduce expected losses in the communication subsystem is to choose physical component that are reliable & mitigate the possible effects of exposures.
- E.g. Transmission Media selection - Bounded (Guided) or Unbounded (Unguided) Media.

Line Error Controls:

- Whenever data is transmitted over a communication line, it can be received in error because of distortion, or noise that occurs on the line.
- Error Detection and Error Correction are the two major approaches under Line Error Controls.

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.
- The simplest form of flow control is "Stop-and-Wait Flow Control" in which the sender transmits a frame of data only when the receiver is ready to accept the frame.

Link Controls:

- This involves two common protocols – HDLC (Higher Level Data Control) and SDLC (Synchronous Data Link Control).

Topological Controls:

- A communication network topology 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.
- These techniques fall into two classes – Polling methods and Contention methods.
- Polling techniques establish an order in which a node can gain access to channel capacity; whereas in Contention methods, nodes in a network must compete with each other to gain access to a channel.

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.
- Three types of devices are used to connect sub-networks in an Internet: Bridge, Router and Gateway.

Virtualization:

- Virtualization means to create a virtual version of a device or resource, such as a server, storage device, network or even an operating system where the framework divides the resource into one or more execution environments.
- Virtualization refers to technologies designed to provide a layer of abstraction between computer hardware systems and the software running on them.
- The core concept of Virtualization lies in Partitioning, which divides a single physical server into multiple logical servers.

For example - Partitioning of a hard drive is considered virtualization because one drive is partitioned in a way to create two separate hard drives.

Major applications of the concepts of the virtualization are given as follows:

- **Server Consolidation:**

- Virtual machines are used to consolidate many physical servers into fewer servers, which in turn host virtual machines.
- This is also known as “Physical-to-Virtual” or 'P2V' transformation.

- **Disaster Recovery:**

- Virtual machines can be used as "hot standby" environments for physical production servers.

- **Testing and Training:**

- Virtualization can give root access to a virtual machine. This can be very useful such as in kernel development and operating system courses.

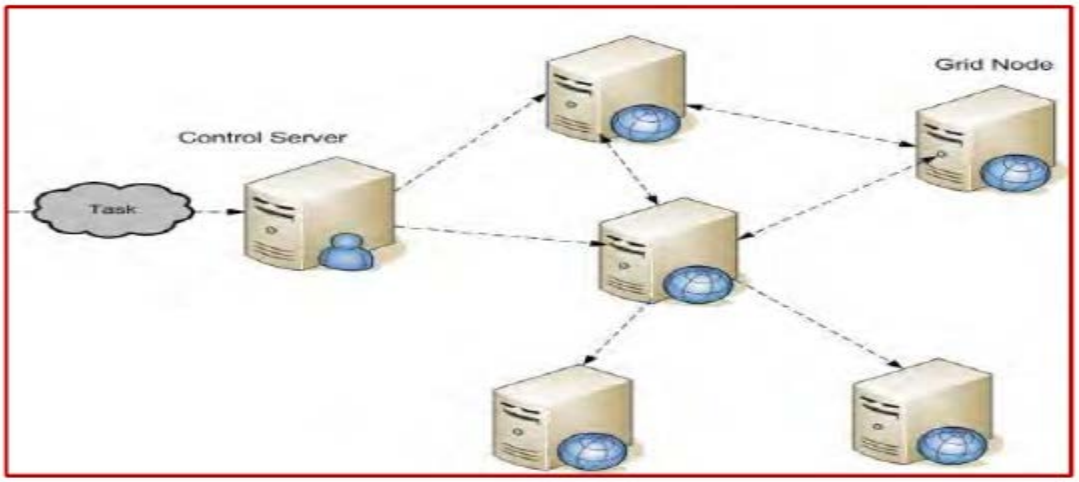
• **Portable Applications:**
- Portable applications are needed when running an application from a removable drive, without installing it on the system's main disk drive.
• **Portable Workspaces:**
- Recent technologies have used virtualization to create portable workspaces on devices like iPods and USB memory sticks.

Some common types of Virtualization:
Hardware Virtualization:
- Refers to the creation of a virtual machine that acts like a real computer with an operating system.
- Software executed on these virtual machines is separated from the underlying hardware resources.
- For example, a computer that is running Microsoft Windows may host a virtual machine that looks like a computer with the Linux operating system.
- The basic idea of Hardware virtualization is to consolidate many small physical servers into one large physical server so that the processor can be used more effectively.
Network Virtualization:
- Network virtualization is a method of combining the available resources in a network by splitting up the available bandwidth into channels, each of which is independent from the others, and each of which can be assigned (or reassigned) to a particular server or device in real time.
- This allows a large physical network to be provisioned into multiple smaller logical networks and conversely allows multiple physical LANs to be combined into a larger logical network.
- This behaviour allows administrators to improve network traffic control, enterprise and security.

Storage Virtualization:
- Storage virtualization is the apparent pooling of data from multiple storage devices, even different types of storage devices, into what appears to be a single device that is managed from a central console.
(E.g. When we access our E-mails it appears to us that all our E-mails are located at one place but in fact it might be located across multiple servers)
- Storage virtualization helps the storage administrator perform the tasks of backup, archiving, and recovery more easily -- and in less time.
- The servers connected to the storage system aren't aware of where the data really is.
- Storage virtualization is sometimes described as "abstracting the logical storage from the physical storage.

Grid Computing:

- Grid Computing is a computer network in which each computer's resources are shared with every other computer in the system.
- It is a distributed architecture of large numbers of computers connected to solve a complex problem.
- In the grid computing model, servers or personal computers run independent tasks and are loosely linked by the Internet or low-speed networks.
- In the ideal grid computing system, every resource is shared, turning a computer network into a powerful supercomputer.



Benefits of Grid Computing:

Making use of Underutilized Resources:

- Grid computing provides a framework for exploiting these underutilized resources and thus has the possibility of substantially increasing the efficiency of resource usage.
- Grid computing (more specifically, a data grid) can be used to aggregate this unused storage into a much larger virtual data store, to achieve improved performance and reliability over that of any single machine.

Resource Balancing:

- For applications that are grid-enabled, the grid can offer a resource balancing effect by scheduling grid jobs on machines with low utilization.
- This feature of grid computing handles occasional peak loads of activity in parts of a larger organization.

Parallel CPU Capacity:

- The potential for usage of massive parallel CPU capacity is one of the most common visions and attractive features of a grid.
- A CPU-intensive grid application can be thought of as many smaller sub-jobs, each executing on a different machine in the grid.
- To the extent that these sub-jobs do not need to communicate with each other, the more scalable the application becomes.
- A perfectly scalable application will, for example, finish in one tenth of the time if it uses ten times the number of processors

Virtual resources and virtual organizations for collaboration:
- The users of the grid can be organized dynamically into a number of virtual organizations, each with different policy requirements.
- These virtual organizations can share their resources such as data, specialized devices, software, services, licenses, and so on, collectively as a larger grid.

Access to additional resources:
- In addition to CPU and storage resources, a grid can provide access to other resources as well.
- For example, if a user needs to increase their total bandwidth to the Internet to implement a data mining search engine, the work can be split among grid machines that have independent connections to the Internet. In this way, total searching capability is multiplied, since each machine has a separate connection to the Internet.

Management:
- The goal to virtualize the resources on the grid and more uniformly handle heterogeneous systems create new opportunities to better manage a larger, more distributed IT infrastructure.
- The grid offers management of priorities among different projects.

Types of Resources:

- A grid is a collection of machines, sometimes referred to as nodes, resources, members, donors, clients, hosts and many other such terms.
- They all contribute any combination of resources to the grid as a whole.

Computation:
The most common resource is Computing Cycles provided by the processors of the machines on the grid.
Three primary ways to exploit the computation resources of a grid:
- To run an existing application on an available machine on the grid rather than locally;
- To use an application designed to split its work in such a way that the separate parts can execute in parallel on different processors; and
- To run an application, that needs to be executed many times, on many different machines in the grid.

Storage:
- The second most common resource used in a grid is Data Storage.
- A grid providing an integrated view of data storage is sometimes called a Data Grid.

Communications:
- Communications within the grid are important for sending jobs and their required data to points within the grid.
- The bandwidth available for such communications can often be a critical resource that can limit utilization of the grid.

Software and Licenses:

- The grid may have software installed that may be too expensive to install on every grid machine.
- Some software licensing arrangements permit the software to be installed on all of the machines of a grid but may limit the number of installations that can be simultaneously used at any given instant.

Special equipment, capacities, architectures, and policies:

- Platforms on the grid will often have different architectures, operating systems, devices, capacities, and equipment.
- Each of these items represents a different kind of resource that the grid can use as criteria for assigning jobs to machines.
- For example, some machines may be designated to only be used for medical research. These would be identified as having a medical research attribute and the scheduler could be configured to only assign jobs that require machines of the medical research resource.

Using a Grid: User's Perspective:

Enrolling and installing Grid Software:

- A user may first have to enroll his machine as a donor on the grid and install the provided grid software on his own machine that may require authentication for security purposes.
- Once the user and/or machine are authenticated, the grid software helps in using the grid as well as donating to the grid.

Logging onto the grid:

- Most grid systems require user to log on to a system using an ID that is enrolled in the grid.
- Once logged on, the user can query the grid and submit jobs.

Queries and submitting jobs:

- The user will usually perform some queries to check to see how busy the grid is, to see how his submitted jobs are progressing, and to look for resources on the grid.

Job submission usually consists of three parts:

- First, some input data and possibly the executable program or execution script file are sent to the machine to execute the job.
- Second, the job is executed on the grid machine. The grid software running on the donating machine executes the program in a process on the user's behalf.
- Third, the results of the job are sent back to the submitter.

Monitoring progress and recovery:

- The user can query the grid system to see how his application and its sub-jobs are progressing.
- A grid system, in conjunction with its job scheduler, often provides some degree of recovery for sub-jobs that fail.

Reserving resources:

- To improve the quality of a service, the user may arrange to reserve a set of resources in advance for his exclusive or high priority use.

Using a Grid: An Administrative Perspective:

Planning: The administrator should understand the organization's requirements for the grid to better choose the grid technologies that satisfy grid's requirements.

Security:

- In a grid, the member machines are configured to execute programs rather than just move data.
- This makes an unsecured grid potentially fertile ground for viruses and Trojan horse programs.
- For this reason, it is important to understand the issues involved in authenticating users and providing proper authorization for specific operations.

Organization:

- It is important to understand how the departments in an organization interact, operate, and contribute to the whole.

Installation:

- Selected grid system must be installed on an appropriately configured set of machines.
- These machines should be connected using networks with sufficient bandwidth to other machines on the grid.
- Machines should be configured and connected to facilitate recovery scenarios.
- Any critical databases for keeping track of the jobs in the grid should have suitable backups.

Managing enrollment of donors and users:

- The administrator is responsible for controlling the rights of the users in the grid.
- The rights of grid users must be properly set so that grid jobs do not allow access to parts of the donor machine to which the users are not entitled.
- Further, procedures for removing users and machines must also be executed by the administrator.

Certificate Authority: The Certificate Authority is one of the most important aspects of maintaining strong grid security. An organization may choose to use an external Certificate Authority or operate one itself. **The primary responsibilities of a Certificate Authority are:**

- Positively identifying entities requesting certificates;
- Issuing, removing, and archiving certificates;
- Protecting the Certificate Authority server;
- Maintaining a namespace of unique names for certificate owners;
- Serving signed certificates to those needing to authenticate entities; and
- Logging activity.

Resource Management:

- Another responsibility of the administrator is to manage the resources of the grid.
- This includes setting permissions for grid users to use the resources as well as tracking resource usage and implementing a corresponding accounting or billing system.

Data sharing:

- For small grids, the sharing of data can be fairly easy, using existing networked file systems, databases, or standard data transfer protocols.
- As a grid grows and the users become dependent on any of the data storage repositories, the administrator should consider procedures to maintain backup copies and replicas to improve performance.

Application Areas of Grid Computing:

- Civil engineers collaborate to design, execute, & analyze shake table experiments.
- An insurance company mines data from partner hospitals for fraud detection.
- An application service provider offloads excess load to a compute cycle provider.
- An enterprise configures internal & external resources to support e-Business workload.

-Large-scale science and engineering are done through the interaction of people, heterogeneous computing resources, information systems and instruments, all of which are geographically and organizationally dispersed.

Grid Computing Security:

Grid systems and applications require standard security functions which are Authentication, Access Control, Integrity, Privacy, and No Repudiation.

To develop security architecture, following constraints are taken from the characteristics of grid environment and application:

Single Sign-on:

A user should authenticate once and they should be able to acquire resources, use them, and release them and to communicate internally without any further authentication.

Protection of Credentials:

User passwords, private keys, etc. should be protected.

Exportability:

The code should be of exportable size i.e. they cannot use a large amount of encryption at a time. There should be a minimum communication at a time.

Support for secure group communication:

In a communication there are number of processes which coordinate their activities. This coordination must be secure.

Support for multiple implementations:

There should be a security policy which should provide security to multiple sources based on public and private key cryptography.