CHAPTER 2: INFORMATION SYSTEM CONCEPTS

INFORMATION

Information means processed Data. Data is facts or values of results, and information is the relations between data and other relations.

ATTRIBUTESINFORMATION

1. **Availability:** Availability of information at the time of need
2. **Reliability**: Whether the information is reliable
3. **Validity:** It measures how close the information is to the purpose for which it asserts to serve.
4. **Quality:** Correctness of information
5. **Frequency:** The frequency with which information is transmitted or received affects its value.
6. **Completeness & Adequacy:** Only complete & adequate information can be used in policy making.
7. **Transparency:** It is essential in decision & policy making
8. **Mode & Format:** Easily understandable by people
9. **Rate:** Time for rate of transmission / reception of information
10. **Update:** Refreshed & updated from time to time.
11. **Purpose/Objective:** Information must have purpose / objective
12. **Value of information:** Required for decision making

SYSTEM

A system is a group of inter connected components working towards the accomplishment of a common goal by accepting inputs and producing outputs in an ordered transformation process.

SYSTEM		
Elements	Abstract	Orderly arrangement of interdependent ideas or constructs
	Physical	Set of tangible elements, operates together to accomplish an objective
Interactive Behaviour	Open	Interacts & changes with environment
	Closed	Does not Interacts & changes with environment
Degree of Human Intervention	Manual	Activities are done by human
	Automated	Activities are carried out by computer / machines
Working Output	Deterministic	Operates in predictable manner
	Probabablistic	Defined in terms of probable behaviour

Important characteristics of Computer Based Information Systems

1. All systems work for predetermined objectives and the system is designed and developed accordingly.
2. Subsystems are interrelated and interdependent for inputs
3. If one subsystem fails; in most of the cases, the whole system does not work.
4. To achieve the goal of the system, the subsystem works with another subsystem called interaction.
5. The work of individual subsystem is integrated to achieve the central goal of system. The goal of individual subsystem is of lower priority than the goal of the entire system.

Major areas of Computer Based Applications

1. **Finance and Accounting**: Ensure the financial viability of the organization, enforce financial discipline and plan and monitor the financial budget

2. **Marketing and Sales:** Maximize the sales and ensure customer satisfaction. Marketing facilitates order procurement, creating new customers & advertisement

3. **Production or Manufacturing**: to optimally deploy man, machine and material to maximize production
4. **Inventory /Stores Management**: inventory management system is designed with a view to keeping the track of materials in the stores

5. **Human Resource Management:** Human resource is the most valuable asset for an organization. Effective and efficient utilization of manpower which is key functional area ensures to ensure free and timely services in business

Knowledge required by a business manager to operate Information systems effectively & efficiently

1. **Foundation Concepts:** It includes fundamental business, and managerial concepts e.g. 'what are components of a system and their functions', or 'what competitive strategies are required'
2. **Information Technologies (IT):** It includes operation, development and management of hardware, software, data management, networks, and other technologies
3. **Business Applications:** It includes major uses of IT in business steps i.e. processes, operations, decision making, and strategic/competitive advantage
4. **Development Processes:** It comprise how end users and IS specialists develop and execute business/IT solutions to problems.
5. **Management Challenges:** It includes 'how the function and IT resources are maintained' and utilized to attain top performance and build the business strategies.

Important implications of information systems in business

1. Helps managers in efficient decision-making to achieve the organizational goals.
2. To survive and thrive in a highly competitive environment on the strength of a well-designed Information system.
3. Helps in making right decision at the right time
4. A good information system may help in generating innovative ideas for solving critical problems.
5. Knowledge gathered though Information system may be utilized by managers in unusual situations
6. Information system is viewed as a process; it can be integrated to formulate a strategy of action or operation.

IT TOOLS CRUCIAL FOR BUSINESS GROWTH

1. **Business Website:** Cost effective advertisement helps to reach large number of customers.
2. **Internet and Intranet**: Time and space is no more obstacles for conducting meeting of people from different locations which provides new platform to business world. Intranet permits the electronic exchange of business data within an organization
3. **Software and Packages**: DBMS, data warehousing, data mining tools, knowledge
Discovery – all these help the business. ERP is one of the latest high end solution to synergize major resources of an organization.
4. **Business Intelligence:** Applications and technologies that are used to collect and provide access and analyze data and information about companies operations.
5. **Computer Systems, Scanners, Laptop, Printer, Webcam, Smart Phone etc:** Increases accuracy; reduce processing times; enable decisions to be made more quickly and speed up customer service

Transaction Processing Systems (TPS)

TPS is an information system that manipulates data from business transactions. Any business activity such as sales, purchase, production, delivery, payments or receipts involves transaction and these transactions are to be organized and manipulated to generate various information products for external use.

Major activities involved in TPS

1. **Capturing data** to organize in files or databases
2. **Processing of files**/databases using application software
3. **Generating information** in the form of reports
4. **Processing of queries** from various quarters of the organization

Components of a TPS

1. **Inputs** – Source documents, such as customer orders, sales, slips, invoices, purchase orders, and employee time cards, are the physical evidence of inputs.
2. **Output** – Any document generated is output. Documents can be input as well as output.
3. **Processing** – Involves the use of journals and registers to provide a permanent and chronological record of inputs
4. **Storage** – Ledgers and files provide storage of data on both manual and computerized systems

Features of a TPS

1. **Large volume of data** – Requires greater storage capacity & their objective is to ensure that the data regarding the economic events in the enterprises are captured quickly and correctly.
2. **Automation of basic operations** – Plays a critical role in the day-to-day functioning of the enterprise. It is an important source of up-to-date information regarding the operations in the enterprise.
3. **Benefits are easily measurable** – TPS reduces the workload of the people associated with the operations and improves their efficiency by automating some of the operations. Benefits are tangible & easily measurable.
4. **Source of input for other systems** – TPS is the basic source of internal information for other information systems. Heavy reliance by other information systems on TPS for this purpose makes TPS important for tactical and strategic decisions as well.

Office Automation Systems (OAS)

It is most rapidly expanding computer based information systems

BENEFITS
1. Improves communication within an organization and between enterprises.
2. They reduce the cycle time between preparation of messages and receipt of messages at the recipients' end.
3. They also reduce the costs of office communication
4. Ensures accuracy of information and smooth flow of communication.

Computer based OAS (or) Broad groups of OAS based on the types of its operations

1. **Text Processing Systems** - Most commonly used components of the OAS, because a large proportion of the office communication takes place in writing using words of a natural language. It reduces effort & minimizes the chances of errors.
2. **Electronic Document Management System**
- Captures information contained in documents, stored for future reference and make them available to the users as and when required
- Very useful specially in case of remote access of documents & internal communication
3. **Electronic Message Communication Systems** – Offer a lot economy not only in terms of reduced time in sending / receiving the message, but also in terms of reliability of message & cost of communication

Components of Message Communication Systems
I. Electronic Mail: Various features of electronic mail:
(a) Electronic Transmission : Quick & fast transmission
(b) Online Development and Editing: Eliminate paper communication
(c) Broadcasting and Rerouting: Large no of target receipts & easy circulation
(d) Integration with other Information Systems: Quick access & accurate information
(e) Portability: Anywhere, anytime access
(f) Economical: Most economical mode for sending & receiving messages

II. Fascimile (fax) – Electronic communication of images of documents over telephone lines.
III. Voicemail: Variation of the email in which messages are transmitted as digitized voice

4. **Teleconferencing and Video-conferencing Systems**
- Business meeting involving more than two persons located at two or more different places uses this system.
- Helps in reducing time & cost of travel.
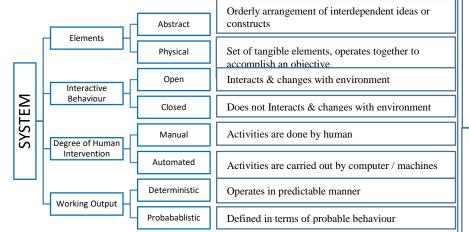
Knowledge Management System (KMS)
It is the process of capturing, developing, sharing, and effectively using organizational knowledge
Types of Knowledge
1. **Explicit Knowledge**: Spoken words, written material and compiled data. This knowledge is easy to codify, transfer and reproduce
2. **Tacit knowledge**: Personal, experimental and context-specific. It is difficult to document and communicate the tacit knowledge.

Management Information Systems (MIS)
MIS is a computer based system that provides flexible and speedy access to accurate data.
.
CHARACTERISTICS
1. **Management Oriented -** Efforts for the development of the IS should start from an appraisal of management needs
2. **Management Directed** – Management should actively direct the system development efforts
3. **Common Data Flows -** It means the use of common input, processing and output procedures and methods
4. **Common Database -** Defined as a "super-file", which consolidates and integrates data records formerly stored in many separate data files.
5. **Computerized** – Accuracy & consistency in processing data
6. **Integrated** – Functional & operational subsystems tied together
7. **Heavy Planning Element** – MIS takes 1-3yrs or longer to get established in company
8. **Sub System Concept** – It is broken down into digestible sub-systems & implemented one by one

PRE-REQUISITES OF AN EFFECTIVE MIS
1. Database
- It is collection of files, which is collection of records and records are nothing but collection of data
- User oriented, common data source, authorized availability
2. Qualified System and Management Staff
System & computer experts – understand problems faced & process planning & decision making function management
Management experts – Understand concepts & operations of a computer
3. Support of Top Management
- If no support from Top management, then no effective control & no/lesser priority
- To gain support, all supporting facts & benefits must be placed before Top management.
4. Control and maintenance of MIS
Some time, users develop their own procedures or short cut methods to use the system & effectiveness is reduced. So the system must be controlled & maintained.

CONSTRAINTS IN OPERATING A MIS
1. Non-availability of experts – overcome by grooming internal staff & proper selection & training
2. Non-availability of cooperation from staff – Tackle by organizing lecturers, showing films & unity of system.
3. MIS is a non-standardized one - due to varied objectives, the approach adopted is non-standardized one
4. Problem of selecting the sub-system to be installed- Need & importance of function for which MIS to be installed first

LIMITATIONS
1. Quality of output depends upon Quality of input & process
2. Not a substitute for effective management
3. Not flexible & adaptive to changing environment
4. No tailor made information packages
5. Ignores non-quantitative factors. E.g.: Morale & attitude
6. Less useful for non-programmed decisions
7. Effective decrease due to frequent changes in top management, organizational structure and operational team.

Decision Support System (DSS)
DSS can be defined as a system that provides tools to managers to assist them in solving semi-structured and unstructured problems in their own, somewhat personalized.

PLANNING LANGUAGE
1. **General-purpose planning languages -** allow users to perform many routine tasks like tackle abroad range of budgeting, forecasting, and other worksheet-oriented problems. Eg. Language in electronic spreadsheet
2. **Special-purpose planning languages -** more limited in what they can do, but do jobs better than the general-purpose planning languages. Eg. statistical languages (SAS & SPSS)

CHARACTERISTICS
1. **Easy** to use
2. **Flexible** & adaptable
3. **Focuses on decision** rather than data & information
4. **Used for decision making** rather than communication
5. **Supports decision making** at all levels of management
6. **Used for structure problems**
7. **User-friendly**
8. **Extensible** & evolve overtime
9. Helps in **group decision making**

COMPONENTS
1. **User** – Users need knowledge of understanding the problem & finding solution & do not need a computer background
- **Manager:** Basic computer knowledge of any level of authority
- **Staff specialist:** More detail oriented & use complex system
2. **Databases** - includes one or more databases that contain both routine and non-routine data from both internal and external sources.
Implementation of database- Implemented @ 3 levels
(i) Physical level – Implementation of database on hard disk
(ii) Logical level – Designed by professional programs, which have complete knowledge of DBMS
(iii) External level - The logical level defines schema, which is divided into smaller units known as sub-schemas & contains data relevant for one manager
3. **Model Base** - allows the user to maintain a dialogue with the model base, which is the **"brain" of DSS** because it performs data manipulations & computations provided by user & database.

EXAMPLES OF DSS IN ACCOUNTING
1. **Cost Accounting System -** Managing costs in this industry require controlling costs of supplies, expensive machinery, technology, and a variety of personnel.
E.g. Health care industry
2. **Capital Budgeting System** – Analytical techniques such as NPV,IRR with decision support tools, the decision makers needs to consider some benefit of new technology not captured in strict financial analysis.
3. **Budget Variance Analysis System** - allows these comptrollers to graph, view, analyze, and annotate budget variances, as well as create additional one-and five-year budget projections using the forecasting tools
4. **General Decision Support System** - The user works interactively with the computer to develop a hierarchical model of the decision problem. Expert choice which support variety of problems requiring decisions, they analyze judgement & present the decision maker with best alternative

Executive Information Systems (EIS))
It is sometimes referred to as an Executive Support System (ESS). It serves the strategic level i.e. top level managers of the organization.

CHARACTERISTICS
1. Can easily be given as a **DSS support** for decision making.
2. Provides extensive **online analysis tool**
3. Serves the information need of **top executives**
4. **Access both internal & external data**
5. Provides rapid **access to timely information**
6. Enable users to extract **summary data**

Characteristics used in Executive Decision Making

1. **Future orientation** – Responsibility of the executives to make sure that the organization keeps pointed toward the future.
2. **High degree of uncertainty** – They work in a decision space where results are not scientifically predictable from actions
3. **Lack of structure**- Unstructured decisions are not as clear-cut as deciding how to debug a computer program or how to deal with an overdue account balance.
4. **Informal Source** – Executives & managers rely heavily on informal source for key info.
5. **Low level of detail** – Most executive decisions are made by observing broad trends

Contents of EIS (or) practical set of principles to guide the design of measures and indicators to be included in an EIS

1. EIS measures must be **easy to understand** and collect & not to add substantially to the workload of managers / staff
2. EIS measures must be based on a **balanced view** of the organization's objective
3. EIS information must be **available** to everyone in the organization.
4. EIS measures must **encourage** management and staff to share ownership of the organization's objectives
5. EIS measures must **evolve** to meet the changing needs of the organization

Dimensions	Decision Support System	Traditional MIS
Philosophy	Providing integrated tools, data, models, and languages to end users	Providing structured information to end users
Orientation	External orientation	Internal orientation
Flexibility	Highly flexible	Relatively inflexible
Analytical capability	More analytical capability	Little analytical capability
System analysis	Emphasis on tools to be used in decision process	Emphasis on information requirement analysis
System design	Interactive process	System development based on static information requirements

Dimensions of Difference	Executive Information System	Traditional Information System
Level of management	For top or near top executives	For lower staff
Nature of Information Access	Specific issues/problems and	Status reporting
Nature of information provided	Online tools and analysis	Offline status reporting
Information Sources	More external, less internal	Internal
Drill down facility to go through details at successive levels	Available	Not available
Information format	Text with graphics	Tabular
Nature of interface	User-friendly	Computer-operator generated

Core Banking System (CBS)

Core Banking is a banking services provided by a group of networked bank branches where customers may access their bank account and perform basic transactions from any of the member branch offices.

Elements of core banking
1. Opening **new accounts**
2. Establishing interest rates, Criteria for **minimum balances**
3. Processing **cash deposits** and withdrawals
4. Processing payments and **cheques**
5. Making and servicing **loans**
6. Establishing **interest rates**
7. **Calculating interest**
8. **Customer Relationship Management**

EXPERT SYSTEM

An Expert System is highly developed DSS that utilizes knowledge generally possessed by an expert to share a problem.

Business applications
1. **Accounting and Finance** – Tax advice and assistance, helping with credit-authorization decisions, investment advice
2. **Marketing** - establishing sales quotas, responding to customer inquiries
3. **Manufacturing** - determining whether a process is running correctly
4. **Personnel** - useful in assessing applicant qualifications
5. **General Business** - helps in assisting with project proposals

Need for Expert Systems
1. Expert labor is expensive and scarce, facing shortage of talent in key positions.
2. No matter how bright or knowledgeable certain people are, they often can handle only a few factors at a time
3. Limitations imposed by human information processing capability and the rushed pace at which business is conducted today put a practical limit on the quality of human decision making

Benefits of Expert Systems
1. **Preserve knowledge** that might be lost through retirement, resignation or death.
2. **Information** in an active-form
3. Assist novices in thinking the way **experienced professional** do.
4. Not subjected to such **human fallings** as fatigue / busy/emotional.
5. Used as a **strategic tool** in the areas of marketing products, cutting costs and improving products

Properties to possess to qualify for Expert System Development
1. **Availability:** Capable of communicating
2. **Complexity:** Complex task requires logical inference processing
3. **Domain:** Subject area of the problem
4. **Expertise:** Solutions to the problem require the efforts of experts
5. **Structure:** The solution process must be able to cope with ill-structured, uncertain, missing, and conflicting data

Enterprise Resource Planning (ERP)

ERP is one of the latest high-end solutions that seek to streamline and integrate operation processes and information flows in the company to synergize the five major resources of an organization namely men, money, machine, materials and market.

COMPONENTS
1. **Software Component**– Most visible part and consists of several modules. E.g. Finance, HR, supply chain mgt.
2. **Process Flow** - illustrates the way how information flows among the different modules
3. **Customer mindset** - the old ways for working which user understand have to be changed
4. **Change Management** - useful in assessing applicant qualifications
5. **General Business** - change needs to be managed at several levels - User attitude; resistance to change; and Business process changes

BENEFITS
1. **Streamlining processes** and workflows with a single integrated system
2. Establish **uniform processes**
3. **Improved** workflow and efficiency
4. **Improved** customer satisfaction
5. Reduced **inventory costs**
6. Reduce **redundant data entry**
7. Reduce in **vendor pricing**
8. Turn **collections faster**
9. **consolidated picture** of sales, inventory and receivables

CHAPTER 4 : BUSINESS CONTINUITY PLANNING AND DISASTER RECOVERY PLANNING

BCP MANUAL
It is a documented description of actions to be taken, resources to be used and procedures to be followed before, during and after an event that severely disrupts all or part of the business operations

BUSINESS CONTINUITY PLANNING (BCP)
It is the creation and validation of a practical logistical plan for how an enterprise will recover & restore partially or completely interrupted critical functions within a predetermined time after a disaster or extended disruption.

BCM POLICY
- It defines the processes of setting up activities for establishing a business continuity capability and the ongoing management and maintenance of the business continuity capability
- Set-up activities incorporate the specification, end-to-end design, build, and implementation
- Ongoing maintenance and management activities include embedding business continuity within the enterprise, exercising plans, updating and communicating them.

OBJECTIVES
1. Critical services and activities undertaken by the enterprise operation for the customer will be identified.
2. Plans will be developed to ensure continuity of key service delivery following a business disruption,
3. Invocation of incident management and BCP.
4. Incident Management Plans & BCP are subject to ongoing testing, revision and updation as required.
5. Planning and management responsibility are assigned to a member of the relevant senior management team.

OBJECTIVES & GOALS
1. Provide for the safety and well-being of people on the premises at the time of disaster
2. Establish management succession and emergency powers
3. Identify critical lines of business and supporting functions
4. Continue critical business operations
5. Minimize the duration of a serious disruption to operations and resources
6. Minimize immediate damage and losses
7. Facilitate effective co-ordination of recovery tasks
8. Reduce the complexity of the recovery effort
→Identify weakness & implement a disaster recovery program. (+5, 7, 8—goals)

METHODOLOGY OF DEVELOPING A BCP
1. Defining recovery requirements from the perspective of business functions
2. Defining how business continuity considerations must be integrated in to ongoing business planning & system development process
3. Developing a business continuity plan that is understandable, easy to use and maintain
4. Selecting business continuity teams that ensure the proper balance required for plan development
5. Documenting the impact of an extended loss to operations and key business functions
6. Obtaining commitment from appropriate management
7. Focusing appropriately on disaster prevention

8 PHASES OF BCP

Phase 1 – Pre-Planning Activities (Project Initiation): This Phase is used to obtain an understanding of the existing and projected computing environment of the organization.

Phase 2 – Vulnerability Assessment and General Definition of Requirements: This phase addresses measures to reduce probability of occurrence of disaster.

Phase 3 – Business Impact Assessment (BIA):

Phase 4 – Detailed Definition of Requirements: During this phase, a profile of recovery requirements is developed. This profile is to be used as a basis for analyzing alternative recovery strategies. Another key deliverable of this phase is the definition of the plan scope, objectives and assumptions.

Phase 5 – Plan Development: During this phase, recovery plans components are defined and plans are documented.

Phase 6 – Testing/Exercising Program: Testing/ exercising goals are established and alternative testing strategies are evaluated.

Phase 7 – Maintenance Program: It is critical that existing change management processes are revised to take recovery plan maintenance into account.

Key task performed in 'Vulnerability Assessment and General Definition of Requirement
1. A thorough Security Assessment of the computing and communications environment including personnel practices; physical security etc.
2. The Security Assessment will enable the project team to improve any existing emergency plans and disaster prevention measures
3. Present findings and recommendations resulting from the activities of the Security Assessment to the Steering Committee so that corrective actions can be initiated in a timely manner.
4. Define the scope of the planning effort.
5. Develop a Plan Framework
6. Assemble Project Team and conduct awareness sessions

BUSINESS IMPACT ANALYSIS (BIA)
- It is essentially a means of systematically assessing the potential impacts resulting from various events or incidents.
- The process of BIA determines and documents the impact of a disruption of the activities that support its key products and services.
- For each activity supporting the delivery of key products & services, the enterprise should:
1. Assess the impacts
2. Identify maximum time period for resumption
3. Identify critical business processes
4. Assess Minimum level of activity
5. Identify length of time
6. Identify any interdependent activities, assets etc.
- The enterprise should have documented approach to conduct BIA

Objectives of performing BCP tests in developing a BCP
1. The recovery procedures are complete and workable
2. The competence of personnel in their performance of recovery procedures can be Evaluated
3. The manual recovery procedures and IT backup systems are operational or restored.
4. Business processes, systems, personnel, facilities and data are obtained and perform recovery processes
5. The success or failure of the business continuity training program is monitored.

Maintenance tasks undertaken in the development of a BCP
1. Determine the ownership and responsibility for maintaining the various BCP strategies within the enterprise;
2. Determine the maintenance regime to ensure the plan remains up-to-date;
3. Determine the maintenance processes to update the plan
4. Implement version control procedures to ensure that the plan is maintained up-to-date
5. Identify the BCP maintenance triggers to ensure that any organizational, operational, and structural changes are communicated to the personnel & ensure that plan remains up-to-date

Components of BCM Process

Fig. 4.6.1: Components of BCM Process

Reviewing BCM Arrangements (or) Audit / self-assessment of enterprise BCM program
1. All key products and services and their supporting critical activities & resources are included in BCM strategy
2. The enterprise BCM
- policy, strategies, framework & plans reflects its requirement
- competent & its capability are effective
- solutions are effective & up to date
- maintainence programs are effectively implemented
3. BCM strategies and plans incorporate improvements
4. BCM procedures are effectively communicated to staff
5. Enterprise has an ongoing program for BCM training
6. Change control processes are in place and operate effectively

Major documents that should be part of Business Continuity Management System
1. Business continuity Policy
2. Business continuity Strategies
3. Business continuity Plan
4. Business continuity Management plan
5. Business impact analysis report
6. Risk assessment report
7. Incident log
8. Training program
9. Exercise schedule and results

TYPES OF PLANS

EMERGENCY PLAN
It specifies the actions to be undertaken immediately when a disaster occurs. It identify those situations that require the plan to be invoked e.g., major fire, major structural damage, and terrorist attack.

BACKUP LAN
It specifies the type of backup to be kept, frequency with which backup is to be undertaken, procedures for making backup, location of backup.

RECOVERY PLAN
Set out procedures to restore full information system capabilities. Recovery plan should identify a recovery committee that will be responsible for working out the specifics of the recovery to be undertaken.

TEST PLAN
To identify deficiencies in the emergency, backup / recovery plan

Alternate Processing Facility Arrangements

COLD SITE
If an organization can tolerate some downtime, cold-site backup might be appropriate. A cold site has all the facilities needed to install a mainframe system –raised floors, air conditioning, power, communication lines, and so on.

HOT SITE
If fast recovery is critical, an organization might need hot site backup. All hardware and operations facilities will be available at the hot site.

WARM SITE
A warm site provides an interme diate level of backup. It has all cold-site facilities in addition to the hardware that might be difficult to obtain or install.

REIPROCAL AGREEMENT
Two or more organizations might agree to provide backup facilities to each other in the event of one suffering a disaster.

Considerations in contract of 3rd party site
1. How soon the site will be made available subsequent to a disaster
2. No of org. that will be allowed to use the site concurrently
3. The period during which the site can be used
4. The conditions under which the site can be used;
5. The facilities and services the site provider agrees to make available
6. The priority to be given to concurrent users

TYPES OF BACKUPS

FULL BACKUP
All files on disk / folder is backed up. At each backup run, all files designated in the backup job will be backed up again.
It is commonly used as an initial or first backup followed with subsequent incremental / differential backup.

Example
Suppose a full backup is done every night from Monday to Friday. The first backup on Monday will contain the entire list of files and folders. On Tuesday, the backup will include copying all the files and folders again, no matter the files have got changed or not.

Advantages
►Restores are fast and easy to manage as the entire list is backed up
►Easy to maintain and restore different versions.

Disadvantages
►Backups can take very long as each file is backed up again ►Consumes the most storage space compared to incremental & differential backups.

INCREMENTAL BACKUP
An incremental backup captures files that were created or changed since the last backup, regardless the type of backup – Full / Incremental.

Example
Suppose an Incremental backup is done every night from Monday to Friday. This first backup on Monday will be a full back up as no prior backup is done.
However, on Tuesday, the incremental backup will only backup the files that have changed since Monday and the backup on Wednesday will include only the changes and new files since Tuesday's backup

Advantages
►Much faster backups.
►Efficient use of storage space as files is not duplicated. Much less storage space used compared to running full backups and even differential backups.

Disadvantages
►Restores are slower than with a full back-up and differential backups
►Restores are a little more complicated. All backup sets (first full backup and all Incremental backups) are needed to perform a restore.

DIFFERENTIAL BACKUP
Differential backups fall in the middle between full backup & incremental backup.
With differential backups, one full backup is done first & subsequent backup runs are the changes made since the last full backup.

Example
A differential backup is done every night from Monday to Friday. On Monday a full back will be first done since no prior backups. On Tuesday, the differential backup will only backup the files that have changed since Monday & any new files added to the backup folders. On Wednesday, the files changed & files added since Monday's full backup will be copied again. While Wednesday's backup does not include the files from the first full backup, it still contains the files backed up on tuesday.

Advantages
►Much faster backups than full backups.
►More efficient use of storage space than full backups
►Faster restores than incremental backups

Disadvantages
►Backups are slower than incremental backups.
►Not efficient as storage as compared to incremental backups.
►Restores are slower than with full backups.

DISASTER RECOVERY PROCEDURAL PLAN

- Emergency procedures
- Fall-back procedure
- Resumption procedure
- Maintenance schedule

- Awareness Activities
- Medical procedure
- Insurance paper
- Backup location

- List of phone no of employees in even of emergency
- Responsibility of individual for executing the plan

- Emergency phone list is for hardware, software, fire etc.
- Details of airline, hotels & transport arrangement

AUDIT OF BCP / DRP

Building, Utilities and Transportation
1. Does the Disaster recovery / Business Resumption plan
- has provision to inspect the building & facilities soon after a disaster, identify damages & repair the premises for safe return of employees
- consider the need for alternative shelter
- consider the failure of electrical power, natural gas, toxic chemical containers, and pipes
- consider the disruption of transportation systems as it could affect the ability of employees to report to work or return home
2. Review any agreements for use of backup facilities
3. Verify that the backup facilities are adequate based on projected needs
4. Are building safety features regularly inspected and tested?

AUDIT OF BCP / DRP

Administrative Procedures
1. Determine if the Disaster recovery / Business Resumption plan
- cover administrative and management aspects
- covers procedures for disaster declaration, general shutdown and migration of operations to the backup facility.
2. Is there a designated emergency operations center where incident management teams can coordinate response and recovery?
3. Have essential records been identified? Whether duplicate set of essential records stored in a secure location?
4. To facilitate retrieval, are essential records separated from those that will not be needed immediately?

AUDIT OF BCP / DRP

Information Technology
1. Determine if the Disaster recovery / Business Resumption plan
- reflects the current IT environment
- includes prioritization of critical applications and systems
- includes time requirements for recovery
- include arrangements for emergency telecommunications
2. In case of interruption, is there alternate means of data transmission?
3. Verify that the backup facilities are adequate based on projected needs
4. Determine whether testing schedule exists and is adequate

CHAPTER 5: ACQUISITION, DEVELOPMENT AND IMPLEMENTATION OFINFORMTION SYSTEMS

Bottleneck (or) Reasons for failure to achieve the systems development objectives

1. User related issues
- ✓ Shifting user needs
- ✓ Resistance to change
- ✓ Lack of use participation
- ✓ Inadequate testing & user training

2. Developer related issues
- ✓ Lack of standard project management& system development methodologies

3. Management related issues
- ✓ Lack of senior management support & involvement
- ✓ Development of strategic systems

4. New technologies

Accountants' Involvement in Development Work
1. Return on Investment
- a) **Cost**
  - ✓ Development cost. Eg. salary
  - ✓ Operating costs. Eg Rent/depreciation
- b) **Benefits**
  - ✓ Tangible & intangible

2. Computing Cost of IT Implementation and Cost Benefit Analysis

3. Skills expected from an Accountant
- ✓ Understand the business objectives
- ✓ Expert book keeper
- ✓ Understanding system development efforts.

Operation Manual
- Typical user guide
- Technical communication document
  - ✓ Cover page
  - ✓ Title page
  - ✓ Preface
  - ✓ Copyright page
  - ✓ Contents
  - ✓ Main function
  - ✓ Troubleshooting
  - ✓ FAQ
  - ✓ Contact details
  - ✓ Glossary
  - ✓ Index

WATERFALL MODEL
- It is a traditional model
- Activities are performed in a sequential manner
- Emphasis is on planning, time schedule, target date, budget &implementation of an entire system at one time
- Tight control is maintained over the life of the project

STRENGH
1. Supports less experience project
2. Orderly sequence ensures quality, Reliability
3. Measurable progress
4. Conserve the resources

WEAKNESS
1. Inflexible, slow, costly
2. Forward movement
3. Problems not discovered till system testing
4. Difficult to respond to changes
5. Excessive documentation
6. Gap b/w user & developer

PROTOTYPING MODEL
- A small or pilot version called prototype is developed
- If the prototype satisfies all the user requirements, it is converted in to a final system or else it is scrapped. If scrapped, the knowledge gained is used to develop the final system.

STRENGH
1. Improves user participation
2. Errors detected & eliminated
3. Innovation & flexible
4. Quick implementation
5. Short time period for development

WEAKNESS
1. Requirement changes frequently
2. Approval process not strict
3. No documentation of non-functional elements
4. Insufficient checks
5. Dissatisfaction & impatience

INCREMENTAL MODEL
- In this method of software development, the software is designed, developed, tested & implemented incrementally.
- It is a combination of waterfall & prototyping model
- The initial software concept, requirement analysis & design are defined using waterfall approach followed by prototyping

STRENGH
1. Moderate control
2. More flexible, less costly
3. Quick processing & delivery
4. Knowledge gain
5. Mitigate integration & architectural risks

WEAKNESS
1. Lack of overall consideration
2. Iteration is rigid & do not overlap each other
3. Difficult to demonstrate early success
4. Completion of some modules earlier
5. System architecture issues

SPIRAL MODEL
- It is a combination of waterfall & prototyping model
- The first prototype is constructed from the preliminary design
- The second prototype is evolved using a 4 fold procedure
  - i) Evaluate the 1st prototype in terms of strength, weakness & risk
  - ii) Requirements of the 2nd prototype
  - iii) Design the 2nd prototype
  - iv) Construct the 2nd prototype

STRENGH
1. Risk avoidance
2. Optimal development
3. Incorporate – Waterfall, Prototype & Incremental

WEAKNESS
1. No exact composition of iteration
2. Highly customized, quite complex
3. Skilled & experiences manager required
4. No established controls in cycle
5. No firm deadlines

PHASES OF SDLC
1. **Preliminary Investigation**
2. **System Requirement analysis**
3. **System Design**
4. **System Acquisition**
5. **System Development**
6. **System Testing**
7. **System Implementation**
8. **Post Implementation Review and Maintenance**

SYSTEM REQUIREMENT ANALYSIS

OBJECTIVES OF SRA/SRS
1. Determination of expectation of stake owners
2. Analyze requirements & determine priorities
3. To find facts using fact finding tools
4. To document activities of fact finding tools
5. To verify that the requirements are complete, consistent, modifiable, testable and traceable
6. To model activities such as developing models to document Data Flow Diagrams

FACT FINDING TECHNIQUES / TOOLS
- ✓ **Documents** – Very good source of information
- ✓ **Questionnaire**s – Large amount of data collected through a variety of users quickly
- ✓ **Interview** – Record first hand user reaction
- ✓ **Observation** – Plays a central role, observes how user react to prototype

PRESENT SYSTEM ANALYSIS
Reviewing
- i. **Historical aspects-** what system changes have occurred in past
- ii. **Data files-** Online & offline files maintained
- iii. **Methods, procedures & data-** Way logical steps communication review
- iv. **Internal controls-** Locate internal controls

Analyzing
- i. **Inputs-** Initial data sources
- ii. **Outputs-** Reports – "How well the needs of organization are met"

Modelling the existing system- Documentation
Undertaking overall analysis of existing system- Detailed investigation

SYSTEM DEVELOPMENT TOOLS (or) 4 categories of major tools that are used for system development
- I. **System Components and Flows**
  - ✓ Flow chart, data flow diagram
  - ✓ System component matrix
- II. **User interface**
  - ✓ Layout form & screen generator
  - ✓ Menu generator, Report generator
  - ✓ Code generator
- III. **Data Attributes and Relationships**
  - ✓ Data dictionary, file layout
  - ✓ Grid charts
- IV. **Detailed System Processes**
  - ✓ Decision tree
  - ✓ Decision table
    - Condition stub
    - Action stub
    - Condition entries
    - Action entries

RAPID APPLICATION DEVELOPMENT (RAD)
- Fast development
- High quality
- Low investment cost
- Active user participation
- Emphasis is on fulfilling business requirement whereas technical design is given less importance
- Joint application development
- Project control is through delivery deadlines called timeboxes

STRENGH
1. Operation version – earlier availability
2. Low cost
3. Quick initial reviews- isolate problem
4. Ability to rapid change
5. Tighter fit b/w user requirement & system specification

WEAKNESS
1. Adverse system quality- Fast speed & low cost
2. Gold plating
3. Violation of programming standards
4. Difficult problems pushed to future
5. Formal review & audit are more difficult

Possible advantages of SDLC from perspective of IS audit
1. IS auditor has clear understanding of various phases of the SDLC
2. Compliance of procedures given in report
3. IS auditor can be a guide during various phases of SDLC if have a technical knowledge & ability
4. Does evaluation of methods & techniques of SDLC phases

PRELIMINARY INVESTIGATION

Aspects to kept in mind while eliciting information to delineate the scope
1. Developer should elicit the need from initiator called champion or executive sponsor of the project –on basis of the scope.
2. An understanding of initiator (senior mgt) & user (operating level) helps in designing appropriate user interface features.
3. Quantification of economic benefits to the user organization must be clearly made
4. Solutions which have a wide impact are likely to be met with greater resistance. Understand the impact of solution on organization
5. Economic benefit is critical consideration. Other factors have to be given weightage too & to be considered from the perspective of user management & resolved

Two primary methods in which the scope of the project can be analyzed
1. Reviewing Internal Documents – Learn about the org.
2. Conducting Interviews – Operation of system
   - Merits of system proposal

Feasibility Study
Dimensions to evaluate feasibility study:-
- ✓ **Technical** – Necessary technology exits?
- ✓ **Financial** – Is solution financially viable?
- ✓ **Operational** – How will solution work?
- ✓ **Behavioral** – Any adverse effect on quality?
- ✓ **Legal** – Is solution valid in legal terms?
- ✓ **Economic** – Return on investment?
- ✓ **Time/Schedule** – Will system be delivered on time
- ✓ **Resource** – HR reluctant for solution?

SYSTEM DESIGN

Design of database (or) Major Activities in Database Designing
1. **Conceptual Modeling-** describe application domain via entities/objects, attributes, static and dynamic constraints, attributes & relationships are described.
2. **Data Modeling-** Conceptual Models need to be translated into data models so that they can be accessed and manipulated by both high-level & low-level programming languages
3. **Storage Structure Design-** To linearize and partition the data structure so that it can be stored on some device.
4. **Physical Layout Design-** How to distribute the storage structure across specific storage media and locations

Factors affecting Input / Output Form Designs
1. **Content-** actual pieces of data to be gathered to produce the required output
2. **Timeliness-** It refers to when users need output on a regular / periodic basis
3. **Format-** It refers to the manner in which data are physically arranged
4. **Media-** Input-output medium refers to physical device used for input & output storage
5. **Form-** The way the information is inputted & presented to users. Quantitative-Non Quantitative text, graphics, video & audio
6. **Volume-** The amount of data that has to be entered in the computer at any one time. The amount of data output required at any one time is known as output volume.

SYSTEM IMPLEMENTATION
System Change-Over Strategies used for conversion from old system to new system
1. **Direct Implementation / Abrupt Change-Over-** One operation, completely replacing the old system in one go.
2. **Phased Changeover-** Conversion to the new system takes place gradually.
3. **Pilot Changeover-** New system replaces the old one in one operation but only on a small scale.
4. **Parallel Changeover-** Both old & new system operate simultaneously / parallel until everything is set

Activities involved in successful conversion with respect to computerized information system
1. **Procedure conversion-** Operating procedures should be completely documented for the new system. It applies to both computer operations & functional area operations.
2. **File conversion** – Both online & offline files that contains information to be converted from one medium to another & to be as accurate as possible.
3. **System conversion** – After confirmation of reliability of new system, daily processing of transactions to be shifted & processed on new system
4. **Scheduling Personnel and Equipment**- Scheduling system manager for processing operation of new information system to be appointed

DATA DICTIONARY

Name of cata field	File in which stored	Source document	Size in bytes	Type	
Inventory quantity on hand	Inventory master file	Form number ABC 123	4	Numeric	← Data dictionary

- Descriptive information about data items in the files
- It is a computer file about data
- Data about data or Metadata of system

SYSTEMS SPECIFICATION
Systems analyst prepares a document called **Systems Requirement Specifications (SRS)**
Contents of SRS
- ✓ Introduction
- ✓ Information description
- ✓ Functional description
- ✓ Behavioral description
- ✓ Appendices

ROLES INVOLVED IN SDLC
1. Team Leader   2. Project Leader
3. Project manager   4. Developer
5. Tester   6. Quality Assurance
7. Domain specialist   8. Database Administrator
9. Steering committee
High power committee of experts
- ✓ Provide overall directions
- ✓ Responsible for costs
- ✓ Conduct regular review of progress
- ✓ Undertake corrective actions
10. System Analyst/Business Analyst
- ✓ Conduct interviews with users to understand their requirement
- ✓ There is a link b/w the users and the designers/programmers, who convert the users' requirements in the system requirements

11. IS Auditor
- ✓ Checks control perspective of application development
- ✓ Involved in Design and Testing phase

AGILE MODEL
- Requirements & solutions evolved through collaboration b/w self-organizing cross functional team
- Working software is delivered frequently
- Customer satisfaction by rapid delivery of useful software
- Welcoming change in requirements even late in development
- Daily cooperation b/w business people & developer
- Face to face communication is the best form of communication
- Projects are built around motivated individual who should be trusted
- Simplicity
- Regular adaption to changing circumstances
- Self organizing teams

STRENGH
1. Adaptive to change
2. Face to face communication
3. Documentation is crisp & saves time
4. High quality result in less time

WEAKNESS
1. For larger ones- efforts are immeasurable
2. Lack of emphasis on design & documentation
3. Potential threats to business continuity
4. More re-work
5. Project can go off track & lacks integration

System Testing

UNIT TESTING — INTEGRATION TESTING — REGRESSION TESTING — SYSTEM TESTING — FINAL ACCEPTANCE TESTING

* categories:
1. Functional Test
2. Performance Test
3. Stress Test
4. Structural Test
5. Parallel Test

INTEGRATION TESTING:
1. Top-down Integration
2. Bottom-up Integration

REGRESSION TESTING:
1. Recovery
2. Security
3. Stress/volume
4. Performance

FINAL ACCEPTANCE TESTING:
1. Quality Assurance
2. User Acceptance
   a. Alpha Testing
   b. Beta Testing

* classification:
Static Testing:
1. Desk check
2. Structured walk through
3. Code Inspection

Dynamic Analysis Testing:
1. Black box
2. White box
3. Gray box

SYSTEM ACQUISITION

FACTORS TO VALIDATE VENDORS PROPOSAL AT THE TIME OF SOFTWARE ACQUISITION
1. The Performance capability of each proposed System in Relation to its Costs
2. The Costs and Benefits of each proposed system
3. The Maintainability of each proposed system
4. The Compatibility of each proposed system with Existing Systems
5. Vendor Support

METHODS OF VALIDATING VENDORS PROPOSAL
1. Checklists
2. Point-Scoring Analysis
3. Public Evaluation Reports
4. Benchmarking Problems related Vendor's Solutions
5. Testing Problems

SYSTEM DEVELOPMENT

CHARACTERISTICS OF GOOD CODED APPLICATION & PROGRAM
1. **Accuracy:** It refers not only to 'what program is supposed to do', but should also take care of 'what it should not do'
2. **Efficiency:** It refers to the performance per unit cost with respect to relevant parameters which should not be affected with the increase in input values.
3. **Usability**: User-friendly interface and easy-to-understand internal/external documentation
4. **Reliability** : Consistency with which a program operates over a period of time.
5. **Readability**: Ease of maintenance of program even in the absence of the program developer
6. **Robustness**: The applications' strength to uphold its operations in adverse situations

SYSTEM MAINTAINENECE
CATEGORIES OF SYSTEM MAINTAINENCE
1. **Scheduled Maintenance:** Planned for operational continuity& avoidance of anticipated risks
2. **Rescue Maintenance:** Previously undetected malfunctions that were not anticipated but require immediate troubleshooting solution.
3. **Corrective Maintenance:** Fixing bugs & defects, errors found in code during executions & data processing & system performance errors.
4. **Adaptive Maintenance**: The software that adapts to the changes in environment which can be hardware or operating system.
5. **Perfective Maintenance**: Accommodation of new or changed user requirements. Increases the system performance & enhance user interface
6. **Preventive Maintenance**: Increasing the systems maintainability such as updating documentation, adding comments, improving the modular structure of the system.

CHAPTER 6: AUDITING OF INFORMATION SYSTEM

Need for Audit of Information system or Impact of IS audit in an organization or Factors influencing an organization towards control and audit of computers?	EFFECTS OF COMPUTERS ON AUDIT	

Need for Audit of Information system or Impact of IS audit in an organization or Factors influencing an organization towards control and audit of computers?

1. Organizational Costs of Data Loss: Data is a critical resource of an organization for its present and future process and its ability to adapt and survive in a changing environment.
2. Cost of Incorrect Decision Making: Management and operational controls taken by managers involve detection, investigations and correction of the processes.
3. Costs of Computer Abuse: Unauthorized access to computer systems, facilities and sensitive data can lead to destruction of assets
4. Controlled evolution of computer Use: Use of Technology and reliability of complex computer systems cannot be guaranteed and the consequences of using unreliable systems can be destructive.
5. High Costs of Computer Error: In a computerized enterprise environment where many critical business processes are performed, a data error can cause great damage.
6. Value of Computer Hardware, Software and Personnel: These critical resources have credible impact on its infrastructure and business competitiveness.
7. Maintenance of Privacy: Data collected contains private information about an individual that needs to be maintained

EFFECTS OF COMPUTERS ON AUDIT

Changes to Evidence Evaluation

1. Automated transaction processing systems: can cause the auditor problems.
2. System generated transactions: Financial systems may have the ability to initiate, approve and record financial transactions
3. Systemic Error: Computers are designed to carry out processing on a consistent basis. Given the same inputs and programming, they invariably produce the same output

Changes to Evidence Collection

1. Data retention and storage: A client's storage capabilities may restrict the amount of historical data that can be retained "on-line" and readily accessible to the audit or due to which the auditor may not be able to review a whole reporting period transactions on the computer system.
2. Absence of input documents: Transaction data may be entered into the computer directly without the presence of supporting documentation resulting in less paperwork being available for audit examination.
3. Lack of availability of printed output: In the absence of physical output, it may be necessary for the auditor to directly access the electronic data retained on the client's computer
4. Audit evidence: Certain transactions may be generated automatically by the computer system.
5. Non-availability of audit trail: The audit trails may exist in computer system for short period, which makes auditor's job very difficult.
6. Legal issues: Making use of Electronic Data Interchange (EDI) and electronic trading over the Internet can create problems with contracts

IS AUDITOR

Explain the set of skills that is generally expected of an IS auditor?
1. Sound knowledge of business operations, practices and compliance requirements;
2. Good knowledge of Professional Standards and Best Practices of IT controls and security.
3. Knowledge of IT strategies, policy and procedural controls
4. Should possess the requisite professional technical qualification and certifications;
5. A good understanding of information Risks and Controls;
6. Ability to understand technical and manual controls relating to business continuity

Functions / Risks reviewed relating to IT systems & process as part of functions
1. Inadequate information security controls. (E.g. missing or out of date antivirus controls, open ports, open systems without password or weak passwords etc.)
2. Inefficient use of resources, or poor governance;
3. Ineffective IT strategies, policies and practices; and
4. IT-related frauds (including phishing, hacking etc.)

IS AUDIT

Objectives of IS Audit

1. Asset Safeguarding Objectives: The information system assets must be protected from unauthorized access by system of internal controls
2. Data Integrity Objectives: Data integrity important from the business perspective of the decision maker, competition and the market environment.
3. System Effectiveness Objectives: Effectiveness of a system is evaluated by auditing the characteristics and objective of the system to meet business and user requirements.
4. System Efficiency Objectives: To optimize the use of various information system resources along with the impact on its computing environment

Major types/Categories of IS Audit

1. Systems and Application: An audit to verify that systems and applications are appropriate, are efficient, and are adequately controlled to ensure valid, reliable, timely, and secure input, processing, and output at all levels of a system's activity.
2. Systems Development: An audit to verify that the systems under development meet the objectives of the organization and to ensure that the systems are developed in accordance with generally accepted standards for systems development.
3. Telecommunications, Intranets, and Extranets: An audit to verify that controls are in place on the client, server, and on the network connecting the clients and servers
4. Information Processing Facilities: An audit to verify that the processing facility is controlled to ensure timely, accurate, and efficient processing of applications under normal and potentially disruptive conditions.
5. Management of IT and Enterprise Architecture: An audit to verify that IT management has developed an organizational structure and procedures to ensure a controlled and efficient environment for information processing.

Steps / Major stages of IS Audit

1. Scoping and pre-audit survey: Auditors determine main area/s of focus based on scope-definitions agreed with management.
2. Planning and preparation: The scope is broken down into greater levels of detail, usually involving generation of audit work plan or risk-control-matrix.
3. Fieldwork: This step involves gathering of evidence by interviewing staff and managers, reviewing documents, and observing processes etc.
4. Analysis: SWOT (Strengths, Weaknesses, Opportunities, Threats) or PEST (Political, Economic, Social, Technological) techniques can be used for analysis.
5. Reporting: Reporting to the management is done after analysis of evidence is gathered and analyzed.
6. Closure: Closure involves preparing notes for future audits and follow up with management to complete actions they promised after previous audits.

TYPES OF AUDIT TOOLS

1. Snapshots: The snapshot software is built into system at those points where material processing occurs which takes images of flow of any transaction as it moves through application. These images can be utilized to assess the authenticity, accuracy, and completeness of the processing carried out on the transaction.

2. Integrated Test Facility (ITF): The ITF technique involves the creation of a dummy entity in the application system files and the processing of audit test data against the entity as a means of verifying processing authenticity, accuracy, and completeness.
   (i) Methods of Entering Test Data
   (ii) Methods of removing the Effects of ITF Transactions

3. System Control Audit Review File (SCARF):
- The SCARF technique involves embedding audit software modules within a host application system to provide continuous monitoring of the system's transactions. Auditors might use SCARF to collect the following types of information:
   ✓ **Application System Errors** - SCARF provides an independent check on the quality of system processing & errors into the system.
   ✓ **Policy and Procedural Variances** - SCARF audit routines can be used to check when variations from these policies, procedures and standards have occurred.
   ✓ **Profiling Data** - Auditors can use embedded audit routines to collect data to build profiles of system users & any deviations indicate errors or irregularities.
   ✓ **Performance Measurement** - Useful for measuring or improving the performance of an application system.
   ✓ **System Exception** - Monitor different types of application system exceptions.
   ✓ **Statistical Sample** - SCARF provides a convenient way of collecting all the sample information together & use analytical review tools.
   ✓ **Snapshots and Extended Records** - It can be written into the SCARF file and printed when required.

4. Continuous and Intermittent Simulation (CIS):
This technique can be used to trap exceptions whenever the application system uses a DBMS.
   Advantages of continuous audit techniques:
   a) **Timely, Comprehensive and Detailed Auditing** – Evidence would be available more timely and in a comprehensive manner.
   b) **Training for new users** – Using the ITFs, new users can submit data to the application system & obtain feedback on mistakes.
   c) **Surprise test capability** – Auditors can gather evidence without the systems staff and application system users being aware that evidence is being collected at that particular moment.
   d) **Information to system staff on meeting of objectives -** Evaluate whether application system meets the objectives of asset safeguarding, data integrity, effectiveness, and efficiency.
   Disadvantages of continuous audit techniques:
   a) Auditors should be able to obtain resources required from the organization.
   b) Continuous audit techniques are more likely to be used if auditors are involved in the development work associated with a new application system.
   c) It is unlikely to be effective unless they are implemented in an application system that is relatively stable.
   d) Continuous auditing techniques is used where the audit trail is less visible & the costs of errors and irregularities are high.
   e) Auditors need the knowledge & experience of working with computer systems to use continuous audit techniques effectively & efficiently.

5. Audit hooks:
There are audit routines that flag suspicious transactions.
For example, internal auditors at Insurance Company determined that their policyholder system was vulnerable to fraud every time a policyholder changed his or her name or address and then subsequently withdrew funds from the policy. They devised a system of audit hooks to tag records with a name or address change & will investigate these tagged records for detecting fraud. This approach of real-time notification displays a message on the auditor's terminal.

PERFORMING IS AUDIT

STEPS

1. Basic Plan

2. Preliminary Review
   (i) Knowledge of Business

   (ii) Understanding the Technology
   ✓ Analysis of business processes and level of automation,
   ✓ Assessing the extent of dependence of the enterprise on Information Technology to carry on its businesses
   ✓ Understanding technology architecture which could be distributed / centralized / hybrid architecture,
   ✓ Studying network diagrams to understand physical and logical network connectivity
   ✓ Understanding extended enterprise architecture
   ✓ Knowledge of various technologies & their advantages & limitations is critical competence requirement for auditor.
   ✓ Studying Information Technology policies, standards, guidelines and procedures

   (iii) Understanding Internal Control Systems
   (iv) Legal Considerations & Audit Standards
   ✓ The auditor should carefully evaluate the legal as well as statutory implications on audit work
   ✓ The IS audit work could be required as part of a statutory requirement in which case he should take into consideration - stipulations, regulations and guidelines.
   ✓ The statutes or regulatory framework may impose stipulations as regards minimum set of control objectives to be achieved by the subject organization.
   ✓ The IS Auditor should also consider the Audit Standards applicable to his conduct and performance of audit work

   (v) Risk Assessment & Materiality
   Key steps that can be followed for a risk-based approach to make an audit plan?
   ✓ Inventory the IS in use in the organization and categorize them.
   ✓ Determine which systems impact critical functions or assets & how close to real time they operate.
   ✓ Assess what risks affect these systems & the likelihood and severity of the impact on the business
   ✓ Decide audit priority, resources, schedule and frequency.

   Categories of Risk
   Inherent Risk:
   Inherent risk is the susceptibility of information resources or resources controlled by the information system to material theft, destruction, disclosure, unauthorized modification, or other impairment, assuming that there are no related internal controls. Internal controls are ignored in setting inherent risk. It is often an area of professional judgement by auditor.

   Control Risk:
   Control risk is the risk that could occur in an audit area, and which could be material, individually or in combination with other errors, will not be prevented or detected and corrected on a timely basis by the internal control system. Control risk is a measure of the auditor's assessment of the likelihood that risk exceeding a tolerable.

   Detection Risk:
   Detection risk is the risk that the IT auditor's substantive procedures will not detect an error which could be material, individually or in combination with other errors. It is associated with lack of identification of disaster recovery plans is ordinarily low since existence is easily verified

AUDIT TRAIL
Audit trails are logs that can be designed to record activity at the system, application, and user level. When properly implemented, audit trails provide an important detective control to help accomplish security policy objectives. Audit trail controls attempt to ensure that a chronological record of all events that have occurred in a system is maintained.

OBJECTIVES
1. Detecting Unauthorized Access: It can occur in real time or after the fact. The primary objective of real-time detection is to protect the system from outsiders who are attempting to breach system controls. A real-time audit trail can also be used to report on changes in system performance that may indicate infestation by a virus or worm. Used to determine if unauthorized access was accomplished, or attempted and failed.

2. Reconstructing Events: Audit analysis can be used to reconstruct the steps that led to events such as system failures, security violations by individuals, or application processing errors. Knowledge of the conditions that existed at the time of a system failure can be used to assign responsibility and to avoid similar situations in the future.

3. Personal Accountability: Individuals are likely to violate an organization's security policy if they know that their actions are not recorded in an audit log. Helps to monitor user activity at lowest level.

Audit of Environmental Controls
   ✓ The IPF & construction with regard to type of materials used for construction
   ✓ Presence of water & smoke detectors
   ✓ Location of fire extinguishers, equipment & refilling date of fire extinguishers
   ✓ Emergency procedures, evacuation plans & marking of fire exits
   ✓ Documents for compliance with legal & regulatory requirements with regard to fire safety equipment
   ✓ Power resources, generators etc. must be checked to test effectiveness of backup power
   ✓ Environment control equipment's – Air conditioner, heaters etc.
   ✓ Identify undesired activities such as smoking, consumption of eatables etc.

CHAPTER 6.1: AUDITING OF INFORMATION SYSTEM

MANAGERIAL CONTROLS AND THEIR AUDIT TRAILS	
MANAGERIAL CONTROLS	**AUDIT TRAILS**
Top Management and Information Systems Management Controls	**Planning**: Auditors evaluate whether top management has formulated a high-quality information system's plan that is appropriate to the needs of an organization or not. **Organizing**: Auditors should be concerned about how well top management acquires and manage staff resources. **Leading:** Generally, the auditors examine variables that often indicate when motivation problems exist or suggest poor leadership **Controlling:** Auditors must evaluate whether top management's choice to the means of control over the users of IS services is likely to be effective or not.
System Development Management Controls	**Concurrent Audit**: Auditors assist the team in improving the quality of systems development for the specific system they are building and implementing. **Post-implementation Audit**: Auditors seek to help an organization learn from its experiences in the development of a specific application system. **General Audit**: Auditors seek to determine whether they can reduce extent of substantive testing needed to form an audit opinion about management's assertions relating to financial statements for systems effectiveness & efficiency.
Programming Management Controls	**Planning**: Auditors must evaluate how well the planning work is being undertaken. **Control**: Auditors must evaluate whether the nature of and extent of control activities undertaken are appropriate for different types of s/w that are developed or acquired. **Design**: Auditors should find out whether programmers use some type of systematic approach to design. **Coding**: Auditors should seek evidence to check whether programmers employ automated facilities to assist them with their coding work. **Testing:** Auditor's primary concern is to see that unit testing; integration testing of the system testing has been undertaken appropriately. **Operation and Maintenance**: Auditors need to ensure effectively & timely reporting of maintenance needs occurs & maintenance is carried out in a well-controlled manner
Data Resource Management Controls	Auditors should determine what controls are exercised to maintain data integrity. They might employ test data to evaluate whether access controls and update controls are working.
Quality Assurance Management Controls	Auditors might use interviews, observations and reviews of documentation to evaluate how well Quality Assurance (QA) personnel perform their monitoring and reporting function.
Security Management Controls	Auditors must evaluate whether security administrators are conducting ongoing, high-quality security reviews or not; and check whether organizations have opted appropriate Disaster Recovery and Insurance plan or not.
Operations Management Controls	Auditors should pay concern to see whether the documentation is maintained securely and that it is issued only to authorized personnel.

Describe how the application controls and their audit trail are categorized

BOUNDARY CONTROLS
It maintains chronology of events
- ✓ Identity of would be user of the system
- ✓ Authentication information supplied
- ✓ Resources requested
- ✓ Terminal identifier

Accounting Audit Trial
- Action privileges / denied

Operations Audit Trial
- Resource usage from log on to log out time
- Log of resource consumption

PROCESSING CONTROLS
The audit trail maintains the chronology of events from the time data is received from the input / communication subsystem to the time data is dispatched to the database, communication, or output subsystems

Accounting Audit Trial
- trace and replicate the processing performed on a data item.
- Triggered transactions to monitor input data entry, intermediate results and output data

Operations Audit Trial
- A comprehensive log on hardware consumption – CPU time used, 2^{nd}ary storage
- A comprehensive log on software consumption – compilers used, subroutine libraries used etc.

INPUT CONTROLS
Responsible for bringing the data and instructions in to the information system. It helps in validation & error detection of data input into system

Accounting Audit Trial
- Identity of the person who was the source of the data
- Identity of the person who entered the data into the system
- Time & date when data was capture
- Device used to enter data

Operations Audit Trial
- Time to key in source data
- No of keying errors identified during verification
- Frequency & command language used

DATABASE CONTROLS
Maintains the chronology of events that occur either to the database definition or the database itself

Accounting Audit Trial
- Attach unique time stamp to all transactions
- Attach before image & after Image
- Accommodating changes that occur within application system

Operations Audit Trial
- Maintain chronology of resource consumption that affects the database / database definition identified during verification

COMMUNICATION CONTROLS
This maintains a chronology of the events from the time a sender dispatches a message to the time a receiver obtains the message.

Accounting Audit Trial
- Unique identifier of the source or sink node
- Time and date at which the message was received by the sink node & traversed by message
- Message sequence number & the image of the message received

Operations Audit Trial
- No of messages traversed at each link & node.
- Queue lengths, no of errors occurring at each link
- Log of system restarts
- Message transit time b/w nodes & at nodes

OUTPUT CONTROLS
Maintains the chronology of events that occur from the time the content of the output is determined until the time users complete their disposal of output because it no longer should be retained.

Accounting Audit Trial
- What output was presented to users?
- Who received the output?
- When the output was received?
- What actions were taken with the output

Operations Audit Trial
- To maintain the record of resources consumed
- graphs, images, report pages, printing time, & display rate to produce various outputs

CHAPTER 8: EMERGING TECHNOLOGIES

GRID COMPUTING

>It is a network of computing or processor machines managed with a kind of software such as middleware, in order to access and use the resources remotely.
>It is a cost effective solution
>Enables heterogeneous resources of computers to work cooperatively and collaboratively to solve a scientific problem.
>Grid computing requires the use of software that can divide and carve out pieces of a program as one large system image to several thousand computers.

CLOUD COMPUTING

1) It is the use of computing resources as a service
2) The internet is visualized as cloud, hence it is called computation done through internet
3) Users can access database resources from anywhere anytime
4) It is a combination of hardware & software
5) Location of physical resources & device access are not known to end user
6) Companies can scale up to massive capacities without having to invest in new infrastructure or license new software
7) Customers use what they need on internet & pay only for what they use

CLOUD VS GRID

Similarities	Differences
1) Both grid & cloud computing are scalable	1) Grid computing is not economically suited for storing small objects such as 1 byte to whereas Cloud computing can store from 1byte to several terabytes
Load balancing of applications running separately on variety of OS & connected through web service.	2) Grid computing focuses on computationally intensive operations whereas
2) Both computing involves multi-tenancy & muti-tasking	Cloud computing focuses on standard & high CPU
3) Both provide service level agreements & pay only for what they use	

CLOUD VS GRID

Basis	On-Premise Private cloud	Outsourced Private Cloud
Location	Usually store in same geographical location of users, else accessed through internet	Located off site and when there is a change of location the data is transmitted through long distances.
Management	Managed by Org. itself	Managed by 3rd party & cloud itself
Network	Network management and network issue resolving are easier and networks have high bandwidth and low latency.	The cloud is fully deployed at 3rd party site & organizations connect either through dedicated connection or Internet.
Performance	Depends on the network & resources	Depends on the 3rd party
SLA	Defined b/w org & its users	Strictly as per 3rd part organization

CLOUD COMPUTING ENVIRONMENT

PUBLIC CLOUD
It is used by general public. This includes individuals, corporations & other types of organizations. Public clouds are administered by 3rd parties or vendors over the internet & the services are offered on pay per use basis.

CHARACTERISTICS
1. **Highly scalable**: The resources being large service providers make sure that all request are granted
2. **Highly available**: Anybody from anywhere can access
3. **Affordable**: User has to pay only for what they are using
4. **Less Secure**: since offered & controlled by 3rd party, it is less secure
5. **Stringent SLA's**: SLA's are strict & violation are avoided

ADVANTAGES
1. No limit on no of users
2. Strict SLA's are followed
3. No infrastructure required for maintaining the cloud
4. Widely used in development, deployment & management of enterprise applications at affordable costs

LIMITATIONS
1. Security assistance is low
2. Privacy & organizational autonomy are not possible

PRIVATE CLOUD
It resides within the boundaries of an organization & is used exclusively for the organizations benefits.

CHARACTERISTICS
1. **Secure**: Since managed by origination, least chance of data being leaked out
2. **Central Control**: No need for organization to rely on anybody & is controlled by organization itself
3. **Affordable**: User has to pay only for what they are using
4. **Weak SLA**: SLA are agreement b/w user & service provider. Formal SLA's do not exist/ are weak in private cloud

ADVANTAGES
1. High level of security & privacy
2. Small in size, controlled & maintained by organization
3. Improves average server utilization

LIMITATIONS
Budget is constraint & they also have loose SLA's

HYBRID CLOUD
- It is a combination of at least one private & one public cloud
- It has private initially & for additional resources public cloud is used
- It is a private cloud extended to the public cloud and aims at utilizing the power of the public cloud by retaining the properties of the private cloud.

CHARACTERISTICS
1. **Scalable**: The hybrid cloud with the help of its public counterpart is also scalable.
2. **Stringent SLAs**: Overall the SLAs are more stringent
3. **Partially Secure**: Private cloud is secured but public cloud has high risk of security breach, so partially secure.
4. **Complex Cloud Management**: Because it involves more than one type of deployment models & high users

ADVANTAGES
1. Highly scalable
2. Better security than public cloud

LIMITATIONS
1. Security features are not as good as public cloud
2. It is complex to manage

COMMUNITY CLOUD
A Private cloud shared b/w several organizations

CHARACTERISTICS
1. **Collaborative and Distributive Maintenance:** Being distributive, better cooperation provides better results.
2. **Cost effective:** The cloud is being shared, so it's cost effective too.
3. **Partially secure:** Since cloud is shared by organization, there is possibility of leakage of data from one organization to another, though safe from external world.

ADVANTAGES
1. Low cost private cloud
2. Allows collaborative work on the cloud.
3. Allows sharing of responsibilities among the organizations.
4. Better security than the public cloud.

LIMITATIONS
1. Autonomy of the organization is lost and security features are not as good as the private cloud.
2. Not suitable where there is no collaboration.

CLOUD COMPUTING SERVICE MODELS

Infrastructure as a Service (IaaS)
It is a hardware-level service, provides computing resources such as processing power, memory, storage, and networks for cloud users to run their application on-demand. This allows users to maximize the utilization of computing capacities.
Examples:
Amazon Web Services (AWS), Google Compute Engine, OpenStack and Eucalyptus.

Characteristics of IaaS
1. **Web access to the resources**: No physical access to server & access made over internet
2. **Centralized management:** Ensures effective resource management & utilization
3. **Shared infrastructure**: one-to-many delivery model and allows multiple IT users to share
4. **Elasticity and Dynamic Scaling**: provide the resources & elastic services where the usage of resources can be increased or decreased as per requirements
5. **Metered Services**: Allows IT users to rent the computing resources instead of buying it & charges is based on amount of usage

Services offered by IaaS
1. **Compute:** Virtual CPU & virtual memory for the virtual machines
2. **Storage: Provides:** Backend storage for virtual machine images & storing files
3. **Network:** Provides virtual networking such as virtual router, switch, and bridge
4. **Load Balancers:** Provide load balancing capability at infrastructure layer

Different instances of IaaS

Database as a Service (DBaaS):
- Provides seamless mechanisms to create, store, and access databases at a host site on demand
- It can be accessed through any Application Programming Interfaces (APIs) or Web User Interfaces

Desktop as a Service (DTaaS):
It is a pay per use cloud service delivery model that enables users to use desktop virtualization without buying or managing their own infrastructure.

Backend as a Service (BaaS):
Provides developers to connect their application to back end cloud storage with new added services.

Network as a Service (NaaS):
- Provides needed data communication capacity to accommodate bursts in data traffic during data-intensive activities
- Operate using three common service models: Virtual Private Network (VPN), Bandwidth on Demand (BoD) and Mobile Virtual Network (MVN).

Storage as a Service (STaaS):
Provides storage infrastructure on a subscription basis at low-cost and convenient way to store data, synchronize data, manage off-site backups, mitigate risks, and preserve records

Platform as a Service (PaaS)
PaaS provides the users the ability to develop and deploy an application on the development platform
Examples:
Google AppEngine, Windows Azure Compute

Characteristics of IaaS
1. **All in One**: Develop, test, deploy, host and maintain applications in the same Integrated Development Environment.
2. **Built-in Scalability**: Capable of handling varying loads efficiently.
3. **Collaborative Platform:** Enables collaboration among developers, most for project planning and communication
4. **Diverse Client Tools:** Offers a wide variety of client tools like Web User Interface (UI), Application Programming Interface (API) etc. & allow developers to choose the tool of their choice.
5. **Offline Access:** Sync data with local IDE & develop locally the app & deploy it online when connected to internet

Services offered by IaaS
1. **Programming Languages:** wide variety of programming languages like Java, PHP, Python, Ruby etc. for the developers to develop applications.
2. **Application Frameworks:** Joomla, WordPress, Sinatra etc. for application development.
3. **Database:** Provide databases like ClearDB, Cloudant, Redis etc. to communicate with database.
4. **Other Tools:** Provides all tools that are required to develop, test, and deploy an application.

Software as a Service (SaaS)
It provides ability to the end users to access an application over the Internet that is hosted and managed by the service provider.
Examples:
Own word document in google doc, edit photo online in pixlr

Characteristics of IaaS
1. **One to Many:** a single instance of the application can be shared by multiple customers.
2. **Web Access:** Allows to access the from any location when device is connected to the Internet.
3. **Centralized Management:** Since hosted and managed from the central location, it provides automatic updates to ensure that each customer is accessing the most recent version
4. **Multi-device Support:** Can be accessed from any end user devices such as desktops, laptops, tablets, smartphones etc.
5. **Better Scalability**: It ensures better scalability than traditional software by deployment of PaaS & IaaS
6. **API Integration:** Capable of integrating with other software/services through standard API
7. **High availability:**

Different instances of SaaS
1. Testing as a Service (TaaS.
2. API as a Service (APIaaS)
3. Email as a Service (EaaS)

OTHER CLOUD SERVICE MODELS

Communication as a Service (CaaS):
It is an outsourced enterprise communication solution that can be leased from a single vender.
Examples are: Voice over IP (VoIP), Instant Messaging (IM), Collaboration and Videoconferencing

Data as a Service (DaaS):
It provides data on demand to a diverse set of users, systems or application. The data may include text, images, sounds, and videos. Data encryption and operating system authentication are commonly provided for security.It is highly used in geography data services and financial data services.

Security as a Service (SECaaS):
It is a new approach to security in which cloud security is moved into the cloud itself whereby cloud service users will be protected from within the cloud using a unified approach to threats. Four mechanisms are Email filtering, Web content filtering, Vulnerability management and Identity management.

Identity as a Service (IDaaS):
It enables users to access the authentication infrastructure that is built, hosted, managed and provided by the third party service provider. It includes directory services, authentication services, risk and event monitoring, single sign-on services, and identity and profile management.

GOALS OF CLOUD COMPUTING
1) To create a highly efficient IT ecosystem
2) To scale the IT ecosystem quickly, easily and cost-effectively based on the evolving business needs
3) To reduce costs related to IT energy/power consumption
4) To enable or improve "Anywhere Access "for ever increasing users
5) To enable rapidly provision resources as needed
6) To access services and data from anywhere at any time
7) To consolidate IT infrastructure

ADVANTAGES OF CLOUD COMPUTING
1. **Almost Unlimited Storage:** Gives almost unlimited storage capacity. So no need to worry about running out of storage space or increasing the current capacity.
2. **Automatic Software Integration:** Software integration occurs automatically & no additional efforts to customize and integrate the applications.
3. **Backup and Recovery:** Since all the data is stored in the cloud, backing it up and restoring the same is relatively much easier.
4. **Cost Efficiency:** It is the most cost efficient method to use, maintain and upgrade. It can significantly lower the company's IT expenses
5. **Easy Access to Information:** One can access the information from anywhere, where there is an Internet connection.
6. **Quick Deployment:** The entire system can be fully functional in a matter of few minutes in case of quick deployment

SECURITY ISSUES/CHALLENGES TO CLOUD COMPUTING
1. **Confidentiality:** Prevention of the unauthorized disclosure of the data & it can be attained by use of TC3 (Total Claim Capture & Control)
2. **Integrity:** Prevention of unauthorized modification of data and it ensures that data is of high quality, correct, consistent and accessible
3. **Availability:** Prevention of unauthorized withholding of data and it ensures the data backup through BCP & DRP
4. **Architecture:** Its reliable and scalable infrastructure is dependent on the design and implementation to support the overall framework. It can significantly lower the company's IT expenses
5. **Audit:** Auditing is type of checking that 'what is happening in the Cloud environment.
6. **Data Stealing:** Some Cloud providers do not use their own server, instead use from other service providers & risk of data stealing occurs.
7. **Privacy:** Most important issue & is embedded in each phase & risk of privacy must be decreased
8. **Software Isolation:** To understand virtualization and other logical isolation techniques

CHARACTERISCTICS OF CLOUD COMPUTING
1. **High Scalability:** Enable servicing for larger audiences through high scalability.
2. **High Availability and Reliability:** Availability of servers is supposed to be high and more reliable as the chances of infrastructure failure are minimal
3. **Agility:** It works in distributed mode & shares resources among users and tasks, improves efficiency
4. **Multi-sharing:** Multiple user & applications can work more efficiently with cost reductions by sharing common infrastructure
5. **Virtualization:** Allows server & storage device to increasingly share & utilize apps by easy migrate
6. **Performance:** Monitored & consistent & loosely coupled architecture are constructed using web services
7. **Maintenance:** They are easier because they are not to be installed on each user system & can be accessed from different places
8. **Services in Pay-Per-Use Mode:** SLA's b/w the provider & user must be defined when complexity of services is offered in pay per use mode

IMPLEMENTATION / ADAPTATION ISSUES OF CLOUD COMPUTING
1. **Threshold Policy:** In order to test if the program works, develops, or improves and implements; a threshold policy is of immense importance in a pilot study before moving the program to the production environment
2. **Interoperability:** If a company outsources or creates applications with one cloud computing vendor, it creates problems of achieving interoperability of applications between two cloud computing vendors
3. **Unexpected Behavior:** It is important to test the application in the cloud with a pilot study to check for unexpected behavior.
4. **Hidden Costs:** The service providers do not reveal 'what hidden costs are'.
5. **Software Development in Cloud:** To develop software using high-end databases, the most likely choice is to use cloud server pools at the internal data corporate centre and extend resources temporarily for testing purposes.
6. **Environment Friendly Cloud Computing:** Cloud computing is more environment friendly as it reduces the number of hardware components needed to run the application

CHAPTER 8: EMERGING TECHNOLOGIES

MOBILE COMPUTING

It refers to the technology that allows transmission of data via a computer without having to be connected to a fixed physical link. Mobile voice communication is widely established throughout the world and has had a very rapid increase in the number of subscribers to the various cellular networks over the last few years. An extension of this technology is the ability to send and receive data across these cellular networks.

COMPONENTS OF MOBILE COMPUTING

Mobile Communication
Infrastructure put in place to ensure that seamless and reliable communication goes on.

Mobile Hardware
This includes mobile devices or device components that receive or access the service of mobility. The characteristics of mobile computing hardware are defined by the size and form factor, weight, microprocessor, primary storage, secondary storage etc.

Mobile Software
It is the actual programme that runs on the mobile hardware and deals with the characteristics and requirements of mobile applications

TANGIBLE BENEFITS OF MOBILE COMPUTING

1. It provides mobile workforce with remote access to work order details
2. Enables mobile sales personnel to update work order status in real-time
3. Facilitates access to corporate services and information
4. Provides remote access to the corporate Knowledgebase
5. Enables to improve management effectiveness by enhancing information quality, information flow, and ability

LIMITATIONS OF MOBILE COMPUTING

1. **Insufficient Bandwidth**:
Mobile Internet access is generally slower than direct cable connections
2. **Security Standards**
Security is major concern, since one can easily attack the VPN through a huge number of networks interconnected through the line.
3. **Power consumption**
Mobile computer rely on expensive batteries when power outlet / portable generator not available
4. **Transmission interferences**
Weather, terrain, and the range from the nearest signal point can all interfere with signal reception
5. **Potential health hazards**
People who use mobile devices while driving are often distracted from driving are thus assumed to be more likely involved in traffic accidents.
6. **Human interface with device:**
Screens and keyboards tend to be small, which may make them hard to use

HOW MOBILE COMPUTING WORKS?

1. The user enters or access data using the application on handheld computing device.
2. The new data are transmitted from handheld to site's information system where files are updated and the new data are accessible to others
3. Now both systems (handheld and site's computer) have the same information and are in sync
4. The process work the same way starting from the other direction.

ISSUES IN MOBILE COMPUTING

SECURITY ISSUES
1. **Confidentiality:** Preventing unauthorized users from gaining access to critical information.
2. **Integrity**: Prevention of unauthorized modification, destruction, creation of information.
3. **Availability**: Ensuring authorized users getting the access they require
4. **Legitimate**: Ensuring that only authorized users have access to services.
5. **Accountability:** Ensuring that the users are held responsible for their security related activities

LOCATION INTELLIGENCE
As the mobile computers move, they encounter networks with different features. It must be able to switch from infrared mode to radio mode & operation to satellite mode when moving from indoor to outdoor & urban to rural.

REVISING THE TECHNICAL ARCHITECTURE
Mobile users are demanding and are important to the business world. The application and data architectures must also be revised to support the demands put upon them by the mobile connectivity.

POWER CONSUMPTION
Mobile computers rely on battery and battery must be capable of longer operation times. Power consumption to be minimized to increase battery life.

BANDWIDTH
Bandwidth utilization can be improved by logging (bulk operations against short requests) and compression of data before transmission.

RELIABILITY, COVERAGE, CAPACITY & COST
Wireless network is less reliable, have less geographic coverage and reduced bandwidth, are slower, and cost more than the wired-line network services

GREEN COMPUTING

It is the study and practice of establishing / using computers and IT resources in a more efficient and environmentally friendly and responsible way. Green computing is the environmentally responsible use of computers & related resources.

GREEN COMPUTING / GREEN IT BEST PRACTICES

Develop a sustainable Green Computing plan
1. **Involve stakeholders** to include checklists, recycling policies, recommendations for purchase & disposal of green computer
2. **Encourage IT community** to use best practices.
3. **Ongoing communication** & campus recruitment to produce notable results

Recycle
1. Dispose e-waste per law
2. Dispose in an environmental friendly manner
3. Recycle computers through manufacturers recycling services

Make environmentally sound purchase decisions
1. Purchase of desktop computers, notebooks and monitors based on environmental attributes
2. Use server & storage virtualization
3. Eliminate environmental sensitive materials
4. Provide a clear, consistent set of performance criteria for the design of products

Reduce Paper Consumption
1. Use e-mail and electronic archiving
2. Print both sides of paper
3. Use online marketing rather than paper based marketing

Conserve Energy
1. Use LCD rather than CRT monitors
2. Use notebooks rather than desktop computers
3. Use the power-management features to turn off hard drives and displays when no activity done
4. Power-down the CPU and all peripherals during inactivity
5. Employ alternative energy sources
6. Adapt more of web conferencing offers instead of travelling

BRING YOUR OWN DEVICE (BYOD)

It refers to business policy that allows employees to use their preferred computing devices, like smart phones and laptops for business purposes. It means employees are welcome to use personal devices to connect to the corporate network to access information and application.

ADVANTAGES OF BYOD
1. **Happy Employees:** Employees love to use their own devices when at work
2. **Lower IT Budgets**: There would be financial savings to the organization since employees would be using the devices they already possess
3. **IT reduces support requirement:** IT department does not have to provide end user support and maintenance for all these devices resulting in cost savings.
4. **Easy Adoption of new technologies:** Employees are generally proactive in adoption of new technologies that result in enhanced productivity of employees leading to overall growth of business.
5. **Increased employee efficiency**: The efficiency of employees is more when the employee works on his/her own device

EMERGING BYOD THREATS
Network Risks
In case of company owned device, it has complete visibility of devices connected to the network which helps to analyze traffic & data exchanged over internet

Device Risks
A lost or stolen device can result in an enormous financial & reputational embarrassment to an organization as the device may hold sensitive corporate information

Application Risks
A majority of employees phones & smart devices that are connected to corporate network aren't protected by security software & organization not as "who is responsible for device security"

Implementation Risks
It must mandate development of a robust implementation policy, as the absence of BYOD policy would fail to communicate employee expectations & increase the chances of device misuse

WEB 2.0

The two major contributors of web 2.0 are
- Technological advances by AJAX
- Other application – RSS, Eclipse
One of the most significant differences between Web 2.0 and the traditional World Wide is that Web 2.0 facilitates greater collaboration and information sharing among Internet users, content providers and enterprises.
Thus migration from the "read-only web" to "read-write web".

APPICATIONS OF WEB 2.0
1. **Social Media:** It is an important application of web 2.0 as it provides a fundamental shift in the way people communicate and share information.
2. **Marketing**: Engages customers in various stages of the product development cycle & allows the marketers to collaborate with consumers on various aspects
3. **Education**: Helps students & faculty with more opportunities to interact & collaborate with their peers in an educations cenario

COMPONENTS OF WEB 2.0
1. Usage of Ajax and other new technologies:
Ajax is a way of developing web applications that combines XHTML and CSS standards-based presentation that allows the interaction with the web page and data interchange with and XSLT
2. Blogging: Blog is a journal, diary, or a personal website that is maintained on the internet, and it is updated frequently by the user
3. Communities: These are an online space formed by a group of individuals to share their thoughts, ideas and have a variety of tools to promote Social Networking
4. Wiki: A Wiki is a set of co-related pages on a particular subject and allow users to share content.
5. Folksonomy: It allows free classification of information available on web using tagging approach
6. File Sharing/Podcasting: This is the facility, which helps users to send their media files and related content online for other people of the network to see and contribute
7. Mashups: People on internet can congregate services from multiple vendors to create a completely new service
8. RSS-generated Syndication: RSS is a format for syndicating web content that allows feed the freshly published web content to the users through the RSS reader

WEB 3.0 /SEMANTIC WEB

- It describes sites wherein the computers will be generated raw data on their own without direct user interaction.
- Web 3.0 is logical step-in evolution of internet & web technologies
- It uses "Data web" technology & described as "Machine to User" standard in internet

COMPONENTS OF WEB 3.0
1. **Semantic Web:** provides the web user a common framework that could be used to share and reuse the data across various applications, enterprises, and community boundaries.
2. **Web Services**: It is a software system that supports computer-to-computer interaction over the Internet.