STUDY MATERIAL

PROFESSIONAL PROGRAMME

INFORMATION TECHNOLOGY AND SYSTEMS AUDIT

MODULE 2

PAPER 4

THE INSTITUTE OF
Company Secretaries of India
IN PURSUIT OF PROFESSIONAL EXCELLENCE
Statutory body under an Act of Parliament

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INFORMATION TECHNOLOGY AND SYSTEMS AUDIT

Technology and Science are transforming our world, changing the way we do business, the way we learn, the way we communicate, and even the way we entertain ourselves. Success in any field – law, medicine, business, education, entertainment, finance and investment – requires a command of technology. As the convergence of Telecommunications and Computing, Information Technology is the foundation of the 21st Century Economy. Company Secretaries Professionals also does not differs from it. In the age of e-filling and XBRL, It is very difficult for a corporate professional like Company Secretaries to survive without knowing the basics of Information Technology and Systems Audit.

Keeping the above in view, the subject Information Technology and Systems Audit have been incorporated at Professional Program. Studying Information Technology and Systems Audit will equip you to understand the basics of Information Technology, E-governance and Information Technology Act. The entire paper has been discussed in eleven study lessons. Every efforts has been made to give a comprehensive coverage of all the topics relevant to the subject and lists, diagrams and examples have been added in the study lesson to make the study easy and understandable.

In order to supplement the information/contents given in the study material, students are advised to refer to the Suggested Readings mentioned in the study material, Student Company Secretary, Business Dailies and Journals. In the event of any doubt, students may write to the Directorate of Academics in the Institute for clarification.

Although care has been taken in publishing this study material, yet the possibility of errors, omissions and/or discrepancies cannot be ruled out. This publication is released with an understanding that the Institute shall not be responsible for any errors, omissions and/or discrepancies or any action taken in that behalf.

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SYLLABUS

MODULE (2) PAPER 4 : INFORMATION TECHNOLOGY AND SYSTEMS AUDIT

Level of Knowledge: Working Knowledge

Objective: *To acquire knowledge of Information Technology Law, Information Systems and Systems Audit.*

Detailed Contents:

1. **Information Technology Law**
   - Information Technology Act – Definitions, Important terms under Information Technology Legislation
   - Digital Signatures
   - Electronic Records
   - Certifying Authority
   - Digital Signature Certificate
   - Cyber Regulation Appellate Tribunal
   - Offences and Penalties
2. **Information Systems**
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   - Computer System: Concept, Types, Categories and Emerging Technologies

- Components of a Computer System
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- Computer Peripherals – Inputs, Output and Storage Devices

4. Computer Software – An Overview

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- Multi-Programming, Multi-Processing, Time Sharing, Batch Processing
- On-Line and Real Time Processing
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- Systems Securities

5. Database Management

- Data Base Concepts
- Data Structure
- Data Base Management System
- Data Base Files
- Data Mining and Warehousing

6. Programming – An overview

- Programming: Concepts, Stages of Programming
- Programme Development Approach
- Algorithm, Flow Charting Concepts
- High Level Languages
- Machine Level Languages

7. Internet and Other Technologies

- Internet and World-Wide Web, Intranets, Extranets, Applications Of Internet, Internet Protocols
- E-Commerce - Nature, Types (B2B, B2C, C2C), Supply Chain Management, CRM, Electronic Data Interchange (EDI), Electronic Fund Transfers (EFT), Payment Portal, E-Commerce Security
- Mobile Commerce, Bluetooth and Wi-Fi

8. Management Information Systems – An Overview

- Concept, Evolution and Elements
- Structure
- Computerized MIS
- Approaches of MIS Development
- Pre-requisites of an Effective MIS(a) Statutory corporations
- MIS and Decision Support Systems
- MIS and Information Resource Management

- Artificial Intelligence and Expert System

9. **Enterprise Resource Management**
10. **E-Governance in India**
11. **Systems Audit – An Overview**
    - Nature, Significance and Scope of Systems Audit
    - Steps Involved in Conducting Systems Audit
    - Systems Audit and Management Functions
    - Systems Audit of Computerized Secretarial Functions
    - Norms and Procedure for Computerization, Computers Control and Security
    - Testing of Computer Systems – Documentation Standards, Policies and Procedures, Audit Approach

LIST OF RECOMMENDED BOOKS

PAPER 4: INFORMATION TECHNOLOGY AND SYSTEMS AUDIT

READINGS

Information Technology and Systems Audit

1. Ramesh Behl : Information Technology for Management, Tata McGraw Hill Education Private Ltd.
2. Jerome Kanter : Managing with Information, Prentice Hall of India
3. P.K. Sinha : Computer Fundamentals: Concepts, Systems and Applications, B.P.B. Publications
4. D.P. Mittal : Law of Information Technology (Cyber Law) with Information Technology (Certifying Authorities) Rules, 2000, Taxmann Pubilcations Pvt. Ltd.
5. Dr. L.M.Prasad and Usha Prasad : Information Systems & Technology, Sultan Chand & Sons
6. Kenneth Laudan Janey P Laudan : Management Information Systems : Pearson Education

*This study material is sufficient for the point of view of syllabus. The students may refer their books for further knowledge and study of the subject.

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LESSON 1

INFORMATION TECHNOLOGY LAW

Lesson 1
Information Technology Law

LESSON OUTLINE

- Information Technology Act, 2000 – Definitions.
- Important terms under Information Technology Legislation.
- Electronic Signatures
- Electronic Records
- Certifying Authority
- Electronic Signature Certificate
- Cyber Appellate Tribunal
- Offences and Penalties

LEARNING OBJECTIVES

In present scenario, Computer and Internet have positively impacted the entire society. Information and Communication Technology has proved to be boon for humanity and it has benefited the human life in many ways. Since with every positive thing, some negatives also creep in, similarly people also started to misuse the wonders of information technology. With a view to upheld the balanced benefits of this technology to society at large, in year 2000, Information Technology Act, 2000 was passed to deal with various matters pertaining to Information Technology, its uses and misuses. Information Technology Act, 2000 provides legal recognition to electronic communication, email, digital signatures, computerized documents and it also provides for legal remedies in case of misuse of Information Technology. It has to be noted that in year 2008 amendment has been done in IT Act, 2000 which was further notified as Information Technology (Amendment) Act, 2008. Hereinafter the Act will refer the IT Act, 2000 including the amendments under IT (Amendment) Act, 2008. After reading this lesson, a student will be able to understand –

- The purpose and objects of Information Technology Act, 2000.
- The meaning and definition of different terms as used in Information technology Act, 2000
- The meaning of digital signatures, electronic records
- The working of certifying authority appointed for issuing digital signatures
- The working of cyber regulation Appellate tribunal
- The consequences of various offences made under the Act and penalty for such offences

An Act to provide legal recognition for transactions carried out by means of electronic data interchange and other means of electronic communication, commonly referred to as "electronic commerce", which involve the use of alternative to paper-based methods of communication and storage of information to facilitate electronic filing of documents with the Government agencies and further to amend the Indian Penal Code, the India Evidence Act, 1872, the Banker's Books Evidence Act, 1891 and the Reserve Bank of India Act, 1934 and for matters connected therewith or incidental thereto.

INTRODUCTION

The United Nations General Assembly by resolution A/RES/51/162, dated the 30 January 1997 has adopted the Model Law on Electronic Commerce as adopted by the United Nations Commission on International Trade Law. This is referred to as the UNCITRAL Model Law on E-Commerce. Following the United Nation(s) Resolution, India passed the Information Technology Act, 2000 in May 2000, which came into force on October 17, 2000.

The Information Technology Act, 2000 was made applicable in India with following objectives

1. To give legal recognition to any transaction which is done electronically or use of internet?
2. To give legal recognition to digital signature for accepting any agreement via computer.
3. To provide facility of filling document online relating to school admission or registration in employment exchange.
4. To provide legal recognition for storage in electronic format.
5. To stop computer crime and protect privacy of internet users.
6. To give legal recognition for keeping books of accounts by bankers and other companies in electronic form.
7. To make more power to IPO, RBI and Indian Evidence Act, 1872 for restricting electronic crime.
8. To amend the Indian Penal Code, 1860, Indian Evidence Act, 1872, The Bankers' Books Evidence Act, 1891 and the Reserve Bank of India Act, 1934

Legislative History of Information Technology Act, 2000

Information Technology Act, 2000 was primarily based on UNICITRAL model law on e-commerce. Attempts were made in year 1998 for introducing law pertaining to Information Technology in India but the Information Technology Act, 2000 was passed only in May, 2000. The Government of India has brought major amendments to Information Technology Act, 2000 in form of the Information Technology (Amendment) Act, 2008. Information Technology (Amendment) Act 2008 is the new version of Information Technology Act, 2000 and it has provided additional focus on Information Security. It has added several new sections on offences including Cyber Terrorism and Data Protection.

Territorial Jurisdiction of the Act: Information Technology Act, 2000 extends to the whole of India including the state of Jammu and Kashmir. Unless otherwise provided in this Act, Information Technology Act, 2000 also applies to any offence or contravention hereunder committed outside India by any person.

Scope of the Act (section 1(4)

Information Technology Act, 2000 is applicable to all electronic transactions except the following –

(a) A negotiable instrument (other than a cheque) as defined in section 13 of the Negotiable Instruments Act, 1881;

(b) A power-of-attorney as defined in section 1A of the Powers of Attorney Act, 1882;

(*c*) A trust as defined in section 3 of the Indian Trusts Act, 1882;

(d) A will as defined in clause *(h)* of section 2 of the Indian Succession Act, 1925 including any other testamentary disposition by whatever name called;

(e) Any contract for the sale or conveyance of immovable property or any interest in such property;

(f) Any such class of documents or transactions as may be notified by the Central Government in the Official Gazette.

Major Definition under I.T Act, 2000

2(1) (a) **"Access"** with its grammatical variations and cognate expressions means gaining entry into, instructing or communicating with the logical, arithmetical, or memory function resources of a computer, computer system or computer network;

2(1) (b) "**Addressee**" means a person who is intended by the originator to receive the electronic record but does not include any intermediary;

2(1) (c) "**Adjudicating officer**" means an adjudicating officer appointed under subsection (1)of section 46;

2(1) (d) **"Affixing digital signature"** with its grammatical variations and cognate expressions means adoption of any methodology or procedure by a person for the purpose of authenticating an electronic record by means of digital signature;

2(1) (e) "**Appropriate Government**" means as respects any matter, –

(i) Enumerated in List II of the Seventh Schedule to the Constitution;

(ii) Relating to any State law enacted under List III of the Seventh Schedule to the Constitution, the State Government and in any other case, the Central Government;

2(1) (f) "**Asymmetric crypto system**" means a system of a secure key pair consisting of a Private Key for creating a digital signature and a Public Key to verify the digital signature;

2(1) (g) "**Certifying Authority**" means a person who has been granted a license to issue a Digital Signature Certificate under section 24;

2(1) (h) "**Certification practice statemen**t" means a statement issued by a Certifying Authority to specify the practices that the Certifying Authority employs in issuing Digital Signature Certificates;

2(1) (i) "**Computer"** means any electronic magnetic, optical or other high-speed data processing device or system which performs logical, arithmetic, and memory functions by manipulations of electronic, magnetic or optical impulses, and includes all input, output, processing, storage, computer software, or communication facilities which are connected or related to the computer in a computer system or computer network;

2(1) (j) "**Computer network**" means the interconnection of one or more computers through –

(i) The use of satellite, microwave, terrestrial line or other communication media; and

(ii) Terminals or a complex consisting of two or more interconnected computers whether or not the interconnection is continuously maintained;

2(1) (l) "**Computer system**" means a device or collection of devices, including input and output support devices and excluding calculators which are not programmable and capable of being used in conjunction with external files, which contain computer programmes, electronic instructions, input data and output data, that performs logic, arithmetic, data storage and retrieval, communication control and other functions;

2(1) (m) "**Controller"** means the Controller of Certifying Authorities appointed under sub-section (I) of section 17;

2(1) (n) "**Cyber Appellate Tribunal**" means the Cyber Regulations Appellate Tribunal established under sub-section (1) of section 48;

2(1) (o) "**Data**" means a representation of information, knowledge, facts, concepts or instructions which are being prepared or have been prepared in a formalized manner, and is intended to be processed, is being processed or has been processed in a computer system or computer network, and may be in any form (including computer printouts magnetic or optical storage media, punched cards, punched tapes) or stored internally in the memory of the computer;

2(1) (p) "**Digital signature**" means authentication of any electronic record by a subscriber by means of an electronic method or procedure in accordance with the provisions of section 3;

2(1) (q) **"Digital Signature Certificate**" means a Digital Signature Certificate issued under subsection *(4)* of section 35;

2(1) (r) "**Electronic form**" with reference to information means any information generated, sent, received or stored in media, magnetic, optical, computer memory, micro film, computer generated micro fiche or similar device;

2(1) (s) "**Electronic Gazette**" means the Official Gazette published in the electronic form;

2(1) (t) "**Electronic record**" means data, record or data generated, image or sound stored, received or sent in an electronic form or micro film or computer generated micro fiche;

2(1) (v) "**Information**" includes data, text, images, sound, voice, codes, computer programmes, software and databases or micro film or computer generated micro fiche:

2(1) (w) "**Intermediary**" with respect to any particular electronic message means any person who on behalf of another person receives, stores or transmits that message or provides any service with respect to that message;

2(1) (x) "**Key pair**", in an asymmetric crypto system, means a private key and its mathematically related public key, which are so related that the public key can verify a digital signature created by the private key;

2(1) (za) "**Originator"** means a person who sends, generates, stores or transmits any electronic message or causes any electronic message to be sent, generated, stored or transmitted to any other person but does not include an intermediary;

2(1) (zc) "**Private Key**" means the key of a key pair used to create a digital signature;

2(1) (zd) "**Public Key**" means the key of a key pair used to verify a digital signature and listed in the Digital Signature Certificate;

2(1) (ze) "**Secure system**" means computer hardware, software, and procedure that –

(a) Are reasonably secure from unauthorized access and misuse;

(b) Provide a reasonable level of reliability and correct operation;

(c) Are reasonably suited to performing the intended functions; and

(d) Adhere to generally accepted security procedures;

2(1) (zh) "**Verify**" in relation to a digital signature, electronic record or public key, with its grammatical variations and cognate expressions means to determine whether –

(a) The initial electronic record was affixed with the digital signature by the use of private key corresponding to the public key of the subscriber;

(b) The initial electronic record is retained intact or has been altered since such electronic record was so affixed with the digital signature.

Further, in explanation to Section 43 and Section 43A of the Information Technology Act, 2000 defines the following terms

(i) "Computer contaminant" means any set of computer instructions that are designed –

(a) to modify, destroy, record, transmit data or programme residing within a computer, computer system or computer network; or

(b) by any means to usurp the normal operation of the computer, computer system, or computer network;

(ii) "computer data base" means a representation of information, knowledge, facts, concepts or instructions in text, image, audio, video that are being prepared or have been prepared in a formalised manner or have been produced by a computer, computer system or computer network and are intended for use in a computer, computer system or computer network;

(iii) "computer virus" means any computer instruction, information, data or programme that destroys, damages, degrades or adversely affects the performance of a computer resource or attaches itself to another computer resource and operates when a programme, data or instruction is executed or some other event takes place in that computer resource;

(iv) "damage" means to destroy, alter, delete, add, modify or rearrange any computer resource by any means

(v) "Computer Source code" means the listing of programmes, computer commands, design and layout and programme analysis of computer resource in any form (Inserted vide ITAA 2008)

(vi) "Body corporate" means any company and includes a firm, sole proprietorship or other association of individuals engaged in commercial or professional activities;

(vii) "Reasonable security practices and procedures" means security practices and procedures designed to protect such information from unauthorized access, damage, use, modification, disclosure or impairment, as may be specified in an agreement between the parties or as may be specified in any law for the time being in force and in the absence of such agreement or any law, such reasonable security practices and procedures, as may be prescribed by the Central Government in consultation with such professional bodies or associations as it may deem fit;

(viii) "Sensitive personal data or information" means such personal information as may be prescribed by the Central Government in consultation with such professional bodies or associations as it may deem fit.

Explanation to Section 66 E of the Information Technology Act, 2000 defines the following terms.

(*a*) "Transmit" means to electronically send a visual image with the intent that it be viewed by a person or persons;

(*b*) "Capture", with respect to an image, means to videotape, photograph, film or record by any means;

(*c*) "Private area" means the naked or undergarment clad genitals, pubic area, buttocks or female breast:

(*d*) "Publishes" means reproduction in the printed or electronic form and making it available for public;

(*e*) "under circumstances violating privacy" means circumstances in which a person can have a reasonable expectation that –

(*i*) he or she could disrobe in privacy, without being concerned that an image of his private area was being captured; or

(*ii*) any part of his or her private area would not be visible to the public regardless of whether that person is in a public or private place.

DIGITAL SIGNATURE

As per Section *2(1) (p) of Information Technology Act, 2000* "**Digital signature**" means authentication of any electronic record by a subscriber by means of an electronic method or procedure in accordance with the provisions of section 3;

Before going into details about provisions relating to digital signature, here it is important to understand the basic concepts relating to digital signature.

What is a digital signature?

A Digital signature (standard electronic signature) takes the concept of traditional paper-based signing and turns it into an electronic "fingerprint". This fingerprint or coded message, is unique to both the document and the signer and binds both of them together. The digital signature ensures the authenticity of the signer. Any changes made to the document after it is signed invalidate the signature, thereby protecting against signature forgery and information tampering. Digital signatures help organizations to sustain signer authenticity, accountability, data integrity and non-repudiation of electronic documents and forms.

Who issues digital Signature?

A digital signature is issued by a Certifying Authority (CA) and is signed with the CA's private key. A digital signature/electronic signature typically contains the: Owner's public key, the Owner's name, Expiration date of the public key, the Name of the issuer (the CA that issued the Digital ID), Serial number of the digital signature, and the digital signature of the issuer. Digital signatures deploy the Public Key Infrastructure (PKI) technology.

Whether digital Signature is permitted/recognized in India?

In India, recognition to digital signature has been given under Income Tax Act, 1961 and Companies Act, 2013. As per provisions of Companies Act, 2013, directors of the companies are required to sign their document by means of digital signature only. Similarly if one file his Income Tax return electronically using digital signature he does not need to submit a physical copy of the return. While in case of paper based signature, one need to physically submit the printed copy of the filled up Form along with the copy of the Provisional Acknowledgement Number of e-Return.

Provisions relating to Digital Signature and/or Electronic Signature

As per section 3 of Information Technology Act, 2000 as amended, any subscriber may authenticate an electronic record by affixing his digital signatures. The authentication of the electronic records shall be effected by the use of asymmetric crypto system and hash function which envelops and transform the electronic records into another electronic record.

Explanation to Section 3 of the Information Technology Act, 20000 defines hash function. As per the explanation provided, "hash function" means an algorithm mapping or translation of one sequence of bits into another, generally smaller, set known as "hash result" such that an electronic record yields the same hash result every time the algorithm is executed with the same electronic record as its input making it computationally infeasible—

(a) To derive or reconstruct the original electronic record from the hash result produced by the algorithm;

(b) That two electronic records can produce the same hash result using the algorithm.

Any person by the use of a public key of the subscriber can verify the electronic record. Here, the private key and the public key are unique to the subscriber and constitute a functioning key pair.

Electronic Signature

The provisions relating to electronic signature have been added by IT Information Technology (Amendment) Act, 2008. Section 3A of Information Technology Act, 2000 provides for authentication of electronic record by such electronic signature or electronic authentication technique which is considered reliable.

Any electronic signature or electronic authentication technique shall be considered reliable if –

(*a*) the signature creation data or the authentication data are, within the context in which they are used, linked to the signatory or, as the case may be, the authenticator and to no other person;

(*b*) the signature creation data or the authentication data were, at the time of signing, under the control of the signatory or, as the case may be, the authenticator and of no other person;

(*c*) any alteration to the electronic signature made after affixing such signature is detectable;

(*d*) any alteration to the information made after its authentication by electronic signature is detectable; and

(*e*) it fulfils such other conditions which may be prescribed.

ELECTRONIC RECORDS

As per Section 2(t) of Information Technology Act, 2000, "Electronic Record" means data, record or data generated, image or sound stored, received or sent in an electronic form or micro film or computer generated micro fiche;

Authentication of electronic records

As per Section 3 of Information Technology Act, 2000, any subscriber may authenticate an electronic record by affixing his digital signature. The authentication of the electronic record are affected by the use of asymmetric crypto system and hash function which envelop and transform the initial electronic record into another electronic record. 'Hash function' means an algorithm mapping or translation of one sequence of bits into another, generally smaller, set known 'as "hash result". An electronic record yields the same hash result every time the algorithm is executed with the same electronic record as its input making it computationally infeasible –

(a) to derive or reconstruct the original electronic record from the hash result produced by the algorithm;

(b) that two electronic records can produce the same hash result using the algorithm.

The private key and the public key are unique to the subscriber and constitute a functioning key pair. The electronic records can be verified by a person by the use of a public key of the subscriber.

Legal Recognition to Electronic Records

Section 4 of Information Technology Act, 2000 provides legal recognition to Electronic Records. As per Section 4 of the Act, where any law provides that information or any other matter shall be in writing or in the typewritten or printed form, then, notwithstanding anything contained in such law, such requirement shall be deemed to have been satisfied if such information or matter is rendered or made available in an electronic form; and accessible so as to be usable for a subsequent reference.

Use of Electronic Records

As per Section 6 of Information Technology Act, 2000, where any law provides for the filing of any form application or any other document with any office, authority, body or agency owned or controlled by the appropriate Government in a particular manner; and the issue or grant of any licence, permit, sanction or approval by whatever name called in a particular manner; and the receipt or payment of money in a particular manner, then, notwithstanding anything contained in any other law for the time being in force, such requirement shall be deemed to have been satisfied if such filing, issue, grant, receipt or payment, as the case may be, is effected by means of such electronic form as may be prescribed by the appropriate Government.

Retention of Electronic Records

Section 7 of the Information Technology Act, 2000 provides for retention of records in electronic format. Where any law provides that documents, records or information shall be retained for any specific period, then, that requirement shall be deemed to have been satisfied if such documents, records or information are retained in the electronic form, provided –

(a) the information contained therein remains accessible so as to be usable for a subsequent reference;

(b) the electronic record is retained in the format in which it was originally generated, sent or received or in a format which can be demonstrated to represent accurately the information originally generated, sent or received;

(c) the details which will facilitate the identification of the origin, destination, date and time of dispatch or receipt of such electronic record are available in the electronic record:

Provided that this clause does not apply to any information which is automatically generated solely for the purpose of enabling an electronic record to be dispatched or received. These provisions will not apply to any law that expressly provides for the retention of documents, records or information in the form of electronic records.

Audit of Electronic Records

As per Section 7A of Information Technology Act, 2000 where in any law, there is a provision of audit of documents, records or information, that provision shall also be applicable for audit of documents, records or information maintained in the electronic form.

Validity of Contracts formed through electronic means

Section 10A of the Information Technology Act, 2000 provides that where in a contract formation, the communication of proposals, the acceptance of proposals, the revocation of proposals and acceptances, are expressed in electronic form or by means of an electronic records, such contract shall not be deemed to be unenforceable solely on the ground that such electronic form or means are used for that purpose.

Attribution of electronic records

Section 11 of Information Technology Act, 2000 provides that an electronic record shall be attributed to the originator if it was sent by the originator himself; or by a person who had the authority to act on behalf of the originator in respect of that electronic record; or by an information system programmed by or on behalf of the originator to operate automatically.

Acknowledgment of receipt of electronic record

Section 12 of Information Technology Act, 2000 provides where the originator has not agreed that the acknowledgment of receipt of electronic record be given in a particular form or by a particular method, an acknowledgment may be given by –

(a) any communication by the addressee, automated or otherwise; or

(b) any conduct of the addressee, sufficient to indicate to the originator that the electronic record has been received.

Where the originator has stipulated that the electronic record shall be binding only on receipt of an acknowledgment of such electronic record by him, then unless acknowledgment has been so received, the electronic record shall be deemed to have been never sent by the originator.

Where the originator has not stipulated that the electronic record shall be binding only on receipt of such acknowledgment, and the acknowledgment has not been received by the originator within the time specified or agreed or, within a reasonable time, then the originator may give notice to the addressee stating that no acknowledgment has been received by him and specifying a reasonable time by which the acknowledgment must be received by him and if no acknowledgment is received within the aforesaid time limit he may after giving notice to the addressee, treat the electronic record as though it has never been sent.

Time and place of dispatch and receipt of electronic record

Section 13 of the Information Technology Act, 2000 contains the provisions relating to ascertainment of time and place of dispatch and receipt of electronic records. Unless agreed otherwise between the originator and the addressee, the dispatch of an electronic record occurs when it enters a computer resource outside the control of the originator.

If the addressee has designated a computer resource for the purpose of receiving electronic records, receipt occurs at the time when the electronic record enters the designated computer resource; or if the electronic record is sent to a non designated computer resource of the addressee, receipt occurs at the time when the electronic record is retrieved by the addressee;

If the addressee has not designated a computer resource along with specified timings, if any, receipt occurs when the electronic record enters the computer resource of the addressee.

Unless agreed otherwise, an electronic record is deemed to be dispatched at the place where the originator has his place of business, and is deemed to be received at the place where the addressee has his place of business. If the originator or the addressee has more than one place of business, the principal place of business shall be the place of business. If the originator or the addressee does not have a place of business, his usual place of residence shall be deemed to be the place of business.

Certifying Authority

A Certifying Authority is a trusted body whose central responsibility is to issue, revoke, renew and provide directories of electronic Certificates. According to section 2(g) of Information Technology Act, 2000, “Certifying Authority” means a person who has been granted a license to issue Electronic Signature Certificates.

Application for becoming certifying Authority

Any person may make an application, to the Controller of certifying authorities, for a license to issue Electronic Signature Certificates provided he fulfills the Central Government prescribed requirements with respect to qualification, expertise, manpower, financial resources and other infrastructure facilities, which are necessary to issue electronic Signature Certificates

A license granted for issuing Electronic Signature Certificate is valid for 5 years and it is not transferable or heritable. The license is subject to the terms and conditions as prescribed by Information Technology (Certifying Authorities) Rules, 2000

Every application for issue of a license shall be in made in form as prescribed by Schedule-I of Information Technology (Certifying Authorities) Rules, 2000 and the application shall be accompanied by a certification practice statement; A statement including the procedures with respect to identification of the applicant; Payment of fees of twenty-five thousand rupees and other documents, as prescribed by Information Technology (Certifying Authorities) Rules, 2000

Renewal of license

A Certifying Authority can apply for renewal of license not less than forty-five days before the date of expiry of the period of validity of licence and comply all the rules of Information Technology (Certifying Authorities) Rules, 2000 which are applied in case of fresh application for becoming certifying Authority.

The Controller may, on receipt of an application for appointment as certifying authority, after considering the documents accompanying the application and such other factors, as he deems fit, grant the licence or reject the application: No application for becoming certifying Authority shall be rejected under unless the applicant has been given a reasonable opportunity of presenting his case.

Suspension of license of a Certifying Authority for issuing electronic signature certificates

The Controller of Certifying Authority may revoke the license of certifying authority, if after proper enquiry, he is satisfied that a certifying authority has made a false or incorrect statement in material particulars in, or in relation to, the application for the issue or renewal of the license and/or it has failed to comply with the terms and conditions subject to which the license was granted and/or it has failed to maintain the standards as specified and/or contravened any provisions of the Act, rule, regulation or order made there under. However no license

shall be revoked unless the Certifying Authority has been given a reasonable opportunity of showing cause against the proposed revocation.

The Controller of Certifying Authority may, if he has reasonable cause to believe that there is any ground for revoking a license, by order suspend such license pending the completion of any inquiry ordered by him provided no license shall be suspended for a period exceeding ten days unless the Certifying Authority has been given a reasonable opportunity of showing cause against the proposed suspension. The Certifying Authority whose licence has been suspended will not issue any Digital Signature Certificate during such suspension.

Certifying Authority to follow certain procedures

Every Certifying Authority shall make use of hardware, software and procedures that are secure from intrusion and misuse and it will provide a reasonable level of reliability in its services which are reasonably suited to the performance of intended functions. It will adhere to security procedures to ensure that the secrecy and privacy of the digital signatures are assured; and observe such other standards as may be specified by regulations.

Disclosures by Certifying Authority

Every Certifying Authority shall disclose in the manner specified by regulations—(a) its Electronic Signature (b) any certification practice statement relevant thereto; (c) notice of the revocation or suspension of its Certifying Authority certificate, if any; and (d) any other fact that materially and adversely affects either the reliability of a Electronic Signature Certificate, which that Authority has issued, or the Authority's ability to perform its services.

Where in the opinion of the Certifying Authority any event has occurred or any situation has arisen which may materially and adversely affect the integrity of its computer system or the conditions subject to which a Electronic Signature Certificate was granted, then, the Certifying Authority shall use reasonable efforts to notify any person who is likely to be affected by that occurrence; or act in accordance with the procedure specified in its certification practice statement to deal with such event or situation.

Controller of Certifying Authority

As per Section 17 of IT Act, 2000 as amended, the Central Government may, by notification in the Official Gazette, appoint a Controller of Certifying Authorities and such number of Deputy Controllers and Assistant Controllers as it deems fit for the purpose of this Act.

The Controller shall discharge his functions under this Act subject to the general control and directions of the Central Government, and Deputy Controllers and Assistant Controllers shall perform the functions assigned to them by the Controller under the general superintendence and control of the Controller.

Functions of the Controller

The Controller may perform all or any of the following functions, namely:–

(a) Exercising supervision over the activities of the Certifying Authorities;

(b) Certifying public keys of the Certifying Authorities;

(c) Laying down the standards to be maintained by the Certifying Authorities;

(d) Specifying the qualifications and experience which employees of the Certifying Authorities should possess;

(e) Specifying the conditions subject to which the Certifying Authorities shall conduct their business;

(f) Specifying the contents of written, printed or visual materials and Advertisements that may be distributed or used in respect of a Digital Signature Certificate and the public key;

(g) Specifying the form and content of a Digital Signature Certificate and the Key,

(h) Specifying the form and manner in which accounts shall be maintained by The Certifying Authorities;

(i) Specifying the terms and conditions subject to which auditors may be Appointed and the remuneration to be paid to them;

(j) Facilitating the establishment of any electronic system by a Certifying Authority either solely or jointly with other Certifying Authorities and regulation of such systems;

(k) Specifying the manner in which the Certifying Authorities shall conduct their Dealings with the subscribers;

(l) Resolving any conflict of interests between the Certifying Authorities and the Subscribers;

(m) Laying down the duties of the Certifying Authorities;

(n) Maintaining a data base containing the disclosure record of every Certifying

(o) Authority containing such particulars as may be specified by regulations, which shall Be accessible to public.

Recognition of foreign Certifying Authorities

The Controller of Certifying Authority may recognize the foreign Certifying Authority with the prior approval of the Central Government provided the foreign Certifying Authority fulfill the prescribed conditions and restrictions. Where any foreign Certifying Authority is recognized, the Electronic Signature Certificate issued by such Certifying Authority shall be valid for the purposes of this Act. The Controller may, if he is satisfied that any Certifying Authority has contravened any of the conditions and restrictions subject to which it was granted recognition, he may, for reasons to be recorded in writing, by notification in the Official Gazette, revoke such recognition.

ELECTRONIC SIGNATURE CERTIFICATES

The provisions relating to Electronic Signature Certificate are contained in Section 35-39 of Information Technology Act, 2000. It provides that Certifying Authority will issue Electronic Signature Certificate on an application by a person in the form prescribed by the Central government. The application should be accompanied by a fee not exceeding Rs. 25,000/- and a certificate practice statement or where there is no such statement, a statement containing such particulars, as may be specified by regulations.

On receipt of an application, the Certifying Authority may, after consideration of the certification practice statement or the other prescribed statement and after making such enquiries as it may deem fit, grant the Electronic Signature Certificate or for reasons to be recorded in writing, reject the application, however no application shall be rejected unless the applicant has been given a reasonable opportunity of showing cause against the proposed rejection.

Representations upon issuance of Digital Signature Certificate

Section 36 of Information Technology Act, 2000 provides that –

A Certifying Authority while issuing a Digital Signature Certificate shall certify that –

(a) it has complied with the provisions of this Act and the rules and regulations made thereunder,

(b) it has published the Digital Signature Certificate or otherwise made it available to such person relying on it and the subscriber has accepted it;

(c) the subscriber holds the private key corresponding to the public key, listed in the Digital Signature Certificate;

(ca) The subscriber holds a private key which is capable of creating a digital signature:

(cb) The public key to be listed in the certificate can be used to verify a digital signature affixed by the private

key held by the subscriber;

(d) the subscriber's public key and private key constitute a functioning key pair,

(e) the information contained in the Digital Signature Certificate is accurate; and

(f) it has no knowledge of any material fact, which if it had been included in the Digital Signature Certificate would adversely affect the reliability of the representations made in clauses (a) to (d).

Suspension of Digital Signature Certificate

The provisions relating to Suspension of Digital Signature Certificate are contained in Section 37 of IT Act, 2000 as amended. This provides that the Certifying Authority which has issued a Digital Signature Certificate may suspend such Digital Signature Certificate, –

(a) on receipt of a request to that effect from

(i) the subscriber listed in to Digital Signature Certificate; or

(ii) any person duly authorized to act on behalf of that subscriber,

(b) if it is of opinion that the Digital Signature Certificate should be suspended in public interest

(2) A Digital Signature Certificate shall not be suspended for a period exceeding fifteen days unless the subscriber has been given an opportunity of being heard in the matter.

(3) On suspension of a Digital Signature Certificate under this section, the Certifying Authority shall communicate the same to the subscriber.

Revocation of Digital Signature Certificate

The provisions relating to Suspension of Digital Signature Certificate are contained in Section 38 of Information Technology Act, 2000

(1) A Certifying Authority may revoke a Digital Signature Certificate issued by it:

(a) where the subscriber or any other person authorized by him makes a request to that effect; or

(b) upon the death of the subscriber, or

(c) upon the dissolution of the firm or winding up of the company where the subscriber is a firm or a company.

(2) Subject to the provisions of sub-section (3) and without prejudice to the provisions of sub-section (1), a Certifying Authority may revoke a Digital Signature Certificate which has been issued by it at any time, if it is of opinion that –

(a) a material fact represented in the Digital Signature Certificate is false or has been concealed;

(b) a requirement for issuance of the Digital Signature Certificate was not satisfied;

(c) the Certifying Authority's private key or security system was compromised in a manner materially affecting the Digital Signature Certificate's reliability;

(d) the subscriber has been declared insolvent **or** dead or where a subscriber is a firm or a company, which has been dissolved, wound-up **or** otherwise ceased to exist

(3) A Digital Signature Certificate shall not be revoked unless the subscriber has been given an opportunity of being heard in the matter.

(4) On revocation of a Digital Signature Certificate under this section, the Certifying Authority shall communicate the same to the subscriber.

Notice of suspension or revocation

The provisions relating to Suspension of Digital Signature Certificate are contained in Section 39 of IT Act, 2000 as amended.

(1) Where a Digital Signature Certificate is suspended or revoked under section 37 or section 38, the Certifying Authority shall publish a notice of such suspension or revocation, as the case may be, in the repository specified in the Digital Signature Certificate for publication of such notice.

(2) Where one or more repositories are specified, the Certifying Authority shall publish notices of such suspension or revocation, as the case may he. in all such repositories.

CYBER APPELLATE TRIBUNAL (CAT)

Cyber Appellate Tribunal has been established by the Central Government in accordance with the provisions under Section 48(1) of the Information Technology Act, 2000 under the aegis of Controller of Certifying Authorities (C.C.A.).

Composition of Cyber Appellate Tribunal

The composition of the Cyber Appellate Tribunal is provided for under section 49 of the Information Technology Act, 2000. Initially the Tribunal consisted of only one person who was referred to as the Presiding Officer but in year 2008, the composition of Cyber Appellate Tribunal was changed.

As per the amended sections, the Tribunal shall consist of a Chairperson and such number of other Members as the Central Government may by notification in the Official Gazette appoint. The selection of the Chairperson and Members of the Tribunal is made by the Central Government in consultation with the Chief Justice of India. The Presiding Officer of the Tribunal is now known as the Chairperson.

Bench of Cyber Appellate Tribunal

The Chairperson of the Cyber Appellate Tribunal may constitute a Bench of the tribunal consisting with one or two members of such Tribunal as the Chairperson may deem fit. Every bench of the tribunal shall be presided over by the Chairperson or the Judicial Member appointed under sub-section (3) of section 50 of the Information Technology Act, 2000. The bench of the tribunal may exercise the jurisdiction, powers and authority of the Cyber Appellate Tribunal. The Benches of the Cyber Appellate Tribunal shall sit at New Delhi and at such other places as the Central Government may, in consultation with the Chairperson of the Cyber Appellate Tribunal, by notification in the Official Gazette, specify. The central government will notify the areas in relation to which each Bench of the Cyber Appellate Tribunal may exercise its jurisdiction. The chairman of the appellate tribunal has been given the power of transferring a member of tribunal from bench to another bench of the tribunal. If at any stage of the hearing of any case or matter, it appears to the Chairperson or a Member of the Cyber Appellate Tribunal that the case or matter is of such a nature that it ought to be heard by a Bench consisting of more Members, the case or matter may be transferred by the Chairperson to such Bench as the Chairperson may deem fit.

Qualification for appointment as Chairperson and Members of Cyber Appellate Tribunal

Section 50 of the Information Technology Act, 2000 provides the qualification for appointing a person as the chairperson or members of the Central Appellate Tribunal

A person shall not be qualified for appointment as a Chairperson of the Cyber Appellate Tribunal unless he is, or has been, or is qualified to be, a Judge of a High Court. The Members of the Cyber Appellate Tribunal, except the Judicial Member shall be appointed by the Central Government from amongst persons, having special knowledge of, and professional experience in, information technology, telecommunication, industry, management or consumer affairs provided such person is in the service of the Central Government or a States Government, and has held the post of Additional Secretary to the Government of India or any equivalent post in the Central

Government or State Government for a period of not less than one year or Joint Secretary to the Government of India or any equivalent post in the Central Government or State Government for a period of not less than seven years.

The Judicial Members of the Cyber Appellate Tribunal shall be appointed by the Central Government from amongst persons who is or has been a member of the Indian Legal Service and has held the post of Additional Secretary for a period of not less than one year or Grade I post of that Service for a period of not less than five years.

Term of office, conditions of service etc of Chairperson and Members

The Chairperson or Member of the Cyber Appellate Tribunal shall hold office for a term of five years from the date on which he enters upon his office or until he attains the age of sixty five years, whichever is earlier. Before appointing any person as the Chairperson or Member of the Cyber Appellate Tribunal, the Central Government shall satisfy itself that the person does not have any such financial or other interest as is likely to affect prejudicially his functions as such Chairperson or Member. An officer of the Central Government or State Government on his selection as the Chairperson or Member of the Cyber Appellate Tribunal, as the case may be, shall have to retire from service before joining as such Chairperson or Member.

Resignation and Removal

(1) The Presiding officer Chairperson or Member of the Cyber Appellate Tribunal may, by notice in writing under his hand addressed to the Central Government, resign his office Provided that the said Presiding officer Chairperson or Member shall, unless he is permitted by the Central Government to relinquish his office sooner, continue to hold office until the expiry of three months from the date of receipt of such notice or until a person duly appointed as his successor enters upon his office or until the expiry of his term of office, whichever is the earliest.

(2) The Presiding officer Chairperson or Member of a Cyber Appellate Tribunal shall not be removed from his office except by an order by the Central Government on the ground of proved misbehaviour or incapacity after an inquiry made by a Judge of the Supreme Court in which the Chairperson or Member concerned has been informed of the charges against him and given a reasonable opportunity of being heard in respect of these charges.

(3) The Central Government may, by rules, regulate the procedure for the investigation of misbehaviour or incapacity of the aforesaid Presiding officer Chairperson or Member.

Powers of the Chairman of Cyber Appellate Tribunal

The Chairperson of the Cyber Appellate Tribunal shall have powers of general superintendence and directions in the conduct of the affairs of that Tribunal and he shall, in addition to presiding over the meetings of the Tribunal, exercise and discharge such powers and functions of the Tribunal as may be prescribed. Where Benches are constituted, the Chairperson of the Cyber Appellate Tribunal may, by order, distribute the business of that Tribunal amongst the Benches and also the matters to be dealt with by each Bench. On the application of any of the parties and after notice to the parties, and after hearing such of them as he may deem proper to be heard, or suo motu without such notice, the Chairperson of the Cyber Appellate Tribunal may transfer any case pending before one Bench, for disposal to any other Bench

Appeal to Cyber Appellate Tribunal

Any person aggrieved by an order made by a Controller or an adjudicating officer under this Act may prefer an appeal to a Cyber Appellate Tribunal having jurisdiction in the matter. If an order is made by the adjudicating officer with the consent of the parties, No appeal shall lie to the Cyber Appellate Tribunal. Every appeal shall be filed within a period of forty-five days from the date on which a copy of the order made by the Controller or

adjudicating officer is received by the person aggrieved and it shall be in such form and be accompanied by such fee as may be prescribed. However the Cyber Appellate Tribunal may entertain an appeal even after the expiry of the said period of forty-five days if it is satisfied that there was sufficient cause for not filing it within that period. On receipt of an appeal, the Cyber Appellate Tribunal may, after giving the parties to the appeal, an opportunity of being heard, pass such orders thereon as it thinks fit, confirming, modifying or setting aside the order appealed against. The Cyber Appellate Tribunal shall send a copy of every order made by it to the parties to the appeal and to the concerned Controller or adjudicating officer. The appeal filed before the Cyber Appellate Tribunal shall be dealt with by it as expeditiously as possible and endeavour shall be made by it to dispose of the appeal finally within six months from the date of receipt of the appeal.

Procedure and Powers of the Cyber Appellate Tribunal

The Cyber Appellate Tribunal shall not be bound by the procedure laid down by the Code of Civil Procedure, 1908 but shall be guided by the principles of natural justice and, subject to the other provisions of this Act and of any rules, the Cyber Appellate Tribunal shall have powers to regulate its own procedure including the place at which it shall have its sittings.

For the purposes of discharging their functions under this Act, The Cyber Appellate Tribunal shall have the same powers as are vested in a civil court under the Code of Civil Procedure, 1908, while trying a suit, in respect of the following matters, namely -

(a) Summoning and enforcing the attendance of any person and examining him on oath;

(b) requiring the discovery and production of documents or other electronic records;

(c) receiving evidence on affidavits;

(d) issuing commissions for the examination of witnesses or documents;

(e) reviewing its decisions;

(f) dismissing an application for default or deciding it ex parte

(g) any other matter which may be prescribed

Every proceeding before the Cyber Appellate Tribunal shall be deemed .to be a judicial proceeding and the Cyber Appellate Tribunal shall be deemed to be a civil court for the purposes of section 195 and Chapter XXVI of the Code of Criminal Procedure, 1973.

Appeal to High Court

Any person aggrieved by any decision or order of the Cyber Appellate Tribunal may file an appeal to the High Court within sixty days from the date of communication of the decision or order of the Cyber Appellate Tribunal to him on any question of fact or law arising out of such order however the High Court may, if it is satisfied that the appellant was prevented by sufficient cause from filing the appeal within the period of 60 days may allow it to be filed within a further period not exceeding sixty days.

Compounding of Contravention

Section 63 of the Information Technology Act, 2000 provides for the compounding of contravention under this Act. Any contravention under this Act may, either before or after the institution of adjudication proceedings, be compounded by the Controller or an officer person authorized by him, subject to such conditions as the Controller or such other officer or the adjudicating officer may specify: Provided that such sum shall not, in any case, exceed the maximum amount of the penalty which may be imposed under this Act for the contravention so compounded. No compounding of contravention may be done to a person who commits the same or similar contravention within a period of three years from the date on which the first contravention, committed by him, was compounded. Where any contravention has been compounded, no proceeding or further proceeding, as

the case may be, shall be taken against the person guilty of such contravention in respect of the contravention so compounded.

OFFENCES AND PENALTIES UNDER INFORMATION TECHNOLOGY ACT, 2000

Computer related offence

Section 65 to Section 67 of the Information Technology Act, 2000 deals with computer related offences. Computer related offences have been defined in section 43 of the Information Technology Act, 2000 which provides that If any person without permission of the owner or any other person who is in-charge of a computer, computer system or computer network, –

(a) accesses or secures access to such computer, computer system or computer network or computer resource;

(b) downloads, copies or extracts any data, computer data base or information from such computer, computer system or computer network including information or data held or stored in any removable storage medium;

(c) introduces or causes to be introduced any computer contaminant or computer virus into any computer, computer system or computer network;

(d) damages or causes to be damaged any computer, computer system or computer network, data, computer data base or any other programmes residing in such computer, computer system or computer network;

(e) disrupts or causes disruption of any computer, computer system or computer network;

(f) denies or causes the denial of access to any person authorised to access any computer, computer system or computer network by any means;

(g) provides any assistance to any person to facilitate access to a computer, computer system or computer network in contravention of the provisions of this Act, rules or regulations made there- under;

(h) charges the services availed of by a person to the account of another person by tampering with or manipulating any computer, computer system, or computer network,

(i) destroys, deletes or alters any information residing in a computer resource or diminishes its value or utility or affects it injuriously by any means;

(j) steal, conceals, destroys or alters or causes any person to steal, conceal, destroy or any other computer source code used for a computer resource with an intention to cause damage;

He would be liable to pay compensation to the party so affected and shall be punishable with imprisonment for a term which may extend to life imprisonment or with fine which may extend to one crore or both .

Compensation for failure to protect data (Section 43A)

As per section 43A of Information Technology Act, 2000 where a body corporate, possessing, dealing or handling any sensitive personal data or information in a computer resource which it owns, controls or operates, is negligent in implementing and maintaining reasonable security practices and procedures and thereby causes wrongful loss or wrongful gain to any person, such body corporate shall be liable to pay damages by way of compensation to the person so affected.

Penalty for failure to furnish information, return, etc

As per section 44 of Information Technology Act, 2000 as amended, If any person who is required under this Act or any rules or regulations made there under to -

(a) furnish any document, return or report to the Controller or the Certifying Authority, fails to furnish the same, he shall be liable to a penalty not exceeding one lakh and fifty thousand rupees for each such failure;

(b) file any return or furnish any information, books or other documents within the time specified therefore in the regulations, fails to file return or furnish the same within the time specified therefore in the regulations, he shall be liable to a penalty not exceeding five thousand rupees for every day during which such failure continues:

(c) Maintain books of account or records, fails to maintain the same, he shall be liable to a penalty not exceeding ten thousand rupees for every day during which the failure continues.

Residuary Penalty

Section 45 of Information Technology Act, 2000 provides whoever contravenes any rules or regulations made under this Act, for the contravention of which no penalty has been separately provided, shall be liable to pay a compensation not exceeding twenty-five thousand rupees to the person affected by such contravention or a penalty not exceeding twenty-five thousand rupees.

Tampering with computer source documents

Section 65 of the Information Technology Act, 2000 provides for punishment upto three years or with a fine which may extend upto Rs. 2 lakhs or with both whoever knowingly or intentionally tampers with the computer code source documents.

Punishment for sending message through communication service etc.

Section 66A of the Information Technology Act, 2000 has been strike down by the Hon'ble Supreme Court of India vide its decision dated 24th March, 2015.

Punishment for dishonestly receiving or retaining any stolen computer resource or communication device

As per section 66B of the Information Technology Act, 2000, whoever dishonestly received or retains any stolen computer resource or communication device knowing or having reason to believe the same to be stolen computer resource or communication device, shall be punished with imprisonment of either description for a term which may extend to three years or with fine which may extend to rupees one lakh or with both.

Punishment for Identity theft

As per section 66C of the Information Technology Act, 2000, Whoever, fraudulently or dishonestly make use of the electronic signature, password or any other unique identification feature of any other person, shall be punished with imprisonment of either description for a term which may extend to three years and shall also be liable to fine with may extend to rupees one lakh.

Punishment for cheating by personating by using computer resource

As per section 66D of the Information Technology Act, 2000, whoever, by means for any communication device or computer resource cheats by personating, shall be punished with imprisonment of either description for a term which may extend to three years and shall also be liable to fine which may extend to one lakh rupee.

Punishment for Violation of privacy

As per section 66E of the Information Technology Act, 2000 whoever, intentionally or knowingly captures, publishes or transmits the image of a private area of any person without his or her consent, under circumstances violating the privacy of that person, shall be punished with imprisonment which may extend to three years or with fine not exceeding two lakh rupees, or with both.

Punishment for Cyber terrorism

As per 66F of the Information Technology Act, 2000 whoever, – (*A*) with intent to threaten the unity, integrity, security or sovereignty of India or to strike terror in the people or any section of the people by –

(*i*) denying or cause the denial of access to any person authorized to access computer resource; or

(*ii*) attempting to penetrate or access a computer resource without authorization or exceeding authorized access; or

(*iii*) introducing or causing to introduce any computer contaminant;

and by means of such conduct causes or is likely to cause death or injuries to persons or damage to or destruction of property or disrupts or knowing that it is likely to cause damage or disruption of supplies or services essential to the life of the community or adversely affect the critical information infrastructure specified under section 70, or

(*B*) knowingly or intentionally penetrates or accesses a computer resource without authorisation or exceeding authorised access, and by means of such conduct obtains access to information, data or computer database that is restricted for reasons for the security of the State or foreign relations, or any restricted information, data or computer database, with reasons to believe that such information, data or computer database so obtained may be used to cause or likely to cause injury to the interests of the sovereignty and integrity of India, the security of the State, friendly relations with foreign States, public order, decency or morality, or in relation to contempt of court, defamation or incitement to an offence, or to the advantage of any foreign nation, group of individuals or otherwise, commits the offence of cyber terrorism shall be punishable with imprisonment which may extend to imprisonment for life.'.

Punishment for Publishing or transmitting of material obscene material in electronic form

As per 67 of the Information Technology Act, 2000 whoever publishes or transmits or causes to be published or transmitted in the electronic form, any material which is lascivious or appeals to the prurient interest or if its effect is such as to tend to deprave and corrupt persons who are likely, having regard to all relevant circumstances, to read, see or hear the matter contained or embodied in it, shall be punished on first conviction with imprisonment of either description for a term which may extend to three years and with fine which may extend to five lakh rupees and in the event of second or subsequent conviction with imprisonment of either description for a term which may extend to five years and also with fine which may extend to ten lakh rupees.

Punishment for Publishing or transmitting of material containing sexually explicit act, etc. in electronic form

As per 67A of the IT Act, whoever publishes or transmits or causes to be published or transmitted in the electronic form any material which contains sexually explicit act or conduct shall be punished on first conviction with imprisonment of either description for a term which may extend to five years and with fine which may extend to ten lakh rupees and in the event of second or subsequent conviction with imprisonment of either description for a term which may extend to seven years and also with fine which may extend to ten lakh rupees.

Punishment for Publishing or transmitting of material depicting children in sexually explicit act, etc. in electronic form

As per 67B of the IT Act, whoever, –

(*a*) publishes or transmits or causes to be published or transmitted material in any electronic form which depicts children engaged in sexually explicit act or conduct; or

(*b*) creates text or digital images, collects, seeks, browses, downloads, advertises, promotes, exchanges

or distributes material in any electronic form depicting children in obscene or indecent or sexually explicit manner; or

(*c*) Cultivates, entices or induces children to online relationship with one or more children for and on sexually explicit act or in a manner that may offend a reasonable adult on the computer resource; or

(*d*) facilitates abusing children online, or

(*e*) records in any electronic form own abuse or that of others pertaining to sexually explicit act with children, shall be punished on first conviction with imprisonment of either description for a term which may extend to five years and with fine which may extend to ten lakh rupees and in the event of second or subsequent conviction with imprisonment of either description for a term which may extend to seven years and also with fine which may extend to ten lakh rupees:

Provided that provisions of section 67, section 67A and this section does not extend to any book, pamphlet, paper, writing, drawing, painting representation or figure in electronic form –

(*i*) the publication of which is proved to be justified as being for the public good on the ground that such book, pamphlet, paper, writing drawing, painting representation or figure is the interest of science, literature, art or learning or other objects of general concern; or

(*ii*) which is kept or used for bonafide heritage or religious purposes.

Publishing of information which is obscene in electronic form [section 67]:

Section 67 provides for punishment to whoever transmits or publishes or causes to be published or transmitted, any material which is obscene in electronic form with imprisonment for a term which may extend to 5 years and with fine which may extend to Rs. 1lakh on first conviction. In the event of second or subsequent conviction the imprisonment would be for a term which may extend to ten years and fine which may extend to Rs. 2lakhs.

Penalty for Misrepresentation [section 71]:

This section provides that any person found misrepresenting or suppressing any material fact from the Controller or the Certifying Authority shall be punished with imprisonment for a term which may extend to 2 years or with fine which may extend to Rs. 1lakh or with both.

Penalty for breach of confidentiality [section 72]:

Section 72 provides a punishment for breach of confidentiality and privacy of electronic records, books, information etc. by a person who has access to them without the consent of the person to whom they belong with imprisonment for a term which may extend to 2 years or with a fine which may extend to Rs. 1lakh or with both.

Punishment for disclosure of information in breach of lawful contract

Section 72A of the Act provides. Save as otherwise provided in this Act or any other law for the time being in force, any person including an intermediary who, while providing services under the terms of lawful contract, has secured access to any material containing personal information about another person, with the intent to cause or knowing that he is likely to cause wrongful loss or wrongful gain discloses, without the consent of the person concerned, or in breach of a lawful contract, such material to any other person, shall be punished with imprisonment for a term which may extend to three years,

Penalty for publishing false electronic signature Certificate [section 73]:

This section provides punishment for publishing a **electronic signature** *Certificate* false in material particulars or otherwise making it available to any other person with imprisonment for a term which may extend to 2 years or with fine which may extend to Rs. 1 lakh or with both.

Penalty for fraudulent publication [section 74]:

This section provides for punishment with imprisonment for a term which may extend to 2 years or with fine which may extend to Rs. 1lakh or with both to a person whoever knowingly publishes for fraudulent purpose any electronic *Signature Certificate*.

LESSON ROUND-UP

1. The Information Technology Act, 2000 was come into effect in year 2000 and it was further amended in year 2008 by IT Amendment Act, 2008.
2. This Act aims to provide the legal infrastructure for e-commerce in India. The Information Technology Act, 2000 also aims to provide for the legal framework so that legal sanctity is accorded to all electronic records and other activities carried out by electronic means. The Act states that unless otherwise agreed, an acceptance of contract may be expressed by electronic means of communication and the same shall have legal validity and enforceability. The said Act also proposes to amend the Indian Penal Code, 1860, the Indian Evidence Act, 1872, The Bankers' Books Evidence Act, 1891, The Reserve Bank of India Act, 1934 to make them in tune with the provisions of the IT Act, 2000.
3. Chapter-II of the Act specifically stipulates that any subscriber may authenticate an electronic record by affixing his digital signature. It further states that any person can verify an electronic record by use of a public key of the subscriber.
4. Chapter-III of the Act details about Electronic Governance and provides inter alia amongst others that where any law provides that information or any other matter shall be in writing or in the typewritten or printed form, then, notwithstanding anything contained in such law, such requirement shall be deemed to have been satisfied if such information or matter is -rendered or made available in an electronic form; and accessible so as to be usable for a subsequent reference. The said chapter also details the legal recognition of Electronic Signatures.
5. Chapter-VI of the said Act gives a scheme for Regulation of Certifying Authorities. The Act envisages a Controller of Certifying Authorities who shall perform the function of exercising supervision over the activities of the Certifying Authorities as also laying down standards and conditions governing the Certifying Authorities as also specifying the various forms and content of Electronic Signature Certificates. The Act recognizes the need for recognizing foreign Certifying Authorities and it further details the various provisions for the issue of license to issue Electronic Signature Certificates.
6. Chapter-VII of the Act details about the scheme of things relating to Electronic Signature Certificates. The duties of subscribers are also enshrined in the said Act.
7. Chapter-IX of the said Act talks about penalties, compensation and adjudication for various offences. The penalties for damage to computer, computer systems etc. has been fixed as damages by way of compensation to affected persons. The Act talks of appointment of any officers not below the rank of a Director to the Government of India or an equivalent officer of state government as an Adjudicating Officer for holding an inquiry in the manner prescribed by the Central Government. The adjudicating officer shall exercise jurisdiction to adjudicate matters in which the claim for inquiry or damage does not exceed Five Crore rupees.
8. Chapter-X of the Act talks of the establishment of the Cyber Appellate Tribunal, which shall be an appellate body where appeals against the orders passed by the Adjudicating Officers, shall be preferred.
9. Chapter-XI of the Act talks about various offences and the said offences shall be investigated only by a Police Officer not below the rank of the Inspector of Police. These offences include tampering with

computer source documents, Computer related offences, publishing of information, which is obscene in electronic form, cyber terrorism etc.

SELF-TEST QUESTIONS

(*These are meant for re-capitulation only. Answers to these questions are not to be submitted for evaluation*)

1. Explain briefly the scope of the Information Technology Act 2000 as amended along with the relevant definitions that are used.
2. What are the conditions subject to which electronic record may be authenticated by means of affixing electronic signature?
3. Discuss the main provisions provided in Information Technology Act 2000 as amended to facilitate E-governance
4. What are the regulations relating to the appointment and powers of the certifying authorities under Chapter VI, Section 17 to 25 of Information Technology Act 2000 as amended?
5. What are the duties of a certifying authority under Section 30 of the Information Technology Act 2000 as amended?
6. What is a Digital Signature? How is it used? What are the duties of certifying authorities in regard to its usage?
7. Write short notes on the following:
   (a) Electronic Signature Certificate
   (b) Encryption.
8. Describe the composition and powers of Cyber appellate tribunal.
9. What are the major objectives of Information Technology Act 2000 as amended? Explain in brief.
10. Briefly explain the power of central government to make rules with respect to the Section 10 of Information Technology Act 2000 as amended.
11. Explain the power of Controller to make regulations under Section 89 of the Information Technology Act 2000 as amended.
12. What are the powers of a Police Officer under the Information Technology (Amendment) Act 2008 to enter and search etc?
13. Define ‘Electronic Signature’ and ‘Electronic Signature Certificate’ in the light of the Information Technology Act 2000 as amended.

    Briefly explain the Punishment for publishing or transmitting of material containing sexually explicit act, etc. in electronic form as per Section 67 A of The Information technology Act, 2000 as amended

Lesson 2
Information Systems

LESSON OUTLINE

- Systems – Concepts
- Systems from a functional perspective
- Information and Data: Definition and Distinctions
- Features and Qualities of Information
- Types of Information
- Process of Generating Information
- Value and Cost of Information
- Information as a Corporate Resource
- Information Needs at Various Levels of Management
- Factors Influencing Information Needs
- Information Systems: Definition and Elements
- Information System Activities
- Types of Information Systems
- Information Systems in Business Management
- Challeanges in information systems
- Recent Trends in Information Systems

LEARNING OBJECTIVES

Information system is a term which is used for the framework that provides us information for decision making process. Information systems have a very important role to play in any business and success of a business organization also depend on the timeliness, accuracy, and quality of information which is the output of an information system.

Information system is important at each level of business management. It supplies information from Strategic management team to middle management and it is very crucial for business successes. The importance of information system in a business management is for following reasons

- An aid in operational excellence
- Helpful in improved decision making
- Necessary for day to day survival
- Competitive Advantage
- Helpful in Cost Management

After going through this lesson the student should be able to:

- Understand the basics of information system
- Importance of Information systems in decision making process.

"What information consumes is rather obvious: it consumes the attention of its recipients. Hence, a wealth of information creates a poverty of attention and a need to allocate that attention efficiently among the overabundance of information sources that might consume it."

Herbert Simon

INTRODUCTION

Information system is a term use for the combination of networks of hardware and software, people, procedures, and organizations use to collect, filter, process, create, and distribute data, so that something meaningful can be extracted. It is playing a crucial role in everyone's life, as we all depend on information for better decision making. Information systems may be different for different types of people as the information need of different users are different; and it is difficult for a single information system to cater all users. Depending on the type of information requirement there are different information systems that exist. An information system which provides accurate, timely and reliable information is the key for an organization success. Here we will discuss

- Systems – An Overview
- Information and Data: Definition and Distinctions
- Information as a Corporate Resource
- Features and Qualities of Information
- Types of Information
- Process of Generating Information
- Value and Cost of Information
- Information Needs at Various Levels of Management
- Factors Influencing Information Needs
- Information Systems: Definition and Elements
- Information System Activities
- Types of Information Systems
- Information Systems in Business Management
- Recent Trends in Information Systems

SYSTEM CONCEPTS

System concepts underlie all business processes and the field of information systems. That's why we need to discuss how generic system concepts apply to business firms and the components and activities of information systems. Understanding system concepts will help you understand many other concepts in the technology, applications, development, and management of information systems that we will cover in this text. For example, system concepts help you understand :

- **Technology**. That computer networks are systems of information processing components that use a variety of hardware, software, data management, and telecommunications network tech-nologies.
- **Applications**. That electronic business and commerce applications involve interconnected business information systems.
- **Development**. That developing ways to use information technology in business includes designing the basic components of information systems.
- **Management**. That managing information technology emphasizes the quality, strategic busi-ness value, and security of an organization's information systems.

Read the Real World Case about how information systems can be used to support business on the next page.

We can learn a lot from this case about the use of information technology to empower and support business professionals today.What is a System?

What is a system? As we discussed at the beginning of the chapter, a system is defined as a set of interrelated components, with a clearly defined bound-ary, working together to achieve a common set of objectives. Many examples of systems can be found in the physical and biological sciences, in modern technology, and in human society. Thus, we can talk of the physical system of the sun and its planets, the biological system of the human body, the technological system of an oil refinery, and the socioeconomic system of a business organization.

However, the following generic system concept provides a more appropriate foundation concept for the field of information systems: A system is a group of interrelated components, with a clearly defined boundary, working together toward a common goal by accepting inputs and producing out-puts in an organized transformation process.

Such a system (sometimes called a dynamic system) has three basic interacting components or func-tions:

- Input involves capturing and assembling elements that enter the system to be processed. For example, raw materials, energy, data, and human effort must be secured and organized for processing.
- Processing involves transformation processes that convert input into output. Examples are a manufacturing process, the human breathing process, or mathematical calculations.
- Output involves transferring elements that have been produced by a transformation process to their ultimate destination. For example, finished products, human services, and management information must be transmitted to their human users.

Example. A manufacturing system accepts raw materials as input and produces finished goods as output. At information system is a system that accepts resources (data) as input and processes them into products (information) as output. A business organization is a system where economic resources are transformed by various business processes into goods and services.

Feedback and Control

The system concept becomes even more useful by including two additional components: feedback and control. A system with feedback and control components is sometimes called a cybernetic system, dial is, a self-monitoring, self-regulating sys-tem.

- Feedback is data about the performance of a system. For example, data about sales performance is feedback to a sale manager.
- Control involves monitoring and evaluating feedback to determine whether a system is mov-ing toward the achievement of its goal. The control function then makes necessary adjustments to a system's input and processing components to ensure that it produces proper output. For example, a sales manager exercises control when reassigning salespersons to new sales territories after evaluating feedback about their sales performance.

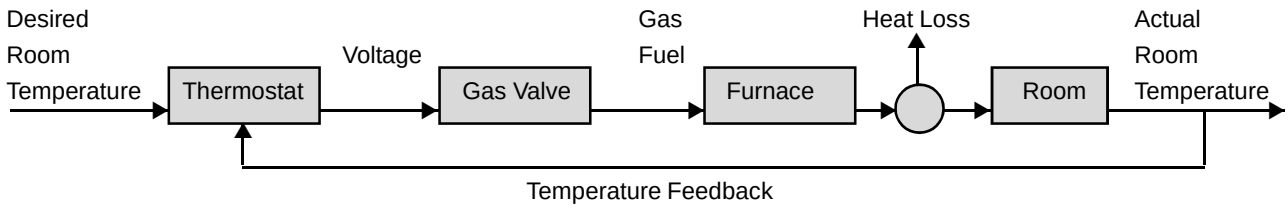
Example. Figure below (Temperature feedback) illustrates a familiar example of a self-monitoring, self-regulating, thermostat- controlled heating system found in many homes; it automatically monitors and regulates itself to maintain a desired temperature. Another example is the human body, which can be regarded as a cybernetic system that automatically monitors and adjusts many of its functions, such as temperature, heartbeat, and breathing. A business also has many control activities. For example, computers may monitor and control manufacturing processes, accounting procedures help control financial systems, data entry displays provide control of data entry activities, and sales quotas and sales bonuses attempt to control sales performance.Other System Figure Characteristics

Figure below (Stakeholder in Business environment) uses a business organization to illustrate the fundamental components of a system, as well as several other system characteristics. Note that

a system does not exist in a vacuum, rather, it exists and functions in an envi-ronment containing other systems. If a system is one of the components of a larger system, it is a sub-system, and the larger system is its environment.

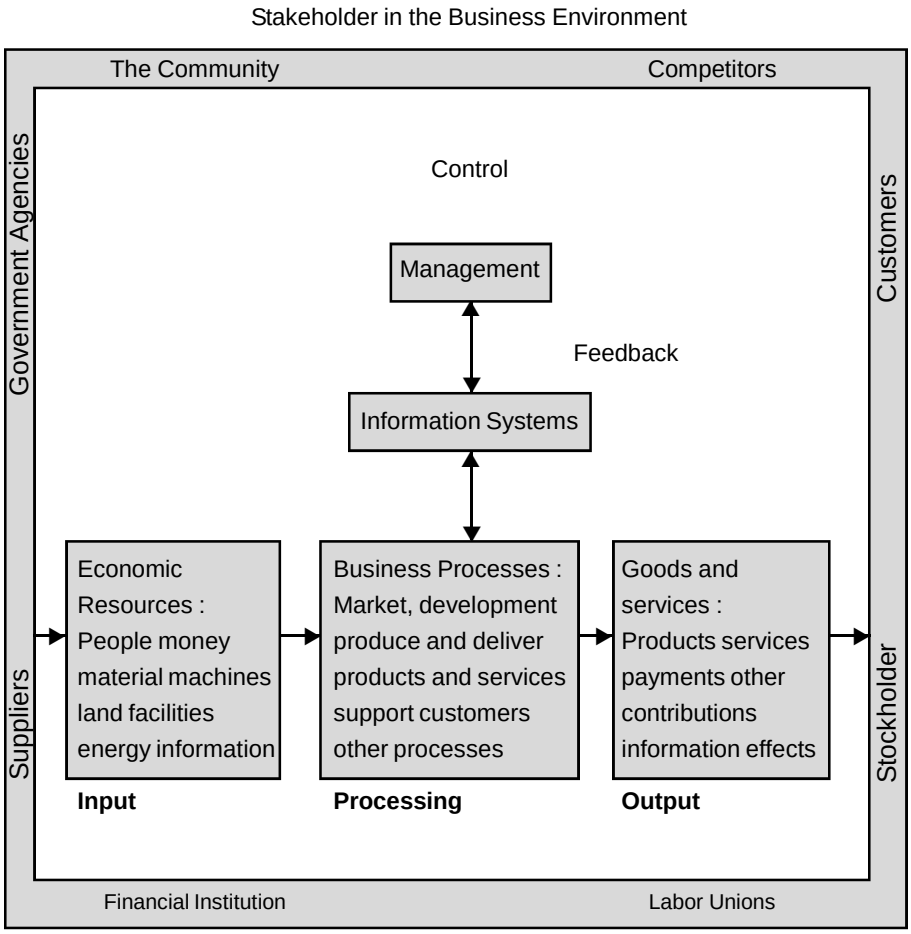
Several systems may share the same environment. Some of these systems may be connected to one another by means of a shared boundary, or interface. Figure also illustrates the concept of an interface.

Figure : A common cybernetic system is a home temperature control system. The thermostat accepts the desired room temperature as input and sends voltage to open the gas valve which fires the furnace. The resulting hot air goes into the room and the thermometer in the thermostat provides feedback to shut the system down when the desired temperature is reached.



FIGURE

A business is an example of an organizational system where economic resources (input) are transformed by various business processes (processing) into goods and services (output). Information systems provide information (feedback) on the operations of the system to management for the direction and maintenance of the system (control) as it exchanges inputs and outputs with its environment.



CHARACTERISTICS OF A SYSTEM

1. Organization of interrelated elements:

Organization implies structure and order. It is the arrangement of components that help to achieve objectives. For example, a computer system is designed around an input device, a central processing unit, an output device, and one or more storage units. When linked together they work as a whole system for producing information**.**

2. Interrelated components interaction:

Interaction refers to the manner in which each component functions with other component of the system. In a computer system, for example, the central processing unit must interact with the input device to solve a problem. In turn, the main memory holds the program and data that the arithmetic unit uses for computation.

The interrelationship between these components enables the computer to perform smooth functions.

3. Interdependencies among system's parts

Interdependence means that parts of the system depend on one another. They are coordinated and linked together according to a plan. One subsystem depends on the input of another subsystem for proper functioning; i.e. the output of one subsystem is, the required input for another subsystem. This interdependence is crucial in systems work.

4. Common objectives

The last quality is central objective. Objectives may be real or stated. It is very common for an organization to state one objective and operates to achieve another. This important point is that users must know the central objective of a computer application early in the analysis for a successful design and conversion.

DIFFERENT TYPES OF SYSTEM

Systems are classified in different ways. Depending on their characteristics, system can be classified in number of ways. The following classifications are worth mentioning.

1. Large and Small systems: This classification is based on the system size. Large complex systems can be the air traffic control system or our global telecommunication network. For small systems, small devices can also be considered as systems: such as a pocket calculator, alarm clock, or 10-speed bicycle.

2. Physical or Abstract systems: Systems can also be classified as physical and Abstract depending on whether they can be touched/seen or not. Examples are solar system and judicial system respectively.

Physical systems are tangible entities and may be static or dynamic in operation. For Example, the physical parts of the computer center are the offices, desks, and chairs that facilitate operation of the computer. They can be seen and counted, they are static. In contrast, programmed computer is a dynamic system. Data, programs, output and application changes as the user's demand or the priority of the information requested changes.

Abstract systems are conceptual or nonphysical entities. They may be models-the abstract conceptualization of physical situations such as traffic system. An abstract system can be a representation of a real or a planned system.

3. Open or Closed systems: Open systems refer to systems that interact with other systems or the outside environment. For example living organisms are considered open systems because they take in substances from their environment such as food and air and return other substances to their environment

Closed systems refer to systems having relatively little interaction with other systems or the outside environment. A watch is an example of a closed system in that it is a relatively self-contained, self-maintaining unit that has rarely interacts or exchange with its environment.

4. Natural or Manmade System: By virtue of their creation this classification applies. For example eco system, respiratory system in a human body are examples of natural systems, whereas computer system, electoral systems are examples of manmade system.

In the set of above classification, Information systems are large, manmade, open abstract system.

SYSTEMS FROM A FUNCTIONAL PERSPECTIVE

Information systems can be classified by the specific organizational function they serve as, well as by organizational level. We now describe typical information systems that support each of the major business functions and provide examples of functional applications for each organizational level.

Sales and Marketing Systems

The sales and marketing function is responsible for selling the organization's products or services. Marketing is concerned with identifying the customers for the firm's products or services, determining what customers need or want, planning and developing products and services to meet their needs, and advertising and promoting these products and ser-vices. Sales is concerned with contacting customers, selling the products and services, tak-ing orders, and following up on sales. Sales and marketing information systems support these activities.

Table below shows that information systems are used in sales and marketing in a num-ber of ways. At the strategic level, sales and marketing systems monitor trends affecting new products and sales opportunities, support planning for new products and services, and monitor the performance of competitors. At the management level, sales and marketing systems support market research, advertising and promotional campaigns, and pricing decisions. They analyze sales performance and the performance of the sales staff.

Examples of Sales and Marketing Information Systems

Systems	***Description***	***Organizational Level***
Order processing	Enter Process, and track orders	Operational
Pricing analysis	Determine prices for products and services	Management
Sales trend forecasting	Prepare 5-year sales forecasts .	StrategicAt

the operational level, sales and marketing systems assist in locating and contacting prospective customers, tracking sales, processing orders, and providing customer service support.

The system uses the output of a typical sales information system at the management level. The system consolidates data about each item sold (such as the prod-uct code, product description, and amount sold) for further management analysis. Company managers examine these sales data to monitor sales activity and buying trends.

Manufacturing and Production Systems

The manufacturing and production function is responsible for actually producing the firm's goods and services. Manufacturing and production systems deal with the planning, development, and maintenance of production facilities; the establishment of production goals; the acquisition, storage, and availability of production materials; and the schedul-ing of equipment, facilities, materials, and labor required to fashion finished products. Manufacturing and production information systems support these activities.

Table below shows some typical manufacturing and production information systems arranged by organizational

level. Strategic-level manufacturing systems deal with the firm's long-term manufacturing goals, such as where to locate new plants or whether to invest in new manufacturing technology. At the management level, manufacturing and production systems analyze and monitor manufacturing and production costs and resources. Operational manufacturing and production systems deal with the status of production tasks.

Example of Manufacturing and Production Information Systems

System	***Description***	***Organizational Level***
Machine control	Control the actions of machines and equipment	Operational
Production planning	Decide when and how many products should be produced	Management
Facilities location	Decide where to locate new production facilities	Strategic

Most manufacturing and production systems use some sort of inventory system. Data about each item in inventory, such as the number of units depleted because of a shipment or purchase or the number of units replenished by reordering or returns, are either scanned or keyed into the system. The inventory master file contains basic data about each item, including the unique identification code for each item, a description of the item, the number of units on hand, the number of units on order, and the reorder point (the number of units in inventory that triggers a decision to reorder to prevent a stockout). Companies can estimate the number of items to reorder, or they can use a formula for calculating the least expensive quantity to reorder called the economic order quantity. The system produces reports that give information about such things as the number of each item available in inventory, the number of units of each item to reorder, or items in inventory that must be replenished.

Product life cycle management (PLM) systems are one type of manufacturing and production system that has become increasingly valuable in the automotive, aerospace, and consumer products industries. PLM systems are based on a data repository that orga-nizes every piece of information that goes into making a particular product, such as formula cards, packaging information, shipping specifications, and patent data. Once all these data are available, companies can select and combine the data they need to serve specific functions. For, example, designers and engineers can use the data to determine which parts are needed for a new design, whereas retailers can use them to determine shelf height and how materials should be stored in warehouses.

For many years, engineering-intensive industries have used computer-aided design (CAD) systems to automate the modeling and design of their products. The software enables users to create a digital model of a part, a product, or a structure and make changes to the design on the computer without having to build physical prototypes. PLM software goes beyond CAD software to include not only automated modeling and design capabilities but also tools to help companies manage and automate materials sourcing, engineering change orders, and product documentation, such as test results, product packaging, and postsales data. The Window on Organizations describes how these systems are providing new sources of value.

Finance and Accounting Systems

The finance function is responsible for managing the firm's financial assets, such as cash, stocks, Bonds, and other investments, to maximize the return on these financial assets. The finance f unction is also in charge of managing the capitalization of the firm (finding new financial assets in stocks, bonds, or other forms of debt). To determine whether the firm is getting the best return on its investments, the finance function must obtain a con-siderable amount of information from sources external to the firm.

The accounting function is responsible for maintaining and managing the firm's finan-cial records – receipt, disbursements, depreciation, payroll – to account for the flow of funds in a firm. Finance and accounting share related problems – how to keep track of a firm's financial assets and fund flows. They provide answers to

questions such as these: What is the current inventory of financial assets? What records exist for disbursements, receipts, payroll, and other fund flows?

Table below shows some of the typical finance and accounting information systems found in large organizations. Strategic-level systems for the finance and accounting function establish long-term investment goals for the firm and provide long-range forecasts of the firm's financial performance. At the management level, information systems help managers oversee and control the firm's financial resources. Operational systems in finance and accounting track the flow of funds in the firm through transactions such as paychecks, payments to vendors, securities reports, and receipts.

Take example of a payroll system, a typical accounting TPS found in all businesses with employees. You can find more examples in real life.

Examples of Finance and Accounting Information Systems

System	***Description***	***Organizational Level***
Accounts receivable	Tracks money owed the firm	Operational
Budgeting	Prepares short-term budgets	Management
Profit planning	Plans long-term profits	Strategic

Human Resources Systems

The human resources function is responsible for attracting, developing, and maintaining the firm's workforce Human resources information systems support activities such as identifying potential employees, maintaining complete records on existing employees, and creating programs to develop employees' talents and skills.

Strategic-level human resources systems identify the manpower requirements (skills, educational level, types of positions, number of positions, and cost) for meeting the firm's long-term business plans. At the management level, human resources systems help man-agers monitor and analyze the recruitment, allocation, and compensation of employees. Human resources operational systems track the recruitment and placement of the firm's employees.

Consider a typical human resources TPS for employee record keeping. It maintains basic employee data, such as the employee's name, age, sex, marital status, address, educational background, salary, job title, date of hire, and date of termination. The system can produce a variety of reports, such as list of newly hired employees, employees who are terminated or on leaves of absence, employees classified by job type or educational level, or employee job performance evaluations. Such systems are typically designed to provide date that can satisfy federal and state record keeping requirements for Equal Employment Opportunity (EEO) and other purpose.

Examples of Human Resources Information System

System	***Description***	***Organizational Level***
Training & Development	Tracks Employee training skills, and performance appraisals	Operational
Compensation analysis	Monitors the range and distribution of employee wages, salaries, and benefits	Management
Human resources planning	Plans the long-term labor force needs of the organization	Strategic

INFORMATION AND DATA: DEFINITION AND DISTINCTIONS

Meaning of Data and its characteristics

Data in Noun form means

- Facts and figures collected together for reference or analysis.
- The quantities, characters, or symbols on which operations are performed by a computer, being stored and transmitted in the form of Information.

Data is a collection of facts, such as values or measurements. It can be numbers, words, measurements, observations or even just descriptions of things.

Data characteristics

(a) Data means Facts, statistics used for reference or analysis.

(b) Data comprises Numbers, characters, symbols, images etc., which can be processed by a computer.

(c) Data must be interpreted, by a human or machine, to derive meaning.

(d) Data is a representation of information.

(e) Data is derived from Latin word ‘datum’ which means “that which is given”.

Data Resources

Data are more than the raw material of information systems. The concept of data resources has been broadened by managers and information systems professionals. They realize that data constitute valuable organizational resources. Thus, you should view data as data resources that must be managed effectively to benefit all end users in an organi-zation.

The concept of data as an organizational resource has resulted in a variety of changes in the modern organization. Data that were previously captured as a result of a common transaction are now stored, processed, and analyzed using sophisticated software applications that can reveal complex rela-tionships about sales, customers, competitors, and markets. In today’s wired world, the data to cre-ate a simple list of an organization’s customers are protected with the same energy as the cash in a bank vault. Data are the lifeblood of today’s organizations and the effective and efficient management of data is considered an integral part of organizational strategy.

Data can take many forms, including traditional alphanumeric data, composed of numbers and alphabetical and other characters that describe business transactions and other events and entities, text data, consisting of sentences and paragraphs used in written communications; image data, such as graphic shapes and figures, and photographic and video images; and audio data, the human voice and other sounds, are also important forms of data.

The data resources of information systems are typically organized, stored, and accessed by a vari-ety of data resource management technologies into :

- Databases that hold processed and organized data.
- Knowledge bases that hold knowledge in a variety of forms such as facts, rules, and case examples about successful business practices.
- For example, data about sales transactions may be accumulated, processed, and stored in a Web-enabled sales database that can be accessed for sales analysis reports by managers and marketing pro-fessionals. Knowledge bases are used by knowledge management systems and expert systems to share knowledge or give expert advice on specific subjects.

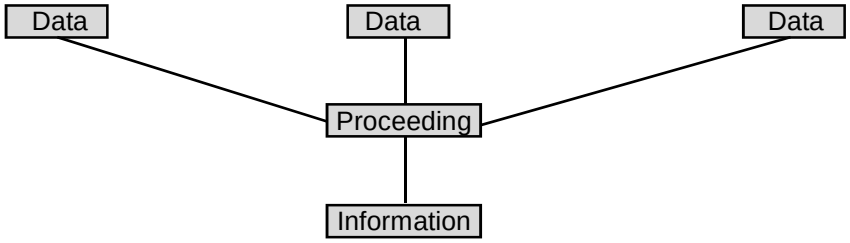
Meaning of Information and its characteristics

Information is Facts provided or learned about something or someone. It can be defined as data that:

- Has been verified to be accurate and timely
- Is specific and organized for a purpose
- Is presented within a context that gives it meaning and relevance, and
- That can lead to an increase in understanding and decrease in uncertainty.

In simple words it means processed data that has some meaning. Data alone are insufficient unless they are processed. Once converted in to information becomes directly applicable. The value of information lies solely in its ability to affect a behavior, decision, or outcome. A piece of information is considered valueless if, after receiving it, things remain unchanged

Information is created from data



Characteristics of Information

1. Information is the useful knowledge derived from the data
2. Information is knowledge derived from study, experience (by the senses), or instruction.
3. Information is any kind of knowledge that is exchangeable amongst people, about things, facts, concepts, etc.,

Data versus Information. The word data is the plural of datum, though data commonly represents both singular and plural forms. Data are raw facts or observations, typically about physical phenomena or business transactions. For example, a spacecraft launch or the sale of an automobile would generate a lot of data describing tlio3C events. Mute specifically, data ate objective measurements of the attributes (the characteristics) of entities (such as people, places, things, and events).

Example. Business transactions such as buying a car or an airline ticket can produce a lot of data. Just think of the hundreds of facts needed to describe the characteristics of the car you want and its financing, or the details for even the simplest airline reservation.

People often use the terms data and information interchangeably. However, it is better as raw material resources that are processed into finished information products. Then we can define information as data that have been converted into a meaningful and useful context for specific end users. Thus, data arc usually subjected to a value-added process (data processing or information processing) where (1) its form is aggregated, manipulated, and organized; (2) its content is at analyzed and evaluated; and (3) it is placed in a proper context for a human user.

The issue of context is really at the heart of understanding the difference between information and data. Data can be thought of as context-independent: A list of numbers or names, by itself, does not provide any understanding of the context in which it was recorded. In fact, the same list could be recorded in a variety of contexts. In contrast, for data to become information, both the context of the data and the

perspective of the person accessing the data become essential. The same data may be considered valuable information to one person and completely irrelevant to the next. Just think of data as potentially valuable to all and the value of information as being relative to its user.

Example. Names, quantities, and dollar amounts recorded on sales forms represent data about sales transactions. However a sales manager may not regard these as information. Only after such facts are properly organized and manipulated can meaningful sales information be furnished, specifying for example, the amount of sales by product type, sales territory, or salesperson.

4. In some context "Information is interpreted data".

Difference between Data and Information

	Data	Information
Definition	In Latin 'datum' means "that which is given".	Information is interpreted data. Data was the plural form of datum singular
Meaning	Data is raw, unorganized facts that need to be processed. Data can be something simple and seemingly random and useless until it is organized.	When data is processed, organized, structured or presented in a given context so as to make it useful, it is called Information.
Example	Each student's test score is one piece of data	The class' average score or the school's average score is the information that can be concluded from the given data.

FEATURES AND QUALITIES OF INFORMATION

1. Relevancy: The information so generated should be relevant to the context for which it is collated. Too much irrelevant information may confuse the intended user so it is necessary to generate only relevant information. No information should be generated only because it can be generated by Information System. A good way of ensuring relevance is to closely define the objectives of any information reports. Another way to improve relevance is to produce information that focuses on "exceptions" - e.g. problems, high or low values, where limits have been exceeded.

2. Up-to-date: Information needs to be timely if it is to be actioned upon. For example, a professional need updated information about applicable laws so that he may give relevant advice to his clients. To improve the speed with which information is produced, businesses usually need to look at upgrading or replacing their information systems.

3. Accurate: As far as possible, information should be free from errors (e.g. the figures add up; data is allocated to the correct categories). The users of information should be informed whenever assumptions or estimates have been used.

4. Meet the needs of the User: Since different users have different information needs The managing director doesn't have time to trawl through thick printouts of each week's production or sales listings - he or she wants a summary of the key facts while the quality control supervisor will want detailed information about quality testing results rather than a brief one-line summary of how things are going. It is a good idea to encourage users to help develop the style and format of information reporting that they require.

5. Concise and User Friendly: Information should be clearly presented (e.g. use summaries, charts) and not too long. It also needs to be communicated using an appropriate medium (e.g. email, printed report, presentation. Businesses should also consider developing "templates" which are used consistently throughout the organization - so that users get used to seeing information in a similar style.

6. Worth the cost: Often forgotten. Information costs money. Data is costly to collect, analyze and report. Information takes time to read and assimilate. All users should question whether the information they receive/ have requested is worthwhile.

7. Reliable: Information should come from authoritative sources. It is good practice to quote the source used - whether it is internal or external sources. If estimates or assumptions have been applied, these should be clearly stated and explained.

TYPES OF INFORMATION

There may be different types of information classifications such as:

Factual vs. Analytical

Objective vs. Subjective

Primary vs. Secondary

1(A) Factual Information: These are just the facts. These information are very objective and real. Something that actually exists, reality, truth is a factual information. Examples of factual information are like; Temperature in a city, winner of academy award etc.

(B) Analytical Information: Interpretations, Analysis, Criticism constitute analytical information. To examine critically, so as to bring out the essential elements or give the essence of something, analysis is required. Examples include; Increase of drug use in the 2013, growth in crime rate etc.

2(A) Objective Information: Without Bias Non-judgmental "not influenced by personal feelings, interpretations, or prejudices; based on facts". It is to the point, clear cut without any personal projection. Examples of objective information needs: Chronology of the Feminist movement, the eight stages of development according to Erik Erikson, etc.

(B) Subjective Information: It includes **o**pinions, personal viewpoints, and evaluations existing in the mind. Examples of subjective information needs include; Criticism of O'Neill's play, Evaluation of a course based on class comments. Book review or movie reviews etc.

3(A) Primary Information: Information in its original form, not translated by anyone else, has not been published elsewhere, is termed as primary. Examples of primary information needs: Explanation or instructions from an employer or teacher, an eyewitness account of a house fire, etc.

(B) Secondary Information: It is repackaged examination, restatement or interpretation of primary information already collected by someone. Examples of secondary information needs: Notes borrowed from a classmate for a missed class, a bibliography on the letters of Ernest Hemingway and so on.

Based on it is meant for information may be Personal Information, or Business Information. There can be other classifications as well like, formal vs informal, confirmed vs tentative etc.

PROCESS OF GENERATING INFORMATION

The goal of information generation is to generate information which is reliable, timely, user friendly and meeting the intended user objectives. If it fails to meet the stated objectives it is considered poor in quality. Therefore information generation requires careful steps so that it serves it purpose. The process basically involves the following steps.

1. Understanding the user need in general
2. Create framework for generating intended information
3. Collecting the data.

4. Process or analyzing data.
5. Collate the result from data, interpret, evaluate.
6. Communicate the result of interpretation, evaluation of data in the form of Information to intended user.

VALUE AND COST OF INFORMATION

Information is of value to decision makers if it is accurate, timely, complete, and relevant. If it is poor on any o these criteria, it will be less useful hence may not have that value. These four criteria are used to distinguish valuable information from information that is of less value.

Accurate information provides a reliable and valid representation of reality. The cost of inaccurate or distorted information can be extremely high.

Consider the demise of the multimillion dollar Mars Climate Orbiter launched by NASA in 1998. The tragic outcome of this mission was blamed on the failure of one scientific team to recognize and correct an error in information from another team. Findings indicate that one team used English units (e.g., inches, feet and pounds) while the other used metric units for key spacecraft operations affecting navigation. This oversight caused the orbiter to burn up in Mars atmosphere before it could deploy to the surface. Oops.

Timely information is information that is available when it is needed. When information is needed almost always depends on the situation. In the fast-paced world of air travel, commercial airlines need virtually daily updates on what other commercial airlines are doing with their ticket prices. If one airline reduces its airfares from Mumbai Airport to New Delhi Airport, other airlines flying the same route would find out quickly about it and respond in a similar manner.

Complete information tends to be comprehensive in covering the issue or topic of interest. Complete information tells a complete story. Without complete information, a decision maker will get a distorted view of reality. Incomplete market information can lead businesses to introduce products and services that customers don't want.

Information is relevant if it has significance or can be applied to a specific situation, problem, or issue of interest. Here are some examples of relevant information. Human resource managers need information on hiring and employee turnover; operations managers need information on costs and productivity; marketing managers need information on sales projections and advertising rates; top executives need information on the strategic actions of their competitors. In contrast, product inventory information is not very relevant to a computer programmer.

INFORMATION AS A CORPORATE RESOURCE

Generally human, financial, physical and knowledge factors that provide a corporate the means to perform its business processes are considered as corporate resources.

Information can be considered as the raw material used in producing each and every decision taken in an organization. Organizations need to decide regularly on what objectives to be achieved, what actions to be taken to achieve these objectives, how and when these actions are to be taken, and the resources to be used for all these activities. These decisions are taken by all the people in the organization who work at different level of organizational hierarchy and handle different aspect of the organizational work.

The exact decision that in individual takes varies from person to person and from time to time, depending on nature of organizational tasks being performed. Also some people need to do more of decision making as compared to implementing the decisions. But everyone in the organization has to take some decisions for which availability of adequate information is critical.

Information is also required to convey decisions taken to the people responsible for implementing the decisions taken, and for monitoring the actual results achieved as the work progresses. In want of information many

decisions cannot be taken and in some cases it results into poor decisions. Therefore information is acting as a resource, which should be managed, so that needy people may get it in time when required. In this way information plays a role of corporate resource in every organization. Like any other resource it need to be formalized, must have some identified and systematize way of generation and dissemination.

INFORMATION NEEDS AT VARIOUS LEVELS OF MANAGEMENT

Information is needed for decision making at all levels of management. Managers at different organizational levels make different types of decisions, control different types of processes, and have different information needs.

Three classical levels of management include

1. Top Management or Strategic Management
2. Middle Management or tactical management
3. Low Level Management or Operational Management

Strategic Management includes directors/owner that make decisions which affect the entire organization, or large parts of it, and leave an impact in the long run. The decision making at this level is highly unstructured. By this we mean, there may not be a proper format for decision making. It requires lot of inputs in terms of information, but there is no fixed way of mixing those inputs.

Middle, or tactical, management receive strategic decisions from strategic management as general directives. Using those directives as guidelines, they develop tactics to meet those strategic directives. The decision making at this level is semi structured. Some pieces of information can be mixed to get some conclusion but some amount of ambiguity is always there.

Operational managers are responsible for daily operations. They make decisions concerning a narrow time span about the deployment of small groups of clerical and/or shop floor workers. Generally the decisions at this level are structured in nature.

People in different management levels have different information needs. Most of the information that managers require is used to make decisions. The decision making process of middle managers and above is less structured than that of operational managers; In general, strategic decisions have no proven methods for selecting a course of action that guarantees a predicted outcome.

Information needs of top or Strategic Management

Strategic management or TOP management of a company comprises the owners/managing director of a company. They are responsible for taking strategic decisions for a company which has long term bearing on company policies and perspectives. Strategic management is responsible for making strategic plan which is necessary to take the company on growth path. To prepare strategic Plan, Top management is not concerned about day to day information of company operations. They do the macro analysis and their decisions are based on macro analysis. Generally the Strategic Management information needs comprises

1. Information about market trend- Macro analysis.
2. Information about Government Policies.
3. Information about Competitors policies and tactics
4. Information about Major exceptions in implementing the company policy at tactical/operation level.
5. Analysis about major happening/event which may have a long term bearing on the strategic decisions of the company

The information need of TOP management is generally unstructured and it not easily defined.

Information needs of Middle Level Management/Tactical Management

Tactical management/Middle Management comprises those who are responsible for preparing annual business plan to achieve the strategic Plan objectives of a company. Tactical Managers prepare Annual Business Plan on the basis of directions received from TOP management. The Information need of middle management comprises

1. Information about Strategic Decisions/Plan of the organization for which they have been working.
2. Information about Latest Technologies in the area they have been working.
3. Information about problems faced by operational management in getting the things implemented.
4. Information about best practices adopted by different organization in the same industries or different industries.

The information need of Middle level management is structured in comparison to TOP management and it can be developed in form of template in some cases.

Information needs of Low Level or Operational Management

Operation management is responsible for implementing the policies framed by tactical management to achieve the business plan of the organization. They are generally responsible for the operational part of the organization. The information need of Operational management is limited but very structured in nature. The information need of Operation management needs to be very accurate and it can be easily developed in the form of template.

FACTORS AFFECTING INFORMATION NEEDS

There are various factors which affected the information need of an organisation. Some of them are explained as below

1. **Management Hierarchy:** Management Hierarchy plays an important role in deciding the information need of a user. Information need of TOP management will be entirely different from the information needs of Operational Management.
2. **Purpose of seeking information:** The information needs will be depends on the purpose of seeking information. If a person wants to investment in a company, he/she will be interested about the financial statement of the company. He/she will have no interest in knowing about the past directors of the company.
3. **Role in the Organization:** Information need of a person also depends on the role of the concerned user. The information needs of different stakeholder in the organization will be different. For example, an employee of the organization will be interested in knowing about the company wage policy. He will have no interest in knowing company policy on market segmentation.

INFORMATION SYSTEMS: DEFINITION AND ELEMENTS

An information system can be defined as:

All people, machines and activities aimed at the gathering and processing of data to supply the information need of people inside and outside the organization. In other words it can be defined as combination of people, hardware, software, communication devices, network and data resources that processes (can be storing, retrieving, transforming information) data and information for a specific purpose.

From the above definition we may observe following elements of an information system

– People

- Hardware
- Software
- Communication devices
- Network
- Data resources

INFORMATION SYSTEM ACTIVITIES

The major activities of an information system are:

1. **Input of data resource:** Input of data resources is prime and an important activity of an Information System. In this activity data about business transactions and other events is captured and prepared for processing. In this activity data entry activities such as recording and editing are covered.

   For example, data about sales transactions may be recorded on source documents such as paper sales order forms. (A source document is the original formal record of a transaction.) Alternatively, salesperson might capture sales data using computer keyboards or optical scanning devices; they are visually prompted to enter data correctly by video displays. This provides them with a more convenient and efficient user interface, that is, methods of end user input and output with a computer system. Methods such as optical scanning and displays of menus, prompts, and fill-in-the-blanks formats make it easier for end users to enter data correctly into an information system.

2. **Processing of data into information:** Data is typically subjected to processing activities such as calculating, comparing, sorting, classifying, and summarizing. These activities organize, analyze and manipulate data, thus converting them into information for end users. The quality of any data stored in an information system must also be maintained by a continual process of correcting and updating activities.

   Example. Data received about a purchase can be (1) added to a running total of sales results, (2) compared to a standard to determine eligibility for a sales discount, (3) sorted in numerical order based on product identification numbers, (4) classified into product categories (such as food and non-food items), (5) summarized to provide a sales manager with information about various product categories and, finally, (6) used to update sales records.

3. **Output of information products:** Information in various forms is transmitted to end-users and made available to them in the output activity. The goal of information systems is the production of appropriate information products for end users. Common information products messages, reports, forms, and graphic images, which may be provided by video displays, audio responses, paper products, and multimedia.

   For example, sales manager may view a video display to check on the performance of a salesperson, accept a computer-produced voice message by telephone, and receive a printout of monthly sales results.

4. **Storage of data resource:** Storage is a basic system component of information systems. Storage is the information system activity in which data and information are retained in an organized manner for later use. For example, just as written text material is organized into words, sentences, paragraphs, and documents; stored data is commonly organized into fields, records, files, and database. This facilitates its later use in processing or its retrieval as output when needed by users of a system.

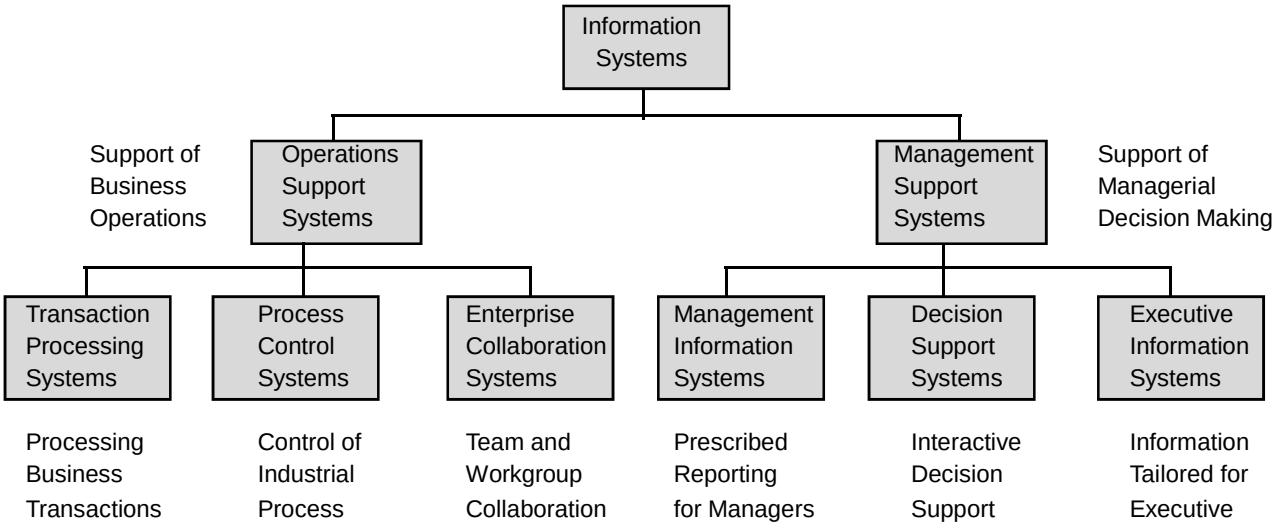
5. **Control of system performance:** An important information system activity is the control of its performance. An information system should produce feedback about its input, processing, output, and the system is meeting established performance standards. Then appropriate system activities must be adjusted so that proper information products are produced for end users.

For example, a manager may discover that subtotals of sales amount in a sales report do not add up to total sales. This might mean that data entry or processing procedures need to be corrected.

TYPES OF INFORMATION SYSTEM

Conceptually, the applications of information systems that are implemented in today's business world can be classified in several different ways. For example, several types of information systems can be classified as either operations or management information systems. Figure below illustrates this

FIGURE Operations and management classifications of information systems. Note how this conceptual overview emphasizes die main purposes of information systems that support business operations and managerial decision making.Information Systems



conceptual classification of information systems applications. Information systems are categorized this way to spotlight the major roles each plays in the operations and management of a business. Let's look briefly at some examples of such information systems categories.

Operations Support Systems

Information systems have always been needed to process data generated by, and used in, business operations. Such operations support systems produce a variety of information products for internal and external use. However, they do not emphasize producing die specific information products drat can best be used by managers. Fur-ther processing by management information systems is usually required. The role of a business firm's operations support systems is to efficiently process business transactions, control industrial processes, support enterprise communications and collaboration, and update corporate databases. See Figure below

Transaction processing systems are an important example of operations support systems that record and process data resulting from business transactions. They process transactions in two basic ways. In batch processing, transactions data are accumulated over a period of time and processed peri-odically. In real-time (or online) processing, data are processed immediately after a transaction occurs. For example, point-of-sale (POS) systems at many retail stores use electronic cash register terminals to electronically capture and transmit sales data over telecommunications links to regional computer centers for immediate (real-time) or nightly (batch) processing.

Process control systems monitor and control physical processes. For example, a petroleum refin-ery uses electronic sensors linked to computers to continually monitor chemical processes and make instant (real-time) adjustment that control the refinery process. Enterprises collaboration system enhance team and workgroup communications and productivity, and include applications that are sometimes called office automation systems.

For example, knowledge workers in a project team may use electronic mail to send and receive electronic messages, and videoconferencing to hold electronic meetings to coordinate their activities.

FIGURE : A summary of operations support systems with examples.

Operations Support Systems
■ Transaction processing systems. Process data resulting from business transactions, update operational databases, and produce business documents. Examples: sales and inventory processing and accounting systems.
■ Process control systems. Monitor and control industrial processes. Examples: petroleum refining, power generation, and steel production systems.
■ Enterprise collaboration systems. Support team, workgroup, and enterprise communications and collaboration. Examples: e-mail, chat, and videoconferencing groupware systems.

Management Support Systems

When information system applications focus on providing information and support for effective decision making by managers, .they are called manage-ment support systems. Providing information and support for decision making by all types of managers and business professionals is a complex task. Conceptually, several major types of information systems support a variety of decision-making responsibilities: (1) man-agement information systems, (2) decision support systems, and (3) executive information systems. See Figure below

Management information systems (MIS) provide information in the form of reports and dis-plays to managers and many business professionals. For example, sales managers may use their net-worked computers and Web browsers to get instantaneous displays about the sales results of their products and to access their corporate intranet for daily sales analysis reports that evaluate sales made by each salesperson. Decision support systems (DSS) give direct computer support to managers during the decision-making process. For example, an advertising manager may use a DSS to perform a what-if analysis as part of a decision to determine where to spend advertising dollars. A produc-tion manager may use a DSS to decide how much product to manufacture based on the expected sales associated with a future promotion and the location and availability' of the raw materials necessary to manufacture the product. Executive information systems (EIS) provide critical informa-tion from a wide variety of internal and external sources in easy-to-use displays to executives and managers. For example, top executives may use touchscreen terminals to instantly view text and graphics displays that highlight key areas of organizational and competitive performance.

FIGURE : A summary of management support systems with examples.

Management Support Systems
■ Management information systems. Provide information in the form of prespecified reports and displays to support business decision making. Examples: sales analysis, production performance, and cost trend reporting systems.
■ Decision support systems. Provide interactive ad hoc support for the decision-making processes of managers and other business professionals. Examples: product pricing, profitability forecasting, and risk analysis systems.
■ Executive information systems. Provide critical information from MIS, DSS, and other sources tailored to the information needs of executives. Examples: systems for easy access to analyses of business performance, actions of competitors, and economic development to support strategic planning.

Other Classifications Information System

Several other categories of information systems can support either operations or management applications. For example, expert systems can provide expert advice for operational chores like equipment diagnostics, or manage-rial decisions such as loan portfolio management. Knowledge management systems are knowledge-based information systems that support the creation, organization, and dis-semination of business knowledge to employees and managers throughout a company. Information systems that focus on operational and managerial applications in support of basic business functions such as accounting or marketing are known as functional business systems. Finally, strategic infor-mation systems apply information technology to a firm's products, services, or business processes to help it gain a strategic advantage over its competitors. See Figure below.

It is also important to realize that business applications of information systems in the real world are typically integrated combinations of the several types of information systems we have just mentioned. That's because conceptual classifications of information systems are designed to emphasize the many different roles of information systems. In practice, these roles are combined into integrated or cross-functional informational systems that provide a variety of functions. Thus, most infor-mation systems are designed to produce information and support decision making for various levels of management and business functions, as well as do record-keeping and transaction processing chores. So whenever you analyze an information system, you will probably see that it provides infor-mation for a variety of managerial levels and business functions.

FIGURE : A summary of other categories of information systems with examples.

Other Categories of Information Systems

- **Expert systems.** Knowledge-based systems that provide expert advice and act as expert consultants to users. Examples: credit application advisor, process monitor, and diagnostic maintenance systems.
- **Knowledge management systems.** Knowledge-based systems that support the creation, organization, and dissemination of business knowledge within the enterprise. Examples: intranet access to best business practices, sales proposal strategies, and customer problem resolution systems.
- **Strategic information systems.** Support operations or management processes that provide a firm with strategic products, services, and capabilities for competitive advantage. Examples: online stock trading, shipment tracking, and c-commerce Web systems.
- **Functional business systems.** Support a variety of operational and managerial applications of the basic business functions of a company. Examples: information systems that support applications in accounting, finance, marketing, operations management, and human resource management.

INFORMATION SYSTEMS IN BUSINESS MANAGEMENT

Information system has been playing a pivotal role in Business Management nowadays. A good information system may be termed as the backbone of business management. In today scenario, it is imperative to say that an Information system is the key to success of a business. A good information system is essential for midsize business to large business. The massive data and increasing volumes of data needs organized storing and fast and effective processing for variety of purposes from decision making to risk management, from transaction processing to state-the art products. This is possible only with the help of an effective information system.

Now the business has become global and most of the businesses are global distributed across the world. These businesses require stable and reliable network infrastructure which can run and handle simultaneous and real time fast processing. Now with the advancement of information technology, simultaneous processing of data on 24x7 bases has got possible. This has increased the efficiency of business. Here we can say that the more businesses grow the more dependent they become of Information Systems

Information system is important at each level of business management. It supplies information from Strategic

management team to middle management and it is very crucial for business successes. The importance of information system in a business management is for following reasons

(a) An aid in operational excellence

(b) Helpful in improved decision making

(c) Necessary for day to day survival

(d) Competitive Advantage

(e) Helpful in Cost Management

WHY INFORMATION SYSTEMS MATTER

Let's start by examining why information systems and information technology (IT) are so important. There are four reasons why IT will make a difference to you as a manager throughout your career.

Capital Management

Information technology has become the largest component of capital investment for firms in the United States and many industrialized societies. In 2005, U.S. firms alone will spend nearly $1.8 trillion on IT and telecommunications equipment and software. Investment in information technology has doubled as a percentage of total business investment since 1980, and now accounts for more than one-third of all capital invested in the United States and more than 50 percent of invested capital in information intensive industries, such as finance, insurance, and real estate.

Between 1980 and 2003, private business investment in information technology (hardware, software, and telecommunications equipment) grew from 19 percent to more than 35 percent of all domestic private business investment. If one included expen-ditures for managerial and organizational change programs and business and consulting ser-vices that are required to use this technology effectively, total information technology expen-ditures would rise above 50 percent of total private business investment.

As managers, many of you will work for firms that are intensively using information systems and making large investments in information technology. You will certainly want to know how to invest this money wisely. If you make wise choices, your firm can outper-form competitors. If you make poor choices, you will be wasting valuable capital. This book is dedicated to helping you make wise decisions about IT and information systems.

Foundation of doing business

In the United States over 23 million managers and over 113 million workers in the labor force rely on information systems every day to conduct business (Statistical Abstract, 2003). In many industries, survival and even existence without extensive use of information sys-tems is inconceivable. Obviously, all of e-commerce would be impossible without substan-tial IT investments, and firms such as Amazon, eBay, Google, E*Trade, or the world's largest online university, the University of Phoenix, simply would not exist. Today's service industries – finance, insurance, real estate as well as personal services such as travel, medi-cine, and education – could not operate without IT. Similarly, retail firms such as Wal-Mart and Sears and manufacturing firms such as General Motors and General Electric require IT to survive and prosper. Just like offices, telephones, filing cabinets, and efficient tall buildings with elevators were once of the foundations of business in the twentieth cen-tury, information technology is a foundation for business in the twenty-first century.

There is a growing interdependence between a firm's ability to use information tech-nology and its ability to implement corporate strategies and achieve corporate goals. What a business would like to do in five years often depends on what its sys-tems will be able to do. Increasing market share, becoming the high-quality or low-cost producer, developing new products, and increasing employee productivity depend more and more on

the kinds and quality of information systems in the organization. The more you understand about this relationship, the more valuable you will be as a manager.

Productivity

Today s managers have very few tools at their disposal for achieving significant gains in pro-ductivity. IT is one of the most important tools along with innovations in organization and management, and in fact, these innovations need to be linked together. A substantial and growing body of research suggests investment in IT plays a critical role in increasing the productivity of firms, and entire nations (Zhu et al. 2004).

For instance, economists at the U.S. Federal Reserve Bank estimate that IT contributed to the lowering of inflation by 0.5 to 1 percentage point in the years from 1995 to 2000 (Greenspan, 2000). IT was a major factor in the resurgence in productivity growth in the United States, which began in 1995 and has continued until today at an average rate of 2.7 percent, up from 1.4 percent from 1973 to 1995 (Baily, 2002). Firms that invested wisely in information technology experienced continued growth in productivity and efficiency.

Strategic Opportunity and Advantage

If you want to take advantage of new opportunities in markets, develop new products, and create new services, chances are quite high you will need to make substantial investments in IT to realize these new business opportunities. If you want to achieve a strategic advan-tage over your rivals, to differentiate yourself from your competitors, IT is one avenue for achieving such advantages along with changes in business practices and management. These advantages might not last forever, but then again most strategic advantages throughout history are short-lived. However, a string of short-lived competitive advantages is a foundation for long-term advantages in business, just as is true of any athletic sport or race.

THE CHALLENGE OF INFORMATION SYSTEMS: KEY MANAGEMENT ISSUES

Although information technology is advancing at a blinding pace, there is nothing easy or mechanical about building and using information systems. There are five major chal-lenges confronting managers:

1. **The information systems investment challenge:** How can organizations obtain business value from their information systems? Earlier we described the impor-tance of information systems as investments that produce value for the firm. We showed that not all companies realize good returns from information systems invest-ments. It is obvious that one of the greatest challenges facing managers today is ensur-ing that their companies do indeed obtain meaningful returns on the money they spend on information systems. It's one thing to use information technology to design, produce, deliver, and maintain new products. It's another thing to make money doing it. How can organizations obtain a sizable payoff from their investment in information systems? How can management ensure that information systems contribute to corpo-rate value?

   Senior management can be expected to ask these questions: How can we evaluate our information systems investments as we do other investments? Are we receiving the return on investment from our systems that we should? Do our competitors get more? Far too many firms still cannot answer these questions. Their executives are likely to have trouble determining how much they actually spend on technology or how to mea-sure the returns on their technology investments. Most companies lack a clear-cut deci-sion-making process for deciding which technology investments to pursue and for managing those investments

2. **The strategic business challenge:** What complementary assets are needed to use informa-tion technology effectively? Despite heavy information technology investments, many organizations are not realizing significant business value from their systems, because they lack-or fall to appreciate-the complementary assets required to make their technology assets work. The power of computer hardware and software has grown much more rapidly than the ability of organizations to apply and use this

technology. To benefit fully from information technology, realize genuine productivity, and become competitive and effective, many organizations actually need to be redesigned. They will have to make fundamental changes in employee and management behavior, develop new business models, retire obsolete work rules, and eliminate the inefficiencies of outmoded business process and organization structures. New technology along will not produce meaningful business benefits.

3. **The globalization challenge:** How can firms understand the business and system require-ments of a global economic environment? The rapid growth in international trade and the emergence of a global economy call for information systems that can support both producing and selling goods in many different countries. In the past, each regional office of a multinational corporation focused on solving its own unique information problems. Given language, cultural, and political differences among countries, this focus frequently resulted in chaos and the failure of central manage-ment controls. To develop integrated, multinational, information systems, businesses must develop global hardware, software, and communications standards; create cross-cultural accounting and reporting structures; and design transnational busi-ness processes.

4. **The information technology infrastructure challenge:** How can organizations develop an information technology infrastructure that can support their goals when business condi-tions and technologies are changing so rapidly? Many companies are saddled with expensive and unwieldy information technology platforms that cannot adapt to innovation and change. Their information systems are so complex and brittle that they act as con-straints on business strategy and execution. Meeting new business and technology challenges may require redesigning the organization and building a new information technology (IT) infrastructure.

   Creating the IT infrastructure for a digital firm is an especially formidable task. Most companies are crippled by fragmented and incompatible computer hard-ware, software, telecommunications networks, and information systems that pre-vent information from flowing freely between different parts of the organization. Although Internet standards are solving some of these connectivity problems, creating data and computing platforms that span the enterprise – and, increasingly, link the enterprise to external business partners – is rarely as seamless as promised. Many organizations are still struggling to integrate their islands of information and technology.

5. **Ethics and security:** *The responsibility and control challenge: How can organizations ensure that their information systems are used in an ethically and socially responsible manner?* How can we design information systems that people can control and under-stand? Although information systems have provided enormous benefits and efficiencies, they have also created new ethical and social problems and challenges. A major management challenge is to make informed decisions that are sensitive to the negative consequences of informa-tion systems as well to the positive ones.

   Managers face an ongoing struggle to maintain security and control. Today, the threat of unauthorized penetration or disruption of information systems has never been greater. Information systems are so essential to business, government, and daily life that organizations must take special steps to ensure their security, accuracy, and reliability. A firm invites disaster if it uses systems that can be disrupted or accessed by outsiders, that do not work as intended, or that do not deliver information in a form that people can correctly use. Information systems must be designed so that they are secure, function as intended, and so that humans can control the process. Managers will need to ask: Can we apply high-quality assurance standards to our information systems, as well as to our products and ser-vices? Can we build systems with tight security that are still easy to use? Can we design information systems that respect people's rights of privacy while still pursuing our organizations gnats? Should information systems monitor employees? What do we do when an information system designed to increase efficiency and productivity elimi-nates people's jobs?

RECENT TRENDS IN INFORMATION SYSTEMS

It is generally accepted that information is a vital commodity for the successful operation of today's organizations. Nowadays modern business organizations are using computerized information systems in order to obtain desired information. However, as the technology advances rapidly the main issue is how can an organization should effectively use such an information system which its management sometimes can be unpredictable in order to effectively help the whole organization structure to improve and take the most out of it.

It seems fairly obvious that Information systems have played an important linking role even before the advent of the Internet. Thus, for example, the possibilities offered by Information systems have strongly influenced the way managers were able to exercise control and therefore constituted an important factor in the organization of large-scale enterprise and their geographic extension. The same is true for governments and their statistical apparatus. The recent integration of computer networks and electronic data exchange facilitated the creation of common databases and policies among governments, speeding up developments, which had started earlier. It also created new possibilities for business, for example enabling companies to develop new organizational practices (e.g. just-in-time).

However, the role of Information systems in the organization is shifting to support business processes rather than individual functions. The focus is outwards to customers, rather than inwards to procedures. Businesses are changing more and more rapidly.

This poses a challenge to existing Information systems, which are often inappropriately structured to meet these needs. It also poses a challenge to the people who design, work and use these systems, since they may hold outdated assumptions.

To ensure the services provided by Information systems whenever needed and their failure will not cause catastrophic disaster their reliability and efficiency become extremely important. Imagine what would happen when a banking system malfunctions due to some critical faults in the system or when a healthcare information system provides wrong advice for patients.

It is even not over-saying that our lives are already under control of computer systems but their reliability and efficiency has become extremely important

Here we would be discussing few of the information system which are evolving and getting widely used by the organizations.

Cloud Computing

Cloud computing is a general term for anything that involves delivering hosted services over the Internet. It is therefore is a term used to describe a new class of network based computing that takes place over the Internet. Its features are:

- It is basically a step on from Utility Computing
- It is a collection/group of integrated and networked hardware, software and Internet infrastructure (called a platform).
- It is delivered using the Internet for communication and transport provides hardware, software and networking services to clients

These platforms hide the complexity and details of the underlying infrastructure from users and applications by providing very simple graphical interface or API (Applications Programming Interface).

Cloud Computing is the practice of using a network of remote servers hosted on the Internet to store, manage, and process data, rather than a local server or a personal computer. In cloud computing, the word cloud is used as a metaphor for "the Internet," so the phrase cloud computing means "a type of Internet-based computing," where different services such as servers, storage and applications are delivered to an organization's computers

and devices through the Internet. The goal of cloud computing is to apply traditional supercomputing, or high-performance computing power, normally used by military and research facilities, to perform tens of trillions of computations per second, in consumer-oriented applications such as financial portfolios, to deliver personalized information, to provide data storage or to power large, immersive computer games. To do this; cloud computing uses networks of large groups of servers typically running low-cost consumer PC technology with specialized connections to spread data-processing chores across them. This shared IT infrastructure contains large pools of systems that are linked together. Often, virtualization techniques are used to maximize the power of cloud computing.

A cloud service has 3 distinct characteristics that differentiate it from traditional hosting.

- It is sold on demand, typically by the minute or the hour
- It is elastic; a user can have as much or as little of a service as they want at any given time.
- The service is fully managed by the provider.

Significant innovations in virtualization and distributed computing, as well as improved access to high-speed Internet and a weak economy, have accelerated interest in cloud computing.

Cloud services

These services are broadly divided into three categories: Infrastructure-as-a-Service (IaaS), Platform-as-a-Service (PaaS) and Software-as-a-Service (SaaS). The name cloud computing was inspired by the cloud symbol that's often used to represent the Internet in flowcharts and diagrams.

1. **Infrastructure-as-a-Service:** It includes Amazon Web Services that provides the customer with virtual server instances and storage, as well as application program interfaces (APIs) that allow the customer to start, stop, access and configure their virtual servers and storage. This model allows a company to pay for only as much capacity as is needed, and bring more online as soon as required. Because this pay-for-what-you-use model resembles the way electricity, fuel and water are consumed, it's sometimes referred to as utility computing.
2. **Platform-as-a-service:** It is defined as a set of software development tools hosted on the provider's infrastructure. Developers create applications on the provider's platform over the Internet. PaaS providers may use APIs, website portalss or gateway software installed on the customer's computer. Force.com, (an outgrowth of Salesforce.com) and GoogleApps are examples of PaaS. Developers need to know that currently, there are not standards for interoperability or data portability in the cloud. Some providers will not allow software created by their customers to be moved off the provider's platform.
3. **In the software-as-a-service:** Under this cloud model, the vendor supplies the hardware infrastructure, the software product and interacts with the user through a front-end portal. SaaS is a very broad market. Services can be anything from Web-based email to inventory control and database processing. Because the service provider hosts both the application and the data, the end user is free to use the service from anywhere.

A cloud can be private or public. A public cloud sells services to anyone on the Internet. (Currently, Amazon Web Services is the largest public cloud provider.) A private cloud is a proprietary network or a data centre that supplies hosted services to a limited number of people. When a service provider uses public cloud resources to create their private cloud, the result is called a virtual private cloud. Private or public, the goal of cloud computing is to provide easy, scalable access to computing resources and IT services.

Uses of Cloud Computing

- Rapid Service

- Secure Service
- Satisfying User Experience
- Lower Costs
- Multi-User Access
- Development Platform
- Infinite Storage

Data security is one of the major concerns with cloud computing. Even though the encryption and security power increases at an exponential rate, the threat of hackers still looms in many companies minds. Experts say that within four years, security systems for cloud computing will be perfected and stronger. As with any form of technology, the employer should have a policy on the use of cloud computing by employees that states the type of monitoring that will be conducted by the employer. This policy will serve to insure that the employer's cloud computing is not abused by employees. The policy should also state that employees have no privacy rights in regard to any contents (data) in the cloud. In contracting with providers such as Box, Dropbox, Microsoft, Apple or Amazon there are growing legal issues that must be addressed by all parties involved with the cloud contract.

Mobile Application

"App" is short for "application," and traditionally this was just a really generic term for any stand alone bit of software that runs on top of a computer's operating system – the way that Microsoft Word runs on top of the Windows operating system. Mobile app is a software application developed specifically for use on small, wireless computing devices, such as smart phones and tablets, rather than desktop or laptop computers. Mobile Apps are generally small, individual software units with limited function. Mobile applications are a move away from the integrated software systems generally found on PCs. A mobile app may be a mobile Web site bookmarking utility, a mobile-based instant messaging client, Gmail for mobile, and many other applications. Mobile apps are designed with consideration for the demands and constraints of the devices and also to take advantage of any specialized capabilities they have. Some apps are free, while others must be bought. Usually, they are downloaded from the platform to a target device, such as an iPhone, BlackBerry, Android phone or Windows Phone, but sometimes they can be downloaded to laptops or desktop computers. Mobile applications are a move away from the integrated software systems generally found on PCs. Instead, each app provides limited and isolated functionality such as a game, calculator or mobile Web browsing. Although applications may have avoided multitasking because of the limited hardware resources of the early mobile devices, their specificity is now part of their desirability because they allow consumers to hand-pick what their devices are able to do.

The simplest mobile apps take PC-based applications and port them to a mobile device. As mobile apps become more robust, this technique is somewhat lacking. A more sophisticated approach involves developing specifically for the mobile environment, taking advantage of both its limitations and advantages. For example, apps that use location-based features are inherently built from the ground up with an eye to mobile given that you don't have the same concept of location on a PC. The most popular smart phone platforms that support mobile apps are Windows Mobile, Android, Symbian, Java ME and Palm. In contrast, a mobile app is software that uses technologies such as Javascript or HTML5 to provide interaction, navigation, or customization capabilities. These programs run within a mobile device's web browser. This means that they're delivered wholly on the fly, as needed, via the internet; they are not separate programs that get stored on the user's mobile device. Mobile apps are sometimes categorized according to whether they are web-based or native apps, which are created specifically for a given platform. A third category, hybrid apps, combines elements of both native and Web apps. As the technologies mature, it's expected that mobile application development efforts will focus on the creation of browser-based, device-agnostic Web applications.

Analytics

Analytics is defined as the scientific process of transforming data into insight for making better decisions. Analytics is the process of obtaining an optimal and realistic decision based on existing data. Analytics is the field of data analysis. Analytics often involves studying past historical data to research potential trends, to analyze the effects of certain decisions or events, or to evaluate the performance of a given tool or scenario. The goal of analytics is to improve the business by gaining knowledge which can be used to make improvements or changes.

Analytics - also known as “business analytics” or “data analysis” - refers to the software and methods that organizations use to understand data. Organizations generate and collect large amounts of data in many forms (for example: text, statistical data, qualitative data, big data) and from many internal and external sources including social media. It is the science of examining raw data with the purpose of drawing conclusions about that information. Data analytics is used in many industries to allow companies and organization to make better business decisions and in the sciences to verify or disprove existing models or theories. Data analytics is distinguished from data mining by the scope, purpose and focus of the analysis. Data miners sort through huge data sets using sophisticated software to identify undiscovered patterns and establish hidden relationships. Data analytics focuses on inference, the process of deriving a conclusion based solely on what is already known by the researcher.

Organizations use predictive analytics and other kinds of analytics software to gain insights into their financial and operational performance and from their customer behaviors. With these insights, they can make accurate predictions and better-informed decisions about emerging opportunities, competitive threats and shifts in their markets to increase competitive advantage. Analytics is the discovery and communication of meaningful patterns in data. Especially valuable in areas rich with recorded information, analytics relies on the simultaneous application of statistics, computer programming and operations research to quantify performance. Analytics often favors data visualization to communicate insight. Firms may commonly apply analytics to business data, to describe, predict, and improve business performance. Specifically, arenas within analytics include Predictive analytics, enterprise decision management, retail analytics, store assortment and stock-keeping unit optimization, marketing optimization and marketing mix modeling, web analytics, sales force sizing and optimization, price and promotion modeling, predictive science, credit risk analysis, and fraud analytics. Since analytics can require extensive computation (see big data), the algorithms and software used for analytics harness the most current methods in computer science, statistics, and mathematics. Analytics is a multi-dimensional discipline. There is extensive use of mathematics and statistics, the use of descriptive techniques and predictive models to gain valuable knowledge from data. The insights from data are used to recommend action or to guide decision making rooted in business context. Thus, analytics is not so much concerned with individual analysis or analysis steps, but with the entire methodology.

Use of Agile Technology: Agile software development

It is a group of software development methods based on iterative and incremental development, where requirements and solutions evolve through collaboration between self-organizing, cross-functional teams. It promotes adaptive planning, evolutionary development and delivery, a time-boxed iterative approach, and encourages rapid and flexible response to change. It is a conceptual framework that promotes foreseen interactions throughout the development cycle. Agile technology is being widely used by the organization in developing information system now a days and it is resulting in various advantages.

Following are the major advantages of agile systems.

(1) Time & Money saving: The very first advantage that the company got to see with the Agile Methodology is the saving of time and money. There is less documentation required though documents help to a great deal in verifying and validating the requirements but considering the time frame of the project, this approach leads to focus more on the application rather than documenting the things. Since it is iterative in its form, it tends to have a regular feedback from the end user so that the same can be implemented

as soon as possible. And because all phases of SDLC need to be completed very quickly, there is a transparency to each individual working on the project with the status of each phase.

(2) Easy to incorporate changes: Another advantage that Agile Methodology offers to other approaches available is that in case there is any Change request or enhancements come in between any phase, it can be implemented without any budget constraint though there needs to be some adjustment in the already allotted time frame which will not be a difficult task for the projects following Agile tactics. Though it is useful for any Programming language or Technology around, it is advisable to make it employ for Web 2.0 or the projects which are new in media.

(3) Fast execution: Daily meetings and discussions for the project following agile approach can help to determine the issues well in advance and work on it accordingly. Quick coding and Testing makes the management aware of the gaps existing in either requirements or technology used and can try to find the workaround for the same.

(4) Short Project life cycle: Hence, with the quicker development, testing and constant feedbacks from the user, the Agile methodology becomes the appropriate approach for the projects to be delivered in a short span of time.

Here we have discussed few of the rapidly evolving trends in information systems but this list is growing and growing. Student are expect to keep them aware of latest trends in information system, development and applications

LESSON ROUND-UP

- System is a set of interrelated elements that collectively work together to achieve some common purpose or goal. Systems can be of different types and may be classified as Physical or Abstract systems, Open or Closed systems, 'Man-made' Information systems, Formal Information systems, Informal Information systems, Computer Based Information systems, Real Time System
- Data is a collection of facts, such as values or measurements. It can be numbers, words, measurements, observations or even just descriptions of things.
- Information is Facts provided or learned about something or someone. It can be defined as Data that (1) has been verified to be accurate and timely, (2) is specific and organized for a purpose, (3) is presented within a context that gives it meaning and relevance, and (4) that can lead to an increase in understanding and decrease in uncertainty
- There are various types of information such as Personal Information, Business Information, Statistical Information, Futuristic Information, Formal Information, Informal Information, Confirmed Information, Tentative Information, grapevine information, Technical Information, General Information, Secret Information, Strategic Information, Historical information, Current Information, Competitor Information.
- Process of generating information includes Understanding the user need in general, creating framework for generating intended information, collecting data, Processing and analyzing data, collating the result from data, interpret, evaluate and communicating the result of interpretation, evaluation of data in form of Information to intended user.
- Information is needed for decision making at all levels of management. Managers at different organizational levels make different types of decisions, control different types of processes, and have different information needs.
- Information needs of Top management is very unstructured and not defined as they require the information for strategic planning of institute while the information need of Middle level management is structured in comparison to TOP management and it can be developed in form of template in some

cases. The information need of Operation management needs to be very accurate and it can be easily developed in the form of template.

– An information system can be defined as all people, machines and activities aimed at the gathering and processing of data to supply the information need of people inside and outside the organization. In other words it can be defined as combination of people, hardware, software, communication devices, network and data resources that processes (can be storing, retrieving, transforming information) data and information for a specific purpose.

– Information system activities includes Input of data resource, Processing of data into information, Output of information products:, Storage of data resource:, Control of system performance:

– There are different types of information system being used which primarily includes Executive Support System, Management Information System, Decision-Support System, Knowledge Management System, Transaction Processing System, Office Automation System.

SELF-TEST QUESTIONS

(These are meant for re-capitulation only. Answers to these questions are not to be submitted for evaluation)

1. What do you mean by System? Explain different types of systems in detail.
2. What is the difference between
   (a) Open system and Closed System
   (b) Physical system and abstract system
   (c) Formal information system and information system.
3. What do you mean by data and information? State the difference between data and information in detail.
4. All information may be categorized as data but all data item may not be categorized as information. Elucidate.
5. Explain about the information gathering process. Also explain the different characteristic of information.
6. Write a short note on information as a corporate resource
7. Explain the different levels of management and their information need in an organisation.
8. What are the factors which affects the information need?
9. What do you mean by information system? Explain any five types of information system which are being used by an organisation.
10. What are the different functions of an information system? Clearly explain
11. Write short note on use of
    (a) Cloud computing
    (b) Agile Technology
    (c) Big data technology
    (d) User Interface
    (e) Mobile application in information systems.

Lesson 3
Computer Hardware – An Overview

LESSON OUTLINE

- Introduction of the term Computers
- Types of Computers
- Classification of computers on the basis of size, functions and generations
- Newer technology in Computers
- Components of a Computer System
- Primary and Secondary Storage, Computer Storage Capacities
- Computer Peripherals – Inputs, Output and Storage Devices

LEARNING OBJECTIVES

Today computers are either directly or indirectly influencing almost every aspect of lives. Whenever human intellect and technology meet, we will find computers. The television channels we watch, the radio stations that we listen to, microwave oven that we use, the car that we drive in, railway ticket reservation and even the cash register at any grocery store are all controlled in some way by computer system. The first fully electronic computers, introduced in the 1940s, were huge machines that required teams of people to operate. Compared to those early machines, today's computers are amazing. Not only are they thousands of times faster, they can fit on your desk, in your lap, or even in your pocket.

A Company Secretary is professional who requires good knowledge of basics of computer and its application so in view of this, study of computers and its components becomes vital.

After reading one would be able to

- Understand the meaning of term computers
- Learn about different types of computers
- Understand the difference between Analog and digital computers
- Learn about the classification of computer on the basis of size, function and generation
- Know about the newer types of computers
- Understand about different components of computers and their functions.
- Learn about different computer peripherals i.e. Input, Output and Storage devices

What a computer is to me is the most remarkable tool that we have ever come up with. It's the equivalent of a bicycle for our minds"

Steve Jobs

COMPUTERS: AN INTRODUCTION

"What is computer" this question that today sounds absurd, as everyone seems to know the answer to this redundant question. The fact actually is, everyone has their own interpretation of what A Computer is as they see it. The word computer has been expanded by different person in different perspective. 4 different expanded form of the word computer are as

COMPUTER Common Operating Machine Particularly Used for Trade, Education, and Research

COMPUTER Common Operating Machine Particularly Used for Training, Education, and Reporting

COMPUTER Commonly Operated Machine Particularly Used for Technological Engineering Research

COMPUTER Complicated Office Machine Put Under Tremendous Effort to Reduce manpower

Thus from the above table we may observe that

(a) Computer is a Machine

(b) Computer is used in Trade, Education, Research, Training and Technological Research.

(c) Computer helps in reducing man efforts.

(d) Computer is used in office for business reporting.

The field of computers has seen such unprecedented growth that it has become an integrated and important part of everyone's life. Today, a computer would is viewed as a youngster's toy which they use to surf the internet, listen songs, see videos, see pictures and more popularly - be connected using social networking. A computer has been reduced to a device that no longer needs any prior experience or learning to operate it, quite in contrast to the past days.

COMPUTER SYSTEM – CONCEPT

A computer is a programmable electronic machine designed to perform mathematical and non-mathematical operations with the help of instructions to process the data to achieve desired results. Speed, accuracy, diligence, large storage capacity, no IQ and no feelings are some characteristic of computer.

Applications and services

Although the application domain of a computer depends totally on human creativity and imagination, it covers a huge area of applications including education, industries, government, medicine, scientific research, law and even music.

In the workplace, many people use computers to keep records, analyze data, do research, and manage projects. With Internet access, you can communicate with people all over the world and find a vast amount of information.

A Computer system is made up of two parts: The hardware and the software.

1. Hardware: The physical equipment required to create, use, manipulate and store electronic data.

2. Software: The computerized instructions that operate a computer manipulate the data and execute particular functions or tasks.

ENIAC (Electronic Numerical Integrator and Computer) was the first general-purpose electronic computer introduced in 1946.

In this chapter we will confine our discussion to the Hardware of the computer

TYPES OF COMPUTERS

Analog Computers

Analog computers are used to process continuous data. Analog computers represent variables by physical quantities. Thus any computer which solve problem by translating physical conditions such as flow, temperature, pressure, angular position or voltage into related mechanical or electrical related circuits as an analog for the physical phenomenon being investigated in general it is a computer which uses an analog quantity and produces analog values as output. Thus an analog computer measures continuously. Analog computers are very much speedy. They produce their results very fast. But their results are approximately correct. All the analog computers are special purpose computers.

Analog computers are used in nuclear power plants, industrial chemical processes and electronic networks (e.g. performance of long distance circuits) etc.

Digital Computers

Digital computer represents physical quantities with the help of digits or numbers. These numbers are used to perform Arithmetic calculations and also make logical decision to reach a conclusion, depending on, the data they receive from the user.

Mostly all computers are digital in nature. It is used in industrial processes, analyzing and organizing large amount of data and resulting the operations of machines.

Hybrid Computers

Various specifically designed computers are with both digital and analog characteristics combining the advantages of analog and digital computers when working as a system. Hybrid computers are being used extensively in process control system where it is necessary to have a close representation with the physical world.

The hybrid system provides the good precision that can be attained with analog computers and the greater control that is possible with digital computers, plus the ability to accept the input data in either form.It is used in nuclear power plants, guided –missile system and spacecraft.

Difference between Analog and Digital Computers

Analog Computers	***Digital Computers***
Analog computers process measured data. A speedometer in your car is a common type of analog device.	A digital computer processed discrete data (digits). In this case 0 and 1
Analog Computers Work on continuous values.	Digital computers Work on discrete values
Analog Computers have low memory.	Digital computers have a very large memory
Analog computers have Slow speed.	Digital computers have fast speed.
Analog computers are less reliable.	Digital computers are more reliable.
Analog computers are used in engineering, science and medical fields.	Digital computers are used in all fields of life.
Analog computers are used to calculate / measure analog quantities like speed and temperature.	Digital computers are used to calculate mathematical and logical operations. It can solve addition, subtraction, division, multiplication and other mathematical and statistical operations.
Analog computers provide less accurate results.	Digital computers provide 100% accurate results.

Normally Analog Computers are specific purpose	Digital Computers are general purpose
Analog computers are difficult to use	Digital computers are easy to use
Examples of Analog computers are: thermometer, analog clock, speedometer etc.	Examples of digital computers are:Personal Computer, laptops, smart phones etc.

CLASSIFICATION OF COMPUTER

Classification by Size

1. Supercomputer

Supercomputers are highly sophisticated computers used for very special tasks like scientific research etc. Supercomputers are the fastest expensive and are employed for specialized applications that require immense amounts of mathematical calculations (number crunching). For example, weather forecasting requires a supercomputer. Other uses of supercomputers scientific simulations, (animated) graphics, fluid dynamic calculations, nuclear energy research, electronic design, and analysis of geological data (e.g. in petrochemical prospecting).

Supercomputers get their processing power by taking advantage of *parallel processing*; they use lots of CPUs at the same time on one problem. A typical supercomputer can do up to ten trillion individual calculations every second.

Supercomputers are the most powerful computers made till now. The main feature of super computer is multiprocessing which enables the computer to perform number of operation simultaneously.

The 1st Supercomputer was built in 1960 in US for US department of defense. India has also made its own Super computer named PARAM in 1991.

2. Mainframe Computer

Mainframes are powerful computers used primarily by corporate and governmental organizations for critical applications, bulk data processing such as census, industry and consumer statistics, enterprise resource planning, and financial transaction processing.

They are large-sized, powerful multi-user computers that can support concurrent programs. That means, they can perform different actions or 'processes' at the same time. Mainframe computers can be used by as many as hundreds or thousands of users at the same time. Large organisations may use a mainframe computer to execute large-scale processes such as processing the organization's payroll.

The chief difference between a supercomputer and a mainframe is that a supercomputer channels all its power into executing a few programs as fast as possible, whereas a mainframe uses its power to execute many programs concurrently. In some ways, mainframes are more powerful than supercomputers because they support more simultaneous programs. But supercomputers can execute a single program faster than a mainframe.

3. Minicomputer

Mini-computers are mid-sized multi-processing computers. Again, they can perform several actions at the same time and can support from 4 to 200 users simultaneously. In recent years the distinction between mini-computers and small mainframes has become blurred. Often the distinction depends upon how the manufacturer wants to market its machines. Organizations may use a mini-computer for such tasks as managing the information in a small financial system or maintaining a small database of information about registrations or applications.

In recent years, the minicomputer has evolved into the "mid-range server" and is part of a network. IBM's AS/400e is a good example.

4. Workstation

Workstations are powerful, single-user computers. They have the capacity to store and process large quantities of data, but they are only used by one person at a time. However, workstations are typically linked together to

form a computer network called a local area network, which means that several people, such as staff in an office, can communicate with each other and share electronic files and data.

A workstation is similar to a personal computer but is more powerful and often comes with a higher-quality monitor. In terms of computing power, workstations lie in between personal computers and mini-computers. Workstations commonly support applications that require relatively high-quality graphics capabilities and a lot of memory, such as desktop publishing, software development and engineering applications.

Workstations are sometimes improperly named for marketing reasons. Real workstations are not usually sold in retail, but this is starting to change; Apple's Mac Pro would be considered a workstation.

The movie Toy Story was made on a set of Sun (Sparc) workstations.

5. Personal computers

Personal computers (PCs), also called microcomputers, are the most popular type of computer in use today. The PC is a small-sized, relatively inexpensive computer designed for an individual user. Today, the world of PCs is basically divided between IBM-compatible and Macintosh-compatible machines, named after the two computer manufacturers. Computers may be called 'desktop' computers, which stay on the desk, or 'laptop' computers, which are lightweight and portable. Organizations and individuals use PCs for a wide range of tasks, including word processing, accounting, desktop publishing, preparation and delivery of presentations, organization of spreadsheets and database management. Entry-level PCs are much more powerful than a few years ago, and today there is little distinction between PCs and workstations.

Classification by function

1. Servers

Server usually refers to a computer that is dedicated to providing a service. They don't focus on trying to solve one very complex problem, but try to solve many similar smaller ones. A server is a central computer that contains collections of data and programs. For example, a computer dedicated to a database may be called a "database server". "File servers" manage a large collection of computer files. "Web servers" process web pages and web applications. Many smaller servers are actually personal computers that have been dedicated to providing services for other computers.

2. Workstations

Workstations are computers that are intended to serve one user and may contain special hardware enhancements not found on a personal computer.

3. Information appliances

Information appliances are computers specially designed to perform a specific user-friendly function —such as playing music, photography, or editing text. The term is most commonly applied to mobile devices, though there are also portable and desktop devices of this class.

4. Embedded computers

Embedded computers are computers that are a part of a machine or device. Embedded computers generally execute a program that is stored in non-volatile memory and is only intended to operate a specific machine or device. Embedded computers are very common. Embedded computers are typically required to operate continuously without being reset or rebooted, and once employed in their task the software usually cannot be modified. An automobile may.

Classification by Generations

Initially, computer generation refers to the different advancements of computer technology. In each new generation, the circuitry has gotten smaller and more advanced than the previous generation before it. Now a

days, it includes advancements of both hardware and software, which together make up an entire computer system.

1. First Generation (1940-1956) Vacuum Tubes

The first computers used vacuum tubes for circuitry and magnetic drums for memory, and were often enormous, taking up entire rooms. They were very expensive to operate and in addition to using a great deal of electricity, generated a lot of heat, which was often the cause of malfunctions.

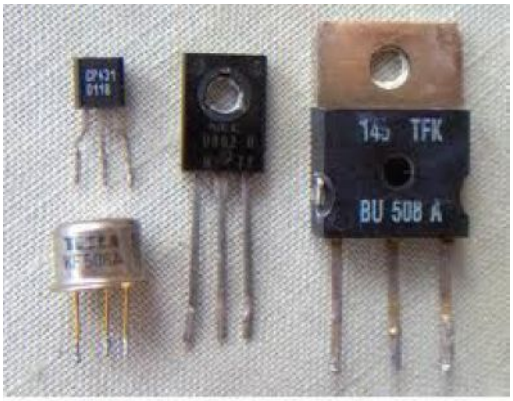
In 1946 two Americans, Eckert, and John Mauchly built ENIAC (Electronic Numerical Integrator and Computer), the first electronic computer which used thousands of vacuum tubes instead of the mechanical switches. These vacuum tubes looked like electric bulbs, took up a lot of space, produced a lot of heat and consumed a lot of electricity. It's purpose was to act like an *amplifier* and a *switch*. In this generation Punched cards, Paper tape, Magnetic tape used as I/O devices, batch Processing used as Operating System and electric wired board languages were used.

Vacuum Tubes

The UNIVAC and ENIAC computers are examples of first-generation computing devices. The UNIVAC was the first commercial computer delivered to a business client, the U.S. Census Bureau in 1951.

2. Second Generation (1956-1963) Transistors

In this generation transistors were used in place of vacuum tube invented by John Bardeen, William Shockley, and Walter Brattain. These transistor were cheaper, consumed less power, more compact in size , more reliable and faster than the vacuum tubes and gave off virtually no heat compared to vacuum tubes. In this generation, magnetic cores were used as primary memory and magnetic tape and magnetic disks as secondary storage devices.



Transistors

Though the transistor still generated a great deal of heat that subjected the computer to damage, it was a vast improvement over the vacuum tube. Second-generation computers still relied on punched cards for input and printouts for output.

Second-generation computers moved from cryptic binary machine language to symbolic, or assembly, languages, which allowed programmers to specify instructions in words. High-level programming languages were also being developed at this time, such as early versions of COBOL and FORTRAN. These were also the first computers that stored their instructions in their memory, which moved from a magnetic drum to magnetic core technology.

The first computers of this generation were developed for the atomic energy industry. IBM 1620, CDC 3600 and CDC 1604 are some examples of this generation.

3. Third Generation (1964-1971) Integrated Circuits

The third generation of computer is marked by the use of IC's(thin wafer of silicon) in place of transistors invented by Javk Kilby. A single IC has many transistors, resistors and capacitors along with the associated circuitry. This development made computers smaller in size, reliable, efficient and cost effective. In this generation, Remote processing, Time-sharing, Real-time, Multi-programming Operating System were used.

Integrated Circuits

Instead of punched cards and printouts, users interacted with third generation computers through keyboards and monitors and interfaced with an operating system, which allowed the device to run many different applications at one time with a central program that monitored the memory. Computers for the first time became accessible to a mass audience because they were smaller and cheaper than their predecessors. IBM-360 series, Honeywell-6000 series, PDP(Personal Data Processor), IBM-370/168, TDC-316 are some examples of this generation.

4. Fourth Generation (1971-Present) Microprocessors

This generation can be characterized by monolithic integrated circuits (millions of transistors put onto one integrated circuit chip) and the microprocessor invented by Marcian Hoff. The microprocessor is the characteristic of fourth generation computers, *a single chip that could do all the processing of a full-scale computer.* The reduced size, reduced cost, and increased speed of the microprocessor led to the creation of the first personal computers.

In 1976, Steve Jobs and Steve Wozniak built the Apple II, the first personal computer in a garage in California and IBM introduced its first personal computer in 1981. Very soon everyday household items such as microwave ovens, television sets and automobiles with electronic fuel injection incorporated microprocessors. In fourth generation computers became easily available and no A.C was required. Concept of internet was also introduced.

As these small computers became more powerful, they could be linked together to form networks, which eventually led to the development of the Internet. Fourth generation computers also saw the development of GUIs, the mouse and handheld devices.

DEC 10, STAR 1000,PDP 11,CRAY-1 (Super Computer) and CRAY-X-MP (Super Computer) are some examples of this generations.

5. Fifth Generation (Present and Beyond) Artificial Intelligence

The Fifth Generation Computer Systems project was an initiative by Japan's Ministry of International Trade

and industry, begun in 1982, to create a computer using massively parallel processing and use of parallel processing and superconductors are helping to make artificial intelligence a reality. Basically this generation is based on parallel processing hardware, Artificial Intelligence software and ULSI(Ultra Large Scale Integration) technology.

Artificial Intelligence is a promising branch in computer science which interprets means and methods of making computers think like human beings. Many computing devices, based on artificial intelligence, are still in development, though there are some applications, such as voice recognition, that are being used today. The latest versions of Microsoft Windows (Windows Vista and Windows 7) have a built-in voice-recognition programme called Speech Recognition.

Quantum computation and molecular and nanotechnology will radically change the face of computers in years to come. The objective of fifth-generation computing is to develop devices that respond to natural language input and are capable of learning and self-organization. Artificial Intelligence includes Robotics, Neural Networks, Game Playing and development of Expert systems to make decisions in real life situations.

NEWER DEVELOPMENT IN COMPUTERS

Laptop Computers

Laptop computers are usually lightweight mobile PCs with an LCD display thin screen. They are sometimes called notebook computers because they can be used instead of a notebook with paper. Laptops can also operate on batteries, so you can take them anywhere you need to work. Unlike desktops, laptops are completely self-contained. The laptop folds and closes like a book. Hence making it easy for you to learn how to use computer faster any where you go.

Handheld Computers

Handheld computers, also called personal digital assistants (PDAs), are battery-powered computers like Blackberry's. Handheld computers are not as fast as desktops or laptops, handhelds are handy for making appointments, keeping track of addresses and phone numbers, and playing games.

Some handhelds have more advanced features, like making telephone calls or getting on the Internet. Instead of a keyboard, handheld computers or PDA's have touch screens that you use with your finger or a stylus, which looks a lot like a pen without ink.

Tablet Computers

Tablet Personal Computers are mobile PCs that combine features of laptops and handhelds. Like laptop computers, Tablet computers are very powerful, fast and have a screen like a tablet. Like handhelds, Tablets can allow you to make notes or draw pictures directly on the screen, usually with a tablet pen instead of a stylus. Tablets can also transform your handwriting into typed text? Some Tablet PCs have a screen that swivels and unfolds to reveal a keyboard under the computer.

Palmtop

A small computer that literally fits in your palm. Compared to full-size computers, palmtops are severely limited, but they are practical for certain functions such as phone books and calendars. Palmtops that use a pen rather than a keyboard for input are often called hand-held computers or PDAs. Because of their small size, most palmtop computers do not include disk drives. However, many contain PCMCIA slots in which you can insert disk drives, modems, memory, and other devices. Palmtops are also called PDAs, hand-held computers and pocket computers

COMPUTER HARDWARE

The hardware are the parts of the computer itself including the Central Processing Unit (CPU) and related microchips and micro-circuitry, keyboards, monitors, case and drives (hard, CD, DVD, floppy, optical, tape, etc...). Other extra parts called peripheral components or devices include mouse, printers, modems, scanners, digital cameras and cards (sound, colour, and video) etc... Together they are often referred to as a personal computer. The different Hardware components of a computer are explained below.

Central Processing Unit

Pronounced as separate letters, CPU is the abbreviation for ***c**entral **p**rocessing **u**nit*. Sometimes referred to simply as the *central processor*, but more commonly called *processor,* the CPU is the brains of the computer where most calculations take place. In terms of computing power, the CPU is the most important element of a computer system.

On large machines, the CPU requires one or more printed circuit boards. On personal computers and small workstations, the CPU is housed in a single chip called a *microprocessor*. Since the 1970's the microprocessor class of CPUs has almost completely overtaken all other CPU implementations.

The CPU itself is an internal component of the computer. Modern CPUs are small and square and contain multiple metallic connectors or pins on the underside. The CPU is inserted directly into a CPU socket, pin side down, on the motherboard.

Each motherboard will support only a specific type (or range) of CPU, so you must check the motherboard manufacturer's specifications before attempting to replace or upgrade a CPU in your computer. Modern CPUs also have an attached heat sink and small fan that go directly on top of the CPU to help dissipate heat.

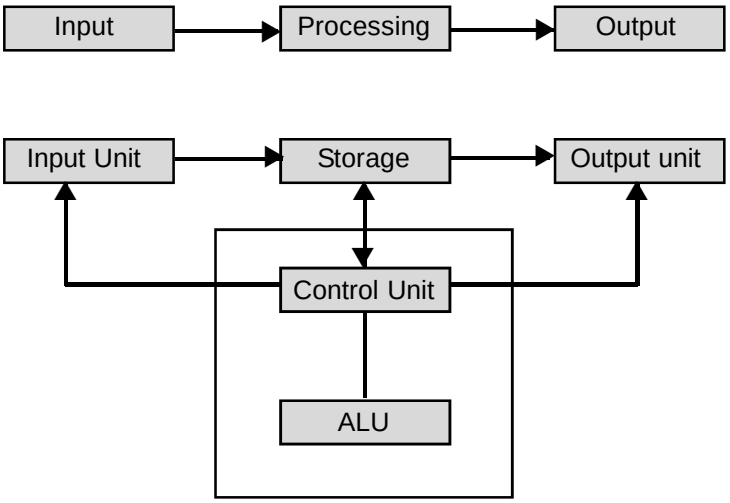
CPU performs the following functions:

- It performs all calculations.
- It takes all decisions.
- It controls all units of the computer.

A PC may have CPU-IC such as Intel 8088, 80286, 80386, 80486, Celeron, Pentium, Pentium Pro, Pentium II, Pentium III, Pentium IV, Dual Core, and AMD etc.

Two typical components of a CPU are the following:

- The *arithmetic logic unit (ALU)*, which performs arithmetic and logical operations.
- The *control unit (CU)*, which extracts instructions from memory and decodes and executes them, calling on the ALU when necessary.



Arithmetic Logical Unit (ALU) :

All calculations are performed in the Arithmetic Logic Unit (ALU) of the CPU. It also does comparison and takes decision. The ALU can perform basic operations such as addition, subtraction, multiplication, division, etc and does logic operations via, >, <, =, <=,>= etc. Whenever calculations are required, the control unit transfers the data from storage unit to ALU once the computations are done, the results are transferred to the storage unit by the control unit and then it is send to the output unit for displaying results.

Control Unit:

It controls all other units in the computer. The control unit instructs the input unit, where to store the data after receiving it from the user. It controls the flow of data and instructions from the storage unit to ALU. It also controls the flow of results from the ALU to the storage unit. The control unit is generally referred as the central nervous system of the computer that control and synchronizes its working.

Functions of Central Processing unit

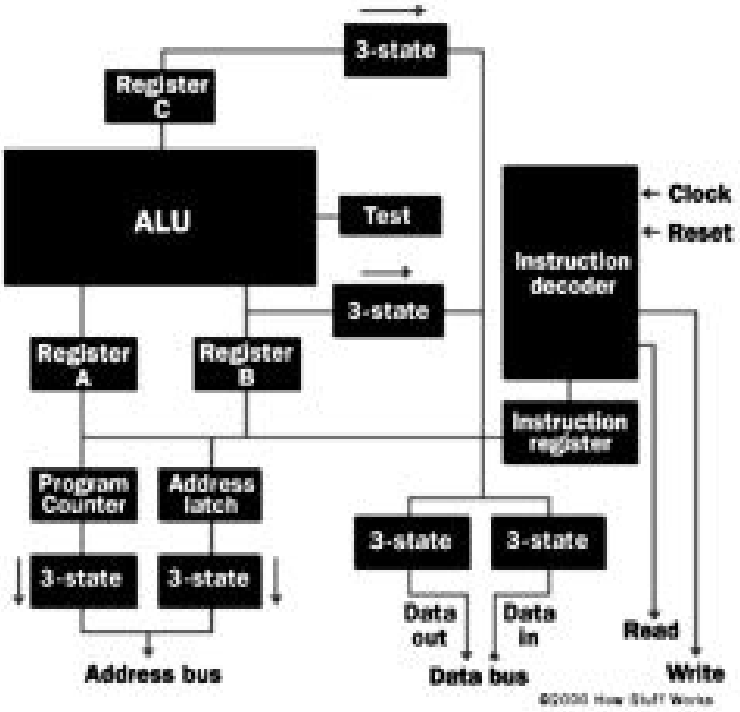
A CPU has four primary functions: **fetch**, **decode**, **execute**, and **write back**.

A. Fetch

In the first step, the CPU retrieves the instruction that it needs to run from program memory. Each instruction in a program (which contains millions of instructions) is stored at a specific address. The CPU has a *program counter*, which keeps track of the CPU's position in the program ""more specifically, the address of the instruction that the CPU is accessing.

B. Decode

For this step, it's important to know that no matter what code a program is written in, the compiler for that specific language breaks the code down to Assembly Language. Assembly language is a language that the CPU understands, but may vary between different CPUs. From there on, an "˜assembler' translates Assembly Language into binary code, which the CPU can manipulate to execute the instructions it is given.



C. Execute

Based on the instructions it is given, the CPU can then do one of three things:

(1) Using its Arithmetic Logic Unit (ALU), the CPU can calculate extremely complicated mathematical functions;

(2) Move data from one memory location to another;

(3) Jump to different addresses in the program based on decisions made by the CPU itself.

The diagram above shows the setup of an extremely simple microprocessor capable of performing these actions.

D. Write back

Typically, each of the actions taken by the CPU produces some sort of output. The CPU takes this output and writes it into the computer's memory. For example, if a program wanted to execute the first item of the list above on two operands, 3 and 5, the output, 8, would be written back into a specific address. However, for the 3rd bullet, the program counter (which, as stated above, is used to keep track of the CPU's progress through a program) simply changes to reflect the start of the next set of instructions.

When these four steps have been completed, the Program Counter moves onto the next instruction and repeats the entire process again, until the termination of the program.

Another important component of a CPU is called the "clock." The clock produces a signal that acts to synchronize the logic units within the CPU as they execute the instructions given in a program. In the diagram above, the purple line represents the signal of a clock as it is being inputted into a logic unit. For every time the line goes from low to high, and back to low (one cycle), an instruction is carried out.

Thus, the CPU Clock speed refers to the number of times that a CPU's clock cycles per second. Typical computers have a clock speed around 2.8 GHz (Gigahertz), which means that the clock cycles 2.8 billion times a second, and execute an equivalent number of instructions!

INPUT DEVICES

Computers need to receive data and instruction in order to solve any problem. Therefore we need to input the data and instructions into the computers. The input unit consists of one or more input devices. Keyboard is the one of the most commonly used input device. Other commonly used input devices are the mouse, floppy disk drive, magnetic tape, etc. All the input devices perform the following functions.

- Accept the data and instructions from the outside world.
- Convert it to a form that the computer can understand.
- Supply the converted data to the computer system for further processing.

Keyboard

The Keyboard is an Input device of a computer. It is mechanical in nature. The keyboard is used to type information into the computer. On the basis of input made through Keyboard computer executes its function. There are many different keyboard layouts and sizes with the most common for Latin based languages being the QWERTY layout (named for the first 6 keys). It is available in 101 and 104 keys. The standard keyboard has 101 keys. It has following basic types of keys-alphanumeric keys, modified keys (shift, Cntrl, Alt), special character keys, function keys (F1 toF12), Cursor movement keys (Arrow, PgUp, PgDn, Home, End), and special purpose keys (Insert, Delete, Escape, Print, Scroll, Scroll lock and Pause}.

Some special keys and their function

1. Backspace: This key is used to delete letters backward.
2. Delete: This key deletes letters forward.
3. Shift: This key, when pressed with another key, will perform a secondary function.
4. Spacebar: This key enters a space between words or letters.
5. Tab: This key will indent what you type, or move the text to the right. The default indent distance is usually ½ inch.
6. Caps Lock: Pressing this key will make every letter you type capitalized.
7. Control (Ctrl): This key, when pressed WITH another key, performs a shortcut.
8. Enter: This key either gives you a new line, or executes a command (pressed in a word processing program, it begins a new line).
9. Number Keypad: These are exactly the same as the numbers at the top of the keyboard; some people just find them easier to use in this position.
10. Arrow keys: Like the mouse, these keys are used to navigate through a document or page.

Mouse

Mouse is also a popular input device. Most modern computers today mainly desktop are run using a mouse controlled pointer. Earlier mouse was mechanical in nature but now optical mouse are also used extensively. Mouse is generally available in 2 button and 3 buttons models. Generally if the mouse has two buttons the left one is used to select objects and text and the right one is used to access menus.

The mouse symbol, or pointer, that appears on the computer screen will change its look and function depending on what it is near or hovering over.

 Your mouse pointer will most often look like an arrow

 When your mouse pointer is over an internet link, it will look like a pointing hand

 When your mouse pointer is over a place where you can type, it will look like an I-beam

 When your computer is busy or ‘working,’ your mouse pointer may look like an hourglass

 or an arrow with an hourglass

There are actually many different pointers (though these are the most common), and they will change automatically depending on what task you are trying to perform.

Now with the popularization of Laptop, use of mouse has declined. Laptop computers use touch pads, buttons and other devices to control the pointer. Handhelds computers use a combination of devices to control the pointer, including touch screens.

Trackball

A trackball is a pointing device consisting of a ball held by a socket containing sensors to detect a rotation of the ball about two axes – like an upside-down mouse with an exposed protruding ball. It is mechanical in nature and available in two and three button models. The user rolls the ball with the thumb, fingers, or the palm of the hand to move a pointer. Compared with a mouse, a trackball has no limits on effective travel; at times, a mouse can reach an edge of its working area while the operator still wishes to move the screen pointer farther. With a trackball, the operator just continues rolling. Some trackballs, such as Logitech’s optical-pickoff types, have notably low friction, as well as being dense (glass), so they can be spun to make them coast.

Image Scanner

Image Scanner often abbreviated as scanner is an input device which scans text or graphics on a printed paper and digitize the same into a form that computer can use. It is photo electric in nature an available in hand held or flat bed model.

Bar Code Reader

A Bar Code reader is an input device which reads the bar code printed and converts the barcode into a machine readable form. Bar Code reader has found wide acceptance in industry and widely used in retail trade. It is also photo electric in nature.

Optical Character Recognition (OCR)

Optical character recognition, usually abbreviated to OCR, is the mechanical or electronic conversion of scanned images of handwritten, typewritten or printed text into machine-encoded text. It is widely used as a form of data entry from some sort of original paper data source, whether documents, sales receipts, mail, or any number of printed records. It is crucial to the computerization of printed texts so that they can be electronically searched, stored more compactly, displayed on-line, and used in machine processes such as machine translation, text-to-speech and text mining. OCR is a field of research in pattern recognition, artificial intelligence and computer vision.

Other Input Devices

A. Web Cameras: Often known as webcam is a video camera that feeds its images in real time to a computer or computer network, often via USB, Ethernet, or Wi-Fi.

B. Digital Cameras: A digital camera (or digicam) is a camera that takes video or still photographs, or both, digitally by recording images via an electronic image sensor. It is the main device used in the field of digital photography.

C. Camcorders: A camcorder (formally a *video camera recorder*) is an electronic device that combines a video camera and a video recorder into one unit; typically for out-of-studio consumer video recording.

D. Microphone: A microphone informally called a mic or mike; is an acoustic-to-electric transducer or sensor that converts sound into an electrical signal. Microphones are used in many applications such as telephones, tape recorders, karaoke systems, hearing aids, motion picture production, live and recorded audio engineering, FRS radios, megaphones, in radio and television broadcasting and in computers for recording voice, speech recognition, VoIP, and for non-acoustic purposes such as ultrasonic checking or knock sensors.

E. Joystick: A **joystick** is an input device consisting of a stick that pivots on a base and reports its angle or direction to the device it is controlling. Joysticks are often used to control video games, and usually have one or more push-buttons whose state can also be read by the computer.

F. Optical Mark Reader: It is a special scanning device that can read carefully placed pencil marks on specially designed documents. OMR is frequently used in forms, questionnaires, answer-sheets.

G. Touch Pen: A stylus for touch screens on mobile devices, such as iPhones and Androids, that requires the body's electricity. The touch pen, which has a rubber tip with high carbon content, allows current to transfer between the user and capacitive screens.

H. Touch pad: A touchpad (or track pad) is a pointing device featuring a tactile sensor, a specialized surface that can translate the motion and position of a user's fingers to a relative position on screen. Touchpads are commonly used in Laptop as a substitute of a mouse.

I. Touch Screen: A touch screen is an electronic visual display that can detect the presence and location of a touch within the display area. The term generally refers to touching the display of the device with a finger or hand. Touch screens can also sense other passive objects, such as a stylus. Touch screens are common in devices such as game consoles, all-in-one computers, tablet computers, and smartphones.

J. Light pen: A light pen is a computer input device in the form of a light-sensitive rod used in conjunction with a computer's CRT display. It allows the user to point to displayed objects or draw on the screen in a similar way to a touch screen but with greater positional accuracy.

K. Graphic digitizer: Graphic Digitizer also known as graphics tablet is an input device which is used to convert hand-drawn images into a format suitable for computer processing. Images are usually drawn onto a flat surface with a stylus and then appear on a computer monitor or screen.

OUTPUT DEVICES

Monitors

It is an output device used for observing, checking, or keeping a continuous record of a process or quantity: A monitor is also known as display/Screen/Visual Display Unit. It is electronic in nature. The monitor comprises the display device, circuitry, and an enclosure. The display device in modern monitors is typically a thin film transistor liquid crystal display (TFT-LCD) thin panel, while older monitors use a cathode ray tube about as deep as the screen size.

Monitors come in many types and sizes. The resolution of the monitor determines the sharpness of the screen. The resolution can be adjusted to control the screen's display.

Printer

Printer is an output device which produces a text or graphics of documents stored in electronic form, usually on physical print media such as paper or transparencies. These are often classified as impact printer or non impact printer. Dot matrix printer, daisy wheel printer, thermal printer and Line printer are known as Impact printer while Inkjet Printer, Laser printer are known as non impact printer.

Many printers are primarily used as local peripherals, and are attached by a printer cable or, in most new printers, a USB cable to a computer which serves as a document source. Some printers, commonly known as *network printers*, have built-in network interfaces, typically wireless or Ethernet based, and can serve as a hard copy device for any user on the network.

Plotter

The plotter is a computer output device which produces drawing on paper based on commands from a computer. Plotter .differ from printer as it draws lines using a pen. It can produce continuous lines. It is mainly used in engineering application and expensive in nature.

Sound Card and Speakers

Sound card and speakers are output devices which facilitates the audio output from computer. Sound card helps in converting digital signal into audio output which is then heard through the speakers. Today with the advent of Multimedia systems, sound cards and speaker have become integral parts of the computer system.

OTHER COMPUTER PERIPHERALS

Modem

Modem is the abbreviated form of Modulator Demodulator. A modem is a device or program that enables a computer to transmit data over, for example, telephone or cable lines. Computer information is stored digitally, whereas information transmitted over telephone lines is transmitted in the form of analog waves. A modem converts between these two forms. It modulates an analog carrier signal to encode digital information, and also demodulates such a carrier signal to decode the transmitted information. The goal is to produce a signal that can be transmitted easily and decoded to reproduce the original digital data. Modems can be used over any means of transmitting analog signals, from light emitting diodes to radio. The most familiar example is a voice

band modem that turns the digital data of a personal computer into modulated electrical signals in the voice frequency range of a telephone channel. These signals can be transmitted over telephone lines and demodulated by another modem at the receiver side to recover the digital data

Video Cards

A video card, display card, graphics card, or graphics adapter is an expansion card which generates a feed of output images to a display. Most video cards offer various functions such as accelerated rendering of 3D scenes and 2D graphics, MPEG-2/MPEG-4 decoding, TV output, or the ability to connect multiple monitors (multi-monitor).

Video hardware can be integrated into the motherboard but recently it has been integrated into the CPU, however all modern motherboards, and even motherboards from the 90's provide expansion ports to which a video card can be attached.

Network Card

A network card is a piece of hardware that allows a computer to connect to a computer network. Sometimes the network card is integrated on the motherboard. Each network card has a unique number; this is used for addressing. It is called the MAC address.

Computer Data Storage

Computer data storage is often called storage or memory, refers to computer components and recording media that retain digital data. Data storage is a core function and fundamental component of computers.

In contemporary usage, 'memory' usually refers to semiconductor storage read-write random-access memory, typically DRAM (Dynamic-RAM). *Memory* can refer to other forms of fast but temporary storage. *Storage* refers to storage devices and their media not directly accessible by the CPU, (secondary or tertiary storage), typically hard disk drives, optical disc drives, and other devices slower than RAM but are non-volatile (retaining contents when powered down).

Historically, *memory* has been called *core*, *main memory*, *real storage* or *internal memory* while storage devices have been referred to as *secondary storage*, *external memory* or *auxiliary/peripheral storage*.

The distinctions are fundamental to the architecture of computers. The distinctions also reflect an important and significant technical difference between memory and mass storage devices, which has been blurred by the historical usage of the term *storage*. Nevertheless, this article uses the traditional nomenclature.

Many different forms of storage, based on various natural phenomena, have been invented. So far, no practical universal storage medium exists, and all forms of storage have some drawbacks. Therefore a computer system usually contains several kinds of storage, each with an individual purpose.

Measurement of Computer Data Storage

A computer memory consists of several electronic cells. Each cell is capable of storing a byte. One byte is equal to 8 binary digit (bit). A binary digit is 1 or 0.

$1024 = 2^{10}$

1 byte = 8 bits

1 Kilobyte (KB) = 1024 byte

1Megabyte (MB) = 1024 KB

1Gigabyte (GB) = 1024 MB

1Terabyte (TB) = 1024 GB

1 Petabyte (PB) = 1024 TB

1 Exabyte (EB) = 1024 PB

1 Zettabyte (ZB) = 1024 EB

1 Yottabyte (YB)= 1024 ZB

TYPES OF COMPUTER MEMORY

Primary Storage

Primary storage (or *main memory* or *internal memory*), often referred to simply as *memory*, is the only one directly accessible to the CPU. The CPU continuously reads instructions stored there and executes them as required. Any data actively operated on is also stored there in uniform manner. This memory is generally used to hold the program being currently executed in the computer, the data being received from the input unit, the intermediate and final results of the program. The primary memory is temporary in nature. The data is lost, when the computer is switched off. In order to store the data permanently, the data has to be transferred to the secondary memory. Main memory is a combination of both RAM and ROM.

Random Access Memory or RAM is a form of data storage that can be accessed randomly at any time, in any order and from any physical location in contrast to other storage devices, such as hard drives, where the physical location of the data determines the time taken to retrieve it. RAM is read write memory i.e. information can be read as well as write on this type of memory. RAM is referred to as volatile memory and is lost when the power is turned off

Read-only memory or ROM is a form of data storage in computers and other electronic devices that can not be easily altered or reprogrammed. ROM in non-volatile and the contents are retained even after the power is switched off.

Difference between Random Access Memory (RAM) and Read-only memory (ROM)

Stands for:	Random Access Memory	Read-only memory
Volatility:	RAM is volatile i.e. its contents are lost when the device is powered off.	It is non-volatile i.e. its contents are retained even when the device is powered off.
Types:	The two main types of RAM are static RAM and dynamic RAM.	The types of ROM include PROM, EPROM and EEPROM.
Use:	RAM allows the computer to read data quickly to run applications. It allows reading and writing.	ROM stores the program required to initially boot the computer. It only allows reading.
Definition:	Random Access Memory or RAM is a form of data storage that can be accessed randomly at any time, in any order and from any physical location.	Read Only Memory is a form of memory which is used for storing program. As the name suggest it can only read but not altered.

Cache Memory

Cache (pronounced cash) is a block of high speed memory where data is copied when it is retrieved from the RAM. This storage of key instructions enables a performance improvement in the processor. Intel processors incorporate level 1 (L1) and level 2 (L2) caches.

There are two groups of extremely fast memory chips that allow the computer to operate faster:

(1) Internal cache (L1) is built into the CPU, and

(2) External cache (L2) resides on the motherboard. The L2 cache is an area of high-speed memory that improves performance by reducing the average memory access time. L2 cache is also called SRAM.

Both L1 and L2 store data recently used by the CPU. When the CPU needs data, it first checks the fastest

source — L1. If the data is not there, the CPU checks the next-fastest source — L2. If the data still cannot be found, a time-consuming search of the slower RAM is required.

Secondary Storage/Secondary Memory

The auxiliary storage memory, also known as the secondary storage memory is an external (to the CPU) memory. This memory is also known as auxiliary storage/secondary storage. A secondary storage device is a storage medium that holds information until it is deleted or overwritten. For example, a floppy disk drive or a hard disk drive is an example of a secondary storage device. Secondary memory is permanent in nature i.e. the information stored in this memory is not lost unless specifically deleted. Secondary storage as permanent in nature is also used for transportation of data from one computer to another.

Secondary storage is actually any storage not currently in use. Even the hard drive in your computer is secondary storage, as programs such as Word or PowerPoint, are stored there when not in use as well as all of your files. Ssecondary memory is much slower and also less costly. Secondary memories may also be considered as input output devices as they provide the information as input and store the final result as output .

Difference between Primary Memory and Secondary Memory

Primary Memory	Secondary Memory
These are semiconductor memories.	These are magnetic and optical memories.
They are characterized as volatile random access memories (RAM) or non-volatile memories (ROM).	They are non-volatile.
They contain program and data that is currently being used by micro processor.	These are used to for bulk storage.
These memories are fast enough to interact with the microprocessor.	Slower than primary memories.
Also known as Main Memory	Also known as Backup Memory or Auxiliary Memory. E.g. Tapes, Floppies, Hard Discs, CD ROMs, DVDs

Computer Storage Capacities

Storage capacity refers to how much disk space one or more storage devices provides. It measures how much data a computer system may contain. For an example, a computer with a 500GB hard drive has a storage capacity of 500 gigabytes. A network server with four 1TB drives has a storage capacity of 4 terabytes.

As of 2011, the most commonly used data storage technologies are semiconductor, magnetic, and optical, while paper still sees some limited usage. *Media* is a common name for what actually holds the data in the storage device. Some other fundamental storage technologies have also been used in the past or are proposed for development.

COMPUTER STORAGE TECHNOLOGY

At present the following three kinds of storage technology are commonly used in modern computers.

1. Semiconductor storage technology
2. Magnetic storage technology
3. Optical storage technology
4. Paper based storage technology

The semiconductor memory is faster, compact and lighter. It consumes less power. It is a static device. There is no rotating part in it. The magnetic and optical memory are slow compared to semiconductor memory. But they are cheaper than semiconductor memory. They are not static devices. They are either in the form of rotating disk or tape.

Semiconductor Storage Technology

Semiconductor memory is an electronic data storage device, often used as computer memory, implemented on a semiconductor-based integrated circuit. Examples of semiconductor memory include non-volatile memory such as read-only memory (ROM), magneto resistive random-access memory (MRAM), and flash memory. It also includes volatile memory such as static random-access memory (SRAM), which relies on several transistors forming a digital flip-flop to store each bit, and dynamic random-access memory (DRAM), which uses one capacitor and one transistor to store each bit. Shift registers, processor registers, data buffers and other small digital registers that have no memory address decoding mechanism are not considered as memory.

Magnetic Storage Technology

Magnetic storage and **magnetic recording** are terms from engineering referring to the storage of data on a magnetized medium. Magnetic storage uses different patterns of magnetization in a magnetizable material to store data and is a form of non-volatile memory. The information is accessed using one or more read/write heads. As of 2011, magnetic storage media, primarily hard disks, are widely used to store computer data as well as audio and video signals. In the field of computing, the term *magnetic storage* is preferred and in the field of audio and video production, the term *magnetic recording* is more commonly used. The distinction is less technical and more a matter of preference. Other examples of magnetic storage media include floppy disks, magnetic recording tape, and magnetic stripes on credit cards.

Optical Storage Technology

Optical storage is any storage method in which data is written and read with a laser for archival or backup purposes. Typically, data is written to optical media, such as CDs and DVDs. For several years, proponents have spoken of optical storage as a near-future replacement for both hard drives in personal computers and tape backup in mass storage.

Optical media is more durable than tape and less vulnerable to environmental conditions. On the other hand, it tends to be slower than typical hard drive speeds, and to offer lower storage capacities.

Magneto-optical disc storage is optical disc storage where the magnetic state on a ferromagnetic surface stores information. The information is read optically and written by combining magnetic and optical methods. Magneto-optical disc storage is *non-volatile*, *sequential access*, slow write, fast read storage used for tertiary and off-line storage.

Paper Based Storage Technology

Paper data storage, typically in the form of paper tape or punched cards, has long been used to store information for automatic processing, particularly before general-purpose computers existed. Information was recorded by punching holes into the paper or cardboard medium and was read mechanically (or later optically) to determine whether a particular location on the medium was solid or contained a hole. A few technologies allow people to make marks on paper that are easily read by machine – these are widely used for tabulating votes and grading standardized tests. Barcodes made it possible for any object that was to be sold or transported to have some computer readable information securely attached to it.

DATA STORAGE DEVICES

USB Flash Drive

A **USB flash drive** is a small device that stores information and files from a computer. Flash drives are an easy way of moving data between different computers or devices to be read or edited. Flash drives are connected to a computer using a USB port, which can be found on many devices. Flash drives take their name from the **flash** memory used to hold files. Flash memory is a type of memory that does not need any moving parts, unlike a CD or Floppy disk.

The capacity of flash drives starts at few megabytes. In April 2010, the ones that could hold most data could hold about 256 gigabytes.

Other common names for a flash drive include: **memory stick**, **keydrive**, **pendrive**, **thumbdrive** and **jumpdrive** or simply **USB**.

USB flash drives have some advantages over other portable storage devices. They are much smaller than floppy disks, and can hold much more data. They do not have moving parts, so they should be more reliable.

Hard Disk

Top and bottom views of a Western Digital WD400 3.5" hard disk

A **hard disk drive** (HDD) , **hard disk** (sometimes ‘disk’ is also spelled *disc*) or **hard drive**, is something used by computers to store information. Hard disks use magnetic recording (similar to the way recording is done on

magnetic tapes) to store information on rotating circular platters. The capacity of a hard drive is usually measured in gigabytes (GB). A gigabyte is one thousand megabytes and a megabyte is one million bytes, which means that a gigabyte is one billion bytes. Some hard drives are so large that their capacity is measured in terabytes, (TB) where one terabyte is a thousand gigabytes (1 TB = 1000 GB). Very early Consumer Grade hard drives were measured in Megabytes

Compact Disc

The read side of a **Compact Disc**

A **Compact Disc** (**CD**) is a type of optical disc. It is flat and round, and is used to store digital data. It was first used to store music and other sounds (and is sometimes called an “audio CD”). The sound on a CD is played using a compact disc player. It was developed by Phillips and Sony.

Later, Compact Discs were made that could be used to store computer files in the same way as audio compact discs. These are called CD-ROMs (Compact Disc Read-Only Memory). The computer reads the disc using a CD-ROM drive. Another use is to store MPEG videos cheaply; these CDs are called VCDs (Video CDs) and are especially popular in Asia. For example, in Indonesia they are used instead of the more expensive DVD.

The diameter of a normal CD is 120 mm. The middle hole in a CD is about the size of a five cent coin (about 1.5 cm). The person who decided the size was Dutch and used the size of an old Dutch coin (old because the Dutch now have switched to the Euro), called a “dubbeltje”, or dime. A CD usually holds a maximum of 74-80 minutes of sound or 650-700 megabytes of data.

DVD

Two kinds of DVD: Single layer (left) and dual layer (right).

A **DVD** (which means **Digital Versatile Disc** or a **Digital Video Disc**) is an optical disc capable of storing up to 4.7 GB of data, more than six times what a CD can hold. DVDs are often used to store movies at better quality than a VHS. DVDs can also have interactive menus and bonus features such as deleted scenes and commentaries. Like CDs, DVDs are read with a laser.

The disc can have one or two sides, and one or two layers of data per side; the number of sides and layers determines how much it can hold. A 12 cm diameter disc may have one of the following storage capacities:

The capacity of a DVD-ROM can be visually determined by noting the number of data sides, and looking at the data side(s) of the disc. Double-layered sides are usually gold-colored, while single-layered sides are usually silver-colored, like a CD. One additional way to tell if a DVD contains one or two layers is to look at the center ring on the underside of the disc. If there are two barcodes, it is a dual layer disc. If there is one barcode, there is only one layer.

DVD Data Storing

Both **CD** and **DVD** discs have equal sizes (diameter, thickness etc.). However, the amount of information they can store is different. These discs are made of the same materials and have the same methods of production.

CDs and DVDs use the same way of keeping information. Both CDs and DVDs have pits and bumps on the data track (the data track represents a path which has certain information). The information is read by a laser.

A DVD disk has several layers, which are made of plastic. All layers have a thickness of 1.2 millimeters. An injection used on a polycarbonate plastic leads to the creation of microscopic bumps. Today's production uses this type of plastic to create different things because it can resist very high and low temperatures.

When layers are made, the bumps appear. Many bumps form one continuous spiral that can include information. After that a spray of a special reflective layer covers the bumps.

Aluminum is applied behind inner layers and semi-reflective gold covers the outer layers. This helps the laser to concentrate through the outer layers onto the inner ones. Then, after applying a protective liquid (lacquer) and pressing the layers, they are treated with infrared light.

LESSON ROUND-UP

- A computer system in contemporary usage refers to a desktop system including the computer along with any software and peripheral devices that are necessary to make the computer function.
- Hardware and software are the two basic parts of a computer system Hardware - any part of a computer system you can touch Software - a set of electronic instructions that tell a compute what to do.
- Computers are of various types as Analog Computers which are used to process continuous data such as flow, temperature, pressure, angular position or voltage and Digital Computers which are used to perform Arithmetic calculations and also make logical decision to reach a conclusion, depending on, the data they receive from the user. Hybrid Computers refers to various specifically designed computers with both digital and analog characteristics combining the advantages of analog and digital computers when working as a system. Hybrid computers are being used extensively in process control system where it is necessary to have a close representation with the physical world.
- Computers can be classified on the basis of size, generations, and functions.
- There are many news technologies being introduced in computers. Now computer has moved from office to home. Tablets, Laptop, Palmtop are some of the newer technologies computers which are used extensively by people.
- A computer collects processes, stores and outputs information Input Device are the peripherals which lets us to communicate with a computer. A keyboard, mouse, and joystick are input devices. Storage Devices are used to place information on a storage media. A floppy drive, recordable CD-ROM, tape drives and DVD-ROM are considered storage devices

- CPU is the abbreviation for ***c**entral **p**rocessing **u**nit*. Sometimes referred to simply as the *central processor*, but more commonly called *processor,* the CPU is the brains of the computer where most calculations take place. In terms of computing power, the CPU is the most important element of a computer system.
- ALU and CU are two major parts of CPU. All calculations are performed in the Arithmetic Logic Unit (ALU) of the CPU. Control unit is generally referred as the central nervous system of the computer that control and synchronizes its working.
- Processor / CPU - Central Processing Unit is the main chip in a computer. The CPU processes instructions, manages the flow of information through a computer system. The CPU communicates with input, output and storage devices to perform tasks.
- Output device lets a computer communicate with us. These devices displays information on a screen, printed copies, or generate sound. Examples of output devices are printer, scanner, plotters, monitors etc.
- Byte refers to one character; a character can be a number, a letter or symbol. Consists of eight bits. Bit - The smallest unit of information a computer can process. Kilobyte (K)- One kilobyte = 1024 characters. This is approximately equal to one page of double spaced text. Megabyte (MB) - One Megabyte = 1,048,576 character. This is approximately equal to one book. Gigabyte (GB) - One Gigabyte = 1,073,741,824 characters. This is approximately equal to a shelf of books in a library. Terabyte (TB) - One terabyte = 1,099,511,627,776 character. This is equal to an entire library of books.
- Hard Drive is the primary device that a computer uses to store information. RAM Temporarily stores information inside a computer. This information is lost when you turn off the computer.
- Motherboard/System board - The main circuit board of a computer. All electrical components plug into the mother board.
- Port – It is a connector at the back of a computer where you plug in an external device such as printer or modem. This allows instructions and data to flow between the computer and the device. Parallel Port - has 25 holes. This type of port is known as a female connector. A parallel port connects a printer or tape drive. Serial Port - has either 9 or 25 pins. This type of port is known as a male connector. A serial port connects a mouse or modem. USB Port - Universal Serial Bus - allows you connect up to 127 devices using on one port.
- MONITOR and VIDEO CARD A monitor and video card work together to display text and images on the screen. Video card - a circuit board that plugs into and expansion slot inside the computer. The video card translates instructions from the computer to a form the monitor can understand. Also called the video adaptor, graphics board or graphics card.

SELF-TEST QUESTIONS

(These are meant for re-capitulation only. Answers to these questions are not to be submitted for evaluation)

1. What do you mean by a computer system? Explain the basic functions of a computer system.
2. What are the difference types of computers? Distinguish among digital, analog and hybrid computers.
3. Classify the computers on the basis of generations
4. Classify the computers on the basis of size
5. What do you mean by Super computers? Explain the difference between Super computer and main frame computers.

6. What is the difference between a work station and person computers? Explain.
7. What do you mean by Central Processing unit (C.P.U)? Explain the functions of C.P.U in details.
8. Explain about four input devices of a computer.
9. Explain about four output devices of a computers
10. What are the storage devices being used in a computers?
11. What do you mean by "Cache Memory"? Explain its basic functions.
12. What do you mean by RAM and ROM? Explain the difference between RAM and ROM.
13. Explain the function of the CPU with suitable diagram.

SHORT QUESTIONS AND MCQS

1. The TV type of screen is called a _____.
2. Which of the following best characterizes the first generation of computing?
   (a) Emphasis on marketing computers to business
   (b) Computers used for mainly scientific calculations.
   (c) Speeds in microseconds (millionth/sec)
   (d) Software is an emphasis
3. Which of the following is not a printer?
   (a) Laser (c) scanner
   (b) Dot matrix (d) Ink-Jet
4. The component of the computer that would best be characterized as a traffic cop is
   (a) Central processing unit (c) Motherboard
   (b) Data Bus (d) RAM
5. The component of the computer that is responsible for temporary storage of information is known as
   (a) Central processing unit (c) Motherboard
   (b) Data Bus (d) RAM
6. What is the basic unit of composition of an image on a screen called?
   (a) Resolution (c) Video Card
   (b) Pixel (d) Bit
7. Which of the following has the least capability to computers?
   (a) Floppy Disk (c) CD-WR
   (b) Hard Disk (d) Zip Disk
8. All the following are input devices except:
   (a) Keyboard (c) Mouse
   (b) Voice Activated Devices (d) Printer

9. PC stands for _____ _____.
10. What was the first name of the two co-founders of Apple?
    (a) Bill
    (b) Paul
    (c) Steve
    (d) Heraldo
11. The third generation of the computer is characterized by the use of .....

Lesson 4
Computer Software – An Overview

LESSON OUTLINE

- Computer Software: An Introduction,
- System Software
- Application Software
- Firmware
- Software Trends
- Multi-Programming,
- Multi-Processing,
- Time Sharing,
- Batch Processing
- On-Line and Real Time Processing
- Systems Securities
- Lesson Round Up
- Self Test Questions

LEARNING OBJECTIVES

Computers have become an important part of each of our's life. Basically a computer system is a combination of two parts. Hardware and Software. Hardware constitutes the physical part of a computer which one can see but the software is something which is intangible in nature. It is the set of instruction which carries out the whole processing by a computer system. In other words we may say that hardware is the body of a computer system while software is the soul of the computer. System. After going through this lesson, student would be able to –

- Understand about software and its classification.
- Understand the functions of different types of software.
- Understand the meaning of Multiprogramming and Multiprocessing.
- Understand about time sharing, batch processing, online processing and real-time processing.
- Understand about requirement of system security and different aspects relating to system security.

Computers themselves, and software yet to be developed, will revolutionize the way we learn.

Steve Jobs

COMPUTER SOFTWARE: AN INTRODUCTION

Computer cannot do anything on its own. It is the user who instructs computer; what to do, how to do and when to do. In order to perform any task, you have to give a set of instructions in a particular sequence to the computer. These sets of instructions are called Programs. ***Software refers to a set of programs that makes the hardware to perform a particular set of tasks in particular order***. The process of writing (or *coding*) programs is called *programming*, and individuals who perform this task are called *programmers*.

Qualities of good Software

Software, commonly known as programs or applications, consists of all the electronic instructions that tell the hardware how to perform a task.

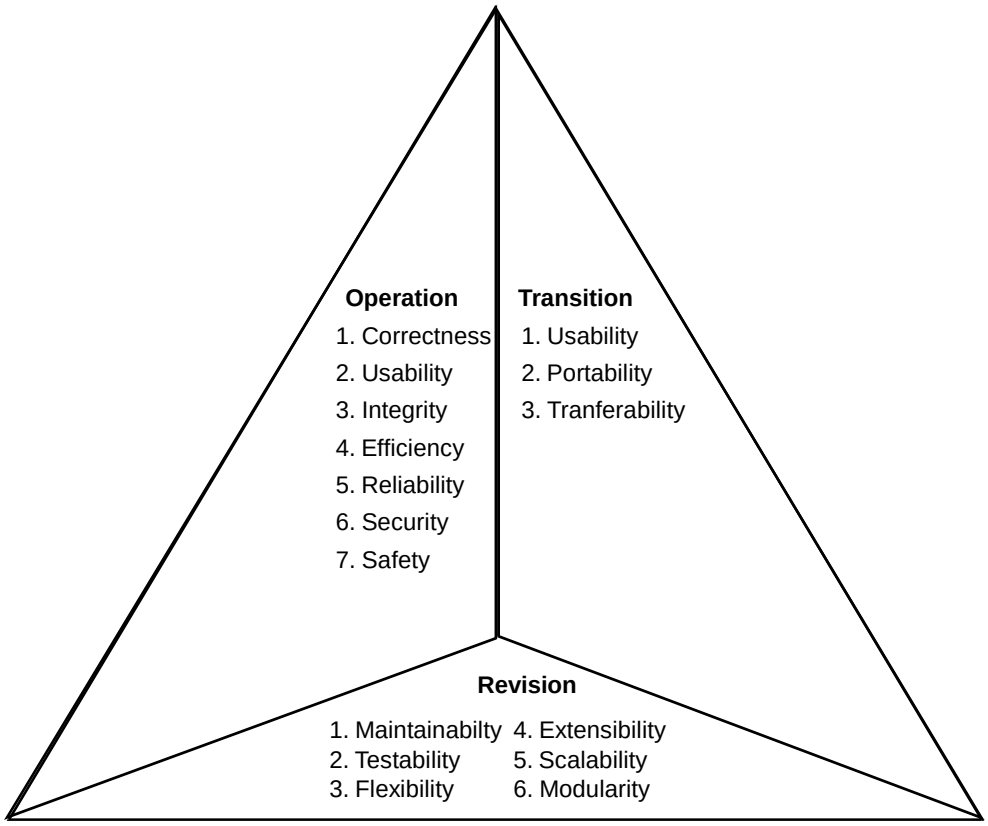
The three characteristics of good software are :-

(1) Operational Characteristics

(2) Transition Characteristics

(3) Revision Characteristics

Software Quality Triangle



Software Quality Triangle with characteristics

What Operational Characteristics should software have?

These are functionality based factors and related to ‘exterior quality’ of software. Various Operational Characteristics of software are:

1. **Correctness:** The software should meet all the specifications stated by the customer.
2. **Usability/Learnability:** The amount of efforts or time required to learn how to use the software should be less. This makes the software user-friendly even for IT-illiterate people.
3. **Integrity:** Software should be integrated with other applications and it should not affect the working of another application.
4. **Reliability:** The software should not have any defects. Not only this, it shouldn't fail while execution.
5. **Efficiency:** The software should make effective use of the storage space and execute command as per desired timing requirements.
6. **Security:** The software shouldn't have ill effects on data / hardware. Proper measures should be taken to keep data secure from external threats.
7. **Safety:** The software should not be hazardous to the environment/life.

Revision Characteristics of software

Various Revision Characteristics of software are:-

1. **Maintainability :** Maintenance of the software should be easy for any kind of user.
2. **Flexibility:** Changes in the software should be easy to make.
3. **Extensibility:** It should be easy to increase the functions performed by it.
4. **Scalability:** It should be very easy to upgrade it for more work (or for more number of users).
5. **Testability:** Testing the software should be easy.

Transition Characteristics of the software

1. **Interoperability:** Interoperability is the ability of software to exchange information with other applications and make use of information transparently.
2. **Reusability:** If we are able to use the software code with some modifications for different purpose then we call software to be reusable.
3. **Portability:** The ability of software to perform same functions across all environments and platforms, demonstrate its portability.

Importance of any of these factors varies from application to application.

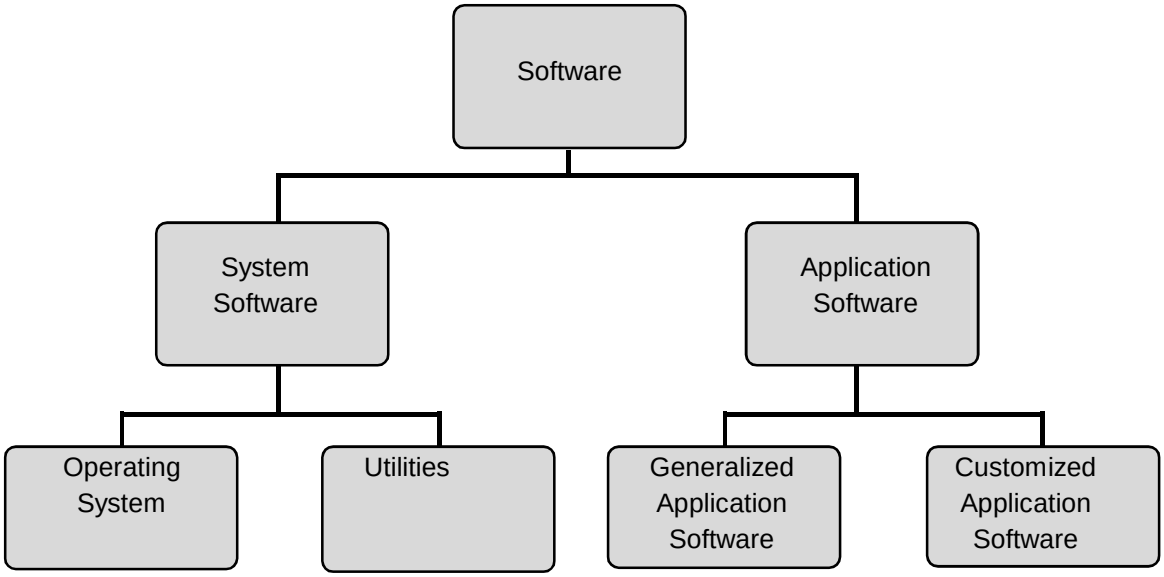
DIFFERENCE BETWEEN HARDWARE AND SOFTWARE

Basis of Difference	Hardware	Software
Definition	Hardware refers to the parts of a computer that you can see and touch,	Software refers to the instructions, or programs, that tell the hardware what to do.
Examples	CD-ROM, monitor, printer, video card, scanners, label makers, routers, and modems.	QuickBooks, Adobe Acrobat, Internet Explorer, Microsoft Word , Microsoft Excel
Types:	Input, storage, processing, control, and output devices.	System software, Programming software, and Application software.
Interdependency:	Hardware starts functioning once software is loaded.	To deliver its set of instructions, Software is installed on hardware.
Function:	Hardware serves as the delivery	To perform the specific task you need to

	system for software solutions. The hardware of a computer is infrequently changed, in comparison with software and data, which are “soft” in the sense that they are readily created, modified, or erased on the computer	complete. Software is generally not needed to for the hardware to perform its basic level tasks such as turning on and responding to input.
Reliability:	Hardware stays at steady reliability level in useful life.	Software needs constant testing after upgrades.
Failure:	Hardware failure is random. Hardware does have increasing failure at the last stage.	Software failure is systematic. Software does not have an increasing failure rate.
Fault:	Hardware faults are physical.	Software faults are not.
Lifetime:	Hardware wears out over time.	Software does not wear out over time.
Nature:	It is physical in nature	It is logical in nature
Definition:	Devices required to store and execute (or run) the software.	Collection of instructions that enables a user to interact with the computer. Software is a program that enables a computer to perform a specific task, as opposed to the physical components of the system (hardware).
Simple small definition:	Anything which we can see when the computer is off is hardware.	Anything which we can see on the screen when the computer is on is software.

CLASSIFICATION OF SOFTWARE

Software can be classified mainly into following categories



SYSTEM SOFTWARE

System software is a program that manages and supports the computer resources and operations of a computer system while it executes various tasks such as processing data and information, controlling hardware components,

and allowing users to use application software. That is, systems software functions as a *bridge* between computer system hardware and the application software. System software is made up of many control programs, including the operating system, communications software and database manager.

Three Kinds of Programs

Systems software consists of three kind of programs –

(a) The system management programs,

(b) system support programs,

(c) system development programs.

(a) System Management Programs

These are programs that manage the application software, computer hardware, and data resources of the computer system. These programs include operating systems, operating environment programs, database management programs, and telecommunications monitor programs. Among these, the most important system management programs are operating systems. The operating systems are needed to study more details. There are two reasons. First, users need to know their functions first. For the second, there are many kinds of operating systems available today.

Telecommunications monitor programs are additions of the operating systems of microcomputers. These programs provide the extra logic for the computer system to control a class of communications devices.

(b) System Support Programs

These are the programs that help the operations and management of a computer system. They provide a variety of support services to let the computer hardware and other system programs run efficiently. The major system support programs are system utility programs, system performance monitor programs, and system security monitor programs (virus checking programs).

(c) System Development Programs

These are programs that help users to develop information system programs and prepare user programs for computer processing. These programs may analyze and design systems and program itself. The main system development programs are programming language translators, programming environment programs, computer-aided software engineering packages.

TYPES OF SYSTEM SOFTWARE

1. OPERATING SYSTEMS

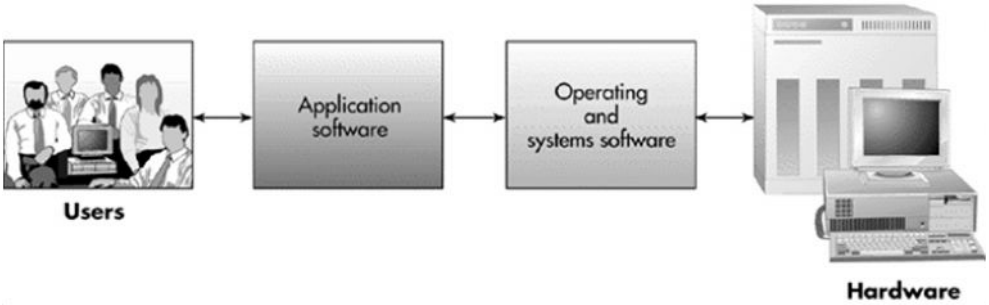
An operating system is a collection of integrated computer programs that provide recurring services to other programs or to the user of a computer. These services consist of process management, disk and file management, memory management, error handling, system accounting and device management. In other words, it manages CPU operations, input/output activities, storage resources, diverse support services, and controls various devices.

Operating system is the most important program for computer system. Without an operating system, every computer program would have to contain instructions telling the hardware each step the hardware should take to do its job, such as storing a file on a disk. Because the operating system contains these instructions, any program can call on the operating system when a service is needed. Operating system acts as an interface between user and handware.

The operating system is the software that allows you to operate the hardware. The programs that we want to

execute, the applications that we want to use all require a platform on which to execute. That platform is provided by the operating system.

Each time you start your computer, the computer loads the operating system (OS) into the computer's memory so that it can be used. This process is sometimes called booting the system. The operating system lets you give commands to the system. When you delete old documents or move a file from one folder to another, you are using the operating system. You use the operating system to tell the computer to run an application such as a word processing or graphics application. The operating system acts as an interface, or link, between the user and the computer hardware.



Operating System Functions

An operating system executes many functions to operate computer system efficiently. Among them, four essential functions are the followings.

- **Resource Management:** An operating system manages a collection of computer hardware resources by using a variety of programs. It manages computer system resources, including its CPU, primary memory, *virtual memory*, secondary storage devices, input/output peripherals, and other devices.
- **Task Management:** The function of the operating system that controls the running of many tasks. It manages one program or many programs within a computer system simultaneously. That is, this function of operating system manages the completion of users' tasks. A task management program in an operating system provides each task and interrupts the CPU operations to manage tasks efficiently. Task management may involve a *multitasking* capability.
- **Memory Management:** Through this operating system keeps track of all the memory locations whether they are free or allocated. It also determines how and how much memory needs to be allocated to a process so that it can be executed smoothly. It also manages the allocation and deallocation of memory when operating system is handling multiple processes at a time.
- **File management:** This is a function that manages data files. An operating system contains file management programs that provide the ability to create, delete, enter, change, ask, and access of files of data. They also produce reports on a file.
- **User Interface:** It is a function of an operating system that allows users to interact with a computer. A user interface program may include a combination of menus, screen design, keyboard commands. A well-designed user interface is essential for an operating system to be popular. Because of the function, users can load programs, access files, and accomplish other tasks.

Examples of Operating Systems

The most popular operating systems are DOS, Windows, Macintosh System, Linux, Android and UNIX.

Disk Operating System (DOS)

DOS (Disk Operating System) was the first widely-installed operating system for personal computers. It is a master control program that is automatically run when you start your PC. DOS stays in the computer all the time

letting you run a program and manage files. It is a single-user command based operating system for PC. To use DOS, you must know where your programs and data are stored and how to talk to DOS.

Windows

Windows is pure GUI (Graphical User Interface) based single user but multitasking operating system from Microsoft, the largest software company in the world .Windows contains built-in networking, which allows users to share files and applications with each other if their PCs are connected to a network. In large enterprises, Windows clients are often connected to a network of UNIX and NetWare servers. The server versions of Windows NT and 2000 are gaining market share, providing a Windows-only solution for both the client and server. Some popular version of Windows OS are Windows 95, Window 98, Windows 2000, Windows XP, Windows Vista and Windows 7 etc.

Android

Android is a Linux-based operating system designed primarily for touch screen mobile devices such as smart phones and tablet computers. Android was unveiled in 2007 along with the founding of the Open Handset Alliance: a consortium of hardware, software, and telecommunication companies devoted to advancing open standards for mobile devices. The first Android-powered phone was sold in October 2008.

Android is open source and Google releases the code under the Apache License. This open source code and permissive licensing allows the software to be freely modified and distributed by device manufacturers, wireless carriers and enthusiast developers. Additionally, Android has a large community of developers writing applications (“apps”) that extend the functionality of devices, written primarily in a customized version of the Java programming language.

Unix

Unix is a multiuser and time sharing operating system, which offers best resource utilization and sharing.

UNIX operating systems are used in widely-sold workstation products from Sun icrosystems, Silicon Graphics, IBM, and a number of other companies.

UNIX is written in C language. Both UNIX and C were developed by AT&T and freely distributed to government and academic institutions, causing it to be ported to a wider variety of machine families than any other operating system.

2. UTILITY SOFTWARE

Utility software is system software designed to help analyze, configure, optimize or maintain a computer. Utility software usually focuses on *how* the computer infrastructure (including the computer hardware, operating system, application software and data storage) operates. Due to this focus, utilities are often rather technical and targeted at people with an advanced level of computer knowledge - in contrast to application software, which allows users to do things like creating text documents, playing video games, listening to music or viewing websites.

Utility software categories

1. Antivirus

A computer virus is malicious code that has the ability to duplicate and send copies of itself to other computers throughout the internet. Viruses can alter, corrupt and delete files, freeze your computer and interfere with computer operation. Antivirus software protects your computer from virus threats, including worms, trojans, spyware, adware, phishing, pharming and greyware.

Antivirus software is a computer program which detects, prevents and takes action to disarm or remove malicious software, such as viruses and worms, from a computer.

A quality antivirus program such as Kaspersky Anti-Virus 2011, gives your computer virus protection and shields your PC from other malware by automatically scanning suspicious files, websites and e-mails.

Microsoft Security Essential, Quick heal Norton etc are other examples of anti viruses.

2. Data Clean up

Disk Cleanup is a system utility which allows scanning the entire hard drive to search for extra room by deleting any unnecessary files such as temporary files from the Internet and cookies. It also allows for deleting Restore Points, uninstalling programs, removing Windows components, and compressing old files all in the click of a mouse.

3. Disk Defragmenter

The Disk Defragmenter is another system utility which is used to reassemble fragmented files. Whenever a file is modified in any way, the computer stores the file in broken pieces across the hard drive rather than putting the whole file in one spot. This can lead to system malfunction and poor performance because the computer must search for all the pieces of a specific file before it can display it. The Disk Defragmenter searches for all pieces of every file on your hard drive and reassembles the files into a specific location. This increases the speed at which files are displayed and results in less delay when opening files or programs.

4. System Restore

System Restore is a system utility that allows returning the computer to an earlier time in which it had not encountered an error. System Restore is great for fixing problems that a virus has caused after using antivirus software to rid the computer of the malware. System Restore allows to manually setting Restore Points on a calendar and also automatically creates Restore Points on a regular basis as well as right before the computer goes through any major change such as installing a new program.

5. Disk Compression and Archivers

Disk compression is a system utility that allows for a program to search the hard drive and compress files, particularly old or unused files. This greatly improves the computer's functionality and performance because it does not have to keep track of so many files at once. It also serves to free up space, which is the main function of disk compression software. Archivers, another form of file compression software, allow compressing a file or folder and then decompressing the file whenever you decide to. The most popular archiver to date is Winrar, which is named after Winzip but has no affiliation. Both Winrar and a plethora of disk compression programs are available on the Internet at no charge.

6. Registry Cleaners

Registry cleaners are programs that allow scanning the computer for any errors in the registry, which is a collection of the core computer files that are essential to performance and functionality, and repairs them if needed. Registry cleaners are widely available on the Internet and give a significant upper hand when cleaning up the mess that a virus or other malware has left on the computer. Likewise, some otherwise safe programs can cause errors in the registry without intending to. Registry files can also be corrupted if the user unknowingly deletes or modifies a file in the registry. This usually occurs when an inexperienced user tries to fix their computer and inevitably causes more damage than before.

7. File Splitters

File splitters are programs that allow to break a file into smaller pieces in order to store or send files. File splitters often come in handy because many online storage services, including email attachments, limit you to a specific file size that can be transferred at one time even though files often exceed these limits. File splitters allow to break the file into two or more pieces, send them simultaneously, and then piece them back together when you are ready to use the file again. A good file splitter is File Splitz. It allows for to break a file of any size into multiple pieces and then rejoin the files together just as easily.

8. Archivers output a stream or a single file when provided with a directory or a set of files. Archive utilities, unlike archive suites, usually do not include compression or encryption capabilities. Some archive utilities may

even have a separate un-archive utility for the reverse operation.

9. Backup software are the system utilities that make copies of all information stored on a disk and restore either the entire disk (e.g. in an event of disk failure) or selected files (e.g. in an event of accidental deletion).

10. A clipboard manager expands the clipboard functionality of an operating system and adds functionality to an operating system's clipboard. Many clipboards provide only one buffer, overwritten by each new "copy" operation. The main task of a clipboard manager is to store data copied to the clipboard in a way that permits richer use of the data. Clipboard managers enhance the basic functions of cut, copy, and paste operations with one or more of the following features:

1. Multiple buffers and the ability to merge, split, and edit their contents
2. Selecting which buffer "cut" or "copy" operations should store data in
3. Selecting which buffer(s) "paste" operations should take data from
4. Handling formatted text, tabular data, data objects, media content, and URLs
5. Saving copied data to long term storage
6. Indexing or tagging of clipped data
7. Searching of saved data

11. Cryptographic utilities provide command-line tools for code signing, signature verification, and other cryptography tasks.

12. Data compression utilities output a shorter stream or a smaller file when provided with a stream or file.

13. Data synchronization utilities establish consistency among data from a source to target data storage and vice versa. There are several branches of this type of utility:

(a) **File synchronization** utilities maintain consistency between two sources. They may be used to create redundancy or backup copies but are also used to help users carry their digital music, photos and video in their mobile devices.

(**b)** **Revision control** utilities are intended to deal with situations where more than one user attempts to simultaneously modify the same file.

14. Disk partitions can divide an individual drive into multiple logical drives, each with its own file system which can be mounted by the operating system and treated as an individual drive.

15. Disk space analyzers for the visualization of disk space usage by getting the size for each folder (including sub folders) & files in folder or drive. showing the distribution of the used space.

16. File managers provide a convenient method of performing routine data management tasks, such as deleting, renaming, cataloging, uncataloging, moving, copying, merging, generating and modifying data sets.

17. Text editors directly modify the text or data of a file. These files could be data or an actual program.

18. Network utilities analyze the computer's network connectivity, configure network settings, check data transfer or log events.

19. Screensavers were desired to prevent phosphor burn-in on CRT and plasma computer monitors by blanking the screen or filling it with moving images or patterns when the computer is not in use. Contemporary screensavers are used primarily for entertainment or security.

20. System monitors for monitoring resources and performance in a computer system.

21. System profilers provide detailed information about the software installed and hardware attached to the computer.

APPLICATION SOFTWARE

Application software consists of Programs that direct computers to perform specific information processing activities for end users. These programs are called application packages because they direct the processing required for a particular use, or application, which users want to accomplish.

KINDS OF APPLICATION SOFTWARE

Application software includes a variety of programs that can be subdivided into general-purpose and application-specific categories.

General-Purpose Application Programs

General-purpose applications packages are programs that perform common information processing Jobs for end users. For example, word processing programs (MS Word), electronic spreadsheet programs (MS Excel), database management programs(MS Access), graphics programs (MS PowerPoint), communications programs, and integrated packages are popular with microcomputer users for home, education, business, scientific, and many other general purposes.

For example- you can use a word processor to write letters, memos, essays, instructions, notes, faxes, invoices and lots more.

Application-Specific Software

Many application programs are available to support specific applications of end users. *Business Application Programs*: Programs that accomplish the information processing tasks of important business functions or industry requirements.

Scientific Application Programs: Programs that perform information processing tasks for the natural, physical, social, and behavioral sciences, engineering and all other areas involved in scientific research, experimentation, and development. There are so many other application areas such as education, music, art, medicine, etc.

APPLICATION SOFTWARE TRENDS

The trend in computer application software is toward multipurpose, expert-assisted packages with natural language and graphical user interfaces. There are two major trends:

Off-The-Shelf Software Packages

There is a trend away from custom-designed one-of- a-kind programs developed by the professional programmers or end users of an organization.

Instead, the trend is toward the use of the "*off-the-self*" software package acquired by end users from software vendors. "*off-the-self*" software refers to the software package developed by the software companies for the end users. This software is inexpensive in nature and is ready to use. This trend accelerated with the development of *inexpensive* and *easy-to-use* productivity software packages for microcomputers, and it continues to grow.

Nonprocedural, Natural Languages

There is a major trend away from technical, machine-specific programming languages using binary-based or symbolic codes and from procedural languages, which use English-like statements and mathematical expressions to specify the sequence of instructions a computer must perform.

Instead, the trend is toward nonprocedural, natural languages that are closer to human conversation. This trend has accelerated with the creation of easy-to-use, nonprocedural *fourth- generation languages* (4GL). It continues to grow as developments in graphics and artificial intelligence produce natural language and *graphical interfaces* that make software packages easier to use.

EXAMPLES OF SOME APPLICATION SOFTWARE

1. Word Processing Software: Word processing is the most common applications software. The great advantage of word processing over using a typewriter is that you can make changes without retyping the entire document. Word processors make it easy to manipulate and format documents. Example: MS Word, Word Pad etc.

2. Spreadsheet Software: Spreadsheets are computer programs that let people electronically create and manipulate spreadsheets (tables of values arranged in rows and columns with predefined relationships to each other). Spreadsheets are used for mathematical calculations such as accounts, budgets, statistics and so on.. Example: Excel, Lotus1-2-3 etc.

3. Database Software: Database management applications are computer programs that let people create and manipulate data in a database. A database is a collection of related information that can be manipulated and used to sort information, conduct statistical analyses or generate reports.. Example: MS Access, MySQL, Oracle etc.

4. Presentation Graphic Software: Allows users to create visual presentation. Example: MS Power Point

5. Multimedia Software: Allows users to create image, audio, video etc. Example: Real Player, Media Player etc.

6. Accounting Software: Allows users to do the accounting of the transaction entered into. Examples Tally, busy, etc

7. Mobile software: Allows users to carry out various applications through mobile. Examples opera mini, ebuddy etc.

Difference between System Software and Application Software

1. System software gets installed when the operating system is installed on the computer while application software is installed according to the requirements of the user.

2. System software includes programs such as compilers, debuggers, drivers, assemblers while application software includes media players, word processors, and spreadsheet programs.

3. Generally, users do not interact with system software as it works in the background whereas users interact with application software while doing different activities.

4. A computer may not require more than one type of system software while there may be a number of application software programs installed on the computer at the same time.

5. System software can run independently of the application software while application software cannot run without the presence of the system software.

SPECIAL SYSTEM SOFTWARE

Firmware

Firmware is a combination of software and hardware. Computer chips that have data or programs recorded on them are firmware. These chips commonly include the following:

- ROMs (read-only memory)
- PROMs (programmable read-only memory)
- EPROMs (erasable programmable read-only memory)

In electronic systems and computing, Firmware is a piece of hardware that contains software. An example might be the BIOS (Basic Input Output System) of a computer. In other terms, firmware is a piece of hardware with a set of instructions that are stored in its own memory. The data which is stored in chip is used to boot the computer after power on and load the operating system from hard disk to main memory. This process is called as *booting* and sometime firmware is called as *bootstrap loader.* Typical examples of devices containing firmware are embedded systems (such as traffic lights, consumer appliances, and digital watches), computers, computer peripherals, mobile phones, and digital cameras. The firmware contained in these devices provides the control program for the device. Firmware is held in non-volatile memory devices such as ROM, EPROM, or flash memory. Changing the firmware of a device may rarely or never be done during its economic lifetime; some firmware memory devices are permanently installed and cannot be changed after manufacture. Common reasons for updating firmware include fixing bugs or adding features to the device. This may require physically changing ROM integrated circuits or reprogramming flash memory with a special procedure. Firmware such as the ROM BIOS of a personal computer may contain only elementary basic functions of a device and may only provide services to higher-level software. Firmware such as the program of an embedded system may be the only program that will run on the system and provide all of its functions.

SOFTWARE TRENDS

In the era of change, software technology has also been seeing changes. Recently following changes have emerged in software technologies.

Agile Software development

Systems are becoming increasingly reliant on software due to needs for rapid fielding of interoperability, net-centricity, and rapid adaptation to change. The need for rapid adaptation and releases led to increased interest in agile methods of software development.

Agile methods break tasks into small increments with minimal planning and do not directly involve long-term planning. Iterations are short time frames (time boxes) that typically last from one to four weeks. Each iteration involves a team working through a full software development cycle, including planning, requirements analysis, design, coding, unit testing, and acceptance testing when a working product is demonstrated to stakeholders. This minimizes overall risk and allows the project to adapt to changes quickly. Stakeholders produce documentation as required. Iteration might not add enough functionality to warrant a market release, but the goal is to have an available release (with minimal bugs) at the end of iteration. Multiple iterations might be required to release a product or new features.

Team is usually cross-functional and self-organizing and members take responsibility for tasks that deliver the functionality iteration requires. They decide individually how to meet iteration's requirements.

Agile methods emphasize face-to-face communication over written documents when the team is all in the same location. Team size is typically small (5-9 people) to simplify team communication and team collaboration. Larger development efforts can be delivered by multiple teams working toward a common goal or on different parts of an effort. This might require a coordination of priorities across teams.

In team meetings team members report to each other what they did the previous day, what they intend to do today, and what their roadblocks are. This face-to-face communication exposes problems as they arise. Agile development emphasizes working software as the primary measure of progress. This, combined with the preference for face-to-face communication, produces less written documentation than other methods. The agile method encourages stakeholders to prioritize "wants" with other iteration outcomes, based exclusively on business value perceived at the beginning of the iteration

Cloud/Software as a Service (SaaS)

Over the past few years, Cloud software solutions (also known as Software as a Service (SaaS)) has been gaining market acceptance. In basic terms, the Cloud is really just a different software delivery method. In this scenario, a software vendor hosts the software application and customers access it via the internet. The Cloud model can be particularly appealing for smaller companies that have limited technology personnel. Cloud implementations for certain types of software such as Customer Relationship Management (CRM), HR/Payroll, Project Management, and low end accounting software have been growing. ERP systems for mid to large companies on the other hand have not seen widespread acceptance yet due to cost and security concerns, however that is now changing and more companies are opening up to the possibility of using Cloud ERP solutions.

Real Analytics

Many organizations began to see information automation outweigh business process automation as their highest priority area. Analytics offer improved visibility to drive operational efficiencies, as well as a platform for growth by addressing heart-of the-business questions that could guide decisions, yield new insights and help predict the future of business. Leading organizations are launching broad initiatives with executive-level sponsorship, ready and eager to achieve their vision via real analytics. Due to exploding data volumes and regulators demands deeper insight into risks, exposure and public responsiveness are much needed.

By investing in a balance of information management, performance management and advanced analytics, organizations can make small steps, smartly made to capture measurable results. Real analytics can provide knowledge, fact-based predictions and business prescriptions if applied to the right problems, and if the suggestions based on results are pushed into action.

Applied Mobility

In today's age of technology what really matter is harnessing available networks, form factor, user interface and raw device computing power to create rich yet simple and intuitive apps to solve real business problems. These solutions can be as simple as placing a mobile layer over existing offerings and business processes which conducts business as usual, but through channels independent of physical locations. These new mobile solutions serve the full spectrum of transactional, analytical and social computing capabilities that are having different design and deployment concepts which is more focused in scope and simple in execution from user perspective compared to multipurpose feature-rich enterprise applications.

The Mobile applications are essentially powerful that they are elegant solutions to well-defined problems, and designed for operations on-the-go. Companies are rethinking business processes and enabling new business models that would not have been possible without mobile technology. Evolutions in location-based services, social networks, mobile payment processing, low-cost device add-ons and integration with enterprise systems has led to the potential for employees, customers and suppliers to consume and produce sophisticated information, goods and services from anywhere. And with the extension of mobile solutions to sensors and actuators in physical goods and equipment, otherwise known as asset intelligence there is the potential for almost anything to become part of the mobile solution footprint.

Capability Clouds

Capability clouds move beyond the building blocks of capacity to deliver finished services that directly address business objectives and enterprise goals. Instead of dealing with machine images or database instances, the discussion shifts to the analytics cloud, the testing cloud or the sales cloud and help to focus on a more important set of values. Also with the advent of capability clouds helps focusing on accelerating time-to-results, adding new functionality or changing business processes and business models rather than cost of ownership and efficiency issues. It is relatively easy for a business unit leader to buy a software-as-a-service tool for point solutions such as workforce planning or compensation management; the main requirement is simply a corporate credit card.

There have been three main drivers of cloud adoption thus far: a preference for operating expense over capital expense; speed to solution; and flexible, scalable access to specialized resources – be they technology, software or people. The capability cloud can add opportunities for agility and innovation in how business processes even business models are acquired composed and revised. For an example the analytics cloud may go beyond just delivering analytics databases, models and tools and offer PHD-level statisticians applying the art of the science where you only pay for the level of service that is needed.

Social Computing

Everyone has started going online for their daily needs and hence we are leaving the trails our opinion, behavior and choices. The data of traces created when mined would provide business with a good source of insight on market positioning, consumer sentiment and employee productivity. By performing analytical operation on the data organizations can better understand their customer needs, preferences, their employee's experiences and problems that require immediate co-corporate attention. With the help of Social computing Businesses are able to take a results oriented and business-led approach, focusing on specific issues and communities, soliciting membership and creating platforms for content, collaboration and transactional support. Now the companies are on the job to develop software for social computing.

TYPES OF PROCESSING

Multiprogramming and Multiprocessing

Multiprogramming is a form of parallel processing in which several programs are run at the same time on a uniprocessor. Since there is only one processor , there can be no true simultaneous execution of different programs. Instead, the operating system executes part of one program, then part of another, and so on. To the user it appears that all programs are executing at the same time.

Several jobs are placed in the main memory and the processor is switched from job to job as needed to keep several jobs advancing while keeping the peripheral devices in use. Thus It improves the CPU efficiency by increasing the CPU utilization. It keeps more than one program in the memory and when a program needs to do I/O, it starts executing another program. Thus no time is wasted and the CPU doesn't need to wait for the I/O to get completed

Multiprocessing is the coordinated processing of programs by more than one computer processor. Multiprocessing is a general term that can mean the dynamic assignment of a program to one of two or more computers working in tandem or can involve multiple computers working on the same program at the same time (in parallel). With the advent of parallel processing, multiprocessing is divided into symmetric multiprocessing (SMP) and massively parallel processing (MPP).

In symmetric (or "tightly coupled") multiprocessing, the processors share memory and the I/O bus or data path. A single copy of the operating system is in charge of all the processors. SMP, also known as a "shared everything" system, does not usually exceed 16 processors. In massively parallel (or "loosely coupled") processing, up to 200 or more processors can work on the same application. Each processor has its own operating system and memory, but an "interconnect" arrangement of data paths allows messages to be sent between processors.

Typically, the setup for MPP is more complicated, requiring thought about how to partition a common database among processors and how to assign work among the processors. An MPP system is also known as a "shared nothing" system.

TIME SHARING

Time Sharing means multiple users simultaneously using the resources of a single processor (scalability).

In data processing, method of operation in which multiple users with different programs interact nearly simultaneously with the central processing unit of a large-scale digital computer is termed as Time sharing. Because the central processor operates substantially faster than does most peripheral equipment, it has sufficient time to solve several discrete problems during the input/output process. Even though the central processor addresses the problem of each user in sequence, access to and retrieval from the time-sharing system seems instantaneous from the standpoint of remote terminals since the solutions are available to them the moment the problem is completely entered. Time-sharing was developed during the late 1950s and early '60s to make more efficient use of expensive processor time. Commonly used time-sharing techniques include multiprocessing, parallel operation, and multiprogramming. Also, many computer networks organized for the purpose of exchanging data and resources are centered on time-sharing systems.

BATCH PROCESSING

Batch processing is execution of a series of programs ("jobs") on a computer without manual intervention. Jobs are set up so they can be run to completion without manual intervention. So, all input data are preselected through scripts, command-line parameters, or job control language. This is in contrast to "online" or interactive programs which prompt the user for such input. A program takes a set of data files as input, processes the data, and produces a set of output data files. This operating environment is termed as "batch processing" because the input data are collected into batches of files and are processed in batches by the program.

ONLINE PROCESSING

Online processing means users directly enter information online (usually, online, in this case, means online to a central processor, rather than its modern connotation of the Internet, but it could mean both!), it is validated and updated directly onto the master file. No new file is created in this case. Therefore, there is near immediate input process, and output. Imagine a cash dispenser transaction or booking a holiday at travel agents or over the Internet. Compared with batch processing the number of transactions will be few.

Online comes in many different flavours such as centralised, distributed, time-share etc and the choice of architecture will depend on cost, speed needed, number of users, number of transactions and time needed for a response.

REAL-TIME PROCESSING

Real time processing is usually found in systems that use computer control. This processing method is used when it is essential that the input request is dealt with quickly enough so as to be able to control an output properly. For example, the computer inside the Engine Control Unit in a car has to manage the engine at every moment based on what the driver wants to do.

Real time processing has to be programmed very carefully to ensure that no input events are missed. For example, a traffic light system is a real-time system but it only needs to process data relatively slowly. On the other hand, controlling a car engine has to deal with input events happening every thousandth of a second so a very fast computer is needed to do this -but both the traffic-light and the car engine computers are carrying out 'real-time' processing.

Examples:

- Traffic lights

- Heart rate monitoring
- Aircraft control
- Computer games
- Controlling robots

The user interface of a real-time system may use specialist input devices to provide data input.. For example, a car driver will be providing input data to the onboard computer with throttle and brake pedals. A gamer may be using a joystick or hand held control to interact with the real-time game. A traffic light system may sense the car at the lights using a buried inductive loop.

SYSTEM SECURITY

In general, the term system security refers to techniques for ensuring that data stored in a computer cannot be read or compromised by any individuals without authorization. System Security is a mechanism through which it is ensured that the organisation data and information is secured from unauthorized access

Traditionally, computer facilities have been physically protected for three reasons:

1. To prevent theft of or damage to the hardware
2. To prevent theft of or damage to the information
3. To prevent disruption of service

Strict procedures for access to the machine room are used by most organizations, and these procedures are often an organization's only obvious computer security measures. Today, however, with pervasive remote terminal access, communications, and networking, physical measures rarely provide meaningful protection for either the information or the service; only the hardware is secure. Nonetheless, most computer facilities continue to protect their physical machine far better than they do their data, even when the value of the data is several times greater than the value of the hardware.

SYSTEM SECURITY MEASURES

System security measures can be bifurcated as given below

Basic system Security measures

These *Basic System Security Measures* apply to all systems regardless of the level of their *System Classification* (see "Definitions," below). It is a baseline, which all systems must meet

1. **Password Protection:** All accounts and resources must be protected by passwords which meet the following requirements, which must be automatically enforced by the system:
   (a) Must be at least eight characters long.
   (b) Must NOT be dictionary or common slang words in any language, or be readily guessable.
   (c) Must include at least three of the following four characteristics, in any order: upper case letters, lower case letters, numbers, and special characters, such as *!@#$%^&*.
   (d) Must be changed at least once per year.
2. **Software Updates:** Systems must be configured to automatically update operating system software, server applications (webserver, mailserver, database server, etc.), client software (web browsers, mail clients, office suites, etc.), and malware protection software (antivirus, anti-spyware, etc). For *Medium* or *High Availability* systems, a plan to manually apply new updates within a documented time period is an acceptable alternative.

3. **Firewall:** Systems must be protected by a firewall that allows only those incoming connections necessary to fulfill the business need of that system. Client systems which have no business need to provide network services must deny all incoming connections. Systems that provide network services must limit access to those services to the smallest reasonably manageable group of hosts that need to reach them.

4. **Malware Protection:** Systems running Microsoft or Apple operating systems must have antivirus and anti-spyware software installed and it must be configured to automatically scan and update.

Intermediate System Security Measures

These *Intermediate System Security Measures* define the security measures that must be applied to *Medium Criticality* and *High Criticality* systems. Note that except under special circumstances, they do not apply to desktop and laptop computers. The requirements are:

1. Authentication and Authorization

(a) **Remove or disable accounts upon loss of eligibility:** Accounts which are no longer needed must be disabled in a timely fashion using an automated or documented procedure.

(b) **Separate user and administrator accounts:** Administrator accounts must not be used for non-administrative purposes. System administrators must be provisioned with non-administrator accounts for end-user activities, and a separate administrator account that is used only for system-administration purposes.

(c) **Use unique passwords for administrator accounts:** Privileged accounts must use unique passwords that are not shared among multiple systems. Credentials which are managed centrally, such as the NetID/password combination, are considered a single account, regardless of how many systems they provide access to.

(d) **Throttle repeated unsuccessful login-attempts:** A maximum rate for unsuccessful login attempts must be enforced. Account lockout is not required, but the rate of unsuccessful logins must be limited.

(e) **Enable session timeout:** Sessions must be locked or closed after some reasonable period.

(f) **Enforce least privilege:** Non-administrative accounts must be used whenever possible. User accounts and server processes must be granted the least-possible level of privilege that allows them to perform their function.

2. Audit and Accountability

(a) **Synchronize system clock:** The system clock must be synchronized to an authoritative time server run by NYU (currently tick.nyu.edu and tock.nyu.edu) at least once per day.

(b) **Enable system logging and auditing:** The facilities required to automatically generate, retain, and expire system logs must be enabled.

(c) **Follow an appropriate log retention schedule:** System logs must be retained for 30-90 days and then destroyed unless further retention is necessary due to legal, regulatory, or contractual requirements.

(d) **Audit successful logins:** Generate a log message whenever a user successfully logs in.

(e) **Audit failed login attempts:** Generate a log message whenever a user attempts to log in without success.

(f) **Audit when a system service is started or stopped:** Generate a log message when a system service is started or stopped.

(g) **Audit serious or unusual errors:** Generate a log message when a serious or unusual error occurs, such as crashes.

(h) Audit resource exhaustion errors: Generate a log message when a resource exhaustion error occurs, such as an out-of-memory error or an out-of-disk error.

(i) Audit failed access attempts: Generate a log message when an attempt to access a file or resource is denied due to insufficient privilege.

(j) Audit permissions changes: Generate a log message when the permissions of a user or group are changed.

(k) Include appropriate correlation data in audit events: For each audit event logged be sure to include sufficient information to investigate the event, including related IP address, timestamp, hostname, username, application name, and/or other details as appropriate.

3. Configuration and Maintenance

(a) Security partitioning: Systems may share hardware and resources only with other systems that have similar security requirements, regardless of their *Criticality* classification. Systems which share similar security requirements have user communities of similar size and character, similar firewall profiles, and similar technical requirements. For example:

(i) Multiple systems of the same *Criticality* may be aggregated together to share hardware and resources provided they have similar security requirements.

(ii) *Medium Criticality* systems may share hardware and resources with *Low Criticality* systems provided that all systems meet these *Intermediate Systems Security Measures*, and share similar security requirements.

(b) Follow vendor hardening guidelines: This document cannot be comprehensive for all systems available. Follow basic vendor recommendations to harden and secure systems.

(c) Disable vendor default accounts and passwords: Many systems come with default accounts which are publicly known. These accounts should be disabled.

(d) Disable all unnecessary network services: Processes and services which are not necessary to complete the function of a system must be disabled.

4. Additional Requirements

(a) Report potential security incidents: Potential security incidents must be reported to ITS Technology Security Services: security@nyu.edu.

(b) Security review: During the design of the technical architecture, a review of the system must be requested from ITS Technology Security Services.

(c) Vulnerability assessment: Before system deployment, a vulnerability assessment must be requested from ITS Technology Security Services.

(d) Physical access: The system must reside in a locked facility, to which only authorized personnel have access.

(e) Documentation: Create and maintain documentation summarizing the business process, major system components, and network communications associated with a system.

Advanced System Security Measures

These *Advanced System Security Measures* define the security measures that must be applied to *High Criticality* systems. The requirements are:

I. Audit and Accountability

(a) Enable process auditing or accounting: Enable process auditing or accounting, which generates log

information about the creation of new processes and their system activity.

(b) Audit privilege escalation or change in privilege: Generate a log message whenever a user changes their level of privilege.

(c) Audit firewall denial: Generate a log message when the host-based firewall denies a network connection.

(d) Audit all significant application events: Log all significant application events.

(e) Write audit events to a separate system: System logs must be written to a remote system in such a way that they cannot be altered by any user on the system being logged.

II. Configuration and Maintenance

(a) Follow advanced vendor security recommendations: This document cannot be comprehensive for all systems and applications available. Conform to best practices and recommendations outlined in vendor security whitepapers and documentation.

(b) Host-based and network-based firewalls: Systems must be protected by both a host-based and a network-based firewall that allows only those incoming connections necessary to fulfill the business need of that system.

(c) Configuration management process: Configuration changes must be regulated by a documented configuration and change management process.

(d) Partitioning: Systems may share hardware and resources only with other systems that have similar security requirements, regardless of their *Criticality* classification. Systems which share similar security requirements have user communities of similar size and character, similar firewall profiles, and similar technical requirements. For example:

(i) Multiple systems of the same *Criticality* may be aggregated together to share hardware and resources provided they have similar security requirements.

(ii) *High Criticality* systems may share hardware and resources with *Medium* and *Low Criticality* systems provided that all systems meet these *Advanced Systems Security Measures*, and share similar security requirements.

III. Additional Requirements

Physical access: The system must reside in a secured, managed data center.

DATA HANDLING SECURITY MEASURES

1. Requirements for Handling Confidential Data

(a) Access control: Access to confidential data must be provided on a least-privilege basis. No person or system should be given access to the data unless required by business process. In such cases where access is required, permission to use the data must be granted by the *Data Steward* (see “Definitions,” below).

(b) Sharing: Confidential data may be shared among the NYU community. It may be released publicly only according to well-defined business processes, and with the permission of the data steward.

(c) Retention: Confidential data should only be stored for as long as is necessary to accomplish the documented business process.

2. Requirements for Handling Protected Data

(a) Access control: Access to *protected data* must be provided on a least-privilege basis. No person or

system should be given access to the data unless required by business process. In such cases where access is required, permission to use the data must be granted by the Data Steward.

(a) Sharing: Protected data may be shared among the among University employees according to well-defined business process approved by the Data Steward. It may be released publicly only according to well-defined business processes, and with the permission of the Data Steward.

(c) Retention: Protected data should only be stored for as long as is necessary to accomplish the documented business process.

(d) Incident Notification: If there is a potential security incident that may place protected data at risk of unauthorized access, ITS Technology Security Services must be notified:

3. Requirements for Handling Restricted Data

(a) Collection: Restricted data should only be collected when all of the following conditions are met:

(i) The data is not available from another authoritative source;

(ii) The data is required by business process; and

(iii) You have permission to collect the data from the appropriate Data Steward.

(b) Access control: Individuals must be granted access to restricted data on a least-privilege basis. No person or system may access the data unless required by a documented business process. In such cases where access is required, permission to use the data must be granted by the Data Steward.

(c) Access auditing: Enable file access auditing to log access to files containing restricted data.

(d) Labeling: Portable media containing restricted data should be clearly marked.

(e) Sharing: Access to restricted data can be granted only by a Data Steward. No individual may share restricted data with another individual who has not been granted access by a Data Steward.

(f) Idle access: Devices which can be used to access *restricted data* must automatically lock after some period of inactivity, through the use of screensaver passwords, automatic logout, or similar controls.

(g) Transit encryption: Restricted data must be encrypted during transmission with a method that meets the following requirements.

(i) Cryptographic algorithm(s) are listed in FIPS 140-2 Annex A, the list of approved security functions.

(ii) Cryptographic key lengths meet best practices for length, given current computer processing capabilities.

(iii) Both the source and destination of the transmission must be verified.

(h) Storage encryption: Restricted data must be encrypted using strong, public cryptographic algorithms and reasonable key lengths given current computer processing capabilities. Keys must be stored securely, and access to them provided on a least-privilege basis (see ISO 11568 for recommendations on securing keys). If one-way hashing is used in lieu of reversible encryption, salted hashes must be used. Possible encryption scenarios are:

(i) Encrypt files containing restricted data using different keys or passwords than those used for system login.

(ii) Encrypt data stored in databases at the column-level.

(iii) In addition to file and/or database encryption, implement full-disk encryption on portable devices containing restricted data.

(i) Retention: Restricted data should only be stored for as long as is necessary to accomplish the documented business process.

(j) Destruction: When restricted data is no longer needed it should be destroyed using methods that are resistant to data recovery attempts such as cryptographic data destruction utilities, on-site physical device destruction, or NAID certified data destruction service.

(k) Incident notification: If there is a potential security incident which may place restricted data at risk of unauthorized access, ITS Technology Security Services must be notified

LESSON ROUND-UP

- Software refers to a set of programs that makes the hardware perform a particular set of tasks in particular order. The process of writing (or *coding*) programs is called *programming*, and individuals who perform this task are called *programmers*.
- Software can be classified mainly into following categories. 1. System Software 2. Application Software.
- An operating system is a collection of integrated computer programs that provide recurring services to other programs or to the user of a computer. These services consist of disk and file management, memory management, and device management. In other words, it manages CPU operations, input/output activities, storage resources, diverse support services, and controls various devices.
- DOS, Windows and Unix are some examples of operating system.
- Android is a Linux-based operating system designed primarily for touch screen mobile devices such as smart phones and tablet computers.
- Utility software is system software designed to help analyze, configure, optimize or maintain a computer. Utility software usually focuses on how the computer infrastructure (including the computer hardware, operating system, application software and data storage) operates
- Application software consists of Programs that direct computers to perform specific information processing activities for end users. These programs are called application packages because they direct the processing required for a particular use, or application, which users want to accomplish. Such as MS Office.
- Firmware is a combination of software and hardware. Computer chips that have data or programs recorded on them are firmware
- Multiprogramming is a form of parallel processing in which several programs are run at the same time on a uniprocessor. Since there is only one processor , there can be no true simultaneous execution of different programs. Instead, the operating system executes part of one program, then part of another, and so on. To the user it appears that all programs are executing at the same time
- Multiprocessing is the coordinated processing of programs by more than one computer processor. Multiprocessing is a general term that can mean the dynamic assignment of a program to one of two or more computers working in tandem or can involve multiple computers working on the same program at the same time (in parallel)
- In data processing, method of operation in which multiple users with different programs interact nearly simultaneously with the central processing unit of a large-scale digital computer is termed as Time sharing
- Batch processing is execution of a series of programs (“jobs”) on a computer without manual intervention. Jobs are set up so they can be run to completion without manual intervention. So, all input data are preselected through scripts, command-line parameters, or job control language

- Online processing means users directly enter information online (usually, online, in this case, means online to a central processor, rather than its modern connotation of the Internet, but it could mean both!), it is validated and updated directly onto the master file. No new file is created in this case. Therefore, there is near immediate input process, and output. Imagine a cash dispenser transaction or booking a holiday at travel agents or over the Internet
- Real time processing is usually found in systems that use computer control. This processing method is used when it is essential that the input request is dealt with quickly enough so as to be able to control an output properly.
- System security refers to techniques for ensuring that data stored in a computer cannot be read or compromised by any individuals without authorization. System Security is a mechanism through which it is ensured that the organisation data and information is secured from unauthorized access

SELF-TEST QUESTIONS

(These are meant for re-capitulation only. Answers to these questions are not to be submitted for evaluation)

1. What do you mean by the term Software? Differentiate between the hardware and software of a system.
2. What are the different characteristics of software? Explain in detail.
3. What are the different types of Computer software? Explain each one in detail.
4. What do you mean by operating system? Explain about different types of operating system.
5. Distinguish among DOS, Windows and Unix operating system.

5a. What are the different Functions of operating systems?

6. What do you mean by utility software? Explain about 5 popular utility software in detail.
7. What do you mean by Application software? Explain about different Application software.
8. What is the difference between Application Software and system software? Explain
9. What do you mean by multiprogramming and multiprocessing? State the difference between multiprogramming and multiprocessing.
10. What do you mean by batch processing, online processing and real-time processing? Explain the difference between online processing and real-time processing.
11. What do you mean by system security? Explain basic system securities measures.
12. Write short note on
    (a) Time sharing
    (b) Android operating system
    (c) Linux
    (d) Characteristic of strong password
    (e) Firewall
    (f) Social Computing
    (g) Agile software development technology
    (h) Firmware
    (i) Software as a Service (Saas)

Lesson 5
Database Management

LESSON OUTLINE

- Data Base Concepts
- Data Structure
- Data Base Management System
- Data Base Files
- Data Mining and Warehousing

LEARNING OBJECTIVES

A database is a collection of related files that are usually integrated, linked or cross-referenced to one another. The advantage of a database is that data and records contained in different files can be easily organized and retrieved using specialized database management software called a database management system (DBMS) or database manager.

Data base and database management system are extensively used in all fields i.e. business, research, education, governance, audit etc. Now the day is not far when database will be far ahead from software. Seeing the importance of database and DBMS, it becomes necessary for professionals like Company Secretaries to know basics concepts of data base and DBMS.

After reading this lesson, you should be able to:

- Understand the meaning of Data base, its types, advantages and disadvantages· Know about basics of data structure.
- Define the term database management system (DBMS), its objectives and functions.
- Understand the meaning of Data Mining and data warehouse and their uses.

The weaker the data available upon which to base one's conclusion, the greater the precision which should be quoted in order to give the data authenticity.

Norman Ralph Augustine

DATABASE MANAGEMENT

Meaning of Database

Database Concept

What is a Database?

To find out what database is, we have to start from data, which is the basic building block of any Database.

Data: Collection of facts, figures, statistics etc. having no particular meaning (e.g. 1, Nistha, 20 etc).

Record: Collection of related data items, e.g. in the above example the three data items had no meaning. But if we organize them in the following way, then they collectively represent meaningful information.

Roll	**Name**	**Age**
1	Nistha	20

Table or **Relation**: Collection of related records.

Roll	**Name**	**Age**
1	Nistha	20
2	Ramesh	22
3	Saurabh	28

The columns of this relation are called **Fields** or **Attributes** . The rows are called **Tuples** or **Records**.

Database: Collection of related relations. Consider the following collection of tables:

T1

Roll	**Name**	**Age**
1	Nistha	20
2	Ramesh	22
3	Saurabh	28

T2

Roll	**Address**	**City**
1	F 350 Alpha 1	Noida
2	D 22 Sec 36	Noida
3	Beta 2 F144	Delhi

T3

Roll	Year
1	I
2	II
3	I

T4

Year	Hostel
I	H1
II	H2

We now have a collection of 4 tables. They can be called a “related collection” because we can clearly find out that there are some common attributes existing in a selected pair of tables. Because of these common attributes we may combine the data of two or more tables together to find out the complete details of a student. Questions like “Which hostel does the youngest student live in?” can be answered now, although *Age* and *Hostel* attributes are in different tables.

In a database, data is organized strictly in row and column format. The rows are called **Tupule** or **Record**. The data items within one row may belong to different data types. On the other hand, the columns are often called **Attribute**. All the data items within a single attribute are of the same data type.

In short, Database is a collection of information organized in such a way that a computer program can quickly select desired pieces of data. One form of Database can be an electronic filing system.

In computing, databases are sometimes classified according to their organizational approach. The most prevalent approach is the relational database, a tabular database in which data is defined so that it can be reorganized and accessed in a number of different ways. A distributed database is one that can be dispersed or replicated among different points in a network. An object-oriented programming database is one that is congruent with the data defined in object classes and subclasses.

To access information from a database, you need a *database management system (DBMS)*. This is a collection of programs that enables you to enter, organize, and select data in a database such as MS Access, SQL Server etc.

Characteristics of Data Base system (Differential features of database system w.r.t. file system)

There are a number of characteristics that distinguish the database approach with the file-based approach.

1. Self-Describing Nature of a Database System

A Database System contains not only the database itself but also the descriptions of data structure and constraints (meta-data). This information is used by the DBMS software or database users if needed. This separation makes a database system totally different from the traditional file-based system in which the data definition is a part of application programs.

2. Insulation between Program and Data

In the file based system; the structure of the data files is defined in the application programs so if a user wants to change the structure of a file, all the programs that access that file might need to be changed as well. On the other hand, in the database approach, the data structure is stored in the system catalog not in the programs. Therefore, one change is all that’s needed.

3. Support multiple views of data

A view is a subset of the database which is defined and dedicated for particular users of the system. Multiple users in the system might have different views of the system. Each view might contain only the data of interest to a user or a group of users.

4. Sharing of data and Multiuser system

A multiuser database system must allow multiple users access to the database at the same time. As a result, the

multiuser DBMS must have concurrency control strategies to ensure several users access to the same data item at the same time, and to do so in a manner that the data will always be correct – data integrity.

5. Control Data Redundancy

In the Database approach, ideally each data item is stored in only one place in the database. In some cases redundancy still exists so as to improve system performance, but such redundancy is controlled and kept to minimum.

6. Data Sharing

The integration of the whole data in an organization leads to the ability to produce more information from a given amount of data.

7. Enforcing Integrity Constraints

DBMSs should provide capabilities to define and enforce certain constraints such as data type, data uniqueness, etc.

8. Restricting Unauthorized Access

Not all users of the system have the same accessing privileges. DBMSs should provide a security subsystem to create and control the user accounts.

9. Data Independence

System data (Meta Data) descriptions are separated from the application programs. Changes to the data structure is handled by the DBMS and not embedded in the program.

10. Transaction Processing

The DBMS must include concurrency control subsystems to ensure that several users trying to update the same data do so in a controlled manner. The results of any updates to the database must maintain consistency and validity.

11. Providing multiple views of data

A view may be a subset of the database. Various users may have different views of the database itself. Users may not need to be aware of how and where the data they refer to is stored.

12. Providing backup and recovery facilities

If the computer system fails in the middle of a complex update process, the recovery subsystem is responsible for making sure that the database is restored to the stage it was in before the process started executing.

13. Managing information

Managing information means taking care of it so that it works for us, and is useful for the work we are doing. The information we collect is no longer subject to “accidental disorganization” and becomes more easily accessible and integrated with the rest of our work. Managing information using a database allows us to become strategic users of the data we have.

Example of a Database

Student

Student Name	No. of Studnet	Class	Department
Ram	17	1	CS
Shyam	8	2	CS

Course

Course Name	Course No.	Credits	Department
Introduction to CS	CS 1310	4	CS
Data Structures	CS3320	4	CS
Discrete Mathematics	MA 2410	3	MA
Database Manage itient	CS3380	3	CS

Prerequisite

Course No.	Prereq No.
CS3380	C53320
CS3380	MA2410
CS3320	CS131A

Session

Session Identity	Course No.	Semester	Year	Professor
85	MA 2410	Fall	96	A
132	CS 1310	Fall	96	B
102	CS3320	Spring	97	C
112	MA2410	Fall	97	D
119	CS1310	Fall	97	E

Grade Report

Student No.	Session Identity	Grade
17	112	14
17	119	12
8	85	16
8	92	16
8	102	14

TYPES OF DATABASES

Flat-File "Databases"

Flat-file databases are so simplest These are very common, both for basic programming storage tasks as well as highly-scalable massively multi-user Internet megasites.

Here's an example of a flat-file database for some company:

Customer	Address	Order	Shipper	Ship Date
Rubble, Barney	93 Pebble Lane, Bedrock	120459	Fedex	2006-08-21
Leela, Taronga	1 Planet Express Plaza, NNY	120788	Fedex	2006-08-23
Griffin, Stewie	31 Spooner Street, Quohog	120791-A	UPS	2006-08-23
Griffin, Stewie	31 Spooner Street, Quohog	120791-B	Fedex	2006-08-23
Leela, Taronga	1 Planet Express Plaza, NNY	120844	UPS	2006-08-24

It's pretty easy to make sense of: one order was sent to Barney, one to Stewie (but split into two for some unknown reason), and two to Leela on different days. But the main disadvantage is flat databases donot provide automatic query environment and possibility of redundancy is more.

Analytic Databases

Analytic databases (a.k.a. OLAP- On Line Analytical Processing) are primarily static, read-only databases which store archived, historical data used for analysis. For example, a company might store sales records over the last

ten years in an analytic database and use that database to analyze marketing strategies in relationship to demographics.

Operational Databases

Operational databases (a.k.a. OLTP On Line Transaction Processing), on the other hand, are used to manage more dynamic bits of data. These types of databases allow you to do more than simply view archived data. Operational databases allow you to modify that data (add, change or delete data).

These types of databases are usually used to track real-time information. For example, a company might have an operational database used to track warehouse/stock quantities. As customers order products from an online web store, an operational database can be used to keep track of how many items have been sold and when the company will need to reorder stock.

DATABASE MODELS

Besides differentiating databases according to function, databases can also be differentiated according to how they model the data.

What is a data model?

Well, essentially a data model is a “description” of both a container for data and a methodology for storing and retrieving data from that container. Actually, there isn’t really a data model “thing”. Data models are abstractions, oftentimes mathematical algorithms and concepts. You cannot really touch a data model. But nevertheless, they are very useful. The analysis and design of data models has been the cornerstone of the evolution of databases. As models have advanced so has database efficiency.

Types of data base models

1. *Flat model*: This may not strictly qualify as a data model. The flat (or table) model consists of a single, two-dimensional array of data elements, where all members of a given column are assumed to be similar values, and all members of a row are assumed to be related to one another.

2. A distributed database is a database in which storage devices are not all attached to a common processing unit such as the CPU, controlled by a distributed database management system (together sometimes called a distributed database system). It may be stored in multiple computers, located in the same physical location; or may be dispersed over a network of interconnected computers. Unlike parallel systems, in which the processors are tightly coupled and constitute a single database system, a distributed database system consists of loosely coupled sites that share no physical components

3. *Hierarchical model*: In this model data is organized into a tree-like structure, implying a single upward link in each record to describe the nesting, and a sort field to keep the records in a particular order in each same-level list.

4. *Network model*: This model organizes data using two fundamental constructs, called records and sets. Records contain fields, and sets define one-to-many relationships between records: one owner, many members.

5. *Relational model*: is a database model based on first-order predicate logic. Its core idea is to describe a database as a collection of predicates over a finite set of predicate variables, describing constraints on the possible values and combinations of values

6. *Object-relational model*: Similar to a relational database model, but objects, classes and inheritance are directly supported in database schemas and in the query language.

7. Star schema is the simplest style of data warehouse schema. The star schema consists of a few “fact tables” (possibly only one, justifying the name) referencing any number of “dimension tables”. The star schema is considered an important special case of the snowflake schema.

Components of Database Systems

The term database system refers to an organization of components that define and regulate the collection, storage, management and use of the data within a database environment.

The database system is composed of the five major parts:

1. Hardware
2. Software
3. People
4. Procedures
5. Data

Hardware

Hardware refers to all of the system's physical devices; for example, computers microcomputers, workstations, servers and supercomputers), storage devices, printers, network devices(hubs, switches, routers, fiber optics) and other devices(automated teller machines, ID readers).

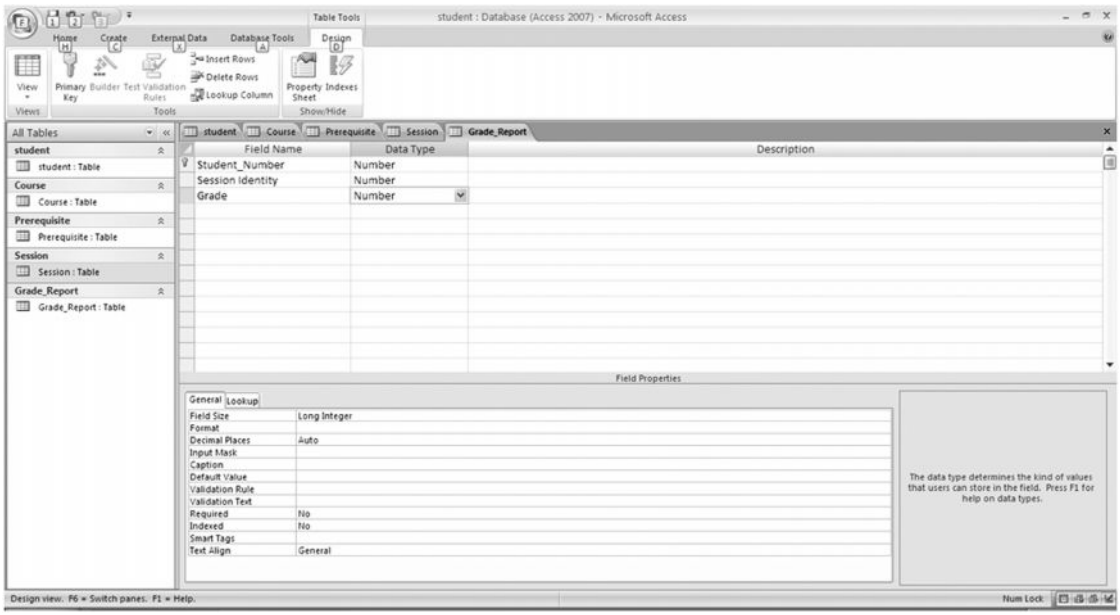
Software

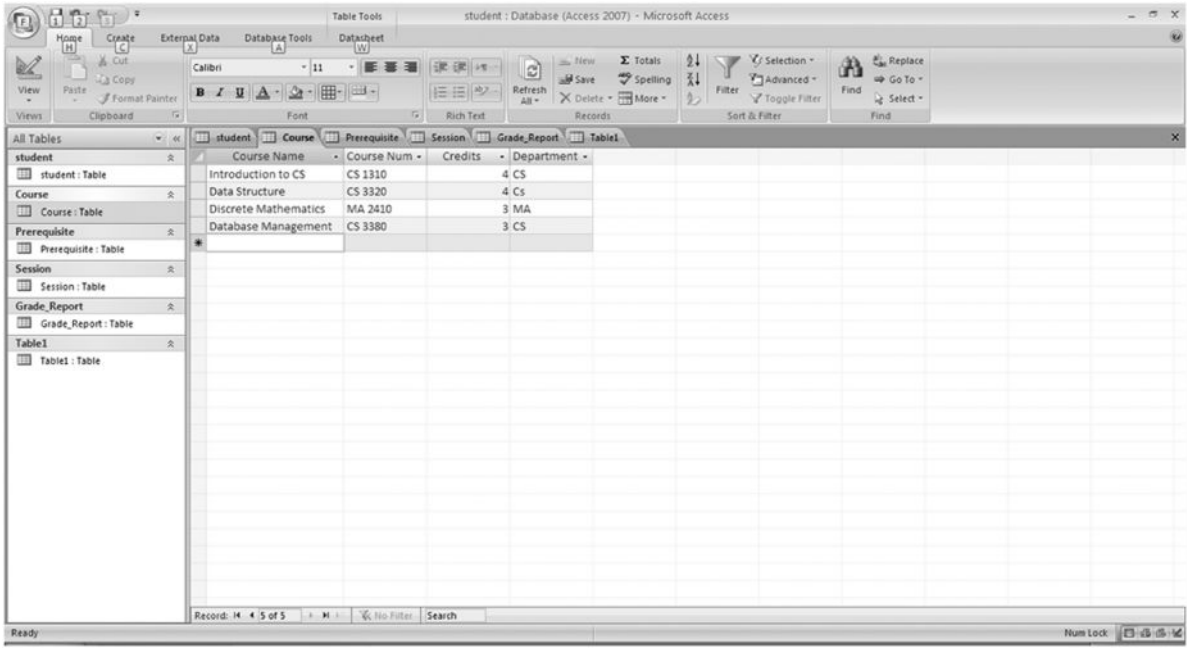
Three types of software are required in data based system :

(a) *Operating System Software*: It manages all hardware components and makes it possible for other software to run on the computers. Examples of operating system software include Microsoft Windows, Linux, Mac OS and UNIX.

(b) DBMS Software- A DBMS (Data Base Management System) refers to a software that is responsible for storing, maintaining and utilizing databases. A database along with a DBMS is referred to as a database system. Some examples of DBMS software include Microsoft SQL Server, Oracle,MySQL and IBM DB2.

(c) *Application programs and utility software*: They are used to access and manipulate data in the DBMS and to manage the computer environment in which data access and manipulation take place. Application programs are most commonly used to access data found within the database to generate reports, tabulations and other information to facilitate decision making. Utilities are the software tools used to help manage the database system's computer components. For example, all major DBMS vendors now provide GUI to help create database structures, control database access and monitor database operations.





People

This component includes all users of the database system. On the basis of primary job functions, five types of users can be identified in a database system.

(a) *System Administrators*: They oversee the database system's general operations.

(b) *Database Administrators*: also known as DBA, manage the DBMS and ensure that the database is functioning properly. The DBA role is sufficiently important in Database Administration and Security.

(c) *Database Designers*: They design the database structure. They are, in effect, the database architects. If the database design is poor, even the best application programmers and the most dedicated DBA cannot produce a useful database environment.

(d) *System Analysts and Programmers*: They design and implement the application programs. They design and create the data entry screens, reports and procedures through which end users access and manipulate the database's data.

(e) *End Users*: They are the people who use the application programs to run the organization's daily operations. For example, clerks, supervisors, managers, etc.

Procedures

Procedures are the instructions and rules that govern the design and use of the database system. Procedures pay an important role in a company because they enforce the standards by which business is conducted within the organization and with customers. Procedures are also used to ensure that there is an organized way to monitor and audit both the data and the information that is generated through the use of the data

Data

The word data covers the collection of facts stored in the database. Because data are the raw material from which information is generated, the determination of what data are to be entered into the database and how that data are to organized is a vital part of the database designer's job.

Elements of Databases

1. The database schema – is a structure defined by the database administrator of a Database system that refers to the organization of data. It is also called as blueprint of database system.

2. Schema objects -A schema is a collection of database objects. A schema is owned by a database user and has the same name as that user. Schema objects are logical structures created by users. Objects such as tables or indexes hold data, or can consist of a definition only, such as a view.

3. Indexes -A database index is a data structure that improves the speed of data retrieval operations on a database table at the cost of slower writes and the use of more storage space.

4. Tables- a data table is a set of data elements (values) that is organized using a model of vertical columns (which are identified by their name) and horizontal rows, the cell being the unit where a row and column intersect.

5. Fields and columns- a column is a set of data values of a particular simple type, one for each row of the table. The columns provide the structure according to which the rows are composed. Columns are also called as fields.

6. Records and rows- it is a set of fields is called as record or tuple or row.

7. Keys - a key part of a relational database and a vital part of the structure of a table. They ensure each record within a table can be uniquely identified by one or a combination of fields within the table. There are various type of keys we used like super key, candidate key, primary key etc.

8. Relationships- we create different type of entities or tables in the database but these entities should have a kind of relationship between them For instance, customers make orders, and orders contain items. There are various kind of relationships like one to one, one to many etc.

9. Data types – this is the characteristics assign to a particular field that which kind of value will it contain. Like character, integer, float etc.

DATA STRUCTURE

What is Data Structure?

In computer science, a data structure is a particular way of storing and organizing data in a computer so that it can be used efficiently. Different kinds of data structures are suited to different kinds of applications, and some are highly specialized to specific tasks. For example, B-trees are particularly well-suited for implementation of databases, while compiler implementations usually use hash tables to look up identifiers.

Data structures provide a means to manage large amounts of data efficiently, such as large databases and internet indexing services. Usually, efficient data structures are a key to designing efficient algorithms. Some formal design methods and programming languages emphasize data structures, rather than algorithms, as the key organizing factor in software design. Storing and retrieving can be carried out on data stored in both main memory and in secondary memory.

In simple words, The term *data structure* refers to a scheme for organizing related pieces of information. The basic types of data structures include:

1. files
2. lists
3. arrays
4. records
5. trees
6. tables

Each of these basic structures has many variations and allows different operations to be performed on the data.

Characteristics of data structures

1. It contains data items that can be elementary item, group item or another data structure. 2. It has a set of

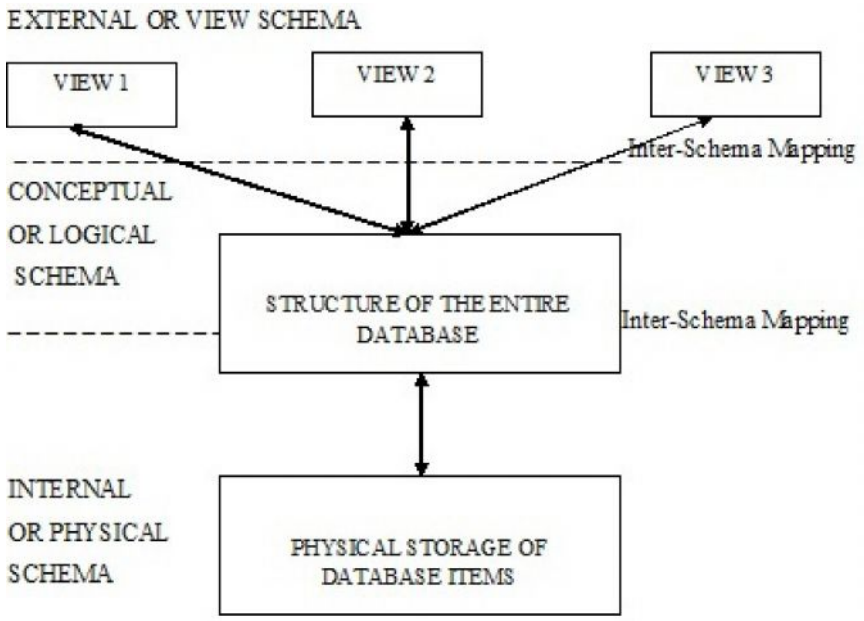
operations that can be performed on data items. Such as searching, insertion etc. 3. It describes the rules of how the data items are related to each other.

Three Views of Data

We know that the same thing, if viewed from different angles produces difference sights. Likewise, the database that we have created already can have different aspects to reveal if seen from different levels of abstraction. The term **Abstraction** is very important here. Generally it means the amount of detail you want to hide. Any entity can be seen from different perspectives and levels of complexity to make it a reveal its current amount of abstraction. Let us illustrate by a simple example.

A computer reveals the minimum of its internal details, when seen from outside. We do not know what parts it is built with. This is the highest level of abstraction, meaning very few details are visible. If we open the computer case and look inside at the hard disc, motherboard, CD drive, CPU and RAM, we are in middle level of abstraction. If we move on to open the hard disc and examine its tracks, sectors and read-write heads, we are at the lowest level of abstraction, where no details are invisible.

In the same manner, the database can also be viewed from different levels of abstraction to reveal different levels of details. From a bottom-up manner, we may find that there are three levels of abstraction or views in the database. We discuss them here.



The word schema means arrangement – how we want to arrange things that we have to store. The diagram above shows the three different schemas used in DBMS, seen from different levels of abstraction.

The lowest level, called the **Internal or Physical schema**, deals with the description of how raw data items (like 1, Nistha, F 350 Alpha 1, H2 etc.) are stored in the physical storage (Hard Disc, CD, Tape Drive etc.). It also describes the data type of these data items, the size of the items in the storage media, the location (physical address) of the items in the storage device and so on. This schema is useful for database application developers and database administrator.

The middle level is known as the **Conceptual or Logical Schema**, and deals with the structure of the entire database. Please note that at this level we are not interested with the raw data items anymore, we are interested

with the structure of the database. This means we want to know the information about the attributes of each table, the common attributes in different tables that help them to be combined, what kind of data can be input into these attributes, and so on. Conceptual or Logical schema is very useful for database administrators whose responsibility is to maintain the entire database.

The highest level of abstraction is the **External or View Schema**. This is targeted for the end users. Now, an end user does not need to know everything about the structure of the entire database, rather than the amount of details he/she needs to work with. We may not want the end user to become confused with astounding amount of details by allowing him/her to have a look at the entire database, or we may also not allow this for the purpose of security, where sensitive information must remain hidden from unwanted persons. The database administrator may want to create custom made tables, keeping in mind the specific kind of need for each user. These tables are also known as **virtual tables**, because they have no separate physical existence. They are crated dynamically for the users at runtime. Say for example, in our sample database we have created earlier, we have a special officer whose responsibility is to keep in touch with the parents of any under aged student living in the hostels. That officer does not need to know every detail except the *Roll, Name, Addresss* and *Age*. The database administrator may create a virtual table with only these four attributes, only for the use of this officer.

Data Independence

It is the property of the database which tries to ensure that if we make any change in any level of schema of the database, the schema immediately above it would require minimal or no need of change.

What does this mean? We know that in a building, each floor stands on the floor below it. If we change the design of any one floor, e.g. extending the width of a room by demolishing the western wall of that room, it is likely that the design in the above floors will have to be changed also. As a result, one change needed in one particular floor would mean continuing to change the design of each floor until we reach the top floor, with an increase in the time, cost and labour. Would not life be easy if the change could be contained in one floor only? Data independence is the answer for this. It removes the need for additional amount of work needed in adopting the single change into all the levels above.

Data independence can be classified into the following two types :

1. **Physical Data Independence**: This means that for any change made in the physical schema, the need to change the logical schema is minimal. This is practically easier to achieve. Let us explain with an example.

   Say, you have bought an Audio CD of a recently released film and one of your friends has bought an Audio Cassette of the same film. If we consider the physical schema, they are entirely different. The first is digital recording on an optical media, where random access is possible. The second one is magnetic recording on a magnetic media, strictly sequential access. However, how this change is reflected in the logical schema is very interesting. For music tracks, the logical schema for both the CD and the Cassette is the title card imprinted on their back. We have information like Track no, Name of the Song, Name of the Artist and Duration of the Track, things which are identical for both the CD and the Cassette. We can clearly say that we have achieved the physical data independence here.

2. **Logical Data Independence**: This means that for any change made in the logical schema, the need to change the external schema is minimal. As we shall see, this is a little difficult to achieve. Let us explain with an example.

Suppose the CD you have bought contains 6 songs, and some of your friends are interested in copying some of those songs (which they like in the film) into their favourite collection. One friend wants the songs 1, 2, 4, 5, 6, another wants 1, 3, 4, 5 and another wants 1, 2, 3, 6. Each of these collections can be compared to a view schema for that friend. Now by some mistake, a scratch has appeared in the CD and you cannot extract the

song 3. Obviously, you will have to ask the friends who have song 3 in their proposed collection to alter their view by deleting song 3 from their proposed collection as well.

DATA BASE MANAGEMENT SYSTEM

DBMS Fundamentals

It is a set of software programs that enables users to create and maintain a database. Data in a database can be added, deleted, changed, sorted or searched all using a DBMS. It provides the facilities of defining, constructing, maintaining, and sharing database among various users and applications.

Examples of some commonly used DBMS are My SQL, Postgre SQL, Microsoft Access, SQL server, file maker, oracle, RDBMS and clipper etc.

Defining a database means specifying the data types, structures and constraints for the data to be stored in a database.

Constructing the database is the process of storing the data itself on some storage medium that is controlled by the DBMS.

Manipulating includes such functions as querying the database to retrieve specific data, updating the database and generating reports from the data.

Sharing, a database allows multiple users and programs to access the database concurrently.

Other two important functions of DBMS are protecting the database and maintaining it over a long period of time.

Protection can be two types- system protection against hardware or software malfunction or crashes and security protection against unauthorized or malicious

DBMSs are commonly used to manage:

- Membership and subscription mailing lists
- Accounting and bookkeeping information
- The data obtained from scientific research
- Customer information
- Inventory information
- Personal records
- Library information

Types of data base management system

1. Hierarchical DBMS

A DBMS is said to be hierarchical if the relationships among data in the database are established in such a way that one data item is present as the subordinate of another one or a sub unit. Here subordinate means that items have “parent-child” relationships among them. Direct relationships exist between any two records that are stored consecutively. The data structure “tree” is followed by the DBMS to structure the database. No backward movement is possible/allowed in the hierarchical database.

2. Network DBMS

A DBMS is said to be a Network DBMS if the relationships among data in the database are of type many-to-many. The relationships among many-to-many appear in the form of a network. Thus the structure of a network database is extremely complicated because of these many-to-many relationships in which one record can be

used as a key of the entire database. A network database is structured in the form of a graph that is also a data structure. Though the structure of such a DBMS is highly complicated however it has two basic elements i.e. records and sets to designate many-to-many relationships. Mainly high-level languages such as Pascal, COBOL and FORTRAN etc. were used to implement the records and set structures.

3. Relational DBMS

A DBMS is said to be a Relational DBMS or RDBMS if the database relationships are treated in the form of a table. there are three keys on relational DBMS 1)relation 2)domain 3)attributes. *A network means it contains a fundamental constructs sets or records. sets contains one to many relationship ,records contains fields statical table that is composed of rows and columns is used to organize the database and its structure and is actually a two dimension array in the computer memory. A number of RDBMSs are available; some popular examples are Oracle, Sybase, Ingress, Informix, Microsoft SQL Server, and Microsoft Access.*

4. Object-Oriented DBMS

Able to handle many new data types, including graphics, photographs, audio, and video, object-oriented databases represent a significant advance over their other database cousins. Hierarchical and network databases are all designed to handle structured data; that is, data that fits nicely into fields, rows, and columns. They are useful for handling small snippets of information such as names, addresses, zip codes, product numbers, and any kind of statistic or number you can think of. On the other hand, an object-oriented database can be used to store data from a variety of media sources, such as photographs and text, and produce work, as output, in a multimedia format.

Advantages and Disadvantages of Database Management System

Advantages

1. **Reduction of Redundancy:** This is perhaps the most significant advantage of using DBMS. Redundancy is the problem of storing the same data item in more one place. Redundancy creates several problems like requiring extra storage space, entering same data more than once during data insertion, and deleting data from more than one place during deletion. Anomalies may occur in the database if insertion, deletion etc are not done properly.

2. **Sharing of Data:** In a paper-based record keeping, data cannot be shared among many users. But in computerized DBMS, many users can share the same database if they are connected via a network.

3. **Conflict Resolution:** Since the database is under the control of the DBA, he/she should resolve the conflicting requirements of various users and applications. In essence, the DBA chooses the best file structure and access method to get optimal performance for the response-critical applications, while permitting less critical applications to continue to use the database, albeit with a relatively slower response.

4. **Data Integrity:** We can maintain data integrity by specifying integrity constrains, which are rules and restrictions about what kind of data may be entered or manipulated within the database. This increases the reliability of the database as it can be guaranteed that no wrong data can exist within the database at any point of time.

5. **Data security:** We can restrict certain people from accessing the database or allow them to see certain portion of the database while blocking sensitive information. This is not possible very easily in a paper-based record keeping.The DBA who has the ultimate responsibility for the data in the DBMS can ensure that proper access procedures are followed, including proper authentication schemes for access to the DBMS and additional checks before permitting access to sensitive data. Different levels of security could be implemented for various types of data and operations.

Disadvantages

1. As DBMS needs computers, we have to invest a good amount in acquiring the hardware, software, installation facilities and training of users.
2. While centralization reduces duplication, the lack of duplication requires that the database be adequately backed up so that in the case of failure the data can be recovered. Centralization also means that the data is accessible from a single source. This increases the potential severity of security breaches and disruption of the operation of the organization because of downtimes and failures. The replacement of a monolithic centralized database by a federation of independent and cooperating distributed databases resolves some of the problems resulting from failures and downtimes.
3. We have to keep regular backups because a failure can occur any time. Taking backup is a lengthy process and the computer system cannot perform any other job at this time.
4. While data security system is a boon for using DBMS, it must be very robust. If someone can bypass the security system then the database would become open to any kind of mishandling.

Scenarios when DBMS should not be used

In spite of the advantages of using a DBMS, there are a few situations in which such a system may involve unnecessary overhead costs, as that would not be incurred in traditional file processing.

The overhead costs of using a DBMS are due to the following:

1. High initial investment in hardware, software, and training
2. Generality that a DBMS provides for defining and processing data
3. Overhead for providing security, concurrency control, recovery, and integrity functions.

Additional problems may arise, if the database designers and DBA do not properly design the database or if the database systems applications are not implemented properly.

Hence, it may be more desirable to use regular files under the following circumstances:

1. The database and applications are simple, well defined and not expected to change.
2. There are tight real-time requirements for some programs that may not be met because of DBMS overhead.
3. Multiple user access to data is not required.
4. An application may need to manipulate the data in a way not supported by the query language.

Requirements for a DBMS

The software responsible for the management data in computers i.e. DBMS (like Oracle, FoxPro, SQL Server etc.) should meet the following requirements:

1. Provide data definition facilities: It should support Data Definition Language (DDL) and provides user accessible catalog Known as Data Dictionary.

2. Provide facilities for storing, retrieving and updating data: It should support Data Manipulation Language (DML), so that required data can be inserted, updated, deleted and retrieved.

3. Supports multiple view of data: The end user should have the facility of flexible query language so that required information can be accessed easily.

4. Provides facilities for specifying Integrity constraints: It should support the constraints like Primary key,

foreign key during creation of tables so that only the valid information is stored in the database. As soon as, we try to insert any incorrect information it should display the error message.

5. Provide security of data : It should have the facilities for controlling access to data and prevent unauthorized access and update.

6. Provide concurrency control mechanism: It should allow simultaneous access and update of data by multiple users

7. Support Transactions: It should support all the properties of transaction known as ACID properties. It means a sequence of operations to be performed as a whole. In other words all operations are performed or none.

8. Provide facilities for database recovery: It should bring database back to consistent state after a failure such as disk failure, faulty program etc.

9. Provide facilities for database maintenance: It should support maintenance operations like unload, reload, mass insertion, deletion and validation of data.

10. Master and transaction file: A master file stores relatively static data. It changes occasionally and stores all the details of the object. For example, in case of banking software the customer file which contains the data about the customer like customer id, account no, account type, name, address; phone number etc. is a master file, because it contains the static data and whole information about the customer.

The other file, which contains the data about the customer transactions, is called as a Transaction file. The customer transaction file contains the data about the account no,\ transaction_)d, date, transaction type (e.g. deposit or withdrawal), amount, balance etc. It is dynamic file and updated each time for any withdrawal and deposit on a given account number.

DATABASE ADMINISTRATOR & HIS FUNCTIONS

The Database Administrator, better known as DBA, is the person (or a group of persons) responsible for the well being of the database management system. S/he has the following functions and responsibilities regarding database management:

1. Definition of the schema, the architecture of the three levels of the data abstraction, data independence.
2. Modification of the defined schema as and when required.
3. Definition of the storage structure i.e. access method of the data stored in sequential, or indexed or direct.
4. The DBA can be responsible for granting authorization such as creating new used-id, password etc, and also creating the access permissions that each user can or cannot enjoy. DBA is responsible to create user roles, which are collection of the permissions (like read, write etc.) granted and restricted for a class of users. S/he can also grant additional permissions to and/or revoke existing permissions from a user if need be.
5. Defining the integrity constraints for the database to ensure that the data entered conform to some rules, thereby increasing the reliability of data.
6. Creating a security mechanism to prevent unauthorized access, accidental or intentional handling of data that can cause security threat.
7. Creating backup and recovery policy. This is essential because in case of a failure the database must be able to revive itself to its complete functionality with no loss of data, as if the failure has never occurred. It is essential to keep regular backup of the data so that if the system fails then all data up to the point of failure will be available from a stable storage. Only those amount of data gathered during the failure would have to be fed to the database to recover it to a healthy status.

Database design and its importance

Database design refers to the activities that focus on the design of the database structure that will be used to store and manage end-user data. A database that meets all user requirements does not just happen; its structure must be designed carefully. Even a good DBMS will perform poorly with a badly designed database. Proper database design requires the designer to identify precisely the database expected use.

Designing a transactional database recognizes accurate and consistent data and operational speed. The design of a data warehouse database recognizes the use of historical and aggregated data. Designing a database to be in a centralized, single-user environment requires a different approach from that used in the design of a distributed, multi-user environment. A well-designed database facilities data management and generates accurate and valuable information. A poorly designed database is likely to become a breeding ground for difficult-to-trace errors that may lead to bad decision making and bad decision making can lead to the failure of an organization.

Functions of Database Management System

A DBMS performs several functions that guarantee the integrity and consistency of the data in the database. Most of these functions are transparent to the users and most can be achieved only through the use of a DBMS.

***1. Data Dictionary Management*:** The DBMS stores definitions of the data elements and their relationships (metadata) in a data dictionary. In turn, all programs that access the data in the database work through the DBMS. The DBMS uses the data dictionary to look up the required data component structures and relationships, thus relieving the programmer from having to code such complex relationships in each program. Additionally, any changes made in a database structure are automatically recorded in the data dictionary. In other words, the DBMS provides data abstraction and it removes structural and data dependency from the system.

***2. Data Storage Management*:** The DBMS creates and manages the complex structures required for data storage, thus relieving programmer from the difficult task of defining and programming the physical data characteristics. A modern DBMS provides storage not only for the data, but also for related data entry forms or screen definitions, report definitions, data validation rules, procedural code, structures to handle video and picture formats, etc. Data storage management is also important for database performance tuning. Performance tuning relates to the activities that make the database perform more efficiently in terms of storage and access speed. Although the user sees the database as a single data storage unit, the DBMS actually stores the database in multiple physical files. Such data files may even be stored on different storage media. Therefore, the DBMS doesn't have to wait for one disk request to finish before the next one starts. In other words, the DBMS can fulfill the database requests concurrently.

***3. Data Transformation and Presentation*:** The DBMS transforms entered data to conform to required data structures. The DBMS formats the physically retrieved data to make it conform to the user's logical expectations. An end user in India would expect to enter data such as June 15, 2010 as 15/06/10 whereas the same date is entered in US as 06/15/10.

***4. Security Management*:** The DBMS creates a security system that enforces user security and data privacy. Security rules determine which users can access the database which data items each user can access and which data operations (read, add, delete or modify) the user can perform. This is especially important in multi-user database system. All database users may be authenticated to the DBMS through a username and password or through biometric authentication such as fingerprint scan. The DBMS uses this information to assign privileges to various database components such as queries and reports.

***5. Multi-user Access Control*:** To provide data integrity and data inconsistency, the DBMS uses sophisticated algorithms to ensure that multiple users can access the database concurrently without compromising the integrity of the database.

***6. Backup and Recovery Management*:** The DBMS provides backup and data recovery to ensure data safety

and integrity. Current DBMS systems provide special utilities that allow the DBA to perform routine and special backup and restore procedures. Recovery management deals with the recovery of the database after a failure such as a bad sector in the disk or a power failure. Such capability is critical to preserving the database's integrity.

***7. Data Integrity Management*:** The DBMS promotes and enforces integrity rules, thus minimizing data redundancy and maximizing data inconsistency. The data relationships stored in the data dictionary are used to enforce data integrity. Ensuring data integrity is especially important in transaction-oriented database systems.

***8. Database Access Languages and API*:** The DBMS provides data access through a query language. A query language is a non-procedural language – one that lets the user specify what must be done without having to specify how is to be done. SQL is the query language and data access standard supported by majority of DBMS vendors. The DBMS also provides application programming interfaces to procedural languages such as COBOL, C, Java, etc. In addition, the DBMS provides administrative utilities used by the DBA and the database designer to create, implement, monitor and maintain the database.

***9. Database Communication Interface*:** Current generation DBMSs accept end-user requests via multiple, different network environments. For example, the DBMS might provide access to the database via the Internet through the use of Web browsers such as Internet Explorer, Firefox.

DATABASE LANGUAGES

A DBMS is a software package that carries out many different tasks including the provision of facilities to enable the user to access and modify information in the database. The database is an intermediate link between the physical database, computer and the operating system and the users. To provide the various facilities to different types of users, a DBMS normally provides one or more specialized programming languages called database languages.

Database languages come in different forms. They are: -

1. Data Description Language (DDL)
2. Data Manipulation Language (DML)

Data Description Language (DDL)

As the name suggests, this language is used to define the various types of data in the database and their relationship with each other.

The basic functions performed by DDL are:-

- Create tables, files, databases and data dictionaries.
- Specify the storage structure of each table on disk.
- Integrity constraints on various tables.
- Security and authorization information of each table.
- Specify the structure of each table.
- Overall design of the Database.

Data Manipulation Language (DML)

A language that enables users to access or manipulate data (retrieve, insert, update, delete) as organized by a certain Data Model is called the Data Manipulation Language (DML). It can be of two types: -

1. *Procedural DML* - It describes what data is needed and how to get it. For example: - Relational Algebra.
2. *Non-Procedural DML* - It describes what data is needed without specifying how to get it. For example: - Relational calculus.

DATABASE FILE

A database file is defined as a collection of related records. A database file is sometimes called a table. A file may be composed of a complete list of individuals on a mailing list, including their addresses and telephone numbers. Files are frequently categorized by the purpose or application for which they are intended. Some common examples include mailing lists, quality control files, inventory files, or document files. Files may also be classified by the degree of permanence they have. Transition files are only temporary, while master files are much more long-lived.

At a minimum, every SQL Server database has two operating system files: a data file and a log file. Data files contain data and objects such as tables, indexes, stored procedures, and views. Log files contain the information that is required to recover all transactions in the database. Data files can be grouped together in file groups for allocation and administration purposes.

SQL Server databases have three types of files, as shown in the following table.

File	Description
Primary	The primary data file contains the startup information for the database and points to the other files in the database. User data and objects can be stored in this file or in secondary data files. Every database has one primary data file.
Secondary	Secondary data files are optional, are user-defined, and store user data. Secondary files can be used to spread data across multiple disks by putting each file on a different disk drive. Additionally, if a database exceeds the maximum size for a single Windows file, you can use secondary data files so the database can continue to grow.
Transaction Log	The transaction log files hold the log information that is used to recover the database. There must be at least one log file for each database.

For example, a simple database named Sales can be created that includes one primary file that contains all data and objects and a log file that contains the transaction log information. Alternatively, a more complex database named Orders can be created that includes one primary file and five secondary files. The data and objects within the database spread across all six files, and the four log files contain the transaction log information.

DATA WAREHOUSE AND DATA MINING

Today in organizations, the developments in the transaction processing technology requires that, amount and rate of data capture should match the speed of processing of the data into information which can be utilized for decision making. A data warehouse is a subject-oriented, integrated, time-variant and non-volatile collection of data that is required for decision making process whereas Data mining involves the use of various data analysis tools to discover new facts, valid patterns and relationships in large data sets. Data mining also includes analysis and prediction for the data. Data mining helps in extracting meaningful new patterns that cannot be found just by querying or processing data or metadata in the data warehouse.

DATA WAREHOUSING

Large amount of operational data are routinely collected and stored away in the archives of many organizations. To take a simple example, the railway reservation system has been operational for over a decade and large amount of data is generated each day on train bookings. Much of this data is probably archived for audit purposes.

This archived operational data can be effectively used for tactical strategic management of the railways. For example, by analyzing the reservation data it would be possible to find out traffic patterns in various sectors and use it to add or remove bogies in certain trains, to decide on the mix of various classes of accommodation, etc. For this analysis building a data warehouse is an effective solution.

Data warehouse is a storage area for processed and integrated data across different sources which will be both operational data and external data. Data warehouses offer organizations the ability to gather and store enterprise information in a single conceptual enterprise repository. It allows its users to extract required data for business analysis and strategic decision making. One can also define a warehouse as a copy of transaction data specifically structured for query and analysis. It is a repository of information, integrated from several operational databases. Data warehouses store large amount of data which can be frequently used by decision support system. It is maintained separately from the organizations operational database. They are relatively static with only infrequent updates. The most effective advantages of data warehousing is high speed of data processing and summarized data.

Characteristics of data warehouse

- *Subject oriented*: A data warehouse is organized around major subjects such as customer, products, sales; etc. Data is organized according to subject instead of application. For example, an insurance company using a data warehouse would organize their data by customer, premium and claim instead of by different product like auto, life; etc. The data organized by subject obtains only the information necessary for the decision support processing.
- *Integrated*: A data warehouse is usually constructed by integrating multiple, heterogeneous sources such as relational databases, flat files, and OLTP file. When data resides in many separate applications in the operational environment, the encoding of data is often inconsistent. When data is moved from operational environment into the data warehouse, they assume a consistent coding convention. Data cleaning and data integration techniques are applied to maintain consistency in naming convention, measures of variables, encoding structure and physical attributes.
- *Nonvolatile*: A data warehouse is always a physically separate store of data, which is transformed from the application data found in the appropriate environment. Due to this separation, data warehouses do not require transaction processing, recovery, concurrency control, etc. The data is not updated or changed in any way once they enter the data warehouse, but are only loaded, refreshed and accessed for queries
- *Time variant*: Data is stored in data warehouse to provide a historical perspective. Every key structure in the data warehouse contains, implicitly or explicitly, an element of time. The data warehouse contains a place for sorting data that are 5 to 10 years old, or older, to be used for comparisons, trends and forecasting.

Database vs. data warehouse

Database is a collection of related information stored in a structured form in terms of table so that it makes easier insertion, deletion and manipulation of data. Database consists of tables that contain attributes. Whereas a data warehouse is a database system optimized for reporting and analysis. It generally refers to the combination of many different databases across entire enterprise. Once the data entered in the data warehouse, it can be then only loaded, refreshed and accessed for queries.

DATA MINING

It is a process of extracting hidden predictive information from large databases. It is a powerful new technology to help companies focus on the most important information in their data warehouses. Data mining tools predict

future trends and behaviors, allowing businesses to make proactive, knowledge-driven decisions. For a commercial business, the discovery of previously unknown statistical patterns or trends can provide valuable insight into the function and environment of their organization. Data-mining techniques can generally be grouped into two categories: predictive method and descriptive method.

***1. Descriptive method*:** It a method of finding human interpretable patterns that describe the data. Data mining in this case is useful to group together similar documents returned by search engine according to their context.

***2. Predictive method*:** In this method, we can use some variables to predict unknown or future values of other variable. It is used to predict whether a newly arrived customer will spend more than Rs. 1000 at a department store.

In its simplest form, data mining automates the detection of relevant patterns in a database, using defined approaches and algorithms to look into current and historical data that can then be analyzed to predict future trends. Because data mining tools predict future trends and behaviors by reading through databases for hidden patterns, they allow organizations to make proactive, knowledge-driven decisions and answer questions that were previously too time-consuming to resolve.

Data mining is not particularly new — statisticians have used similar manual approaches to review data and provide business projections for many years. Changes in data mining techniques, however, have enabled organizations to collect, analyze, and access data in new ways. The first change occurred in the area of basic data collection. Before companies made the transition from ledgers and other paper-based records to computer-based systems, managers had to wait for staff to put the pieces together to know how well the business was performing or how current performance periods compared with previous periods. As companies started collecting and saving basic data in computers, they were able to start answering detailed questions quicker and with more ease.

Usefulness of Data warehousing and Data mining in context to a large retail firm

Data Warehouse focuses on data storage; therefore it maintains a copy of information from the source transaction system. For example data warehouse of Future Value Retail would contain data from all the billing machines of their retail outlets and help the usability of the customer by the organization and enhance the usefulness in the following manner-

(i) Assemble data from multiple sources into a single database, enabling a central view across the enterprise.

(ii) Maintain a centralized history of data from all the stores and billing counters.

(iii) Improve the quality of data by enhancing its consistency across all stores irrespective of language, currency etc.

(iv) Restructures the data in the form of tables and views so that it makes sense to the business users.

(v) This will help in Data Mining, analytical processing and market research.

Data mining is the process of extracting hidden predictive information from large database. It involves the use of various data analysis tools to discover new facts, valid patterns and relationships in large data sets. For example, data mining in Future retail group would assist in the following:

(i) It would help the company in focusing on the most important information in the data warehouses; this could be related to ticket size, sales patterns.

(ii) It facilitates in extracting meaningful patterns like on which weekday, maximum sales took place.

(iii) It helps in analysis like which brand is doing better, which product is being sold mostly.

(iv) It assists in prediction of monthly sales, inventory to be ordered etc.

(v) It assists in designing marketing, pricing and operational strategies like whether to run discount or loyalty programme etc.

LESSON ROUND-UP

- Database is a collection of related files that are usually integrated, linked or cross-referenced to one another. The advantage of a database is that data and records contained in different files can be easily organized and retrieved using specialized database management software called a database management system (DBMS) or database manager.
- The term database system refers to an organization of components that define and regulate the collection, storage, management and use of the data within a database environment. The database system is composed of: 1. Hardware, 2. Software, 3. People, 4. Procedures, 5. Data
- A database management system is a set of software programs that allows users to create, edit and update data in database files, and store and retrieve data from those database files. Data in a database can be added, deleted, changed, sorted or searched all using a DBMS.
- DBMSs are commonly used to manage, Membership and subscription mailing lists, Accounting and bookkeeping information, The data obtained from scientific research, Customer information, Inventory information, Personal records, Library information
- The Advantages of a DBMS includes improved data availability, Minimized data redundancy, data Accuracy, Program and file consistency, User-friendliness, Improved security. DBMS have certain disadvantages which includes high cost, security issues etc.
- Data Model can be defined as an integrated collection of concepts for describing and manipulating data, relationships between data, and constraints on the data in an organization. The purpose of a data model is to represent data and to make the data understandable.
- Data structure is a particular way of storing and organizing data in a computer so that it can be used efficiently. Data structures provide a means to manage large amounts of data efficiently, such as large databases and internet indexing services. Usually, efficient data structures are a key to designing efficient algorithms.
- Database administrators (DBAs) are primarily responsible for specific databases in the subsystem. In some companies, DBAs are given the special group authorization, SYSADM, which gives them the ability to do almost everything in the DB's subsystem, and gives them jurisdiction over all the databases in the subsystem. The DBA can be responsible for granting authorizations to the database objects, although sometimes there is a special security administration group that does this.
- Data Definition Languages is used to define the various types of data in the database and their relationships with each other while Data Manipulation Language (DML) enables users to access or manipulate data (retrieve, insert, update, delete).
- A database file is defined as a collection of related records. A database file is sometimes called a table. A file may be composed of a complete list of individuals on a mailing list, including their addresses and telephone numbers.
- A data warehouse is a subject-oriented, integrated, time-variant and non-volatile collection of data that is required for decision making process whereas Data mining involves the use of various data analysis tools to discover new facts, valid patterns and relationships in large data sets. Data mining also includes analysis and prediction for the data. Data mining helps in extracting meaningful new patterns that cannot be found just by querying or processing data or metadata in the data warehouse

SELF-TEST QUESTIONS

(These are meant for re-capitulation only. Answers to these questions are not to be submitted for evaluation)

1. Differentiate between database system and file based system.
2. Write the difference between DBMS and RDBMS?
3. Define data models. What are the different data models are available?
4. What do you mean by Data Definition Languages (DDL) and Data Manipulation Languages (DML)?
5. What is Data Warehousing? Explain its characteristics?
6. What is Data mining? Compare Data mining and Data Warehousing?
7. What is database? What are the characteristics of database system?
8. What are the functions of a database administrator?
9. Explain the advantages and disadvantages of a DBMS.
10. What are the scenarios where we do not require database system? Explain any one.
11. How are data warehousing and data mining useful for an organisation? Answer taking a large retail firm as an example.

Lesson 6
Programming – An Overview

LESSON OUTLINE

- Programming
- Programming process
- Program development cycle
- Basic programming concepts
- Programming methodologies
- Algorithm
- Flowchart
- Programming languages
- High level language
- Machine level language
- Lesson Round Up
- Self Test Questions

LEARNING OBJECTIVES

We have already discussed that computer is made of hardware and software. Software is nothing but Software ***refers to a set of programs that makes the hardware perform a particular set of tasks in particular order***. The process of writing (or *coding*) programs is called *programming*, and individuals who perform this task are called *programmers*.

Programming is very important for computing and Professionals like Company Secretaries must know about the basics of programming and related concepts. After going through this lesson, one would be able to –

- Understand the basic concept relating to programming, programming process and programming development cycle
- Understand about the programming concepts like algorithm and flow chart
- Draw simple flow chart and algorithm relating to different business processes
- Understand basis of different Programming languages.

"Measuring programming progress by lines of code is like measuring aircraft building progress by weight."

(Bill Gates)

First, solve the problem. Then, write the code. ***(John Johnson)***

WHAT IS PROGRAMMING?

In the most basic sense, programming means creating a set of instructions for completing some specific task. In this sense, many of our daily activities can be described as programmatic – they involve specific steps that often follow a set order.

For Example, if one want to reach Delhi from Lucknow, first he will have to select the travel mode, arrange the selected travel mode, and travel from New Delhi to Lucknow. Missing any of these steps will end up in his failure to reach the destination

In this general sense, our lives are filled with programs and programming. When you make your bed you follow certain steps in a programmatic fashion. The steps must be the correct ones *and* they must be in the correct order. If you want to make your grandmother's favorite apple pie, you would ask her how to do it, and she most likely would send you a program – a recipe. A program is therefore also useful for replicating a product even if you are far removed from the original creator of the product.

In the context of computing, programming means creating a set of instructions not for a person but for a computer, in order to accomplish a specific task. To do so you use a set of directives – a programming language – known to both the programmer and the computer operating system. The kind of things we program computers to do is different from what we "program" ourselves to do. Usually a set of instructions, or program, for a computer is intended to complete a task that:

(a) is repetitious, and therefore would exceed human capacity for long term attention to detail;

(b) controls machinery in conditions unsuitable for humans because of physical limitations, hazardous conditions, etc.;

(c) requires a high degree of accuracy;

(d) Requires high speed.

PROGRAMMING PROCESS

The programming process consists of 5 steps. These are really only guidelines that have come to be recognized as being part of writing good, easily understood, and useful computer programs.

1. Analyzing the problem
2. Designing the solution
3. Coding the solution
4. Testing the solution
5. Documenting the solution

Problem Analysis: This is where the clear statement of the problem is stated. The programmer must be sure that he understands the problem and how to solve it. He must know what is expected of the problem, i.e. what the program should do, the nature of the output and the input to consider so as get the output. He must also understand the ways of solving the problem and the relationship between the input and the expected output.

Design: The planning of the solution to the problem in the first stage takes place in this stage. The planning consists of the process of finding a logical sequence of precise steps that solve the problem. Such a sequence of steps is called an algorithm. Every detail, including obvious steps should appear in the algorithm. The three popular methods used to develop the logic plan are: flowcharts, a pseudo code, and a top-down chart. These tools help the programmer break down a problem into a sequence of small tasks the computer can perform to

solve the problem. Planning may also involve using representative data to test the logic of the algorithm by hand to ensure that it is correct.

Coding: Translation of the algorithm in stage two into a programming language takes place here. The process for writing the program is called **coding.** The programmer uses the algorithm devised in the design stage along with the choice of the programming language he got from stage three.

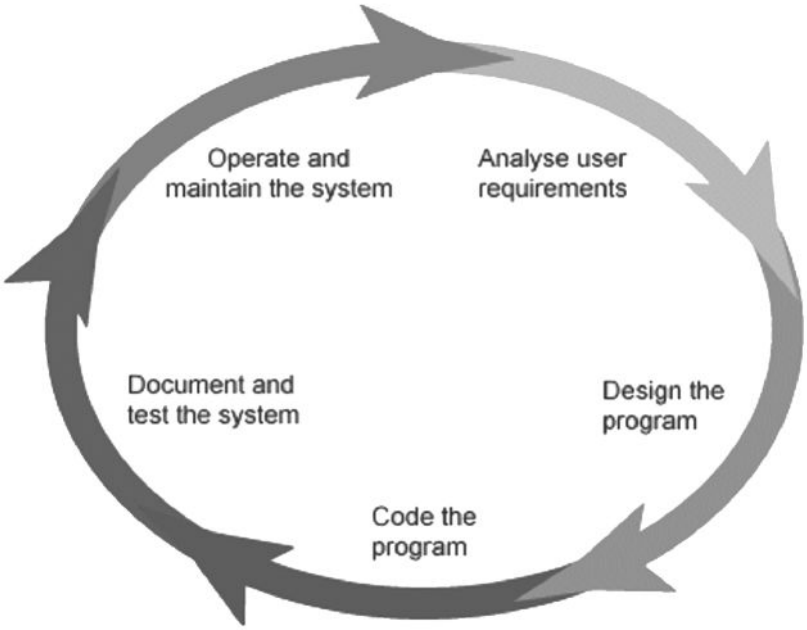
Testing and Debugging: The process involves the location and removal of error in the program if any. Testing is the process of checking if the program is working as expected and finding errors in the program, and debugging is the process of correcting errors that are found (An error in a program is called a bug.).

Documentation: This is the final stage of program development. It consists of organising all the material that describes the program. The documentation of the program is intended to allow another person or the programmer at a later date, to understand the program. Internal documentation remarks consist of statements in the program that are not executed, but point out the purpose of various parts of the program. Documentation might also consist of a detailed description of what the program does and how to use the program. Other types of documentation are flowchart and pseudo code that were used to construct the program. Although documentation is listed as the last step in the program development cycle, it should take place as the program is being coded. It is sometimes the first step during program execution because the programmer can use program documentation in developing a new program by just improving on the previous work.

PROGRAM DEVELOPMENT LIFE CYCLE

When programmers build software applications, they just do not sit down and start writing code. Instead, they follow an organized plan, or methodology, that breaks the process into a series of tasks. There are many application development methodologies just as there are many programming languages. There different methodologies, however, tend to be variations of what is called the program development life cycle (PDLC).

The program development life cycle (PDLC) is an outline of each of the steps used to build software applications. Similarly to the way the system development life cycle (SDLC) guides the systems analyst through development of an information system, the program development life cycle is a tool used to guide computer programmers through the development of an application. The program development lifecycle consists of six steps.



STEP	PROCEDURE	DESCRIPTION
1	Analyze the problem	Precisely define the problem to be solved, and write program specifications – descriptions of the program's inputs, processing, outputs, and user interface.
2	Design the program	Develop a detailed logic plan using a tool such as pseudocode, flowcharts, object structure diagrams, or event diagrams to group the program's activities into modules; devise a method of solution or algorithm for each module; and test the solution algorithms.
3	Code the program	Translate the design into an application using a programming lanaguage or application development tool by creating the user interface and writing code; include internal documentation – comments and remarks within the code that explain the purpose of code statements.
4	Test and debug the program	Test the program, finding and correcting errors (debugging) until it is error free and contains enough safeguards to ensure the desired results.
5	Formalize the solution	Review and, if necessary, revise internal documentation; formalise and complete end-user (external) documentation
6	Maintain the program	Provide education and support to end users; correct any unanticipated errors that emerge and identify user-requested modifications (enhancements). Once errors or enhancements are identiied, the program development life cycle begins again at Step 1.

BASIC PROGRAMMING CONCEPTS

Even though each programming language you use is unique, there are certain concepts common to all languages. Three of the most common concepts and structures used in programming are discussed below.

1. **Sequence of commands** (The right commands in the right order.)

   It is important not only to give the right commands or steps – they must also be given in the correct sequence. We can easily see in some of our ordinary examples – making a sandwich, tying one's shoes, following a recipe – that proper order is essential to our success. We might call such obvious sequences *task order*, because the proper sequence is dictated by the nature of the task.

2. **Conditional structures** (Do certain things based on a true or false, yes or no decision.)

   These provide for one outcome or sequence of events to be executed if a statement is true, and another outcome or sequence of events to be triggered if the statement is false.

   In most programming languages these structures take the form **if . . . then . . . else**.

   Computing examples:

   Example 1:

   If a word exists in a list, **then** print it out,

   Else tell the user that the word does not exist.

   Example 2:

   If a sentence contains the word "silly" **then** put that sentence into the silly list.

   Else if it doesn't contain the word "silly" **then** put it into the serious list.

3. **Looping structures** (A list of instructions to do more than once.)

   These kinds of structures are used if an outcome will be generated after repetition of certain operations number of times. Like table of a number, factorial of a number etc. The loop may run for a predetermined number of times, until a certain condition becomes true, or as long as a certain condition remains true.

   Here are some ways that looping might be done:

   Do the following 20 times.

   Do the following once for each word in the list

   Repeat the following until the user presses the option key

   Repeat the following as long as the option key is depressed.

PROGRAMMING METHODOLOGIES

Some of the Programming methodologies are stated below:

1. Procedural Programming: A procedural program is a series of steps, each of which performs a calculation, retrieves input, or produces output. Concepts like assignments, loops, sequences and conditional statements are the building blocks of procedural programming. Major procedural programming languages are COBOL, FORTRAN, C.

2. Functional Programming: A functional program is a collection of mathematical functions, each with an input (domain) and a result (range). Interaction and combination of functions is carried out by functional compositions, conditionals and recursion. Major functional programming languages are Lisp, Scheme, Haskell, and ML.

3. Logic (Declarative) Programming: A logic programme is a collection of logical declarations about what outcome a function should accomplish rather than how that outcome should be accomplished. Logic programming provides a natural vehicle for expressing non-determinism, since the solutions to many problems are often not unique but manifold. The major logic programming language is Prolog.

4. Object-Oriented (OO) Programming: The OO program is a collection of objects that interact with each other by passing messages that transform their state. The fundamental building blocks of OO programming are object modelling, object, classes, polymorphism and inheritance. Major object-oriented languages are C++, Java etc.

5. Event Driven Programming: An event driven program is a continuous loop that responds to events that are generated in an unpredictable order. These events originate from user actions on the screen (mouse clicks or keystrokes, for example), or else from other sources (like readings from sensors on a robot). Major event-driven programming languages include Visual basic and Java.

6. Concurrent Programming: A concurrent program is a collection of cooperating processes, sharing information with each other from time to time but generally operating asynchronously. Concurrent programming languages include SR, Linda, and High performance FORTRAN.

ALGORITHM

To make a computer do anything, one need to write a computer program. To write a computer program, one have to tell the computer, step by step, exactly what he want it to do. The computer then “executes” the program, following each step mechanically, to accomplish the end goal.

When one tells the computer *what* to do, he also gets to choose *how* it’s going to do it. That’s where computer algorithms come in. The algorithm is the basic technique used to get the job done. An algorithm is a step to step procedure to solve a given problem. It is a sequence of instructions (or set of instructions) to make a program more readable; a process to answer a question. The number of steps of an algorithm will be countable and finite. In short an algorithm can be defined as: “A sequence of activities to be processed for getting desired output from a given input.”

Most computer programmers spend a large percentage of their time creating algorithms. (The rest of their time is spent debugging the algorithms that don't work properly.) The goal is to create efficient algorithms that do not waste more computer resources (such as RAM and CPU time) than necessary. This can be difficult, because an algorithm that performs well on one set of data may perform poorly on other data. Poorly written algorithms can cause programs to run slowly and even crash.

Type of Algorithms

The algorithm can be classifies to the three types of *control structures*. They are:

1. Sequence
2. Branching (Selection)
3. Loop (Repetition)

These three control structures are sufficient for all purposes. The sequence is exemplified by sequence of statements place one after the other – the one above or before another gets executed first.

The *branch* refers to a binary decision based on some condition. If the condition is true, one of the two branches is explored; if the condition is false, the other alternative is taken.

The *loop* allows a statement or a sequence of statements to be repeatedly executed based on some loop condition. It is represented by the 'while' and 'for' constructs in most programming languages, for unbounded loops and bounded loops respectively. The loop is also known as the *repetition* structure.

Characteristics of Algorithms

The following are the major considerations in the design of algorithms

1. An algorithm must have a beginning and an end
2. The non ambiguity requirement for each step of an algorithm cannot be compromised.
3. The range of inputs for which an algorithm works has to be specified carefully
4. The same algorithm can be represented in several different ways
5. Several algorithms for solving the same problem may exist
6. Algorithms for the same problem can be based on very different ideas and can solve the problem with dramatically different speeds
7. It must terminate at a reasonable period of time.

Algorithm Design

Before writing an algorithm for a problem, one should find out what is/are the inputs to the algorithm and what is/are expected output after running the algorithm. While writing algorithms we will use following symbol for different operations:

'+' for Addition

'-' for Subtraction

'*' for Multiplication

'/' for Division and

'=' for assignment

For example A= B*3 means A will have a value of B*3.

Use of Sequence Control Structure

Example 1 Write an algorithm to find addition, subtraction, multiplication and division of two numbers.

Step1: Start

Step2 : Input A, B

Step3 : C=A+B

Step3 : D=A-B

Step4 : E= A* B

Step5 : F=A/B

Step6 : Print C, D, E, F

Step7 : Stop

Example 2 Write an algorithm to interchange the value of two numbers.

Step1 : Start

Step2 : Input A, B

Step3 : C=A

Step4 : A=B

Step5 : B=C

Step6 : Print A, B

Step7 : Stop

Use of Branching or Selection Control Structure

Example 1 Write an algorithm to find the largest number between two numbers.

Step1 : Start

Step2 : Input A,B

Step3 : Is (A>B)

Step4 : Yes Print A

Step5 : No Print B

Step6 : Stop

Example 2 A algorithm to find the largest value of any three numbers.

Step1: Start

Step2: Input A,B and C

Step3: Is (A>=B) and (A>=C) then Max=A

Step4: Is (B>=A) and (B>=C) then Max=B

Step5: Is (C>=A) and (C>=B) then Max=C

Step6: Print Max

Step7: Stop

Use of Loop or Repetition Control Structure

Example 1 An algorithm to calculate even series between 1 and 100

Step1 : Start

Step2 : I = 2

Step3 : Print I

Step4 : I = I+2

Step5 : If (I <=100) then go to Step 3

Step6 : Stop

Example 2 An algorithm to calculate odd series between 1 and 100

Step1 : Start

Step2 : I = 1

Step3 : Print I

Step4 : I = I+2

Step5 : Is (I <=100) then go to Step 3

Step6 : Stop

Example 3 An algorithm to find addition of the first N numbers.

Step1 : Start

Step2 : X = 0

Step3 : SUM = 0

Step4 : Input N

Step5 : X = X + 1

Step6 : SUM = SUM + X

Step7 : Is X<N then go to Step 5

Step8 : Print SUM

Step9 : Stop

FLOWCHARTS

Flowchart is a graphical representation of an algorithm and it should flow from top to bottom. Flowcharts are generally drawn in the early stages of formulating computer solutions. Flowcharts facilitate communication between programmers and business people. These flowcharts play a vital role in the programming of a problem and are quite helpful in understanding the logic of complicated and lengthy problems. Once the flowchart is drawn, it becomes easy to write the program in any high level language. Often we see how flowcharts are helpful in explaining the program to others. Hence, it is correct to say that a flowchart is a must for the better documentation of a complex program.

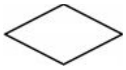
Flow chart symbols

Flowcharts are usually drawn using some standard symbols; however, some special symbols can also be developed when required. Some standard symbols, which are frequently required for flowcharting many computer programs are shown below :

Start or end of the program

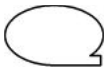
Computational steps or processing function of a program. It indicates any type of internal operation inside the Processor or Memory.

Input or output operation. It indicates that the computer is to obtain data or output results.



Decision making and branching. Used to ask a question that can be answered in a binary format (Yes/No, True/False).

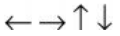
Connector or joining of two parts of program. It allows the flowchart to be drawn without intersecting lines or without a reverse flow.



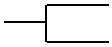
Magnetic Tape

Magnetic Disk

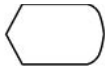
Off-page connector



Flow line (Shows direction of flow)

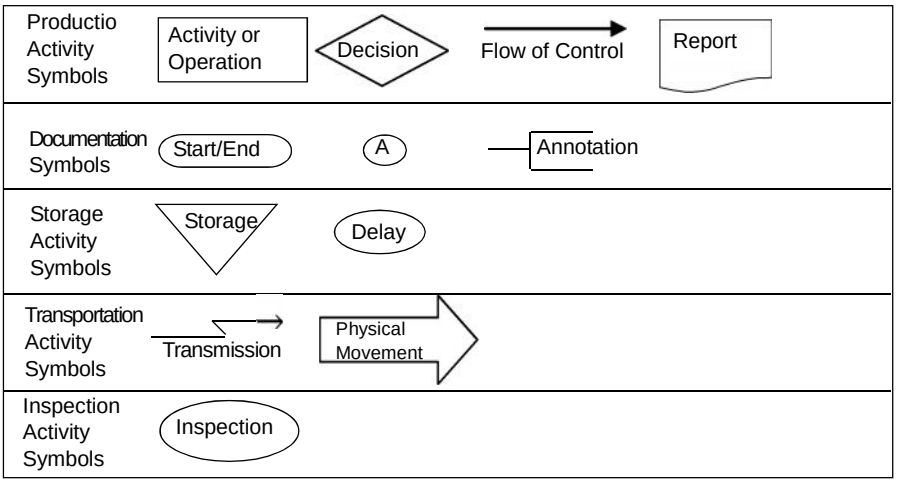


Annotation



Display

Ansi Standrad Flowchart symbols



Advantages of Using Flowcharts

The benefits of flowcharts are as follows:

1. *Communication*: Flowcharts are better way of communicating the logic of a system to all concerned.
2. *Effective analysis*: With the help of flowchart, problem can be analysed in more effective way.
3. *Proper documentation*: Program flowcharts serve as a good program documentation, which is needed for various purposes.

4. *Efficient Coding*: The flowcharts act as a guide or blueprint during the systems analysis and program development phase.
5. *Proper Debugging*: The flowchart helps in debugging process.
6. *Efficient Program Maintenance*: The maintenance of operating program becomes easy with the help of flowchart. It helps the programmer to put efforts more efficiently on the complex part of the program.

Limitations of Using Flowcharts

1. *Complex logic*: Sometimes, the program logic is quite complicated. In that case, flowchart becomes complex and clumsy.
2. *Alterations and Modifications*: If alterations are required the flowchart may require re-drawing completely.
3. *Reproduction*: As the flowchart symbols cannot be typed, reproduction of flowchart becomes a problem.

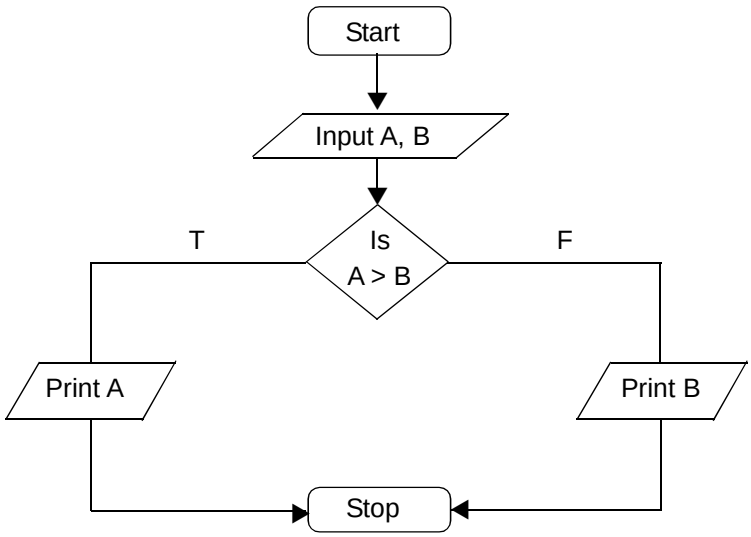
The essentials of what is done can easily be lost in the technical details of how it is done

Flow Chart some examples

Like algorithm, flowchart can also classify into three types such as sequence, branching and looping. Now, we will discuss some examples on flowcharting. These examples will help in proper understanding of flowcharting technique.

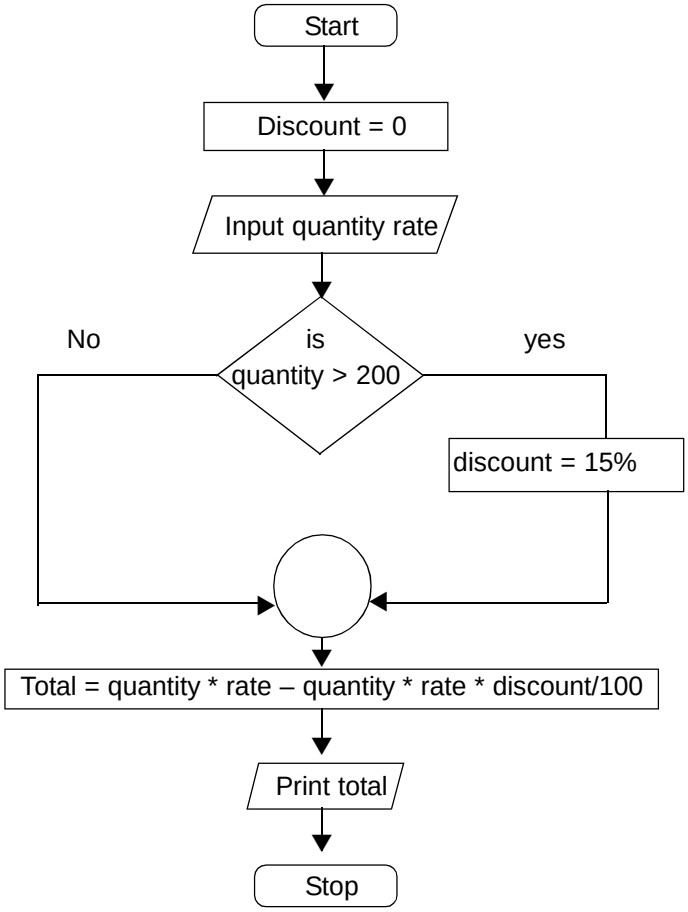
***Example No.* 1**: Draw a flowchart to find the largest number between the two numbers A and B.

Ans. The required flowchart is shown as below –

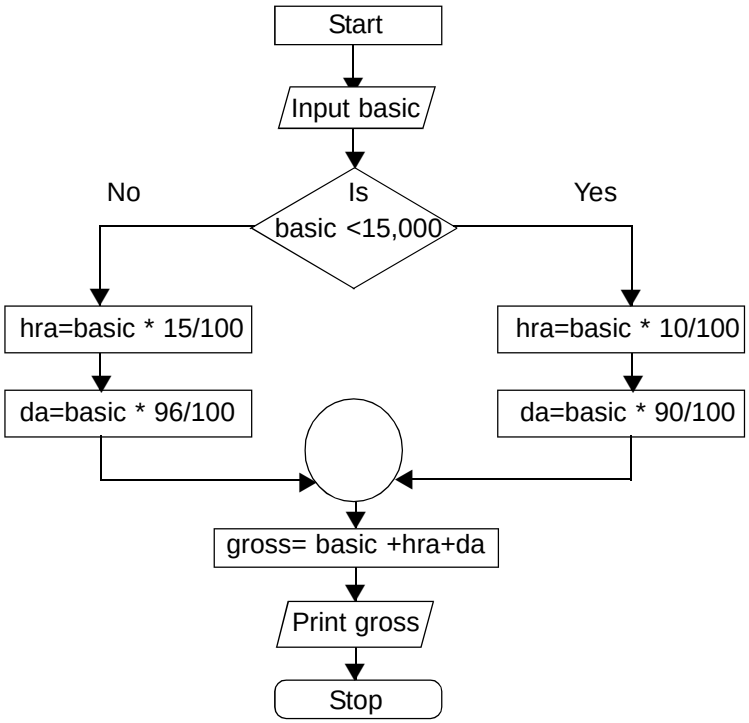


***Example No.* 2**: While purchasing certain items, a discount of 15% is offered if the quantity purchased is more than 200. Draw a flowchart to calculate the total expenses.

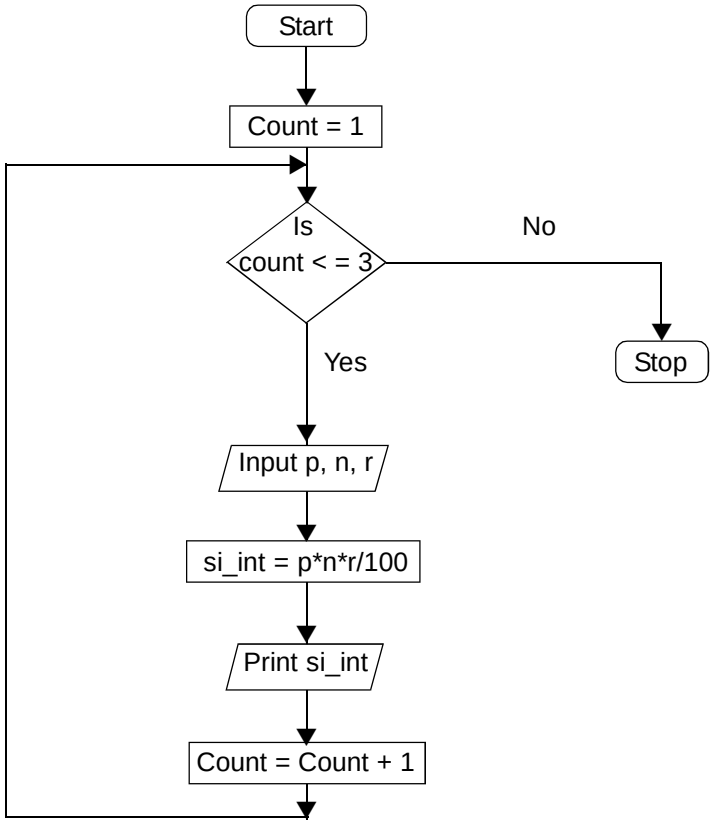
Answer: The required flowchart is shown as below



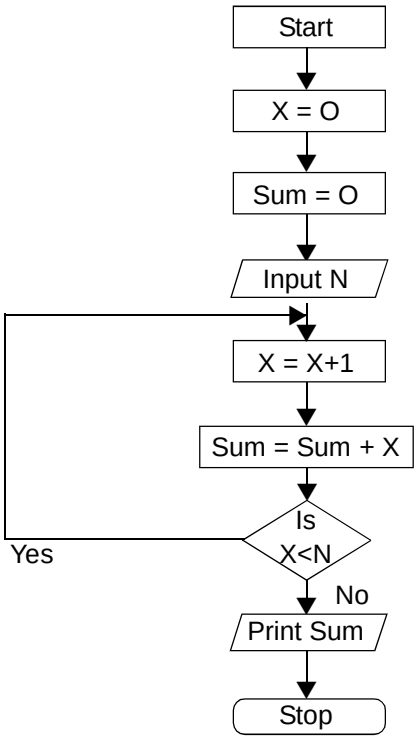
Example 3 : If basic salary is less than 15,000 then hra=10% of basic salary and do=90% of basic salary. If basic salary is either equal to or above of 15,000 then hra=15% and da=96% of basic salary. Draw a flow chart to find the gross salary of employee



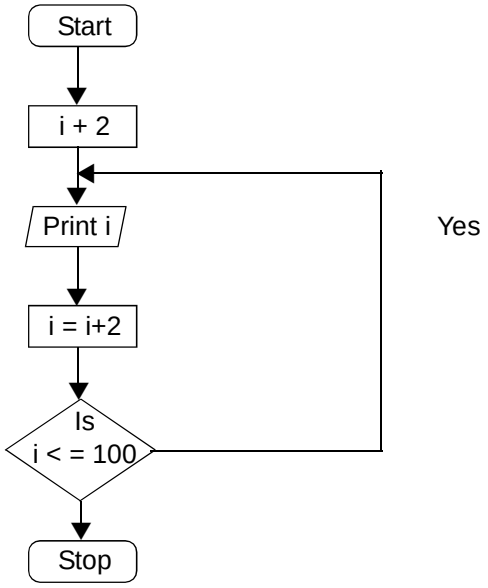
Example 4 : Draw a flowchart for calculation of simple interest (si_int) for four sets of principle (p), time (n) and rate (r)



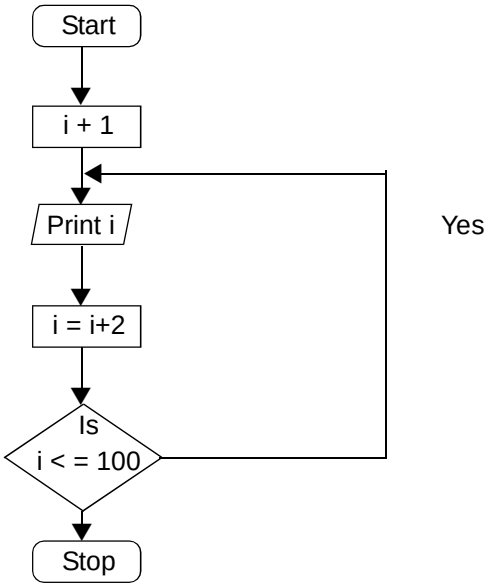
Example 5 : Draw a flowchart for addition of the first n numbers.



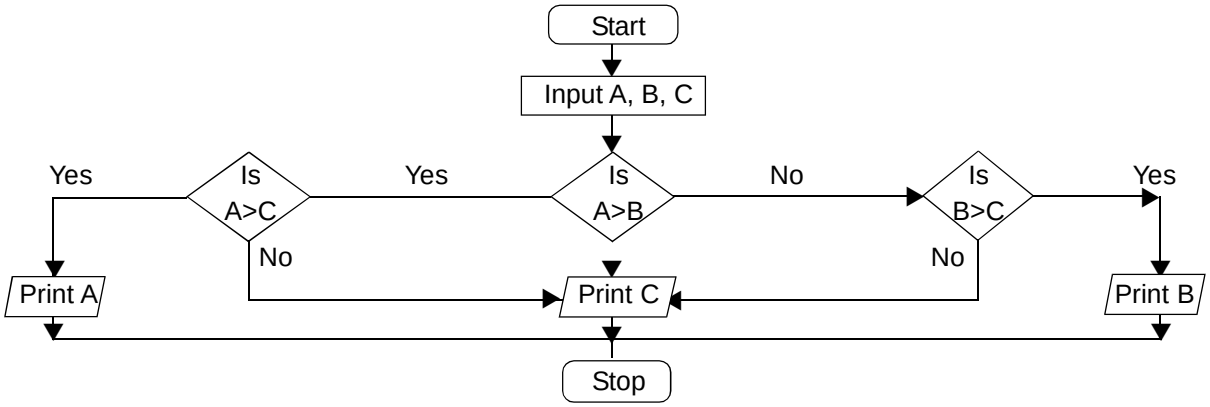
Example 6 : Draw a flowchart to find the even serico between 1 to 100 number



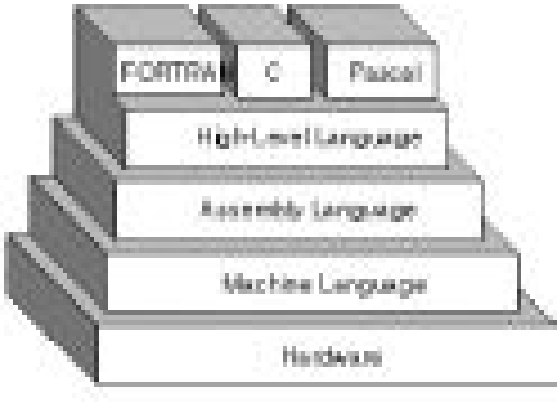
Example 7 : Draw a flowchart to find the old serico between 1 to 100 number



Example 8 : Draw a flowchart to find the largest among the three numbers A, B an C



PROGRAMMING LANGUAGE



Computer language or programming language is a coded syntax used by computer programmers to communicate with a computer. Computer language establishes a flow of communication between software programs. The language enables a computer user to dictate what commands the computer must perform to process data. These languages can be classified into following categories.

1. Machine language
2. Assembly language
3. High level language

Machine Language

Machine language or machine code is the native language directly understood by the computer's central processing unit or CPU. This type of computer language is not easy to understand, as it only uses a binary system, an element of notations containing only a series of numbers consisting of one and zero, to produce commands.

Assembly Level Language

Assembly Level Language is a set of codes that can run directly on the computer's processor. This type of language is most appropriate in writing operating systems and maintaining desktop applications. With the assembly level language, it is easier for a programmer to define commands. It is easier to understand and use as compared to machine language.

High level Language

High Level Languages are user-friendly languages which are similar to English with vocabulary of words and symbols. These are easier to learn and require less time to write. They are problem oriented rather than 'machine' based. Program written in a high-level language can be translated into machine language and therefore can run on any computer for which there exists an appropriate translator.

ASSEMBLER, COMPILER AND INTERPRETER

Any program that is not written in machine language has to be translated in machine language before it is executed by the computer that means used for translation are themselves computer programs. There are three types of translator programs i.e. Assembler, Compiler and Interpreter.

Assembler

Assembler is a computer program which is used to translate program written in Assembly Language into machine language. The translated program is called as object program. Assembler checks each instruction for its correctness and generates diagnostic messages, if there are mistakes in the program. Various steps of assembling are:

1. Input source program in Assembly Language through an input device.
2. Use Assembler to produce object program in machine language.
3. Execute the program.

Compiler

A compiler is a program that translates a programme written in HLL to executable machine language. The process of transferring HLL source program in to object code is a lengthy and complex process as compared to assembling. Compliers have diagnostic capabilities and prompt the programmer with appropriate error message while compiling a HLL program. The corrections are to be incorporated in the program, whenever needed, and the program has to be recompiled. The process is repeated until the program is mistake free and translated to an object code. It translates the program all at once not statement by statement.Thus the job of a complier includes the following:

1. To translate HLL source program to machine codes.
2. To trace variables in the program
3. To include linkage for subroutines.
4. To allocate memory for storage of program and variables.
5. To generate error messages, if there are errors in the program.

Interpreter

The basic purpose of interpreter is same as that of complier. In compiler, the program is translated completely and directly executable version is generated. Whereas interpreter translates each instruction, executes it and then the next instruction is translated and this goes on until end of the program. In this case, object code is not stored and reused. Every time the program is executed, the interpreter translates each instruction freshly. It also has program diagnostic capabilities. However, it has some disadvantages as below:

1. Instructions repeated in program must be translated each time they are executed.
2. Because the source program is translated fresh every time it is used, it is slow process or execution takes more time. Approx. 20 times slower than complier.

LESSON ROUND-UP

– In the most basic sense, programming means creating a set of instructions for completing some specific task. Many of our daily activities can be described as programmatic – they involve specific steps that often follow a set order. In the context of computing, programming means creating a set of instructions not for a person but for a computer, in order to accomplish a specific task.

– Programming Process may refer to the only guidelines that have come to be recognized as being part of writing good, easily understood, and useful computer programs consists of 5 steps namely Analyzing the problem, Designing the solution, Coding the solution, Testing the solution, Documenting the solution.

- The program development life cycle (PDLC) is an outline of each of the steps used to build software applications.
- Algorithm is a process or set of rules to be followed in calculations or other problem-solving operations, esp. by a computer.
- A flowchart is a diagrammatic representation that illustrates the sequence of operations to be performed to get the solution of a problem
- Computer language or programming language is a coded syntax used by computer programmers to communicate with a computer. Computer language establishes a flow of communication between software programs.
- Machine language or machine code is the native language directly understood by the computer's central processing unit or CPU. Assembly Level Language is a set of codes that can run directly on the computer's processor.
- High Level Languages are user-friendly languages which are similar to English with vocabulary of words and symbols. These are easier to learn and require less time to write
- Any program that is not written in machine language has to be translated in machine language before it is executed by the computer. The means used for translation are themselves computer programs. There are three types of translator programs i.e. Assembler, Compilers and Interpreters.

SELF-TEST QUESTIONS

(These are meant for re-capitulation only. Answers to these questions are not to be submitted for evaluation)

1. What do you mean by the term Programming? Explain the basic characteristics of Programming.
2. What is the programming process? Explain the steps involved in programming process.
3. What is program development life cycle? Explain in detail.
4. What do you mean by the term 'Algorithm'? Explain the characteristics of good algorithm.
5. What are the steps involved in designing an algorithm? Explain in detail
6. Write an algorithm to find multiplication of the first N numbers.
7. What do you mean by flow chart? Explain the different characteristics of a flow chart.
8. Explain about different symbols used in flow charting.
9. Draw a flow chart for calculating the sum of squares of first 10 odd numbers.
10. Draw a flow chart for calculating the sum of 15 natural numbers which are greater than 3.
11. Draw a flowchart to find the smallest of three numbers.
12. What do you mean by programming languages? Explain different types of Programming languages.
13. What do you mean by assembler and compiler? Differentiate among assembler, compiler and interpreter.

Lesson 7
Internet and Other Technologies

LESSON OUTLINE

- Systems- An Overview
- Internet
- World-Wide Web
- Intranets
- Extranets
- Applications of Internet
- Internet Protocols
- E-Commerce
- Supply Chain Management
- Customer relationship Management (CRM)
- Electronic Data Interchange (EDI)
- Electronic Fund Transfers (EFT)
- Mobile Commerce
- Bluetooth
- WI-FI

LEARNING OBJECTIVES

Internet and internet driven technologies i.e. Bluetooth, wi-fi and so has become an integral part of our life. It has affected each of us life in one or other way. It is internet only which enables us to do various tedious tasks in minutes. All Government agencies and regulatory bodies are promoting use of internet and its applications. After reading this lesson students will be able to:

- Understand Internet and a variety of its applications and other related technologies.
- Understand various aspects related to Internet Protocols, E-commerce security.
- Get an idea about e-commerce and its various variants.
- Understand the mechanism of internet driven technologies i.e. electronic fund transfer system, EDI etc.

The Internet is becoming the town square for the global village of tomorrow.

Bill Gates

INTERNET

The Internet is a global system of interconnected computer networks. It is a network of networks that consists of millions of private, public, academic, business, and government networks, of local to global scope, that are linked by a broad array of electronic, wireless and optical networking technologies. It is formed by the joining of many smaller networks around the world to form the largest network in the world.

The Internet carries an extensive range of information resources and services, such as the inter-linked hypertext documents of the World Wide Web (www) and the infrastructure to support email. It uses the standard Internet protocol suite (TCP/IP) to serve billions of users worldwide.

The Internet has enabled and accelerated new forms of human interactions through instant messaging, Internet forums, and social networking. Online shopping has boomed both for major retail outlets and small artisans and traders. Business-to-business and financial services on the Internet affect supply chains across entire industries. Most traditional communications media including telephone, music, film, and television are being reshaped or redefined by the Internet, giving birth to new services such as Voice over Internet Protocol (VoIP) and Internet Protocol Television (IPTV). Newspaper, book and other print publishing are adapting to web site technology, or are reshaped into blogging and web feeds.

Origin of Internet

The origin of the Internet reach back to research commissioned by the United States government in the 1960s to build robust, fault-tolerant communication via computer networks. The funding of a new U.S. backbone by the National Science Foundation in the 1980s, as well as private funding for other commercial backbones, led to worldwide participation in the development of new networking technologies, and the merger of many networks. The commercialization of what was by the 1990s an international network resulted in its popularization and incorporation into virtually every aspect of modern human life. As of June 2012, more than 2.4 billion people – over a third of the world's human population – have used the services of the Internet; approximately 100 times more people than were using it in 1995, when it was mostly used by tech-savvy middle and upper class people in the United States and several other countries

WORLD WIDE WEB

The World Wide Web (abbreviated as www commonly known as the web), is a system of interlinked hypertext documents (these are standard document format for internet, written using Hyper Text Mark up Language, HTML), accessed via the Internet. It provides a standard method for exchanging and publishing information on the internet. It is accessed through web browsers which display web pages of embedded graphics and HTML/ XML encoded text.

British Engineer Sir Tim Berners-Lee in March, 1989, wrote a proposal that referenced his database and software project 'ENQUIRE', and described a more elaborate information management system. In Year 1990, he published a more formal proposal to build a "Hypertext project" called "Worldwide Web" to be viewed by "browsers" using client–server architecture.

This project has only give birth to World Wide Web.

Features of World Wide Web

1. Medium of Publishing Information: The 'world wide web' or 'web' for short is a medium for publishing information on the internet in an easy to use form. If we take the analogy of television then internet would be equivalent to the broadcasting equipment such as mast and transmitter and World Wide Web to the content of different T.V. programmes. The medium is based on standard document format known as HTML (Hyper Text Mark up Language).

2. Easy retrieval of Information: The amount of information available on the Internet has become so large that it is difficult to search for specific information. The World Wide Web (www) makes retrieval easy and quick.

3. Easy Navigation of Documents: The www is a search tool that helps you find and retrieve information from a Web site using links to other sites and documents. The www was built on the technology called Hypertext. This technology increases accessibility to linked documents on the Internet and helps user to navigate between documents very easily.

4. Linking of Documents: Hypertext is identified by underlined text and a different color usually. Some places will refer these types of technique as Jump-Off Points. Hypertext can make links within the same document or to other documents.

5. Helpful in sharing information: The www is intended to help people share information resources, and services with the widest possible community of users. Thus a user can access the www on Apple, UNIX, Macintosh, DOS, Windows, and other operating systems.

6. Easy search, transverse and other use of information: www lets you search, traverse, and use many types of information at numerous sites and in multiple forms. This interface is called a browser. Some people refer to a browser as a 'web browser' often these terms are used interchangeably

7. Use of Protocol: Just like the Internet, the www has a protocol, which is known as HyperText Transfer Protocol (HTTP). HTTP acts as an interface between a Web Client Software, such Netscape Navigator.

Web Browsers

A browser is a piece of software that acts as interface between the user and inner workings of the internet specifically the World Wide Web. With a web browser, one can view web pages that may contain text, images, video and other multimedia, and navigate between them via hyperlinks (it is a method of moving between one website page and another indicated to the user by an image or text highlighted by underlying and/ or different colour). Browsers are also referred to as web clients, or universal clients, because in the client/server model, the browser functions as the client program. The browser acts on the behalf of user. The browser -

- Contacts a web server and sends a request for information.
- Receives the information and then display it on the user's computer.

Text and graphical information can be displayed in browser. The www incorporate hypertext, photographs, sounds, video etc. that can be fully experienced through graphical browser.

Popular browser includes

1. Netscape Navigator.
2. Microsoft Internet Explorer
3. Mosaic
4. Opera
5. Lynx
6. Hot java
7. Mozilla Navigator
8. Safari
9. Mozilla Firefox
10. Google Chrome

Features of web browsers:

Regardless of which browser one use, web browser may support some or all of these features.

- Book mark for favourite websites
- Multiple browsing windows
- Frames or multiple views with in a window
- Secure data transmission
- Java and other Language support
- Web interface to FTP and Gopher internet Sites.

Web addresses:

Web addresses refers to particular pages on a web server which are hosted by company or organisation. The technical name for these is uniform resource location. They are usually prefixed by http://www to denote the web protocol and then broken down as follows:

http://www.domain-name.extension/file name

Domain Name: It refers to the name of server and usually selected to be the same as the name of the company, the extension indicates its type. A domain name always contains two or more components separated by period called dot.

The top-level portion of a domain describes the type of organisation holding the name. An important category for top level domains covers the following:

1. com : Commercial Organisation
2. edu : Educational Institutions
3. net : Organisation involved in internet operations
4. org : Miscellaneous Organisations
5. in : It is the country code for India. Two letter abbreviations are used for it.
6. gov : Government entities.

INTRANET

It refers to a private network within a single company using internet standards to enable employees to share information using e-mail and web-publishing. It is accessible only by authorised employees, contractors and customers. It is basically used to communicate non-sensitive but broadly useful information such as Recent Corporate News:

(a) General product information

(b) Details of health insurance

(c) Travel expense forms

(d) Product pricing

(e) In-house training programmes.

The need for intranet is the result of many factors such as:

(a) cost effectiveness

(b) Prompt availability of information to company and users

(c) Less expensive means of communication to remain in touch with employees located in scattered offices

(d) Custom support

Advantages of Intranet

Important advantages of Intranet include the following:

- Easy, economic and fast system of communication within enterprise
- Based on internet protocol it expands accessibility
- Serves information automatically
- Replaces Grapevine and permit inter-employee communication with more transparency
- Improves productivity of executives by devoting more time in analysing information than waiting for information
- Ready to access the information globally
- Makes the flow of Information need driven
- Handles multimedia data effortlessly

Disadvantages of Intranet

Important disadvantages of Intranet include the following:

- Risk of Security to the corporate information resources
- Needs to change the work culture for effectiveness of internet
- Danger of reduction in face to face interaction between employees leading to impersonisation of the company

Successful Strategies for Intranet

For effective success of Intranet in a company, one may implement the following strategies:

1. **Include widely used applications and make them simple to use:** Use the intranet to simplify employee's lives. For instance, by putting travel expense reports on-line, employees do not have to waste time filling out hard-copy reports, making copies for numerous people, and sending them through regular or interoffice mail, which can take days. Instead, they can complete reports and send them to as many people as needed. The recipients receive them in moments.
2. **Secure the system:** Security of intranets is vital. If the information on an intranet is corrupted (such as an inaccurate posting of company job openings) or if a competitor accesses the information (such as pricing policies for different products), it can lead to distrust.
3. **Integrate databases into intranet applications:** Databases are at the heart of intranet applications. The data and information that employees access from the intranet come from one or more databases. Companies must invest the time and money to build databases that are accurate, complete, and reliable.
4. **Invest in excellent network capacities:** Clearly, networks are essential for the success of intranets. Without a robust network infrastructure, an intranet simply will not be able to function. If the network is frequently down or if the network is too slow, employees will get frustrated and may not use the intranet.

5. **Motivate employees to use the intranet:** Change is not easy. Many people prefer to do things the way always have. To convince people of the benefit of change, intranets must be easy to use with user-friendly, intuitive interfaces. Further, companies should give incentives encouraging employees to use the intranet.

EXTRANET

It is also a private network but formed by extending an intranet beyond a company to customers, suppliers and collaborators. E-banking is an example of extranet. An extranet is a network which allows controlled access from the outside, for specific business or educational purposes. In a business-to-business context, an extranet can be viewed as an extension of an organization's internet that is extended to users outside the organization, usually partners, vendors, and suppliers, in isolation from all other Internet users. For decades, institutions have been interconnecting to each other to create private networks for sharing information. One of the differences that characterize an extranet, however, is that its interconnections are over a shared network rather than through dedicated physical lines Extranet provides information customers need such as detailed product description, frequently asked questions about different products, offices maintenance information warranties and how to contact customer service and sales office. Earlier, it was difficult for customers to access much of this information because paper version of it at the customer site became scattered and out dated. By using extranet, companies are making this type of information increasingly available at a single interactive site that is easy to navigate.

Successful Strategies for Extranet

Some of the important strategies necessary for success of extranet are discussed as under:

1. Understand the return on investment: The business should develop its extranet with specific goals in mind, such as improving customer satisfaction, reducing operating costs, increasing sales, or any other goal. Companies must establish clear goals and work toward them because extranets are expensive.

2. Select your audience and meet its needs: Extranets are designed to cater to the external entities of a business, such as customers, suppliers, government regulators, and stockholders. The company should carefully select the entity or entities that it wants the extranet to serve. The information needs of a stockholder are quite different from the information needs of a supplier. Once a decision is made about the audience for the extranet, the next step is to carefully identify specific information problems the extranet will address.

3. Be willing to change: An extranet is a work in progress. Companies must continue to invest in the extranet if it is to meet the changing needs of its audience. Otherwise, the extranet will become quickly outdated, defeating its purpose.

4. Keep things simple: People want clean, crisp, easy-to-click-on applications. Because many visitors may not be proficient with the Internet, it is important to make extranets intuitive and easy to use. Users do not want to spend an enormous amount of time on clerical functions, so such functions, in particular, should be easy to use.

5. 24 hours a day: Extranets should be up and running 24 hours a day, 7 days a week. Visitors should be able to access the extranet anytime from anywhere. In the case of global companies, this becomes imperative, given the time different between different countries.

6. Work with end users: When IT staffs try to build an extranet without help, the project's chances of success sharply diminish. Successful extranets are a joint venture between IT and the business end users.

APPLICATIONS OF THE INTERNET

1. Communication: Internet has become an indispensible means of communication now days. Internal communication mode such as E-mail has become the synonym for business communication. Now it is the time where most of the business communication happens over e-mail only.

E-mail is the most popular internet service which refers to sending business communication electronically over a network to single recipient or to many recipients. The receiver can retrive the mail at his or her convenience or the user is automatically notified when there is E-mail in the electronic mail box. An E-mail system requires messaging system that stores and forward the messages to the right individual and mail program that allow the user to send and receive messages. E-mail messages on the Internet can be transmitted from one user to another often in seconds. Some more details on E mail are covered later in this chapter.

2. Management of Business Operations: Internet has become a must have resource for all business concerns. Now most of the organisation owns their web portals where one may get ins and outs of the organisation. Internet has brought remarkable changes in the working of the business organisations.

3. Education: Internet is extensively used presently in providing education. Now for getting an internationally recognized degree, it is not necessary for someone to go thousands of miles away, he may use online education facility and get recognized sitting at home. Many organisation have emerged which are providing free online education through MOOCS (Massive open online course). One needs to simply register with them online and they can sit at home freely. This has become possible only through the Internet.

4. Research and studies: Internet has proved to be a boon for research and studies. Now, most of the good libraries have got digitized and these are available online. One may get their online access by paying the requisite fee. In addition to the online libraries, ample ofmaterial is freely available on internet. Researches may find enormous details about a topic in just a click. This has become possible only through the Internet.

5. E-commerce: E Commerce is another application of internet which has makes everyone's life easier. Now sitting at home, one may buy railway tickets, transfer money from one account to another, buy insurance policies, and buy house hold goods. E-commerce has benefited business, consumer and even to the government.

6. E-governance: E-governance is another application of internet. In the age of internet, government has also taken serious steps for computerisation of government offices. This will help in elimination of various disadvantages of bureaucracy.

The above list of internet application is just indicative and students may enumerate various others applications too.

ELECTRONIC MAIL (E-MAIL)

E-mail (short for electronic mail) is a convenient way to communicate with others. When you send an e mail message, it arrives almost instantly in the recipient's e mail inbox. You can send e mail to many people simultaneously, and you can save, print, and forward e mail to others. You can send almost any type of file in an e mail message, including documents, pictures, and music files.

Advantages of E-Mail

Some of the major advantages of e-mail are summarised as follows:

1. Speed: E-mail messages can be transmitted very quickly. A typical message containing 400 words, for example, can be transmitted in under a second. As a means of communication, e-mail is considered extremely fast, with some messages able to reach their destination in a matter of minutes. Since e-mail is considered to be an extremely fast method of communication, users often use the derisory term 'snail mail' to refer to the conventional postal system.

2. Cost: The cost of sending or receiving messages is considered very low. Hundreds of messages can be sent or received for the cost of a brief telephone call, making e-mail for cheaper than the postal service.

3. Multiple copies: E-mail allows multiple copies of the same basic message to be created and transmitted. As an example, Eudora, a leading e-mail package, uses a special directory to hold the names and e-mail addresses of friends and colleagues. Using some of the functions of the directory, groups of people can be assigned an alias (sometimes known as a nickname), for example the name of a department might be used as an alias for all of the people working there. A message can be created in the usual, way and addressed to the alias. When the message is transmitted, copies are sent automatically to each of the people belonging to the group.

4. Auditing: Even the simplest e-mail package will provide a number of features that allow users to audit their messages. Most programs allow users to keep copies of any messages they produce, automatically marking them with the date and time they were created. Some programs can automatically create receipts that can be used to check if a message sent to another user has been received, or even if the message has been read.

5. Sharing data: E-mail messages can be used to transmit data files to other users. Files can be attached to messages and transmitted in the usual way. All types of data can be sent in this way, including word processor files, spreadsheet data, graphics and database files.

6. Multimedia: The latest e-mail packages allow users to include multimedia elements in their messages. Messages can include a variety of different elements, including graphics, video, hyperlinks to information on the Internet and sound files.

7. Group work: E-mail supports group work and remote working. Group work involves several people working on the same project, using IT to help them communicate with each other and share data files. Remove working (Teleworking) involves people working away from a central office - perhaps at home - but staying in contact through e-mail and other methods.

8. Flexibility: The hardware and software used for handling e-mail can also be used for a variety of other purposes. A typical modem, for example, can also be used to send or receive fax messages.

Popular Uses of Internet

Surf- Point and click your way to thousands of hyperlinked websites and resources for multimedia information, entertainment or electronic commerce.

E-mail – Use e-mail and instant messaging with colleagues, friends and other internet users.

Discuss – Participate in discussion forums of special internet newsgroups or hold real time tet conversations in website chat rooms.

Publish – Post your opinion, subject matters or creative work to a website or weblog for others to read.

Buy and sell – You can buy and sell practically anything via e-commerce retailers, wholesalers, service providers and online auctions.

Download – Transfer data files, software, reports, articles, pictures, music, videos and other types of files to your computer system.

Compute – Log on to and use thousands of internet computer systems around the world.

Other Uses – Make long distance phone calls, hold desktop videoconferences, listen to radio programs, watch television, play video games, explore virtual world etc.

Protocol

It is a standard set of rules and procedures for the control of communication and network. Protocols determine

how data are transmitted between computing devices and over networks. Protocols are established by international agreement and ensure that computers everywhere can talk to one another. There are a variety of protocols for different kinds of information and functions. They define issues such as error control and data compression methods. The protocol determines the following: type of error checking to be used data compression method (if any), how the sending device will indicate that it has finished a message and how the receiving device will indicate that it has received the message.

INTERNET PROTOCOLS

Internet protocols include TCP/IP (Transfer Control Protocol/Internet Protocol), HTTP (Hypertext Transfer Protocol), FTP (File Transfer Protocol), and SMTP (Simple Mail Transfer Protocol).

TCP/IP

TCP (Transmission Control Protocol) and IP (Internet Protocol) are two different procedures that are often linked together. The linking of several protocols is common since the functions of different protocols can be complementary so that together they carry out some complete task. The combination of several protocols to carry out a particular task is often called a “stack” because it has layers of operations. In fact, the term “TCP/IP” is normally used to refer to a whole suite of protocols, each with different functions. This suite of protocols is what carries out the basic operations of the Web. TCP/IP is also used on many local area networks.

When information is sent over the Internet, it is generally broken up into smaller pieces or “packets”. The use of packets facilitates speedy transmission since different parts of a message can be sent by different routes and then reassembled at the destination. It is also a safety measure to minimize the chances of losing information in the transmission process. TCP is the means for creating the packets, putting them back together in the correct order at the end, and checking to make sure that no packets got lost in transmission. If necessary, TCP will request that a packet be resent.

Internet Protocol (IP) is the method used to route information to the proper address. Every computer on the Internet has to have its own unique address known as the IP address. Every packet sent will contain an IP address showing where it is supposed to go. A packet may go through a number of computer routers before arriving at its final destination and IP controls the process of getting everything to the designated computer. Note that IP does not make physical connections between computers but relies on TCP for this function. IP is also used in conjunction with other protocols that create connections.

UDP and ICMP

Another member of the TCP/IP suite is User Datagram Protocol (UDP). (A datagram is almost the same as a packet except that sometimes a packet will contain more than one datagram.) This protocol is used together with IP when small amounts of information are involved. It is simpler than TCP and lacks the flow-control and error-recovery functions of TCP. Thus, it uses fewer system resources.

A different type of protocol is Internet Control Message Protocol (ICMP) . It defines a small number of messages used for diagnostic and management purposes. It is also used by Pingand Traceroute.

Hypertext Transfer Protocol

Web pages are constructed according to a standard method called Hypertext Markup Language (HTML). An HTML page is transmitted over the Web in a standard way and format known as Hypertext Transfer Protocol (HTTP). This protocol uses TCP/IP to manage the Web transmission.

Mail Protocols POP3 and SMTP

Email requires its own set of protocols and there are a variety, both for sending and for receiving mail. The most common protocol for sending mail is Simple Mail Transfer Protocol (SMTP). When configuring email clients, an

Internet address for an SMTP server must be entered. The most common protocol used by PCs for receiving mail is Post Office Protocol(POP). It is now in version 3 so it is called POP3. Email clients require an address for a POP3 server before they can read mail. The SMTP and POP3 servers may or may not be the same address. Both SMTP and POP3 use TCP for managing the transmission and delivery of mail across the Internet.

File Transfer Protocol

File Transfer Protocol (FTP) lives up to its name and provides a method for copying files over a network from one computer to another. More generally, it provides for some simple file management on the contents of a remote computer. It is an old protocol and is used less than it was before the World Wide Web came along. Today, Its primary use is uploading files to a Web site. It can also be used for downloading from the Web but, more often than not, downloading is done via HTTP. Sites that have a lot of downloading (software sites, for example) will often have an FTP server to handle the traffic. If FTP is involved, the URL will have *ftp:* at the front.

ELECTRONIC COMMERCE (E-COMMERCE)

Electronic commerce or E-commerce is a term for any type of business, or commercial transaction that involves the transfer of information across the Internet. It covers a range of different types of businesses, from consumer based retail sites, through auction or music sites, to business exchanges trading goods and services between corporations. It is currently one of the most important aspects of the Internet to emerge.

In Year 1997 OECD (Organization for Economic Corporation and Development, defines that E-Commerce refers generally to all the forms of transactions related to commercial activities, including both organizations and individuals, that are based upon the processing and transmission of digitized data, including text, sound and visual images.

E-commerce allows consumers to electronically exchange goods and services with no barriers of time or distance. Electronic commerce has expanded rapidly over the last few years and is predicted to continue at this rate, or even accelerate. In the near future the boundaries between "conventional" and "electronic" commerce will become increasingly blurred as more and more businesses move sections of their operations onto the Internet.

European Commission in Year 1997 defines, that Electronic Commerce is about doing business electronically. It is based on the electronic processing and transmission of the data, including text, sound, and video. It encompasses many diverse activities including electronic trading of goods and services, online delivery of digital content, electronic fund transfers, electronic share trading, electronic bills of lading, commercial auctions, collaborative design and engineering, online sourcing, public procurement, direct consumer marketing, and after sales service. It involves both products (e.g. consumer goods, specialized medical equipment) and services (e.g. information services, financial and legal services); traditional activities (e.g. health care, education) and new activities (e.g. virtual malls).

Thus, E-commerce refers to the paperless exchange of business information using Electronic Data Interchange, electronic mail, electronic bulleten board, electronic funds transfers and other networked based technologies. It is not only automates manual process and paper transaction but also help organisations move to a fully electronic environment and change the way they operate.

In a holistic sense electronic commerce can be summarized as:

- It is a business strategy.
- It uses technology to achieve business goals.
- It improves external business relationships.
- It is an evolution in the way companies Internet.

- It provides information to facilitate delivery of goods and services.
- It supports change initiatives and reinforces business process re-engineering.

Elements of E-commerce

1. A product or a service: In case of E-Commerce, it is virtual product shown on a web site. One can demonstrate multimedia presentation of the product and all its features on the web page itself, which may not be possible in case of physical product of commerce activity.

2. A place to sell the product: In the e-commerce case, a website displays the products in all ways & act as a place for E-Commerce.

3. A way to get customers to visit your website: In case of E-Commerce search engines and linkages with other web sites play an important role in helping the customers to reach web sites of the e-organizations.

4. A way to accept orders: The orders are accepted on the web site itself. On the web pages of the E-commerce companies shopping carts are being provided. One can click on the icon and fill in the shopping card to order items to be purchased and it is accepted by the E-comm. Company as order from the customer.

5. A way to accept money: In case of traditional commerce, buyers and sellers are in direct contact with each other. The payments in E-commerce are made using Electronic Fund Transfer in various form using credit cards, smart cards, e-checks, etc. The information of payment is routed through Value Added Networks (VANs) and Payment Gateway Systems, etc.

6. A fulfilment facility to ship product to customers: The shipment of the product to the customer is made through third party. The most of the E-commerce companies are having their chain of suppliers in various localities and items are shipped through these suppliers to the customers.

7. A way to accept returns: As is the case of commerce, in case of E-commerce all the trading companies have the system of accepting the returns if the goods and services are not to the satisfaction of the customer or not upto the standards/ specifications mentioned in the product catalogue or brochures hosted on the web pages.

8. A way to handle warranty claims: Sometimes if the product breaks in the way or some other problems crop up with the product. In such situation, warranty claims are to be honoured as in the case of commerce.

9. A way to provide customer service: The main tools of the customer service are E-mail, On-line forms, on-line knowledge bases and frequently asked questions.

E-commerce Application –

- Retail stores
- Auction Sites
- Cooperating Business
- Electronic Banking
- Booking Tickets (Trains, Cinema , Airlines etc.)
- Electronic Publishing
- Filling tax returns with Government department.

Type of E-commerce

E-commerce types represent a range of various schemas of transactions which are distinguished according to their participants. Usually E-commerce is divided into three general most well-known types, but the notion is much wider. Here four such models are specified.

1. B2B or Business to Business

2. B2C or Business to Consumer

3. C2C or Consumer to Consumer

4. C2B or Consumer to Business

B2B OR BUSINESS TO BUSINESS

It is considered as one of the most perspective and extensively developing E-commerce trend nowadays. It refers to electronic commerce between businesses and also supplies chain technology, which is the largest and most successful e-commerce technology nowadays. The parties of B2B schema are "Business Partners". Internet platforms give an opportunity to considerably simplify all steps of the operations, make the trade more immediate. An example of a schema B2B is selling site templates to companies for using as a design base, besides any other interactions involving bulk deliveries are included. B2B means an established working relationship therefore it is a better solution to deliver comparing to B2C, although it needs to link together two complex accounting systems.

Characteristics of B2B E-commerce

(a) It requires two or more business entities interacting with each other directly or through an intermediary.

(b) The intermediaries in B2B may be the market makers and directory service providers that assist in matching the buyers and sellers and striking a deal.

(c) The business application of B2B electronic commerce can be utilized to facilitate almost all facets of the interactions among organizations, such as Inventory Management, Channel Management, Distribution Management, Order fulfilment and delivery, and payment management.

(d) The B2B electronic commerce can be

- Supplier-Centric,
- Buyer-centric, or
- Intermediary-centric.

Supplier-Centric B2B E-commerce

In a supplier centric B2B E-commerce, a supplier sets up the electronic commerce market place for various buyer businesses to interact with the supplier at its electronic market place. Typically, a dominant supplier in the domain of products sets up such a market place. The supplier may provide customized solutions and pricing to fit the needs of buyers' businesses. Usually, differential price structure is dependent upon the volume and loyalty discount. Example, Cisco Connection Online (CCO)

Buyer-Centric B2B E-commerce

In a Buyer centric B2B E-commerce, the major business with high volume purchase capacity creates an electronic marketplace for purchase and acquisition. The electronic marketplace is used for placing requests for quotations (RFQs) and carry out the entire purchase process on-line by the buyer. This kind of facility may be utilized by high volume and well recognized buyers, as they may have adequate capacity and business volumes to lure suppliers to bid at the site. Example, General Electric's Trading Process Network

Intermediary-Centric B2B E-commerce

In Intermediary-Centric B2B E-commerce, a third party may set up the electronic marketplace and attract both

the buyer and seller businesses to interact. The Buyers and Sellers, both benefit from the increased options in terms of pricing, quality, availability and delivery of goods. The third party electronic marketplace acts as a hub for both the suppliers and buyers, where buyers place their request for the quotations and sellers respond by bidding electronically leading to a match and ultimately to a final transaction. It is essential that Intermediary Company represent large number of the members in that specific markets segment, i.e., both the buyers and the sellers. The Intermediary reduces the need of buyers and sellers to contact a large number of potential partners on their own. Example, IndiaMart.com

B2C OR BUSINESS TO CONSUMER

It has lately gained a big popularity due to simplified and accelerated way to buy products. Business to Consumer refers to selling and buying of goods and services via the web. The parties are: a company (a web retailer) who trades to an individual (a web customer). Retail trading (via online shops) is the most well-know example of such a type of transactions allowing consumers to purchase by lower prices and with more convenience. The disadvantages of B2C E-Commerce type are selling to un-trusted strangers and extra effort to get customer and payment information. However, B2C almost always involves customer typing information into an order screen therefore it is a better solution to provide comparing to B2B.

In B2C E-commerce, the businesses offer a set of merchandise at given prices, discounts and shipping and delivery options and the sellers and consumers both benefit:

1. Through the round the clock shopping
2. Accessibility from any part of the world,
3. Increased opportunity for direct marketing,
4. Customizations and
5. Online customer service

Berner&Noble.com, sells books, softwares and music to individual customers. Dell is also an example of B2C e-commerce, people can specify their own unique computer online and Dells assembles the components and ship the computer directly to the customer.

The B2C model of electronic commerce transaction is ideally suited for the following:

1. Goods that can be easily transformed into the digital format such as books, music clips and videos, software packages
2. Items that follow a standard specifications: printer ribbons, ink cartridges etc
3. Highly rated brand items or items with return security: Dell & Compaq Computers, Electronic Gadgets from Sony etc.
4. Items that may be sold in packets that cannot be opened even in physical stores, Kodak film rolls
5. Relatively cheap items: where the savings outweigh the risks
6. Items that can be experienced online such as Music, Videos etc

C2C or Consumer to Consumer

It refers to online dealing of goods and services between people. The parties are two consumers (individuals). This type of transaction is fulfilled due to online market dealer like auction sites, becoming more and more popular nowadays For example Olx.com, Bazee.com and Ebay.com- customer buy and sell directly to each other through sites. It reduces the use of classified pages of a newspaper to advertise and sell personal items.

Characteristics of C2C E-commerce

1. It promotes opportunity for consumers to transact goods or services to other consumers present on Internet.

2. The C2C in many a situations models the exchange systems with a modified form of deal making.
3. For the deal making purposes large virtual consumer trading community is developed. The customer operates by the rules of this community to compete, check and decide his own basic transaction prices.
4. It mimics the traditional economic activities corresponding to 'classified ads' and auctions of personal possessions.
5. Much of the transactions in this category correspond to the small gift items, craft merchandise and similar items that are normally sold through the 'flea' markets or Bazaars

C2B OR CONSUMER TO BUSINESS

It is an emerging concept where consumers demand specific products or services from respective businesses by presenting themselves as a buyer group. Example of this type is contacting a tour and travel operator via their website for purchasing a holiday package as well as such sites as CTB and SpeakOut.com. These sites provide consumers with market strategies. They are also used by businesses to gain insight into consumer wants.

Characteristics of C2B E-commerce

1. The transactions originated by the customer have the set of specifications and the required price for a commodity, service or an item.
2. The business entity is expected to match the requirements of the consumers to the best possible extent.
3. The Consumer to Business (C2B) enables a consumer to determine the price of a product and/or service offered by a company.
4. It reduces the bargaining time and increases the flexibility at sales place for both the merchant and the consumer. For Example, PriceLine.com

The Business Values of the E-commerce

Today most companies are building e-business and e-commerce websites to achieve six major business values-

- Generate new revenues from online sales.
- Reduce transaction costs through online sales and customer support.
- Attract new customers via web marketing and advertising and online sales.
- Increase the loyalty of existing customers via improved web customer service and support.
- Develop new web based markets and distribution channels for existing products.
- Develop new information based products accessible on the web.

E-COMMERCE SECURITY

E-commerce security is the protection of e-commerce assets from unauthorized access, use, alteration, or destruction. It can be measured on the following dimensions.

- Integrity : Prevention against unauthorized data modification
- Authenticity : Authentication of data source
- Confidentiality : Protection against unauthorized data disclosure

- Privacy : Provision of data control and disclosure
- Availability : Prevention against data delays or removal
- Non-repudiation : Prevention against any party from reneging on an agreement after the fact

E-Commerce Threats

Threats may refer to anyone with the capability, technology, opportunity, and intent to do harm. Potential threats can be foreign or domestic, internal or external, state-sponsored or a single rogue element. Details of some threats in e-commerce are as given:

1. Intellectual property threats: Use existing materials found on the Internet without the owner's permission, e.g., music downloading, domain name (cyber squatting), software pirating.

2. Client computer threats: This is about spying software like Trojan horse, or of other computer software attacks like Active contents, Viruses etc.

3. Communication channel threats: It includes Sniffer program, Backdoor, Spoofing, and Denial-of-service, etc.

4. Server threats: It covers Privilege setting, Server Side Include (SSI), Common Gateway Interface (CGI), File transfer, Spamming etc.

Counter Measure

Counter measure is a procedure that recognizes, reduces, or eliminates a threat. Now the counter measure adopted for different type of E-commerce threat are discussed below –

1. Intellectual property protection

- Through Legislature & Authentication

2. Client computer protection

(a) Privacy: Cookie blockers

(b) Digital certificate

(c) Browser protection

(d) Antivirus software

(e) Computer forensics expert

3. Communication channel protection

(a) Use of Encryption

(b) Use of Secure Sockets Layer (SSL)

(c) Use of Secure Hyper Text Transfer Protocol (S-HTTP)

(d) Use of Digital signature

4. Server protection

(a) Access control and authentication

(i) Digital signature from user

(ii) Username and password

(iii) Access control list

(b) Firewalls

Minimizing Security Threats

1. Perform a risk assessment: A list of information assets and their value to the firm.

2. Develop a security policy: A written statement on:

- What assets to protect from whom?
- Why these assets are being protected?
- Who is responsible for what protection?
- Which behaviours are acceptable and unacceptable?

3. Develop an implementation plan: It is a set of action steps to achieve security goals.

4. Create a security organization: An organization or a unit to administer the security policy

5. Perform a security audit: A routine review of access logs and evaluation of security procedures.

SUPPLY CHAIN MANAGEMENT

It can be understood as the integration of key business processes from the supplier to the end customer for the smooth flow of products in the value chain. It is the coordination of all supply activities of an organization from its supplier and delivery of products to its customer. It involves all the parties involved, directly or indirectly, in fulfilling a customer's request. It not only includes the manufacturers, but also suppliers, transporters, warehouses, retailers, and even customers. Each stage in the supply chain is connected through the flow of products, information, and money.

A supply chain is a network of facilities and distribution options that performs the functions of procurement of materials, transformation of these materials into intermediate and finished products, and the distribution of these finished products to customers. Supply chains exist in both service and manufacturing organizations, although the complexity of the chain may vary greatly from industry to industry and firm to firm.

A simple example of Supply Chain may be a very simple supply chain for a single product, where raw material is procured from vendors, transformed into finished goods in a single step, and then transported to distribution centres, and ultimately, customers. Realistic supply chains have multiple end products with shared components, facilities and capacities.

Supply chain management is typically viewed to lie between fully vertically integrated firms, where the entire material flow is owned by a single firm and those where each channel member operates independently. Therefore coordination between the various players in the chain is the key in its effective management. Cooper and Ellram (1993) compare supply chain management to a well-balanced and well-practiced relay team. Such a team is more competitive when each player knows how to be positioned for the hand-off. The relationships are the strongest between players who directly pass the baton, but the entire team needs to make a coordinated effort to win the race.

Role of E-Commerce in a Supply Chain Management

Internet capabilities are having a profound impact on organizations' supply chains. Increasingly, companies are recognizing that the efficient and effective flow of information and materials along their supply chains is a source of competitive advantage and differentiation.

E-supply chain management (e-SCM) is the collaborative use of technology to enhance B2B processes and improve speed, agility, real-time control, and customer satisfaction. It involves the use of information technologies to improve the operations of supply chain activities (e.g., E-procurement), as well as the

management of the supply chains (e.g., planning, coordination, and control). E-SCM is not about technology change alone; it also involves changes in management policies, organizational culture, performance metrics, business processes, and organizational structure across the supply chain. The success of an e-supply chain depends on the following:

1. The ability of all supply chain partners to view partner collaboration as a strategic asset. Tight integration and trust among the trading partners generate speed, agility, and lower cost.
2. A well-defined supply chain strategy. This includes a clear understanding of existing strengths and weaknesses, articulating well-defined plans for improvement, and establishing cross-organizational objectives for supply chain performance. Senior executives' commitment is also essential and must be reflected through appropriate allocation of resources and priority setting.
3. Information visibility along the entire supply chain. Information visibility refers to the information about inventories at various segments of the chain, demand for products, capacity planning and activation, synchronization of material flows, delivery times, and any other relevant information that must be visible to all members of the supply chain at any given time. To enable visibility, information must be managed properly: with strict policies, discipline, and daily monitoring. It must also be shared properly.
4. Speed, cost, quality, and customer service. These are the metrics by which supply chains are measured. Consequently, companies must clearly define the measurements for each of these four metrics, together with the target levels to be achieved. The target levels should be attractive to the business partners.
5. Integrating the supply chain more tightly. An e-supply chain will benefit from tighter integration, both within a company and across an extended enterprise made up of suppliers, trading partners, logistics providers, and the distribution channel

CUSTOMER RELATIONSHIP MANAGEMENT

Customer relationship management (CRM) is an information industry term for methodologies, software, and usually Internet capabilities that help an enterprise manage customer relationships in an organized way. For example, an enterprise might build a database about its customers that described relationships in sufficient detail so that management, salespeople, people providing service, and perhaps the customer directly could access information, match customer needs with product plans and offerings, remind customers of service requirements, know what other products a customer had purchased, and so forth.

CRM has come a long way in a few short years. Today, CRM is the central customer repository for all things "customer". In our age of the distributed workforce, going to the backroom to pull the customer's file from the cabinet is not practical. Further, as multiple people from departments all over your company have the need for direct interaction with the customer, this central customer record is critical. More complex than a rolodex or contact manager, CRM is enabling businesses of all sizes to be more efficient and predictably and thoughtfully service, sell and market to their customers.

According to one industry view, CRM consists of:

- Helping an enterprise to enable its marketing departments to identify and target their best customers, manage marketing campaigns and generate quality leads for the sales team.
- Assisting the organization to improve telesales, account, and sales management by optimizing information shared by multiple employees, and streamlining existing processes (for example, taking orders using mobile devices)
- Allowing the formation of individualized relationships with customers, with the aim of improving customer satisfaction and maximizing profits; identifying the most profitable customers and providing them the highest level of service.

– Providing employees with the information and processes necessary to know their customers understand and identify customer needs and effectively build relationships between the company, its customer base, and distribution partners.

E-Commerce & CRM

In the age of the global economy, customers want to buy your product or service when it is convenient for them. The need to have rich descriptions, images and details about your products online is driven by customer demand. That demand is only half the battle, the customer then wants to be able to instantly purchase that product and of course, get it right away, after all your competitor can offer that to them. Today's e-Commerce solutions have graduated to a level far beyond a simple shopping cart. Customers want the ability to manage all aspects of the purchase and their relationship with you through this means. Perhaps most important to this phenomenon is the experience the customer receives after the order confirmation is complete. Order execution to the customer and if necessary back to you, must be simple, quick and seamless.

Harnessing the power of the Internet to drive a closer relationship with customers should be the goal of every business. Over the last several years, many companies who invested in CRM and E-Commerce technology lost their way as they believed it was an electronic panacea designed to eliminate the need to talk to their customers and orders would just flow in because they had a shopping cart on their website with colorful product images. E-Commerce and CRM are tools designed to learn more about customers, their preferences and a clever way to market and re-market to them. However, most importantly, these tools are and should be a convenience for your customer, not your company.

ELECTRONIC DATA INTERCHANGE

Electronic Data Interchange (EDI) is the computer-to-computer exchange of business documents in a standard electronic format between business partners. Now we will discuss the basic element of the definition of EDI given above

Computer-to-computer exchange: EDI replaces postal mail, fax and email. While email is also an electronic approach, the documents exchanged via email must still be handled by people rather than computers. Having people involved slows down the processing of the documents and also introduces errors. Instead, EDI documents can flow straight through to the appropriate application on the receiver's computer (e.g. the Order Management System) and processing can begin immediately.

The EDI process looks like this: no paper, no people involved:

Business documents: These are any of the documents that are typically exchanged between businesses. The most common documents exchanged via EDI are purchase orders, invoices and Advance Ship Notices. But there are many, many others such as bill of lading, customs documents, inventory documents, shipping status documents.

EDI Exchanges the information in Standard format: Because EDI documents must be processed by computers rather than humans, a standard format must be used so that the computer will be able to read and understand the documents. A standard format describes when each piece of information is and in what from (e.g. integer, decimal, mmddyy). Without a standard format, each company would send documents using its company-specific format and, much as an English-speaking person probably doesn't understand Japanese, the receiver's computer system doesn't understand the company-specific format of the sender's format. There are several EDI standards in use today, including ANSI, EDIFACT, TRADACOMS and XML. And, for each standard there are many different versions, e.g. ANSI 5010 or EDIFACT version D12, Release A. When two businesses decide to exchange EDI documents, they must agree on the specific EDI standard and version. Businesses typically use an EDI translator – either as in-house software or via an EDI service provider – to translate the EDI format so the data can be used by their internal applications and thus enable straight through processing of documents.

Information is exchange between/among Business partners: The exchange of EDI documents is typically between two different companies, referred to as business partners or trading partners. For example, Company A may buy goods from Company B. Company A sends orders to Company B. Company A and Company B are business partners.

BENEFITS OF EDI

It document re-keying

By removing the manual keying of key business documents such as Orders, Invoices, Acknowledgments and Dispatch Notes your company can benefit significantly by:

- Reduced labour costs
- Elimination of human keying errors
- Faster document processing
- Instant document retrieval
- Remove reliance on the postal service

It Eliminate Paper Work

Paper-based transactions have some inherent disadvantages when compared with the electronic transactions:

- Stationery and printer consumable costs
- Document storage costs
- Lost documents
- Postage costs

It Reduce Lead Times and Stockholding

Electronic trading documents can be delivered far more quickly than their paper counterparts, thus the turnaround time from order to delivery can be reduced.

- By using EDI for forecasting and planning, companies are able to get forward warning of likely orders and to plan their production and stock levels accordingly.
- Companies receiving advanced shipping notes or acknowledgments know in advance what is actually going to be delivered, and are made aware of shortages so alternate supplies can be sourced.
- Integrating electronic documents means they can be processed much faster, again reducing lead times and speeding up payments.

It Increase quality of the trading relationship

Electronic trading documents when printed are much easier to read than copies faxed or generated on multi-part stationery by impact printers.

- Accurate documents help ensure accurate supplies.
- Batches of electronic documents are usually sequentially numbered; therefore missing documents can easily be identified, not causing companies to wade through piles of paper.

It gives a Competitive Edge

The organisation which uses EDI gates relatively competitive advantage over the organisation which uses the manual data interchange processes.

ELECTRONIC FUND TRANSFER (EFT)

Electronic funds transfer is one of the oldest electronic payment systems. EFT is the groundwork of the cash-less and check-less culture where and paper bills, cheques, envelopes, stamps are eliminated. EFT is used for transferring money from one bank account directly to another without any paper money changing hands. The most popular application of EFT is that instead of getting a pay-check and putting it into a bank account, the money is deposited to an account electronically. EFT is considered to be a safe, reliable, and convenient way to conduct business.

The advantages of EFT contain the following:

- Simplified accounting
- Improved efficiency
- Reduced administrative costs
- Improved security

Electronic Payment Portal

Payment portal or Payment gateway is an e-commerce application service provider service that authorizes payments for e-businesses, online retailers, bricks and clicks, or traditional brick and mortar. It is the equivalent of a physical point of sale terminal located in most retail outlets. Payment gateways protect credit card details by encrypting sensitive information, such as credit card numbers, to ensure that information is passed securely between the customer and the merchant and also between merchant and the payment processor.

The Benefits of Electronic Payments

1. **Speed**: Sending cash or cheques by post for goods is slow, and has security and currency conversion implications.
2. **Convenience**: Electronic payments ensure that your store is open for business globally, 24-hours a day, seven days a week.
3. **Efficiency**: The following points contribute to its efficiency.
   (a) Electronic payment systems leave behind an electronic documented audit trail, streamlining your auditing and accountancy processes.
   (b) Bank wires are cumbersome and expensive.
   (c) Accepting payments online streamlines the buying cycle. By making your order, stock, purchase, payment and dispatch processes electronic, from website to back office, you don't have to re-key order data.
   (d) Shopping site software can be easily integrated with popular back office packages, such as Sage, to automate ordering, stock control, invoicing and accounting systems.
4. **Reduced costs**: Accepting online payments means that many banking processes become automatic.
5. **Increased customer base**: Online payments take advantage of impulse buyers. 95 per cent of electronic purchases are by credit card. If your website doesn't offer payment by credit cards as an option, you could lose out on this market

MOBILE COMMERCE

M-commerce is a term that is used to refer to the growing practice of conducting financial and promotional activities with the use of a wireless handheld device. The term m-commerce is short for mobile commerce, and recognizes that the transactions may be conducted using cell phones, personal digital assistants and other

hand held devices that have operate with Internet access. While still in its infancy, the concept of m-commerce has been refined in recent years and is beginning to become more popular.

It is quite different from traditional e-Commerce. Mobile phones impose very different constraints than desktop computers. But they also open the door to a slew of new applications and services. They follow you wherever you go, making it possible to look for a nearby restaurant, stay in touch with colleagues, or pay for items at a store.

Key Components of M-commerce Applications

- Mobile storefront modules are an integral part of m-commerce apps, where all commodities and services are categorized and compiled in catalogues for customers to easily browse through the items on sale and get essential information about the products.
- Mobile ticketing module is an m-commerce app component that is closely linked to promotional side of commercial business and enables vendors to attract customers by distributing vouchers, coupons and tickets.
- Mobile advertising and marketing module empowers merchants to leverage m-commerce channels in order to manage its direct marketing campaigns, which are reported to be very effective especially when targeted at younger representatives of digital information consumers.
- Mobile customer support and information module is a point of reference for information about a particular retailer, its offerings and deals. The news about the company, current discounts, shop locations and other information is either pushed to users' m-commerce apps or can be found in m-commerce app itself.
- Mobile banking is inextricably linked to selling process via m-commerce apps, because no purchase can be finalized without a payment. There are various options for executing mobile payments, among which are direct mobile billing, payments via sms, credit card payments through a familiar mobile web interface, and payments at physical POS terminals with NFC technology.

Characteristics of Mobile Commerce

1. Fast Processing: One important characteristic of mobile commerce is that it allows the user to process a transaction fast. Not only does the customer receive his item almost instantly via download, e-mail or another form of electronic delivery, the business owner receives payment for his product or service more quickly compared to traditional methods. The customer must set up a payment option, such as a credit card or an agreement to pay using a specified account, to process the payment immediately before downloading the item. Of course, the speed of delivery is dependent on the reliability of the Internet and network services.

2. Reduced Business Costs: Mobile commerce also helps reduce costs for the seller. She rarely needs to pay for a separate office space, overhead costs or employees. In some cases a small business owner who sets up a mobile commerce operation doesn't need an office at all. The seller can monitor sales online or by receiving statements from a processing service. The main expense for this type of business owner is advertising to disseminate information on how users can access the product or service. The lowered cost allows the business owner to take advantage of a higher per-sale profit. He also can offer the product at a lower price compared to delivery in other formats.

3. Little Need for Maintenance: Another characteristic of mobile commerce is that it requires very little maintenance from the seller. The owner sets the product up for mobile delivery one time and then receives payment for sales automatically. From time to time, he may need to perform a few maintenance duties, such as correcting a technology error or updating the product, but overall it is a selling format that requires very little management compared with other selling strategies.

Note – They follow whenever you go principle.

Supporting Technologies of M-commerce

Supporting technologies for m-commerce includes the following:

1. Network Technology: Data is transmitted via mobile telecommunication network which may be 2G, 3G or wireless network like Wi-Fi and Bluetooth etc.
2. Mobile Phone: These are end user devices which may be smart phones, PDAs etc. Each device has certain characteristics like memory, network connectivity, bandwidth etc. that influences its usability.
3. Payment Mechanisms: m-payment mechanisms are used for m-commerce. They facilitate payments over mobile network.

Future of M-commerce

The most prominent m-commerce trend is its own growth. According to Forrester, annual m-commerce sales are predicted to quadruple to $31 billion in the next five years. In 2012, some ecommerce sites (like Amazon) saw remarkable growth, while most businesses experienced only limited m-commerce success. However, one thing they all have in common is that they now universally recognize m-commerce as an important way to enhance their brand, increase their sales and keep up with competitors. In short, the future of m-commerce is bright, and looks like it's getting even brighter.

Another trend in m-commerce is that customers desire more information on mobile websites. Studies show that 80% of smart phone users want more product information when shopping on their mobile devices. A large part of m-commerce's appeal may be convenience, but if that convenience comes at the sacrifice of information, customers will be sure to look elsewhere. The larger trend here is that ultimately, businesses are in uncharted waters when it comes to their mobile offerings, they're still finding out what works and what doesn't.

BLUETOOTH

Bluetooth allows two devices to be connected to each other wirelessly. The most common use of Bluetooth technology is in hands-free devices such as headsets used with mobile phones. Bluetooth technology can also be used to transfer data between two electronics devices without using wires.

Bluetooth was invented in 1994 by Ericsson. The company later started working with a larger group of companies called the Bluetooth Special Interests Group, or "SIG," to develop the technology into what it is today. Bluetooth is not owned by any one company and is developed and maintained by SIG. The name Bluetooth came from a code name originally used by SIG for the project and is a reference to a 10th century Danish king named Harold Bluetooth, who was responsible for uniting Norway, Sweden, and Denmark.

Bluetooth technology was designed primarily to support simple wireless networking of personal consumer devices and peripherals, including cell phones, PDAs, and wireless headsets. Wireless signals transmitted with Bluetooth cover short distances, typically up to 30 feet (10 meters). Bluetooth devices generally communicate at less than 1 Mbps.

Features of Bluetooth Technology

Bluetooth technology uses radio waves to send information between two devices that are close to each other. Unlike traditional radio waves, Bluetooth waves typically can only travel 33 feet or less. Bluetooth networks feature a dynamic topology called a piconet or PAN. Piconets contain a minimum of two and a maximum of eight Bluetooth peer devices. Devices communicate using protocols that are part of the Bluetooth Specification.

Uses of Bluetooth Technology

Bluetooth is used is mobile phones, headsets, headphones, MP3 players, computers, boom boxes, laptops, computer mice, GPS units, and car stereos. Almost any Bluetooth device can be paired with another Bluetooth device in order to exchange information.

Benefits of Bluetooth Technology

Bluetooth technology enables two devices to be connected together wirelessly, eliminating the clutter and

confusion typically associated with wires. Bluetooth can be used to allow users to make hands-free calls using their mobile phone and headset or speakerphone in their ear car. Bluetooth can also be used to connect a computer mouse to home computers, headphones to MP3 players, digital cameras to printers, and it can wirelessly send data from your computer to another device.

WI-FI

Wi-Fi is the name of a popular wireless networking technology that uses radio waves to provide wireless high-speed Internet and network connections. A common misconception is that the term Wi-Fi is short for "wireless fidelity," however this is not the case. Wi-Fi is simply a trademarked term meaning IEEE 802.11x.

The Wi-Fi Alliance, the organization that owns the Wi-Fi (registered trademark) term specifically defines Wi-Fi as any "wireless local area network (WLAN) products that are based on the Institute of Electrical and Electronics Engineers' (IEEE) 802.11 standards.

How Wi-Fi Works?

Wi-Fi works with no physical wired connection between sender and receiver by using radio frequency (RF) technology, a frequency within the electromagnetic spectrum associated with radio wave propagation. A wireless network uses radio waves, just like cell phones, televisions and radios do. In fact, communication across a wireless network is a lot like two-way radio communication. Here's what happens:

- A computer's wireless adapter translates data into a radio signal and transmits it using an antenna.
- A wireless router receives the signal and decodes it. The router sends the information to the Internet using a physical, wired Ethernet connection.

The process also works in reverse, with the router receiving information from the Internet, translating it into a radio signal and sending it to the computer's wireless adapter.

Features of Wi-Fi

WiFi has brought a new aspect in the ground of networking. The broadcast of data is completed via radio waves and the cost of cables for network lying down. Wi-Fi enables a user to get access to internet anywhere in the given location. Now you can make a network in Hotels, Libraries, colleges, universities, campus, private institutes, and coffee shops and even on a public place to make your business more profitable and connect with their client any time. Wi-Fi makes waves for business with their highly effective cable less media.

LESSON ROUND-UP

- The Internet is a global system of interconnected computer networks that use the standard Internet protocol suite (TCP/IP) to serve billions of users worldwide. It is a network of networks that consists of millions of private, public, academic, business, and government networks, of local to global scope, that are linked by a broad array of electronic, wireless and optical networking technologies.
- The World Wide Web (abbreviated as WWW commonly known as the web), is a system of interlinked hypertext documents accessed via the Internet. With a web browser, one can view web pages that may contain text, images, videos, and other multimedia, and navigate between them via hyperlinks
- A Web-browser is a piece of software that acts as interface between the user and inner workings of the internet specifically the World Wide Web
- Web addresses refers to particular pages on a web server which are hosted by company or organisation.
- Intranet refers to a private network which uses Internet technology and is designed to meet the internal

information needs of the employees. It is accessible only by authorised employees, contractors and customers

- Extranet refers to private network which operates similarly to an intranet but is directed at customers or suppliers rather than at employees. Extranet provides information customers need such as detailed product description, frequently asked questions about different products, offices maintenance information warranties and how to contact customer service and sales office
- Electronic Mail is the abbreviated form of acronym e-mail. It is one of the most important applications of internet. Electronic mail (E-mail) is a fast and efficient method to exchange messages and other data
- The Internet Protocol (IP) is the method or protocol by which data is sent from one computer to another on the Internet. Each computer (known as a host) on the Internet has at least one IP address that uniquely identifies it from all other computers on the Internet.
- Electronic commerce or ecommerce is a term for any type of business, or commercial transaction that involves the transfer of information across the Internet. It covers a range of different types of businesses, from consumer based retail sites, through auction or music sites, to business exchanges trading goods and services between corporations. It is currently one of the most important aspects of the Internet to emerge. It is basically classified as
  1. B2B or Business to Business refers to electronic commerce between businesses and also supplies chain technology, which is the largest and most successful e-commerce technology nowadays.
  2. B2C or Business to Consumer refers to selling and buying of goods and services via the web.
  3. C2C or Consumer to Consumer refers to online dealing of goods and services between people.
  4. C2B or Consumer to Business is growing trend where consumers demand specific products or services from respective businesses by presenting themselves as a buyer group.
- A supply chain is a network of facilities and distribution options that performs the functions of procurement of materials, transformation of these materials into intermediate and finished products, and the distribution of these finished products to customers
- E-supply chain management (E-SCM) is the collaborative use of technology to enhance B2B processes and improve speed, agility, real-time control, and customer satisfaction. It involves the use of information technologies to improve the operations of supply chain activities (e.g., e-procurement), as well as the management of the supply chains (e.g., planning, coordination, and control)
- CRM (customer relationship management) is an information industry term for methodologies, software, and usually Internet capabilities that help an enterprise manage customer relationships in an organized way
- Electronic Data Interchange (EDI) is the computer-to-computer exchange of business documents in a standard electronic format between business partners.
- Electronic funds transfer is one of the oldest electronic payment systems and used for transferring money from one bank account directly to another without any paper money changing hands.
- M-commerce is a term that is used to refer to the growing practice of conducting financial and promotional activities with the use of a wireless handheld device.
- Bluetooth allows two devices to be connected to each other wirelessly. The most common use of Bluetooth technology is in hands-free devices such as headsets used with mobile phones. Bluetooth technology can also be used to transfer data between two electronics devices without using wires.

– Wi-Fi is the name of a popular wireless networking technology that uses radio waves to provide wireless high-speed Internet and network connections.

SELF-TEST QUESTIONS

(These are meant for re-capitulation only. Answers to these questions are not to be submitted for evaluation)

1. What do you mean by the term 'Internet'? State its basic applications.
2. What are the term internet and intranet? Are these the same? Discuss.
3. What is the mechanism being used by many communication to communicate with its suppliers/ customers? Discuss and state its difference with internet.
4. What are the differences between 'Internet' Intranet' and Extranet? Explain.
5. What do you mean by electronic mail? State its basic features.
6. What do you mean by the term www? State its basic features and differences with internet.
7. What do you mean by 'Internet Protocols'? State its basic characteristics.
8. What do you mean by e-commerce? State its various features.
9. Explain about different classifications of e-commerce.
10. Explain the application of e-commerce in supply chain management and customer relationship management.
11. What do you mean by the term e-security? Explain different dimensions of e-security and how to check the security threats.
12. What do you mean by EDI? State its characteristics and advantages.
13. What is 'e-payment portal'? What are the benefits of electronic payment?
14. What do you mean by the acronym 'EFTS'? Explain its basic features, advantages and security issues.
15. What do you mean by the term 'M Commerce'? Discuss about is future prospective.
16. Explain supporting technologies of m-commerce.
17. Write short note on Bluetooth and Wi-Fi applications.

Lesson 8
Management Information Systems – An Overview

LESSON OUTLINE

- MIS Concepts
- Evolution of MIS
- Structure of MIS
- Characteristics of MIS
- Myths about MIS
- Computerized MIS
- Approaches to MIS Development
- Pre-requisites of an Effective MIS
- Impact of MIS on different levels of corporate management
- Constraints in operating MIS
- Limitation of MIS
- Miscellaneous Information Systems
- Entrusting MIS in a Corporate Enterprise
- Artificial Intelligence
- Expert system

LEARNING OBJECTIVES

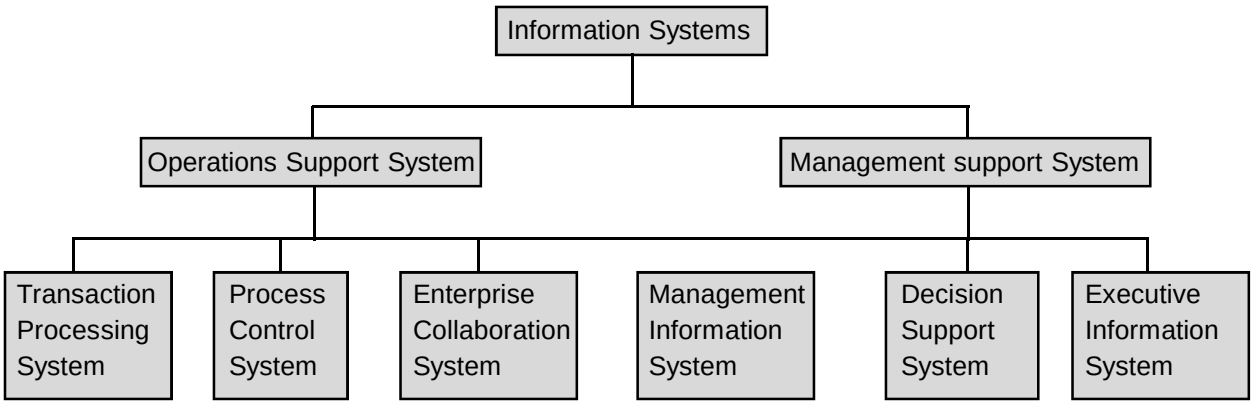
In present business scenario, specific, correct, integrated, reliable information is vital for success for an organisation. The success of a business decision depends on the reliability and correctness of the information. Management Information System provides the necessary information to different levels of management as per their specific needs. After going through this lesson, students will be able to

- Understand the basics of MIS: concepts, evolution, and characteristics.
- Understand the MIS requirements of different levels of management
- Review the MIS system of an organisation with respect to its appropriateness for the organisation
- Understand the basics of decision support system, artificial intelligence and expert system and their relation with MIS.

The objectives of an effective Management Information System (MIS) is providing Right Information to the right person at the right place at the right time in the right form at the right cost.

MIS CONCEPTS

Executives in an organization provide leadership and direction for planning, organizing, staffing, supervising, and controlling business activities. Each of these business activities involves decision making process. For making decisions, executives need the information. The required information is to be provided by information specialist or by data processing department. With the increasing competition in the era of information economy, the demands for organized, need base information is increasing day by day. Depending on the hierarchy the information need differs, accordingly different types of information systems are required. To achieve this goal, different types of information systems are devised. The MIS is derived from these information systems used in the organizations A classification of various information systems is shown in the figure below. Through there are other information systems that also exists.



As it is shown MIS basically a part of information systems family. It is a pre specified reporting system for managers. It provides information to the managers in the form of routine reports. The main purpose of MIS is to provide timely, specific and accurate information at all levels in an organization. It is a broad concept rather than the single system. Some MIS activities are highly integrated with routine data processing, while other MIS applications are designed for a particular knowledge work activity or decision making function.

Major postulates of Management Information Systems are:

1. Information form of a MIS is periodic, exception and based on demands.
2. Information formats are pre-specified and fixed.
3. Information is provided by extraction and manipulation of operational data.
4. It provides information about the performance of the organization.
5. It supports the intelligence and implementation stages of decision making.
6. It supports structured decisions for operational and tactical planning and control.

Requirements of MIS

In a technology bound society, companies rely on management information systems (MIS) to provide data to make business decisions. Management information systems are designed to support the complete computing system in a company. This includes software systems, databases, hardware resources, project applications…any computerized process used to help a company function efficiently.

Managers use management information systems to gather and process large amounts of data to analyze where the company has been and forecast where the company is going. Management information systems are vital for

production/operations management and supply chain management decisions. Management information systems professionals may specialize in systems analysis, database design, application or maintenance programming, networking, project management, telecommunications, electronic commerce and web development.

There are three levels of information requirements for designing an MIS. They are:

- At the organizational level, information requirements define an overall structure for the information system and specific applications and database.
- Application level requirements include social or behavioural - covering work organization objectives, individual roles and responsibility assumptions, and organizational policies - and technical, which are based on the information needed for the job to be performed. A significant part of the technical requirement is related to outputs, inputs, stored data, structure and format of data and information processes.

At the user level, database requirements can be classified as perceived by the user or as required for physical design of the database.

A well-defined MIS provides information to all levels of management for the following purpose.

- To report the organization performance to tax authorities, shareholders, regulatory authorities and other stakeholders such as suppliers and customers etc.
- To prepare future plans for short and long term basis.
- To exercise day-to-day control on various operations in the different functional areas in the organization.
- To allocate different type of resources to different functional areas.
- To allow management by exception.
- To develop database of business partners and to devise procedures to deal with them.
- To develop the training tools for the new recruits in the organization at all levels.

EVOLUTION OF MIS

The MIS represents the electronic automation of several different kinds of counting, tallying, record-keeping, and accounting techniques of which the by far oldest, of course, was the ledger on which the business owner kept track of his or her business. Automation emerged in the 1880s in the form of tabulating cards which could be sorted and counted. These were the punch-cards still remembered by many: they captured elements of information keyed in on punch-card machines; the cards were then processed by other machines some of which could print out results of tallies. Each card was the equivalent of what today would be called a database record, with different areas on the card treated as fields. World-famous IBM had its start in 1911; it was then called Computing-Tabulating-Recording Company. Before IBM there was C-T-R. Punch cards were used to keep time records and to record weights at scales. The U.S. Census used such cards to record and to manipulate its data as well. When the first computers emerged after World War II punch-card systems were used both as their front end (feeding them data and programs) and as their output (computers cut cards and other machines printed from these). Card systems did not entirely disappear until the 1970s. They were ultimately replaced by magnetic storage media (tape and disks). Computers using such storage media speeded up tallying; the computer introduced calculating functions. MIS developed as the most crucial accounting functions became computerized.

Waves of innovation spread the fundamental virtues of coherent information systems across all corporate functions and to all sizes of businesses in the 1970s, 80s, and 90s. Within companies major functional areas developed their own MIS capabilities; often these were not yet connected: engineering, manufacturing, and inventory systems developed side by side sometimes running on specialized hardware. Personal computers (“micros,” PCs) appeared in the 70s and spread widely in the 80s. Some of these were used as free-standing “seeds” of MIS systems serving sales, marketing, and personnel systems, with summarized data from them transferred to

the “mainframe.” In the 1980s networked PCs appeared and developed into powerful systems in their own right in the 1990s in many companies displacing midsized and small computers. Equipped with powerful database engines, such networks were in turn organized for MIS purposes. Simultaneously, in the 90s, the World Wide Web came of age, morphed into the Internet with a visual interface, connecting all sorts of systems to one another.

Midway through the first decade of the 21st century the narrowly conceived idea of the MIS has become somewhat fuzzy. Management information systems, of course, are still doing their jobs, but their function is now one among many others that feed information to people in business to help them manage. Systems are available for computer assisted design and manufacturing (CAD-CAM); computers supervise industrial processes in power, chemicals, petrochemicals, pipelines, transport systems, etc. Systems manage and transfer money worldwide and communicate worldwide. Virtually all major administrative functions are supported by automated system. Many people now file their taxes over the Internet and have their refunds credited (or money owning deducted) from bank accounts automatically. MIS was thus the first major system of the Information Age. At present the initials IT are coming into universal use. “Information Technology” is now the category to designate any and all software-hardware-communications structures that today work like a virtual nervous system of society at all levels.

As far as its evolution is concerned it can be linked with the following disciplines –

Management Accounting

The field of accounting consists of two major areas, i.e. financial accounting and management accounting. Financial Accounting is concerned with measurement of income for specific periods of time such as month or a year and the reporting of financial status at the end of the period. The first one is known as an income statement and other one as balance sheet. Though it is very important to see the status of finances but these two statements are of limited use as far as managerial decision making is concerned. In fact these statements are more relevant to the investors. The other branch of accounting, i.e., Management Accounting deals with relevant costs end other analysis useful for managerial control and managerial decisions. It employs techniques such as capital budgeting, break even analysis, transfer pricing etc. Its focus is on the preparation of budgets and measurement of performance based on the budgets. It is oriented towards internal controls and management decisions. Historically, accounting department was always responsible for data processing because the first application of processed data was related to accounting function. Management accounting information was used to carry analysis, to identify specific information requirement of executives for performing their functions in their respective departments. For example, to determine the break-even point, the information requirements are fixed costs, variable cost and the selling price of the product. To find out economic order quantity one needs to know carrying cost, holding cost, product demand for the year and purchasing cost/order cost.

These set of information are always a part of MIS, therefore the birth of MIS can be traced to management accounting. However, the support systems which provide users with access to data and models are beyond the scope of traditional management accounting.

Management Science/Operational Research

Management Science/Operational Research is the application of scientific method and quantitative analysis techniques to management problems. The use of management science methods emphasizes on the use of systematic approach to problem solving and application of scientific method to investigation. It utilizes mathematical models and mathematical and statistical procedures for analyzing problems. Finally, it aims at achieving optimal decision.

Management Science techniques were incorporated in the Decision Support System (DSS) which is a component of MIS, to make quantitative and analytical information available to the users of MIS. The information systems (DSS) make use of models, and computer based solution algorithms. In addition, these systems provide quantitative information and procedures to facilitate model building for future plans and activities and to simulate the real situation even before they occur.

Management and Organization Theory

MIS is a support system for organizational functions; therefore, it draws upon concepts of organization, organization behavior, management, and decision making. The field of management and organization theory has provided many important concepts and philosophies which are key to understand the functions of MIS. Some of these concepts are:

- Behavioural theory of organizational and individual decision-making.
- Individual motivation.
- Group processes and group decision making.
- Leadership techniques.
- Organizational change process.
- Organizational structure and design.

There are several management theories-behavioural, empirical, decision, quantitative and management process. Out of these, decision, quantitative and management process are more relevant to us. According to decision theory, the most important task of managers is to make decisions.

The second theory known as "Management Process" is the most widespread approach of management. Under this, management is defined in terms of what managers do. According to this, management performs the functions of planning, organizing staffing, directing and controlling.

The knowledge of these management theories enabled the MIS designers to ascertain the type of decisions made and functions performed by executives in business organizations.

Computer Science

Computers were not originally planned for processing information but today this is the major use for which they are applied in business situations. The reasons for this are their speed of processing, calculating and retrieval of data. In fact, computer technology has been considered as a major factor in inducing MIS development. It has come as a significant tool in information processing and storage.

From the above discussion, it is quite apparent that MIS has been evolved from various disciplines in management. It maintained and provided the necessary information to its executives for planning, controlling and decision-making purposes. For example, control of inventory is an important management function. At the time when no integrated MIS was in use, perhaps the Inventory In-charge managed the function based on the information emanating from his department like the information that certain items have been exhausted or are nearing exhaustion. He would then have taken steps to replenish the stocks in the usual manner. However, with the development, the information which he needs now includes-cost of maintaining inventories, purchase schedule, economic order quantities, lead time, rate of consumption, etc.

In this approach of integrated MIS, management theories and specially the financial management concepts have contributed the enrichment. Further, when one has to manage a very large number of inventories here, he takes the aid of computer.

ELEMENTS OF MIS

MIS is a system that helps management in the process of decision making. The three elements of MIS are Management, Information and System. It is necessary to understand these three components:

Management

The term "Management" as defined by Marry Follett is "The art of getting things done through people" It also

refers to a set of functions and processes designed to initiate and coordinate group efforts in an organized setting, directed towards promoting certain interests, preserving certain values and pursuing certain goals. It involves mobilization, combination, allocation and utilization of physical, human and other needed resources in a judicious manner by employing appropriate skills, approaches and techniques. It is a process of conceiving and converting certain worthwhile ideas into results by getting things done through people by offering them monetary and other inducement in return for their contributions.

In short "Management" may be thought of as the sum total of these activities which relate to the laying down of certain plans, policies and purposes, securing men, money, materials and machinery needed for their goal achievements; putting all of them into operation, checking their performance and providing material rewards and mental satisfaction to the men engaged in the operation.

Information

It is a source for increment in knowledge. In MIS, it is obtained by processing data in to a form meaningful to the users. To illustrate, the concept, let us discuss the following situations; if somebody throws the word eleven during discussion, it means nothing to the participant. It is a data item, but it is placed within a context familiar to the intended recipient. Let us analyze another situation, if a manager is asking a question, "What are the sales of the packaged goods by marketing department and projection for the next quarter?" The answer would be 11 only. Here, it is information not the data item since the number 11 is being used in a context.

System

A physical system is a set of components that operate together to achieve a common objective or multiple objectives. These objectives are realized in the outputs of the system. An efficient system uses its inputs economically in producing its outputs. An effective system produces the outputs that best meet the objectives of the system. MIS can be thought of as a system (set of hardware, software, manpower, procedures, etc) to provide timely and accurate information to the management users in an organisation. The objective of the management information system is to provide formal informational support to the members of the organization.

STRUCTURE OF MANAGEMENT INFORMATION SYSTEM

Management Levels and their information needs

The levels of management consist of top, middle, and first line management (supervisory). The activities in the organizations are of three types:

- Strategic planning,
- Tactical and
- Operational.

Each of these levels to perform - strategic planning, tactical, and operational activities requires different set of information. The activities and information needs of three levels of management are illustrated in the following.

1. Top level (Strategic level) Management and their information requirements

Top management is defined as a set of management positions, which are concerned with the overall tasks of designing directing and managing the organization in an integrated manner. They are responsible for interacting with representatives of the external environment, such as financial institutions, political figures, and important clients of the organization.

The structure of top level normally consists of Chairman and members of the Board of Directors, Chief Executive Officer and the heads of the major departments of the company. In fact, this level consists of those executives,

whose responsibilities relate to the whole organization or in other words, they are accountable for effectiveness and efficiency of the operations of the organization as a whole.

Top management's main responsibility is in the direction of determining the overall goals and objectives of the business. It deals mainly with long-term strategic plans, policy matters and broad objectives of the company. Also, it establishes a budget framework under which the various departments will operate.

Top management needs the information on the trends in the external environment (economic, technological, political and social) and on the functioning of the internal organizational sub-system. Apart from historical information, top management requires on-going or current information also which is generated through forecasts of the future. Thus, mostly the information utilized by top management is futuristic and external in nature. Much of the information so generated for strategic planning purpose tends to be incomplete and not fully reliable. It may not be available on time. For control purposes, top management receives summary and "exception reports" (For example on production, sales, cash, profits, and so on) from the middle management. The distinction between strategic planning information requirement and tactical information requirement is not always clear because both systems use some of the common information.

Characteristics of Information required for Strategic Planning

1. Ad hoc Basis: The information may be produced either regularly or periodically. For example, top management uses periodic accounting system reports such as the income statement, balance sheet, statement of sources and uses of funds, and capital statements in its planning functions. However, strategic planning information is more often produced when it is needed, on an ad hoc basis.

2. Unexpected Information: The information produced by the system may not be the same that was anticipated. For example, economic forecast information may be requested for the economy as a whole and for the industry in particular. The result of the economic forecast may be a surprise to the organization planners.

3. Predicted nature: The information produced is usually predictive of the future events rather than descriptive of past events. Long range planners try to set a course for an organization through an uncharted future. Their primary task is to choose a route that will improve the organization's level of success.

4. Summary Form: The information produced is usually not detailed but in summary form. Long range planners are not usually interested in detailed information; they are concerned with more global data. For example strategic planners may not be interested in the customer invoices but overall buying trends for their product vis-à-vis the product of the competitors.

5. External Data: A large part of data used for input to the system is acquired from the external sources. To mention, rate of borrowed capital, investment opportunities, demographic characteristics of a market group, and economic conditions etc. and the example of this type of information.

6. Unstructured format**:** The data used for input to the system may contain data that are unstructured in format. For example: forecasts of future stock market trends may be using the opinions of stock buyers, sales people, or market analysts obtained in casual conversations.

6. Subjectivity: The input to the system may be highly subjective in nature.

2. Middle level (Tactical level) Management and their Information Needs

Middle level management is defined as a group of management positions, which tend to overlap the top and supervisory management levels in the hierarchy. Middle management positions consist of heads of functional departments and chiefs of technical staff and service units. Middle management, therefore, includes such people as the Manager of Sales, the Manager of Purchasing, Finance Manager, and the Manager of Personnel etc.

Middle management may be viewed as "administrative" management in the sense that it is responsible for the elaboration, classification and operationalization of organization goals, strategies and policies in terms of action

programmes and norms of performance. Middle management is concerned with the task of formulating pragmatic operating policies and procedures for the guidance of supervisory management.

The nature of information required at the middle management level is less diverse and complex. Middle management is fed with information both from top management and supervisory management. Much of the information used by the middle management is internal in nature. Middle management does not require much "futuristic" information since its decisions are not strategic and long range in nature. For example, the information needs of a sales managers are: corporate sales goals and targets, strategies and policies for operatinalising them. They also needs information on sales potential and trends in different market segments, geographical territories, competitive conditions and so on. Further, they needs information on weekly sales turnover from different zones and for different products, customer complaints, delay in dispatches, finished goods inventory position and the like for the purposes of control. Tactical Information Systems are designed to generate a variety of reports, including summary reports, exceptional reports, and ad hoc reports, etc.

Characteristics of Information required for Tactical Planning

1. Predictive Nature: The information from a tactical system is sometimes produced periodically. For example, a branch credit manager for an organization may receive a weekly report showing the total dollar amount of accounts that are more than 60 days overdue, 90 days overdue, and in hands of a collection agency. The report might compare the three amounts with the same data from other branches of the organization. The same data can be compared for different time periods may be this year and last two years to see the trends. Based on this information, credit manager can decide whether the overdue account totals are within the normal range for the branch or whether the difference between the amounts warrants special managerial action or decisions. Thus, this information system provides the means by which the credit manager can quickly identify problems and bring them under control. On the other hand, tactical information systems can produce information when it is needed on ad hoc basis.

2. Unexpected Findings: The information provided by a tactical information system may not be the information that was expected to be produced. For example: querying an accounting system database, a manger can find the characteristics of major customer related to credit difficulty. It may have relation with customer position and type of employer. Investigation may reveal that overdue problem is with those customers whose employer had a cut in its workforce. The unemployment of these customers is creating an overdue problem. As a credit agency, it has to analyze the purchasing of these customers as a fresh.

3. Comparative Nature: The information produced is usually comparative in nature rather than merely descriptive. They provide managers with information that alerts them to major variation from the accepted standards. These types of information systems are similar to the control process systems that monitor output of the system continuously and provide feedback when output parameters are at variance with accepted standards.

4. Summary Form: The information produced is not detailed but is in summary form, however, in comparison to the strategic planning systems, it may be more elaborate. For example: a credit manager is not interested in a detailed listing of each customer account and its balance. In large organizations, there would be an enormous quantity of data and would not, therefore, be information to the manager. The manager needs information relating to credit performance or balances of accounts that are overdue or in collection.

5. Both External and Internal Sources: The data used, as input to the system may not always confine to sources internal to the organization. It may be from external sources also. For example: the credit manager may compare the information pertaining to problems to other branches, to other periods from the same organization, or to a goal set up by top management. The credit manager may like to compare sometimes it with the experience of the whole industry.

Supervisory level (Operational level) Management and their Information Needs

Supervisory management is defined as a team of management positions at the base of the hierarchy. It consists

of section officers, office managers and superintendents, foreman and supervisors who are directly responsible for instructing and supervising the efforts of rank and file, clerical and "blue-collar" employees and workers. Supervisory management is also called operation management" in the sense that it is concerned with implementing operational plans, policies and procedures for purposes of conversion of inputs into outputs. At the supervisory level, managers are responsible for routine, day-to-day decision and activities of the organization, which do not require much judgement and discretion. The function and process of the supervisory management are standardized as far as possible. The perspective of supervisory management is generally short-range and insular. It functions in a relatively closed environment.

Supervisory management mostly needs internal information on operational aspects of the functioning of activity units. It in fact, generates internal information for example, on purchase and sales, production, use of inputs etc. at the operating level. It also receives information from the middle management levels on operational plans and programmes. The nature of information is routine and structured. It tends to be reliable and relatively complete. There is little element of complexity of uncertainty involved in the information.

Characteristics of Information required for Supervisory Planning

1. Repetitiveness: The information produced by these systems is usually repetitive in nature at periodic intervals such as daily, weekly, or monthly.

2. Predictability: The information they produce usually does not contain any surprises for the manager or the users of the information. These systems produce results at the expected time. For example: People are paid by the system what they are expected to be paid and customers are billed for what they purchased.

3. Emphasis on the past: The information generated by the systems usually describes the past. For example: payroll accounting systems describes the work done by the employees in the past for which they are being paid. Invoices describe past sales to customers.

4. Detailed nature: The information produced is very detailed. To mention, as an example, pay-checks provide detailed information on the work week of each employee along with all allowances and deductions. Customer invoices describes the details of purchases.

5. Internal origin: The data for operational system usually spring entirely from internal sources. That is data for pay-checks come from internal documents of the organization.

6. Structured form: The form of the data input and the form of the output produced by the operational information systems is structured. That is the data on time cards are carefully formatted in identical fashion on each. Or the data on each customer invoice are carefully formatted in identical fashion.

7. Great accuracy: The accuracy of the data used as input to such systems and of the output produced by such systems is usually very high. The data input and information output are carefully checked in a variety of ways.

Comprehensive Structure of MIS

The structure of a MIS is known as comprehensive if it possesses the following characteristics:

- It should be closely directed by management.
- It should integrate various sub-systems of the management.
- It should avoid duplication and redundancy of data.
- It should make the dissemination of information an effective one.
- It should be capable of meeting the information requirement of managers at different functions.

Taking into consideration the above characteristics, the suitable structure of a comprehensive MIS may be a federation of information sub-systems for different functions, viz. production, material management, marketing,

finance, engineering and personnel. Each sub-system of information system is supposed to provide information support to executives for operational control, management control and strategic planning.

The MIS structure can be described in terms of support for decision making, management activity, and organizational functions. These three approaches are synthesized into MIS structure.

MIS is nothing but a conceptual framework that allows one to describe an existing or planned information system. Physical structure defines the way of implementing the MIS. Both the structures are described here.

Conceptual Structure of MIS

It is defined as a federation of functional units, each of which embedded with four major information processing components: Transaction processing, operational control information system support, managerial control information system support, strategic planning information system support. Each of the subsystem of the information system has some unique data files, which are used only by that subsystem. There are files that need to be accessed by more than one application and need to be available for general retrieval. These files are organized in the form of a database, which is managed by the data base management system.

A further amplification of the structure is the introduction of common software. In addition to application programs written especially for each subsystem, there are common applications, which serve multiple functions. Each subsystem has linkages to these common applications. Severals models are available which can be used by many applications.

The information requirement of executives for operational control, management control and strategic planning itself depend upon-operational function, level of management activity and type of decision-making. Different operational functions have different information requirements. Their information requirements vary not only in content but in characteristics as well.In fact, the content of information depends upon the activities to be performed under an operational function. Also an operational function influences the characteristics which a particular information must possess. For example, the information used for preparing employees payroll by the accounts department should be highly accurate.

The level of management activity too influences the characteristics of information. For example, strategic planning requires more external information and information on the behavior of relevant and likely future events. Management control requires more accurate, precise, current and repetitive information. Operational level requires information in detailed form about the performance.

The information or data requirements of each sub-system can be met by developing two types of data files, viz., unique and common. Unique data files may meet the specific information requirements of each operational function at different level of management activity for making programmed and non-programmed decisions. Common data file, stores data/information meant for general use in the decision-making process. The data stored in the data files is usually in the raw form and thus, requires processing. Processing of data may be performed by using softwares and decision models kept under model base. The use of data, in database may be controlled by Data Base Management System.

A conceptual make up of MIS is basically the visualization of all discussed sub systems their data requirements, processing, to allow a smooth generation and flow of information as required by different users.

Physical Structure of MIS

The physical structure of an MIS is the application of all the conceptual development for the purpose. It is identical to the conceptual structure in the sense that conceptual structure works on a theoretical plane while physical system works on an empirical plane.

Integrated processing of data is required for achieving MIS goals. Physical execution is achieved by designing several related applications as a single system in order to simplify the interconnections and reduce duplication

of input. A good example is an order entry system. The recording of an order initiates a sequence of processing, each step using new data but also much of the data from processing. A large number of documents and reports are prepared from the initial entry of the order plus later entry of actual quantity shipped, freight, amounts received on account, and returns and allowances. An integrated order entry system crosses functional boundaries.

Issues of MIS

Management Information System (MIS) can be defined as collecting and processing of raw data into useful information and its dissemination to the user in the required format. It consists of information, which impacts managements to feel the pulse of the organization and take decisions accordingly. In fact a full MIS consists of all the systems that the institution uses too generate the information that guide management's decisions and actions. Microfinance Institutions (MFI'S), over the past few years, have been paying increasing attention to information systems. They are increasingly realizing that information lies at the very heart of microfinance. The practitioners as well as donors have become aware of the vital need for formal and informal financial institutions to manage large amounts of data. As a result, there is a massive drive to improve the effective understanding and use of these data. Needless to say that it is no possible to collect and collate large volumes of data without adopting new technology. As a result the MFIs are watching the developments in information technology very closely.

Despite the availability of technology today there is a problem in developing a good and problem free MIS software for the MFIs. The diverse nature of microfinance creates an intriguing complexity for software application development. Some of the complexities in developing a single or a small number of software to meet the needs of the MFIs are discussed below:

- Many Institutional Models: The organizational forms is a function of the specific of social , political, economics , regulatory and legal environments throughout the world. There are a variety of organizational forms that are assumed by the MFIs for carrying on their work. The MFIs can be in the form of credit union, cooperatives, Non governmental Organizations (NGO) and even banks. All have their own varied type of requirement for MIS and its automation.
- Different Lending Methodologies: MFIs have vastly different lending methodologies across the globe and even within the same country. Some MFIs follow individual lending some follow village banking methodology and yet others may be following solidarity group lending. In Indian for example some MFIs follow the e Grameen Model as per the example of the Grameen Bank, Bangladesh while other follow Self Help Group Model as propagated by the institutions like National Bank for Agriculture and Rural development (NABARD)
- Methodology on Interest Payment: The practices for calculating interest and the periodicity for its payment vary according to the product and organisation. These variations can occur even within the same organisation depending on the product and the area of operation.
- Other varied requirements: There are variations in terms of the currencies languages and reporting requirements of the MFIs.

CHARACTERISTICS OF MIS

Some of the major characteristics of MIS are listed as under.

1. Comprehensiveness: Management Information System is comprehensive in nature. It takes inputs from transactions processing systems and process information primarily for users at all levels. It caters to the need of large variety of people in different hierarchy as routine information requirement exist practically at all levels. Therefore reporting system in the form of MIS is most sought after information system in any organization.

2. Co-ordinated: Management information system is centrally co-ordinated to ensure that information is passed back and forth among the sub-systems as needed and to ensure that information system operates efficiently.

3. Sub-systems: A MIS is composed of sub-systems or quasi separate component system that is the part of the overall - unified system. Each of these systems shares the goals of the management information system and of the organization. Some of the systems serve just one activity or level in the organization, while others serve multi-levels or multiple activities. The overall structure of the multiple systems should be carefully established as a part of long range system planning.

4. Integration: A MIS is rationally integrated, so as to become more meaningful. Sub-systems are integrated so that the activities of each are inter-related with those of the others. This integration is accomplished primarily by passing data between these systems. Computer programmes and files can be designed to facilitate data flows among the systems, and manual procedures are also used to accomplish this integration. While integration makes information processing more efficient by reducing both intermediate processing and the incidence of independent generation of the same data by multiple departments, an even more important benefit is that it provides more timely, complete and relevant information. Senior managers particularly, benefit from integrated systems because they need cross functional information. Although total information of sub-systems is neither achievable nor desirable, a substantial degree of integration is required for an effective management information system.

5. Transformation of Data into Information: A MIS transforms data into information in variety of ways. When data is processed and is useful to a particular manager for a particular purpose, it becomes information. There are many different ways in which data can be transformed within an information system. For example, cost data for a particular organization may be summarized on a full-cost, variable-cost, and standard-cost basis for each organization unit, as well as by each cost type, customer type, and product, line. The numerous ways in which MIS should transform data into information are determined by the characteristics of the organizational personnel, the characteristics of the task for which information is needed.

6. Enhance Productivity: A MIS enhances productivity in several ways. It enables routine tasks such as document preparation to be carried out more efficiently, it provides higher levels of service to external organizations and individuals, it supplies the organization with early warnings about internal problems and external threats, it gives early notice of opportunities, it facilitates the organization's normal management processes and it enhances managers' ability to deal with unanticipated problems.

7. Conforms to Managers' Styles and Characteristics: A management information system is developed in recognition of the unique managerial styles and behavioural patterns of the personnel who will use it, as well as the contributions made by managers. At the organization's Top levels, the management information system is likely to be carefully tailored to each individual manager's personal tastes. At the organization's lowest levels, the management information system is more likely to be tailored to the unusual way in which clerical and operations personnel use information and interact with the information system. For middle managers, the information system is tailored to the general characteristics of managers. For professional and technical personnel, the information system is tailored to the nature of the specialized task, but with attention also given to the way the minds of these specialists process information.

8. Relevant Information: A MIS should provide only relevant information. Determining which information is relevant may be difficult in situations in which analyses vary from managers to manager or according to particular circumstances, such as in the case of special problems. Systems designers must carefully consider the human factor when developing a management information system. Otherwise, the resulting system will be ineffective and probably will be discarded by its users.

9. Uses Established Quality Criteria: A management information system must be designed to the required tolerance for timeliness, relevance, and accuracy of information. These tolerances vary from task to task and from level to level within an organization.

10. Feedback: A management information system should provide feedback about its own efficiency and effectiveness. The reporting of computer malfunctions and transactions processing error rates is a simple example of this feedback. Statistics prepared by the system about who uses each system facility and how much they use each one are more sophisticated forms of feedback. Computer programs can record and report how much computer time is used by each user, how many pages are printed for each user, and how much internal data file space is utilized by each user's data, as examples; these and other usage statistics can be used for managerial analysis or as basis for charging each user for computer usage if desired.

11. Flexibility: It must be designed so that it can be easily modified if required. For example, different information is needed because the environment changes or if the organization undertakes new activities (such as introducing new products) which require new modes of processing. The information system should be capable of being easily expanded the accommodate growth or new types of processing activities and also easily contracted.

12. Modularity: The MIS should be composed of many modules or sub-systems rather than be designed as one and only one for a few large systems.

13. Selective Sharing of Data: Another desirable quality of an MIS is selective sharing of data. Two or more managers often need to utilize the same information; at the same time the system should have features, which allow ready access to information by multiple managers. An advanced feature that promotes this sharing is data bases. On the other hand, it is often important to reserve certain information for the exclusive use of only selected managers. Sometimes, this need extends down to the record or field level, in which case some parts of a record are available to all managers, but only certain managers permitted to examine other parts. For example, an employee's current address or marital status may be needed by employee or other personnel, but access to information about pay rate, hours worked, gross pay, and other details of payments may be restricted to certain payroll managers. This selective sharing quality can be established by controls that are part of the computer programs.

14. Computerized: It is possible to have a MIS without using a computer. But its use increases the effectiveness of the System. In fact, its use equips the system to handle necessary attributes of the computer to MIS ; for example, accuracy and consistency in processing data and reduction in staff. These needs in management information system makes the computer a prime requirement.

MYTHS ABOUT MIS

Let us clarify some of the misconceptions or "myths" about MIS:

1. The study of management information system is about the use of computers: This statement is not true. MIS may or may not be computer based, computer is just a tool. Whether it should be used while installing a MIS depends largely on several factors, e.g., how critical is the response time required for getting an information; how big is the organisation, and how complex are the needs of the information processing.

2. More data in reports means more information for managers: This is a misapprehension. It is not the quantity of data, but its relevance, which is important to managers in the process of decision-making. Data provided in reports should meet information requirements of managers. It is the form of data and its manner of presentation which is of importance to business managers. Unorganised mass of data bring confusion.

3. Accuracy in reporting is of vital importance: The popular belief is that accuracy, in reporting should be of high order. At the operating level, it is true. Other examples, where accuracy is really important can be; the dispensing of medicine; the control of aircraft; the design of a bridge etc. Accuracy, however, is relevant but not

an absolute ideal. Higher levels of accuracy involve higher cost. At higher decision levels, great accuracy may not be required. The degree of accuracy is closely related to the decision problem. Higher management is concerned with broad decisions on principles and objectives. A fairly correct presentation of relevant data often is adequate for top management decision. For a decision, on a few project proposals top management is not interested in precise rupee terms of the project cost. A project cost estimated at a fairly correct figure is all what it wants.

Basic Requirement of MIS

In the present context, most of the organizations are using computer-based management information system in the era of information economy. The basic requirements of a computer based MIS are listed as below :

1. Hardware: It refers to the physical computer equipment and associated devices. The hardware must provide five basic functions, i.e., input of data entry, output, secondary storage for data and programmes, central processor (Computation, Control, and primary storage) and communication.

2. Software: It is a broad term; it means the instructions or programs that direct the operation of the hardware. The software requirement if of book types: System Software and Application Software.

3. Database: The database contains all data utilized by the application software. An included set of stored data which is often referred to as file. The physical existence of the stored data is known as database.

4. Procedures: Formal operating procedures are physical components because they exist in a physical from such as a manual or instruction booklet. Basically, three major types of procedure are required:

- User Instructions (for users of the application to record data, employ a terminal to enter or retrieve data, or use the result)
- Instructions for preparation of input by data preparation personnel
- Operating instructions for computer operations personnel.

5. Operations Personnel: It includes personnel such as Computer operators, system analysts, programmers, data preparation personnel.

COMPUTERIZED MIS

Management Information System refers to the formal system installed in an organization for purposes of collecting, organizing, storing and processing data and presenting useful information to management at various levels. It serves as an aid to managerial functions of planning and control. Many medium sized and large enterprises find it convenient to computerize their MIS to make it automatic and highly organized. The advent of high-speed electronic computers has proved to be a boon to organizations for making their Management Information Systems very sophisticated and efficient by computerizing them. The vary character and content of MIS have undergone significant changes as a result of computerization; so much so, MIS has almost come to mean computer based MIS. There are non-computer-based management information systems also.

Features of Computer based MIS

1. Organization and updating of huge mass of raw data of related and unrelated nature derived from internal and external sources at different period of time.
2. Ability to process data into information with accuracy and high speed. It involves making complex computations, analysis, comparisons and summarization's. Though humans can do the processing, the computer's ability to process huge data is phenomenal, considering its speed, reliability and faithfulness in perfectly following the set of instructions.
3. Super-human memory, tremendous volume of data and information and the set of instructions can be

stored in the computer and can be retrieved as and when needed. Management can get any bit of stored information from the computer in a matter of seconds.

4. The input data in the computer can be processed into a number of different outputs and for a variety of purposes. The system is so organized that managers at different levels and in different activity units are in a position to obtain information in whatever form they want, provided that relevant "Programmes" or instructions have been designed for the purpose.
5. The information processing and computer technology have been so advanced that managers are able to obtain real time information without any waiting period.
6. Computer based MIS opens up new vistas for management to make efficient timely decisions on vital operations of the enterprise and major strategic and tactical problem. It also helps organizations to gain substantial economies by reduction of clerical and computational time.

APPROACHES TO MIS DEVELOPMENT

For developing MIS following three approaches are generally used.

Top down approach

The development of MIS under top down approach begins by defining the objectives of the organization, the kind of business it is in to, and the constraints under which it operates. The activities or functions for which information would be required are also identified. The crucial strategic and tactical decisions are also defined and the decisions necessary to operate the activities are specified. From the activities or functions and the decisions to be made, the major information requirements are ascertained.

This approach develops a model of information flow in the organization, which acts as a guide for designing the information system. By using the model of information flow various information sub-systems may be defined. Each sub-system comprises of various modules. A module is a basic unit for information system's development. The selection of module for developing system is made on the basis of the priority assigned to them. The various sub-systems and their modules are coordinated to achieve the objective of integration. The information system so developed is viewed as a total system fully integrated rather than as a collection of loosely coordinated sub-systems.

As the name indicates, top management takes the initiative in formulating major objectives, policies and plans in a comprehensive manner and communicates them down the line to middle and supervisory management levels for translating them into action plan. This approach only concentrates on implementation and day-to-day control.

Bottom up approach

The development of information system under this approach starts from the identification of life stream systems. Life stream systems are those systems, which are essential for the day-to-day business activities. The examples of life stream systems include - payroll, sales order, inventory control and purchasing etc. The development of information system, for each life stream system starts after identifying their basic transactions, information file requirements and information processing programs.

After ascertaining the data/information requirements, files requirements and processing programs for each life stream system, the information system for each is developed. The next step is towards the integration of data kept in different data files of each information system. The data is integrated only after thoroughly examining various applications, files and records. The integrated data enhances the sharing ability and evolving ability of the database. It also ensures that uniform data being used by all programs. Integrated data also provides added capability for inquiry processing and ad hoc requests for reports.

The next development under bottom up approach may be the addition of decision models and various planning

models for supporting the planning activities involved in management control. Further, these models are integrated to evolve model base. The models in the model base facilitate and support higher management activities. They are useful for analyzing different factors, to understand difficult situations and to formulate alternative strategies and options to deal them.

A comparison of top down and bottom up approaches reveals the following points:

- Top management takes the main initiative in formulating major objectives, strategies and policies, for developing MIS under top-down approach. In the bottom up approach it is the supervisory management who identifies the life stream systems for which MIS may be developed.
- Middle and supervisory management levels have a little role in the development of system under top down approach. Under bottom up approach, management refrains from guiding the development of system developed by supervisory level.
- The information system developed under top down approach is more consistent with the systems approach and is also viewed as a total system, which is fully integrated. The information system developed under bottom up approach is developed through an orderly process of transition, building upon transaction processing sub-system. This system may not be integrated.

Integrated Approach of MIS Development

If used objectively, it can overcome the limitations of the above two approaches. This approach permits managers at all levels to influence the design of the system. Top management will identify the structure and design of MIS suitable to the concerned department. The design is presented to the lower level management for their views and modification. The lower management is permitted to suggest changes, additions, or deletions and return the design with their suggestions to the top level for approval. The revised design is drawn and evaluated by the top level and sent down again in a modified form for further consideration if required. This is an iterative process. It continues until a final design is achieved, that satisfies the requirement at all levels in the organization.

PRE-REQUISITES OF AN EFFECTIVE MIS

The pre-requisites of an effective MIS are nothing but mainly its resources and management support. These are described in the following section :

Qualified Systems and Management Personnel: One of the important pre-requisites of well-defined MIS is that qualified personnel's at all levels should man it. These experts should take into account views of their fellow employees. The personnel's of the MIS comprises of at least two category of personnel viz.:

(i) Systems, Domain, and Computer Experts;

(ii) Management Experts.

Systems, Domain and computer experts should also be capable of understanding management concepts to facilitate the understanding of problems faced by the concern. They should be well versed with the process of decision making and information requirements for planning and control functions. Management experts on the other hand should also understand clearly the concepts and operations of a computer. This basic knowledge of computer based systems will be useful to the management experts and will help them in understanding the problems of another category of experts. This will help the management in dealing with hiring suitable experts, recruiting fresh candidates and developing them to meet the specific requirement of the organization. Top management in the organization should also take in to account the turnover of the experts in the field of MIS. In addition, there is a third category of the personnel's who are very important and they are the users of the system.

Database

The word is now taking new name such as data warehouse, which is being used presently in, large corporates. Database is consolidation of many files, which contain the data of the organization. The data in a database is organized in such a way that access to the data is improved and data redundancy is reduced. It also increases the data integrity.

The main feature of database is that all subsystems will utilize the same database kept in different files. The other important features of databases are:

I. Avoiding uncontrolled data redundancy and inconsistency: Application shares the data stored in a database, rather than owning private files that would often store redundant data. This reduces the storage costs; there is no need to update multiple copies of the same data. This prevents the possibility that inconsistent data will reside in multiple files.

II. Program-Data Independence: When the database is managed by a DBMS, programs can be written independent of the actual physical layout of the data or even of the total logical structure of the data. DBMS knows these structures; it thus provides the mapping from a logical view of the data in a given application to the actual physical layout of the data on the storage device.

III. Flexible Access to shared data: The database approach has opened data for access to users and applications. Query languages enable end users to access data directly. Applications can be written to use any data stored in corporate databases, rather than to rely only on specially created files.

IV. Reliability: The reliability of the stored data is ensured by the DBMS managed databases themselves, rather than by special programming. A variety of relationships between entities may be rather easily defined.

V. Centralized Control of data: There are many advantage of centralized control of database: Few are listed in the following:

(a) Global planning and consist evolution of the data resources are possible.

(b) Security may be maintained by specifying the authorization for data access and modification to the uniform interface for all programs and users- that is to the DBMS; these security measures may be employed to protect the privacy of individuals i.e. the stored data of the concern.

(c) Integrity constraints may be imposed to further ensure the accuracy of data in the database.

(d) Corporate wide standards can be enforced in naming and representing the data.

Support of Top Management

For a MIS to be effective, it should receive full support of top management. The basic reason for this is that the resources involved in computer based information system are large and growing larger and larger in view of the importance of technology in the present context. To get these resources for implementing the MIS, the support of top management is essential.

Control and Maintenance of MIS

Control of the MIS means the operation of the system as it was designed to operate. Sometimes, users develop their own procedure or short cut methods to use the system, which reduces its effectiveness. To check such habits of users, the management at each level in the organization should devise methods for information control. Maintenance is closely related to control. During the maintenance systems management will discover needs for improvement in the system. However, formal methods of changing and documentation have to be identified by the management.

Evaluation of MIS

An effective MIS should be capable of meeting the information needs of its executives in future as well. To maintain this capability evaluation of MIS and timely action thereof is required. The evaluation of MIS should take in to account the following:

- Flexibility in built, with the system to meet any expected and unexpected information requirement in future.
- Ascertaining the views of the users and the designers about the capabilities and deficiencies of the system.
- Guiding the appropriate authority about the steps to be taken to keep the effectiveness of MIS alive.

COMPUTER AND ITS EFFECT ON MIS

The effects of applying computer technology to information systems can be listed below:

1. Increase in speed of processing and retrieval of data: Modern business situations, are characterized by, high degree complexity, keen competition and high risk and reward factors. This invariably calls for system capable of providing relevant information with minimum loss of time. Manual systems howsoever well organized often fail to match the demand for information for decision-making. Computer with its unbelievably fast computational capability and systematic storage of information with random access facility has emerged as an answer to the problems faced by management. Processing of data in relevant form and design and retrieval of it, when needed, in fact requires considerably less time and facilitate the management action and decision-making. The speed of computer processing is in nano-range, i.e.; an operation takes only billionths of a second. This characteristic of computer has accounted for as a major factor in inducing MIS development. Computers today are capable of meeting varied type of information requirement of executives.

2. Expanded Scope of use of information system: The importance and utility of information system in business organizations was realized by most of the concerns, after the induction of computers for MIS development. System experts in business organizations develop areas and functions, where computerized MIS could be used to improve the working of concern. This type of applications hitherto, not feasible under the manual system. For example, it was made possible by using an on line real time system to provide information to various users sitting at a remote distance from a centrally located computer system.

3. Widened scope of analysis: The use of computer can provide multiple type of information accurately and in no time to decision-makers. Such information equips an executive to carry out a thorough analysis of the problem and to arrive at the final decision. Computers are capable of providing various types of sales reports for example, Area wise sales; Commission of each sales man; product wise sales etc. These reports are quite useful in analyzing the sales department working and to ascertain their weaknesses, so that adequate measures may be taken in time. In this way, the use of computer has widened the scope of analysis.

4. Complexity of system design and operation: The need for highly processed and sophisticated information based on multitudes of variables has made the designing of system quite complex. During the initial years, after the induction of computer for MIS development, systems experts faced problems in designing systems and their operations. The reason at that time was the non-availability of experts required for the purpose. But these days the situation is better. The manufacturers have developed some important programs (software) to help their users. Some private agencies too are there who can perform the task of developing programs, to cater the specialized needs of their customers, either on consultancy basis or on contract.

5. Integrates the working of different information sub-systems: A suitable structure of management information system may be a federation of information sub-system, viz., production, material, marketing, finance, engineering

and personnel. Each of these sub-systems is required to provide information to support operational control, management control and strategic planning. Such information may be made available by common-data-base. This common-data -base may meet out the information requirements of different information sub-system by utilizing the services of computers for storing, processing, analyzing and providing such information as and when required. In this way, computer technology is useful for integrating the day-to-day working of different information sub-systems.

6. Increased the effectiveness of information systems: Information received in time is of immense value and importance to a concern. Prior to the use of computer technology for information purposes, it was difficult to provide the relevant information to business executives in time even after incurring huge expenses. The use of computer technology has overcome this problem. Now, it is quite easy to provide timely, accurate and desired information for the purpose of decision-making. Hence, we can conclude, that the use of computer has increased the effectiveness of information system also.

7. More comprehensive information: The use of computer for MIS, enabled system experts to provide more comprehensive information to executives on business matters.

IMPACT OF MIS ON DIFFERENT LEVELS OF CORPORATE MANAGEMENT

Top level of corporate management spends mostly it's time for business planning. The major responsibilities of this level include long and short-range planning, resource and capacity analysis, setting of profit and budget goals, and in general establishing the business objectives of the company. It is thus apparent that there is a heavy planning and lesser control element in the work domain of top level management.

Presently, the impact of computers and MIS on the working of this level is minimum. The reasons for lesser computer effect on top level are:

(i) Unstructured nature of data

(ii) Non-availability of suitable systems and computer experts

(iii) Reliance on intuitive abilities.

The impact of MIS on top level too is far less than at the middle or supervisory level. This fact is apparent from the following table, which has been constructed on the basis of several surveys.

	Decision Making Process	**Job Contents**	**Job Members**
Top Management	Scant Influence	Scant Change	No Influence
Middle Management	Moderate Influence	Moderate Change	Scant Influence
Lower or Supervisory level	Major Influence	Major Change	Moderate Influence

In fact MIS in its present form is more effective for control than for planning. Therefore, it can be concluded that the impact of MIM on top management level is almost non-existent.

The potential impact of computers on top level management may be quite significant. An important factor, which may account for this change is the fast development in the area of computer science. It is believed that in future computers would be able to provide simulation models to assist top management in planning their work activities. For example, with the help of a computer it may be possible in future to develop a financial model by using simulation technique, which will facilitate executives to test the impact of ideas and strategies formulated on future profitability and in determining the needs for funds and physical resources. By carrying sensitivity analysis with the support of computers, it may be possible to study and measure the effect of variation of individual factor to determine the final results. Also the availability of a new class of experts will facilitate effective communication with computers. Such experts may also play a useful role in the development and processing of models. In brief, potential impact of computers would be more in the area of planning and decision-making.

Futurists believe that in future top management will realize the significance of techniques like simulation, sensitivity analysis and management science. The application of these techniques to business problems with the help of computers would generate accurate, reliable, timely and comprehensive information to top management. Such information will be quite useful for the purpose of managerial planning and decision-making. Computerized MIS will also influence in the development, evaluation & implementation of a solution to a problem under decision-making process.

The impact of computers and MIS on middle management is moderate. This level of management translates the management objectives into plans, arranges resources to achieve such objectives and goals as laid down by top management. Also it reviews the result of operations performed at the supervisory level. It thus acts as a bridge between the other two levels. The information provided by computer serves only limited purpose to middle management. Such information is quite effective for carrying out an analysis of the operations but has little impact on the formulation of organizational plans.

Potential impact of computers and MIS on middle management level will be significant. It will bring a marked change in the process of decision-making. At this level, most of the decisions will be programmed and thus will be made by the computer, thereby drastically reducing the number of middle level manager's requirement. For example, In the case of inventory control system, computer will carry records of all items with respect of their purchase, issue and balance. The reorder level, reorder quantity etc. for each item of material will also be stored in computer after its pre-determination. Under such a system as soon as the consumption level of a particular item of material will touch reorder level, computer will inform for its purchase immediately. The futurists also foresee the computer and the erosion of middle management as the vehicles for a major shift to decentralization. The new information technology will enable management to view an operation as a single entity whose effectiveness can only be optimized by making decisions that take into account the entity and not the individual parts.

The impact of computers and MIS today at supervisory management level is maximum. At this level, managers are responsible for routine, day to day decision and activities of the organization, which do not require much judgement and discretion. In a way, supervisory mangers job is directed more towards control function, which are highly receptive to computerization. For control, such mangers are provided with accurate, timely, comprehensive and suitable reports. A higher percentage of information requirements of executives are met out at this level.

Potential impact of computers and MIS on supervisory level will completely revolutionize the working at this level. Most of the controls in future will be operated with the help of computers. Even the need of supervisory mangers for controlling the operation/activities now performed manually will be either fully or partially automated.

In future MIS would provide highly accurate, precise and desired information to control operations with the support of computers.

CONSTRAINTS IN OPERATING MIS

Major constraints which come in the way of operating a management information system are the following :

1. Non-availability of experts, who can diagnose fully the objectives of the organisation and give a desired direction needed for operating management information system.

2. Difficulty usually faced by experts, in selecting the sub-systems of MIS, to be designed and operated upon first.

3. Source of availability of experts for running MIS effectively, is not always known to the management.

4. Due to varied objectives of business concerns, the approach adopted by experts for designing and implementing MIS is non-standardised one.

5. Non-availability of cooperation from staff.

6. Non-availability of heavy financial resources required for running the MIS effectively.

7. Turnover of experts is quite high.

8. It is difficult to quantify the benefits of MIS, so that it can be easily comparable with cost.

9. Perception problems as its utility are not readily perceptible by many users.

LIMITATIONS OF MIS

1. The main limitations of MIS are as follows:

2. The quality of the outputs of MIS is basically governed by the quality of inputs and processes.

3. MIS is not a substitute for effective management .It means that it cannot replace managerial judgement in making decisions in different functional areas. It is merely an important tool in the hands of executives for decision-making and problem solving.

4. MIS may not have requisite flexibility to quickly update itself with the changing needs of time, especially in the fast changing and complex environment.

5. MIS cannot provide tailor made information packages suitable for the purpose of every type of decisions made by executives.

6. MIS takes into account mainly quantitative factors; thus it ignores non-quantitative factors like morale, attitudes of members of the organization, which have an important bearing on decision-making process of executives.

7. MIS is less useful for making non-programmed decision-making. Such type of decisions is not of routine type and thus they require information, which may not be available from existing MIS to executives.

8. The effectiveness of MIS is reduced in the organization, where the culture is to hold information and not share with others.

9. MIS effectiveness decreases due to frequent changes in top management organizational structure and operational team.

MISCELLANEOUS INFORMATION SYSTEMS

Transaction Processing Systems (TPS)

A data processing system processes transactions and produces reports. It represents the automation of fundamental, routine processing to support operations. Prior to computers, data processing was performed manually or with simple machines. A management information system is more comprehensive; it encompasses processing in support of a wider range of organizational functions and management processes. However, every MIS will also include transaction processing as one of its functions.

What does it takes into account to make a data processing system into a management information system? Can a rather mundane data processing system be a MIS if a simple database, retrieval capabilities, and one or two decision models are added? This is not a useful question. MIS is a concept and an orientation toward which an information system design moves rather than an absolute state. Therefore, the significant issue is the extent to which an information system adopts the MIS orientation and supports the management functions of an organization. The answer is usually a matter of degree rather than a simple yes or no.

One important aspect of the difference between MIS and routine data processing is the capability to provide analysis, planning, and decision making support. An MIS orientation means users have access to decision

models and methods for querying the database on an ad hoc basis; the database is also, of course, an essential part of routing transaction processing and reporting. Furthermore, a MIS orientation means information resources are utilized so as to improve decision-making and achieve improved organizational effectiveness. Information resources are also used as a means of achieving a competitive advantage.

Decision Support Systems (DSS)

It is computer based information system that combines data, analytical tools, and user-friendly software to support decision-making at the management level. A decision support system (DSS) is an information system application that assists decision-making. DSS tend to be used in planning, analyzing alternatives, and trial and error search for solutions. They are generally operated through terminal-based interactive dialogs with users. They incorporate a variety of decision models.

DSS are more targeted than MIS System. MIS systems provide managers within routine flow of data and assist in the general control of the organization. In contrast, DSS are slightly focused on a specific decision of classes of decision such as routing, querying, on three basic parameters which are given in the following :

(i) **Philosophy**: DSS provides integrated analytical tools, data, model base (a collection of mathematical and analytical models), and a interface to the user in the form of a user friendly software, MIS provides a structured information to the end-users at all level in an organization.

(ii) **System Analysis**: DSS establish what tools are used to incorporate the decision making Process of a organization. Whereas MIS identify information requirement at different levels in the organization.

(iii) **Design:** The design of DSS is based on Iterative Process and keeps on changing with every feedback of the user. On the other hand, MIS deliver a system based on frozen requirements.

Four core capabilities of DSS are

1. **Representations**: It includes the presentation of the information in the form of graphs, charts, lists, reports, formatted reports, symbols, etc. These results are being used for control mechanism.
2. **Operations**: It includes logical & mathematical manipulation of data. These operations are confined to gathering information, generating statistics, preparing reports, assigning risk and values, generating alternatives using simulation etc.
3. **Memory aids**: It also provides updating of databases and memory, viewing of data, work spaces, libraries and linkages among libraries and work places.
4. **Control aids**: It provides the facility to user to control the activity of DSS. It includes a language permitting user control of operations, representations and memory. It also include features such as tutorials, help commands, functions keys, conventions etc.

Executive Information Systems (EIS)

It provides executives information in a readily accessible interactive format. It is a computer based system that accesses data concerning critical success factors of an organization and allows high level executives to display this information on demand. They are meant for top level executives in an organization. The characteristics of a good executive information system are as follows:

(1) Simple use interfaces are crucial. Good systems provide a wide variety of user interfaces such as a mouse, a touch screen, or a keyboard and allow the executive to choose which ever he or she is comfortable with.

(2) An EIS should be secure because the data that is contained and (or accessed by an EIS is obviously important and often proprietary information

(3) An EIS should support what-if-analysis and adhoc queries.

(4) An EIS should have the capability of allowing the executives to drill down into the data

(5) Very quick response time is necessary

(6) Colour graphics capabilities are important for displaying the information

(7) The data used in an executive information system may reside in many different locations therefore efficient network is essential for expert systems.

The following points summarizes the Executive Information System:

It directly supports the value added work in the organization.

Its users are the people who do value added work which requires a special skills.

It can support communication or information sharing between people doing different parts of the task. It may help in explaining the result of the task to customers.

It provides tools, information, or structured methods for making decisions.

Examples of EIS are (I) system to generate competitive bids (ii) system to diagnose machine failures (iii) system to support loan approval process.

Its common features are (I) user friendly interface (ii) user friendly methods of analyzing data.

Artificial Intelligence

Artificial intelligence is the branch of computer science concerned with making computers behave like humans. Artificial intelligence is the intelligence exhibited by machines or software. It is an academic field of study which studies the goal of creating intelligence, whether in emulating human-like intelligence or not. Major Artificial intelligence researchers and textbooks define this field as “the study and design of intelligent agents”, where an intelligent agent is a system that perceives its environment and takes actions that maximize its chances of success. John McCarthy, who coined the term in 1955, defines it as “the science and engineering of making intelligent machines”. Artificial intelligence research is highly technical and specialized, and is deeply divided into subfields that often fail to communicate with each other. Some of the division is due to social and cultural factors: subfields have grown up around particular institutions and the work of individual researchers. Artificial intelligence research is also divided by several technical issues. Some subfields focus on the solution of specific problems. Others focus on one of several possible approaches or on the use of a particular tool or towards the accomplishment of particular applications. The central problems (or goals) of Artificial intelligence research include reasoning, knowledge, planning, learning, natural language processing (communication), perception and the ability to move and manipulate objects. General intelligence is still among the field’s long term goals. Currently popular approaches include statistical methods, computational intelligence and traditional symbolic Artificial intelligence. There are a large number of tools used in Artificial intelligence, including versions of search and mathematical optimization, logic, methods based on probability and economics, and many others. The Artificial intelligence field is interdisciplinary, in which a number of sciences and professions converge, including computer science, mathematics, psychology, linguistics, philosophy and neuroscience, as well as other specialized fields such as artificial psychology.

- The field was founded on the claim that a central property of humans, intelligence—the sapience of Homo sapiens – ”can be so precisely described that a machine can be made to simulate it”. This raises philosophical issues about the nature of the mind and the ethics of creating artificial beings endowed with human-like intelligence, issues which have been addressed by myth, fiction and philosophy since antiquity. Artificial intelligence has been the subject of tremendous optimism but has also suffered stunning setbacks. Today it has become an essential part of the technology industry, providing the heavy lifting for many of the most challenging problems in computer science.

Expert system

An expert system is a computer program that simulates the judgement and behaviour of a human or an organization that has expert knowledge and experience in a particular field. An expert system is a computer program that simulates the judgement and behaviour of a human or an organization that has expert knowledge and experience in a particular field. Typically, such a system contains a knowledge base containing accumulated experience and a set of rules for applying the knowledge base to each particular situation that is described to the program. Sophisticated expert systems can be enhanced with additions to the knowledge base or to the set of rules.

Expert systems typically consist of three parts:

(1) A knowledge base which contains the information acquired by interviewing experts, and logic rules that govern how that information is applied;

(2) An Inference engine that interprets the submitted problem against the rules and logic of information stored in the knowledge base; and an

(3) Interface that allows the user to express the problem in a human language such as English. Despite its earlier high hopes, expert systems technology has found application only in areas where information can be reduced to a set of computational rules, such as insurance underwriting or some aspects of securities trading.

Typical tasks for expert systems involve classification, diagnosis, monitoring, design, scheduling, and planning for specialized endeavours. Facts for a knowledge base must be acquired from human experts through interviews and observations. This knowledge is then usually represented in the form of “if-then” rules (production rules): “If some condition is true then the following inference can be made (or some action taken).” The knowledge base of a major expert system includes thousands of rules. A probability factor is often attached to the conclusion of each production rule, because the conclusion is not a certainty. For example, a system for the diagnosis of eye diseases might indicate, based on information supplied to it, a 90 percent probability that a person has glaucoma, and it might also list conclusions with lower probabilities. An expert system may display the sequence of rules through which it arrived at its conclusion; tracing this flow helps the user to appraise the credibility of its recommendation and is useful as a learning tool for students. Human experts frequently employ heuristic rules, or “rules of thumb”, in addition to simple production rules. For example, a credit manager might know that an applicant with a poor credit history, but a clean record since acquiring a new job, might actually be a good credit risk. Expert systems have incorporated such heuristic rules and increasingly have the ability to learn from experience. Nevertheless, expert systems remain supplements, rather than replacements, for human experts.

Example of Expert System as :

1. System which generate competitive bids
2. System to help sales people and suggest the best choice for the customer.
3. System which helps in diagnose of failures may be machine or human being.
4. Systems to support a loan approval system.
5. Systems to support training in specialized areas where experts are in scarcity.
6. System to find price inconsistencies between different equity markets.

Limitations of Expert system

– Expert systems are sometimes overrated.

– Expert systems can be expensive to develop and maintain.

- It is difficult to elicit the knowledge of experts
- It lacks common sense
- Expert system cannot learn a its own
- The validation of expert systems can be difficult.

ENTRUSTING MIS IN A CORPORATE ENTERPRISE

The MIS in a corporate enterprise is usually entrusted to an officer who is designated as Chief of Management Information Department and reports to chief executive of the concern. To suggest who should succeed in this position in the corporate enterprise requires a thorough analysis of present state of MIS. The MIS presently may be in any of the following form:

(a) It may be manual one.

(b) It may be computerized one.

(c) It may be a manual but is heading for computerization.

Under a manual management information system in a corporate enterprise, the tasks of procuring, refining, analyzing, storing and retrieval of data /information are carried out by manual means. To carry out these functions a set of suitably designed form is used. Each form of this set is used for a specific function.

To specify who has to collect a specific information, the necessary form to be used the frequency of collecting the information and a manual known as MIS manual provides all such related matters guidelines. Such a system of information may be entrusted to a person who possesses the experience of working with several functional areas. This choice of such person is based on following reasons :

- The person entrusted with MIS knows quite clearly on the basis of his experience and interaction with other departments, the type of decisions made by different executives.
- He can also ascertain the information requirement of executives from his knowledge and experience gained, while working closely with different functional areas.
- He can also perceive the frequency and the changing needs of information requirement of executives.
- His familiarity with the behavior and ways of working of his colleagues also helps him in performing his task well.

In the case of computerized management information system the information is collected manually and is transferred to a computer system for analysis, storage and retrieval. Such type of information system may be entrusted to a computer and system expert, who is well conversant with management concepts and the working of business executives. This choice of entrusting MIS is supported by these reasons.

- The head of management information system possesses the requisite capabilities, which are necessary for developing various applications & guiding the smooth running of system.
- He can also foresee the changing information requirements of executives by analyzing the decisions made and the problems, which may be faced in future.

Lastly, the system, which involves the computerization of the present manual -system may be entrusted to a project leader. This project leader may not directly carryout the task of converting the system but may render all possible help to the outside consultants. The help of outside consultants may be sought till the project leader gains the necessary confidence to run it independently.

The main reasons for this choice are the following:

- Due to lack of project leaders in the area of computers, he may be assisted by outside consultants, till the development of the system is complete and he gains necessary confidence of handling the system independently.
- Since the project leaders works closely with outside consultants, so they understands the system quite thoroughly than anyone else.

MIS in Indian Organizations

Although the significance of and need for MIS have been well realized in developed countries like U.S.A., it has not yet been so in countries like India. The rapid advancement of technology and the consequent advent of computers have mainly contributed for the success of MIS in developed countries. In India, where computers were not heard earlier to 1950s, the big organizations, their financial capacities could not take a clue from their counterparts in those advanced countries and hence lagged behind. Even after three decades of computer advent in India and operations of MIS in certain big organizations, it still has remained a moot point whether it would serve any useful purpose and its installation justified.

It is, however, fallacious to seek any alibi for the present unsatisfactory and unfruitful results of MIS in the Indian organizations. That the Indian organizations lag behind in the computer technology which is, no doubt essential for the development of MIS, does no longer hold water as an excuse for its inadequate application and operation after three decades of computer introduction.

The major hurdle is the reluctance on the part of industrialists to convince themselves of the usefulness of MIS. With their traditional thinking, they do not extend a wholehearted cooperation and unstinted support to the implementation of MIS, without which any effort in this direction would prove futile. As a result, where MIS has been introduced, it has received only a lukewarm support and has not passed the take off stage. Another important reason for the unsatisfactory functioning of MIS in many Indian organizations is the lack of proper training on the part of the personnel dealing with it. Ineffective handling of the system by these inexperienced people has been mainly responsible for the tardy development of MIS in India. Another constraint is that India being a poor country, many business organizations cannot afford to invest huge funds required for the installations of MIS.

Even though the various problems put forth above are responsible for the slow growth of MIS, they are not altogether insurmountable. It should be realized that MIS, can be developed in a phased manner without facing any financial burden and the resultant benefits would be more than the expenses in operating the system by exposing them to different training programs designed for purpose. If MIS, is taken up with all the necessary sincerity and confidence, it would deliver the goods expected of it by the Indian organizations also. The efforts made for its development in these organizations would definitely bear fruits.

LESSON ROUND-UP

- MIS refers to the system which is made to provide updated, reliable and relevant information to management for its decision making.
- A well-defined MIS provides information to all levels of management for formulating strategies and policies, for reporting the organization performance to tax authorities, shareholders, regulatory authorities, preparing future plans for short and long term basis, exercising day-to-day control on various operations, allocating different type of resources to different functional areas.
- MIS is not a new concept. It is an age-old concept which is used to manage the various activities in the organizations. Before the emergence of electronic computing machine, it had been existed in its manual form. It has been used as a mean to develop structured decision making processes in the organizations at all levels for internal as well as external controls.

- MIS is a system that helps management in the process of decision making. The three elements of MIS are Management, Information and System.
- MIS not only cater the requirement of Top management but it serves the information requirement of middle level management and operational management too.
- MIS may or may not be computer based, computer is just a tool. Whether it should be used while installing a MIS depends largely on several factors, e.g., how critical is the response time required for getting information; how big is the organisation, and how complex are the needs of the information processing.
- More data in reports means more information for managers: s a misapprehension. It is not the quantity of data, but its relevance, which is important to managers in the process of decision-making.
- The conception that Accuracy in reporting is of vital importance is true only for operating level. For strategic level and middle level, Accuracy is relevant but not an absolute ideal. Higher levels of accuracy involve higher cost. At higher decision levels, great accuracy may not be required.
- For developing MIS, there are three approaches used, Top down approach, bottom down approach and integrated approach. Under top down approach begins by defining the objectives of the organization, the kind of business it is in, and the constraints under which it operate. The crucial strategic and tactical decisions are also defined and the decisions necessary to operate the activities are specified. From the activities or functions and the decisions to be made, the major information requirements are ascertained. Bottom up approach starts from the identification of life stream systems. Life stream systems are those systems, which are essential for the day-to-day business activities. The development of information system, for each life stream system starts after identifying their basic transactions, information file requirements and information processing programs. After ascertaining the data/ information requirements, files requirements and processing programs for each life stream system, the information system for each is developed. The data is integrated only after thoroughly examining various applications, files and records. Integrated Approach If used objectively, it can overcome the limitations of the above two approaches. This approach permits managers at all levels to influence the design of the system. Top management will identify the structure and design of MIS suitable to the concerned department.
- Major constraints which come in the way of operating a management information system are Non-availability of experts, Varied objectives of business concerns, Non-availability of cooperation from staff. Non-availability of heavy financial resources Turnover of experts
- A computer system that combines data, analytical tools, user-friendly software to support decision-making at the management level is called decision support system.
- DSS is not a synonym of MIS. DSS provides integrated analytical tools, data, model base and a interface to the user in the form of a user friendly software while MIS provides a structured information to the end-users. DSS establish what tools are used to incorporate the decision making Process of a organization where as MIS identify information requirement at different levels in the organization.
- Artificial Intelligence is the effort to develop computer based systems that can behave like humans, with the ability to learn languages, accomplish physical tasks, use a perceptual apparatus, and emulate human expertise and decision making. An example of such an effort is the diagnosis of a specific illness and prescription of a course of treatment by a physician. These are artificial intelligence programs called expert systems that will perform limited diagnosis of an illness with an accuracy rate greater than the physician. The primary areas of artificial intelligence research and applications today are robotics, computer vision, speech recognition, natural language processing, expert systems, and neutral networks.

– Expert Systems: It is a knowledge intensive computer program that captures the expertise of a human in a limited domain of knowledge and experience. It stores and provide expert knowledge to support decisions in specific areas.

SELF-TEST QUESTIONS

(These are meant for re-capitulation only. Answers to these questions are not to be submitted for evaluation)

1. What do you understand by the term MIS? Explain about its evolution?
2. What do you mean by Management information system? Is MIS and Computer system same? Explain why management information system is needed.
3. What are basic elements of Management Information System (MIS)? Explain their relative importance in a MIS system.
4. Explain about three tiers structure of Management Information System. Explain the difference between strategic decision making and operating decision making
5. Explain the difference among information requirement of strategic tactical and operational decision making.
6. What are the basic characteristics of management information system in an organisation? Explain
7. State some basic myths about Management information system and the truth behind the misconceptions.
8. What do you mean by Computerized MIS? Explain why computerized MIS is preferred over manual MIS?
9. Explain the difference between Top down approach and bottom up approaches of MIS development.
10. What are the prerequisites of an effective MIS? Explain in detail.
11. What do you mean by Decision support system (DSS)? Explain the difference between DSS and MIS.
12. What do you mean by Artificial Intelligence? Explain its characteristics.
13. What is an executive information system and what are its characteristics?

Lesson 9
Enterprise Resource Management

LESSON OUTLINE

- Enterprise Resource Management (ERM)
- ERP: Goods of Objective
- Origin of ERP
- Different modules of ERP
- ERP: Basic Features
- Characteristics of ERP Solution
- Steps in ERP implementation
- Critical success factor for ERP implementation
- Benefits of ERP
- Limitation of ERP
- Criterion for choosing ERP System/ Vendor
- Major ERP Service provides

LEARNING OBJECTIVES

ERM (enterprise resource management) describes software that lets an enterprise manage user access to its network resources efficiently. ERM system is also widely known as Enterprise Resource Planning system, same terminology is used everywhere in this lesson. Since ERP is an integral part of most of the organization and in the capacity of a professional /employee one need to deal basic aspects of ERP so its study become very important for a management professional. After going through this lesson, the student will be able to:

- Understand the basic concepts of ERP its usefulness for an organization.
- Know the major issues involved in ERP implementation
- Understand the critical success factor for ERP implementation
- Get a view of major ERP service provides

Because we have an integrated ERP system that produces consistent data over the years, we can exploit the information to come up with cost reduction and strategy improvement ideas. Data makes it easier to justify these innovations.

Lalit Panda

ENTERPRISE RESOURCE MANAGEMENT

In the fast changing scenario the ability to respond to new customer needs and seize market opportunities as they arise is crucial. Successful companies today recognize that a high level of interaction and coordination along the supply chain will be key ingredient of their continuous success. Enterprises are continuously striving to improve themselves in the areas of quality, time to market customer satisfaction, performance and profitability.

ERM (enterprise resource management) describes software that lets an enterprise manage user access to its network resources efficiently. ERM describes software that manages all of a company's assets and resources, including such basic applications as general ledger, accounts payable and receivable, as well as manufacturing, inventory, and human resources. ERM system is also widely known as Enterprise Resource Planning system. In rest of the lesson, we will be using the word ERP for ERM.

ERP is an acronym for Enterprise Resource Planning, but even its full name doesn't shed much light on what ERP is or what it does. For that, we need to take a step back and think about all of the various processes that are essential to running a business, including inventory and order management, accounting, human resources, customer relationship management (CRM), and beyond. At its most basic level, ERP software integrates these various functions into one complete system to streamline processes and information across the entire organization.

The central feature of all ERP systems is a shared database that supports multiple functions used by different business units. In practice, this means that employees in different divisions—for example, accounting and sales—can rely on the same information for their specific needs.

ERP software also offers some degree of synchronized reporting and automation. Instead of forcing employees to maintain separate databases and spreadsheets that have to be manually merged to generate reports, some ERP solutions allow staff to pull reports from one system. For instance, with sales orders automatically flowing into the financial system without any manual re-keying, the order management department can process orders more quickly and accurately, and the finance department can close the books faster. Other common ERP features include a portal or dashboard to enable employees to quickly understand the business' performance on key metrics.

ERP GOALS AND OBJECTIVES

The following are the broad–based goals and objectives of an ERP system that also mitigate or eliminate the aforementioned concerns:

1. Replace legacy systems and existing interconnected modules with a functionally integrated system that will provide a "state-of-the-art" technical infrastructure and empower functional users to better serve
2. Develop new, more efficient processes that fully leverage the technology investment and eliminate data and knowledge silos on campus;
3. Empower functional users as well as customers with more control over system function, service, and scheduling
4. Eliminate paper and forms where feasible and sensible;
5. Provide easy access to data and information without compromising security and regulatory requirements;
6. Provide support for all variations of best business practices.
7. Enable implementation of these practices with a view towards enhancing productivity.

8. Helps in transforming the enterprise functions to be agile, cost-effective and focused on supporting the business objectives.
9. Facilitate the organization making prompt and effective management decisions.

Origin of ERP

The term ERP was coined in 1990 by Gartner[1], but its roots date to the 1960s. Back then, the concept applied to inventory management and control in the manufacturing sector. Software engineers created programs to monitor inventory, reconcile balances, and report on status. By the 1970s, this had evolved into Material Requirements Planning (MRP) systems for scheduling production processes.

In the 1980s, MRP grew to encompass more manufacturing processes, prompting many to call it MRP-II or Manufacturing Resource Planning. By 1990, these systems had expanded beyond inventory control and other operational processes to other back-office functions like accounting and human resources, setting the stage for ERP as we've come to know it.

Today, ERP has expanded to encompass business intelligence (BI) while also handling "front-office" functions such as sales force automation (SFA), marketing automation and ecommerce. With these product advancements and the success stories coming out of these systems, companies in a broad range of industries—from wholesale distribution to ecommerce—use ERP solutions.

Moreover, even though the "e" in ERP stands for "enterprise," high-growth and mid-size companies are now rapidly adopting ERP systems. Software-as-a-Service (SaaS) solutions—also referred to as "cloud computing"—have helped fuel this growth. Cloud-based solutions not only make ERP software more affordable, they also make these systems easier to implement and manage. Perhaps even more importantly, cloud ERP enables *real-time* reporting and BI, making them even valuable to executives and staff seeking visibility into the business.

As a result, companies of all sizes and a wide range of industries are transitioning to cloud ERP systems. In fact, Forrester predicts that SaaS-based ERP adoption will rise 21 percent annually through 2015.[2] When you stop to consider the benefits of ERP, it's easy to see why it's become so popular and why its use will continue to grow so rapidly.

The Business Value of ERP

At its core, ERP helps employees do their jobs more efficiently by breaking down barriers between business units. More specifically, an ERP solution:

- Gives a global, real-time view of data that can enable companies to address concerns proactively and drive improvements
- Improves financial compliance with regulatory standards and reduces risk
- Automates core business operations such as lead-to-cash, order-to-fulfillment, and procure-to-pay processes
- Enhances customer service by providing one source for billing and relationship tracking.

When you add up these advantages, the value of ERP—particularly cloud ERP—is clear. With an ERP solution, employees have access to accurate information that enables them to make better decisions faster. Not only that, but ERP software helps to eliminate redundant processes and systems, dramatically lowering the cost of doing business overall.

MODULES OF ERP

ERP Module

Enterprise Resource Planning (ERP) software is usually packaged in functional "pieces" that can be implemented in various combinations. These ERP software modules address specific functions like inventory control, planning, customer order management, purchasing, production control, general ledger, accounts payable, etc.

This functional organization adds to the flexibility of the ERP product. A distribution company that does little or no manufacturing can license and install the financial applications, purchasing, customer order management and inventory, for example, and have a solution "tailored" to their needs. If at a later time they expand into manufacturing, they can license additional modules that will essentially snap in place and expand the system as needed.

This modular design also allows software developers to put together product offerings for specific industries. By adding a module of food safety software, quality management and lot tracking, or product configuration, for example, an otherwise general purpose ERP system becomes a niche product that is well suited for a company in the food industry. By developing modules with specific functionality, an ERP vendor can assemble a variety of niche products like ERP for automotive suppliers, ERP software for life sciences, ERP for chemicals, etc.

Modular design helps developers focus on specific industries and functional needs while not re-inventing the wheel by duplicating the more universal functions like inventory control and purchasing. Customers benefit by not having to buy and maintain functionality that they don't want or need.

Most ERP software has grown and broadened over the years in part by adding new modules to the product offerings. Some of these are developed from scratch to capture demand opportunities and some in response to customer requests. Some modules are the result of acquisition: the ERP developer might buy a company with a "point solution" that can be converted into a module of the ERP system.

The major modules of ERP on functional basis are given in table below. These modules include sales, production, material, finance, and personnel.

Business	Sales	Production	Materials	Finance	Personnel
Forecasting	Forecasting	Planning	Purchase	Accounting	Human Resource
Planning	Planning	Order Control	Inventory	Funds Mgt.	Payroll
Goals	Sales Budget	WIP	Stores	Balance Sheet Processing	Accounting
Objectives	Order Processing	Quality	Valuation	Schedules	Skill Attendance Inventory
Targets	Order Execution	Scheduling	Analysis	Analysis	Analysis
Strategy Control	Delivery Invoicing	Dispatch	Control	Control	Control
Fixed Assets	Maintenance	Quality Control	Cost	Management Accounting	Consolidation of Business operations

Modules of ERP

ERP BASIC FEATURES

Enterprise resource planning (ERP) features and functions help integrate management, staff, and equipment, combining all aspects of your business into one system in order to facilitate every element of the manufacturing

process. Typical ERP system modules include features and functions for accounting, human resources (HR), manufacturing management, customer relationship management (CRM), and other business functions. ERP systems with manufacturing management functionality also include features and functions for inventory, purchasing, and quality and sales management. ERP software is often configured with specialized features and functions for a particular industry or type of manufacturing. For example you can compare ERP systems for discrete manufacturing, process manufacturing, engineer-to-order (ETO) manufacturing, distribution, fashion and apparel, mining, etc. To find the best ERP system for your business, it's important to understand which features and functions you need before you compare ERP solutions.

General Features of ERP

- Screen based flow control.
- Application Logic.
- Common service functions such as the currency, date, editing, and help.
- Diagnostic functions.
- Transaction flow control.
- Help functions.
- Central table system for management of parameters, texts and master data, online logical checks and validations.
- Word processing, text, text editing.
- Action massages.
- Enterprise Modeling: Structure/Policy/Rules/Guidelines.

Business System

- Business forecasting for products groups markets.
- Target fixing and allocation by the key parameters.
- Business planning in terms of the resources to execute.
- Strategy formulation and implementation.
- MIS for strategy monitoring and control.
- Business modeling for the strategy development and testing.
- DSS for resource planning.
- Information base management for management applications.

Sales

- Basic data (master) management.
- Order processing
- Dispatching and invoicing
- Order analysis, forecasting
- Sales analysis, budgets and controls
- Finished goods stores management

- Dealer, distributor management system
- Receivable analysis
- Market/Customer/Product analysis
- Market research information database
- Marketing personnel management
- Sales forecasting and budgeting.

Production

- Basic master data management.
- Bill of materials, classification.
- Process sheet, routing.
- Work order generation, scheduling and control.
- Production Planning: BOM, MRP, MPS and capacity planning.
- Interface of CAD/CAM/CAE systems.
- Quality systems for data capture, analysis, and control.
- WIP tracking, valuation.
- Work station/machine centre management.
- Production-Materials interface.
- Collection of unit data for valuation and costing.

Materials

- Purchasing and procurement.
- Goods receipt and issue system.
- Stock management and valuation.
- Inventory analysis.
- Stores ledger, valuation, analysis, disposal.
- Excise/customs interface.
- Data integration with production, and accounts systems.
- Quotation/Inquiry processing.
- Subcontracting, material accounting and bill passing.

Finance

- General accounting functions.
- Ledger, payables and receivables.
- Subsidiary ledgers.
- Cash-flow management.

- Loan management, funds management.
- Working capital management
- Budgeting, planning and control.
- Balance sheet processing.
- Tax management, status reporting.
- Assets accounting.
- Cost accounting: Cost centers accounting, product costing.
- Cost analysis for business decisions.
- Bank reconciliation.
- Letter of credit management.
- Consolidation of accounts.

Personnel

- Personnel data management.
- Personnel attendance system, time management.
- Payroll accounting: salary, wages, incentives, bonus, income tax and other deductions, and contributions to various public and provident funds.
- Human resources management: Planning, recruitment, training and up-gradation.
- Personnel cost, projection and planning.

Fixed Assets

- Fixed assets accounting: Inventory, register.
- Depreciation accounting.
- Capital work in Progress.
- Fixed assets retirement and disposal.
- Year and processing for balance sheet schedules.

Maintenance

- Plant maintenance planning
- Breakdown, preventive, conditional maintenance.
- Maintenance management: Initiation, planning, execution, control, and cost accounting.
- Monitoring performances for maintenance action as all kinds of productive assets.
- Contract management.

Quality Control

- System of data gathering to assess quality and measure against standard.
- Analysis of quality by process, material, work centre location.
- Analysis of quality by reason and actions taken.

- Building quality assurance data for equipment/process/technology selection.
- Monitoring quality across the organization from input to output for operating decisions and business decisions.

Consolidation of Business Operations

- Accounting by units and divisions with local focus.
- Consolidation by accounts in corporate functions.
- Bringing out comprehensive report system for business decisions.

CHARACTERISTICS OF ERP SOLUTION

Most of the ERP solutions need some changes to suit the environment. The Business requirement changes from company to company and the ERP in such cases need customization to satisfy the local requirements of the business.

The ERP solution has an advantage of fast implementation as the design and development is eliminated being a package. Due to object oriented technology and the client server architecture, the changes are easy to make, which are less at the server and more at the client's end.

Since, it has modular structure; one can implement the solution in a phased manner module by module. It can be implemented first on a smaller scale and expanded subsequently with more users, more locations and more modules as well. Since, the whole solution is a package product, the manufacturer of the package brings out newer versions of the product offering more facilities to the user to improve the utility of the solution.

There are more than a dozen ERP solutions available in the market each having its own speciality. Though, they are characterized as described earlier, they differ in feel, look, presentation, processing efficiency and user-friendliness.

Some of these products are developed as an application in a particular organization and then turned into a packaged solution. In view of this, some of the ERP solutions are more useful and efficient in similar organizations. The specific industry features have been taken care of more efficiently as customized solutions. Since, the designer/developer has choice of RDBMS, front-end tools, the interface tools, and so on the package efficiency changes with the choice of tools. Some of these packages run better, if installed on a particular hardware platform; and used by a particular organization.

Though tools, technology and approach may be same or similar, the manner in which they are used decides the efficiency of the solutions.

Many decision makers have purchased such software only to find out later that it was not the right fit for their specific business. Although there is a myriad of information available to aid in the ERP Systems selection process, there are six essential qualities essentially required:

1. Functionality

This is the most important characteristic of an ERP system to research. In order to know what functions your selected system is required to possess, you first need to ask yourself what areas are of most importance to you. If your ERP software is optimized for larger companies and you are a small business, you should look into a system that more represents your specific needs. Functionality is the base of a great ERP solution, while additional features are bonuses. Focus on the necessities and optional add-ons can get addressed along the way.

2. Common Platform with Wide Recognition

Choosing a commonly accepted cloud based ERP platform will ensure there is a high amount of products and support for those products available. Well recognized ERP solutions have plenty of resources available for

support and implementation. By choosing a solution with many certified partners, call centers, support plans, and support teams who are familiar with related systems to choose from, you increase your likelihood of effective use. The higher the number of companies using a particular ERP solution, the more likely the software is going to stay on the market for a while. Find an ERP solution that others in your industry use comfortably and effectively.

3. Support and Stability

It is essential that the ERP software companies that you are considering come with a support guarantee; otherwise you may leave yourself vulnerable to hidden costs for necessary upgrades if the product you chose becomes obsolete. It is also important to consider how stable the software publisher is and whether they are likely to retain their position within the market, thereby continuing to provide the support you require.

4. Costs and Fees

This includes not only the initial purchasing and implementation cost, but any on-going costs you are likely to incur through the need for maintenance, upgrades, additional users, etc. While some systems may offer discounts at the time of purchase, you may find yourself facing higher costs in the future, negatively affecting your bottom line and ROI. Also, ensure the software companies you are considering have a cap on their annual fees, including support and updates.

5. Effective Data Usage

One of the distinct advantages of ERP systems is the ability to efficiently access and use your data. While most provide adequate transaction processing, it is equally important that the data can be easily accessible by decision makers. Timely and current information access ensures critical decisions can be made based upon the most recent data.

6. Fast Adoption

The ERP system you choose should be easy to adapt to for end users. It is crucial that those users become both familiar and comfortable with those functions and use. For example, because many of Microsoft Dynamics' key features resemble Microsoft Office functions, users are usually able to adapt to it quickly.

STEPS IN ERP IMPLEMENTATION

Implementation of Enterprise Resource Planning (ERP) system is a challenging transition and a rewarding change, if implemented properly. Here is a 10 step framework that walks you through high-level steps that will take you from day 1 of planning to launch. Successful ERP implementation involves the following:

1. Need Assessment

The first step in any ERP implementation is to identify the company's needs. Start by finding and documenting the critical business processes, inflection points and key performance indicators (KPI). This will help in pinpoint the right ERP solution, as well as the appropriate specialists needed as we go through this important transition. Remember this is about business processes that support the enterprise. While information technology considerations are important, IT shouldn't be the driver of the analysis.

2. Hire a Team of Specialists

Many organizations lack the internal expertise and experience for ERP implementation. One needs to consider hiring or contracting with an experienced professional to guide you through the implementation process. This will prevent a lot of headaches and wasted time, as well as giving the time to focus on other tasks.

3. ERP System Evaluation and Selection

Selection of the right ERP solution is one of the most critical steps in the process. The right program depends on the industry, business needs and system preferences. One consideration is whether somebody needs an on-

premise ERP system or a cloud computing ERP system. Many businesses have made the jump to the cloud. That may be the right solution, but understand it's not always the best option. It will depend on specific business requirements and organization's capacity to support the process. ERP consultant can also assist with this decision.

4. Prepare for Change

Implementing a new ERP system can be a major change for a company, especially if the company never used one in the past. It's important to stay transparent with the employees about the change and engage them when possible. ERP transitions are as much about changing culture as changing technology.

5. Data Preparation

Don't assume that all of the current data can be converted into the new system. Analyze the current data and decide which pieces need to be converted. After the data is all entered into the ERP database (most databases allow data entry via spreadsheet) one needs to clean it up. Review the information database and weed out anything that you deem unnecessary, like old customers or those who are no longer in business. Data integrity is critical to a successful implementation.

6. ERP Implementation

After completing the first five steps, it's time to launch the new system. The ERP consultants have mapped out a specific plan of how to install, configure and optimize the system for working environment. Plans are bound to change (at least slightly) during this process so always keep your major needs and end goals in mind.

7. Testing

While the performance and integrity of ERP systems have come a long way since their introduction in the 90's do not assume everything will execute smooth. System and user acceptance testing is a key phase of the implementation process.

8. Training & Education

After your system is configured, you need to train the employees on how to use the new program. Try finding a group that specializes in on sight training to make sure everyone is up to speed. Ensure the IT team has an extra session of training to know how to handle any tech problems that may arise in the future.

9. Go Live

Once the system has been configured, tested and your employees have been trained, it's time to go live. One can now safely activate your ERP system. It wouldn't hurt to do another round of testing after launching, just in case.

10. Ongoing Support

Unfortunately, one can't just install the ERP system and never touch it again. Advanced ERP implementations require time and attention beyond the initial installation. This includes upgrades to your system and general maintenance.

CRITICAL SUCCESS FACTORS FOR ERP IMPLEMENTATION

A lot has been said about the competitive advantage provided by ERP. An organization decides to take the plunge into the ERP route. The consultants will be hired to bring the "best practices" in the industry. It requires both the knowledge; functional knowledge as well as the software programming skills. The following factors are critical in ERP success.

First and foremost is the top management commitment: The large investments needed to implement ERP ensure that the decisions are invariably taken at the top management level. It is fortunate, but not sufficient. This ensures top management involvement, but it is not tantamount to top management commitment. Here is an

example; to be successful, the ERP team must consist of your "best" people, not those that "can be spared" during the project team. Unless top management takes a conscious decision to take out the "best" people for an extended period of time (several months) at the cost of "losing the best people" during implementation, ERP has little chance of success.

The management commitment involves the management of change. ERP is likely to turn the organization "upside down" unleashing lots of energy from vested interests. Unless top management is involved directly, it is impossible for any line manager to face the oppression to such changes.

Another real test of top management commitment is the resistance to over-customization, particularly in the Indian context. One reason why many computerization efforts in Indian organizations have not been particularly successful is not having "systems in place". ERP implementation is a golden opportunity to put such "systems in place". Thanks to excellent IT skills available in many Indian organizations, there is a strong tendency to "do it your way" leading to large-scale customization. We in the Indian corporate scene recognize that there is no point doing such standard processes and practices in any distinctively different "our" way. It is better to follow the "standard" way and concentrate on "innovative" ways of doing better business.

BENEFITS OF ERP

Enterprise Resource Planning (ERP) involves the organization of computing systems, business processes and procedures under one umbrella designed to improve business efficiency. Originally designed for manufacturing organizations, ERP is now available for a wide range of industries, including financial services companies and companies focused on customer service. In the past, ERP systems were designed for very large organizations. However, many suppliers now offer products for small and medium-sized businesses. ERP systems are being implemented by most of the organisation for innumerable benefits. Some of them are as given:

1. Integrated Information

The key benefit of implementing ERP is integration. ERP helps in reducing operational costs by coordinating various departments of the organization. The major idea behind ERP is to control accuracy as well as redundancy of data and data entry. This centralized working system is able to replace multiple, disconnected databases with a single system, incorporate different applications and data sources. It also aims to lowers help desk support and marketing cost. In addition, this real time application has the capabilities of interfacing internal and external entities. Moreover, ERP is an ideal application to improve the cooperation between departments and employees as well as communication with prospects and customers.

2. Standardization of processes

A manufacturing company that has grown through acquisitions is likely to find that different units use different methods to build the same product. Standardizing processes and using an integrated computer system can save time, increase productivity, and reduce head count. It may also enable collaborating and scheduling production across different units and sites.

3. Standardization of human resource information

This is especially useful in a multi-site company. A unified method for tracking employee time and communicating benefits is extremely beneficial, because it promotes a sense of fairness among the workforce as well as streamlines the company as a whole.

4. Effective Management of Repeatable Processes

One of the fundamental objectives of ERP systems are repeatable processes. By creating repeatable processes, management is able to ensure that tasks are done using organization-wide best practices. Employees are able to improve quality by performing tasks the same way each time.

Repeatable processes also reduce the risk of a key employee leaving with his or her knowledge of how a job is done.

These types of processes are also easier to change. Because a large number of people are performing the same set of tasks, finding improvements can be easier. Rolling out those changes organization-wide can also be easier.

5. Lower Training Costs

Standardizing these processes also results in lower training costs. Because the processes are the same throughout an organization, training programs that are standardized, reduce overall development costs. By standardizing processes, training can be patterned and optimized to reduce the time spent in training. Reduced time spent in training means less non-productive time.

6. Reduced Inventory Costs

Many ERP systems, especially systems designed for manufacturing industries, are customizable for lean manufacturing or other parts-control management systems. By linking repeatable processes with inventory usage, a manufacturer can maintain lower parts inventories.

This is possible because of the integration between processes and ordering. Each time a procedure is executed; inventory levels can be updated in real time. Once a pre-defined level of parts inventory is reached, replacements can be automatically ordered from the supplier.

7. Improved Business Visibility

Depending on how a system is implemented, one objective of an ERP system might focus on business performance and operations visibility. By creating reports based on actual manufacturing tasks, the overall performance of the organization can be more easily analyzed and optimized.

Things that might require tracking include time it takes to complete tasks, production levels, and production units per units of time and almost any measurable that could help an organization analyze performance.

8. Increased Profits

By optimizing production through process visibility, the cost per production unit can be reduced. Reducing training costs can, again, add to the bottom line. By reducing inventory levels, less money is tied up in non-liquid business resources which increase available cash to allow a company to make faster business decisions.

9. Enhanced and Efficient Technology

This software enhances day to day management activities. It also supports strategic planning that defines objectives for the business. Since it has better data accessibility, top management can also use this tool to make better and more effective decisions. In addition, ERP system has a capability of eliminating manual activities and streamlining critical business processes for many departments of an organization. The following are some more benefits that improve the efficiency of an ERP system:

10. Easy Reporting

An ERP system improves and customizes reporting. It provides easy technique of generating reports. With better access to data you can generate and manipulate reports anytime you want to.

11. User Friendliness

This robust and user-friendly application easily eliminates problems without over-grown data tables. Moreover, non-technical people can easily access data or information using ERP applications. This handy application also allows you to deal with high volumes because of its real time capability and future based orientation.

12. Easy Data Accessibility

An ERP system enables you to access real time data and increase self-service of critical information. Many ERP vendors are providing mobile functionalities so that you can always remain connected and well-informed in regards your business processes and performance.

13. Increased Security

ERP system not only improves data integrity and security but also enhances the data restrictions, allowing you to keep your customer information and company data safe and secure.

14. Providing Business and Financial Solution

ERP offers the best business and financial solutions for almost every type of organization. By permitting flow of resources and finances into different and vital business activities it enables enterprises to increased efficiencies in its daily operations.

15. Accuracy & Consistency

An ERP enables companies to maintain consistent and accurate data throughout all the departments enabling the complete flow of information to be viewed through a single system. The department heads can see the timing of employees and total work completed. It provides better visibility and helps in improving the performance of the organization.

16. Better Resource Management

This centralized application provides the tools and reporting capabilities to allow management to better allocate valuable resources. This allows decision makers to monitor and take action during crucial times and prevent delays.

For any productive business organization ERP can play a vital role. A successfully implemented centralized ERP system will help in improving alignment of strategies and operations, productivity and insight, financial management and corporate governance. ERP system also enables in reducing costs through increased flexibility and overall risk. Before implementing ERP system be assured in terms of where and how the organisation will benefit, discussion with the potential suppliers of ERP in this regards plays a vital role.

LIMITATIONS OF ERP

Each good system is having some limitations and for these limitations, sometime people become reluctant to implement good system. ERP is also not different and it has also got some limitations. The limitations which are associated with an ERP system are discussed herein:

1. Difficult to implement in running businesses

Implementing an ERP system in a new business can be very effective. Implementing the same system in an older business can be very difficult. All employees must be trained, and there will be significant down time as the business switches all applications over to the new system. Some businesses cannot afford the profit loss this downtime would require. ERP systems also tend to have industry standards for specific types of businesses, and the strict moulds may lower creativity or competitive advantage.

2. Customization is problematic

Every business has its own requirement and there is no ERP which may be suited for all business's requirement so to implement an ERP system in an organisation, first the detailed study about the different processes of a business is done and then various customizations is done to make the ERP suitable for a particular organisation requirement. The customization process involves lot of money and resources which works as a limitation to the implementation of an ERP system in an organisation.

3. Policy Limitations

ERP systems do not fit the business plans of every enterprise. Often, ERP systems must be customized to allow for specific tasks. Not all ERP systems allow this—depending on the system or company the business uses, it may be against policy to make such drastic changes to the application.

4. Ongoing Support

Support for ERP systems often can be difficult to depend on. Technical response can be adept at dealing with minor problems, but major complications with the ERP systems can be beyond the limited customer service available to businesses.

5. Lack of user participation in ERP implementation

The participation of users is very important for successful implementation of ERP projects – So, exhaustive user training and simple user interface might be critical. Moreover involvement of key users at the pre implementation stage and implementation stage is very important and lack of their involvement acts as a limitation for ERP system.

6. Problem of Harmonization of ERP processes with the business processes

Harmonization of ERP systems can be a mammoth task (especially for big companies) and requires a lot of time, planning, and money.

7. Resistance to change

Implementing ERP system in an organisation requires lot of process changes, starting new process etc. In this process, certain people's profile gets redundant and they need to transfer to other processes. Moreover implementing ERP requires people to new the new processes and technologies. All this become a reason of resistance by people which works as a big limitation for ERP implementation.

8. High Annual Charges

Most of the ERP vendors charge large sum of money for annual license renewal that is unrelated to the size of the company using the ERP or its profitability. This acts as a big limitation for an ERP implementation.

9. Cutting Expenses on Training

Success depends on the skill and experience of the workforce, including training about how to make the system work correctly. Many companies cut costs by cutting training budgets. Privately owned small enterprises are often undercapitalized, meaning their ERP system is often operated by personnel with inadequate education in ERP in general. This acts as a big limitation.

10. Dependency on one Vendor/High switching cost

Once an ERP system is implemented it becomes a single vendor lock-in for further upgrades, customizations etc. Moreover once a system is established, switching costs are very high for any one of the partners (reducing flexibility and strategic control at the corporate level).

CRITERION FOR CHOOSING THE ERP SYSTEM/ERP VENDOR

The right Enterprise Resource Planning system can integrate key business functions, boosting the bottom line. The wrong ERP application can drain your IT budget. The difference between the two can be as simple as knowing which questions to ask as you research the options**.** The following five criteria should top your list when evaluating ERP vendors.

1. Functional Specifications. Does the application accommodate your business needs?

Functional compatibility depends on a complex analysis of your company's unique business needs and the ERP industry's varied solutions.

2. Define and prioritize company processes. Identify core corporate functions, and develop a comprehensive picture based on input from all stakeholders.

3. Identify "showstoppers." A showstopper is the "missing feature or unsupported business process that transforms an otherwise great fit into a complete mismatch." Often these glitches lurk beneath the radar, surfacing upon implementation. The software that can count widgets but can't track corn syrup; the application that won't assign dual currency prices to export items—depending on the enterprise, even the most advanced ERP solution can become a nightmare.

You can avoid functional incompatibility by determining that the ERP system is designed for:

- Discrete or process manufacturing
- Work orders or repetitive manufacturing
- Distributor or manufacturer process management
- Multi-plant or a warehouse environment
- Multilanguage and/or multicurrency needs

4. Evaluate your options: Not all ERPs are created equal. A clue to a product's relative strengths is its origin. Some ERP vendors began by developing manufacturing software; others entered the field via a robust human resources package, or a data warehouse solution. The Oracle Accelerate program leverages the company's broad spectrum of world-class business applications to deliver a comprehensive, modular ERP package.

5. Business Model: Does the application mesh with your corporate culture?

Functional compatibility is absolutely crucial—but it's also important to consider structural fit. "You have to examine more subtle issues such as your company's corporate culture and management style," advises business technology expert Derek Slater. An ERP package may look great on paper, but will it mesh with your model of doing business? Consider not only what your company needs to accomplish, but also how it will do so.

For example, hands-on managers may want to drill down to the details; a big-picture executive will be better served by sleeker financials. Oracle's ERP application excels in aggregating data into expansive transaction reports. Other applications favor a more granular approach.

6. Flexibility: Can the application be modified? Will it scale to accommodate evolving needs? Enterprise Resource Planning is a long-range investment. A flexible system will grow with your company, accommodating new specifications as they emerge. Flexibility is also crucial in the implementation phase, to ensure that the program can align with existing business needs and achieve integration. Look for an ERP solution that will accommodate new operating protocols, future business growth, market expansion, and any other initiatives that might arise.

To evaluate ERP flexibility, consider:

- System parameters and default settings
- Custom screen and menu options
- Tools for modifying standard forms
- Data access options and custom reporting
- Modular format

7. Time to Implement: Will the rollout be quick, effective, and painless?

Implementation can be a daunting prospect when company-wide integration is at stake. Check your ERP provider's implementation track record and methodology. An efficient rollout minimizes the costs and disruption associated with conversion. A speedy, vendor-supported implementation process also promotes user buy-in and a faster time to ROI.

8. Industry Expertise: Does the vendor have a proven track record in your industry?

The ERP solution you choose should come with a pedigree of successful installations in your field. “There are very few companies that don’t have specialized processes dictated by their industry,” says consultant David Dobrin. A proven track record means that the vendor is already well attuned to the particular business requirements of this market sector. “For manufacturers,” for example, “the right system is one that, from its beginning, has been based on a strong process engineering foundation.” Some ERP integration specialists even recommend an on-site visit to an ERP customer in the same industry, if possible. Many ERP providers offer applications customized to a particular industry. The Oracle Accelerate program includes applications for 32 industries, ranging from aerospace to defense to wholesale distribution.

The formula for finding the perfect ERP match is fairly straightforward, provided the team performs the due diligence research. Functional and structural compatibility, flexibility, solid vendor support, and a proven track record add up to an ERP solution that works.

MAJOR ERP SERVICE PROVIDERS

SAP at a glance: Company information

- SAP is the world leader in enterprise applications in terms of software and software-related service revenue. Based on market capitalization, we are the world’s third largest independent software manufacturer. Browse company facts and information below.
- More than 263,000 customers in 188 countries
- More than 68,800 employees – and locations in more than 130 countries
- A 42-year history of innovation and growth as a true industry leader
- Annual revenue (IFRS) of € 16,82 billion
- Listed under the symbol “SAP” on stock exchanges, including the Frankfurt Exchange and NYSE

Founded in 1972, SAP today is the world leader in enterprise applications in terms of software and software-related service revenue, and the world’s third-largest independent software manufacturer based on market capitalization. SAP is headquartered in Walldorf, Germany; it’s legal corporate name is SAP AG. The corporation is listed on the Frankfurt Stock Exchange as well as stock exchanges in Berlin and Stuttgart in Germany and the New York Stock Exchange in the United States. At the end of 2013, its market capitalization was €76.5 billion. SAP is a member of the German DAX and of the Dow Jones EURO STOXX 50 index.

Its continued growth over four decades is attributable to relentless innovation, a diverse portfolio, and our ability to anticipate ever-changing customer requirements. The company’s culture puts our customers’ success at the centre of everything it does, and is driven by passions – which are:

- **Success** – We measure our success by our customers’ success.
- **Accountability** – We embrace accountability and strive to always make good on our promises.
- **Professionalism** – We exhibit professionalism by consistently delivering quality work.
- **Integrity** – We are honest and fair and take responsibility for all our actions.
- **Teamwork** – We value teamwork because it enables us to exceed our individual limits and share greater success.

- **Trust** – We work for each other's success and take personal responsibility for all of our relationships.

SAP derives the revenue from fees charged to its customers for licensing of on-premise software products and solutions, and the use of its cloud solutions by subscription. It also derives revenue from support, consulting, development, training, and other services.

SAP markets and distributes it's products, solutions, and services primarily through a worldwide network of local subsidiaries, which are licensed to distribute SAP offerings to customers in defined territories. Distributorship agreements are in place with independent resellers in some countries. As of December 31, 2013, SAP AG controlled directly or indirectly 272 subsidiaries. These subsidiaries perform various tasks such as sales and marketing, consulting, research and development, customer support, training, or administration.

Business Model

Creating economic, social, and environmental value over the long-term is central to the SAP vision of helping the world run better and improving people's lives. To realize the vision, SAP provides software and services to customers throughout the world, all based on deep expertise in business processes spanning 25 industries.

To provide software and related services to its customers, it rely on financial capital provided by investors. SAP leverage the intellectual capital to continually increase its knowledge base and expertise. Engaged, highly skilled, and agile employees are central to innovating with and building relationships with customers and partners, and ultimately to business success.

The direct sales organizations drive most business development for SAP. Sales go-to-market strategies are established at the global level, and adapted and executed by the regional subsidiaries. Customer-facing employees, in close collaboration with sales support and marketing, drive demand, build pipeline, and enhance relationships with customers within target industries.

In addition, our extensive provides scalability to meet the demand for SAP innovation and provide customers with a wide selection of third-party competencies. Company has developed an independent sales and support force through independent value-added resellers. It has also established partnerships with hardware and software suppliers, system integrators, and third-party consultants.

Its sales model has been focused on charging a one-time, upfront fee for a perpetual license to its software that is typically installed at the customer site. In addition, the customer usually concludes a contract that covers support and software updates. As it sees customers' preferences evolve, it expanded the delivery of solutions in the cloud, which the company believe is a simple and efficient software consumption model. Its cloud solutions are offered under a subscription-based licensing model. With this model, the customer periodically pays a fee to use software for a limited amount of time. This software is installed at an SAP or an SAP partner location, and the customer accesses the software through the Internet.

To help companies invest in SAP solutions and the associated services and hardware, the SAP financing service offers customers payment plans optimized for maximum economic benefit. It can help preserve liquidity, provide an alternative to credit from their existing banking relationships, and balance their budgetary priorities – while giving customers the flexibility to choose the best possible solutions.

It measures the outcome of its activities through four performance indicators: revenue, margin, customer loyalty, and employee engagement. Each of these directly correlates with our ability to deliver financial returns to the providers of capital. Ultimately, it is the highly engaged employees who build the customers' success and loyalty to SAP.

SAP contributes to the creation of long-term value for society in a number of ways. At SAP and within its ecosystem, it support job creation and economic prosperity through demand for highly qualified workers to sell, implement, and enhance the software for customers. Its solutions support the learning and talent development of our customers' employees. Other SAP solutions enhance health and safety, both on the manufacturing side and in the final consumer products, which impact millions of people worldwide.

Its greatest positive environment impact stems from enabling improvements through the solutions it provides to customers. For example, the software plays a primary role in driving supply chain optimization, efficiency gains in production processes, and transparency regarding energy consumption and emissions.

SAP also leverage the expertise in business processes across industries to direct its innovations to the world's greatest challenges, such as the social and environmental strains posed by a rapidly expanding global middle class. Its goal is to create long-term value by providing solutions not just for the current challenges faced by its customers, but also those of the future. This framework underscores how SAP can create its greatest impact through the use of our solutions by more than 253,500 customers worldwide.

ORACLE

Main Highlights of Oracle

Oracle was founded in 1977 by Larry Ellison, Bob Miner and Ed Oates. It is one of the biggest computer technology companies in the world, and the third biggest software company (in terms of revenue). Oracle sells over 300 unique software modules from asset lifecycle management to inventory management to sales order management. Overall, the company has more than 370,000 customers - including all 100 of the Fortune 100 - in 145 countries around the world.

Oracle is one of the world's leading enterprise software companies. Through a series of high-profile acquisitions and their own development, Oracle has built a sophisticated portfolio of business software applications, which complement the company's traditional strength in database and infrastructure systems. The company boasts more than 65,000 customers. Oracle offers applications for nearly any industry, any size organization and to address nearly any business challenge. Their core applications include customer relationship management (CRM), enterprise resource planning (ERP), financial management, human capital management, supply chain management and transportation management.

Oracle has roughly a dozen enterprise software product lines. The core ERP lines include Oracle Fusion Applications, Oracle E-Business Suite, PeopleSoft Enterprise and JD Edwards Enterprise One. Oracle Siebel CRM is a leading CRM suite. Oracle acquired PeopleSoft in 2003 and Siebel in 2005. JD Edwards was purchased by PeopleSoft before the Oracle acquisition.

Oracle also offers business analytics applications through its Hyperion line, project management software through its Primavera line, product lifecycle management through its Agile line and many other independent applications.

Backed by the strength of one of the largest software application companies in the world; committed to technology innovation/integration. Oracle's ERP solution suite helps customers achieve 30-80% lower total cost of ownership, benefit from a predictable cost model, and reduce risk Partner expertise: Oracle solutions leverage third party solutions and add on applications from 19,000 partner companies

After thirty years of providing leading-edge solutions, Oracle remains a major player for database technology and applications in enterprises throughout the world. The company is the world's leading supplier of software for information management, and the world's second largest independent software company. Oracle technology can be found in nearly every industry, and in the data centers of 98 of the Fortune 100 companies. Oracle is the first software company to develop and deploy 100 percent internet-enabled enterprise software across its entire product line: database, business applications, and application development and decision support tools.

Oracle was one of the first companies to make its business applications available through the internet—an idea that is now pervasive. With the release of Oracle Fusion Middleware, Oracle has begun debuting new products and functionality that reflect the company's goal to connect all levels of enterprise technology to help customers access the knowledge they need to respond to market conditions with speed and agility. Today, Oracle Real Application Clusters, Oracle E-Business Suite, Oracle Grid Computing, support for enterprise Linux, and Oracle Fusion all fuel a commitment to innovation and results that has defined Oracle for thirty years.

Oracle applications are now running in over 1,500 public sector organizations, 10 of the world's top 10 banks, 20 of the world's top 20 telecom companies, and 10 of the top 10 academic universities worldwide.

Oracle ERP Key Strengths

1. Oracle's ERP solution suite helps customers achieve 30% - 80% lower total cost of ownership, benefit from a predictable cost model, and reduce risk.
2. With Oracle's powerful, on-demand software technology, over 3.6million end users are able to increase their productivity and gain competitive advantage, resulting in a superior ownership experience.
3. Oracle Enterprise Manager is the only management software that provides complete management solution for business applications, using a unique top-down approach. It provides strong monitoring and management that encompasses end-user experience, application flows, and the underlying software and system infrastructure.
4. Oracle offers proven and open solutions—and a network of partner expertise. The company's solutions are built on open standards and leverage third-party solutions and add-on applications. Oracle's 19,000-strong partner network delivers deep, industry-specific functionality and best practices.

Highlights

Backed by the strength of Microsoft, one of the largest IT companies in the world, it uses very familiar Microsoft interface. Headquarters at Redmond, the company was founded in 1975, New Mexico, USA. It offers complete business management software: ERP, e-commerce, supply chain, manufacturing, CRM, HR, project accounting etc.

Microsoft is creating a family of devices and services for individuals and businesses that unites and empowers people at home, at work and on the go, for the activities they value most. Business solutions from Microsoft, powered by Microsoft Dynamics, play an important and unique role in this strategy. As the world grows smaller and more complicated, technology plays an important role enabling a business to connect their people, with their suppliers and most importantly with their customers. Microsoft Dynamics energizes and empowers these connections with real time information and collaboration. Enabling individuals to drive their vision while also helping organizations manage their end-to-end business processes.

Microsoft Dynamics ERP is software that allows companies of all sizes to manage their entire business organizations, including supply chain, procurement, human resources, financials, and projects. Because this solution touches so many pieces of a business, these ERP solutions collect data to provide you with insights into where you can gain efficiencies, cut costs, or make additional investments.

The following ERP Solutions are offered by the company:

1. **Microsoft Dynamics GP**: is a mid-market business accounting software or ERP software package marketed in North and South America, UK and Ireland, the Middle East, Singapore, Australia and New Zealand. It is used in many additional countries with partner supported localizations. It is one of four accounting packages acquired by Microsoft that now share the Microsoft Dynamics Business Solutions brand.
2. **Microsoft Dynamics NAV**: Microsoft Dynamics NAV is quick to implement, easy-to-use enterprise

resource planning (ERP) software that helps more than 100,000 companies worldwide manage their accounting and finances, supply chain, and operations. It's part of a complete solution for business from Microsoft that helps you work and grow efficiently. Start with what you need now, and easily adapt as your business needs change. The product is part of the Microsoft Dynamics family, and intended to assist with finance, Manufacturing, CRM, supply chains, analytics and electronic commerce for Small and Medium-sized Enterprise and local subsidiaries of large international Groups|small and medium-sized enterprises and local subsidiaries of large international Groups.

3. **Micro soft Dynamics AX**: A business solution that supports both operational and administrative processes of organizations, this single solution comes with localizations—in the box—for 36 countries. With a specialized focus on manufacturing, retail, service industries, and public sector, Microsoft Dynamics AX includes capabilities such as financial management, manufacturing, retail, business intelligence and reporting, supply chain management, and human capital management. Microsoft Dynamics AX 2012 R3 is now available in Enterprise Agreements (EAs), Enterprise Agreement Subscription (EAS), and Campus and School Agreement—Enrolment for Education Solutions (CASA-EES) under Volume Licensing. The EA is appropriate for organizations with more than 250 PCs, devices, and/or users.

Customer Focus

Microsoft distributes its products primarily through the following channels: OEM; distributors and resellers, and online services. Its customers include individual consumers, small and medium-size organizations, enterprises, governmental institutions, educational institutions, internet service providers, application developers, and OEMs.

The company's ERP solution suite, Microsoft Dynamics, offers integrated, adaptable business applications for small and medium-sized organizations and divisions of large enterprises. These integrated solutions—delivered through a worldwide network of experienced Microsoft Certified Partners—work like and with familiar Microsoft software and help automate and improve financial, customer relationship, and supply chain management.

Highlights

Infor is the 10th largest software company in the world, with approximately $2.1 billion in revenue. Over the past six years, Infor has grown to become one of leading business software companies in the world by building and acquiring some of the best solutions in the world. A company unparalleled in application breadth, market experience, open technology and global reach, Infor has 8,000+ employees, direct offices and implementation and support capabilities in 100 countries, and over 70,000 customers worldwide.

The thought leaders at Infor understand that their customers want to reduce the number of vendors they work with and Infor strives to continue as their trusted "vendor of choice." Infor has a consistent 95% customer retention rate — one of the highest in the industry — and 72% of its license revenues are generated by its current customers. Additionally, over 1,000 new customers chose Infor last year for its unparalleled application breadth, open technology, and global reach. The company is committed to continuing its growth by broadening its best-in-class focus, and by providing the most innovative solutions and services globally.

Offers a variety of ERP solutions that help companies in a wide spectrum of subsectors automate, plan, collaborate, and execute based on their unique business requirements. It is world's tenth largest software company. Over 70,000 customers worldwide with 95% customer retention rate, the company serves mid-market manufacturers. Headquartered at Alpharetta, Georgia, it was founded in 2002.

ERP Solutions it offers includes:

Infor ERP Baan/LN

Infor ERP SyteLine

Infor ERP VISUAL

Infor ERP BPCS/LX

Infor ERP Adage

Customer Focus

Infor's customer base comprises mid-market discrete manufacturing enterprises in industrial equipment, high-tech electronics, automotive, metal and plastic fabrication, and aerospace sectors, and mid-market process manufacturers in consumer goods, chemical, and food and beverage markets.

LESSON ROUND-UP

- ERM (enterprise resource management) describes software that lets an enterprise manage user access to its network resources efficiently. ERM (enterprise resource management) also describes software that manages all of a company's assets and resources, including such basic applications as general ledger, accounts payable and receivable, as well as manufacturing, inventory, and human resources.
- ERM system is also widely known as Enterprise Resource Planning system.
- ERP system is implemented in organisation for providing support for all variations of best business practices, enabling implementation of these practices for enhancing productivity, helping in transforming the enterprise functions to be agile, cost-effective and focused on supporting the business objectives and to facilitate the organisation making prompt and effective management decisions.
- The basic modules of an ERP system includes, supply chain, finance, material, finance, human resource. Each module of an ERP system has got some module. For example finance module contain finance, treasury. Cost, account receivable, accounts payable and fixed assets accounting module.
- Various characteristics of an ERP system include Modular structure, Scalable architecture. Seamless integration of modules, RDBMS independent, Independence of hardware platform, Interface capabilities, PC download/upload facility.
- The steps involved in the implementation of an ERP Solution include Identification of the needs for implementing an ERP package, deciding the desired results, Reengineering of the business processes to achieve the desired results. Selecting of ERP package, Installing the requisite hardware and networks, finalizing the implementation consultants. Implementation of the ERP software.
- Critical success factor for implementing ERP includes top management commitment, the management of change and the resistance to over-customization.
- For any productive business organization ERP can play a vital role. A successfully implemented centralized ERP system will help in improving alignment of strategies and operations, productivity and insight, financial management and corporate governance. ERP system also enables in reducing costs through increased flexibility and overall risk. Before implementing ERP system be assured in terms of where and how the organisation will benefit, discussion with the potential suppliers of ERP in this regards plays a vital role.

- Implementing an ERP system in a new business can be very effective. Implementing the same system in an older business can be very difficult. All employees must be trained, and there will be significant down time as the business switches all applications over to the new system. Some businesses cannot afford the profit loss this downtime would require. ERP systems also tend to have industry standards for specific types of businesses, and the strict molds may lower creativity or competitive advantage.
- Major ERP players in the market are SAP, BAAN.ORACLE, and Microsoft Dynamics. In all of these SAP and Microsoft dynamics captures a bigger market share while others are having significant share.

SELF-TEST QUESTIONS

(These are meant for re-capitulation only. Answers to these questions are not to be submitted for evaluation)

1. What do you mean by the term “ERM’? Explain the basic objectives of implementing ERM.
2. What are the critical success factors for implementing ERP in an organisation? Explain in details.
3. What do you mean by the term ERP? Explain its features, its advantages and limitations?
4. AB and Limited want to implement SAP in the organisation while it has been using another ERP presently. What are the consideration which AB limited needs to keep in consideration while switchover to SAP?
5. Who are the major players in ERP implementation? Explain two of them in detail.
6. While selecting an ERP system, what are the criterions which need to be kept into consideration?

Lesson 10
E-Governance in India

LESSON OUTLINE

- Meaning of governance
- Meaning of governance
- History of E Governance in India
- Models of e governance
- Benefits of E Governance
- E Governance evolution in India-Challenges
- E governance action plan
- Requirements for implementing successful E governance
- National E-governance division
- National e governance plan
- E governance infrastructure
- State wide area network (SWAN)
- National service delivery gateway (NSDG)
- Common Service centre

LEARNING OBJECTIVES

E-Governance is the use of information and communication technologies to support good governance.E-governance is the natural progression from computerization of Government departments with the developments in information and communication technology and increasing access of internet based services and platforms to common people.

E governance has revolutionized the entire government machinery and it has helped in removing various disadvantages of government regulatory system. It is the result of e governance revolution that we are able to perform functions like book railway/bus ticket online, file our tax return instantaneously and get access of company's master data instantaneously. The benefits of e governance are many more and list is very long.

After reading this lesson, one would be able to

- Understand the meaning and objectives of E-Governance
- Learn about Various models of E-Governance
- Different areas of E-Governance
- Benefit and challenges in E-Governance
- Requirements of implementing successful E-Governance
- Know about national E-Governance division and national E-Governance plan
- Learn about E governance infrastructure, SWAN and NSDG

E-Governance in India has steadily evolved from computerization of Government Departments to initiatives that encapsulate the finer points of Governance, such as citizen centricity, service orientation and transparency. The National e-Governance Plan (NeGP), takes a holistic view of e-Governance initiatives across the country, integrating them into a collective vision and a shared cause. In this section we are highlighting the initiatives of the Central and State governments to bring public services closer to the citizens.

MEANING OF E-GOVERNANCE

E-Governance or 'electronic governance' is basically the application of Information and communications Technology to the processes of Government functioning in order to bring about 'Simple, Moral, Accountable, Responsive and Transparent' (SMART) governance. This would generally involve the use of IcTs by government agencies for any or all of the following reasons: (a) Exchange of information with citizens, businesses or other government departments (b) Speedier and more efficient delivery of public services (c) Improving internal efficiency (d) Reducing costs / increasing revenue (e) Re-structuring of administrative processes and (f) Improving quality of services.

Although the term 'e-Governance' has gained currency in recent years, there is no standard definition of this term. Different governments and organizations define this term to suit their own aims and objectives.

Gartner Group defines e-governance as: "the continuous optimization of service delivery, constituency participation, and governance by transforming internal and external relationships through technology, the Internet and new media."

The UNESCO definition (www.unesco.org) is: "E-governance is the public sector's use of information and communication technologies with the aim of improving information and service delivery, encouraging citizen participation in the decision-making process and making government more accountable, transparent and effective. E-governance involves new styles of leadership, new ways of debating and deciding policy and investment, new ways of accessing education, new ways of listening to citizens and new ways of organizing and delivering information and services. …….. Its objective is to engage, enable and empower the citizen."

According to Keohane and Nye (2000), "Governance implies the processes and institutions, both formal and informal, that guide and restrain the collective activities of a group. Government is the subset that acts with authority and creates formal obligations. Governance need not necessarily be conducted exclusively by governments. Private firms, associations of firms, nongovernmental organizations (NGOs), and associations of NGOs all engage in it, often in association with governmental bodies, to create governance; sometimes without governmental authority." Clearly, this definition suggests that e-governance need not be limited to the public sector. It implies managing and administering policies and procedures in the private sector as well.

Basically, e-Governance is generally understood as the use of Information and communications Technology (IcT) at all levels of the Government in order to provide services to the citizens, interaction with business enterprises and communication and exchange of information between different agencies of the Government in a speedy, convenient efficient and transparent manner.

Dr. APJ Abdul Kalam, former President of India, has visualized e-Governance in the Indian context to mean:

> "A transparent smart e-Governance with seamless access, secure and authentic flow of information crossing the interdepartmental barrier and providing a fair and unbiased service to the citizen."

OBJECTIVES OF E-GOVERNANCE

E –Government can transform citizen services, provide access to information to empower citizens, enable their participation in government and enhance citizen economic and social opportunities, so that they can make better lives, for themselves and for the next generation. The e-governance objectives can be summarized as:

- To provide citizens access to information and knowledge about the political process, about services and about choices available.
- To make possible the transition from passive information access to active citizen participation by Informing, Representing, Encouraging, Consulting and involving the citizen.
- To satisfactorily fulfil the public's needs and expectations on the front office side, by simplifying their interaction with various online services.

- In the back-office side, to facilitate a speedy, transparent, accountable, efficient and effective process for performing government administration activities.

E-GOVERNNCE EVOLUTION IN INDIA

Today's is the world of change and revolution. Things which are not dynamic are considered as mortal. The rise of e-government has been one of the most striking developments of the web Global shifts towards increased deployment of IT by governments emerged in the nineties, with the advent of the World Wide Web. The technology as well as e-governance initiatives have come a long way since then. Recognizing the increasing importance of electronics, the Government of India established the Department of Electronics in 1970. The subsequent establishment of the National Informatics centre (NIc) in 1977 was the first major step towards e-Governance in India as it brought 'information' and its communication in focus. However, the main thrust for e-Governance was provided by the launching of NIcNET in 1987 – the national satellite-based computer network. This was followed by the launch of the District Information System of the National Informatics centre (DISNIc) program to computerize all district offices in the Country for which free hardware and software was offered to the State Governments. NIcNET was extended via the State capitals to all district headquarters by 1990.

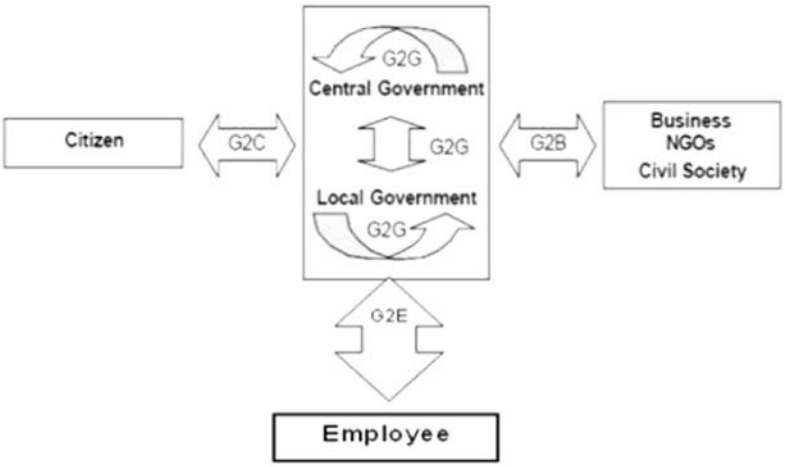
E-Governance was started in India by AKSHAYA in Kerala. This project involves setting up around 5000 multipurpose community technology centers called Akshaya e- Kendra's across Kerala. Run by private entrepreneurs, each e-Kendra set up within 2-3 kilometers of every household, will cater to the requirements of around 1000-3000 families to make available the power of networking and connectivity to common man. Akshaya is a social and economic catalyst focusing on the various facets of e-learning, e-transaction, e-governance, information and communication.

E-Governance is not only popular in India but also worldwide. To make working of government more efficient, responsive and transparent many developed and developing countries have taken some useful steps for the expansion of e-governance in their respective countries.

E-GOVERNANCE MODELS

E-GOVERNANCE itself is governed by the needs and demands of citizens, businesses, government and employees. These four models of e-governance are as:-

1. Government to citizens (G2C)
2. Government to government (G2G)
3. Government to employees (G2E)
4. Government to business or Business to government (G2B or B2G)



GOVERNMENT TO CITIZEN (G2C)

This model of e-governance refers to those activities in which the government provides one- step, on-line access of information and services to citizens. G2C applications enable citizens to ask questions of government agencies and receive answers such as file income taxes (federal, state and local), pay taxes (income, real estate), renew driver licenses etc. It gives citizens the choice of when to interact with the government (e.g. 24 hours a day, 7 days a week), from where to interact with the government (e.g. service centre or from one's home/workplace) and how to interact with the government (e.g. through internet, fax, telephone, e-mail etc.)

Type of services which are provided by this model includes:-

- Payment of online bills such as electricity, water, telephone bills etc.
- Online registration of applications.
- Copies of land-record.
- Online filling of complaints.
- Availability of any kind of online information.

GOVERNMENT TO GOVERNMENT (G2G)

This model refers to the services which are shared between the governments. There is lots of information that need to be shared between various government agencies, department and organizations. Many of these activities are aimed at improving the efficiency and effectiveness of overall government operations. These types of services or information are as:-

- Sharing of information between police department of various state.
- Government document exchange which includes preparation, approval, distribution, and storage of all governmental documents is also done through e-governance.
- Most of the finance and budget work are also done through e-governance.

GOVERNMENT TO EMPLOYEES (G2E)

This model increases the transparency between government and its employee. Here, employee can keeps a check on the functioning and working of government and government can keeps on its employees. Information that can be shared by this model:-

- All kind of data submission (attendance record, employee record etc) from various government offices is done by this model
- Employee can file all kinds of complaints and dissatisfaction by this model.
- All kind of rule- regulation and information for employees can be shared by this.
- Employees can check their payment and working record.
- Employees can register all kind of working forms online.

GOVERNMENT TO BUSINESS OR BUSINESS TO GOVERNMENT (G2B OR B2G)

In G2B, the government deals with businesses such as suppliers using the internet and other ICTs. It includes two-way interactions and transactions government to business and business to government. B2G refers to the business selling products and services to government. The B2G initiatives can be transactional such as in licensing, permits, procurement and revenue collection. The objective is to cut red tape, save time, reduce operational costs and to create a more transparent business environment when dealing with the government.

They share information through this model like:-

- Collection of taxes.
- Rejection and approval of patent is also done by this model.
- Payment of all kind of bills and penalty.
- Sharing of all kind of information, rules and data.
- Complaints or any kind of dissatisfaction can be shown by this.

E-governance is beyond the scope of e-government. While e-government is defined as a mere delivery of government services and information to the public using electronic means, e-governance is not just about government web site and e-mail. It is not just about service delivery over the Internet. It is not just about digital access to government information or electronic payments. E-governance will allow citizens to communicate with government, participate in the government's policy-making and to communicate with each other. The e-governance will truly allows citizens to participate in the government decision-making process, reflect their true needs and welfare by utilizing e-government as a tool.

DIFFERENT AREAS OF E-GOVERNANCE

Today area of e-governance is very wide. E-Governance is implemented by government in almost every field. From urban states to rural areas and from politics to teaching e-Governance has spread its root everywhere. Either its public or private sector, common man or businessman all is largely dependent on e-governance. Here we have presented different areas where e-governance is widely used. In the following section, we are describing the projects used in urban and rural areas of India.

1. E-GOVERNANCE IN URBAN AREAS

Transportation:- Services provided by e-governance in this area are:-

- Issuance of Time Table of buses.
- Provision of booking facility for Interstate transport.
- Transportation Improvement Program.
- Regional Transportation Plans.
- Congestion Management Process.
- Transportation Demand Management.

Various projects:-

1. CFST:-Citizen Friendly Services of Transport Department by Andhra Pradesh government to provide services such as Issue of learner licensees, Issue of driving licenses, Renewal of driving licenses etc
2. Vahan and Sarathi:-The backend applications Vahan &Sarathi help in speeding the overall work flow in the transport department by Tamil Nadu govt.
3. OSRTC:- The Orissa State Road Transport Corporation project was started to provide transport related facilities online .
4. HRTC: - Himachal Road Transport Corporation project is for online bookings, cancellation of seats, for enquiry about departure of buses, availability of seats and buses etc.

Online payment of bills and taxes:-Services provided by e-governance in this area's are as follows –

- Online Transaction
- Payment of Bill

- Payment of taxes
- Payment of house EMIs

Various Projects:-

1. FRIENDS: - This project is started by Kerala Government for its citizens to make online payment of electricity and water bills, revenue taxes, license fees, motor vehicle taxes, university fees, etc.
2. E-SEVA:-Electronic seva by Andhra Pradesh government to pay utility bills, avail of trade licenses and transact on government matters for these facilities.
3. DOMESTIC: - This project is started by Daman and Diu. It is an Electricity Billing System for domestic consumers.
4. E-Pourasabha Municipal Application:-E-Pourasabha is an e-governance application for urban local bodies. It is implemented for Tax Collection system, Property Tax, Water Tax etc.
5. E-Mitra by the Government of Rajasthan
6. SAMPARK by Chandigarh government
8. E-Suvidha by the government of Uttar Pradesh

Information and public relation key services:-With these kinds of projects people can get any kind of information with just a single click.

Various projects:-

1. LokMitra by the government of Himachal Pradesh : The services offered include information about vacancies, tenders, market rates, matrimonial services, village e-mail.
2. Mahiti Shakti : By Gujarat government to provide information related to its working to its citizens.
3. OLTP : With this project 16 government departments in Andhra Pradesh are connected on a single network.

Municipal services : Services provided are as :

- House Tax Assessment, Billing and Collection.
- Maintain records of Land & property.
- Issue of Death Certificates.
- Registration & Attorneys of properties.
- Review and approval authority for site plans

Various projects:-

1. E-Panjeeyan:-It is started by Assam government to deal with the computerization of the Document registration work at Sub Registrar Office.
2. SDO Suite:-This project is executed by Assam government. This system helps in issuing various certificates like Land sale Permission, Legal heir certificate, Issue of Passport Verification Certificate, Birth and Death Report,
3. Palike:-The Palike-property tax software capture the basic details of the owner and property, payment details for which receipt is generated and given to the citizen was hosted.
4. Rural Digital Services (Nemmadi):-Provide services such as issuance of certificates, issuance of orders in respect of Social Security Schemes such as old age pension, widow pension, freedom fighter pension etc.
5. TRIS:- Tripura Registration Information System is meant for capturing of online photograph and bio-metric impression, Service for visit commission, request for duplicate document, searching of document etc.

Roads and traffic management:- Services provided by this type of e-governance is:-

- Network of Roads & Bridges
- Road construction and their maintenance
- Traffic Management
- Safety, Accident and pollution control

Various projects:-

1. BHOOSWADEENA-This project is computerized land acquisition system with tight integration with BHOOMI. The purpose of this project is to develop a system to automate the process Land acquisition
2. I-Geo Approach Internet Geometrics:-Purpose of this project is development of Geometrics based web enabled decision support system for Rural Road Network of Madhya Pradesh.
3. RSPCB (Rajasthan State Pollution Control Board);-The project relates to establishment of computer based system by fulfilling the Hardware, Software and Networking Requirements The project will be beneficial to the Government, Central Pollution Control Board, RSPCB itself.
4. CFST:- Citizen Friendly Services of Transport Department This project is started by the government of Andhra Pradesh to keeps check on pollution control, road safety, road signs and safety of its citizens.

2. E-GOVERNANCE IN RURAL AREAS

In rural areas e-governance has its very powerful impact. Here, from agriculture to local information everything is done through e-governance.

Agriculture:- Following are the projects used in Agriculture.

1. Gyandoot: In the State of Madhya Pradesh it is an Intranet-based Government to citizen (G2c) service delivery initiative.
2. BELE:- It is a web-based application with 3-tier architecture for capturing and monitoring the major activities and services.
3. AGMARKNET: - It is a project approved by Department of Marketing & Inspection (DMI), Ministry of Agriculture, and Government of India.
4. SEEDNET:-It is a SEED informatics network under ministry of Agriculture, Government of India. The project was started in Chhattisgarh in the month of July' 2008 for Kharif season.
5. Mustard Procurement Management System:- It is started by Haryana government. It Conducted the Survey of mustard sown by the farmers and feed this data in to the database of the system. This data is then processed and generate coupons having information of dates on which farmer may visit in the market (mandi) to sale his mustard.

Local information: - For local information such as prices of seeds, fertilizers, loan rates etc. government has started e-governance service in this area also.

Various projects:-

1. E-JanSampark:-Services & Information accessible to the common man in his locality to meet his basic need. This project is started by Chandigarh.
2. Prajavani: - it is started by the Government of Andhra Pradesh. it is a Web based On-line Monitoring of Public Grievances.
3. Web Portal for Hyderabad and Cyberabad Police : It is designed by Hyderabad, developed and hosted

with many exciting public utility features like Safety tips for all citizens, verificatiosn status of Passports, Stolen vehicles etc.

4. Intranet Portal of Chandigarh Administration:-It provides an environment where administration could interact.
5. E-DISHA EkalSewa Kendra:-This project is started by Haryana government.E-Disha to deliver any service from any counter/location, so at the peak requirements of services, counters can be extended as per crowd.
6. E-Samadhan: - the Government of Himachal Pradesh stressed upon to develop grievances redressed mechanism so that the genuine public grievances may be redressed in a time bound manner.

Land record management:-.By facilitating e-governance service in this area, millions of land records can be maintain in a very short time span.

Major projects in this area are:-

1. Bhoomi :- It is the first e-Governance land records management system project which is successfully implemented for the benefits of the common man by the Government of Karnataka.
2. Comprehensive Modernization of Land Records (CMLR):- This project is started by the government of Andhra Pradesh. It allows integrating functions of property registration, mutations and updating of field survey maps.
3. Land Record Computerisation: - The objective of the project is to computerize fresh allotment, land transfer, regularisation of occupied land etc. related actives of the Dept. of Land Management at district level.
4. Gyandoot: - it is an intranet in Dhar district of Madhya Pradesh, connecting rural cybercafés catering to the everyday needs of the masses.
5. Land Records Management System by the State Government of Punjab.
6. Devbhoomi State Government of Uttarakhand.
7. Bhu-Lekh – UP State Government of Uttar Pradesh.
8. E-Dhara State Government of Gujarat.

Panchayat:-Services provided by e-governance in this area are:-

- Issue of Birth/Death certificate.
- Application for inclusion of name in Voter list.
- Conducting various welfare schemes for the poor and needy sections of the society.
- Preparing district wise planning, implementing those plan, and review for success.
- To provide wage employment to the needy from amongst the poorest section of the rural society.
- Rural water supply and sanitation.

Various projects:-

1. E-GramViswa Gram Project:- This Project Initiates e-Gram Project connecting 13716 Gram Panchayats and 6000 Citizen Common Service Centres as a part of the e-Gram connectivity Project by Gujarat.
2. RajNidhi: - “RajNidhi” is a web enabled information kiosk system developed jointly by Rajasthan state’s Department of Information Technology and Rajasthan State Agency for Computer Services (Raj Comp) [4].

3. Raj-SWIFT:-The Rajasthan State's Department of Information Technology (DoIT) has developed Government's own Intranet called as "raj-SWIFT"[4]
4. Support for P & RD sector in Assam:-NIC, Assam State Centre has been identified as the technical consultant for e-Governance solution and computerization of the Department of Panchayat and Rural Development.
5. SamanyaMahiti by the State Government of Karnataka

3. E-GOVERNANCE IN HEALTH

Services provided in this area are:-

- Availability of medicines
- Special health camps
- Facilities at Anganwadi canters

Various projects:-

1. Online Vaccination Appointment for International Traveller:-Citizen centric application for the purpose of vaccination of the persons proceeding abroad and issuance of International Health Certificate
2. SMS based Integrated Disease Surveillance System: - it is an SMS based Integrated Disease Surveillance System facilitates to report the occurrences of disease, number of persons affected from the area of occurrences immediately to the concerned authority.
3. Hospital OPD Appointment:-Hospital OPD Appointment System is another welfare measure undertaken by Chandigarh Administration to make life of citizens simpler.
4. NLEP (National Leprosy Eradication Program):-NLEP is web based application developed for monitoring of leprosy cases in Chhattisgarh State.
5. HEALING:-it is a Health Information system for Kerala Government which is developed and implemented for Medical Health & Family Welfare department

4. E-GOVERNANCE IN EDUCATION:

- Providing basic education (elementary, primary, secondary) to children
- Providing computer education to children
- Results for 10th& 12thclasses
- Information on eligibility for "Distribution of books" scheme

Various projects:-

1. CASCET:-This project is started by the Karnataka governments for Education Department.
2. Online Scholarship Management System:-It is meant for the purpose of distribution of scholarships and fees reimbursement.
3. AISES (All India School Education Survey):- This project is started by Assam government. This project is used for surveying the number of schools in district.
4. CAPnic:-This is for the Centralized seat allotment process for professional courses and come under Kerala governments.
5. VHSE Examination Management System:-it has been developed to handle pre-examination related activities of the vocational higher secondary education.

BENEFITS OF E-GOVERNANCE

E-Governance is about reform in governance, facilitated by the creative use of Information and communications Technology. It is expected that this would lead to:

– *Better access to information and quality services for citizens*: IcT would make available timely and reliable information on various aspects of governance. In the initial phase, information would be made available with respect to simple aspects of governance such as forms, laws, rules, procedures etc. later extending to detailed information including reports (including performance reports), public database, decision making processes etc. As regards services, there would be an immediate impact in terms of savings in time, effort and money, resulting from online and one-point accessibility of public services backed up by automation of back end processes. The ultimate objective of e-Governance is to reach out to citizens by adopting a life-cycle approach i.e. providing public services to citizens which would be required right from birth to death.

– *Simplicity, efficiency and accountability in the government*: Application of IcT to governance combined with detailed business process reengineering would lead to simplification of complicated processes, weeding out of redundant processes, simplification in structures and changes in statutes and regulations. The end result would be simplification of the functioning of government, enhanced decision making abilities and increased efficiency across government – all contributing to an overall environment of a more accountable government machinery. This, in turn, would result in enhanced productivity and efficiency in all sectors

– *Expanded reach of governance*: Rapid growth of communications technology and its adoption in governance would help in bringing government machinery to the doorsteps of the citizens. Expansion of telephone network, rapid strides in mobile telephony, spread of internet and strengthening of other communications infrastructure would facilitate delivery of a large number of services provided by the government. This enhancement of the reach of government – both spatial and demographic – would also enable better participation of citizens in the process of governance.

CHALLENGES IN E-GOVERNANCE

i. Lack of Integrated Services - Most of the e-Governance Services being offered by state or central governments are not integrated. This can mainly be attributed to lack of communication between different departments. So the information that resides with one department has no or very little meaning to some other departments of Government.

ii. Lack of Key Persons – E-Governance projects lack key persons, not only from technological aspect, but from other aspects as well such as lack of proper coordination among government machineries and solution developers.

iii. Lack of Infrastructure- underutilization of existing ICT infrastructure and lack of infrastructure for sustaining e-Governance projects on national level.

iv. Population - This is probably the biggest challenge. Apart from being an asset to the country it offers some unique issues, an important one being Establishing Person Identities. There is no unique identity of a person in India. Apart from this, measuring the population, keeping the database of all Indian nationals (& keeping it updated) are some other related challenges.

v. Different Languages- A challenge due to the diversity of the country. It enforces need to do governance (up to certain level), in local languages. Ensuring e-Governance in local language is a big task to achieve.

REQUIREMENTS OF IMPLEMENTING SUCCESSFUL E-GOVERNANCE

Some of the requirements for implementing successful e-governance across the nation are:

1. E-Governance framework across the nation with enough bandwidth to service a population of one billion.
2. Connectivity frameworks for making the services reach rural areas of the country or development of alternative means of services such as e-governance kiosks in regional languages. There should be a strong connectivity for an effective e-governance.
3. National Citizen Database which is the primary unit of data for all governance vertical and horizontal applications across the state and central governments.
4. E-governance and interoperability standards for the exchange of secure information with non-repudiation, across the state and central government departments seamlessly.
5. A secure delivery framework by means of virtual private network connecting across the state and central government departments.
6. Data centers to handle the departmental workflow automation, collaboration, interaction, exchange of information with authentication.

Proper arrangement of capital, it refers to money used by government to provide their services or to that sector of the economy based on its operation.

For success of an e-governance project and superior service delivery, it is imperative that the government agencies focus on whole citizen experience. Focusing on the citizen is essential for long term success. The govt. agencies need to integrate information from each and every point of citizen interaction. The overall architecture for e-Governance needs to ensure that the architecture components are extensible and scalable to adapt to the changing environments. The e-Governance applications that are emerging as islands of successes have to be interoperable.

Suggestion for implementing successful e-governance

(a) Create Literacy and commitment to e-governance at high level

The most important requirement is a training program for policy makers in E-Governance (Senior Public Servants), politicians and IT task force members. The training program needs to be focused according to the requirements of the policy makers at the top. Such programs can be need based and outsourced when required. In addition it should be made mandatory for all the stake holders in implementation and maintenance of e-governance services to have the general IT skills. There may be specific requirements for training in certain specific projects. Such programs can be need based and outsourced when required. A few suggestive programs include e-governance training, Building web interfaces for citizen interaction, Document management and workflow applications, security and PKI solutions, Office Automation, networking etc.

(b) Conduct Usability Surveys for assessment of existing e-governance projects

There is a varying degree of development of e-governance among the different states. A few States have leapfrogged into a digital era whereas a few are yet to start with any initiative. There is a tremendous divergence in the extent of implementation of the concept of e-Governance. It is, therefore, not possible to come up with a framework for implementation of e-Governance which is straightaway applicable to all states and the Central Government. Therefore an e-readiness exercise should be carried out in all states, government departments to understand their level of acceptability of the e-governance.

(c) Starting with implementation of pilot projects and replicating the successful ones

The pilot projects taken in various states should be accessed for their achievement levels. They should be classified as success or failure according to the desired output written down before implementation of the projects. The study should be carried out by an independent agency for the implementation agency. The study should be

carried out at each stage of implementation. Bottlenecks and causes of delays should be documented, even though they are removed later. The successful projects should be replicated over the nation with members drawn from the implementing team. The projects, which could not achieve the desired outcome, should be documented for possible causes of failure. Various bottlenecks and causes of delay should be identified.

(d) Follow the Best Practices in e-governance

The study of Best Practices will bring forward the best practices being followed in some states, nationally and internationally. The national and international Best Practices study will give a great momentum to the process of E-Governance. The State Governments will not have to re-invent wheel every time and they can learn from the developments already made.

(e) Build National resource Database of e-governance projects

This would allow any organization planning an IT project to instantly ascertain whether any such project has already been implemented anywhere in the country. Intending implementers would know who the key people in similar projects are and how to reach them. It is well known that it is much easier to replicate a solution than to evolve it the first time around. So the lead-time to implement projects can be reduced substantially.

If a project is already in operation in a similar environment somewhere in the country, acceptance by all concerned is much faster and smoother elsewhere. So change management becomes much easier and the time and effort involved in such implementations. Due recognition would accrue to the pioneers who created the successes. It would enable others to learn from them if they wish.

For implementing agencies, be they Government owned organizations like NIC, CDAC and State PSUs or private IT companies, it offers a unique opportunity to derive the full return and reward, both domestically and internationally, from their successes and the IPRs/ products that they have created. It would help create an archive of e-governance applications in the country.

(f) Have clearly defined Interoperability policy

The e-governance architecture needs to ensure that the components are scalable and adaptable to the future requirements. It has also to ensure that the local architecture fits into the State level and the same into National and Global architecture. Interoperability is a major criterion while defining the architecture.

(g) Manage and Update content on govt. websites efficiently and regularly

Content is the ‘heart’ of any IT project. The govt. agency has to keep in mind some of the important technical guidelines, while developing the software and computerization, to facilitate the future integration. The department also needs to address the security of transactions and messages. The process of content development encompasses a whole range of activities starting with a comprehensive study of the system and identification of the objectives. It ends up with delivery of the intended benefits to the citizens or other users of the IT System. The govt. agencies must ensure that the data on the sites is always updated and relevant.

Conclusion

It is evident from above discussion that objectives of achieving e-governance and transforming India go far beyond mere computerization of stand-alone back office operations. It means, to fundamentally change as to how the government operates, and this implies a new set of responsibilities for the executive and politicians. It will require basic change in work culture and goal orientation, and simultaneous change in the existing processes. Foremost of them is to create a culture of maintaining, processing and retrieving the information through an electronic system and use that information for decision making. It will require skilled navigation to ensure a smooth transition from old processes and manual operations to new automated services without hampering the existing services. This can be achieved by initially moving ahead in smaller informed initiatives in a time bound manner and avoiding large and expensive steps without understanding the full social implications. Every small

step thus taken should be used to learn about hurdles and improve upon the next steps, both in terms of direction and magnitude. The proposed changes are likely to be met with a lot of inertia which cannot be overcome by lower and middle level officials with half hearted attempts to diffuse the technology. The change in the mindset to develop and accept the distributed and flat structured e-governance system is required at the top level system to beat the inertia.

NATIONAL E-GOVERNANCE PLAN

Over the years, a large number of initiatives have been undertaken by various State Governments and Central Ministries to usher in an era of e-Government. Sustained efforts have been made at multiple levels to improve the delivery of public services and simplify the process of accessing them.

E-Governance in India has steadily evolved from computerization of Government Departments to initiatives that encapsulate the finer points of Governance, such as citizen centricity, service orientation and transparency. Lessons from previous e-Governance initiatives have played an important role in shaping the progressive e-Governance strategy of the country. Due cognizance has been taken of the notion that to speed up e-Governance implementation across the various arms of Government at National, State, and Local levels, a programme approach needs to be adopted, guided by common vision and strategy. This approach has the potential of enabling huge savings in costs through sharing of core and support infrastructure, enabling interoperability through standards, and of presenting a seamless view of Government to citizens.

The National e-Governance Plan (NeGP), takes a holistic view of e-Governance initiatives across the country, integrating them into a collective vision, a shared cause. Around this idea, a massive countrywide infrastructure reaching down to the remotest of villages is evolving, and large-scale digitization of records is taking place to enable easy, reliable access over the internet. The ultimate objective is to bring public services closer home to citizens, as articulated in the Vision Statement of NeGP.

> **"Make all Government services accessible to the common man in his locality, through common service delivery outlets, and ensure efficiency, transparency, and reliability of such services at affordable costs to realise the basic needs of the common man"**

The Government approved the National e-Governance Plan (NeGP), comprising of 27 Mission Mode Projects (MMPs) and 8 components, on May 18, 2006. The Government has accorded approval to the vision, approach, strategy, key components, implementation methodology, and management structure for NeGP. However, the approval of NeGP does not constitute financial approval(s) for all the Mission Mode Projects (MMPs) and components under it. The existing or ongoing projects in the MMP category, being implemented by various Central Ministries, States, and State Departments would be suitably augmented and enhanced to align with the objectives of NeGP.

Implementation Strategy, Approach and Methodology of NeGP

Implementation of e-Governance is a highly complex process requiring provisioning of hardware & software, networking, process re-engineering and change management. Based on lessons learnt from the past and the experience from successful e-Governance applications, the approach and methodology adopted for NeGP contains the following elements:

(i) ***Common Support Infrastructure:*** NeGP implementation involves setting up of common and support IT infrastructure such as: State Wide Area Networks (SWANs), State Data Centres (SDCs), Common Services Centres (CSCs) and Electronic Service Delivery Gateways.

(ii) ***Governance:*** Suitable arrangements for monitoring and coordinating the implementation of NeGP under the direction of the competent authorities have also been substantially put in place. The programme also involves evolving/ laying down standards and policy guidelines, providing technical support, undertaking capacity building, R&D, etc. DEITY is required to adequately strengthen itself and various institutions like NIC, STQC, CDAC, NISG, etc. to play these roles effectively.

(iii) ***Centralised Initiative, Decentralised Implementation:*** e-Governance is being promoted through a centralised initiative to the extent necessary to ensure citizen-centric orientation, to realise the objective of inter-operability of various e-Governance applications and to ensure optimal utilisation of ICT infrastructure and resources while allowing for a decentralised implementation model. It also aims at identifying successful projects and replicating them with required customisation wherever needed.

(iv) ***Public-Private Partnerships (PPP):*** PPP model is to be adopted wherever feasible to enlarge the resource pool without compromising on the security aspects.

(v) ***Integrative Elements:*** Adoption of unique identification codes for citizens, businesses and property is to be promoted to facilitate integration and avoid ambiguity.

(vi) ***Programme Approach at the National and State levels:*** For implementation of the NeGP, various Union Ministries/Departments and State Governments are involved. Considering the multiplicity of agencies involved and the need for overall aggregation and integration at the national level, NeGP is being implemented as a programme, with well-defined roles and responsibilities of each agency involved. For facilitating this, appropriate programme management structures have also been put in place.

(vii) ***Facilitator role of DEITY:*** DEITY is the facilitator and catalyst for the implementation of NeGP by various Ministries and State Governments and also provides technical assistance. It serves as a secretariat to the Apex Committee and assists it in managing the programme. In addition, DEITY is also implementing pilot/ infrastructure/ technical/ special projects and support components. DARPG's responsibility is towards Government Process Re-engineering and Change Management, which are desired to be realised across all government departments. Planning Commission and Ministry of Finance allocate funds for NeGP through Plan and Non-plan budgetary provisions and lay down appropriate procedures in this regard.

(viii) ***Ownership of Ministries:*** Under the NeGP, various MMPs are owned and spearheaded by the concerned line Ministries. In case there are any ongoing projects which fall in the MMP category, they would be suitably enhanced to align them with the objectives of NeGP. For major projects like Bharat Nirman, Rural Employment Guarantee Schemes, etc. the line ministries concerned are advised to make use of e-Governance as also automation techniques from the inception stage. States have been given the flexibility to identify a few additional state-specific projects, which are relevant for the economic development of the State.

NATIONAL E-GOVERNANCE DIVISION (NEGD)

The Capacity Building Scheme under the National e-Governance Plan (NeGP) of Government of India envisions establishment of an institutional framework for State-Level decision-making including setting-up of State e-Mission Teams (SeMTs) having relevant expertise and experience to provide technical and professional support to States and Union Territories.

For this purpose, the Department of Information Technology (DIT), Government of India, has created NeGD as an autonomous business division within Media Lab Asia, under the Ministry of Communications and Information Technology, Government of India, for taking up the tasks being carried out by the Programme Management Unit National e-Governance Plan (PMU-NeGP) at DIT.

Functions of NeGD

1. Programme Management of NeGP, inter-alia including facilitating and supporting DIT in undertaking the following tasks and responsibilities assigned to DIT under NeGP:
   (a) Facilitating implementation of NeGP by various Ministries and State Governments
   (b) Providing technical assistance to Central Ministries and State Line Departments
   (c) Serving as a secretariat to the Apex Committee
   (d) Undertaking technical appraisal of all NeGP projects to examine issues such as overall technology architecture, framework, standards, security policy, service delivery mechanism, sharing of common infrastructure etc.
   (e) Human Resource Development, Training and Awareness Building
   (f) Framing core policies, technical assistance, R&D, awareness and assessment and creation of organization structure
   (g) Acting as a Central Agency for an effective implementation of Capacity Building Scheme inter-alia involving provisioning of manpower at various SeMTs across States/ UTs
2. Positioning of a Capacity Building Management Cell for effective management of manpower at SeMTs together with management of other Scheme activities including training, setting up HR policies, etc.

E-GOVERNANCE INFRASTRUCTURE

E-governance infrastructure in Indian may be understood with the help of following figure.

The infrastructure required for implementing E governance in India is categorized as

1. State Wide Area Network (SWAN)

2. Data Centre
3. NSDG
4. Common Services Centers

STATE AREA WIDE NETWORK (SWAN)

Wide Area Network is an advanced telecommunication infrastructure, which is used now-a-days extensively, for exchange of data and other types of information between two or more locations, separated by significant geographical distances. The medium of connectivity can be copper, optical fiber cable or wireless, as may be found feasible. Such wide area networks, in a way, create a highway for electronic transfer of information in the form of voice, video and data. Department of IT in Government of India is implementing an approved Scheme known as State Wide Area Network (SWAN) Scheme, envisaged to create such a connectivity in each State / UT, to bring speed, efficiency, reliability and accountability in overall system of Government-to-Government (G2G) functioning.

SWAN Features

A wide area network deployed in a State or UT would have two components viz.

- Vertical Component
- Horizontal Component

The vertical component of SWAN is implemented using multi-tier architecture (typically, three-tier) with the State/UT Headquarter (SHQ) connected to the each District Head Quarter (DHQ) which in turn gets connected to the each Block Head Quarter (BHQ). Each SHQ, DHQ and BHQ point of connection is called a Point of Presence (PoP), which is a point of bandwidth aggregation for several network links getting connected at this point. The bandwidth provisioning for network connectivity between all the above PoPs is a minimum of 2 Mbps. Presently, the connectivity provisioning between every SHQ and DHQ is for 4 Mbps and DHQ to every BHQ is 2 Mbps. For the horizontal component, the government departments at each tier are connected to the respective PoPs.

The SWAN aims to create a dedicated Closed User Group (CUG) network of minimum speed of 2 Mbps by connecting around 7500 pops, providing Data, Voice & Video connectivity to more than 50,000 govt. offices. The networks aim at increasing the efficiency of the government delivery mechanism and optimize the performance. The backbone thus created would provide reliable, vertical and horizontal connectivity within the State / UT administration and would facilitate electronic transactions between all the government departments.

To ensure desired Quality of Service (QoS) by the Network Operator and the Bandwidth Service Provider, a Third Party Audit mechanism has been created in the SWAN Scheme which would monitor the performance of the SWAN network in each State / UT. The Third Party Audit (TPA) agency shall perform for a period of five years from the date of final acceptance test of the network and primarily monitor the compliance of the Service Level Agreement (SLA) which the State / UT would enter with the Network Operator and also with the Bandwidth Service Provider.

Status of SWAN Implementation as on April, 2012

- Till date individual SWAN proposals have been considered and approved for 33 States/UTs with an total DeitY outlay of Rs. 1,964.97 crore and Rs 562.41 have been released so far.
- The SWANs in 19 States/UTs namely, Haryana, Himachal Pradesh, Punjab, Tamil Nadu, Gujarat, Karnataka, Kerala, Jharkhand, Chandigarh, Delhi, Puducherry, Tripura, Lakshadweep, West Bengal, Sikkim, Chhattisgarh, Uttar Pradesh, Orrisa and Maharashtra have been implemented.

- The SWANs in 4 States namely, Assam, Madhya Pradesh, Bihar, Uttarakhand are in advanced stage of implementation, Network trials are being conducted at different tiers of SWAN.
- The SWANs in 4 States/ UTs namely, Andhra Pradesh, Arunachal Pradesh, Manipur, Meghalaya have identified the Network Operator and implementation is underway.
- The SWANs in 4 States namely, Jammu & Kashmir, Rajasthan, Mizoram, Nagaland, have initiated the bid process to identify the Network Operator for implementation.
- The 2 UTs namely Dadra & Nagar Haveli and Daman & Diu are in RFP/BOM finalization stage.
- The State of Goa and UT of Andaman & Nicobar Islands have implemented Wide Area Networks outside SWAN Scheme.
- Special arrangement has been made with BSNL for providing bandwidth at concessional tariff.

STATE DATA CENTRE

State Data Centre (SDC) has been identified as one of the important element of the core infrastructure for supporting e-Governance initiatives of National eGovernance Plan (NeGP).

Under NeGP, it is proposed to create State Data Centres for the States to consolidate services, applications and infrastructure to provide efficient electronic delivery of G2G, G2C and G2B services. These services can be rendered by the States through common delivery platform seamlessly supported by core Connectivity Infrastructure such as State Wide Area Network (SWAN) and Common Service Centre (CSC) connectivity extended up to village level. State Data Centre would provide many functionalities and some of the key functionalities are Central Repository of the State, Secure Data Storage, Online Delivery of Services, Citizen Information/Services Portal, State Intranet Portal, Disaster Recovery, Remote Management and Service Integration etc. SDCs would also provide better operation & management control and minimize overall cost of Data Management, IT Resource Management, Deployment and other costs.

Department of Information Technology (DIT) has formulated the Guidelines to provide Technical and Financial assistance to the States for setting up State Data Centre. These Guidelines also include the implementation options that can be exercised by the State to establish the SDC.

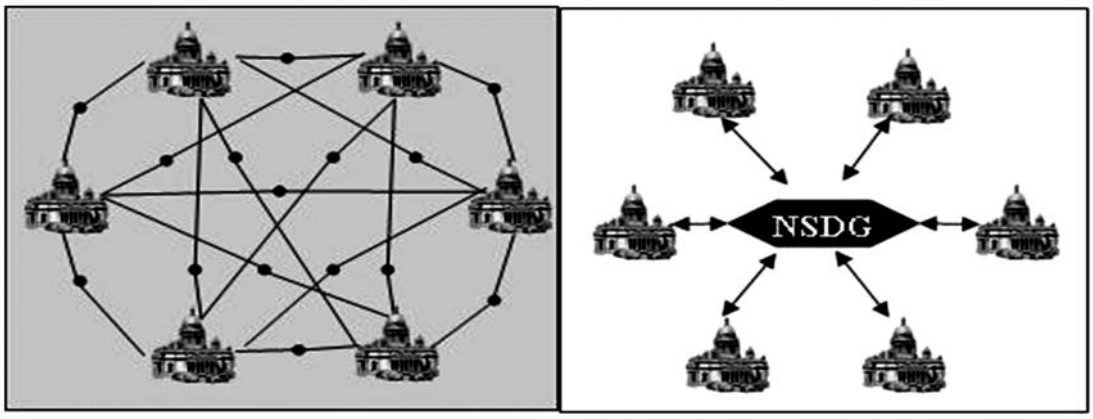
NATIONAL SERVICE DELIVERY GATEWAY (NSDG)

The National e-Governance Plan (NeGP) of the Govt. of India aims to make all Government services accessible to the common man in his locality, through common service delivery outlets and ensure efficiency, transparency & reliability of such services at affordable costs to realize the basic needs of the common man. One of the goals of the Government to meet this vision is the need to cooperate, collaborate and integrate information across different departments in the Centre, States and Local Government. Government systems characterized by islands of legacy systems using heterogeneous platforms and technologies and spread across diverse geographical locations, in varying state of automation, make this task very challenging. The National e-Governance Service Delivery Gateway (NSDG), a MMP under the NeGP, can simplify this task by acting as a standards-based messaging switch and providing seamless interoperability and exchange of data across.

Vision of NSDG

The emergence of many e-governance applications for different departments to provide online services to citizens, businesses and government would require increasing interactions amongst departments and with external agencies at various levels in Government. Departments would need to develop connectors/adaptors for point to point connections between departments creating a mesh as shown in figure given below and also tight coupling between applications. This would lead to applications that are difficult to maintain and upgrade in case of version change and change in government policies and business rules. The NSDG is an attempt to reduce such point to

point connections between departments and provide a standardized interfacing, messaging and routing switch through which various players such as departments, front-end service access providers and back-end service providers can make their applications and data inter-operable. The NSDG aims to achieve a high order of interoperability among autonomous and heterogeneous entities of the Government (in the Centre, States or Local bodies), based on a framework of e-Governance Standards.



Objectives of the NSDG

The objectives of the NSDG are

1. To act as a core infrastructure for achieving standards-based interoperability between various e-Government applications implemented at various levels and geographically dispersed locations.
2. To evolve Gateway messaging standards and build a government owned Central Gateway based on these standards.
3. Act as a catalyst in enabling the building of Standards based e-Governance applications with Gateway as the middleware to ensure interoperability
4. Enable integration across Centre, State or Local Governments there by enabling Integrated Service Delivery and a Service Oriented Architecture (SOA) leading to joined up government
5. Help protect the legacy investments in software and hardware by easily integrating them with other technology platforms and software implementations
6. De-link the back-end departments/Service Providers (SP) from the front-end Service Access Providers thereby
   (a) Ensuring separation of concerns of service access from the service implementation i.e. separates the Portal, CSC, Kiosks etc from the government services which reside in the backend departments.
   (b) Encouraging competition at the front-end by allowing independent service access providers to provide services with varying levels of complexity, cost and service quality levels.
7. Enable adding of shared services on to the core services as and when required,as special common services of the Gateway without affecting the core functionality of the Gateway, thereby providing flexibility and modularity.
   (a) encourage back-end services to be plugged into the infrastructure as and when they are ready,
8. Reduce the cost of e-Governance Projects by rationalizing, distributing and optimizing the services framework
9. Use PKI infrastructure for secure transactions. Provision exists for encryption of department payload to

ensure confidentiality of department data. The gateway provides digital signature and certificates to all stakeholders interacting with the gateway for identification, authentication and authorization. Transaction and audit logs help track government data.

10. Use PKI infrastructure for secure transactions. Provision exists for encryption of department payload to ensure confidentiality of department data. The gateway provides digital signature and certificates to all stakeholders interacting with the gateway for identification, authentication and authorization. Transaction and audit logs help track government data.
11. Enable transaction logging and time stamping for tracking of transactions and centralised control
12. Help the Departments backend workflow evolve gradually as the Gateway acts as a middleware de-linking the backends from the front end. This means that even the departments which do not have the complete automation or work flow at the back can still deliver e-Service to the citizens in a limited manner through the Gateway. To cite as an example, a server may be put up at the department for message exchange with Gateway in absence of readily available infrastructure at the department.

COMMON SERVICES CENTERS

In the year 2006, The Government of India launched CSC Scheme for setting up of more than one lakhs (100,000) internet enabled centers in rural areas under the National e-Governance plan (NeGP) in a Public Private Partnership (PPP) mode.

The Common Services Centers (CSC) are proposed to be the delivery points for Government, Private and Social Sector services to rural citizens of India at their doorstep . The CSC Scheme is envisaged to be a bottom-up model for delivery of content, services, information and knowledge, that can allow like–minded public and private enterprises – through a collaborative framework – to integrate their goals of profit as well as social objectives, into a sustainable business model for achieving rapid socio–economic change in rural India.

As on 31st December 2012, a total of 99,247 CSCs are operational in thirty three States/UTs. 100% CSCs have been rolled out in 10 (Ten) States (Arunachal Pradesh, Chandigarh, Gujarat, Kerala, Madhya Pradesh, Manipur, Meghalaya, Mizoram, Sikkim & Tripura). More than 70% of the rollout has been completed in 12 (Twelve) States (Assam, Bihar, Chhattisgarh, Himachal Pradesh, Jharkhand, Maharashtra, Pondicherry, Punjab, Rajasthan, Uttar Pradesh, Uttaranchal and West Bengal). As of November 2012, approximately 10,000 CSCs are providing financial services including banking, micro&finance and insurance services to over 1.8 lakhs citizens.

The State Governments like Andhra Pradesh, Assam, Bihar, Gujarat, Haryana, Jharkhand, Kerala, Maharashtra, Orissa, Rajasthan, Tamil Nadu, Uttar Pradesh and West Bengal have issued Government Orders / Notifications to the various departmental heads / District Level authorities/ Stakeholders for use of CSC to deliver various G2C Services. The various G2C Services offered are: Agricultural services, RTI Services, NREGA MIS Data Entry service, Postal Products, Land Records, Issuance of Birth and Death Certificates, Utility Services, Electoral Services, Transport Services, Grievances, e-District Services, etc. Financial Inclusion has started in the States of Andhra Pradesh, Jammu & Kashmir, Madhya Pradesh, Meghalaya, Maharashtra, Tripura and Uttar Pradesh.

LESSON ROUND-UP

- *'E-governance is the application of information & communication technologies to transform the efficiency, effectiveness, transparency and accountability of informational & transactional exchanges with in government, between govt. & govt. agencies of National, State, Municipal & Local levels, citizen & businesses, and to empower citizens through access & use of information'*.
- There are four models of E-Governance e.g.
  - Government to citizens (G2C)

  - Government to government (G2G)
  - Government to employees (G2E)
  - Government to business or Business to government (G2B or B2G)

- There are various challenges to governance evolution in India as *Lack of IT Literacy and awareness regarding benefits of e-governance, Underutilization of existing ICT infrastructure, attitude of government department* Lack of coordination between Govt. Department and Solution developers, Resistance to re-engineering of departmental processes, Lack of Infrastructure for sustaining e-governance projects on national level
- For getting the e governance implemented following may be done
  (a) Create Literacy and commitment to e-governance at high level
  (b) Starting with implementation of pilot projects and replicating the successful ones
  (c) Follow the Best Practices in e-governance.
  (d) Build National resource Database of e-governance projects
  (e) Have clearly defined Interoperability policy
  (f) Manage and Update content on govt. websites efficiently and regularly
- National E-governance division (NeGD) has been formed by Government of India as an autonomous business division within Media Lab Asia, under the Ministry of Communications and Information Technology, Government of India, for taking up the tasks being carried out by the Programme Management Unit National e-Governance Plan (PMU-NeGP) at DIT.
- The National e-Governance Plan (NeGP), takes a holistic view of e-Governance initiatives across the country, integrating them into a collective vision, a shared cause.

  The Government approved the National e-Governance Plan (NeGP), comprising of 27 Mission Mode Projects (MMPs) and 8 components, on May 18, 2006.
- Wide Area Network is an advanced telecommunication infrastructure, which is used now-a-days extensively, for exchange of data and other types of information between two or more locations, separated by significant geographical distances. Such wide area networks, in a way, create a highway for electronic transfer of information in the form of voice, video and data. Department of IT in Government of India is implementing an approved Scheme known as State Wide Area Network (SWAN) Scheme, envisaged to create such a connectivity in each State / UT, to bring speed, efficiency, reliability and accountability in overall system of Government-to-Government (G2G) functioning.
- The National e-Governance Plan (NeGP) of the Govt. of India aims to make all Government services accessible to the common man in his locality, through common service delivery outlets and ensure efficiency, transparency & reliability of such services at affordable costs to realize the basic needs of the common man. The National e-Governance Service Delivery Gateway (NSDG), a MMP under the NeGP, can simplify this task by acting as a standards-based messaging switch and providing seamless interoperability and exchange of data across.
- In the year 2006, The Government of India launched CSC Scheme for setting up of more than one lakhs (100,000) internet enabled centers in rural areas under the National e-Governance plan (NeGP) in a Public Private Partnership (PPP) mode. The Common Services Centers (CSC) are proposed to be the delivery points for Government, Private and Social Sector services to rural citizens of India at their doorstep.

– The CSC Scheme is envisaged to be a bottom-up model for delivery of content, services, information and knowledge, that can allow like – minded public and private enterprises – through a collaborative framework – to integrate their goals of profit as well as social objectives, into a sustainable business model for achieving rapid socio-economic change in rural India.

SELF-TEST QUESTIONS

(These are meant for re-capitulation only. Answers to these questions are not to be submitted for evaluation)

1. What do you mean by the term E-governance? Explain its importance and history in India.
2. What are the objectives of e-governance? Explain briefly.
3. Explain the different e-governance models being used in India.
4. What is G2E model of e-governance? What type of information can be shared by this model?
5. Explain the challenges being faced by government in implementing e governance in India.
6. Write a short note on e governance action plan.
7. What do you mean by national e governance division?
8. What are the challenges in e-governance?
9. Write a short note on National e governance plan.
10. Explain the different constituent of E governance infrastructure in India.
11. Write a short note on
    (a) State wide area network (SWAN)
    (b) National service delivery gateway (NSDG)
    (c) Common Service centre
    (d) Impact of e-governance in rural area

Lesson 11
Systems Audit – An Overview

LESSON OUTLINE

- Nature, Significance and Scope of Systems Audit.
- Steps Involved in Conducting Systems Audit
- Systems Audit and Management Functions
- Systems Audit of Computerized Secretarial Functions
- Norms and Procedure for Computerization, Computers Control and Security
- Testing of Computer Systems – Documentation Standards, Policies and procedures and Audit Approach

LEARNING OBJECTIVES

Information systems auditing or systems audit is the process of collecting and evaluating evidence to determine whether a computer system safeguards assets, maintains data integrity, allows organizational goals to be achieved effectively, and uses resources efficiently.Information system audit is done to verify that systems and its various applications are appropriate, efficient and adequately controlled. Information system audit is carried out to ensure valid, reliable, timely and secure input processing and output at all levels of a system's activity. System audit supports traditional audit objectives and also helps management in achieving various control objectives. Technology plays a major role in facilitating all functions of business in this era, not just in transaction capturing and processing but even in lesser known areas like Corporate Governance and Risk Management. With changing paradigms, knowledge and experience in technology are not merely desirable, but basic requirements for growth and even survival in the evolving global village. Information system audit also seeks to leverage technology to enhance the professional skills of its users. In view of above, it become necessary for a company secretary to know about basic concepts relating to systems audit. After going through this lesson, one should be able to –

- The purpose of enacting Information Technology Act, 2000.
- Understand about the nature and scope of system audit
- Understand the information system audit process
- Understand the relationship between information system audit and different functions of management.
- Design a information system audit plan·
  Carry out the system audit of secretarial function

The systems audit, unlike the other audits, is not restricted to audit of reported items only. It has to take into cognizance the choice, use and risk of Technology. It has to look at the realities of business processes and constantly changing legal framework.

INTRODUCTION

As computer technology has advanced, most of the organisations have become increasingly dependent on computerised information systems to carry out their operations and to process, maintain, and report essential information. As a consequence, the reliability of computerised data and of the systems that process, maintain and report these data are a major concern to audit. Information system auditor mainly known as IT Auditors evaluate the reliability of computer generated data supporting financial statements and analyse specific programs and their outcomes. In addition, IT Auditors examine the adequacy of controls in information systems and related operations to ensure system effectiveness.

IT Audit is the process of collecting and evaluating evidence to determine whether a computer system has been designed to maintain data integrity, safeguard assets, allows organisational goals to be achieved effectively, and uses resources efficiently. Data integrity relates to the accuracy and completeness of information as well as to its validity in accordance with the norms. An effective information system leads the organisation to achieve its objectives and an efficient information system uses minimum resources in achieving the required objectives. IT Auditor must know the characteristics of users of the information system and the decision making environment in the auditee organisation while evaluating the effectiveness of any system.

Use of computer facilities has brought about radically different ways of processing, recording and controlling information and has combined many previously separated functions. The potential for material systems error has thereby been greatly increased causing great costs to the Organisation, e.g., the highly repetitive nature of many computer applications means that small errors may lead to large losses. An error in the calculation of Income Tax to be paid by employees in a manual system will not occur in each case but once an error is introduced in a computerised system, it will affect each case. A bank may suffer huge losses on account of an error of rounding off to next rupee instead of nearest rupee. This makes it imperative for the auditor to test the invisible processes, and to identify the vulnerabilities in a computer information system as the costs involved, because of errors and irregularities, can be high. Company Secretary Professional is not different from this. Company Secretary cannot function effectively in this information age without adequate knowledge of information system, its benefits and limitations. The Company Secretary addresses the vital areas of good corporate governance and compliance within the regulatory framework of the applicable laws. Besides handling secretarial functions, s/he is also a custodian and user of the top level MIS that goes to the Board of Directors. .

This study lesson has been prepared to provide an insight into the subject of systems audit in the modern context of enterprise systems and connectivity with buyers, suppliers and other stakeholders.

DEFINITION OF SYSTEM AUDIT

The legendary Ron Weber defines IT Audit as “the process of collecting and evaluating evidence to determine whether a computer system safeguards assets, maintains data integrity, allows organisational goals to be achieved effectively and uses resources efficiently”.

IT Audit is a broad term that includes Financial Audits (to assess the correctness of an organization’s financial statements), Operational Audits (evaluation of internal control structure), Information Systems Audit(including performance Audit), Specialized Audits (evaluation of services provided by a third party such as outsourcing etc.) and Forensic Audits. However, a common factor is the formation of an opinion regarding the degree of reliance that can be placed on the IT systems in the audited organization. Audits of Information Technology Systems under development and IT enabled audits (using CAATs) also fall under this broad Grouping.

Information systems’ audit represents a complex activity for assessing an information system in order to set forth a qualified opinion regarding the conformity between the system and the regulating standards, as well as over the information system’s capacity of achieving the organization’s strategic objectives, by efficiently using

the informational resources and by ensuring the integrity of the processed and stored data.

Objectives of Information system audit

The objectives of IT audit include assessment and evaluation of processes that

(a) Ensures asset safeguarding –'assets' which include the following five types of assets:

1. Data

   Data objects in their widest sense, i.e., external and internal, structured and non-structured, graphics, sound, system documentation etc.

2. Application Systems

   Application system is understood to be the sum of manual and programmed procedures.

3. Technology

   Technology covers hardware, operating systems, database management systems, networking, multimedia, etc.

4. Facilities

   Resources to house and support information systems, supplies etc.

5. People

Staff skills, awareness and productivity to plan, organize, acquire, deliver, support and monitor information systems and services.

(b) Ensures that the following seven attributes of data or information are maintained.

1. Effectiveness - deals with information being relevant and pertinent to the business process as well as being delivered in a timely, correct, consistent and usable manner. Deals with System effectiveness – evaluating whether the IT system meets the overall objectives of top management and users.

2. Efficiency - concerns the provision of information through the optimal (most productive and economical) usage of resources. Deals with System efficiency – efficient systems use optimum resources to achieve the required objectives

3. Confidentiality - concerns protection of sensitive information from unauthorized disclosure.

4. Integrity - relates to the accuracy and completeness of information as well as to its validity in accordance with the business' set of values and expectations.

5. Availability - relates to information being available when required by the business process, and hence also concerns the safeguarding of resources.

6. Compliance - deals with complying with those laws, regulations and contractual arrangements to which the business process is subject; i.e., externally imposed business criteria. This essentially means that systems need to operate within the ambit of rules, regulations and/or conditions of the organisation. For example, an FIR to be filed normally requires signature of the complainant as per rules, and needs to be reengineered by changing the rules to permit web based complaints. Similarly, banking operations will have to conform to the banking regulations and legislation. It is also the duty of the IT Auditor to see that the work practices are in tune with the laws of the land such as the IT Act promulgated by the Government of India.

7. Reliability of information - relates to systems providing management with appropriate information for it to use in operating the entity, in providing financial reporting to users of the financial information,

and in providing information for reporting to the regulatory bodies regarding compliance with laws and regulations.

Thus, IT Audit is all about examining whether the IT processes and IT Resources combine together to fulfill the intended objectives of the organization to ensure Effectiveness, Efficiency and Economy in its operations while complying with the extant rules. This can be depicted diagrammatically as follows:

IT Audit Manual Volume I

NATURE, SIGNIFICANCE AND SCOPE OF SYSTEMS AUDIT

Nature of System Audit

It has been the practice in Industry to carry out financial, managerial and technical audits. The oldest and most prevalent audit has been the financial audit. Traditionally, financial auditors have been going by the paper-based book of accounts. They have been focusing mainly on ensuring internal controls and compliances with the laws of the land, and thereby, good governance.

Managerial audit has been focusing on the basic management policies and practices, with the aim of determining whether the enterprise is in good shape, has good processes and has a good feedback framework for managerial effectiveness and performance.

Technical audit has been focusing more on the shop floor details, such as, whether the manufacturing and maintenance functions are performing efficiently.

With the increasing use of computer-based systems in the enterprise, the complexity of systems and risk of errors, sabotage and fraud have increased manifold. In a network setup, a transaction is initiated in a physically different location, posted in the books elsewhere and the management information aggregated from the data viewed somewhere else. Because of the number of agencies involved and the increased risk exposure of mechanized systems, it is no longer sufficient to go by auditing of the book-based accounts. One has to see the vulnerability of the IT setup to external “crackers” and “hackers”.

The nature of systems audit, unlike the other audits, is not restricted to audit of reported items only. It has to take into cognizance the choice, use and risk of technology. It has to look at the realities of business processes and constantly changing legal framework.

Significance of System Audit

For any business (for profit or for nonprofit) to survive, it must have an adequate information security system in place. IT audit is important because it gives assurance that the IT systems are adequately protected, provide reliable information to users and properly managed to achieve their intended benefits. Many users rely on IT

without knowing how the computers work. A computer error could be repeated indefinitely, causing more extensive damage than a human mistake. IT audit could also help to reduce risks of data tampering, data loss or leakage, service disruption, and poor management of IT systems. Few of important reasons for which system audit is gaining significance are:

1. Ensuring the security of information
2. Standardization.
3. Improvement in business efficiency.
4. Improved system and process controls.
5. Plan for contingencies and disaster recovery.
6. Evaluating the effectiveness and efficiency related to the use of resources.
7. Reduced risk and enhanced system security
8. Prevention and detection of errors and fraud
9. Building Confidence and Public Reputation

Scope of Information System Audit

The information system of any company has different functions and activities coupled with a number of computer installations at different geographical locations. There are risks inherent to information systems which may impact the information system in different ways. The scope of systems audit covers the entire IS management process. The scope includes review of the entire design & development process, the review of technology choice, the processes employed to assess risks and losses that could accrue to the system, the possibility of computer frauds, the care taken in managing changes to the system, extent of testing and reliability of the system

The IS auditor is expected to adopt a risk-based approach for making an audit plan. Following are the main areas of scope for an IT auditor

Report Validation - To provide assurance that the reporting module of the system is working according to the specification, are error free and can be trusted i.e. Functional Audit of the reports produced by the system, formulas used for different calculations are in line with industry best practices nationally and internationally.

Application software review - To provide assurance whether the financial and operational applications meet the current and future needs of the organization. The auditor must access control and authorizations, error and exception handling, business process flows within the application software and complementary controls (enterprise level, general, application and specialist IT control) and procedures and validation of reports (both operational and financial) generated from the system.

Network security review – To provide assurance that the database and the web server system is fully secure and is corresponding to the controls objectives of control system. Review of internal and external connections to the system, perimeter security, firewall review, router access control lists, port scanning and intrusion detection are some typical areas of coverage.

Data integrity review - To provide assurance that the database design and structure provides the best possible design for the organizational needs and corresponding application and future integration needs. The purpose is scrutiny of live data to verify adequacy of controls and impact of weaknesses, as noticed from any of the above reviews.

Business continuity review – It includes existence and maintenance of fault tolerant and redundant hardware, backup procedures and storage, and documented and tested disaster recovery/business continuity plan,

effectiveness of disaster recovery plan, as well as ensuring existence of well defined I.S Audit manual and its compliance thereon.

The IS Auditor must analyze business process risks and controls based on an understanding of planned or implemented controls and identified control gaps. The IS auditor is required to review role of Internal audit in relation to IS audit. This may involve evaluating audit plans and reporting to audit committee and senior management on controls, specific resources required for performing IS audit function.

STEPS INVOLVED IN CONDUCTING SYSTEMS AUDIT

The following are the steps in information systems audit:

1. **The preliminary review phase**

   The first step in an IS audit is the preliminary review of the computer installation. The main objective of this step is to obtain the information necessary for the auditor to make a decision on how to proceed with the audit. This stage includes a review of the management and application controls existing in the company. During the review, the auditor tries to understand the management practices used at different levels of the computer hierarchy.

   The main sources of information during this phase include interviews with installation personnel, observations of installation activities, and reviews of installation documentation. Questionnaires, flowcharts, and other databases can also be used to gather required information. Based on the initial review, the auditor takes a decision whether to proceed with the audit or abandon the entire process.

2. **The detailed review phase**

   The objective of this phase is to obtain the information necessary for the auditor to have an in-depth understanding of the controls used in a computer installation. Upon review, once again a decision by the auditor as to proceed with the process or abandon it must be taken.

   On taking a decision to proceed with the audit process, the auditor reviews both the management and application controls. The management controls are reviewed first, as major weaknesses in these controls enables the auditor to abandon the review of application controls. In this phase, the auditor must also identify the causes of loss existing within the installation and the controls established to reduce the effects of these causes of loss. At the end of this phase the auditor must evaluate whether the controls established reduce the expected losses to an acceptable level.

   Like the preliminary stage, the auditor obtains information for conducting the audit from various sources like company databases, interviews with the concerned personnel, questionnaires etc.

3. **The compliance testing phase**

   The objective of this phase is to determine whether or not the system of internal controls operates as it is supposed to operate. The auditor checks whether all internal controls exist and are working reliably. The auditor makes use of both manual sources of information mentioned above and computer-assisted evidence collection techniques to gather inputs for evaluation.

   At the conclusion of this phase, the auditor must evaluate the internal control system in the light of the evidence collected on the reliability of individual controls.

4. **The substantive testing phase**

   The objective of this phase is to obtain sufficient evidence to enable the auditor make a final judgement on whether or not material losses have occurred during computer data processing. The external and the internal auditor express the results of this phase differently. The former expresses his judgement in the form of an opinion as to whether any misstatement of accounts really exists. The latter however, is

concerned with a broader perspective i.e. given the state of the internal control system, have the losses occurred or could they occur in future due to the weaknesses in control systems used to safeguard assets.

The following are the five types of substantive tests that can be used within a data processing installation:

(i) Tests to identify erroneous processing

(ii) Tests to assess the quality of data

(iii) Tests to identify inconsistent data

(iv) Tests to compare data with physical counts

(v) Confirmation of data with outside sources

5. Overall evaluation

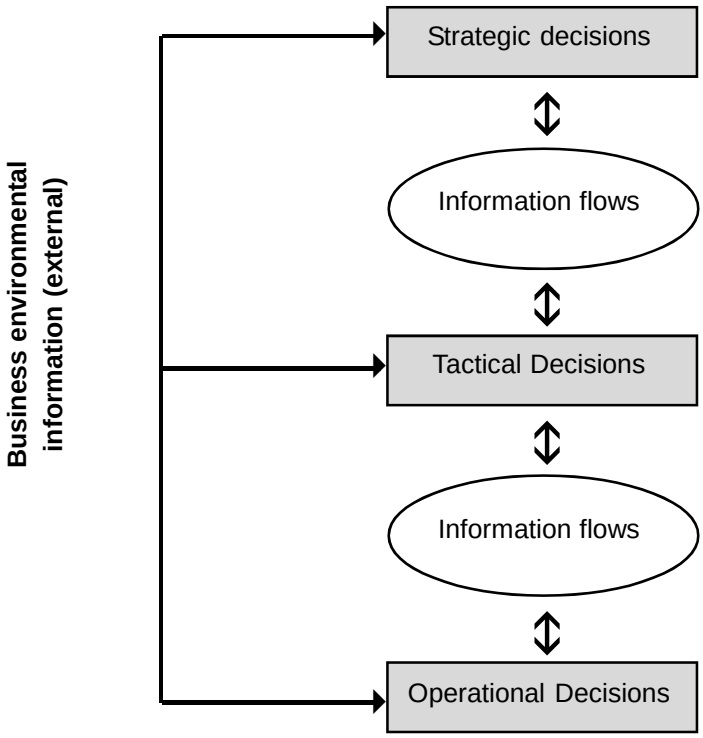
Upon substantive testing, the auditor once again has an overall view of the control systems existing within the company.

6. Documentation

On completing the audit process, the auditor prepares a comprehensive audit report giving details of all the phases of review and testing conducted. The audit report also consists of the recommendations of the auditor for improvement in control systems.

SYSTEMS AUDIT & MANAGEMENT FUNCTIONS

If we look at the time-honored management pyramid,



We notice the major role information systems have to play in decision-making across the Management functions. Information systems usually focus inwards and are endoscopic in nature. Information gathering from the external business world is mostly manual or done through disjointed systems such as taking information out of the Internet, etc. The Strategic vision and direction are set based upon the top management's perception of opportunities. The information feedback from operations and operational decisions flow to help the middle management in its tactical management. The information flow from Tactical Decisions enable the Top Management to assess where the organization is, vis-à-vis its vision and strategic direction.

Systems Audit helps the management to be assured that its feedback loop is healthy and is not likely to miss out on vitally important details. Any deficiencies in the Information systems and in the creation, maintenance and usage of the information are pointed out by the systems audit function. In turn, this also reinforces the Stakeholders' faith in the basic management processes that are tracked by information flows.

All organizations suffer from fragmentation of knowledge across functions and across departments as well. Paretto's principle seems to apply well in that 20% of the people get to have 80% of the knowledge of their departmental/functional area. The challenge before all managements is, how to manage knowledge. Knowledge needs to be distributed instead of being hoarded, so that the activities of the company are at the optimal best.

In its primitive form, a Knowledge Management system today is a glorified form of document management system. The extent and granularity of indexing determine how closely relevant a piece of knowledge can be. Raw knowledge has to be validated to make sure that it is well supported by facts. Only then it can be used. Use of invalidated knowledge can be dangerous. Systems are evolving from information management to knowledge management. The traditional management function of planning, directing, coordinating, analyzing and staffing are deeply impacted by information and knowledge.

At a more mundane level, all functional managers need to cooperate with IS Audit so that the exposure of a weakness can be converted into a strength.

SYSTEM AUDIT OF DIFFERENT FUNCTIONS

IS Audit is an evaluation of adequacy of controls. In a computerised environment, controls can be classified as under, which are verified by the IS Auditor:

A. Management Controls

1. Security Policy and Standards
2. Constitution of Steering Committee
3. Business Continuity Planning
4. Systems Development Methodology

B. Operational Controls

1. Monitoring physical assets
2. Ensuring adequate environmental controls such as Air-conditioning (dust, temperature & humidity controls), Power Conditioning (Online UPS functioning all the time with backups, proper earthing)

C. Organizational Controls

1. Defining roles, responsibilities and duties of User Departments and IT Department
2. Defining roles, responsibilities and duties within IT Department – such as developers, operators and administrators

D. Application Controls

1. Each of the Computer Systems and subsystems must have its own set of controls for Inputs, Processing & Outputs. Processing controls should also ensure checks for legal compliance.
2. While performing the audit, each of the controls needs to be studied for its existence and adequacy.

AUDIT OF MANAGEMENT CONTROLS

Security Policy and Standards

The IS auditor should first verify whether the organization has a Security Policy. If it does not exist, the auditor needs to point this out, unless the management has a corporate IS Security policy and follows standard implementation of IS Security across all units and divisions.

If a security policy exists, it needs to be examined for currency and adequacy in proportion to the risk. The security policy has to be always dynamically updated.

Steering Committee for Security

The formulation and implementation of a sound security policy should not be the handiwork of just the IT Department. It should be a team effort, brought into effect by a committee in which there is at least one member of the Board of Directors apart from the CIO and User HoDs. The auditor should point out the absence of such a committee.

Without such a committee having regular planned meetings with agenda and action points, the implementation of security policy would be in jeopardy. The auditor needs to stress upon the possible benefits of a properly functioning steering committee or conversely, the disbenefits of not having such a committee. In recommending the constitution and functioning of the committee, the auditor should be specific about composition, individual roles and responsibilities and monitoring/ escalating mechanism.

Business Continuity Planning

Business Continuity is a very important aspect of Information Systems. It encompasses all aspects that can result in usage discontinuity. As a simple example, let us say that a company has three servers connected to a single UPS. The UPS is not under Annual Maintenance Contract. Its batteries may be dying out. Since there is no mechanism to look into the health of the UPS, it can go down without a warning, resulting in a server tripping. All work halts till the UPS can be set right. If such a catastrophe occurs in a remote place, then the time to repair/ replace the UPS can be longer.

The IS Auditor should examine all such possibilities by which the availability of Computer Systems is threatened with temporary or permanent breakdown. In sensitive areas, even proofing against mob violence/terrorist strikes should be kept in view.

Systems Development Methodology

In most companies Systems Development is badly handled. And proper documentation is not maintained. The code is developed in great hurry and control aspects are given the go by. The accuracy of the processing and the legal compliance are left as open questions.

The IS auditor should verify whether following documents exist or not:

1. Functional requirement Specifications
2. Software requirement Specifications
3. Design Description
4. Software code

5. Test Plan
6. Unit test results
7. Integration test results
8. Acceptance test results

The documentation should be properly cross-indexed. The effect of a change made in the system should be well understood. It should not happen that, due to ignorance of the entirety of the business process and its ramifications, a change made in one area affects other areas, that too after a lapse of time.

Every time a change is made, a thorough testing should be done and documented.

The IS Auditor should get necessary evidence and comment on the lack of proper adherence to procedure.

AUDIT OF OPERATIONAL CONTROLS

The Auditor should observe the operations and comment on the drawbacks. Some of the possible scenarios are:

(a) Anybody walks into the server room and has access to documents/media/ machines.

(b) Backup media not labeled properly and kept under lock and key.

(c) One set of backup not regularly kept at another location

(d) No documented and organized change control process. Software and data are arbitrarily changed.

(e) Correction of errors not done by reversal of entry but by running dangerous script on the database backend.

(f) Administrator passwords freely floating around and used by developers, operations staff and administrators.

(g) Dirty network cabling with loose cables hanging around, hand crimped cables, cables not tagged for easy identification.

(h) Switches/hubs lying loose on tables/hanging on walls.

(i) Data controls not properly checked and filed.

(j) Preventive Maintenance of Servers not done.

(k) Machines working with covers kept off.

(l) Media not properly labeled and recorded in media register.

(m) Absence of gate pass culture: machines arbitrarily taken from/into computer rooms.

(n) Unknown and untrusted CDs directly used without checking for virus.

The above scenarios speak of a very casual IT setup. Such carelessness can result in serious downtime. Sensitive data can be pilfered from the servers. The IS auditor needs to highlight these flaws as serious lapses.

Audit of Environmental Controls

The following environmental factors need to be checked and commented upon by the auditor:

(i) Online UPS not used; either line-interactive UPS or Offline UPS used, or CVT used.

(ii) Electrical cabling loose / points having loose contact.

(iii) No separate earth pit for the Computing equipment.

(iv) Switches/Hubs/Routers not fed UPS power.

(v) Server room door kept open.

(vi) AC not functioning properly, especially in summer.

(vii) In winter AC set at 29 Deg C instead of 22 Deg C.

(viii) No pest control measures taken.

(ix) Eatables taken into server room/ Smoking in the server room.

(x) Heavy duty printer kept inside server room: scope for dust.

(xi) UPS, AC, other electricals not under regular AMC.

(xii) No genset backup in case City power supply fails for long hours.

(xiii) No smoke detectors/fire alarms in server room area.

(xiv) Fire extinguishers not kept filled and ready.

(xv) No fire drill carried out to make people aware of dos and don'ts

The above are serious lapses that can seriously affect the functioning of the IT Setup and cause work stoppages.

AUDIT OF ORGANIZATIONAL CONTROLS

There needs to be an effective Organization Chart for the IT function. In some Organizations, IT is treated as a technician's job. A very junior person is made the head of IT. He/she will be unable to hold his own when powerful functional heads as the Finance Head or the Production head keep breathing fire. It is best to have the IT function reporting to the CEO. The Head of IT is the Chief Information Officer or CIO.

The CIO should have three reportee managers – one for taking care of the development team, one for ensuring Information System / IT Center security and another for managing the facilities (i.e., operations and maintenance of hardware, OS, database administration, vendor management, service providers, etc.) It is advisable not to club IS security with operations or development.

The IS auditor should look for a succession plan for the IT Management team. The main concern here is that a few persons may be knowing the ins and outs of the software. They may be fixing problems because of their deep knowledge of the code. Other than in their minds, there is no documentation of what they know. Either because of their leaving the organization or their disgruntlement, they may not keep doing the good work. Such an event would compromise the functioning of the systems and emergent solution to the problem may be very expensive.

The IS Auditor should check for clear-cut definition of User role, IT Role so that there are no ambiguous overlaps. For example, it should be clear that the Wage Administration section would advise tax rate changes, etc. to the development and maintenance team member concerned. Under the formal authorization of the user HoD, such changes should be carried out. Deciding which data should be kept and which should not be kept is the responsibility of the User and not IT Department. Making a final pronouncement on the correctness of processing by software is again the concerned User Department responsibility.

There are companies in which there is no specific duty allocation to IT Staff members. This is not desirable, since everybody escapes accountability. One section of IT Department must take the responsibility for developing and maintaining the software. They should have nothing to do with the Hardware upkeep, System, Network and Database administration. This should be looked after by another set of people. Systems security was earlier the purview of the system administration staff. Given the increasing dependence on computer systems and the ever-increasing security risks, it is necessary to ensure that no person who has executive responsibility should have anything to do with an audit type of function. This is the reason why Security and Audit of systems should

be the responsibility of a different section. This group needs to have a very good technical knowledge of IT and security risks. It would only audit and report findings to the management without getting into actual solution implementation. Any deviation in this regard needs to be pointed out by the IS Auditor, including an impact analysis.

SYSTEMS AUDIT OF COMPUTERIZED SECRETARIAL FUNCTIONS

The procedure to be followed for performing a systems audit remains the same irrespective of functionality, Only the testing of application controls varies for audit of different functions.

Application controls

These are manual or automated procedures that typically operate at a business process level and apply to the processing of transactions by individual applications. Application controls can be preventative or detective in nature and are designed to ensure the integrity of the accounting records. Accordingly, application controls relate to procedures used to initiate, record, process and report transactions or other financial data. These controls help ensure that transactions occurred, are authorised and are completely and accurately recorded and processed.

In relation to system audit of computerised secretarial function, Application controls apply to data processing tasks such as feeding shareholders details, directors details, date of meeting, details of agenda items etc. and are normally divided into the following categories:

(i) Input controls

After verifying the system development methodology, the secretarial audit should verify the input controls in the systems and procedures developed for computerized secretarial function.

The input will consist of the details of the various shareholders. The Master Data would contain the name, address, nominee, or joint account holding details, as also income-tax status. Before the Dividend Warrant application program could be run in a live environment the steps that would be taken would be to ensure all master records have been corrected, upto and including Share Transfers as approved by the last Share Transfer Meeting, and also all correspondence received regarding change of address, income-tax status etc.

The first and initial input control would be to run the data file of the shareholders and obtain the total of the shareholding to ensure that it is equal to the subscribed share capital. An error at this stage would indicate that some wrong corrections have been made to the Master Data like the transferee details would have been included and the transferors details might not have been deleted or when a transferor has effected a part transfer, suitable corrections might not have been effected.

(ii) Processing controls

An example of a programmed control over processing is a run-to-run control. The totals from one processing run, plus the input totals from the second processing, should equal the result from the second processing run. For instance, the beginning balances on the unpaid dividend ledger plus the dividend declared ledger (processing run 1) less the dividend paid (processing run 2) should equal the closing balances on the unpaid dividend ledger.

(iii) Output controls

Batch processing matches input to output, and is therefore also a control over processing and output. Other examples of output controls include the controlled resubmission of rejected transactions or the review of exception reports (eg the list of directors reports showing the name of director who is debtors of more than Rs 1 lakhs of the same company).

(iv) Master files and standing data controls

Generally, every time after the Share transfer Meeting, the Master file of the Shareholders would be modified to take into account the latest changes in shareholdings. General practice that could be followed would be that at every point of time it would be ensured that the Master File contains the correct total figure of shareholdings. When modifications have to be made because of the authorized share transfers, there would be a separate verification program to ensure that the number of shares transferred by the transferors is equal to the number of shares transferred to the transferees.

So, when performing the Systems Audit, one must verify these records to ensure whether all these procedures have been followed. It is not uncommon to hear of stray incidents when transferor and transferee might have received dividend warrants or the transferor receiving the dividend warrant and not the transferee! In those circumstances, while the computer is conveniently blamed, the real culprits are the individuals who are not following the procedures correctly. In a manual environment, before the procedure of computing dividend warrants is commenced, it is manually ensured that all of the transfers as per the list as authorized by the Directors have been correctly posted. The same procedure needs to be verified in a computerized environment. As we would not be verifying the manual posting, a computer program is run to ensure the integrity of the Master file of the shareholders

NORMS AND PROCEDURES FOR COMPUTERIZATION

Computerization often known as automation is very important for an organisation. In present scenario, automation of information system has become an essentiality and without automation, it is very difficult to run an organisation. In this section of study, we will discuss about norm of automation and its procedure.

Automation refers to the use of computers to manage the administrative and information processing tasks in records offices, records centres, and archival institutions.

If used wisely, computers can assist records personnel in managing records better to ensure their continued value as evidence. Automation can help organisations implement authentic and reliable record-keeping practices, through the improved tracking of records through their life cycle as well as the consistent application of records schedules and descriptive standards. Maintaining evidence through authentic and reliable records is a cornerstone of good business practice and helps ensure a valuable record for society.

What Should Be Automated?

The range of technology applications and functions available can make it difficult to select a particular technological solution to a records or archives problem.

The question is not whether records and archives management functions can be automated. Many functions can be automated if the resources are available. But it is important to determine if automation is warranted. Two key questions must be asked:

1. Should a specific records or archives management function be automated at this time?
2. How should a particular records or archives management function be automated?

All records and archives functions should be fully functional in a manual system before attempts are made to automate them. Automating an inefficient process will not transform it into an effective one. If done correctly, however, automation can not only improve archival and records functions but can also make it possible to undertake activities that were too complicated or time consuming to be done in the past on a regular basis.

All records and archives functions should be fully functional in a manual system before attempts are made to automate them.

Because automating an inefficient and ineffective manual process will not help an organisation achieve its objectives, some organisations should consider systems analysis and business process re-engineering in anticipation of automation.

Business process re-engineering (BPR): The fundamental rethinking and radical redesign of business processes to achieve dramatic improvements in critical, contemporary measures of performance, such as cost, quality, service and speed.

It is also important to consider the resources available and staff commitment required before commencing an automation project. Financial resources are important, but people are an even more critical element in any automation process. When considering automation, the key stakeholders need to be identified.

Stakeholder: Any person, group or other organisation that has a claim on an organisation's attention, resources or output or is affected by that output.

These stakeholders may include government officials who rely on the archival institution to maintain their records and supply information or return specific files when requested. Other stakeholders are the citizens who depend on the records and archives institution to be able to preserve and locate important records (such as property files) and the staff of the records and archives institution. Researchers may be another key stakeholder group; they can be directly affected by the way information or records are made available to them.

Whether an automation programme succeeds or fails often depends on the support it receives from stakeholders. Automation may entail redesigning work processes and thus changing people's jobs or the way services are offered. It is crucial to assess people's capacity for change in their work environment and to prepare them for that change. Staff may have to be trained in computer skills. Similarly, users may have to be given guidance about the way automated systems work if they are to be expected to use the technology themselves.

Reasons for Automation

Automation should be viewed as a tool to facilitate daily operations and planning in a records and archives institution. If implemented well, automation can increase staff efficiency, perform routine tasks automatically and analyse data more quickly than could be done manually. Manual information systems may not be fast enough or sophisticated enough to meet growing user demands as well as the higher expectations and standards brought about in society by increased computerisation. If people find that they can access information in one office or agency using computers, they will soon come to expect other offices to provide the same level of service.

Public and private sector organisations increasingly rely upon computers and information technology to deliver their services and programmes more efficiently. Records and archives institutions are not exceptions to this trend. Almost any recordsrelated activity can be automated in some fashion. For example, word processing can be used for correspondence, inventory development and report generation. Spreadsheets can be used to manage budgets or track project expenditures. Databases can maintain information about staff or about records or archives.

Automation should facilitate daily operations and planning.

The pressures to automate are great. In this age of 'instant' information, there is an increasing demand for speedy access to information, records and archives. Furthermore, existing manual systems may lead to duplication of effort and repetition of work. Manual systems can be time consuming, costly, inflexible and prone to human error. However, as will be discussed below, computerisation is only effective if the proper analysis and planning is completed prior to the purchase and implementation of new technology. Computers alone are not a solution for poor processes or a lack of standards in the management of records or archives. For example, a computer cannot be a replacement for, or an alternative to, a properly designed classification system. On the other hand, if such a classification system is in place prior to computerisation, the computer can automate it, facilitate access and provide a faster search mechanisms for it and permit the assignment of relevant file numbers to paper records quickly and efficiently.

Following are some reasons an organisation might choose to automate its records or archives functions, or

indeed any of its functions.

- accuracy of information and calculations
- speedy retrieval of information
- reliability of information once input
- increased ability to manipulate data once input
- ability to ensure greater accuracy and consistency in the performance of routine tasks
- large capacity for storage of information
- accessibility of information
- expandability of computer systems
- flexibility of computer systems
- cost efficiency of operations
- better utilisation of personnel
- savings in space and equipment
- instantaneous updating
- multiple simultaneous access to information
- new approaches to work processes.

Automation also assists in eliminating repetitious work, such as typing new file labels and index cards. Computers can print labels automatically, update indexes regularly, produce reports based on data already entered into the computer, and otherwise reduce time and increase efficiency. Personnel can then focus their work on more significant tasks.

The computerisation of some tasks offers much more flexibility. For example, the computer makes it possible to organise and maintain an index with several searchable 'fields' or attributes of information. As a result, the computer provides increased points of access to information. This access can facilitate the location of items for users who may not be aware of the exact terminology for an item.

PROCEDURE OF COMPUTERISATION

Assessment and Planning

Planning is a critical management function that must occur within the organisational context; that is, other organisational components must be taken into account while carrying out any planning exercise. In other words, automation projects cannot be planned for in isolation from the organisation's mandate, mission, functions, resources and other systems.

The computerisation of work processes also requires knowledge, skills and wisdom from more than one discipline. Any automation project has a greater chance of success if it begins with good planning and with consultation with the user and the technology communities, with programme managers, records managers, archivists and systems specialists, as well as with other government officials who depend on records. A system that does not meet the needs of users is counter-productive and represents a misuse of resources. An automation project can only be successful if all stakeholders are involved and, particularly, if senior management supports, endorses and leads such an initiative.

The goals and purposes for automating the records management system should be clearly stated by senior

management and communicated to employees. Future users of the system should be consulted to seek their expertise and ideas and promote their acceptance of the new tool. Training and orientation in the new tool is also critical to its success.

Planning ensures the project is completed on time and within budget and that the final product addresses the needs of the organisation as identified. Planning can be quite complex, but it is a necessary part of an automation project. Without planning, the systems developed may be inadequate, people may be poorly trained and the final project may not be successful. Planning involves

- conducting an initial assessment
- developing goals, objectives and priorities
- determining resource needs
- getting support for the project
- conducting a feasibility study
- developing a detailed project plan
- assembling a project team and project structure.

Conducting an Initial Assessment

Whether manual or automated, systems exist within an organisational framework and therefore must be organised in order to meet the needs of the organisation. Prior to developing the automation project in depth, it is wise to conduct an initial assessment of the organisation, to determine if an automation project is in fact even viable. A number of technology-specific factors should be identified and evaluated during this initial assessment phase, including:

- the problem(s) to be resolved by the development of a new automated system
- how technology initiatives fit into overall mission and business objectives
- current or pending legislation that may affect the choice or use of technology
- the state of existing systems within the organisation and how they should relate to any new system
- the system of managing materials in agency records offices as well as in the records centre
- the nature of any existing or planned records management initiatives within the organisation and how they affect or should co-exist with any new system
- the expected benefits resulting from the implementation of an automated system
- how costs will be measured and at what point the costs will outweigh the benefits
- the constraints and limitations of the automation project, including policy, financial requirements and technical skills
- the time and resources required to conduct a feasibility study
- the level of senior management support (it is best to seek a champion for the records system automation project to offer support at senior levels)
- the project team members, their roles and responsibilities.

Once this initial assessment has been completed, it is possible to determine the goals, objectives and priorities for the project and develop the terms of reference for a feasibility study.

Other non-technical factors can affect the feasibility of an automation project. These factors might include the

organisational culture and the physical layout or environmental conditions within the office. Work practices and office cultures will influence the design and implementation of both computer hardware and software. Failure to understand the organisational culture in may result in barriers during the implementation of any automation project. For example, re-engineering a process may entail reorganisation of tasks, additions of duties or deletions of certain steps. This process can affect behaviours and office routines that have been in place for years. If the new automated processes do not work well, they may be of little value because the older routines will persist. In this case, senior management should stress that the re-engineering is not being done for the benefit of automation. Rather, changes are being made to further the goals and objectives of the organisation.

Several physical factors can assist or impede the automation process, including the actual physical layout of the office, environmental issues and infrastructure. Computers and peripherals require large amounts of workspace to create an efficient working environment. Also, computer users can experience muscle pains if office furniture does not support parts of the body, such as the back and arms. Poor alignment between the computer monitor and the line of vision can result in neck problems. The potential for these concerns needs to be identified during the assessment.

The physical environment is also a factor. Consistent temperature and relative humidity must be maintained to ensure proper functioning of the computer technology. Furthermore, computers are also sensitive to excessive dust or dirt, and air conditioners will help to filter the air. Computer technology also relies on dependable power supplies, without significant surges or long-term power cuts. The initial assessment must address these issues as well. Preservation issues are discussed in more detail below.

Developing Goals, Objectives and Priorities

If the initial assessment proves favourable toward further exploration of automation options, the scope of the project needs to be established. Any automation project (or indeed any project in the organisation) must be well planned, based on clear and achievable goals and objectives and well-established priorities.

If the records management automation project does not blend well with the parent organisation's overall business goals, objectives and priorities, there is likely to be little support for its development. For example, if someone in a records office wished to develop an automated retention and disposal schedule at the same time as all classification systems were being revised, management may reasonably feel the automation project is premature.

When considering how automation in the records and archives institution will support the organisation's business objectives and priorities, consider the following issues.

Purpose of the System

The purpose of records and archives management systems must be phrased in terms of the larger organisation. Records professionals may want to clarify the purpose of the automated system, what other functions it could or should perform and what information is needed within the system. However senior management will want to know the business objectives to be supported by the automated system.

Automated systems must serve the purposes of the larger organisation.

Technical Considerations

During the assessment and planning process, it is important to consider the organisation's capacity for maintaining the system and its ability to provide the training necessary to support the use and application of automated tools. This process entails working with individuals responsible for information technology in the organisation and understanding their procedures, policies and areas of expertise. Some questions to consider in this area include the following.

- Is there sufficient technical support to solve hardware and software problems in a timely manner?

- What types of software are supported by the institution?
- What systems are already in place?
- How will the new system work with existing systems?
- Are policies and procedures in place for backing up data on a regular basis?
- What precautions are in place to combat viruses?
- What type of training is offered internally to assist employees in gaining and developing their own computer skills?
- Is there someone close by who can answer questions about software packages used by the organisation?

Organisational Factors

Goals, objectives and priorities for the automation project will differ depending on who in the organisation is involved. A key decision to be made is to determine who should be involved in the automation decision-making process. Other major organisational decisions include the following.

- Who will be authorised to enter, change and delete data?
- Who will have access to view data in the new system?
- Are different levels of access needed in the system?
- How will the new system be implemented (for example, full automation of one records office or incrementally by introducing one computer into a number of records offices)?
- Will it be implemented all at once or in phases?
- What levels and types of training are required for different staff members and other users to understand and utilise the system?

Resource Requirements

Resources are measured in terms of money, time and people. The major question usually is: what will the system cost? However, an expensive system may provide few installation and implementation problems and in the long run be less costly than a less expensive system that is difficult to install, hard for records centre staff to use and shuts down periodically.

An equally important question to ask is: what will be the benefits? This should be answered in terms of the immediate office as well as in terms of the business goals of the larger organisation. Other resource questions include the following.

- Where will necessary funds come from?
- When is the system to be installed?
- Are there sufficient funds to work within this time frame?
- Do sufficient funds exist for long-term maintenance of the hardware and preservation of the data in the system?
- Is there sufficient space to install such a system?
- What are the human resources requirements?

Political Issues

Software designed for automated records management systems includes assumptions about the value of records,

the extent to which it is acceptable to provide access to records, users' interest in accessing records and the capacity of the economy to afford the technology. Automating records systems may be well received if a government or organisation values accountability, efficiency, effectiveness and economy; they may be poorly received if the government or organisation is not aware of the importance of good records care. Questions to ask include the following.

- Does senior management accept the value of records as evidence?
- Does senior management see the need for the automated system?
- Will management provide financial and organisational support for the programme over the long term?
- Are there any potential champions of the project among senior officials?
- Who must be involved?
- Who should be involved?
- What consequences will acceptance or rejection of the proposal have on the organisation and its departments?

The answers to these questions will help organisers of the project to develop a written statement of goals, objectives and priorities. This statement will form the basis for the organisation and implementation of the automation project. A sample statement of goals, objectives and priorities is presented in the figure below.

In this example, observe that the goal is two-pronged. The records office desires to standardise descriptive data to enhance their own management of records and it wants to make some of this information accessible to users. The two parts of the goal are presented in more detail in the objectives. However, the top priority is to increase managerial control over records through standardisation and creating an easily updatable database. User access is secondary and will be phased in over the course of the automation project. This is not to say that user access is not important. However, objectives must be balanced in a realistic fashion taking into consideration the five areas discussed above, the purpose of the system, technical considerations, organisational factors, resource requirements and political issues.

A written statement of goals, objectives and priorities will form the basis for the organisation and implementation of the automation project.

Computers Control and Security

With increasing dependence on computers, the risk of breach of System security is also increasing. The rising stakes often tempt people to defraud organizations and get away with criminal gains.

If there is no control on printing of Dividend Warrants in the system, an investor could walk away with multiple dividends for the same amount invested. A vendor could get away with multiple payments for goods delivered once. Customer dues can be conveniently whitewashed. Insiders in collusion with external elements perpetrate most of the frauds and share the spoils.

The first principle of control lies in controlling access to the computer system. Nobody should be allowed direct access to the servers other than authorized administrators. Access to the server room can be controlled through swipe-card, fingerprint and other biometric devices. In sensitive data centers, there are movement-sensing cameras that constantly carry out surveillance. Security officers watch the displays in each zone and act when suspicious activity occurs. The key areas are network control area, server bay, power supply, air-conditioning and security control room. Each zone has remote-lockable doors acting as "man-traps". An intruder can be restrained in the forbidden zone till security officers can nab the person. Modern data centers are also built with flood-proofing, fireproofing and earthquake-proofing measures to ensure that even accidentally through acts of God, the crucial systems are unaffected.

Logical access should be limited to the role played by the user. For example, a data entry clerk need not have access to the Payroll Database. S/he needs only a Read-Write-Update access to the raw data files that can be tracked to the operator. An Accounts clerk need not have access to production data logs.

In order to ensure that the access rights are properly followed, we have the system of passwords. The System Administrator assigns access rights to the users as required by their work. The user protects his/her access through passwords. Ideally, passwords should be minimum 12 characters long, having a combination of letters and numerical digits. Where permitted one can use special characters also. There are cases where users cannot remember their passwords. So they write the password on Post and paste the same on their machines. Or else they use easy to guess words such as their own names or name of wife/child/pet. Such words are usually small and can easily be broken into.

The computer system remembers our passwords by storing them in internal, encrypted files. An expert cracker can retrieve the password if the Operating System has not been set up for the highest security levels.

For example, let us say that a security breach occurs in Microsoft Windows 2000 Operating System. This is reported to Microsoft and they issue an immediate “hotfix” or patch to the OS software that prevents the security hole from being misused. Later on, Microsoft collects similar corrections and bug fixes into a “Service Pack”. Details of such Hotfixes and Service Packs are available in Microsoft’s web site. Users can download such patches and correct their OS. Similarly there are other resources for correcting Unix bugs. When such patches are applied and the recommended security steps are taken care of at the time of the operating system installation, we say that the OS has been “hardened”.

Another class of insecurity comes in through Viruses. Computer Viruses are malicious programs capable of replicating themselves and destroy data or annoy users with meaningless messages. There are malicious codes known as Trojans that can seep into the system through electronic mail attachments. They can remain in the server and copy critical and secret information such as email addresses of others, passwords, credit card numbers, etc. and transmit the information to their creators. In turn the creators can indulge in frauds or cause trouble by changing the password, etc.

Internet web sites are attacked by different methods. The Denial–of-Service (DoS) attacks essentially flood the web server by sending thousands of high priority system messages. The server is rendered too busy responding to such spurious messages than attending to productive work.

In “spoofing” attacks, the user is deluded to get into some unwanted site by overriding the Domain Name Service entries. It needs to be remembered that information travels in packets that have the destination IP address. All computers in the network receive all the packets though they respond only to packets destined for them. A hacker or cracker can use this information to recraft the information content in the packet.

Modern information systems are used to connect external agencies such as service providers, customers and suppliers to the internal network through the medium of Internet. This is where the major risk lies.

Networks are protected from attackers by using:

- Appliances or software called “Firewalls” which restrict entry to outsiders based on security policy.
- Content Inspection & Intrusion Detection Systems, which monitor incoming packets and look for known or suspicious attack patterns. When they encounter suspicious code, they block the packets containing the same and thus protect the server.
- Antivirus software that is kept up-to-date with latest viral identities so that infected files can be identified and quarantined if not cured.

Organizations require security experts to keep a constant watch on network security as attack patterns are dynamically changing. Recent studies by the FBI have shown that most of frauds and damages have been done with insider collusion. Hence one needs to watch activities within and without.

Security of Information in transit over the network is taken care of by encryption, secure tunnels and tracking.

Encryption basically consists of transforming the information from an intelligible form to a non-intelligible form while sending. While receiving, the received information is transformed back to the original form. Modern encryption uses a pair of keys, one called "public" which is downloaded to the sender on initiation of the session. The sender's machine uses a mathematical algorithm to encrypt the information. This encrypted information can only be decrypted with the "private" key, which the receiver has, on his/her machine. Thus even if a cracker traps the information, s/he cannot decrypt it. It is no use trying to decrypt by permutation because not even the fastest of computers can crack the encryption in years of continuous working!

Secure tunnels are established by a combination of encryption and authentication by a special signature. Tracking tools are available to monitor the entire path taken by the transmitted information. In the event of suspicious activity, the offending machine can be identified and reported.

A major concern in carrying out commercial activities over the Internet or any public network is "repudiation". For instance, a person A buys some goods online and feeds his/her credit card number. When the card company presents the bill, A can refute it, saying that the purchase was not ordered by him/her and that it is the case of misuse. Modern technology offers methods by which the sender can be uniquely identified and it can be established that the order was, indeed, placed by A. This is known as "non-repudiation".

Computer Security is a very technical and complex subject. An IS Auditor needs to be aware of the type of attacks. S/he should know the various risks and consequences. S/he should verify whether there is a security policy in the organization and whether there is a mechanism to keep it up-to-date.

The IS Auditor should also verify whether passwords are being properly constructed and kept safe. The Systems Administrator should be aware of the security risks and their mitigation. This is what can be commented upon by the IS Auditor if s/he sees a gap.

TESTING OF COMPUTER SYSTEMS – DOCUMENTATION STANDARDS, POLICIES AND PROCEDURES AND AUDIT APPROACH

Documentation of the system

Systems documentation normally takes the form of narrative descriptions, flowcharts or a combination of the two.

Narrative Descriptions

A narrative description helps to give a complete picture of the system. It provides a detailed record of the system under audit and, taken together with other forms of system records, it should cover:

1. System objectives and targets;
2. Links and interfaces with other systems;
3. The environment in which the system operates;
4. The allocation of authority and responsibility;
5. All key controls and systems processes;
6. Exceptional situations or cases that may need to be dealt with by the system;
7. Ad hoc controls such as management reviews.

Narratives may cover detailed descriptions of transaction flows but in some cases these can be better recorded through flowcharts. It is often useful to use a combination of narratives and flowcharts – using flowcharts to describe more complex parts of the system. If flowcharts are used as well they and the narrative descriptions

should be cross-referenced to each other.

Narrative descriptions may be usefully divided into:

- A summary overview of the system; and
- Separate detailed descriptions of the main constituent parts of the system.

Full use should be made of headings and they should be organised in a logical way in order to give a clear picture and make handling and updating easier. Wherever possible the source of the information and the names and titles of people interviewed should be recorded. A clear concise record of the system should be prepared.

Flowcharts

Flowcharting is a diagrammatic method of recording and describing a system, which shows the flow of documents or information and the related internal controls within a system.

Flowcharts can help:

1. To obtain a perspective on the whole system;
2. Gain an understanding of the auditee's objectives;
3. Identify segregation of duties;
4. Help the person supervising the audit to identify areas which are not being covered by the audit.

Flowcharting is likely to be most effective if a logical, top-down approach is taken by starting with an overview or summary flowchart, followed by detailed flowcharts of specific processes if necessary.

There are various methods of, and symbols for, flowcharting.

When preparing flowcharts remember:

(a) Flowcharts are primarily designed to show document flows rather than operations – although other operations can be explained by means of narrative notes if necessary;

(b) Try to avoid mixing up the 'regular' process and exceptional processes (two or three transactions per period) on the same flowchart. Prepare separate charts for the regular and the exceptional processes;

(c) To consider whether it is better to record the system by preparing one or more basic flowcharts which show the main flows in the system - supplemented by narrative description where necessary;

(d) To flowchart the actual system. In some cases it may be necessary to record the 'official' system , and in those cases the charts must be labeled clearly to show whether it is the official (prescribed) or the actual (real functioning) system;

(e) To work in pencil. This will save time redrawing the flowchart when you make a mistake;

(f) That each flowchart should have a title, the date of creation and of any amendments to it and the name of the person who drafted it;

(g) To make sure that all documents (and every copy of each document) on the flowchart are fully dealt with;

(h) To think carefully before preparing a flowchart. Ask yourself whether it's really necessary or whether narrative description will be just as effective and less time-consuming.

Flowcharting can be a very effective way of recording document flows in a system.

Advantages of flowcharting are:

- Information can be easily communicated and assimilated;
- Flowcharts highlight the relationship between different parts of the system;
- The auditor can see the whole flow of documents: potential bottlenecks can be identified easily;
- Flowcharts offer a consistent method of recording;
- The auditor has to obtain a clear understanding of information flow in order to draw up a flowchart of a complex system;
- Cross-referencing between systems is made easier.

There are a number of disadvantages to using flowcharts. The most important is the time they can take to prepare. It is very easy for auditors to spend a lot of time preparing a flowchart when it would have been more efficient and useful to do a narrative description instead. Other disadvantages are:

- They are limited in scope and may not identify managerial and organizational controls;
- The technique and conventions have to be learned and practised;
- Complex flowcharts may confuse rather than clarify;
- The auditor usually needs some training and experience to be fluent in preparing them.

Organisation Charts

The organisational structure relating to the system under audit should be recorded. A copy of an existing organisation chart will suffice, as long as it is accurate and up to date.

An up-to-date organisation chart will show details of the information flow, relationships in the organization and responsibilities. It is also useful in identifying staff and deciding where audit testing needs to be done. The date the chart was prepared should be recorded.

The chart may include:

- Main department/units with a description of their functions;
- Job titles, grades and names of staff together with lines of responsibility;
- All reporting lines.

Minimum Contents of System Documentation

Whichever method is used for documenting the procedures in each system there are certain items, which should be included on every system file. These are:

- Examples of documents describing their purpose and use. These documents and reports should be filed in the order in which they are used in the system, and cross-referenced to the narrative note or flowchart.
- Examples of reports (whether computerised or manually prepared) describing their purpose and use;
- Details of the number of transactions passing through the system. These are essential to a full understanding of the context of the system in relation to the overall activities of the entity. It is therefore necessary to summarise data such as:

  (a) Number of transactions;

  (b) Value of transactions;

  (c) Seasonal fluctuations.

(d) Forms used to evaluate the system.

It may also be useful for the auditor to know the number of employees or a stratification of the transactions by value or age to assist in the evaluation of risk when a weakness is highlighted.

The Documentation Standards have been touched upon in the section on Change Management. Documentation guidelines are decided by policies.

In the Audit Approach, an IS Auditor goes through the documentation to understand the system and the controls provided for. The IS Auditor may get clues from other audits such as Financial audits to focus on areas that need attention. S/he then prepares specific test cases, which are passed through the Computer system. Deviations are noted down and covered in the report.

Importantly, the IS Auditor looks at the standard of documentation. Is it clear? Is it Current? Is it complete? An example of Documentation Standards for the Data Model approach is given as *Annexure A.*

ANNEXURE A

Title Page: It should contain a general description of the System, the areas it covers and the areas it does not cover.

Documentation:

1. Requirements Documentation: The purpose of the requirement section of the documentation is to define the problem so that the solution can be planned.

1.1 Name – Short title is given

- Problem statement – State what needs to be done, e.g. Share Capital needs to be updated after each transfer meeting.
- Problem Illustration – Complete and detailed specification of the problem should be given. Any assumptions made regarding the problem should be stated. This should provide a real world description of the problem, its input, its output and its processing.

1.2 Input Information

1.2.1 Input Files (to repeat for each input file)

- Name
- Description – how is the file used?
- What is the purpose?
- Format – How are the data organized and formatted?
- Size – What is the expected number of lines (or records or items)
  – Is the number fixed or variable? If variable, is there a minimum or maximum?
- Sample – provide a sample of properly formatted input.

1.2.2 Input Items: Repeat for each data element or program input

- Description – What does the input or data element mean?
- Type – What is its logical data type (e.g. integer, alpha-numeric etc.)
- Range of acceptable values – What is the acceptable range for this program

1.3 Output Information

1.3.1 Output files (repeat for each file or stream)

- Name
- Description – How is it used? What is its purpose?
- Format – How are the data organized and formatted in the output file
- Size – How many number of lines (records or items) are accepted
- Is the number fixed or variable? If variable, is there a minimum or maximum.
- Sample – provide a sample of properly formatted output.

1.3.2 Output items: Repeat for each program output

- Name
- Description – What does the output element mean? What is it used for?
- Type – What is its logical data type (integer, alphanumeric)
- Range of Acceptable Values – What is the acceptable range for this program.

1.4 User Interface Information

- Description – How will the user interact with the program?
- Types of user interfaces include menu selection, Form Fields, command language etc.
- Sample – include illustrations of screens.

1.5 Specifications: Description of functionality

2. The purpose of section of the documentation is to describe the plan for the solution of the problem. The software system consists of all components of the software product. The components are a collection of related items (sub-routines, constant etc.)

2.1 System Description: This section includes a list of each system component.

2.2 Component Information: A solution will include several types of system components. It consists of:

- Data abstraction
- Functional abstraction.

Module Information (repeat for each module)

- Module Name – Name of the Data abstraction
- Descriptions – briefly describe the task it performs. Specify accepting inputs and outputs

Data Abstraction Attributes – repeat for each attribute.

- Name
- Description
- Type
- Range of acceptable values.

Data Abstraction operations —

- Name – Name of the operation
- Description – briefly describe the task it performs.
- Specify accepting inputs and the outputs.

Functional Abstraction Components: Functional abstraction components consist of collection of sub routines that work together to carry out a portion of the requirements of the overall system. All sub-routines other than the main routine and those listed in the section on audit abstraction components should be covered in this section.

Sub Routine Information:

- Name
- Brief description of its function
- Input parameter – Name, type and purpose for each parameter
- Output parameter – Name, type and purpose for each parameter.

Design diagrams: Diagrams should be used to illustrate the design.

Structure chart is a true diagram of the sub-routine in a program. It indicates the interconnection among the sub-routines.

Pseudo Code –This section should describe in an easily readable and modular form how the software system will solve the given problem. Using simple Standard English terms, there should be a description of the problem and how exactly the solution is obtained.

III. Implementation Document: The purpose of this documentation is to give details of how the system has been implemented.

Physical Organization of System Components: Different components of the System. The architecture will appear in different compilation.

Comments: The program design information should be explained. It should broadly cover System Documentation, Problem Statement, Problem Specification, System Architecture.

Programming style: Programming style refers to those conventions that enhance the readability of the program.

IV. Verification and Validation Documents: The purpose of the verification and Validation documents is to demonstrate the operation of the program, describe how it is run on the machine and present evidence of program verification and validation.

IV.1 Planning

- Approach – What is the approach which has been adopted to ensure system software works correctly.
- Test Cases and Test Audit include a list of input data that test thoroughly the logic of the program and demonstrates that the program satisfies its requirements. If each of the test data explain the requirements it will exercise.

IV.2 Outcome of Verification and Validation

Summary of verification and validation results: Give a brief description of the results from your verification and validation activities.

Verification and Validation Process: Provide a description of the procedure followed and any changes made.

IV.3 Operating Directions: The name and version number of the compiler used

– Name and location of the version program file, executable file, and any data files used.

– Names and locations of different files which are needed to be compiled to execute this program.

IV.4 If the program has any bugs that needs to be indicated. Explain what parts of the program work and also any caution that needs to be exercised to avoid problems.

V. Version History

– Revision I

– Revision II

– Original Version

LESSON ROUND-UP

– Information systems auditing or systems audit is the process of collecting and evaluating evidence to determine whether a computer system safeguards assets, maintains data integrity, allows organizational goals to be achieved effectively, and uses resources efficiently.

– The objectives of information system audit include verifying safeguarding of assets, data integrity, system effectiveness and system efficiency.

– To start system audit, a plan has to be developed, covering scope and objectives, key strategies for Analysis and understanding of standard procedures, Evaluation of system and internal controls. Audit procedures and documentation of evidence etc.

– Information systems auditing is not just a simple extension of traditional auditing. The discipline of information systems auditing has been shaped by knowledge obtained from four other disciplines i.e. traditional auditing, computer science, behavioural science and information system management.

– The nature of systems audit, unlike the other audits, is not restricted to audit of reported items only. It has to take into cognizance the choice, use and risk of Technology. It has to look at the realities of business processes and constantly changing legal framework

– The scope of systems audit covers the entire IS management process. The scope includes review of the entire design & development process, the review of technology choice, the processes employed to assess risks and losses that could accrue to the system, the possibility of computer frauds, the care taken in managing changes to the system, extent of testing and reliability of the system. \

– IS Audit is an evaluation of adequacy of Management controls, Operational Controls, Organisation controls and application controls.

– Steps involved in conducting IS audit includes, purviewing of the environment, Understanding the Information Systems, Identification of the Audit Risks, Audit Evidence, Key Control Points and Identify Control Weaknesses, Verifying veracity of computer files, Conduct Audit Tests, Concluding the Audit

– Collecting evidence on the reliability of a computer system is often more complex than collecting evidence on the reliability of a manual system. Auditors confront a diverse and sometimes complex range of internal control technology that did not exist in manual systems. Auditors must understand these controls if they are to be able to collect evidence competently on the reliability of the controls.

– Given the increased complexity of computer systems and internal control technology, it is also more difficult to evaluate the consequences of control strengths and weaknesses for the overall reliability of systems. First, auditors must understand when a control is acting reliably or malfunctioning. Next, they

must be able to trace the consequences of the control strength or weakness through the system.

– For doing the system Audit of Computerised Secretarial Function, the auditor should note that the procedure to be followed for performing a Systems Audit remains the same irrespective of functionality. The testing of application controls alone vary. Systems audit consists of evaluating the Management Controls, Environmental Controls, Organizational Controls and Application Controls

SELF-TEST QUESTIONS

(These are meant for re-capitulation only. Answers to these questions are not to be submitted for evaluation)

1. Discuss nature and significance and scope of systems audit. Also mentions various steps involved in conducting in information system audit.
2. Discuss system audit of computerised secretarial functions.
3. Write short notes on:
   (a) Norms and procedures for computerisation
   (b) Computer control and security
   (c) Testing of computer system
   (d) Objectives of Information Systems Auditing
4. Discuss the Foundations of Information Systems Auditing.
5. What do you mean by operation control? Describe in details
6. What is the meaning of documentation standards? Explain its importance.
7. State the relationship of Systems audit and various management functions.

GLOSSARY

Algorithm	In computing, a finite set of well defined rules for the solution of a problem in a finite number of steps.
Applet	A small *Java program* that can be embedded in an *HTML* page. Applets differ from full-fledged Java applications in that they are supposed to be restricted to provide some security to the user.
Application	A *system* that has been developed to serve a specified purpose, for example to pay suppliers' invoices, place orders with suppliers and maintain stock records. An application incorporates both clerical and computerised procedures; *controls* over *transaction* input, processing and output; and *file* management. It should also maintain an *audit trail* (see also *system software*; *program*).
ASCII	American Standard Code for Information Interchange. ASCII was developed to *standardise* data transmission among disparate hardware and *software* systems, and is built into most mini and personal computers. It is a coding scheme using 7 or 8 *bits* that assigns numeric values to up to 256 characters. These include letters, numerals, punctuation marks, control characters and other symbols. ASCII text is often referred to as a "plain text"
Asymmetric encryption	A cryptographic *algorithm* that employs a *public key* for *encryption* and a *private key* (see *secret key*) for *decryption*; or in *authentication*, a private key for signing and a public key for signature verification. Public and private *keys* are related and form an asymmetric key set.
Audit trail	A chronological set of *records* that collectively provide documentary evidence of processing, sufficient to enable reconstruction, review and examination of an activity.
Authenticity	The attribute of genuineness. For evidence to be authentic it must be all that it purports to be.
Authentication	(1) The act of determining that a *message* has not been changed since leaving its point of origin. **(**2) A process that verifies the claimed identity of an individual.
Availability	The ability to access and use a *system*, resource or *file*, where and when required.
Backup	A duplicate copy (e.g. of a *program*, of an entire disc or of *data*) made either for archiving purposes or for safeguarding valuable *files* from loss should the active copy be damaged or destroyed. A backup is an "insurance" copy.
Bandwidth	A measurement of how much *data* can be sent across a communications circuit at the same time. It is usually measured in *bits* per second (BPS).

Biometrics	In *access control*, automated methods of verifying or recognising a person based upon behavioural or physical characteristics (e.g. fingerprints, handwriting, and facial or retina geometry).
BIOS	Basic Input/Output System. The set of essential *software* routines that test hardware at start-up, start the *operating system* and support the transfer of *data* among hardware *devices*. On PC-compatible computers, the BIOS is stored in read-only memory (*ROM*) so that it can be executed when the computer is turned on. Although critical to performance, the BIOS is usually invisible to computer users.
Bit	Shortened term for binary digit. It is the smallest unit of *information* handled by a computer. One bit expresses a 1 or a 0 in a binary numeral, or a true or false logical condition, and is represented physically by an element such as a high or low voltage at one point in a circuit or a small spot on a disk magnetised one way or the other. A single bit conveys little information a human would consider meaningful. A group of 8 bits, however, makes up a *byte*, which can be used to represent many types of information, such as a letter of the alphabet, a decimal digit or other character.
Black box testing	Testing that involves no knowledge of the internal structure or logic of a *system*.
Boot	The process of starting or resetting a computer. When first turned on (cold boot) or reset (warm boot), the computer executes important *software* that loads and starts the computer's *operating system* and prepares it for use. Thus, the computer can be said to pull itself up by its own "bootstraps".
Browsing	Searching through storage to locate or acquire *information*, without necessarily knowing of the existence or the format of the *data* being sought.
Buffer	(1) In computing, an area of storage that is temporarily reserved for use in performing an input/output operation, into which *data* is read or from which it is written. (2) In data communications, a storage area used to compensate for differences in the rate of flow of data, or time of occurrence of events, when transferring data from one *device* to another.
Bug	An error in *programming code* that produces an undesirable variation from design performance in a *program* during execution.
Business continuity	A formal plan, or integrated set of plans, designed to enable key business processes to continue in operation following a major system failure or disaster. Essential ingredients include the identification of key business *processes*, adequate system *backups* and a workable continuity *strategy*.
Byte	A unit of *data* generally comprising 8 *bits*. A byte can represent a single character, such as a letter, a digit or a punctuation mark. Because a byte represents only a small amount of *information*, amounts of computer memory and storage are usually given in kilobytes (1,024 bytes), megabytes (1,048,576 bytes), or gigabytes (1,073,741,824 bytes).

Call centre	A central point where customer and other telephone calls are handled by an organisation, usually assisted by some amount of computer automation. Typically, a call centre has the ability to handle a considerable volume of calls at the same time, to classify calls and forward them to someone qualified to handle them, and to record calls. Call centres commonly handle such activities as customer services, order entry, reservations, *help desk* facilities, dispatch systems, telesales and collections. Telephone banking, insurance and share dealing are among financial applications.
CASE	Computer Aided Systems Engineering. *Software* tools that support *systems* analysis, design and construction.
Central Processing Unit	(CPU) computer hardware that houses the electronic circuits that control/ direct all a computer's operations.
Certification authority	In cryptography, an authority trusted by all users to create and assign *digital certificates*.
Change Control	In *project management*, uncontrolled changes are one of the most common causes of delay and failure. Change Control is the process of implementing procedures which ensure that proposed changes are properly assessed and, if approved, incorporated into the project plan.
Change management	IN IT service management, the *process* of *controlling* and managing requests to change an *IT Infrastructure* or *IT service*, and then controlling and managing the implementation of the changes that are subsequently approved.
Channel	In data communications, a path along which signals can be sent. The term may also refer to a mechanism by which the path is effected.
Ciphertext	In *cryptography*, unintelligible text produced through the use of *encryption*.
Classification	The process of formally identifying *incidents, problems* and *known errors* by origin, symptoms and cause.
Client	(1) A computer that interacts with another computer, usually referred to as the *server*, using a client *program*. E-mail is an example - an e-mail client connects to an e-mail server to send and receive *messages*. (2) A term sometimes used by auditors to refer to an audited organisation.
Code	*Program* instructions written by a programmer in a programming language.
Confidentiality	In *information security*, the property that *information* is not made available or disclosed to unauthorised individuals, entities or processes.
Controls	In *information security*, *policies*, *procedures* and mechanisms designed to ensure that activities achieve their authorised objectives. Controls can be preventive (e.g. a 'no smoking' policy is enforced), detective (e.g. a smoke detector), corrective (e.g. a sprinkler system) or restorative in character (e.g. a disaster recovery plan).

Cryptography	The discipline that embodies principles, means and methods for the transformation of *data* in order to hide its *information* contents, prevent its undetected modification, and/or prevent its unauthorised use.
Data	In computing, (1) a representation of facts, concepts, *information*, or instructions in a manner that is suitable for processing by an *information system*. (2) The building blocks of information.
Data dictionary	In *databases*, a centralised repository of *information* about the stored *data*, providing details of its meaning, relationship (to other data), origin, usage and format.
Data file	A *file* consisting of *data* in the form of text, numbers or graphics, as distinct from a *program* file containing commands and instructions. Data files may also be called documents or spreadsheets.
Database	An extensive and comprehensive set of *records* collected and organised in a meaningful manner to serve a particular purpose.
DBMS	Database Management System. *Software* that handles *database* access requests from *application* processes. Essentially a DBMS handles storage, access, *data* sharing among multiple users, and database administration tasks (e.g. controlling what data an application *user* can view and update).
Decrypt	In *cryptography*, to convert by use of the appropriate *key*, *encrypted* text (see cipher text) into its equivalent plaintext.
Device	A generic term for printers, scanners, mice, keyboards, serial ports, video adapters, disk drives and other computer subsystems. Such devices frequently require their own controlling *software*, called *device drivers*.
Digital certificate	In *cryptography*, a message that guarantees the authenticity of the data contained within it. In *public key cryptography* it is important that anyone using a public key can be sure about its *authenticity*. Such a guarantee may be issued by a *Certification Authority* trusted by the users, and based on assurances obtained from applicants for digital certificates. A certificate generally contains the public key owner's identity, the public key itself and its expiry date. A user supplies the certificate and the recipient *decrypts* it using the certification authority's public key (often performed automatically by the recipient's *browser*/e-mail software). The recipient gains assurance that a trusted authority has signed the user identity and corresponding public key.
Digital signature	A *data* block appended to a *file* or *message* (or a complete *encrypted* file or message) such that the recipient can *authenticate* the file or message contents and/or prove that it could only have originated with the purported sender.
Document	*Information* in readable form. The medium on which the document is held (e.g. paper, fiche, film and magnetic disk) is not important.

EBCDIC	Extended Binary Coded Decimal Interchange Code. Developed by IBM, and mostly used by *mainframe* systems, EBCDIC is a standard way of representing text symbols using binary numbers
EDI	Electronic Data Interchange. In computing and communications, the transmission of documents from one computer to another over a *network*. Although EDI is sometimes carried out over direct links between trading partners (and increasingly the *Internet*), it is more usual to involve a value added supplier to operate an electronic mailbox through which documents are exchanged on a store and collect basis, similar to e-mail. The ability of communicating computer systems to exchange and process *information* in this way can significantly speed up processing and reduce manual transcription errors.
EFT	Electronic Funds transfer. *Systems* designed to move funds between banks using electronic communications rather than paper media. Common EFT systems include BACS (Bankers' Automated Clearing Services) and CHAPS (Clearing House Payment System).
Electronic business	Using an electronic *network* to simplify and speed up all stages of the business process including such as activities as design and manufacturing; buying, selling and delivering; and transacting government business.
Electronic commerce	Using an electronic *network* to simplify and speed up the process of buying, selling and delivering.
Electronic government	Using an electronic *network* to deliver government *information* to, and transact government business with other departments of state, citizens and businesses, and other governments.
Encryption	(Also encipher). The process of transforming *information* into an unintelligible form in such a way that the original information cannot be obtained ("one-way" encryption) or cannot be obtained without using the inverse *decryption* process ("two-way" encryption).
Encryption algorithm	A set of mathematically expressed rules implemented in either *firmware* or *software*, and used in conjunction with a *secret key* for *encrypting* plaintext and decrypting *cipher text*.
ETHERNET	A common *LAN* technology that employs CSMA/CD (carrier sense multiple access with collision detection) over either coaxial cable or twisted pair wiring. CSMA/CD allows computers to transmit when the *network* is free.
File	A complete, named and collection of *information*. (1) In computing, a *file* can contain program *code*, *data* (e.g. *transactions* to be processed by a *program*), or user-created data (e.g. a word processor file). Most commonly, however, the term refers to data (numbers, words, or images) that a user has created and then saved for subsequent retrieval, editing or printing. (2) In *information systems*, a collection of *documents*. The medium on which the documents are stored (e.g. paper, fiche, microfilm, magnetic disks) is not important.

File server	In a local area *network* (*LAN*), a computer that provides access to *files* for *workstations* that are connected to the network.
Firewall	A security system used to prevent unauthorised access between networks (both internal/internal, and internal/external) by examining and filtering IP data *packets*. A firewall will allow only approved traffic in and/or out by filtering packets based on source/destination *IP address*, source/destination port. The firewall inspects the identification information associated with all communication attempts and compares it to a rule-set consistent with the organisation's security policy. Its decision to accept or deny the communication is then recorded in an electronic log.
Firmware	Programming that is inserted into Programmable Read-Only Memory (PROM), thus becoming a permanent part of a computing *device*. Firmware is created and tested like other *software*. It can also be distributed like other software and installed in the PROM by the user. Firmware is sometimes distributed for printers, *modems* and other computer *devices*.
	Fourth Generation Language Any programming language that uses English terminology and allows rapid *software* development. With 4GLs the user specifies what is required and the programming language works out what actions are needed to carry out the required task. *Structured Query Language* (SQL) is a commonly used 4GL.
FTP	File Transfer Protocol. In communications, a *protocol* that ensures the error-free transmission of *program* and *data files* via a data communications link.
Function Point Analysis	In planning and estimating, a technique used to determine the size of a development task. It entails breaking a *project* down into function points (factors such as inputs, outputs, enquiries, logical internal sites, etc.), which are then classified by degree of complexity. Factors are then applied from which time estimates may be developed.
Gateway	A computer or other *device* that links two *networks*, routing and often converting *protocols* or *messages* from one network to the other. The term can also refer to a system capability that provides direct access to other remote networks or *services*.
GANTT Chart	A bar chart plotting the phases or *activities* of a *project* against a predefined timeline to completion.
Gigabyte	(GB) 1,024 megabytes (2^{30} *bytes*). Often interpreted, though, as approximately one million *bytes*.
Hash total	A figure obtained by some operations upon all the items in a collection of *data* and used for control purposes. A recalculation of the hash total, and comparison with a previously computed value, provides a check on the loss or corruption of the data.

Host	A computer connected to a *network* that offers services to one or more users.
HTML	Hypertext Markup Language. The programming language used for *web pages*. It is called a “mark-up” language because it is used to describe the formatting to be used to display the document. The html file contains both the text and *code* (called tags). It is read by a web browser, which interprets the code and displays the web pages in the format specified by the HTML.
HTTP	Hypertext Transfer Protocol is the set of rules for exchanging files (text, graphic images, sound, video, and other multimedia files) on the *World Wide Web*. By comparison with the *TCP/IP* suite of *protocols*, which forms the basis of *information* exchange across the *Internet*, HTTP is an *application* protocol.
Hub	A *device* that connects several devices (terminals, printers, etc.) to a *network*.
ICT	Information and Communications Technology. The acquisition, processing, storage and dissemination of *information* using a combination of computer and telecommunications technologies.
Information	Knowledge that was unknown to the recipient prior to its receipt. Information is derived from *data*, which to be of value needs to be valid (e.g. not duplicated or fraudulent), complete, accurate, relevant and timely.
Information security	The result of any system of policies and procedures for identifying, controlling and protecting *information* against unauthorised disclosure, manipulation, modification; unavailability and destruction. Unauthorised disclosure refers to information that is, for example, commercially sensitive, nationally classified or subject to *data protection* legislation. Manipulation is concerned with changing some attribute of the *data*, such as *file* ownership, security classification, destination, etc. Modification involves unauthorised alteration of the data itself, which can take place without leaving any trace. Unavailability refers to an inability to access and process the data (e.g. due to computer or communications failure). Data can be destroyed quickly and efficiently in electronic or magnetic storage *devices* (e.g. by degaussing, powering down *volatile* storage and overwriting).
Information security policy	A formal statement that defines top management intentions on *information security*, and provides general direction for protecting the *confidentiality, integrity and availability* of corporate *information*.
Information system	The means for organising, collecting, processing, transmitting, and disseminating *information* in accordance with defined *policies* and *procedures*, whether by automated or manual means.
Input controls	Techniques and procedures used to verify, validate and edit *data* to ensure that only correct data is entered into a computer *system*.

Integrity	In *information security*, the property that *information* is valid, complete and accurate.
Internet	A worldwide system of linked computer *networks* that enables data communication *services* (based on *TCP/IP*) such as remote logon, file transfer, electronic mail, and newsgroups. The Internet is not a discrete computer network, but rather a way of connecting existing computer networks that greatly extends the reach of each participating system. It is not single service, has no real central hub, and is not owned by any one group (see also IETF).
Intranet	A private *network* inside an organisation that uses the same kinds of *software* and *protocols* found on the *Internet*. Intranets may or may not be connected to the Internet.
IP	Internet Protocol. A *protocol* that defines and routes data across the *Internet*. It uses *packet switching* and makes a best effort to deliver its *packets* (see also *TCP/IP*).
IP address	Every computer on the *Internet* is assigned a unique number so it can be identified. *IP* addresses are 4 dot-separated numbers (for example, 205.243.76.2) that specify both the *network* the computer is connected to and the *host*.
ISDN	Integrated Services Digital Network. A medium speed, digital connection. It provides up to 128kbps *bandwidth* over two *channels*. Like normal phone lines, it has a number that can be dialled into and it can dial out to any other ISDN number, unlike leased lines which are strictly point-to-point. Like leased lines, ISDN provides a reliable digital *service* that is not normally affected by line noise and other ailments that modems can experience.
IS Steering Committee	The top management group responsible for the overall direction of *information systems* (IS). The ISSC owns, commissions, directs and agrees their organisation's *IS Strategy*.
IS Strategy	An organisation's master plan for directing, developing, installing and operating the *information systems* necessary to satisfy its business needs. An IS strategy should be supported by a business case to provide purpose and economic justification for what is proposed. It should also include measurable performance targets and deadlines against which its success can be monitored. Due to the delay generally involved in bringing new *IT infrastructure* into operation, an IS strategy usually covers a three to five year planning period. It should, however, be monitored and updated frequently to ensure that it continues to represent an effective and workable plan. See *IS Steering Committee*.
Key	In *cryptography*, a symbol or sequence of symbols that controls the operations of *encryption* and *decryption*. It is essential that keys are protected against unauthorised disclosure.

LAN	Local Area Network. A *network* that connects PCs and other computers within a limited geographic area by high-performance cables so that users can exchange information, share expensive peripherals, and draw on the resources of a massive secondary storage unit, call a *file server*.
Logical	In computing, conceptual or virtual (i.e. within the computer; in *cyberspace*), as compared with physical or actual (i.e. outside the computer; real world).
Logical access	The act of gaining access to computer *data*. Access may be limited to "read only", but more extensive access rights include the ability to amend data, create new *records*, and delete existing records (see also *physical access).*
Login	The act of connecting to a computer and being *authenticated* as a legitimate user. The usual requirements are a valid user name (or user ID) and password, but in higher *risk* scenarios a user may also have to insert a physical token (e.g. a *smartcard*) and/or provide *biometric* proof of identity.
Mainframe	A high-level computer designed for the most intensive computational tasks. Mainframe computers are often shared by multiple *users* connected to the computer by terminals.
Macro	A macro is a list of actions to be performed that is saved under a short key code or name. *Software* can then carry out the macro's instructions whenever the user calls it by typing its short key code or specifying the macro name.
Media	The physical material, such as paper, disc and tape, used for storing computer-based *information*.
Memory	Memory generally refers to the fast semiconductor storage (Random Access memory, or *RAM*) directly connected to the *processor* that is dependent on electrical power for activation. Memory is often differentiated from computer storage (e.g., hard disks, floppy disks, CD-*ROM* disks) that is not dependent on electricity and is therefore a more permanent means for holding *data*.
Memory chip	Or "chip", is an integrated circuit devoted to memory storage. The memory storage can be *volatile* and hold *data* temporarily, such as *RAM*, or non-volatile and hold data permanently, such as *ROM*, EPROM, EEPROM or PROM.
Message	In data communications, an electronic communication containing one or more *transactions* or one or more items of related *information*.
MICR	Magnetic Ink Character Recognition. A technique for the identification of characters printed with ink that contains particles of a magnetic material. Used widely in the banking industry to capture sort codes and account numbers on cheques.

Microprocessor	A central processing unit (*CPU*) on a single microchip. A microprocessor is designed to perform arithmetic and logic operations that make use of small number-holding areas called *registers*. Typical microprocessor operations include adding, subtracting, comparing two numbers, and moving numbers from one area to another. These operations are the result of a set of instructions that are part of the microprocessor design. A modern microprocessor can have more than one million transistors in an integrated-circuit package that is roughly one inch square. Microprocessors are at the heart of all computers, from *mainframes* down to *smartcards*.
Middleware	*Software* that is neither part of the *operating system*, nor an *application*. It occupies a layer between the two, providing applications with an interface for receiving services. Common examples are communications *programs* and *transaction* processing monitors.
Modem	A communications *device* that enables a computer to transmit *information* over a standard telephone line. Because a computer is digital (it works with discrete electrical signals representing binary numbers 1 and 0) and a telephone line is analogue (carries a signal that can have any of a large number of variations), modems are needed to convert digital to analogue and vice versa. The term is short for Modulator/Demodulator.
Multiplexor	Equipment that takes one or more *data channels* and combines the signals into one common channel for transmission. At the receiving end a demultiplexor extracts each of the original signals.
Network (1)	In data communications, a computer-based communications and data exchange *system* created by physically connecting two or more computers. The smallest *networks*, called local area networks (*LAN*'s), may connect just two or three computers so that they can share an expensive peripheral, such as a laser printer, but some LAN's connect hundreds of computers. Larger networks, call wide area networks (*WAN*s), employ telephone lines or other long-distance communications media to link computers.
Network (2)	A diagram that shows the logical relationships between *activities*.
Objective	A desired goal, or end result.
OCR	Optical Character Recognition. Techniques and equipment for reading printed, and possibly hand-written, characters on a *document* and converting them to digital code (e.g. *ASCII*) for input to a computer.
Off-the-shelf	A packaged item ready for sale. The term can refer to hardware, *software* or both.
On-line	Generally describes a computer that is connected to a *network* and is thereby ready for operation or interaction over the network. It may also refer to the ability to connect to the *Internet* by virtue of having an Internet account.

Operations bridge	The combination in one physical location of computer operations, *network* control and the *Help Desk*.
Operating system	In computing, a collection of *software* designed to directly control the hardware of a computer (e.g. input/output requests, resource allocation, data management), and on which all other *programs* (including *application programs*) running on the computer generally depend.
Output controls	*Controls* whose objectives are to ensure that computer outputs are complete and accurate, are securely held until distribution (they may include financial instruments), and are distributed to the intended recipient(s) in a timely manner.
Outsource	The use of an external contractor to provide (1) both the IT *systems* and the personnel required to run them (see also *facilities management*). (2) support *services*, such as hardware maintenance.
Packet	(Sometimes referred to as a 'frame') in communications, a packet comprises a well-defined block of bytes consisting of 'header', *'data'* and 'trailer'. Packets can be transmitted across *networks* or over telephone lines. The format of a packet depends on the *protocol* that created it. Various communications *standards* and *protocols* use special purpose packets to monitor and control a communications session.
Packet switching	A transmission method in which *packets* are sent across a shared medium from source to destination. The transmission may use any available path or circuit, and the circuit is available as soon as the packet has been sent. The next packet in the transmission may take a different path, and packets may not arrive at the destination in the order in which they were sent.
Password	In *Access Control*, confidential *authentication information* usually composed of a string of characters, that may be used to control access to physical areas and to *data*.
Physical access	In *access control*, gaining access to physical areas and entities (see *logical access*).
Platform	The computer hardware, and the associated *operating systems software* necessary for its operation, on which *applications software* is run.
Port	an interface between the CPU and a peripheral *device*.
Procedure	A set of instructions for performing a task. Procedures should be consistent with *policy* requirements.
Process	In IT Service Management, a sequence of operations that are intended to achieve a defined objective. Processes require *policy*, people, procedures and *IT infrastructure*.
Processing controls	*Controls* whose objectives are to ensure that only valid *data* is processed, and that processing is both complete and accurate.

Program	In computing, a series of instructions that conform to the syntax of a computer language, that when executed (or “run”) on a computer will perform a given task.
Protocol	A set of rules that must be followed for any data communications to be made. Protocols enable totally different *platforms* (e.g. computers connected to the *Internet*) to communicate with each other. For one computer to communicate with another, both must adhere to the same *protocol(s)*.
Public key	In *cryptography*, the *key*, in an *asymmetric* encryption system, of a user’s key set that is known to other users.
Query	In computing, a specific set of instructions for extracting particular *data* from a *database*.
RAM	Random Access Memory. Semiconductor-based memory that can be read and written by the central processing unit (CPU) or other hardware *devices*. The term is generally understood to refer to volatile memory that does not permanently hold *data* or *programs*.
Record	(1) In computing, a collection of related *data* treated as a unit. A record is the main unit of storage within a *file*. (2) In record management, anything that provides permanent evidence of, or *information* about past events. Although the term *document* includes records, records are particular types of document that are not subject to amendment, and for which there is often a legal or contractual requirement.
Risk management	The total process involved in reducing identified *risks* to a level that is acceptable to an organisation’s top management.
ROM	Read-Only Memory. A semiconductor circuit into which *code* or *data* is permanently installed by the manufacturing process. ROM contains instructions or data that can be read or executed, but not modified.
Script	A simple *program* consisting of a set of instructions that are designed to perform or automate a task or function.
Secret key	In *cryptography*, the *key* of a user’s key set in an *asymmetric* or *public key* cryptographic system, which may be known only to that user.
Server	A computing unit or *node* in a *network* that provides specific *services* to network *users*, e.g. a printer server provides printing facilities to the network, and a *file* server stores users’ files.
Service Level Agreement	Or SLA, is a written agreement between a user and an IT service provider that documents the agreed service levels for an IT service (e.g. hours of operation, maximum downtimes, transaction throughput, terminal response times, security, contingency). An SLA is not normally a contract in itself, but it may form part of a contract.

Smartcard	A plastic card (of identical dimensions to a credit card) that has electronic logic embedded in it in the case of a *stored data card*, or a *microprocessor* in the case of cards with processing ability. Smartcards are commonly used to perform *digital signatures*, *authenticate* users for *access control* purposes, and *encrypt* or *decrypt messages*.
SMTP	Simple Mail Transport Protocol. The *protocol* that is used to move e-mail and any attachments between mail *servers*.
Software	Instructions for the computer. A series of instructions that performs a particular task is called a *program*. The two main types of software are *system software* (*operating system*), which controls the workings of the computer and *application programs*, which perform the tasks for which people use computers. A common misconception is that software is *data*. It is not. Software tells the hardware how to process the data. Software is "run" (or "executed"), whereas data is "processed."
Software package	A *software program* or *application* sold to the public, ready to run, and containing all necessary components and documentation. Also called "shrink wrapped" or "off-the-shelf" software.
Software maintenance	Any modification to a *software* product after delivery to correct faults, to improve performance or other attributes, or to adapt the product to a changed environment.
Specification	A detailed description of the requirements for a product or *service*.
Spoofing	In *Information Security*, (1) assuming the characteristics of another computer system for purposes of deception. (2) Malicious *code* that masquerades as the *operating system*, presenting a *login* screen and tricking the user into revealing their *password*.
SQL	Structured Query Language, the traditional language for accessing *data* stored in a relational *database*.
Strategy	A detailed and systematic plan of action.
Superuser	A user with unrestricted access to user *files* and system *utilities*. For reasons of security, this level of access should only be granted to the minimum number of staff necessary to perform system administration duties.
Symmetric encryption	A form of *data encryption algorithm* that employs the same value of *key* for both encryption and *decryption* processes.
System	Any collection of components that work together to perform a task. Examples are a hardware system consisting of a *microprocessor*, its allied chips and circuitry, input and output *devices*, and peripheral devices; an *operating system* consisting of a set of *programs* and data *files*; a *database management system* used to process specific kinds of *information*; or an *application system* used to perform a particular business function.

System Development Life Cycle	(SDLC). is the process of developing *information systems* through investigation, analysis, design, implementation, and maintenance.
System software	*Software* primarily concerned with co-ordinating and controlling hardware and communication resources, access to *files* and *records*, and the control and scheduling of *applications* (see also *operating system*).
TCP/IP	**T**ransmission Control Protocol/Internet Protocol. A set of *protocols* that make *Internet* services (Telnet, FTP, e-mail, etc.) possible among computers that don't belong to the same *network*.
Test environment	A computer system or part of a computer system (made up of hardware and *system software*), which is used to run, and sometimes to build, software *releases* for acceptance testing.
Test data	In computing, *data* prepared solely to test the accuracy of the *programming* and logic of a *system*. It is used to prove each branch and combination of branches (within feasible limits) of a system and should, therefore, be as comprehensive as possible.
Threat	In *Information Security*, actions and events that may jeopardise a *system's* objectives.
Transaction	A discrete activity within a computer *system*, such as an entry of a customer order or an update of an inventory item. Transactions are usually associated with *applications*.
Trapdoor	A hidden hardware or *software* mechanism that permits *access controls* to be bypassed. Trapdoors often inserted by system developers as a convenient means of testing computer *programs* and diagnosing *bugs*.
Trojan Horse	In *Information Security*, an apparently useful *program* that performs unauthorised functions by taking advantage of an innocent user's access rights in order to copy, misuse or destroy *data*. For example, a Trojan Horse hidden in a text editor might covertly copy sensitive *information* contained in a *file* being edited to another file that is accessible by the attacker
UNIX	A highly portable, general purpose, multi-user *operating system*, generally used on small and mid-range computers (versions are also available for PCs). There is many common features between the numerous commercial versions of UNIX. UNIX provides facilities for sharing resources (disc space, CPU time, etc.) and for protecting *users' files*. For each file users can allocate individual read, write and execute privileges to themselves, members of groups and all other users. The operating system is also multitasking, which allows users to relegate *programs* that require no interaction to background processing whilst working interactively on other tasks.
URL	Uniform Resource Locator. A uniform method where a *host* can be accessed at a specific address using a specific *protocol.* An example is http://www.Icsi.edu/, the URL for ICSI.

UPS	In *business continuity* an acronym for Uninterruptible Power Supply. A *device*, connected between a computer (or other electronic equipment) and a power source, that ensures that the computer's power supply is not interrupted. In most cases it also protects the computer against potentially damaging events, such as power surges and brownouts. All UPS units are equipped with a battery and a loss-of-power sensor; if the sensor detects a loss of power, it switches over to the battery so that the user has time to close down the computer in a controlled manner, thus avoiding *data* loss.
Utility program	*Software* designed to perform maintenance work on a system or on system components (e.g., backing up data; disk and *file* recovery; editing; sorting and merging; file and memory *dumps*)
Virus	A computer *program* designed to carry out unwanted and often damaging operations. It replicates itself by attaching to a host, which depending on the type of virus, may be a program, *macro* file or magnetic disc. In common with a human virus, the effects of a computer virus may not be detectable for a period of days or weeks during which time the virus will attempt to spread to other systems by infecting files and discs. Eventually, the effects manifest themselves when a date or sequence of events triggers the virus.
Virtual Private Network	A VPN is a private data *network*, but one that uses the public telecommunication infrastructure, such as the Internet. It is similar in concept to a system of owned or leased lines, but provides comparable capabilities at much lower cost by using shared rather than private infrastructure. Using a virtual private network involves *encrypting data* before sending it through the public network and *decrypting* it at the receiving end. An additional level of security involves encrypting not only the data but also the originating and receiving network addresses. VPN software is typically installed as part of the organisation's *firewall* server.
Volatile	In *data* storage, a term used to describe any *device* that needs to be powered on in order to function. Most microchip storage technologies are volatile, compared with optical and magnetic storage devices which are non-volatile (although considerably slower to access).
Vulnerability	In *Information Security*, a weakness or flaw (in location, physical layout, organisation, management, procedures, personnel, hardware or software) that may be exploited by a *threat* to cause an *impact*.
Web browser	Or web client, is *software* designed to navigate the *WWW*, view its *information* resources and, when used interactively, exchange information. Netscape Navigator and Internet Explorer , Mozilla, Firebox are widely used examples of web browsers.
Web server	An *Internet host* computer that stores *web pages* and responds to requests to see them. Web servers talk to *web browsers* by using a language named *HTTP*.

Web site	A location on the World Wide Web (*WWW*). It is synonymous with *web page* and *web server*.
Web page	The basic building block of the World Wide Web (*WWW*). *Information* displayed on a web page can include highly sophisticated graphics, audio and video, the locus of contemporary creativity. Web pages are linked together to form the WWW.
Wide Area Network	(WAN) - a telecommunications *network* that is dispersed over a wide geographic area – possible world wide - as distinct from a local area network (*LAN*) that is generally confined to a confined geographic area, such as a building. A wide area network may be privately owned or rented; either way it usually requires the use of public (shared user) networks (e.g. the *Internet*) and/or leased communication circuits. See also VPN.
Work Breakdown Structure	A tree diagram that breaks a *project* down in increasing levels of detail. The lowest level of a work breakdown structure comprises *activities*.
Workstation	This term tends to have different meanings in different contexts. Generally it refers to a high-powered microcomputer, typically single-user but very powerful machines.
Worm	(1) In communications, a malicious *program* which, unlike a *virus*, is free-standing (i.e. it does not require a host). Worms replicate themselves across *networks*, cause both traffic congestion and can cause network failure. (2) In computing, Write Once Read Many (WORM). A data storage *device* to which *code* or *data* can be written but not altered or erased. They are generally implemented on non-rewritable optical discs, although pseudo-WORM magnetic tape devices are becoming available.
WWW	World Wide Web. Refers to the *information* resources of the *Internet* that are accessible via *web pages* using a *web browser*. Technically speaking, the WWW refers to the abstract cyberspace of information whereas the Internet is the physical side of the *network*, i.e. the computers and communications that link computers throughout the World.
XML	Extensible Markup Language, is a set of tags and declarations used as a complement to *HTML* in the construction of *web pages*.

PROFESSIONAL PROGRAMME

INFORMATION TECHNOLOGY AND SYSTEMS AUDIT

PP-IT&SA

TEST PAPERS

A Guide to CS Students

To enable the students in achieving their goal to become successful professionals, Institute has prepared a booklet 'A Guide to CS Students" providing the subject specific guidance on different papers and subjects contained in the ICSI curriculum. The booklet is available on ICSI website and students may down load from *http://www.icsi.edu/Portals/0/AGUIDETOCSSTUDENTS.pdf*

WARNING

It is brought to the notice of all students that use of any malpractice in Examination is misconduct as provided in the explanation to Regulation 27 and accordingly the registration of such students is liable to be cancelled or terminated. The text of regulation 27 is reproduced below for information:

"27. Suspension and cancellation of examination results or registration

In the event of any misconduct by a registered student or a candidate enrolled for any examination conducted by the Institute, the Council or the Committee concerned may suo motu or on receipt of a complaint, if it is satisfied that, the misconduct is proved after such investigation as it may deem necessary and after giving such student or candidate an opportunity to state his case, suspend or debar the person from appearing in any one or more examinations, cancel his examination result, or studentship registration, or debar him from future registration as a student, as the case may be.

Explanation - Misconduct for the purpose of this regulation shall mean and include behaviour in a disorderly manner in relation to the Institute or in or near an Examination premises/centre, breach of any regulation, condition, guideline or direction laid down by the Institute, malpractices with regard to postal or oral tuition or resorting to or attempting to resort to unfair means in connection with the writing of any examination conducted by the Institute".

PROFESSIONAL PROGRAMME

INFORMATION TECHNOLOGY AND SYSTEMS AUDIT

TEST PAPER 1

(This Test Paper is for recapitulate and practice for the students. Students need not to submit responses/answers to this test paper to the Institute.)

Time Allowed : 3 Hours *Maximum Marks : 100*

Question No 1 is compulsory and attempt 5 questions out of 6.

1. (a) Describe briefly the major objectives of Information Technology Act 2000?

   (b) Explain the different levels of management and their information need in an organization.

   (c) What are the factors which affects the information need?

   (d) Explain the term "Cloud Computing"

   (*5 Marks each*)

2. (a) Describe the procedure and powers of cyber appellate tribunal. (*2 Marks*)

   (b) (i) Which section deals with the punishment for identify theft?

   (ii) What does a 'Secure System' means in the Information Technology Act 2000? (*2 Marks each*)

   (c) Briefly explain the use of Big Date Analytics in Information system. (*4 Marks*)

   (d) Distinguish among 'Primary storage', 'Cache Memory' and 'Secondary storage'. (*4 Marks*)

3.Write notes on the following :

   (i) State Wide Area Network (SWAN)

   (ii) Impact of e-governance in rural ares

   (iii) Android Operating System

   (iv) Firmware (4 marks each)

4. (a) What do you mean by the term "ERM"? Explain the basic objective of implementing ERM.

   (b) What the basic characteristics of Management Information System in an organization? Explain briefly.

   (c) What are the difference among 'internet and Extranet? Explain briefly.

   (d) Draw a flow chart do find the smallest number among the three numbers (4 marks each)

5. (a) What do you mean by the term 'e-security'. Explain different dimension of e-security and how to check the security threats? (*8 Marks*)

   (b) Explain briefly the following E-Governance model – (*8 Marks*)

   (i) Governance to citizen (G2C)

   (ii) Governance to Government (G2G)

   (iii) Governance to Employee (G2E)

   (iv) Governance to Business (G2B) (8 mark each)

6. (a) Explain any two internet protocol ?

(b) Differentiate among Assembler, Compiler and Interpreter

(c) Write an algorithm to find multiplication of the first N numbers

(d) Explain the term Artificial Intelligence. (*4 Marks each*)

PROFESSIONAL PROGRAMME

INFORMATION TECHNOLOGY AND SYSTEMS AUDIT

TEST PAPER 2

(This Test Paper is for recapitulate and practice for the students. Students need not to submit responses/answers to this test paper to the Institute.)

Time Allowed : 3 Hours *Maximum Marks : 100*

Question No 1 is compulsory and attempt 5 questions out of 6.

1. (a) Explain the power of controller to make regulations under section 89 of the Information Technology Act, 2000 as amended.

   (b) What is the importance of Information System in business management? Give some reasons.

   (c) Writ short notes on the following –

      (i) Mobile application

      (ii) Agile Technology

   (d) Explain supporting technologies of "M Commerce. (*5 marks each*)

2. (a) Distinguish between the following :

      (i) Date warehousing and Data mining

      (ii) DDL and DML

      (iii) Database and DBMS

      (iv) DSS and MIS (*4 marks each*)

3. (a) What are the major constraints which came in the way of operating MIS?

   (b) What is the difference between application software and system software? Explain with suitable example.

   (c) Explain the function of ALU and CU of CPU with suitable diagram.

   (d) What are major responsibilities of 'Database Administrator'? (*4 marks each*)

4. (a) What is the supply chain Management? Briefly explain the rate of E-commerce in supply chain Management.

   (b) Differentiate among B2B, B2C and C2B.

   (c) Writ an algorithm to find addition of the first N number.

   (d) Briefly explain the objectives of national Service delivery gateway (NSDG) (*8 marks*)

5. (a) What are the objectives of e-governance? Explain the challengers being faced by government in implementing e-governance in India. (*8 marks*)

   (b) What are database and database management system? Explain the term with suitable examples. Can files qualify as a database? (*8 marks*)

6. (a) Differentiate among B2B, B2C and C2B.

(b) Explain the term ‘Expert System’ with its limitations.

(c) What is e-payment portal? What are the benefits of e-payment portal?

(d) Draw a flow chart for calculation the sum of first to odd numbers. (*4 marks each*)