STUDY MANUAL

INFORMATION SYSTEMS AND TECHNOLOGY FOR BUSINESS (PEA 1)

ASSOCIATION OF NATIONAL ACCOUNTANTS OF NIGERIA (ANAN)

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MODULE 1

1.00 INFORMATION SYSTEM

1.01 Learning Outcomes

On successful completion of this module, students should be able to:

i. Appraise the types, characteristics, classes and cost of information;
ii. Analyse the cycle of data processing, content and dynamism of the various content and dynamism of the various information systems and how they impact an organisation's success;
iii. Evaluate the different types of information systems that support decision making at various levels of management;
iv. Assess computer languages, computer networking and design of systems development and implementation;
v. Deconstruct the role of information systems in enhancing the analysis and processing of data into information for decision support;
vi. Evaluate the major types of knowledge work systems and how they provide value for the firms.

1.02 Information and its Features

Information can be defined as any of the following:

a. Data that have been processed in such a way as to be useful to the recipient.
b. Facts told or knowledge given or gained.
c. Information is Data endowed with relevance and purpose.

In an organizational sense, information is more complex than the frequent use of the word. In this case, information is seen as "Data that have been interpreted and understood by the recipient of the message.

From the definition above, it will be noted that it is the user and not the sender, that determines what information is. Therefore, what is information to one person at a particular time might be mere data to somebody else or to the same person at another time.

Accordingly, it is important for the producers of reports and messages of all types to be aware of the user's requirements, education, position in an establishment, context etc in which the message will be used, to increase the likelihood of information being derived from the message.

Therefore, "Data is facts, event, transaction etc which have been recorded". It is the term used for collections of facts and figures e.g. hours worked, invoice values, items received, percentage scores of students etc. The facts are stored and processed to produce message in the form required by the user, which is now termed information.
Also, Data incur costs, while information which is properly communicated and acted upon creates value, when it improves the resulting decision. The value of information can only come from the results of decisions and actions based on the information.

Types of Information

There are two types of Information;

1. **Formal Information**

   Formal information is that information that has been prepared and provided through recognized official channels. Examples of this are;

i. Annual Budgets;

ii Management Briefings;

iv. Information on Intranet. Etc

2. Informal Information

These are information obtained through unauthorized and unofficial means in an organization. It is popularly known as the grapevine or rumours. Such information has the following characteristics:

i. Incompleteness;

ii. Unreliability;

iii. Spreads fast;

iv. Sources not traceable

Classes of Information

Information can be classified in numerous ways, some of which are:

(a) According to LEVELS of management (i.e. Strategic, Tactical and Operational Information).

(b) According to USAGE (i.e. used for, Planning, Control and Decision Making.

(c) According to SOURCE (i.e. information could be collected Internally, Externally, or Government).

(d) According to the FORM, (i.e. it can be Written, Visual or Oral Information).

(e) According to TYPE, (i.e. it can be Detailed or Aggregated).

(f) According to the FREQUENCY (i.e. the frequency of producing the information. It can be Real Time, Hourly, Daily, Weekly, Monthly, and Yearly (etc).

Functions of Information

(1) Information reduces uncertainty.
(2) Information is an aid to monitoring and control.
(3) Information is a means of communication.
(4) Information supplements the memory.
(5) Information acts as an aid to Simplification.

Characteristics of Information

Good information has the following properties:

1. Relevance

Good information must be relevant to its purpose. Irrelevancies in information make understanding more difficult and cause frustration to the user.

2. Understandability

Good information must be understandable by the user. This is what transforms data into information. If information is not understood, it cannot be used and thus cannot add value.

Some factors that affect understandability are:

a. Language

The signals or message through which information is conveyed can affect the understandability. The language used could be English, French etc and could be mathematical notation.

b. Preferences of users

Some users prefer tabulation while some prefer it in prose. Some prefer statistical and numeric presentation, while some do not even understand such. The sender must be aware of the preference of the user.

c. Remembered knowledge

The extent of remembered knowledge e.g. technical knowledge, affects understanding.

3. Accuracy

Good information must be sufficiently accurate for its purpose and for the manager to rely on it. The level of accuracy must be related to the decision levels involved (i.e. the level of accuracy increases from strategic up to operational level).

4. Completeness

Good information must be complete for the problem. It is required that good information is complete in respect of the key points of the problem.

5. Conciseness

Good information must not contain unnecessary details, as this can distort the information and lead to wrong decision making. It must be as brief as possible, containing the right level of detail.

6. Timeliness

Good information must be communicated on time to be useful. Vital information will only be worthless when it is not communicated on time, because of delays in data gathering, processing or communication.

7. Reliability

Information must be reliable if users are to benefit from it. There should be confidence in the source of the information. With this, the manager can have trust in the information and act promptly on, it to create value.

Cost of Management Information

Since data incur cost, while information creates value, the following are some of the cost of information, which can be seen as the cost of data:

(1) Cost of collecting and recording the basic data.

(2) Cost of processing the information.

(3) Cost of printing, duplicating and distributing the reports.

(4) Cost of the time to read, understand and digest the information by managers.

(5) Cost of storage and subsequent retrieval of information.

1.03 Information Systems for Decision Making

Information systems can be defined technically as a set of interrelated components that collect (or retrieve), process, store, and distribute information to support decision making and control in an organization.

It is the combination of human and computer based resources used for the collection, storage, retrieval, communication and use of data for efficient management of operations and for business planning.

In addition to supporting decision making, coordination, and control, information systems may also help managers and workers analyze problems, visualize complex subjects, and create new products.

Information systems contain information about significant people, places, and things within the organization or in the environment surrounding it. It is the system that produces information for management of a corporate entity.

By information we mean data that have been shaped into a form that is meaningful and useful to human beings. Data, in contrast, means raw facts.

Most businesses are increasingly using information system to support management decision making by all types and levels of managers. Several types of information system are available to support a variety of management decision making.

These include: Transaction Processing System, Management Information systems, Decision Support Systems, Executive Support Systems and Knowledge work systems. Below are the major types of information system that support decision making.

S/NO	Types of information systems	Emphasis
1.	Management information systems	Support operational decision making for structured problems.
2.	Decision support systems	Support managers making decisions for semi-structured problems.
3.	Executive support systems	Support senior-level executives making unstructured and long-term decisions requiring judgment, evaluation and insight.
4.	Group Decision support systems	Support people working in groups, making decisions more effectively and efficiently.
5.	Knowledge work systems	Support knowledge workers to create and

		discover new knowledge.

Table above shows major types of information system that support management decision making.

Transaction Processing System (TPS)

The Transaction Processing System (TPS) records day-to-day transactions, such as customer orders, bills, inventory levels, and production output. The TPS helps supervisors, by generating databases that act as the foundation for the other information systems.

A transaction processing system (TPS) helps an organization keep track of routine operation and records these events in a database.

For this reason, some firms call this, the data processing system (DPS). One of the most essential transaction processing systems for any organization is in the accounting area.

An accounting department handles these transactions: sales order processing, accounts receivable, inventory and purchasing, accounts payable, and payroll. All of these are recorded in the general ledger, the sixth activity.

Management Information System (MIS)

A management information system (MIS) is a computer-based information system that produces standardized reports in summarized, structured form.

It is used to support middle managers. The management information system summarizes the detailed data of the transaction processing systems in standard reports, for middle-level managers. Such reports might include production schedules and budgets summaries.

A Management Information System differs from a transaction processing system in a significant way. Whereas a transaction processing system creates databases, a management information system uses database. Indeed, a management information system can draw from the databases of several departments.

Thus, a management information system requires a database management system that integrates the databases of the different departments. Middle managers need summary data, often drawn from across different functional areas.

A management information system produces reports that are predetermined. That is, they follow a predetermined format and always show the same kinds of content.

Decision Support Systems (DSS)

Decision Support Systems (DSS) use internal information from Transactions Processing Systems (TPS) and Management Information Systems (MIS) and other internal information to assist the decision-making processes of managers.

DSS is an interactive computer-based system for supporting decision making when the problem is not structured. DSS can be used in planning, modeling, analysis of alternatives and decision making.

This is a form of Management Information System. It is used by management to aid in making decision on issues, which are semi-structured or unstructured.

The Decision Support System (DSS) provides a flexible tool for analysis. The DSS help middle-level managers and others in the organization analyze a wide range of problems, such as the effect of events and trends outside the organization.

Like the management information system, the decision support system, draws on the detailed data of the transaction processing system.

Complex problems are often very poorly defined with high level of uncertainty about the true nature of the problem, the various responses which management would undertake or the likely impact of those actions.

These highly ambiguous environments do not allow the easy application of many of the techniques or systems developed, for well-defined problems or activities.

DSS is intended to provide a wide range of alternative information gathering and analytical tools with a major emphasis on flexibility and user friendliness. It can be used to project the consequences of several business alternatives.

Based on these projections, executives can select the most appropriate or the most promising course of action.

The term DSS is usually taken to mean "computer system" which is designed to produce information in such a way as to help managers, make better decisions. Peter Keen, a British systems specialist, first coined it in the late 1970s.

DSS do not make decision. The objective is to allow the managers, consider several alternatives and evaluate them under a variety of potential conditions, e.g. spreadsheet.

DSS, then, is quite different from a transaction processing system, which simply records data. It is also different from a management information system, which summarizes data in

predetermined reports. A DSS is used to analyze data. Moreover, it produces reports that do not have fixed format. This makes the DSS a flexible tool for analysis.

Tools that support DSS include: Modeling and Simulation, Spread sheets, Forecasting, Non-linear and Linear programming, Sensitivity analysis, Regression analysis and Expert Systems. The common DSS techniques are shown below.

S/NO	Techniques	Purpose
1.	What if analysis	Check the impact of a change in a variable of the model.
2.	Sensitivity analysis	Ask "what if" repeatedly to predict outcomes when one variable or more are changed multiple times.
3.	Pivot table	Identify and understand patterns in business information.
4.	Goal seeking analysis	Find inputs necessary to achieve a goal.
5.	Optimization analysis	Find the optimum value for a target variable by repeatedly changing other variables subject to specified constraints.

Common techniques and purposes of DSS

Business Value of DSS

DSS assist managers perform analysis and information recall in a more expeditious manner using a combination of man/computer system that facilitate their decision-making process.

In an environment characterized with large database requiring considerable data manipulation involving complex relationships, it is only when computer system is used to complement human effort that quicker analysis can be performed.

Group Decision Support Systems (GDSS)

Managers are often faced with decision making situation that requires interaction with groups of people.

Information technology can provide a variety of computer-based tools to support group and organizational decision making.

A special category of systems known as Group Decision Support Systems (GDSS) has been developed to support group and organizational decision making to increase the effectiveness of group decision making.

A GDSS is a computer-based system for facilitating the solution of unstructured problem by a set of decision makers working together as a group.

GDSS provides tools and technologies gearing primarily toward group decision making while collaboration systems and web-based tools for videoconferencing, and electronic meetings support some group decision making but with clear emphasis on communication.

GDSS has special hardware and software tools to support GDSS-guided meetings. The hardware includes computer and networking equipment, overhead projectors, and display screen.

Special electronic meeting software collects, documents, ranks, edits and stores the idea offered in a decision-making meeting.

Business Value of GDSS

GDSS improves the efficiency and quality of group decision making in business meeting. GDSS makes group communication easier, projects the anonymity of participants as well as facilitate increase in meeting size and productivity.

Executive Support Systems (ESS)

The Executive Support System (ESS), also known as the Executive Information System (EIS) or Enterprise Information System (EIS) or Management Support System (MSS), is an easy-to-use system that presents information in a very highly summarized form.

It helps top-level managers oversee the company's operations and develop strategic plans. The ESS combines the internal data of TPS and MIS with external data.

This is an information system, which gives the executive easy access to key internal and external data. EIS have been made possible by the increasing cheapness and sophistication of microcomputers and network technology.

An executive information system is likely to have the following features:

(a) Provision of summary level data captured from the organization main system (which might involve integrating the executive's desktop micro with the organization's mainframe).

(b) A facility, which allows the executive to drill-down from higher or summary levels of information to lower, more detailed information, if this is required.

(c) Data manipulation facilities (e.g. comparison with budget or prior year data, trend analysis).

(d) Graphics, for user-friendly presentation of data.

The basic philosophy of Executive Information System is that it should:

(1) Be easy to use, as an executive information system may be consulted during a meeting for instance.

(2) Make data easy to access so that it describes the organization from the executive's point of view, not just in terms of its data flows.

(3) Provide tool for analysis (including ratio analysis, forecasts, what-if-analysis etc.).

(4) Provide presentational aids, so that information can be conveyed without bothering the executive with too many trivial choices of scale, colour and layout.

Executive support system is a specially designed, simplified system for top executives. ESS permits a firm's top executives to gain direct access to information about the company's performance.

Decision making at the strategic level requires both business intelligence and knowledge to support the complexity associated with business strategies.

Executive Support Systems (ESS) support senior-level executives to make unstructured, long term, non- routine decisions requiring judgment, evaluation and insight that focus on strategic issues and long-term trends in the internal and external environments.

These decisions do not have a right or wrong answer, only effective and efficient answer. ESS present graphs and data from many sources through an interface that is easy for senior managers to use.

ESS is designed to incorporate data about external event but they also draw summarized information from internal management information systems and decision support systems.

They filter, compress, and track critical data, displaying the data of greater significance to senior managers. Such systems include business analytics for analyzing tends, forecasting and drilling down to data at greater levels of detail.

Business Value of ESS

ESS helps senior executives monitor business performance, track activities of competitors, recognize changing market conditions and identify problems and opportunities.

Office Automation System

Office automation systems (OAS) are designed primarily to support data workers. These systems focus on managing documents, communicating, and scheduling. Documents are managed using word processing, desktop publishing, and other image technologies. Communication uses e-mail, voice messaging and video-conferencing.

Knowledge Work Systems (KWS)

Knowledge management has become a topical issue for most businesses because one of the major sources of wealth creation and prosperity is production and distribution of information.

Knowledge management refers to attempts to improve the way firms create, acquire, store and apply knowledge.

Knowledge management increases the ability of the organization to learn from its environment and to include Knowledge into its business processes.

Development in information technology which made it possible for people to share information and Knowledge has encouraged the adoption of Knowledge management systems to code and share best practices, create corporate Knowledge directories and create Knowledge networks.

A specialized category of Knowledge management system known as Knowledge work systems (KWS) is built for scientists, engineers, and other Knowledge workers charged with discovering and creating new knowledge for a company.

Knowledge workers use OAS systems. Additionally, they use specialized information systems called knowledge work systems (KWS) to create information in their areas of expertise.

For example, engineers involved in product design and manufacturing, use computer-aided design/computer-aided manufacturing (CAD/CAM) systems.

These KWS consist of powerful microcomputers running special programs that integrate the design and manufacture activities. CAD/CAM is widely used in the manufacture of automobiles and other products.

KWS provide tools and technologies to create and discover new Knowledge. Figure highlights the major KWS applications.

S/NO	Applications	Focus
1.	Computer-aided design (CAD)	Automates the creation and revision of designs using computers and sophisticated graphics software.
2.	Virtual reality systems	Uses interactive graphics software to create computer-generated simulations.
3.	Augmented reality (AR)	Provide a live direct and indirect view of a physical real-world environment.
4.	Virtual reality modeling language (VRML)	Organizes multiple media animation, image and audio.
5.	Investment work stations	Streamline the entire investment process from stock selection to updating records.

Major KWS applications

Knowledge Workers and Knowledge Work

Knowledge worker are individuals valued for their ability to interpret and analyse information.

They include researchers, scientists, designers, architects and engineers responsible for creating information and Knowledge.

Knowledge workers use business intelligence along with personal experience to make decisions based on information and intuition. They play the following roles in the organization:

- Keeping the organization up to date in Knowledge.

- Serving as internal consultants in respect of their area of Knowledge

- Acting as change agents

Knowledge workers rely not only on office systems which are designed to increase worker productivity but on systems that enable them have access to external databases because of their focus on Knowledge in the external world.

Knowledge workers therefore require specialized system with powerful graphics, analytical tools and document management capabilities.

Expert Systems

One of the most practical and widely implemented applications of artificial intelligence in business is the development of expert systems and other knowledge-based information systems. An expert system is a knowledge-based information system that uses its knowledge about a specific, complex application area to act as an expert consultant to end users. Expert systems combine the knowledge on a given subject of one or more human experts, into a computerized system that simulates the human expert's reasoning and decision-making processes. Thus, the computer also becomes an "expert" on subject.

1.04 Decision Making Process

Decision making is required at operational, managerial and strategic levels.

Regardless of what level is the decision required, decision making process is multi-stepped and there several decision-making models. One of these models identified four steps to include the following:

S/NO	Steps	Details
1.	Intelligence	Problem definition-why is there a problem, where,

		and what effects it is having on the firm.
2.	Design	Identify every possible solution.
3.	Choice	Choosing among solutions alternatives.
4.	Implementation	Make the chosen solution work and if doesn't work repeat the process.

***Four steps decision making model*.**

Types of Decisions

Structured Decisions: These are decision where established procedures exist for making the decision. Structured decisions are made frequently and are repetitive in nature.

These decisions are supported by management information systems which help managers monitor and control the business by providing information on the firm's performance.

Semi-structured decisions: These are decisions where there are partly established procedures for making the decisions but need to be supported with human judgment to arrive at the conclusion.

Decision support systems are useful for semi-structured problems where problem solving is improved by interaction between computer systems and the manager.

Unstructured decision: Unstructured decisions arise where no established procedures exist to guide the decision makers toward the correct solution.

1.05 Data Processing Cycle

Data Processing is the act of converting/transforming raw fact into meaningful message. It can be Manual, Mechanical or Computerized.

The stages of processing data are made up of four steps as follows:

- Data Collection,
- Data Classification,
- Data Maintenance andSummarization
- Report Generation.

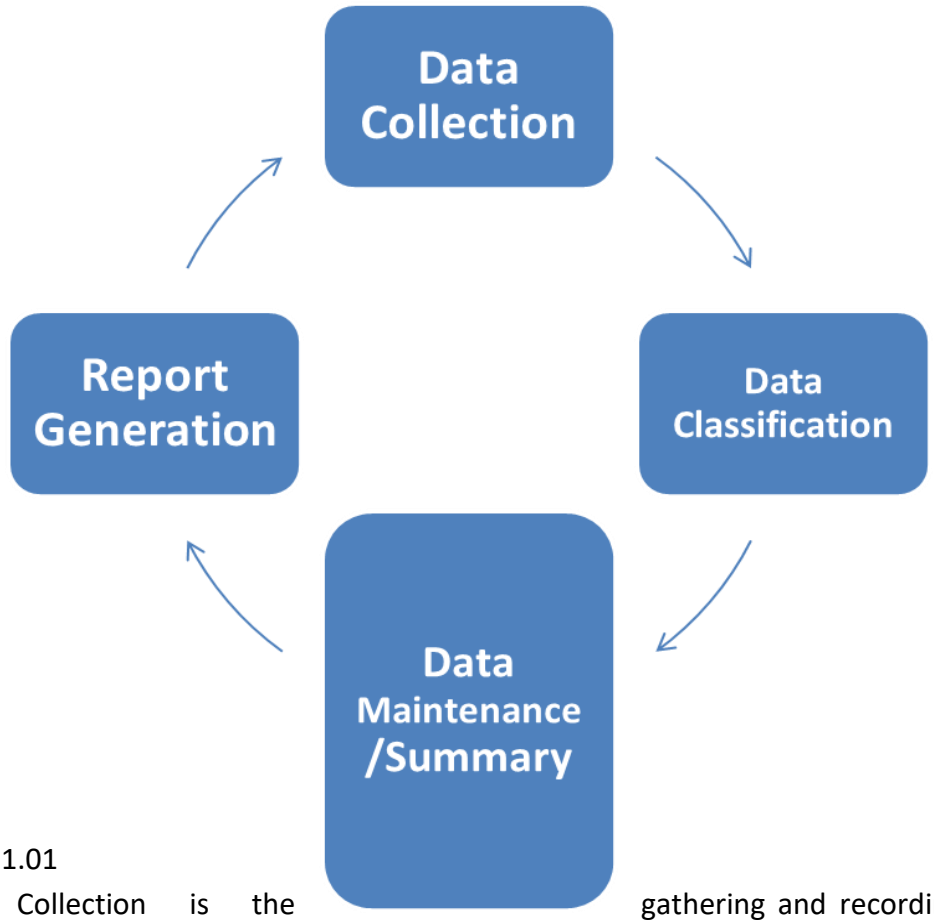


Figure 1.01

Data Collection is the gathering and recording raw data in a logical manner. Data Classification is the batching, verifying and sorting of data. Batching is assembling source documents of a similar nature such as sales invoices. Verifying involves checking the accuracy and integrity of data. Sorting is arranging data according to a pre-designated code

Data Maintenance and Summarization involves calculating, comparing, summarizing and storing of data. Report Generation is the end-result of data processing. It is to generate report and communicate it to the right and appropriate level of management or personnel.

Types of Reports

i. Routine/Periodic Reports

These are regular reports, arriving at pre-determined time intervals and containing the same type of information. They are presented in exactly the same format on each occasion. They are scheduled reports.

ii. Exception Reports

These Reports are generated because of some exceptional situation, e.g. production lines that fail to achieve their targets. They focus on problem areas where action and decision may be required.

iii. Request/Demand Reports

These reports are produced in response to specific request for information, which may be available and important, but has not been included in the routine report. They provide information in more detail.

iv. Special Reports

These are reports, arising out of some special or unusual situations, which may require information, that is not readily available and may require some special exercise in data capture. Usually arise infrequently, may be expensive to produce and are designed from scratch, specifically for the particular requirement.

1.06 Computer Language

Computer languages are special instruction codes used to program computers. There are so many of them, but generally, they fall into two groups:

a. Low level languages

b. High level languages

Low-Level Languages

These are languages whose instructions are at the level of computer's understanding. In this category, are the Machine language and Assembly language respectively?

Machine language (first-generation languages) programs are written by representing each instruction in set of strings (sequence) of binary digits (bits) Os and 1s. This is the computers' own language as the bits represent signal. They are the most basic level of programming languages.

Assembly languages (second-generation languages), on the other hand are the next level of programming languages. They were developed to reduce the difficulties in writing machine language programs. It is a form of short hand for the machine languages; they make use of

symbols called mnemonics and hexadecimal values, which are obtained, from a combination of one of the following numbers from the number set called hexadecimal values i.e. 012345678, ABCDEF. A program written in assembly languages must however be translated into machine language by a language translator program called Assembler for the computer to understand and use it.

High-Level Languages

These languages are also called the third-generation languages. They use instructions called ***Statements*** that closely resemble human language or the standard notation of mathematics. These languages are used to write programs much faster, as compared to low-level languages. This category includes Formula Translator- FORTRAN, Common Business Oriented Language-COBOL, Pascal- Named after the Mathematician PASCAL, Beginners all Purpose Symbolic Instructional Code-BASIC, C and C + + language which are called object-oriented languages etc.

Language Translators

These are themselves programs and used as programming tools to convert or translate programs written in any other language into machine coded (Language) form. Assemblers, Compilers and Interpreters are the three types of language translator.

The Assembler is used to translate program written in Assembly Language into Machine Language. Compilers and Interpreters convert/translate programs written in high-level languages into machine language. The Interpreter translates high-level language, one instruction at a time into an object program. The translation rate is slow. The Compiler, on the other hand, compiles the whole instructions before translating them at once.

1.07 Computer Networking

If you had to connect the computers for two or more employees together in the same office, you would need a computer network. Exactly what is a computer network? In its simplest form, a computer network consists of two or more connected computers.

Computer Networking is the interconnection of two or more computers to each other or to one separate computer for resources sharing, speed in operation, simultaneous operations, and to enable a range of users to have access to the same data.

Computer Networking is the link of two or more computer systems together that share resources among themselves. Networks are achieved locally or across local boundaries with the incorporation of communication facilities.

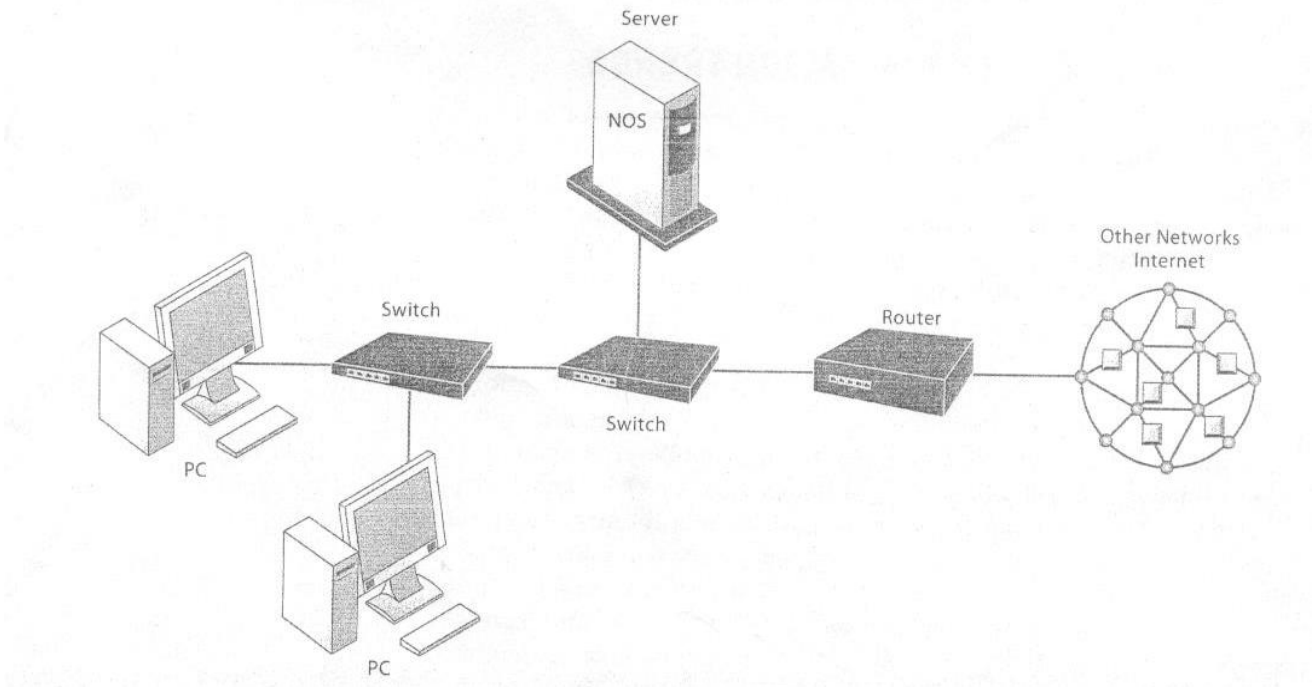
The ability of several computers to communicate with each other depends largely on the operating system which co-ordinates the transfer and storage of data. Networks typically, but not always, involve on-line storage of great quantities of data.

One computer, known as the Host or Slave or Server, serves as a controller, providing access to mass storage and powerful processing resources to each of the other computers in the system.

Networking has been used to achieve such facilities as Electronic Data Interchange (EDI) and Electronic Data Transfer (EDT).

Each computer on the network contains a network interface device to link the computer to the network. The connection medium for linking network components can be a telephone wire, coaxial cable, or radio signal in the case of cell phone and wireless local area networks (Wi-Fi networks).

Figure 1.02



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Types of Computer Networking

There are many kinds of networks and ways of classifying them. One way of looking at networks is in terms of their geographic scope.

There are basically, two types of computer network, namely:

1. Local Area Network (LAN)

2. Wide Area-Network (WAN)

Local Area Network

This is a private network of computers and access devices localized within a limited geographic area. Local Area Network connects computer and other information processing devices within a limited physical area. The popularity of LAN is due to its capacity to allow sharing of resources among multiple users.

Local Area Network uses a variety of telecommunication media such as ordinary telephone wiring, coaxial cable, or even wireless radio systems to interconnect computers workstations and computer peripherals.

Wide Area Network

This network cuts across geographic areas. It is aided by the use of communication tools like the Modem, Satellite, and Telephone etc.

Banks, Manufacturing firms, government agencies etc, transmit and receive information among stakeholders, using Wide Area Networking.

Metropolitan and Wide Area Networks

Wide area networks (WANs) span broad geographical distances - entire regions, states, continents, or the entire globe. The most universal and powerful WAN is the Internet. Computers connect to a WAN through public networks, such as the telephone system or private cable systems, or through leased lines or satellites.

A metropolitan area network (MAN) is a network that spans a metropolitan area, usually a city and its major suburbs. Its geographic scope falls between a WAN and a LAN.

Storage area networks (SANS) connect multiple storage devices on a separate high-speed network dedicated to storage. The SAN creates a large central pool of storage that can be rapidly accessed and shared by multiple servers.

Some Types of Networks

Type	Area
Local area network (LAN)	Up to 500 meters (half a mile); an office or floor of a building
Campus area network (CAN)	Up to 1,000 meters (a mile); a college campus or corporate facility A city
Metropolitan area network (MAN)	A city or metropolitan area
Wide area network (WAN)	A transcontinental or global area

Computer Network Topology

This is the way the computers, access devices, and workstations are arranged within a network to communicate with one another. It applies to either the Local or Wide Area Network. Examples are:

Ring Network

This is a network topology, which links each workstation to its two neighbors in the form of a large circle or ring of devices, with no central controller. A major disadvantage of the ring network is its vulnerability to disruption in services. If any node becomes inoperative, the entire network loses service until the broken link in the chain becomes fixed.

Star Network

This is a network topology in which all workstations are wired into a central controlling computer that switches all messages.

All nodes are connected only to this computer. Thus, direct peer-to-peer communication is not possible. If one station wishes to contact another station, the message must be routed through the controller.

Usually, the controller is the main computer for the system, so, if network communications is actively high, the computer is forced to spend most of its time switching messages rather than performing data processing.

In addition, the operation of the entire network is dependent on the reliability of the central controller.

Bus Network

This is a computer network topology that is a form of a peer-to-peer communication.

The network does not require a central controlling computer. Thus, any station in the network can contact any other station or all other stations, without going through an intermediary computer or message switching devices.

Figure 1.03

NETWORK SETUP

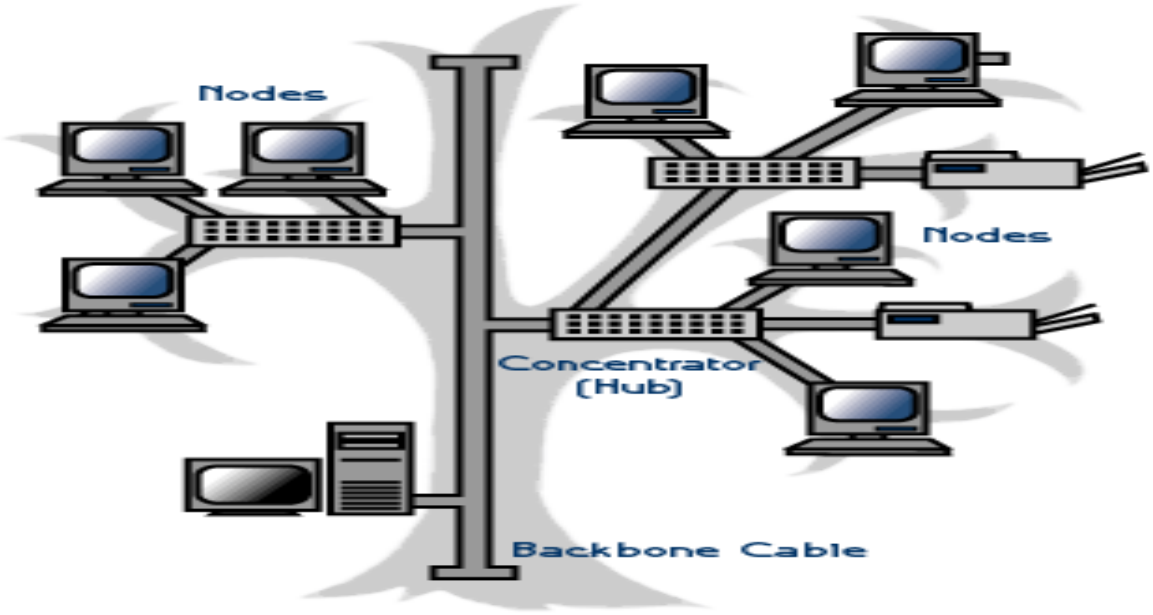

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Figure 1.04

RING TOPOLOGY

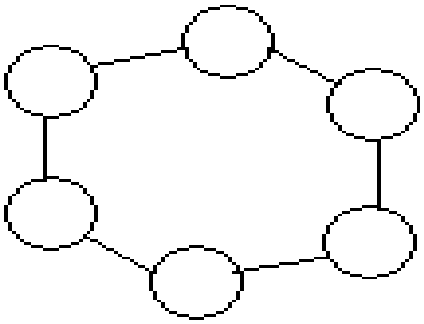


Figure 1.05

BUS TOPOLOGY

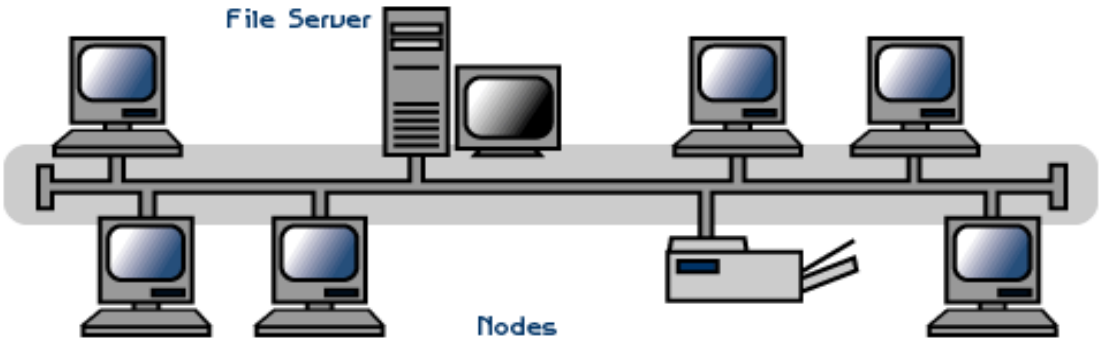
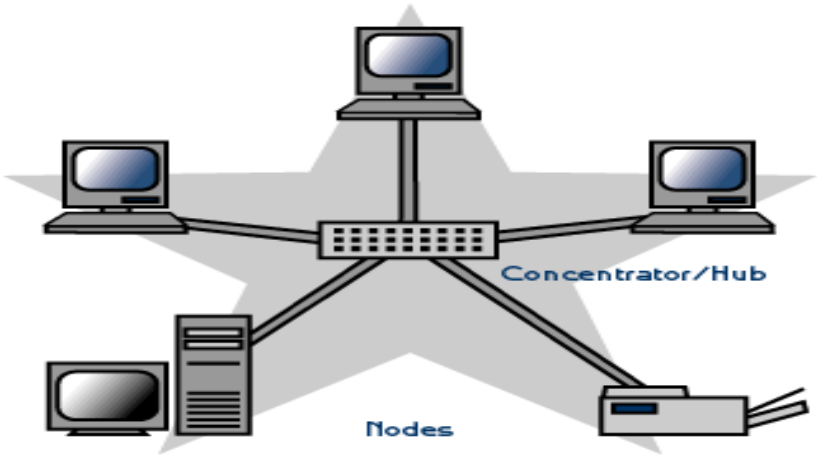


Figure 1.06
STAR TOPOLOGY



Source:

The Network Operating System (NOS) routes and manages communications on the network and coordinates network resources. It can reside on every computer in the network, or it can reside primarily on a dedicated server computer for all the applications on the network.

A server computer is a computer on a network that performs important network functions for client computers, such as serving up Web pages, storing data, and storing the network operating system (and hence controlling the network).

Server software such as Microsoft Windows Server, Linux, and Novell Open Enterprise Server are the most widely used network operating systems.

Most networks also contain a switch or a hub acting as a connecting point between the computers. **Hubs** are very simple devices that connect network components, sending a packet of data to all other connected devices. A **switch** has more intelligence than a hub and can filter and forward data to a specified destination on the network.

What if you want to communicate with another network, such as the Internet? You would need a router. **A router** is a communications processor used to route packets of data through different networks, ensuring that the data sent gets to the correct address.

Network switches and routers have proprietary software built into their hardware for directing the movement of data on the network. This can create network bottlenecks and makes the process of configuring a network more complicated and time-consuming.

Software-defined networking (SDN) is a new networking approach in which many of these control functions are managed by one central program, which can run on inexpensive commodity servers that are separate from the network devices themselves.

This is especially helpful in a cloud computing environment with many different pieces of hardware because it allows a network administrator to manage traffic loads in a flexible and more efficient manner.

Networks in Large Companies

The network we've just described might be suitable for a small business. But what about large companies with many different locations and thousands of employees?

As a firm grows, and collects hundreds of small local area networks, these networks can be tied together into a corporate-wide networking infrastructure.

The network infrastructure for a large corporation consists of many of these small local area networks linked to other local area networks and to firm-wide corporate networks.

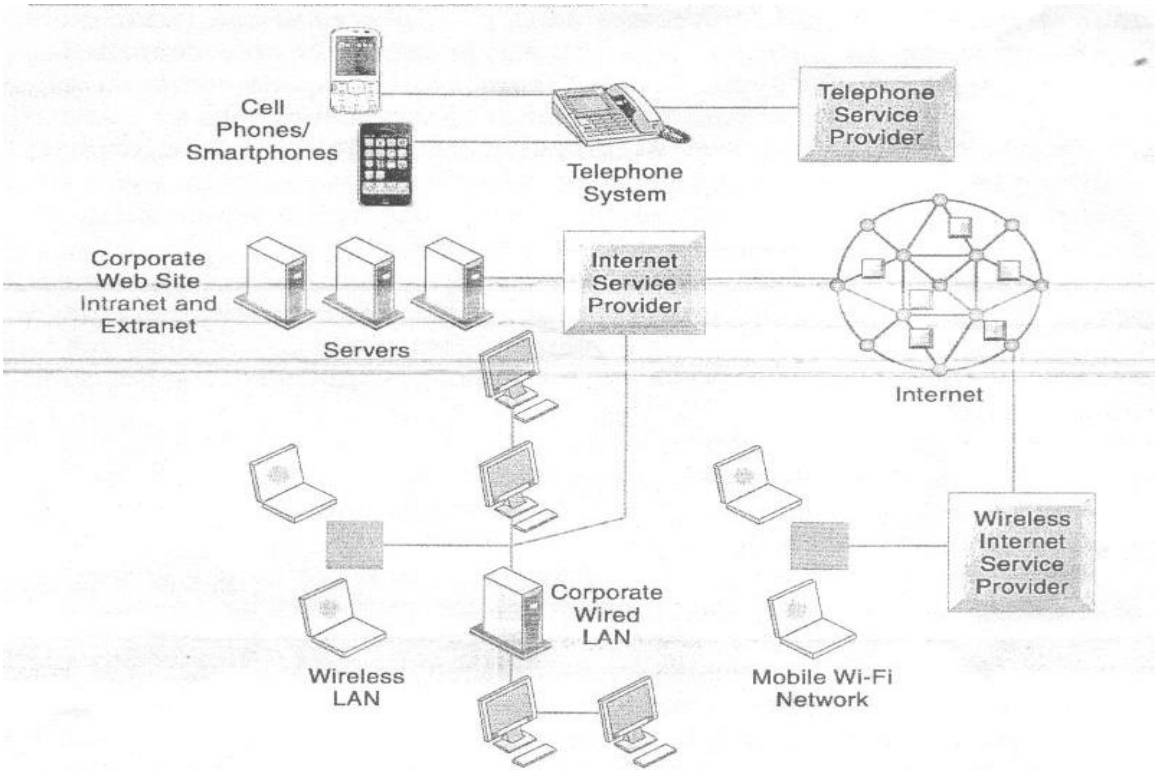
Several powerful servers support a corporate Web site, a corporate intranet, and perhaps an extranet. Some of these servers link to other large computers supporting back-end systems.

In addition to these computer networks, the firm's infrastructure usually includes a separate telephone network that handles most voice data. Many firms are dispensing with their traditional telephone networks and using Internet telephones that run on their existing data networks.

As you can see from this figure, a large corporate network infrastructure uses a wide variety of technologies, everything from ordinary telephone service and corporate data networks to Internet service, wireless Internet, and cell phones.

One of the major problems facing corporations today is how to integrate all the different communication networks and channels into a coherent system that enables information to flow from one part of the corporation to another and from one system to another. As more and more communication networks become digital, and based on Internet technologies, it will become easier to integrate them.

Figure 1.07



Source:

Corporate Network Infrastructure

Today's corporate network infrastructure is a collection of many different networks from the public switched telephone network, to the Internet, to corporate local area networks linking workgroups, departments, or office floors.

Key Digital Networking Technologies

Contemporary digital networks and the Internet are based on three key technologies: client/server computing, the use of packet switching, and the development of widely used communications standards (the most important of which is Transmission Control Protocol/Internet Protocol, or TCP/IP) for linking disparate networks and computers.

Client/Server Computing

Client/server computing is a distributed computing model in which some of the processing power is located within small, inexpensive client computers, and resides literally on desktops, laptops, or in handheld devices.

These powerful clients are linked to one another through a network that is controlled by a network server computer. The server sets the rules of communication for the network and provides every client with an address, so others can find it on the network.

Client/server computing has largely replaced centralized mainframe computing in which nearly all the processing takes place on a central large mainframe computer. Client/server computing has extended computing to departments, workgroups, factory floors, and other parts of the business that could not be served by a centralized architecture. The Internet is the largest implementation of client/server computing.

Packet Switching

Packet switching is a method of slicing digital messages into parcels called packets sending the packets along different communication paths as they become available, and then reassembling the packets once they arrive at their destinations. Prior to the development of packet switching, computer networks used leased, dedicated telephone circuits to communicate with other computers in remote locations.

In circuit-switched networks, such as the telephone system, a complete point-to-point circuit is assembled, and then communication can proceed.

These dedicated circuit- switching techniques were expensive and wasted available communications capacity - the circuit was maintained regardless of whether any data were being sent.

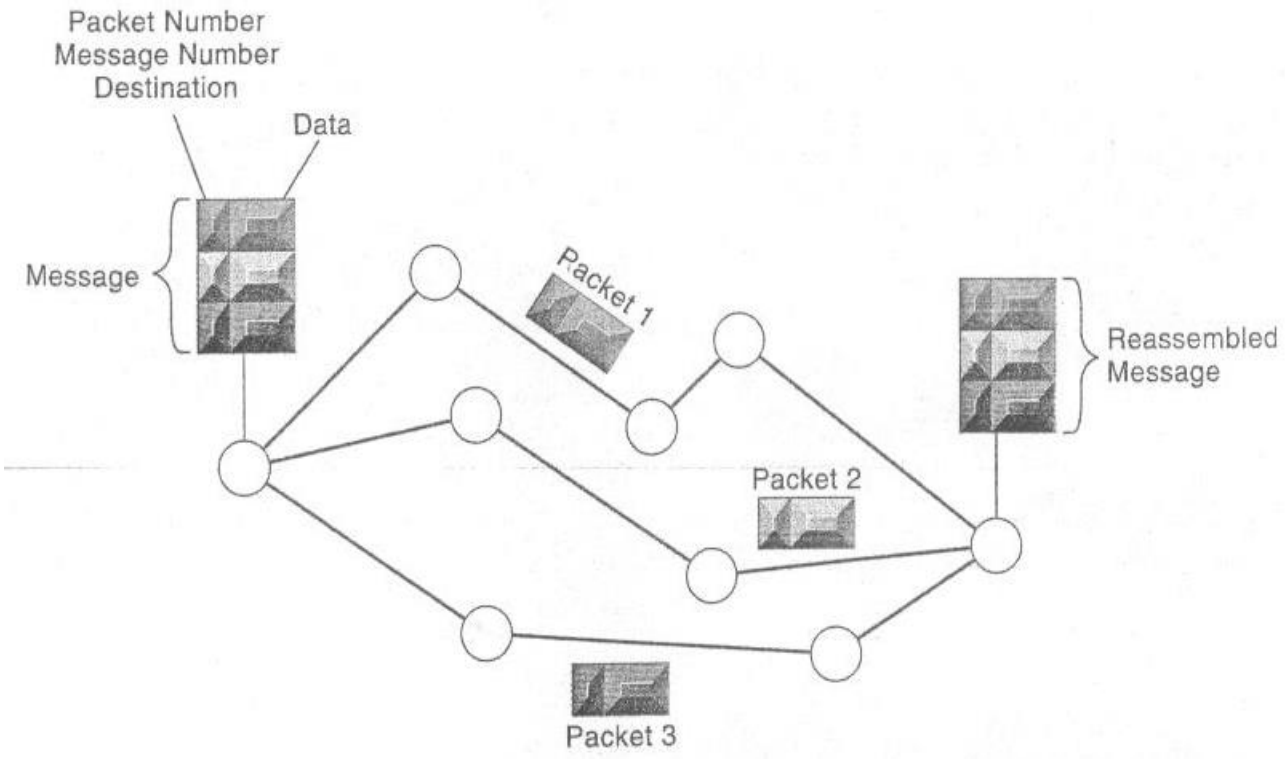
Packet switching makes much more efficient use of the communications capacity of a network. In packet-switched networks, messages are first broken down into small fixed bundles of data called packets.

The packets include information for directing the packet to the right address and for checking transmission errors along with the data.

The packets are transmitted over various communications channels using routers, each packet traveling independently.

Packets of data originating at one source will be routed through many different paths and networks before being reassembled into the original message when they reach their destinations.

Figure 1.08 PACKET-SWITCHED NETWORKS AND PACKET COMMUNICATIONS



.**Source:**
Data are grouped into small packets, which are transmitted independently over various communications channels and reassembled at their destination

TCP/IP and Connectivity

In a typical telecommunications network, diverse hardware and software components need to work together to transmit information. Different components in a network communicate with each other only by adhering to a common set of rules called protocols.

A **protocol** is a set of rules and procedures governing transmission of information between two points in a network.

In the past, many diverse proprietary and incompatible protocols often forced business firms to purchase computing and communications equipment from a single vendor.

But today, corporate networks are increasingly using a single, common, worldwide standard called **Transmission Control Protocol/Internet Protocol (TCP/IP).**

TCP/IP was developed during the early 1970s to support U.S Department of Defense Advanced Research Projects Agency (DARPA) efforts to help scientists transmit data among different types of computers over long distances.

TCP/IP uses a suite of protocols, the main ones being TCP and IP. TCP refers to the Transmission Control Protocol, which handles the movement of data between computers. TCP establishes a connection between the computers, sequences the transfer of packets, and acknowledges the packets sent.

IP refers to the Internet Protocol (IP), which is responsible for the delivery of packets and includes the disassembling and reassembling of packets during transmission. Figure 14 illustrates the four-layered reference model for TCP/IP, and the layers are described as follows:

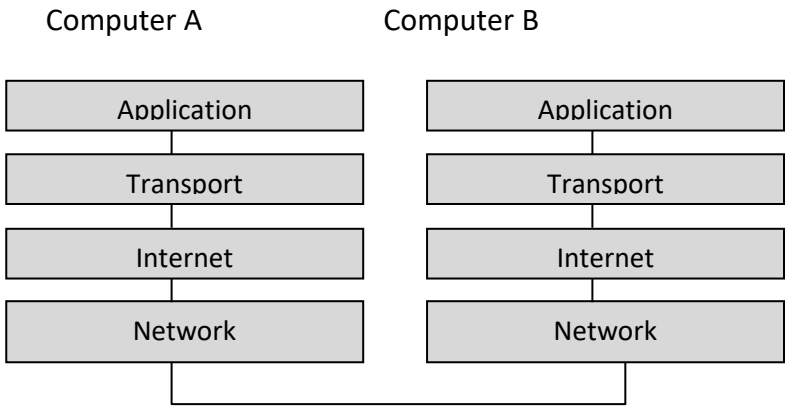
1. ***Application layer:*** The Application layer enables client application programs to access the other layers and defines the protocols that applications use to exchange data. One of these application protocols is the Hypertext Transfer Protocol (HTTP), which is used to transfer Web page files.

2. ***Transport layer****:* The Transport layer is responsible for providing the Application layer with communication and packet services. This layer includes TCP and other protocols.

3. ***Internet layer***: The Internet layer is responsible for addressing, routing, and packaging data packets called IP datagrams. The Internet Protocol is one of the protocols used in this layer.

4. ***Network Interface layer:*** At the bottom of the reference model, the Network Interface layer is responsible for placing packets on and receiving them from the network medium, which could be any networking technology.

Table 1.1 THE TRANSMISSION CONTROL PROTOCOL/INTERNET PROTOCOL (TCP/IP) REFERENCE MODEL



Source:

This figure illustrates the four layers of the TCP/IP reference model for communications.

Two computers using TCP/IP can communicate even if they are based on different hardware and software platforms. Data sent from one computer to the other passes downward through all four layers, starting with the sending computer's Application layer and passing through the Network Interface layer.

After the data reach the recipient host computer, they travel up the layers and are reassembled into a format the receiving computer can use. If the receiving computer finds a damaged packet, it asks the sending computer to retransmit it. This process is reversed when the receiving computer responds.

Communications Networks

Signals: Digital Vs. Analog

There are two ways to communicate a message in a network: either using an analog signal or a digital signal. An *analog signal* is represented by a continuous waveform that passes through a communications medium and has been used for voice communication.

The most common analog devices are the telephone handset, the speaker on your computer, or your iPod earphone, all of which create analog waveforms that your ear can hear.

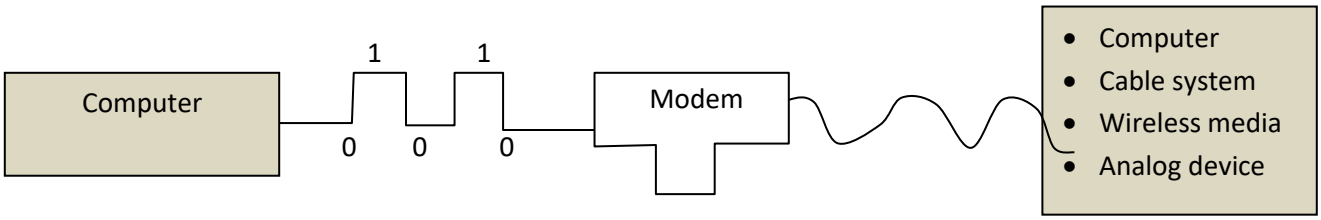
A *digital signal* is a discrete, binary waveform, rather than a continuous waveform. Digital signals communicate information as strings of two discrete states: one bit and zero bits, which are represented as on-off electrical pulses.

Computers use digital signals and require a modem to convert these digital signals into analog signals that can be sent over (or received from) telephone lines, cable lines, or wireless media that use analog signals. **Modem** stands for modulator-demodulator.

Cable modems connect your computer to the Internet using a cable network. DSL modems connect your computer to the Internet using a telephone company's landline network. Wireless modems perform the same function as traditional modems, connecting your computer to a wireless network that could be a cell phone network, or a Wi-Fi network.

Without modems, computers could not communicate with one another using analog networks (which include the telephone system and cable networks).

Figure 1.09: Functions of The Modem



A modem is a device that translates digital signals into analog form (and vice versa) so that computers can transmit data over analog networks such as telephone and cable networks.

Source:

Transmission Media and Transmission Speed

Networks use different kinds of physical transmission media, including twisted pair wire, coaxial cable, fiber optics, and media for wireless transmission. Each has advantages and limitations.

A wide range of speeds is possible for any given medium depending on the software and hardware configuration.

Bandwidth: Transmission Speed

The total amount of digital information that can be transmitted through any telecommunications medium is measured in bits per second (bps). One signal change, or cycle, is required to transmit one or several bits; therefore, the transmission capacity of each type of telecommunications medium is a function of its frequency.

Table 1.2: Physical Transmission Media

Transmission Medium	Description	Speed
Twisted pair wire (CAT 5)	Strands of copper wire twisted in pairs for voice and data communications. CAT 5 is the most common 10Mbps LAN cable. Maximum recommended run of 100 meters.	10 Mbps to 1 Gbps
Coaxial cable	Thickly insulated copper wire, which is capable of high-speed data transmission and less subject to interference than twisted wire. Currently used for cable TV and for networks with longer runs (more than 100 meters).	Up to 1 Gbps
Fiber optic cable	Strands of clear glass fiber, transmitting data as pulses of light generated by lasers. Useful for high-speed transmission of large quantities of data. More expensive than other physical transmission media and harder to install; often used for network backbone.	500 Kbps to 6Tbps
Wireless transmission media	Based on radio signals of various frequencies and includes both terrestrial and satellite microwave systems and cellular networks. Used for long-distance, wireless communication and Internet access.	Up to 600 + Mbps

The range of frequencies that can be accommodated on a telecommunications channel is called its **bandwidth**. The bandwidth is the difference between the highest and lowest frequencies that can be accommodated on a single channel. The greater the range of frequencies, the greater the bandwidth and the greater the channel's transmission capacity.

Virtual Meeting Systems/Video Conferencing

To reduce travel expenses, many companies, both large and small, are adopting video-conferencing and Web conferencing technologies.

A video-conference allows individuals at two or more locations to communicate simultaneously through two-way video and audio transmissions. High-end video-conferencing systems feature **tele-presence** technology, an integrated audio and visual environment that allows a person to give the appearance of being present at a location other than his or her true physical location.

Source:

Free or low-cost Internet-based systems such as Skype group videoconferencing, Zoom.us, etc is of lower quality, but still useful for smaller companies. Apple's FaceTime and Google video chat tools are useful tools for one-to-one videoconferencing.

Companies of all sizes are finding Web-based online meeting tools such as Cisco WebEx, Microsoft Live Meeting, and Adobe Connect especially helpful for training and sales presentations. These products enable participants to share documents and presentations in conjunction with audio conferencing and live video via Webcam.

This is a multi-media communication between or amongst two or more people at the same time.

This is a relatively new and exciting development that could significantly change the way many people work.

Video Conferencing became popular during the gulf war of 1990, when many business people did not want to travel for fear of a hijack or sabotage.

Each participant in a video conferencing will need the following:

- A device to capture video (a digital video camera).
- A microphone system. This is for audio communication.
- Speakers for audio communication.
- A computer that can handle the digitized video input.
- Software to manage the conference.

- A communication channel, for example, cable or across the Internet.

Types of Video Conferencing

The following are the three types of video conferencing:

1. Point to Point Video Conferencing

This is the simplest form of video conferencing. It is a communication between just two participants. All you need to know is the Internet provider address of the other person.

2. Group Video Conferencing

Under this type, several users simultaneously contact a central computer, which is running reflector software to communicate with themselves at the same time. You need to know the Internet Provider address of the reflector site.

3. Broadcast Video Conferencing

This is like the group video conferencing, except that the flow of information is one way only from the Reflector to the participants. The reflector site is used to transmit information to any connected user.

1.08 Systems Development

The life cycle of a system starts with the initial conceptualization and determination of the need for such system.

It goes through various stages, to finally when the need arises and is established for a new system, and the current system is now replaced upon the development of another (new) system. This process is termed System Development.

It refers to the techniques that are followed, to ensure the correct type of information system is acquired, installed and properly maintained.

Unlike some activities, there is no stereotype method that a system analyst must follow in analyzing a system.

Systems development is the terms used to describe the planning tasks when installation of computer system is being considered.

The following are the various steps in system development:

1. ***Preliminary Investigations***

The system development process may be initiated for several reasons, any of which requires investigation to determine a course of action. An existing system may not be meeting user's needs, so users may request that it should be improved upon.

To complete an investigation, one or more systems analysts or consultants might be saddled with the responsibility of interviewing the people who made request for the new or improved system.

In the alternative, a systems steering committee can be set up to work with the consultant.

Their findings are submitted to management in a written report that recommends the actions that should be considered.

The report may advise management to:

i. Make no changes and continue with the present system.

ii. Conduct a full system analysis and design study.

iii. Implement recommendations that were made because of an earlier investigation if any.

2. ***Feasibility Studies***

Assuming the management elects to conduct a full system analysis and design as recommended in the report from the preliminary stage, the next stage will be to carry out the study of the proposed system.

It is common practice to mandate a computer manufacturer or a management consultant to carry out this study, but a great disadvantage of this, is that neither of them would be familiar with the structure and the operations of the company.

The feasibility study must be in-depth enough to enable management to take a decision on whether or not to proceed with detailed investigation and design. Their report should contain the following information:

(a) The recommended equipment and its characteristics, period of delivery, installation plan and stand-by arrangements.

(b) All the costs, including capital outlay, leasing and rental option, delivery/installation charges, maintenance charges, insurance charges and conditions of sale.

(c) Software support available from the manufacturer.

(d) Equipment maintenance facility offered by manufacturers, the availability of spare parts, frequency of routine maintenance and major overhauls.

(e) Any special environmental or installation requirement such as Uninterrupted Power Supply (UPS), air conditioner, hollow floor or ceiling to house cables, space, fire protection and stand-by arrangement and safety aspects.

(f) A job plan giving an outline description of how the equipment will be used, the files required, the system input and output, the program required, and time scale involved in processing.

3. *System Analysis*

System Analysis is the term used to describe the process of collecting and analyzing facts, in respect of existing operations procedures and systems, to obtain a full appreciation of the situation prevailing, so that an effective computerization system may be designed and implemented, if proved feasible.

System analysis and design for computers is not an exact science for which there can be precise rules and procedures. The method, techniques and documents an organization can use, can only be according to its requirements.

The data needed can be collected by interviews, questionnaires, examination of the current system's documentation and direct observation.

(a) *Interview*

People generally resist change; the system analyst must therefore be tactful and his ability to communicate effectively must be brought to bear.

(b) *Questionnaires*

Although the interview has a wide application and is very common, in some specialized cases, questionnaires are employed.

(c) *Observation*

This is one of the most reliable means of fact-finding, as the analyst himself will be there to see what is happening. However, there is the tendency of those involved in the operation putting on fake appearances when they are aware they are under scrutiny.

(d) *Documents*

Besides conducting interviews, the analyst identifies all documents in the system and their flow. The steps that create the documents are well studied and all the interrelationship of data processing equipment, personnel and documents are used.

4. ***System Design***

If management elects to implement a recommended alternative, system design begins.

The design of a new system will result in the preparation of a Systems Specification otherwise called System Definition.

The design of a new system involves the following:

(a) Output

(b) Input

(c) File Formats

(d) Procedures

5. ***System Specification/Definition***

The System Specification is the last stage of systems analysis and design. The efforts in the first four stages described above are with a view to prepare a system specification.

System specification is the detailed documentation of the proposed new system and it serves both as a means of communication to:

i. Management, for approval.

ii. Programmers, to enable them to write their programs.

iii. Operating Staff, for them to be aware of the proposed operating procedures.

iv User, who must be aware of its contents and agree with it.

v. Also, as record for future control, evaluation, modifications and training purpose.

One of the major reasons for documentation is because of future modifications, when the analysts that designed the system are no longer in the employment of the firm or they are seconded to handle other projects.

6. ***System Implementation***

The implementation stage is concerned with the coordinating and controlling of the activities that are necessary to put the new system into operation.

This stage normally commences from the design stage through specification. It is a stage where all the planning efforts are being actualized.

The implementation will cover the following:

(a) Hardware Installation.

(b) Training of Staff.

(c) Testing.

(d) File conversion.

(e) Change over procedures.

The methods of changing over are:

(i) Direct

(ii) Parallel

(iii) Phased

(i) Pilot

7. ***System Evaluation/Review***

After a system is installed and operational, it should be reviewed and evaluated. Evaluation determines if the system meets its objectives and its operational costs as projected.

The time anticipated to develop the system should be reviewed against the actual time, to see if the system was completed on schedule, and if not, why?

1.09 Review Questions

1. Information systems support decision making. Discuss the different types of information systems that support decision making and what type of decision do they support?

2. What is the role of information systems in enhancing quicker analysis of data needed to support decision making by managers?

3. What is the role of information system in helping people working in a group making decision more effectively and efficiently?

4. What is the role of information systems in helping senior executives make decision more effectively?

5. Discuss the major types and business values of knowledge work systems in the firms.

6. How do business intelligence and business analytics support decision making?

MODULE 2

2.00: INFORMATION TECHNOLOGY

2.01 Learning Outcomes

On successful completion of this module, students should be able to:

i. Assess information technology infrastructure, its components, evolution and drivers;
ii. Evaluate the information technology platforms and standards and how they operate;
iii. Design the stages of systems development and organize the implementation in an organization.

2.02 Introduction

Technology is the branch of knowledge that deals with applied science, engineering, the industrial art etc. It is the use of scientific knowledge to solve practical problems.

Information Technology is the technology of the production, storage, and communication of information using computers and microelectronics.

It is the branch of engineering that deals with the use of computers and telecommunications to retrieve, store and transmit information.

Information technology is one of the many tools managers use to cope with changes. Computer hardware is the physical equipment used for input, processing and output activities in an information system. It consists of the following: computers of various sizes and shapes (including mobile handheld devices); various input, output, and storage devices; and telecommunications devices that link computers together.

Computer Software consists of the detailed, preprogrammed instructions that control and coordinate the computer hardware components in an information system. Data Management Technology consists of the software governing the organization of data on physical storage media.

Networking and telecommunications technology, consisting of both physical devices and software, links the various pieces of hardware and transfers data from one physical location to another. Computers and communications equipment can be connected in networks for sharing

voice, data images, sound, and video. A network links two or more computers to share data or resources, such as a printer.

The Internet has created a new “universal” technology platform on which to build new products, services, strategies, and business models. This same technology platform has internal uses, providing the connectivity to link different systems and networks within the firm. Internal corporate networks based on Internet technology are called intranets.

Private intranets extended to authorized users outside the organization are called extranets, and firms use such networks to coordinate their activities with other firms for making purchases, collaborating on design, and other inter organizational work. For most business firms today, using Internet technology is both a business necessity and a competitive advantage.

The World Wide Web is a service provided by the Internet that uses universally accepted standards for storing, retrieving, formatting, and displaying information in a page format on the Internet. Web pages contain text, graphics, animations, sound, and video and are linked to other web pages. By clicking on highlighted words or buttons on a web page, you can link to related pages to find additional information and links to other locations on the Web. The Web can serve as the foundation for new kinds of information systems such as UPS’s web-based package tracking system.

All these technologies, along with the people required to run and manage them, represent resources that can be shared throughout the organization and constitute the firm’s information technology (IT) infrastructure. The IT infrastructure provides the foundation, or platform, on which the firm can build its specific information systems.

Each organization must carefully design and manage its IT infrastructure so that it has the set of technology services it needs for the work it wants to accomplish with information systems.

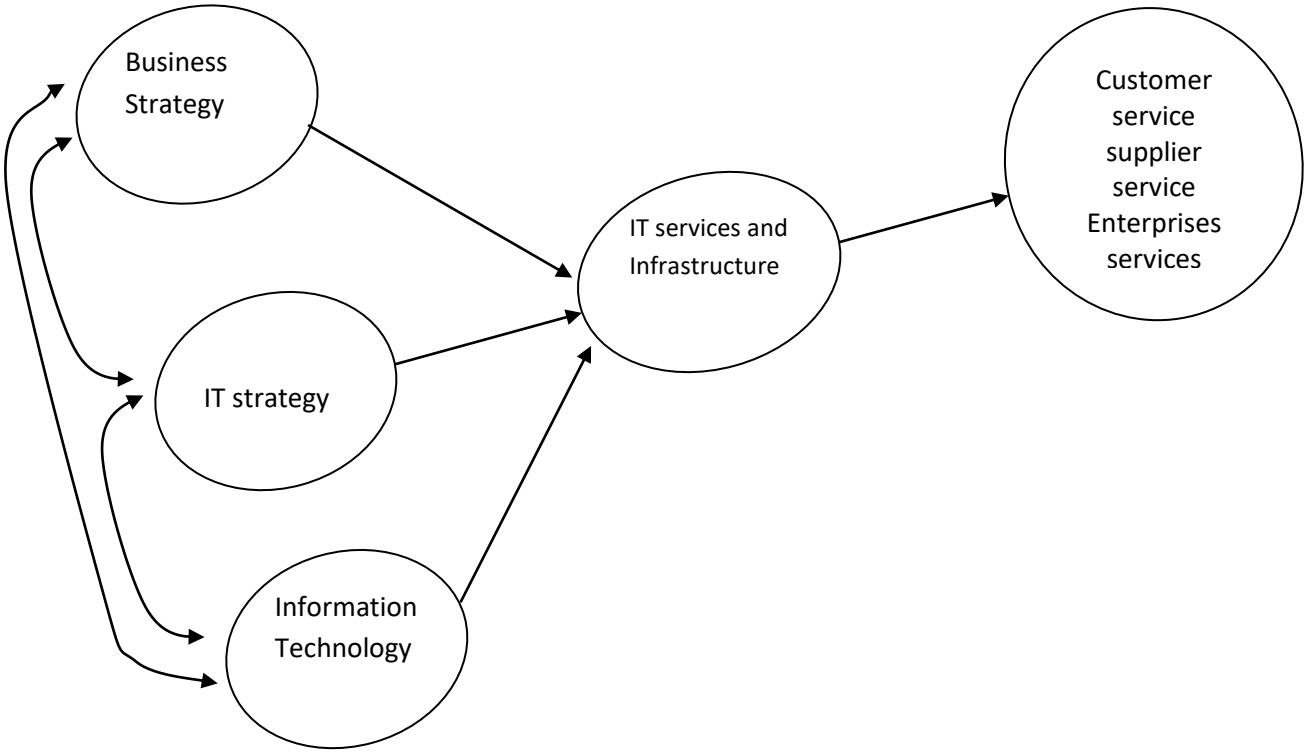
The Interactive Session of Technology describes some of the typical technologies used in computer-based information systems today. Investing heavily in information systems technology makes businesses more efficient and customer oriented.

An organisation can use an array of information technologies, including bar code scanning systems, wireless networks, large mainframe computers, hand-held computers, the Internet, and many different pieces of software for tracking packages, calculating fees, maintaining customer accounts, and managing logistics.

2.03 Information Technology (IT) Infrastructure

Information Technology (IT) infrastructure could be defined as the shared technology resources that provide the platform for an organisation's specific information system applications.

Figure 2.01 Connection between the Organisation, IT Infrastructure and Business Capabilities



Source:

An I.T infrastructure includes investment in hardware, software, and services - such as consulting, education, and training - that are shared across the entire firm or across entire business units in the organisation. An organisation's IT infrastructure provides the foundation for serving customers, working with vendors, and managing internal firm business process.

The services an organisation can provide to its customers, suppliers, and employees are direct functions of its IT infrastructure.

Ideally, this infrastructure should support the organisation's business and information systems strategy. New information technologies have a powerful impact on business and IT strategies, as well as the services that can be provided to customers.

2.04 Components of IT Infrastructure

An IT infrastructure consists of a set of physical devices and software applications that are required to operate the entire enterprise.

An IT infrastructure is also a set of firm wide services budgeted by management and comprising both human and technical capabilities. These services include the following:

a. Computing platforms used to provide computing services that connect employees, customers and suppliers into a coherent digital environment, including large mainframes, midrange computers, desktop and laptop computers, and mobile handheld and remote cloud computing services.
b. Telecommunications services that provide data, voice, and video connectivity to employees, customers, and suppliers.
c. Data management services that store and manage corporate data and provide capabilities for analyzing the data.
d. Application software services, including online software services, that provide enterprise-wide capabilities such as enterprise resources planning, customer relationship management, supply chain management, and knowledge systems that are shared by all business units.
e. Physical facilities management services that develop and manage the physical installation required for computing, telecommunication, and data management services.
f. IT management services that plan and develop the infrastructure, coordinate with the business units for IT services, manage accounting for the IT expenditure, and provide project management services.
g. IT standards services that provide the firm and its business units with policies that determine which information technology will be used, when and how.
h. IT education services that provide training in system use to employees and offer managers training in how to plan for and manage IT investments.

i. IT research development services that provide the firm with research on potential future IT project and investments that could help the firm differentiate itself in the marketplace.

2.05 Evolution of IT Infrastructure

The IT infrastructure in organizations today is an outgrowth of over 50 years of evolution in computing platforms. There have been five (5) stages in this evolution, each representing a different configuration of computing power and infrastructure elements. The eras are general-purpose mainframe and minicomputer computing, personal computers, client/server networks, enterprise computing, and cloud and mobile computing.

Technologies that characterize one era may also be used in another time for other purposes. For example, some companies still run traditional mainframe systems or use mainframe computers as massive servers supporting large web sites and corporate enterprise applications.

General-Purpose Mainframe and Minicomputer Era: (1959 to Present)

The introduction of the IBM 1401 and 7090 transistorized machines in 1959 marked the beginning of widespread commercial use of **mainframe** computers. In 1965, the mainframe computer truly came into its own with the introduction of the IBM 360 series.

The 360 was the first commercial computer with a powerful operating system that could provide time sharing, multitasking, and virtual memory in more advanced models. IBM has dominated mainframe computing from this point on. Mainframe computers became powerful enough to support thousands of online remote terminals connected to the centralized mainframe using proprietary communication protocols and proprietary data lines. The mainframe era was a period of highly centralized computing under the control of professional programmers and systems operators (usually in a corporate data center), with most elements of infrastructure provided by a single vendor, the manufacturer of the hardware and the software.

This pattern began to change with the introduction of **minicomputers** produced by Digital Equipment Corporation (DEC) in 1965. DEC minicomputers (PDP-11 and later the VAX

machines) offered powerful machines at far lower prices than IBM mainframes, making possible decentralized computing, customized to the specific needs of individual departments or business units rather than time sharing on a single huge mainframe.

In recent years, the minicomputer has evolved into a midrange computer or midrange server and is part of a network.

Personal Computer Era: (1981 to Present)

Although the first truly personal computers (PCs) appeared in the 1970s (the Xerox Alto, the MITS Altair 8800, and the Apple 1 and II, to name a few), these machines had only limited distribution to computer enthusiasts.

The appearance of the IBM PC in 1981 is usually considered the beginning of the PC era because this machine was the first to be widely adopted by businesses. At first using the DOS (Disk operating system), a text-based command language, and later the Microsoft Widows Operating System, the **Wintel PC** computer (Windows Operating System software on a computer with an Intel microprocessor) became the standard desktop personal computer.

Proliferation of PCs in the 1980s and early 1990 launched a spate of personal desktop productivity software tools – word processors, spreadsheets, electronic presentation software, and small data management programs that were very valuable to both home and corporate users.

These PCs were stand-alone system until PC operating system software in the 1990s made it possible to link them into networks.

Client/Server Era (1983 to Present)

In client/server computing, desktop or laptop computers called clients are networked to powerful server computers that provide the client computers with a variety of services and capabilities.

Computer processing work is split between these two types of machines. The client is the user point of entry, whereas the server typically processes and stores shared data, serves up Web pages, or manages network activities.

The term “server” refers to both the software application and the physical computer on which the networked software runs. The server could be a mainframe, but today, server computers

typically are more powerful versions of personal computers, based on inexpensive chips and often using multiple processors in a single computer box, or in server racks.

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

Whereas simple client/server networks can be found in small businesses, most corporations have more complex, **multitiered** (often called **N-tier) client/server architectures** in which the work of the entire network is balanced over several different levels of servers, depending on the kind of service being requested.

Client/server computing enables business to distribute computing work across a series of smaller, inexpensive machines that cost much less than centralized mainframe systems. The result is an explosion in computing power and applications throughout the firm.

Enterprise Computing Era (1992 to Present)

In the early 1990s, firms turned to networking standards and software tools that could integrate disparate networks and applications throughout the firm into an enterprise-wide infrastructure.

As the internet developed into a trusted communications environment after 1995, business firms began seriously using the Transmission Control Protocol/Internet Protocol (TCP/IP) networking standard to tie their disparate networks together.

The resulting IT infrastructure links different pieces of computer hardware and smaller networks into an enterprise-wide network so that information can flow freely across the organization and between the firm and other organizations.

It can link different types of computer hardware, including mainframes, servers, PCs, and mobile devices, and it includes public infrastructures such as the telephone system, the internet, and public network services. The enterprise infrastructure also requires software to link disparate applications and enable data to flow freely among different parts of the business, such as enterprise applications and Web services.

Cloud and Mobile Computing Era (2000 to Present)

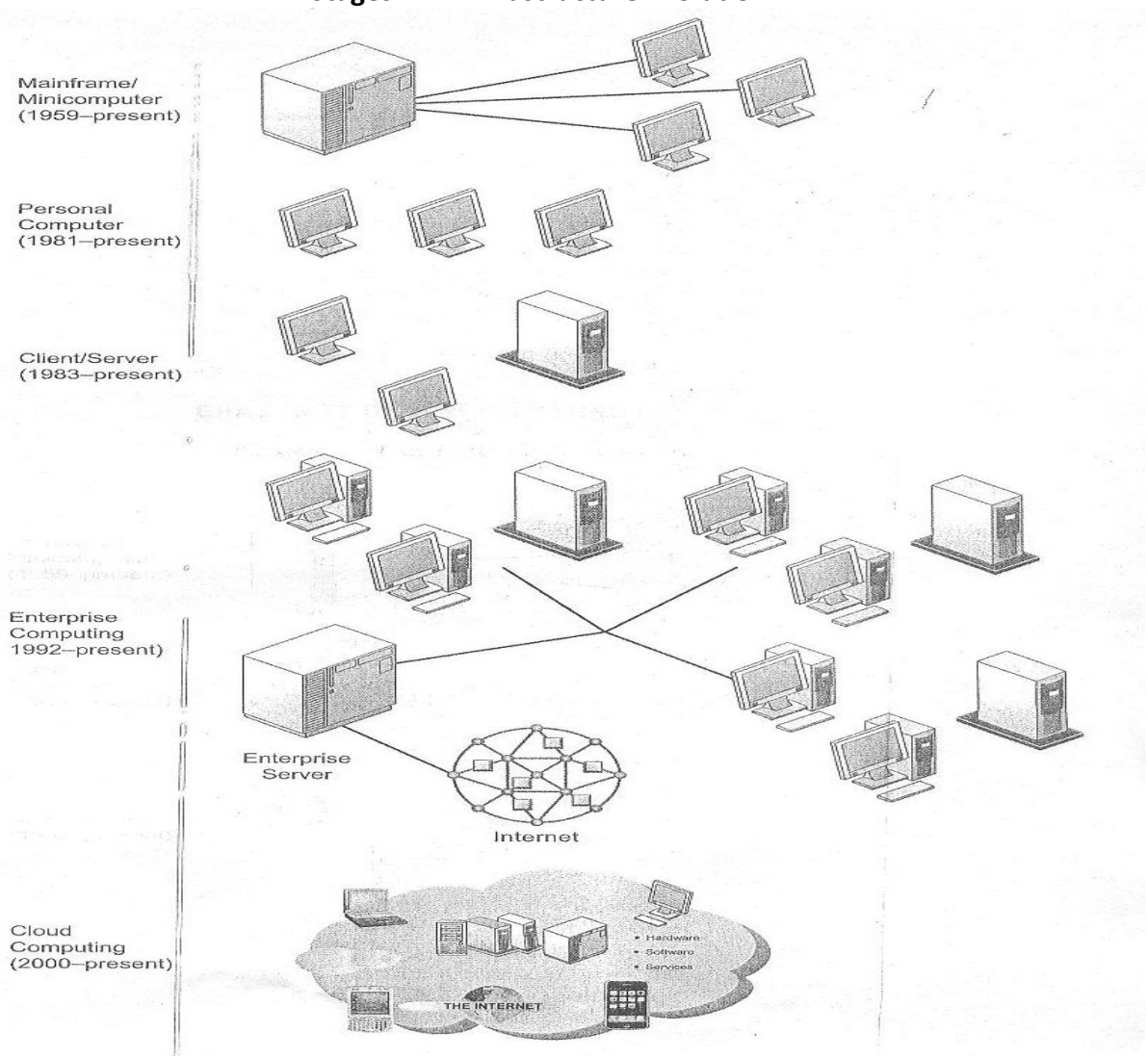
The growing bandwidth power of the internet has pushed the client/server model one step further, towards what is called the “cloud computing model”.

Cloud Computing refers to a model of computing that provides access to a shared pool of computing resources (computers, storage, applications, and services) over a network, often the internet. These “clouds” of computing resources can be accessed on an as-needed basis from any connected device and location. Currently, cloud computing is the fastest growing form of computing.

Thousands or even hundreds of thousands computers are located in cloud data centers, where they can be accessed by desktop computers, laptop computers, tablets, entertainment centers, smart phones, and other client machines linked to the internet, with both personal and corporate computing increasingly moving to mobile platforms - IBM, HP, Dell and Amazon operate huge, scalable cloud computing centers that provide computing power, data storage and high-speed internet connections to firms that want to maintain their IT infrastructures remotely.

Software firms such as Google, Microsoft, SAP, Oracle, and Salesforce.com sell software applications as services delivered over the internet.

Figures 2.02: **ERAS IN I.T INFRASTRUCTURE EVOLUTION**
Stages in IT Infrastructure Evolution



Source:

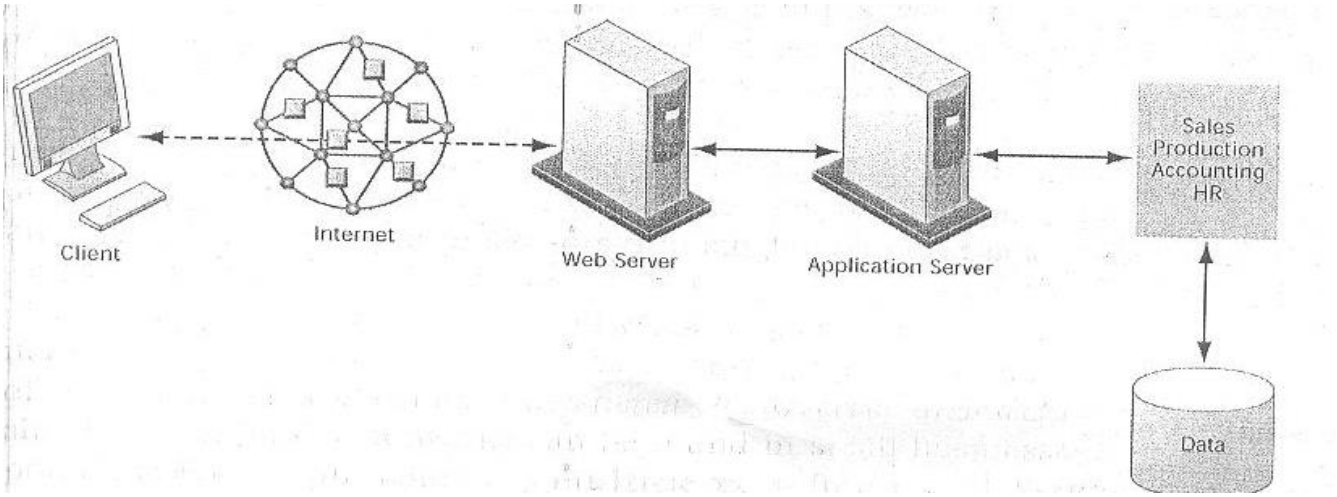
Illustrated here are the typical computing configurations characterizing each of the five eras of IT infrastructure evolution.

Figure 2.03: A Multitiered Client/Server Network (N-Tier)

In a multi-tiered client/server network, client requests for service are handled by different levels of servers.

2.06 Technology Drivers of Infrastructure Evolution

The changes in IT infrastructure have resulted from developments in computer processing, memory chips, storage devices, telecommunications and networking hardware and software, and software design that have exponentially increased computing power while exponentially reducing costs. Some of the most important developments are:



Moore's Law and Micro-processing Power

In 1965, Gordon Moore, an early manufacturer of integrated circuits, wrote in *Electronics* magazine that since the first microprocessor chip was introduced in 1959, the number of components on a chip with the smallest manufacturing costs per component (generally transistors) had doubled each year. This assertion became the foundation of **Moore's Law**.

Exponential growth in the number of transistors and the power of processors coupled with an exponential decline in computing costs is likely to continue. Chip manufacturers continue to miniaturize components. Today's transistors should no longer be compared to the size of a human hair but rather to the size of a virus.

By using nanotechnology, chip manufacturers can even shrink the size of transistors down to the width of several atoms. **Nanotechnology** uses individual atoms and molecules to create computer chips and other devices that are thousands of times smaller than current technologies permit.

Chip manufacturers are trying to develop a manufacturing process that could produce nanotube processors economically. Nanotubes are tiny tubes about 10,000 times thinner than a human hair. They consist of rolled-up sheets of carbon hexagons and have the potential uses as minuscule wires or in ultra small electronic devices and are very powerful conductors of electrical current.

The Law of Mass Digital Storage

A second technology driver of IT infrastructure change is the Law of Mass Digital Storage. The amount of digital information is roughly doubling every year. Fortunately, the cost of storing digital information is falling at an exponential rate of 100 percent a year. The law shows that the number of megabytes that can be stored on magnetic media for $1 from 1950 to the present roughly doubled every 15 months.

Metcalfe's Law and Network Economics

Moore's Law and the Law of Mass Storage help us understand why computing resources are now so readily available. But why do people want more computing and storage power? The economics of networks and the growth of the Internet provide some answers.

Robert Metcalfe - inventor of Ethernet local area network technology claimed in 1970 that the value or power of a network grows exponentially as a function of the number of network members. Metcalfe and others point to the increasing returns to scale that network members receive as more and more people join the network. As the number of members in network grows linearly, the value of the entire system grows exponentially and continues to grow forever as members increase.

Demand for information technology has been driven by the social and business value of digital networks, which rapidly multiply the number of actual and potential links among network members.

Declining Communications Costs and the Internet

A fourth technology driver transforming IT infrastructure is the rapid decline in the costs of communication and the exponential growth in the size of the Internet. An estimated 2.3 billion people worldwide now have Internet access (Internet World Stats, 2012). As communication costs fall toward a very small number and approach zero, utilization of communication and computing facilities explode.

To take advantage of the business value associated with the Internet, organisations must greatly expand their Internet connections, including wireless connectivity, and greatly expand the power of their client/server networks, desktop clients, and mobile computing devices.

There is every reason to believe these trends will continue. One reason for the growth in the internet population is the rapid decline in internet connection and overall communication costs.

A major component of IT is the computer.

2.07 Defining Computer

A computer can be defined as an electronic device used in processing data and information. It can manipulate and store data for the user's retrieval. It has capacity to process data to generate information. This data can also be stored for later use or further manipulation.

In addition, a computer is an electronic device that accepts data and instructions, processes the data in accordance with a user instruction (program) and generates results.

It consists of input, processing, output, and storage units. It is a system of functional unit that can perform substantial computation, including numerous arithmetic operation and logic operations.

2.08 Features of a Computer

There are certain attributes that characterize a computer that tend to make it advantageous over other means of data processing. Some of these advantages include:

(a) Speed

Computers are electronic devices and as such, can operate at a fast speed. That makes the computer so fast in operation that in a matter of seconds, it can accomplish what will take human beings' days to accomplish.

(b) Accuracy

Computers do not make mistakes if they are accurately programmed and to a large extent, not faulty in terms of components. Computers can operate error-free, so they can be trusted to produce accurate results which are very vital to the user.

It therefore implies that the output or the result of the processing will normally be achieved based on the original data input to the computers. That forms the popular saying "garbage in garbage out (GIGO)".

(c) Reliability

Just as they are accurate, a computer is reliable and consistent in the information produced by it.

Given the same program and same data, the result produced should always be the same. That is why computer-type devices like the microprocessors are introduced into household appliances and automobiles to increase their productivity and reliability.

This does not mean that the computer cannot breakdown. When it breaks down, it will no longer be operational if downtime is sustained. The amount of time that the computer stays in an inactive condition is referred to as downtime.

(d) Versatility

Computers are versatile. They can be used in many fields. Some areas in which computers can be used include; research, aviation, sales force automation, medicine, accounting, auditing, teaching and learning, designing and manufacturing, entertainment, etc

(e) Mass storage capability

Computers can store very large amounts of data for long periods of time.

(f) Precision

It is possible to represent information, especially numerical quantities, to any (reasonable) desired degree of magnitude. This quality is very useful in scientific and engineering applications.

(g) Security

Since data and information in computer systems are stored in machine-readable form, they are protected from unauthorized people by using passwords or some other form of identification. It therefore can be said that the computer provides a measure of security for data and information stored on it.

2.09 Components of a Computer System

A computer system consists of two (2) broad components. The Hardware and the Software. The Hardware is the physical unit, which is the electronic component of the computer system, which makes up the computer configuration.

The Software is the suite of programs which are processed by the hardware and allows the hardware to function effectively and efficiently. A program is a sequence of instructions written in a particular computer language, which is carried out by the hardware to solve a given problem.

Hardware Components

Computer Hardware, in a broad sense, refers to all physical, electrical and mechanical components of a computer system. In effect, any part of a computer that can be seen, touched or felt, will constitute a component of the computer hardware.

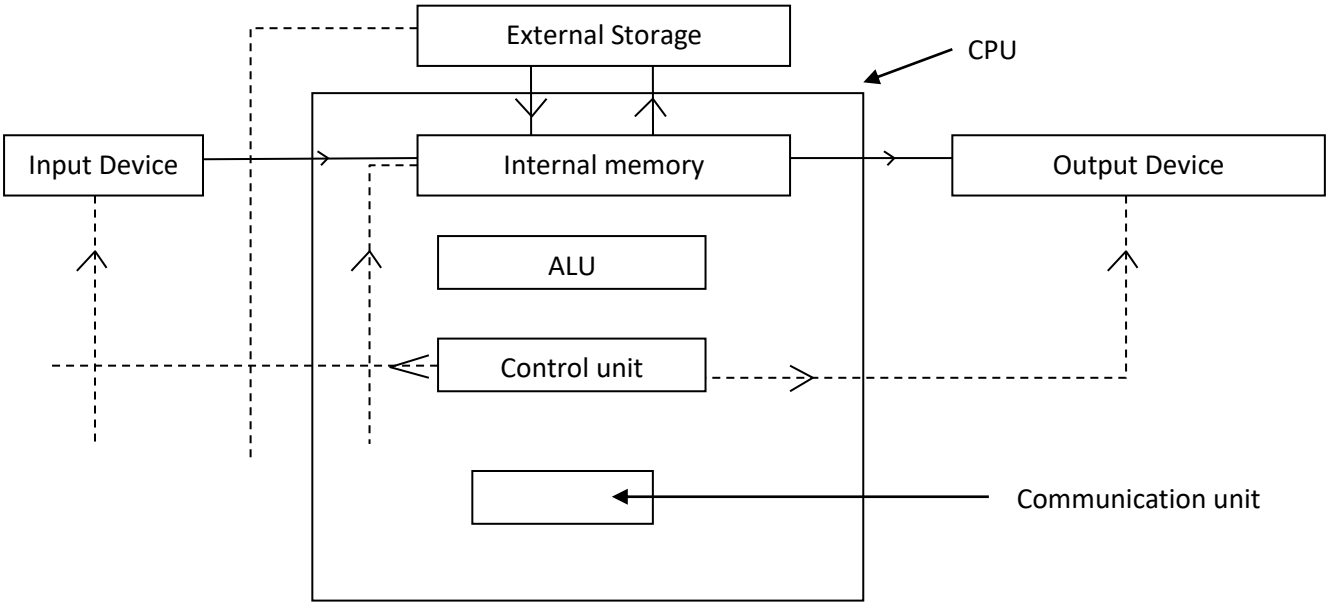
This implies that, there exist other functional entities in a computer, which are not in themselves physical components, but still have pronounced effects on the overall operation of the computer.

These in computer terminology are referred to as Software.

Computer hardware alone without the necessary software is like a “lifeless shell” incapable of being used in any user-oriented application.

The hardware is divided into six (6) major components: Input, Process, Output, Memory, Permanent Storage and Input/Output

Figure 2.04: Functional Component of Hardware



Key: -·-> Data signal transfer
→ Control signal

The CPU consists of the processor (ALU and Control Unit) and the primary memory. Working in concert with the processor during processing is the primary memory, which temporarily stores incoming data and processed results for easy access.

The support devices are primarily involved with input, output and/or secondary storage functions. Storage devices provide an area to keep programs and data/information as well to save and retrieve them.

The Elementary Structure of the Hardware

(a) Input Device: Is one which transfers data and programs to the internal memory.

The purpose of the input components of a computer system is to:

(i) Accept data in the required form
(ii) Convert this data into machine-readable form; and
(iii) Transmit this data to the Central Processing Unit (CPU)

(b) Central Processing Unit (CPU): The CPU is the brain of the computer system.
It is the main unit of the hardware. This is the unit that does the work of the computer system. It executes computer programs.

This unit is made of three (3) components, the main/internal memory, the arithmetic and logic unit (ALU) and the control unit. It accepts data from an input device, performs instructions specified by the results to an output device. The ALU and control unit interprets and executes instructions received from the computer system.

Main Memory/Internal Memory
This is also called the primary memory. A memory is made up of many cells, with each cell capable of storing one bit. It contains the following:

- Programs which contain instructions that will be used for processing;
- Data that have been read from an input device or a secondary storage device;
- Intermediate results; i.e. data that are currently being processed or are used for processing other data;
- Output information that is ready to be sent to an output device or a secondary storage device.

The purpose of the main memory (also known as Random Access Memory RAM or Primary Memory or Immediate Access Memory) is to:

(i) Store programs during their execution; and
(ii) Store data that is being used by the current program.

Data and instructions stored can be addressed and accessed very quickly and hence it is referred to as immediate access storage (IAS). The reasons for holding programs and data in the memory are to speed up processing.

The transfer of data, such as program instructions, within memory is faster than the transfer of data between the processor and peripheral devices. It has a small capacity and hence it is complemented by the external storage, which has a larger capacity, but a slower access time.

Data and programs needed for immediate uses are in the main memory while data and program needed for later use are in the backing storage.

It must be clear that all data and programs must be resident in the internal memory before processing can take place. The primary memory is produced from silicon chips and is based on metal oxide semiconductor (MOS) technology (also called metal oxide semiconductor field effects transistor technology (MOSFET) and is divided into RAM and ROM.

i. RAM (Random Access Memory):

This is the larger part of the primary memory and is used for working storage requirement when running application programs i.e. it holds the data and program in current use. Data can be written on to or read from RAM.

RAM can access any location in the memory in any order with the same speed. The term "random access" implies that the computer can go directly to any given address within the memory and read or write data there.

The time taken to read a symbol from a cell is called read-time and the time taken to write a symbol is called write-time.

Since RAM is the larger part of the memory, the primary memory is loosely called RAM relative to other forms of memory. RAM is expensive.

RAM is volatile i.e. it loses its contents when the computer's power is shut off. So, the data and instructions in RAM are temporary.

RAM is also called the User's Memory.

ii. ROM (Read only memory)

A memory is said to be **read only** if information is permanently written and can only be read. Such a memory cannot be written to.

ROM is non-volatile micro programs for 1/O operations and the booting programs are kept in ROM.

The following variants of ROM are available.

a. **PROM (Programmable ROM)**

This can be programmed by the user unlike ROM which is preprogrammed by the manufacturer. A special device is required for putting the bit pattern into a PROM programmer.

b. **EPROM (Erasable Programmable ROM)**

When data are recorded on EPROM, they are just like ROM in behaviour, but the contents of the ROM can be changed by the use of an ultraviolet light to revert all the cells to "I"s. Then new data and programs can be written on the chip.

Cache Memory

This is a high-speed memory capable of keeping up with the processing speed of the processor. It acts as a buffer between the processor and the slower primary memory. As the processor is not delayed by memory accesses, the overall speed of processing is increased. The operating system (OS) transfers segments of programs and data from disk backing storage into the Cauchy buffer.

Arithmetic and Logic Unit (ALU)

The Arithmetic and Logic Unit (ALU) is the part of the processor where arithmetic and logic operations are carried out. The arithmetic operations include:

- Addition and subtraction
- Multiplication and division
- Exponentiation

The logic operations include:

- Comparison
- Branch operation (a branch operation changes the order of program execution); and
- Movement of data

The Control Unit (CU) of the processor performs the following operations:

- receives instruction in a program one at a time, from the main memory
- Interprets the instruction
- Sends out control signals to the peripheral devices (particularly the I/O devices)

Output Device

This unit of the computer hardware

(i) Accepts information/data from the CPU
(ii) Converts this information/data into the required output form; and
(iii) Sends it to the user through required output device

Storage Device: is an external (bulk) auxiliary device providing for the storage of records and programs until required for the processing activities.

The purpose of this unit is to:

(i) Maintain a permanent store of data and programs when not being used by the computer.
(ii) Maintain a store for the program and data currently being used if the main memory is not large enough to accommodate the entire program and data.
(iii) Serve as a backup of data held in the main memory
(iv) Act as a secondary input/output device when the input is in magnetic form or the output is required in a magnetic form.

Device

The term device is used to describe any piece of hardware that is connected to the processor such as keyboard, monitor, disk drive, printer, scanner, modem and so on. Such devices are sometimes described as peripheral devices. They may also be classified as input/output (I/O) devices and storage devices.

Peripheral Devices

Peripheral is a generic name for all input/output components and secondary storage devices that depend on direct connection or telecommunication links to the CPU of a computer system.

Thus, all peripheral devices are on-line devices, that is, separate from, but can electronically be connected to and controlled by the computer system unit.

I/O Devices (Input/Output Devices)

As the name suggest, I/O devices are responsible for communicating with the computer, providing input for the computer to process and arranging to display output for users. The keyboard and mouse are the commonly used input devices.

A monitor is the commonest output device that produces a soft copy while a printer is for hardcopy (paper) output. Storage devices are used to store information in a computer system.
The memory unit, Random Access Memory (RAM) is used to store information inside the computer while the computer is switched on. Disk storage is the commonest form of external storage, followed by tapes, floppy disks, Universal Serial Bus (USB) devices.

Input Devices

(a) Keyboard

This is a text-based input device that allows the user to input alphabets, numbers and other characters. It consists of a set of keys mounted on a board. Such keys include;

(ii) Function keys labeled F1, F2…..F12. Functions assigned to these keys differ from one software package to another. These keys are also user programmable.

(iii) Alphanumeric keypad. It consists of keys for English alphabets, 0 to 9 number and special characters like +, -, / * etc. Some keys also contain alphabets of other languages.

(iv) Other special keys like ENTER, Space bar, Backspace, Delete, Insert, Shift, Caps Lock, Tab, Ctrl, Alt, Esc, Numeric keypad and cursor movement keys.

(b) Mouse

This is a small device used to point to icons on the screen and select to perform one or more actions. It can be used to select menu commands, resize windows, start programs etc.
Most actions beings performed by a mouse include:

- Left click: used to select an item
- Double click: used to start a program or a file
- Right click: usually used to display a drop-down window of commands.
- Drag and Drop: Allows one to select and move an item from one location to another on the input screen.

(c) Joystick

This is a vertical stick which moves the graphic cursor in a direction the stick is moved. It typically has a button on top that is used to select the option pointed by the cursor. Joystick is primarily used as an input device with video games, and control robots.

(d) Touch Screen

This allows the user to operate or make selections by simply touching the display screen. Medium hand-held computer (personal Digital Assistants) also use touch screen.

(e) Light Pen

This is a pen-shaped device used to select objects on the display screen. It is like the mouse in the way it functions. However, it uses a light pen to move the pointer and select any object on the screen by pointing to the object.

(f) Magnetic Ink Character Recognition (MICR)

This is a method of data entry widely used in the banking system to process cheques. Each cheque has an identifying information (cheque number, account code, and bank sort code), printed in magnetic ink.

(g) Optical Character Recognition (OCR)

Optical character recognition OCR, though, different from magnetic ink character recognition, is similar in concept.

Whereas the OCR optically detects the characters on the document and converts them to codes which are then sent to the processor, the MICR magnetically detects the characters.

The OCR reads characters and codes on items like merchandise tags, product labels, credit card receipt, utility bills, airtime tickets and other documents like marked multiple-choice examination sheets.

(h) Scanner

This is an input device used for direct data entry from the source document into the computer system. This converts the document, pictures images into digital form so that they can be fed into the computer.

Capturing information like this reduces the possibility of errors typically experienced during large data entry.

(i) Bar Code Reader

This is a special type of scanner that is used to input data from bar codes. A bar code is a set of lines of different thickness that represent different numbers.

Most products in retail shops or supermarkets have bar codes on them. A bar code reader operates by shinning a beam of light on the lines that make up the barcode and detecting the amount of light that is reflected.

Output Devices

Monitors

These are the commonest output devices for a computer system and they produce a soft copy of the document requested. A soft copy is an output that does not persist over time. Monitors are of different types:

(a) Visual Display Unit (VDU)

This consists of a cathode ray tube (CRT) to display output together with the keyboard to accept input. The combination allows a dialogue with the computer. The application of VDU is limited to those where no permanent record of output is required.

(b) Liquid Crystal Display (LCD)

This is a display technology that uses liquid crystal solution. Also, called “flat screen”, they are slow and sleek, when compared to CRT monitors and power consumption is minimal.

Print Output Devices

After video displays, document print outputs are the most common form of visual output for the user. Print output is being produced in a hard copy form.

A hard copy output such as printed paper or microfilm is one that persists over time. Print output is important for permanent records at least in hard copy form. It is portable and may be posted or delivered to end users.

Based on technology used, printers may be classified as impact or non-impact printers.

Impact Printers

Impact printers are those that use the typewriting printing mechanism wherein a hammer strikes the paper through a ribbon to produce output. Dot Matrix and character printers fall under this category.

Non-impact Printers

These printers cause characters to be printed by means of some chemical, by heat process. Non-impact printers can print more than 2,000 characters per second.

Typical of non-impact printers are Laser Jet Printers of various series, which use laser beams, Ink Jet Printers that spray droplets of inks on the paper to form characters and Xerox which use Xerographic principles to print up to 400 lines per minute.

Dot Matrix Printer

This type of printer has a moveable pint head, which consists of a matrix of pins. The set of pins corresponding to the shape of the character to be printed is impacted on the ribbon which then leaves an inked image on the page.

Dot Matrix printers are commonly used in retail stores and banks to print documents and receipts. Some ATMs are equipped with dot matrix printers. Dot matrix is also used in industries.

Dot matrix printers have some advantages for their use. Printing is not hampered when the ribbon is low in ink, although printing quality may be faded.

Dot matrix printers are durable, because they do not contain highly sensitive components like other modern-day printers. One disadvantage of these printers is that they can be quite noisy and could be rather annoying to use.

Ink Jet Printers

This type of printers ejects a stream of special ink through a fine nozzle to form the characters that are printed on the paper. Inkjet printers provide good output quality.

They can also provide a variety of fonts and produce diagrams. Modern inkjet printers can also produce high-quality multi-colored output. They are quiet in operation.

Laser Jet

This is a popular printer generally used in making large volume printing especially Desktop Publishing (DTP).

Its operation is very similar to that of the photocopying machines. The laser beams are used to create an image of the document on a drum coated with photoelectric material.

When the paper comes in contact with the drum, a permanent image is printed on paper with the help of the toner. Speed of the laser jet printer is measured as dots per inch (dpi).

External Storage Devices

External storage devices are also called secondary, auxiliary, backing or bulk storage devices.

They are used to save (store) programs and data for repeated use. They are non-volatile and have higher capacity than the primary memory.

Also, they cost far less than the primary memory. A major disadvantage is that they are slower than the primary memory.

The purpose of secondary storage also known as backup or external storage is to:

(a) Maintain a permanent storage of data and program when not being used by the CPU.

(b) Maintain a store for the program and data currently being used, if the main memory is not large enough to accommodate the entire program and data.

(c) Maintain a copy of data held in the main memory for security purposes.

(d) Act as a secondary input/output device when the input is in magnetic form or the output is required in magnetic form.

Two primary technologies used for the external storage media are **Magnetic and Optical Technology.**

Magnetic Storage

The primary types of magnetic storage are Hard Disk, diskettes (floppy disks) disk cartridges and magnetic tape. These include:

(a) The Hard Disk

To increase the storage capacity of a disk and decrease its access time, it is necessary to use a hard disk. Hard disks are single, hard, magnetic disk(s) sealed within their own drives.

The environment is protected from dust. They can rotate at faster speeds than the floppy disks and rather than read/write head being in contact with the surface of the disk it floats just above it.

(b) Floppy Diskette

The floppy disk is a small sized auxiliary storage device commonly used for storing the data and programs. The floppy disk is inserted into the disk drive before writing or reading data from disk.

The floppy disk may be logically thought of as a magnetic disk. It is logically divided into several circles called tracks. Each track is further partitioned into sectors where data for retrieval or storage are placed. Each sector within each trace can occupy 512bytes of data.

The floppy disk is covered with a rigid envelop. For reading and writing on disk, the head must be in contact with the disk surface which is used to store data and read data stored in the floppy disk.

(c) Tape Storage

Magnetic tape stores data in form of records. Several records are collected together and stored in a block. Between these blocks of data are parts of the tape on which no data is stored.

These are called inter block gaps. There is a header label that gives information such as the name of the tape, the name of the program that is used to update it and the last date of update.

When reading or writing data, the tape drive passes the tape from reel to reel over a read/write head, which either reads data into the processor, or writes from CPU to the tape

The tape is very slow to access in comparison with magnetic disks. Typically, tape storage is used to keep a backup of the information stored on a disk or information that may not be needed for urgent processing.

Optical Storage

Optical disk technology consists of encoding data as a series of microscopic bits on the surface of a disk that is covered with a transparent plastic coating. These bits can be read by means of laser light focused with great accuracy onto the spinning disks.

(a) CD-ROM (Compact Disk Read-Only Memory)

This is a WORM (Write Once, Read Many Times) device that has "read only" access but very much large storage.

Optical scanning techniques, using lasers, are employed with CD-ROMs, which allow massive amounts of data to be stored in a compact area. CD-ROM is more reliable and durable than magnetic media (disks and tapes)

(b) CD-R (CD Recordable)

CD recordable is a storage medium that combines the reliability and storage capacity of CD-ROM with the flexibility of magnetic disks because it allows users to store their information on them. However, a CD-R does not allow the recorded data on it to be erased.

(c) CD-RW (CD Re-Writable)

CD Rewritable optical disk system also functions like the CD-R, but it can be written and overwritten repeatedly, just like a hard disk.

(d) DVD (Digital Video Disk or Digital Versatile Disk)

DVD whose capacity ranges from 4.8GB upwards is now replacing the CD-ROMS. A special drive is needed to read these DVD disks and write on them. DVD disks are commonly used for distributing films as a rival to video tapes.

Software Structure

The software is a suite of programs that allows the hardware to function optimally and which allows the end user to interact with the hardware.

Software is a generic term used for all computer programs that run on the hardware system and their accompanying documentation.

The documentation i.e. the complete set of instructions enables computer system users to use the computer system to perform some tasks.

The computer programs are divided into Systems Software and Application software (often called application packages).

A computer program can be defined as a sequence of instructions to solve a particular problem written in a particular computer language.

The most important system software is the Operating System (OS) and there are OS for various task/processes such as single user, multiprocessing, multiprogramming and distributed processing.

Systems Software

This consists of background program that enable application of software (application packages) to run smoothly on a specific set of hardware.

Systems software refers to the suite of programs that facilitates the optimal use of the hardware system and provides suitable environment for the writing, editing, debugging, testing and running of users' programs.

Thus, systems software forms an interface between application program and the hardware system. Usually, every computer system comes with a collection of these programs because they constitute an essential part.

System software includes both operating system software and utility software.

Operating System Software

Operating system software controls the application software and manages how the hardware devices work together.

When using Excel to create and print a graph, the operating system software controls the process, ensures that a printer is attached and has paper, and sends the graph to the printer along with instructions on how to print it.

Some computers are configured with two operating system, so they can **dual boot** – provide the user with the option of choosing the operating system when the computer is turned on.

Operating system software also supports a variety of useful features, one of which is **multitasking**.

Multitasking allows more than one piece of software to be used at a time. Multitasking is used for instance, when creating a graph in Excel and simultaneously printing a word processing document.

With multitasking, both pieces of application software are operating at the same time. There are different types of operating system software for personal environments and for organizational environments (see Table 1 below).

Table 1: Operating System Software

Linux	An open source operating system that provides a rich environment for high-end workstations and network servers. Open source refers to any program whose source code is made available for use or modification as users or other developer see fit.
Mac OS X	The operating system of Macintosh computers
Microsoft Windows	Generic name for the various operating system in the Microsoft Windows family, including Microsoft Windows CE, Microsoft Windows, Microsoft Windows ME, Microsoft Windows 7, Microsoft Windows 8, Microsoft Window XP, Microsoft Window NT, and Microsoft Windows server etc.
MS-DOS	The standard, single-user operating system of IBN and IBM-compatible computers, introduced in 1981. MS-DOS is a command-line operating system that requires the user to enter commands, arguments and syntax.
UNIX	A 32-bit multitasking and multiuser operating system that originated at AT&T's Bell Laboratories and is now used on a wide variety of computers from mainframes to PDAs.

Utility Software

Utility software provides additional functionality to the operating system. Utility software includes antivirus software, screen savers, disk defrag, disk cleanup and anti-spam software.

Operating systems are customized by using the **Control Panel**, which is a Windows feature that provides options that set default values for the Windows operating system.

For example, the **system clock** works like a wristwatch and uses a battery mounted on the motherboard to provide power when the computer is turn off.

If the user moves to a different time zone, the system clock can be adjusted in the control panel.

Table 2: Types of Utility Software

Crash –proof	Helps save information if a computer crashes
Disk image for data recovery	Relieves the burden of reinstalling applications if a hard drive crashes or becomes irretrievably corrupted.
Disk optimization	Organizes information on a hard disk in the most efficiency way.

Encrypt data	Protect confidential information from unauthorized eyes
File and data recovery	Retrieves accidental deletion of photos or document.
Text protect	In Microsoft Word, prevents users from typing over existing text after accidentally hitting the insert key. Launch the insert Toggle Key program, and the PC will beep whenever a user presses the insert key.
Preventive security	Through programs such as Window Washer, erases file histories, browser cookies, cache contents, and other crumbs that application and Windows leave on a hard drive.
Spyware	Removes any software that employs a user's internet connection in the background without the user's knowledge or explicit permission.
Uninstaller	Can remove software that is no longer needed.

Application Software

Application software is used for specific information processing needs, including payroll, customer relationship management, project management, training, and many others.

Application software is used to solve specific problems or perform specific tasks. From an organizational perspective, payroll software, collaborative software such as video conferencing (within groupware), and inventory management software are all examples of application software.

Personal information management (PIM) software handles contact information, appointments, task list and email. **Course management software** contains course information such as a syllabus and assignments and offers drop boxes for quizzes and homework along with a grade book.

Table 3: Types of Application Software

Browser	Enables the user to navigate the World Wide Web. The two leading browsers are Netscape Navigator and Microsoft Internet Explorer.
Communication	Turns a computer into a terminal for transmitting data to and receiving data from distant computers through the telephone system.
Data management	Provides the tools for data retrieval, modification, deletion, and insertion; for example, Access, MySQL, and Oracle
Desktop Publishing	Transforms a computer into a desktop publishing workstation, leading packages include Adobe FrameMaker, Adobe Page Maker and Quark Xpress.
E-mail	Provides e-mail services for computer users including receiving mail, sending mail, and storing messages. Leading email software includes Microsoft Outlook, Microsoft Outlook Express, and Eudora.
Groupware	Increases the cooperation and joint productivity of small groups

	of co-workers.
Presentation Graphics	Creates and enhances charts and graphics so that they are visually appealing and easily understood by an audience. A full-features presentation graphics package such as Lotus Freelance Graphics or Microsoft PowerPoint includes facilities for making a wide variety of charts and graphs and for adding title, legends, and explanatory text anywhere in the chart or graph.
Programming	Possesses an artificial language consisting of a fixed vocabulary and a set of rules (called syntax) that programmers use to write computer programs. Leading programming languages include Java, C++, C#, and .NET
Spreadsheet	Simulates an accountant's worksheet on-screen and let users embed hidden formulas that perform calculations on the visible data. Many spreadsheet programs also include powerful graphics and presentation capabilities to create attractive products. The leading spreadsheet application is Microsoft Excel.
Word Processing	Transforms a computer into a tool for creating, editing, proofreading, formatting, and printing documents. Leading word processing application include Microsoft Word and WordPerfect
Accounting	Used for accounting functions. E.g. Peachtree, Sage, DacEasy, etc

2.10 Technology Standards

Today's enterprise infrastructure and Internet computing would be impossible both now and in the future without agreements among manufacturers and widespread consumer acceptance of **technology standards**. Technology standards are specifications that establish the compatibility of products and the ability to communicate in a network.

Technology standards unleash powerful economies of scale and result in price declines as manufacturers focus on the products built to a single standard. Without these economies of scale, computing of any sort would be far more expensive than is currently the case today.

Beginning in the 1990s, corporations started moving toward standard computing and communications platforms.

The Wintel PC with the Windows operating system and Microsoft Office desktop productivity applications became the standard desktop and mobile client computing platform.

(It now shares the spotlight with other standards, such as Apple's iOS and Macintosh operating systems and the Android operating system.)

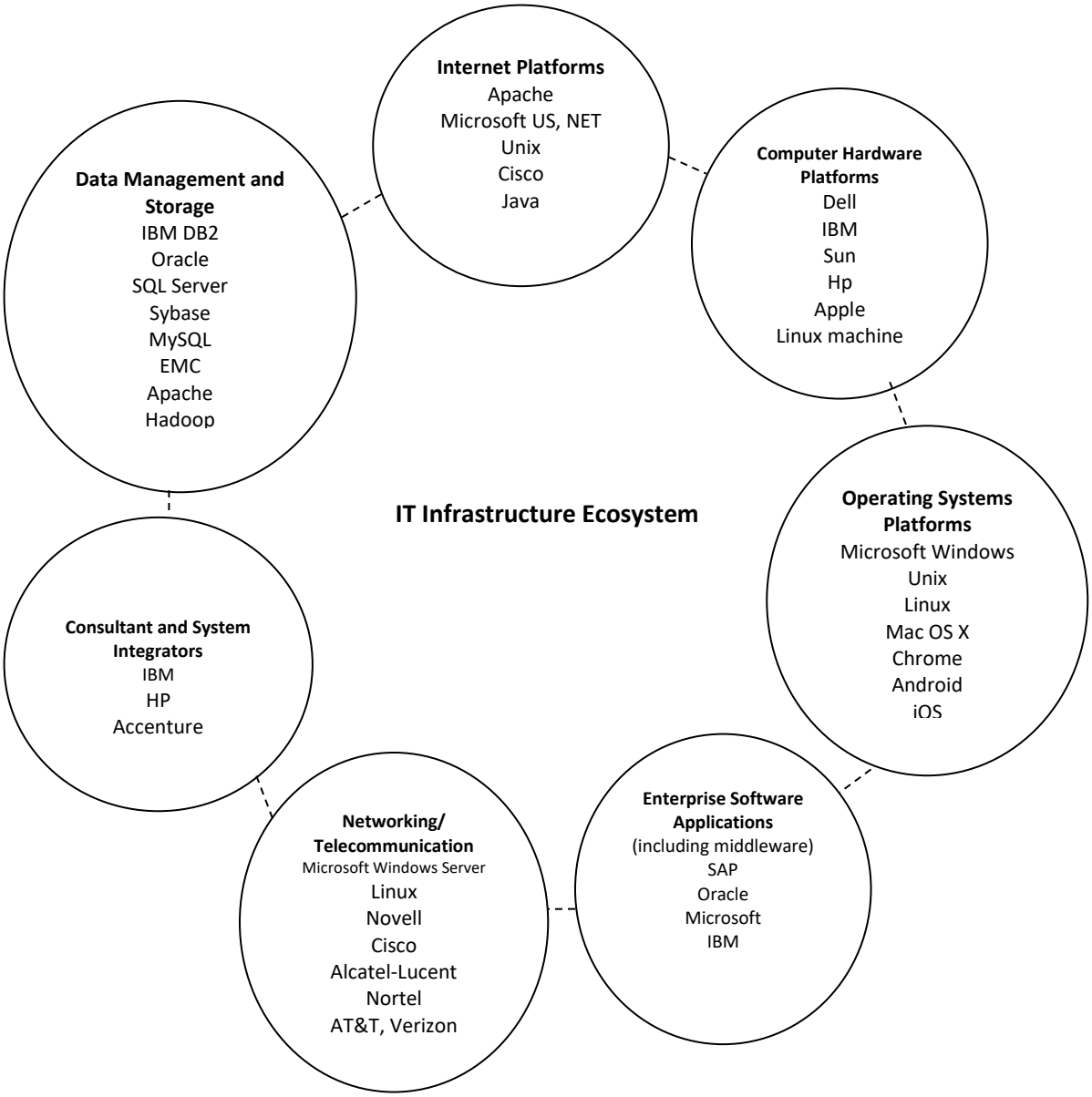
Widespread adoption of Unix-Linux as the enterprise server operating system of choice made possible the replacement of proprietary and expensive mainframe infrastructures.

In telecommunications, the Ethernet standard enabled PCs to connect in small local area networks (LANs) and the TCP/IP standard enabled these LANs to be connected into firmwide networks, and ultimately, to the Internet.

Some Important Standards in Computing

STANDARD	SIGNIFICANCE
American Standard Code for Information Interchange (ASCII) (1958)	Made it possible for computer machines from different manufacturers to exchange data; later used as the universal language linking input and output devices such as keyboards and mice to computers. Adopted by the American National Standards Institute in 1963.
Common Business Oriented Language (COBOL) (1959)	An easy-to-use software language that greatly expanded the ability of programmers to write business-related programs and reduced the cost of software.
Unix (1969—1975)	A powerful multitasking, multiuser, portable operating system initially developed at Bell Labs (1969) and later released for use by others (1975). It operates on a wide variety of computers from different manufacturers. Adopted by Sun, IBM, HP, and others in the 1980s, it became the most widely used enterprise-level operating system.
Transmission Control Protocol/Internet Protocol (TCP/IP) (1974)	Suite of communications protocols and a common addressing scheme that enables millions of computers to connect in one giant global network (the Internet). Later, it was used as the default networking protocol suite for local area networks and intranets.
Ethernet (1973)	A network standard for connecting desktop computers into local area networks that enabled the widespread adoption of client/server computing and local area networks, and further stimulated the adoption of personal computers.
IBM/Microsoft/Intel Personal Computer (1981)	The standard Wintel design for personal desktop computing based on standard Intel processors and other standard devices, Microsoft DOS, and later Windows software. The emergence of this standard, low-cost product laid the foundation for a 25-year period of explosive growth in computing throughout all organizations around the globe. Today, more than 1 billion PCs power business and government activities every day.
World Wide Web (1989)	Standards for storing, retrieving, formatting, and displaying information as a worldwide web of electronic pages incorporating text, graphics, audio, and video enables creation of a global repository of billions of Web pages.

FIGURE: 2.0 The IT Infrastructure Ecosystem



There are seven major components that must be coordinated to provide the firm with a coherent IT infrastructure. Listed here are major technologies and suppliers for each component.

Computer Hardware Platforms

The server market uses mostly Intel or AMD processors in the form of blade servers in racks, but also includes Sun SPARC microprocessors and IBM chips specially designed for server use.

Blade servers are computers consisting of a circuit board with processors, memory, and network connections that are stored in racks. They take up less space than traditional box-based servers.

Secondary storage may be provided by a hard drive in each blade server or by external mass storage drives.

The marketplace for computer hardware has increasingly become concentrated in top firms such as IBM, HP, Dell, and Sun Microsystems (acquired by Oracle), and three chip producers: Intel, AMD, and IBM.

The industry has collectively settled on Intel as the standard processor for business computing, with major exceptions in the server market for Unix and Linux machines, which might use Sun or IBM processors.

Mainframes have not disappeared. Mainframes continue to be used to reliably and securely handle huge volumes of transactions, for analyzing very large quantities of data, and for handling large workloads in cloud computing centers.

The mainframe is still the digital workhouse for banking and telecommunications networks.

However, the number of providers has dwindled to one: IBM. IBM has also repurposed its mainframe systems, so they can be used as giant servers for massive enterprise networks and corporate Web sites. A single IBM mainframe can run up to 17,000 instances of Linux or Windows Server software and can replace thousands of smaller blade servers.

Operating System Platforms

Microsoft Windows Server comprises about 35 percent of the server operating system market, with 65 percent of corporate servers using some form of the **Unix** operating system or **Linux**, an inexpensive and robust open source relative of Unix. Microsoft Windows Server can provide enterprise-wide operating system and network services and appeals to organizations seeking Windows-based IT infrastructures.

Unix and Linux are scalable, reliable, and much less expensive than mainframe operating systems. They can also run on many different types of processors. The major providers of Unix operating systems are IBM, HP, and Sun, each with slightly different and partially incompatible versions.

At the client level, 90 percent of PCs use some form of the Microsoft Windows **operating system** (such as Windows 8, Windows 7, or Windows Vista, Windows XP) to manage the resources and activities of the computer.

However, there is now a much greater variety of operating systems than in the past, with new operating systems for computing on handheld mobile digital devices or cloud-connected computers.

Google's **Chrome OS** provides a lightweight operating system for cloud computing using netbooks. Programs are not stored on the user's PC but are used over the Internet and accessed through the Chrome Web browser. User data reside on servers across the Internet.

Android is an open source operating system for mobile devices such as smartphones and tablet computers developed by the Open Handset Alliance led by Google. It has become the most popular smartphone platform worldwide, competing with iOS,

Apple's mobile operating system for the iPhone, iPad, and iPod Touch.

Conventional client operating system software is designed around the mouse and keyboard, but increasingly becoming more natural and intuitive by using touch technology.

iOS, the operating system for the phenomenally popular Apple iPad, iPhone, and iPod Touch, features a **multitouch** interface, where users employ one or more fingers to manipulate objects on a screen without a mouse or keyboard.

Microsoft's **Windows 8**, which runs on tablets as well as PCs, has a user interface optimized for touch, but also works with a mouse and keyboard.

Data Management and Storage Platforms

Enterprise database management software is responsible for organizing and managing the organisation's data so that they can be efficiently accessed and used.

The leading database software providers are IBM (DB2), Oracle, Microsoft (SQL Server), and Sybase (Adaptive Server Enterprise). MySQL is a Linux open source relational database product now owned by Oracle Corporation, and Apache Hadoo is an open source software framework for managing massive data sets.

The physical data storage market is dominated by EMC Corporation for large-scale systems, and a small number of PC hard disk manufacturers led by Seagate and Western Digital.

Digital information is doubling every year, with a staggering 1.8 zettabytes created in 2011 alone (IDC, 2011) storing all the tweets, blogs, videos, e-mails, and Facebook postings, as well as traditional corporate data.

With the amount of new digital information in the world growing so rapidly, the market for digital data storage devices has been growing at more than 15 percent annually over the last five years.

In addition to traditional disk arrays and tape libraries, large firms are turning to network-based storage technologies.

Networking/Telecommunications Platforms

Windows Server is predominantly used as a local area network operating system, followed by Linux and Unix. Large, enterprise wide area networks use some variant of Unix. Most local area networks, as well as wide area enterprise networks, use the TCP/IP protocol suite as a standard.

The leading networking hardware providers are Cisco, Alcatel-Lucent, Nortel, and Juniper Networks. Telecommunications platforms are typically provided by telecommunications/telephone services companies that offer voice and data connectivity, wide area networking, wireless services, and Internet access.

Leading telecommunication service vendors include MTN, GLO, ETISALAT, ZAIN, AT&, T Verizon etc. This market is exploding with new providers of cellular wireless, high-speed internet, and internet telephone services.

Internet Platforms

Internet platforms overlap with, and must relate to, the firm's general networking infrastructure and hardware and software platforms.

They include hardware, software, and management services to support a firm's Web site, including Web hosting services, routers, and cabling or wireless equipment.

A Web hosting service maintains a large Web server, or series of servers, and provides fee-paying subscribers with space to maintain their Web sites.

The Internet revolution created a veritable explosion in server computers, with many firms collecting thousands of small servers to run their Internet operations.

Since then there has been a steady push toward server consolidation, reducing the number of server computers by increasing the size and power of each and by using software tools that make it possible to run more applications on a single server.

The Internet hardware server market has become increasingly concentrated in the hands of IBM, Dell, and Sun (Oracle), and HP, as prices have fallen dramatically.

The major Web software application development tools and suites are supplied by Microsoft (Microsoft Expression Studio and the Microsoft .NET family of development tools), Oracle-Sun (Sun's Java is the most widely used tool for developing interactive Web applications on both the

server and client sides), and a host of independent software developers, including Adobe (Creative Suite) and Real Networks (media software).

2.11 Consulting and System Integration Services

Today, even a large firm does not have the staff, the skills, the budget, or the necessary experience to deploy and maintain its entire IT infrastructure.

Implementing a new infrastructure requires significant changes in business processes and procedures, training and education, and software integration. Leading consulting firms providing this expertise include Accenture, IBM Global Services, HP, Infosys, and Wipro technologies.

Software integration means ensuring the new infrastructure works with the firm's older, so-called legacy systems and ensuring the new elements of the infrastructure work with one another.

Legacy systems are generally older transaction processing systems created for mainframe computers that continue to be used to avoid the high cost of replacing or redesigning them.

Replacing these systems is cost prohibitive and generally not necessary if these older systems can be integrated into a contemporary infrastructure.

2.12 Contemporary Hardware Platform

The exploding power of computer hardware and networking technology has dramatically changed how businesses organize their computing power, putting more of this power on networks and mobile handheld devices.

We look at eight hardware trends: the mobile digital platform, consumerization of IT, grid computing, virtualization, cloud computing, green computing, high-performance/power-saving processors, and autonomic computing.

The Mobile Digital Platform

New mobile digital computing platforms have emerged as alternatives to PCs and larger computers.

Smartphones such as the iPhone, Android, and BlackBerry smartphones have taken on many functions of PCs, including transmission of data, surfing the Web, transmitting e-mail and instant messages, displaying digital content, and exchanging data with internal corporate systems.

The new mobile platform also includes small, lightweight netbooks optimized for wireless communication and Internet access, **tablet computers** such as the iPad, and digital e-book readers such as Amazon's Kindle with Web access capabilities.

Smartphones and tablet computers are becoming an important means of accessing the Internet.

These devices are increasingly used for business computing as well as for consumer applications.

For example, senior executives at large multinational organisations are using smartphone applications that drill down into vehicle sales information, financial performance, manufacturing metrics, and project management status.

2.13 Contemporary Software Platform

There are four major themes in contemporary software platform evolution:

- Linux and open source software
- Java, HTML, and HTML5
- Web services and service-oriented architecture
- Software outsourcing and cloud services

LINUX and Open Source Software

Open source software is software produced by a community of several hundred thousand programmers around the world.

According to the leading open source professional association, OpenSource.org, open source software is free and can be modified by users.

Works derived from the original code must also be free, and the software can be redistributed by the user without additional licensing.

Open source software is not restricted to any specific operating system or hardware technology, although most open source software is currently based on a Linux or Unix operating system.

The open source movement has been evolving for more than 30 years and has demonstrated that it can produce commercially acceptable, high-quality software.

Popular open source software tools include the Linux operating system, the Apache HTTP Web server, the Mozilla Firefox Web browser, and the Apache Open Office desktop productivity suite.

Open source tools are being used on netbooks as inexpensive alternatives to Microsoft Office.

Major hardware and software vendors, including IBM, HP, Dell, Oracle, and SAP, now offer Linux-compatible versions of their products.

Linux

Perhaps the most well-known open source software is Linux, an operating system related to Unix. Linux was created by the Finnish programmer Linus Torvalds and first posted on the Internet in August 1991.

Linux applications are embedded in cell phones, smartphones, netbooks, and consumer electronics. Linux is available in free versions downloadable from the Internet or in low- cost commercial versions that include tools and support from vendors such as Red Hat.

Although Linux is not used in many desktop systems, it is a major force in local area networks, Web servers, and high-performance computing work. IBM, HP, Intel, Dell, and Oracle have made Linux a central part of their offerings to corporations.

The rise of open source software, particularly Linux and the applications it supports, has profound implications for corporate software platforms: cost reduction, reliability and resilience, and integration, because Linux works on all the major hardware platforms from mainframes to servers to clients.

Software for The Web: JAVA, HTML, AND HTML5

Java is an operating system-independent, processor-independent, object-oriented programming language that has become the leading interactive environment for the Web. Java was created by James Gosling and the Green Team at Sun Microsystems in 1992.

The Java platform has migrated into cell phones, smartphones, automobiles, music players, game machines, and finally, into set-top cable television systems serving interactive content and pay-per-view services. Java software is designed to run on any computer or computing device, regardless of the specific microprocessor or operating system the device uses.

Oracle Corporation estimates that 3 billion devices are running Java, and it is the most popular development platform for mobile devices running the Android operating system.

For each of the computing environments in which java is used, Sun created a Java Virtual Machine that interprets Java programming code for that machine.

In this manner, the code is written once and can be used on any machine for which there exists a Java Virtual Machine.

Java developers can create small applet programs that can be embedded in Web pages and downloaded to run on a Web browser.

A Web browser is an easy-to-use software tool with a graphical user interface for displaying Web pages and for accessing the Web and other Internet resources.

Microsoft's Internet Explorer, Mozilla Firefox, and Google Chrome browser are examples. At the enterprise level, Java is being used for more complex e-commerce and e-business applications that require communication with an organization's back-end transaction processing systems.

HTML and HTML5

HTML (Hypertext Markup Language) is a page description language for specifying how text, graphics, video, and sound are placed on a Web page and for creating dynamic links to other Web pages and objects.

Using these links, a user need only point at a highlighted keyword or graphic, click on it, and immediately be transported to another document.
HTML was originally designed to create, and link static documents composed largely of text. Today, however, the Web is much more social and interactive, and many Web pages have multimedia elements.

Third-party plug-in applications like Flash, Silverlight, and Java have been required to integrate these rich media with Web pages.

However, these add-ons require additional programming and put strains on computer processing. This is one reason Apple dropped support for Flash on its mobile devices.

The next evolution of HTML, called **HTML5**, solves this problem by making it possible to embed images, audio, video, and other elements directly into a document without processor-intensive add-ons.

HTML5 will also make it easier for Web pages to function across different display devices, including mobile devices as well as desktops, and it will support the storage of data offline for apps that run over the Web. Web pages will execute more quickly and look like smartphone apps.

Although HTML5 is still under development, elements are already being used in several Internet tools, including Apple's Safari browsers, Google Chrome, and recent versions of the Firefox Web browser.

Google's Gmail and Google Reader have adopted parts of the HTML5 standard as well. Web sites listed as 'iPad ready" are making extensive use of HTML5 including CNN, The New York Times, and CBS.

Web Services and Service-Oriented Architecture

Web services refer to a set of loosely coupled software components that exchange information with each other using universal Web communication standards and languages.

They can exchange information between two different systems regardless of the operating systems or programming languages on which the systems are based.

They can be used to build open standard Web-based applications linking systems of two different organizations, and they create applications that link disparate systems within a single company.

Web services are not tied to any operating system or programming language, and different applications can use them to communicate with each other in standard way without time-consuming custom coding.

The foundation technology for Web services is **XML**, which stands for **Extensible Markup Language**.

This language was developed in 1996 by the World Wide Web Consortium (W3C, the international body that oversees the development of the Web) as a more powerful and flexible markup language than hypertext markup language (HTML) for Web pages.

Whereas HTML is limited to describing how data should be presented in the form of Web pages, XML can perform presentation, communication, and storage of data.

In XML, a number is not simply a number; the XML tag specifies whether the number represents a price, a date, or a ZIP code.

By tagging selected elements of the content of documents for their meanings, XML makes it possible for computers to manipulate and interpret their data automatically and perform operations on the data without human intervention.

Web browsers and computer programs, such as order processing or enterprise resource planning (ERP) software, can follow programmed rules for applying and displaying the data.

XML provides a standard format for data exchange, enabling Web services to pass data from one process to another.

Web services communicate through XML messages over standard Web protocols. Companies discover and locate Web services through a directory much as they would locate services in the Yellow Pages of a telephone book.

Using Web protocols, a software application can connect freely to other applications without custom programming for each different application with which it wants to communicate. Everyone shares the same standards.

The collection of Web services that are used to build a firm's software systems constitutes what is known as a service-oriented architecture.

A **service- oriented architecture (SOA)** is set of self-contained services that communicate with each other to create a working software application. Business tasks are accomplished by executing a series of these services.

Software developers reuse these services in other combinations to assemble other applications as needed.

Virtually all major software vendors provide tools and entire platforms for building and integrating software applications using Web services. IBM includes Web service tools in its WebSphere e-business software platform, and Microsoft has incorporated Web services tools in its Microsoft .NET platform.

Software Outsourcing and Cloud Services

Today, many business firms continue to operate legacy systems that continue to meet a business need and that would be extremely costly to replace.

But they will purchase or rent most of their new software applications from external sources.

There are three external sources for software: software packages from a commercial software vendor, outsourcing custom application development to an external vendor, (which may or may not be offshore) and cloud-based software services and tools.

Software Packages and Enterprise Software

A software package is a prewritten commercially available set of software programs that eliminates the need for a firm to write its own software programs for certain functions, such as payroll processing or order handling.

Enterprise application software vendors such as SAP and Oracle-PeopleSoft have developed powerful software packages that can support the primary business processes of a firm worldwide from warehousing, customer relationship management, and supply chain management, to finance and human resources.

These large-scale enterprise software systems provide a single, integrated, worldwide software system for firms at a cost much less than they would pay if they developed it themselves.

Software Outsourcing

Software outsourcing enables a firm to contract custom software development or maintenance of existing legacy programs to outside firms, which often operate offshore in low-wage areas of the world.

The largest outsourcing expenditures are to domestic U.S firms providing middleware, integration services, and other software support that are often required to operate larger enterprises systems.

Offshore software outsourcing firms have primarily provided lower-level maintenance, data entry, and call center operations, although more sophisticated and experienced offshore firms, particularly in India, have been hired for new-program development.

However, as wages offshore rise and the costs of managing offshore projects are factored in, some work that would have been sent offshore is returning to domestic companies.

Cloud-Based Software Services and Tools

In the past, software such as Microsoft Word or Adobe Illustrator came in a box and was designed to operate on a single machine.

Today, you can download the software from the vendor's Web site, or to use the software as a cloud service delivered over the Internet.

Cloud-based software and the data it uses are hosted on powerful servers in massive data centers and can be accessed with an Internet connection and standard Web browser.

In addition to free or low-cost tools for individuals and small businesses provided by Google or Yahoo, enterprise software and other complex business functions are available as services from the major commercial software vendors.

Instead of buying and installing software programs, subscribing companies rent the same functions from these services, with users paying either on a subscription or per-transaction basis.

Services for delivering and providing access to software remotely as a Web-based service are now referred to as **software as a service (SaaS).**

A leading example is Salesforce.com, which provides on-demand software services for customer relationship management.
To manage their relationship with an outsourcer or technology service provider, firms need a contract that includes a **service level agreement (SLA).**

The SLA is a formal contract between customers and their service providers that defines the specific responsibilities of the service provider and the level of service expected by the customer.

SLAs typically specify the nature and level of services provided, criteria for performance measurement, support options, provisions for security and disaster recovery, hardware and software ownership and upgrades, customer support, billing, and conditions for terminating the agreement.

Mashups and Apps
The software you use for both personal and business tasks may consist of large self-contained programs, or it may be composed of interchangeable components that integrate freely with other applications on the Internet.

Individual users and entire companies mix and match these software components to create their own customized applications and to share information with others.

The resulting software applications are called **mashups**. The idea is to take different sources and produce a new work that is ‘greater than” the sum of its parts. You have performed a mashup if you’ve ever personalized your Facebook profile or your blog with a capability to display videos or slide shows.

Web mashups combine the capabilities of two or more online applications to create a kind of hybrid that provides more customer value than the original sources alone.

Apps are small pieces of software that run on the internet, on your computer or on your mobile phone or tablet and are generally delivered over the internet.

Google refers to its online services as apps, including the Google Apps suite of desktop productivity tools. But when we talk about apps today, most of the attention goes to the apps that have been developed for the mobile digital platform.

It is these apps that turn smartphones and other mobile handheld devices into general-purpose computing tools.

Some downloaded apps do not access the Web, but many do, providing faster access to Web content than traditional Web browsers. Now, the most commonly downloaded apps are games, news and weather, maps/navigation, social networking, music, and video/movies.

But there are also serious apps for business users that make it possible to create and edit documents, connect to corporate systems, schedule and participate in meetings, track shipments, and dictate voice messages. There are also a huge number of e-commerce apps for researching and buying goods and services online.

Application Software Packages and Outsourcing

Much of today's software is not developed in-house but is purchased from external sources. Firms can rent the software from a software service provider they can purchase a software package from a commercial vendor, or they can have a custom application developed by an outside outsourcing firm.

Application Software Packages

During the past several decades, many systems have been built on an application software package foundation.

Many applications are common to all business organizations, for example, payroll, accounts receivable, general ledger, or inventory control.

For such universal functions with standard processes that do not change a great deal over time, a generalized system will fulfill the requirements of many organizations.

If a software package can fulfill most of an organization's requirements, the company does not have to write its own software. The company can save time and money by using the prewritten, predesigned, pretested software programs from the package.

Package vendors supply much of the ongoing maintenance and support for the system, including enhancements to keep the system in line with ongoing technical and business developments.

If an organization has unique requirements that the package does not address, many packages include capabilities for customization.

Customization features allow a software package to be modified to meet an organization's unique requirements without destroying the integrity of the packaged software.

If a great deal of customization is required, additional programming and customization work may become so expensive and time-consuming that they negate many of the advantages of software packages.

When a system is developed using an application software package, systems analysis will include a package evaluation effort. The most important evaluation criteria are the functions provided by the package, flexibility, user friendliness, hardware and software resources, database requirements, installation and maintenance efforts, documentation, vendor quality, and cost.

The package evaluation process often is based on a **Request for Proposal (RFP)**, which is a detailed list of questions submitted to packaged-software vendors.

When a software package is selected, the organization no longer has total control over the systems design process. Instead of tailoring the systems design specifications directly to user requirements, the design effort will consist of trying to mold user requirements to conform to the features of the package.

If the organization's requirements conflict with the way the package works, and the package cannot be customized, the organization will have to adapt to the package and change its procedures.

Outsourcing

If a firm does not want to use its internal resources to build or operate information systems, it can outsource the work to an external organization that specializes in providing these services.

Cloud computing and software as a service (SaaS) providers, are one form of outsourcing companies use the software and computer hardware provided by the service as the technical platform for their systems.

In another form of outsourcing, a company could hire an external vendor to design and create the software for its system, but that company would operate the system on its own computers. The outsourcing vendor might be domestic or in another country.

Domestic outsourcing is driven primarily by the fact that outsourcing firms possess skills, resources, and assets that their clients do not have.

2.14 Consumerization of I.T. and BYOD

The popularity, ease of use, and rich array of useful applications for smartphones and tablet computers have created a groundswell of interest in allowing employees to use their personal mobile devices in the workplace, a phenomenon popularly called "b*ring your own device*" (BYOD).

BYOD is one aspect of the **consumerization of IT**, in which new information technology that first emerged in the consumer market spreads into business organizations. Consumerization of IT includes not only mobile personal devices but also business use of software services such as Google and Yahoo search, Gmail, Google Apps, Dropbox and even Facebook and Twitter that originated in the consumer marketplace as well.

Consumerization of IT is forcing businesses, especially large enterprises, to rethink the way they obtain and manage information technology equipment and services.

Historically, at least in large firms, the central IT department was responsible for selecting and managing the information technology and applications used by the firm and its employees.

It furnished employees with desktops or laptops that were able to access corporate systems securely. The I.T. department maintain control over the firm's hardware and software to ensure that the business was being protected and that information systems served the purposes of the firm and its management.

Today, employees and business departments are playing a much larger role in technology selection, in many cases demanding that employees be able to use their own personal computers, smartphones, and tablets to access the corporate network.

It is more difficult for the firm to manage and control these consumer technologies, and make sure they serve the needs of the business.

2.15 Grid Computing

Grid computing involves connecting geographically remote computers into a single network to create a virtual supercomputer by combining the computational power of all computers on the grid. Grid computing was impossible until high-speed Internet connections enabled firms to connect remote machines economically and move enormous quantities of data. Grid computing requires software programs to control and allocate resources on the grid.

The business case for using grid computing involves cost savings, speed of computation, and agility.

2.16 Virtualization

Virtualization is the process of presenting a set of computing resources (such as computing power or data storage) so that they can all be accessed in ways that are not restricted by physical configuration or geographic location.

Virtualization enables a single physical resource (such as a server or a storage device) to appear to the user as multiple logical resources.

For example, a server or mainframe can be configured to run many instances of an operating system so that it acts like many different machines.

Virtualization also enables multiple physical resources (such as storage devices or servers) to appear as a single logical resource, as would be the case with storage area networks or grid computing.

Virtualization makes it possible for a company to handle its computer processing and storage using computing resources housed in remote locations. VMware is the leading virtualization software vendor for Windows and Linux servers.

By providing the ability to host multiple systems on a single physical machine, virtualization helps organizations increase equipment utilization rates, conserving data center space and energy usage.

Most servers run at just 15-20 percent of capacity, and virtualization can boost server utilization rates to 70 percent or higher.

Higher utilization rates translate into fewer computers required to process the same amount of work. Virtualization also facilitates centralization and consolidation of hardware administration.

It is now possible for companies and individuals to perform all their computing work using a virtualized IT infrastructure, as is the case with cloud computing.

High-Performance and Power-Saving Processors

Another way to reduce power requirements and hardware sprawl is to use more efficient and power-saving processors.

Contemporary microprocessors now feature multiple processor cores (which perform the reading and execution of computer instructions) on a single chip.

A **multicore processor** is an integrated circuit to which two or more processor cores have been attached for enhanced performance, reduced power consumption, and more efficient simultaneous processing of multiple tasks.

This technology enables two or more processing engines with reduced power requirements and heat dissipation to perform tasks faster than a resource-hungry chip with a single processing core.

Today there are PCs with dual-core, qua-core, six-core, and eight core processors.

Intel and other chip manufacturers have developed microprocessors that minimize power consumption, which is essential for prolonging battery life in small mobile digital devices.

Highly power-efficient microprocessors, such as ARM, Apple's A4 and A5 processors, and Intel's Atom are in netbooks, digital media players, and smartphones.

The dual-core A5 processor used in the iPhone 4S and the iPad2 has about 1/50 to 1/30 the power consumption of a laptop dual-core processor.

2.17 Autonomic Computing

With large systems encompassing many thousands of networked devices, computer systems have become so complex today that some experts believe they may not be manageable in the future.

One approach to this problem is autonomic computing. **Autonomic computing** is an industry-wide effort to develop systems that can configure themselves, optimize and tune themselves,

heal themselves when broken, and protect themselves from outside intruders and self-destruction.

You can glimpse a few of these capabilities in desktop systems. For instance, virus and firewall protection software can detect viruses on PCs, automatically defeat the viruses, and alert operators.

These programs can be updated automatically as the need arises by connecting to an online virus protection service such as McAfee. IBM and other vendors are starting to build autonomic features into products for large systems.

2.18 Systems for Collaborations and Social Business

With all these systems and information, you might wonder how it is possible to make sense of them. How do people working in firms pull it all together, work towards common goals, and coordinate plans and actions?

Information systems cannot make decisions, hire or fire people, sign contracts, agree on deals, or adjust the price of goods to the marketplace. In addition to the types of systems we have just described, businesses need special systems to support collaboration and teamwork.

What is Collaboration?

Collaboration is working with others to achieve shared and explicit goals. Collaboration focuses on task or mission accomplishment and usually takes place in a business, or other organization, and between businesses.

You collaborate with a colleague in Austria having expertise on a topic about which you know nothing. You collaborate with many colleagues in publishing a company blog.

If you are in a law firm, you collaborate with accountants in an accounting firm in servicing the needs of a client with tax problems.

Collaboration can be short-lived, lasting a few minutes, or longer term, depending on the nature of the task and the relationship among participants. Collaboration can be one-to-one or many-to-many.

Employees may collaborate in informal groups that are not a formal part of the business firm's organizational structure or they may be organized into formal teams. **Teams** have a specific mission that someone in the business assigned to them.

Team members need to collaborate on the accomplishment of specific tasks and collectively achieve the team mission. The team mission might be to "win the game," or "increase online sales by 10 percent." Teams are often short-lived, depending on the problems they tackle, and the length of time needed to find a solution and accomplish the mission.

Collaboration and teamwork are more important today than ever for a variety of reasons.

- **Changing nature of work:** The nature of work has changed from factory manufacturing and pre-computer office work where each stage in the production process occurred independently of one another and was coordinated by supervisors.

  Work was organized into silos. Within a silo, work passed from one machine tool station to another from one desktop to another, until the finished product was completed.

  Today, jobs require much closer coordination and interaction (talking, e-mailing, presenting and persuading) among the parties involved in producing the service or product.

  Even in factories, workers today often work in production groups, or pods.

- ***Growth of professional work***: "Interaction" jobs tend to be professional jobs in the service sector that require close coordination and collaboration.

  Professional jobs require substantial education, and the sharing of information and opinions to get work done.

  Each actor on the job brings specialized expertise to the problem, and all the actors need to take one another into account to accomplish the job.

- ***Changing organization of the firm***: For most of the industrial age, managers organized work in a hierarchical fashion.

  Orders came down the hierarchy, and responses moved back hierarchy. Today, work is organized into groups and teams, and the members are expected to develop their own methods for accomplishing the task.

  Senior managers observe and measure results but are much less likely to issue detailed orders or operating procedures. In part, this is because expertise and decision-making power have been pushed down in organizations.

- ***Changing scope of the firm***: The work of the firm has changed from a single location to multiple locations - offices or factories throughout a region, a nation, or even around the globe. For instance, Henry Ford developed the first mass-production automobile plant at a single Dearborn, Michigan factory.

  In 2012, Ford employed over 166,000 people at around 90 plants and facilities worldwide. With this kind of global presence, the need for close coordination of design, production, marketing, distribution, and service obviously takes on new importance and scale. Large global companies need to have teams working on a global basis.

- ***Emphasis on innovation:*** Although we tend to attribute innovations in business and science to great individuals, these great individuals are most likely working with a team of brilliant colleagues.

  Think of Bill Gates and Steve Jobs (founders of Microsoft and Apple), both of whom are highly regarded innovators, and both of whom built strong collaborative teams to nurture and support innovation in their firms.

  Their initial innovations derived from close collaboration with colleagues and partners. Innovation, in other words, is a group and social process, and most innovations derive from collaboration among individuals in a lab, a business, or government agencies.

  Strong collaborative practices and technologies are believed to increase the rate and quality of innovation.

- ***Changing culture of work and business*****:** Most research on collaboration supports the notion that diverse teams produce better outputs, faster than individuals working on their own.

2.19 Social Business

Many firms today enhance collaboration by embracing **social business -** the use of social networking platforms, including Facebook, Twitter, and internal corporate social tools to engage their employees, customers, and suppliers.

These tools enable workers to set up profiles, form groups, and "follow" each other's status updates. The goal of social business is to deepen interactions with groups inside and outside the firm to expedite and enhance information-sharing, innovation, and decision making.

A key word in social business is “conversations.” Customers, suppliers, employees, managers, and even oversight agencies continually have conversations about firms, often without the knowledge of the firm or its key actors (employees and managers).

Supporters of social business argue that, if firms could tune into these conversations, they would strengthen their bonds with consumers, suppliers, and employees, increasing their emotional involvement in the firm.

All of this requires a great deal of information transparency. People need to share opinions and facts with others quite directly, without intervention from executives or others.

Employees get to know directly what customers and other employees think; suppliers will learn very directly the opinions of supply chain partners; and even managers presumably will learn more directly from their employees how well they are doing. Nearly everyone involved in the creation of value will know much more about everyone else.

If such an environment could be created, it is likely to drive operational efficiencies, spur innovation, and accelerate decisions making.

If product designers can learn directly about how their products are doing in the market in real time, based on consumer feedback, they can speed up the redesign process. If employees can use social connections inside and outside the company to capture new knowledge and insights, they will be able to work more efficiently and solve more business problems.

Business Benefits of Collaboration and Social Business

There is a general belief among both business and academic communities that the more a business firm is “collaborative,’ the more successful it will be, and that collaboration within and among firms is more essential than in the past.

A recent global survey of business and information systems managers found that investments in collaboration technology produced organizational improvements that returned over four times the amount of the investment, with the greatest benefits for sales, marketing, and research and development functions.

Table 9: Applications of Social Business

Social Business Application	Description
Social networks	Connect through Personal and business profiles
Crowdsourcing	Harness collective knowledge to generate new ideas and solutions
Shared workspaces	Coordinate projects and tasks; co-create content

Blogs and wikis	Publish and rapidly access knowledge; discuss opinions and experiences
Social commerce	Share opinions about purchasing or purchase on social platforms
File sharing	Upload, share, and comment on photos, videos, audio, text documents
Social marketing	Use social media to interact with customers; derive customer insights
Communities	Discuss topics in Open forums; share expertise

Table 10: **Business Benefits of Collaboration and Social Business**

BENEFIT	RATIONALE
Productivity	People interacting and working together can capture expert knowledge and solve problems more rapidly than the same number of people working in isolation from one another. There will be fewer errors.
Quality	People working collaboratively can communicate errors, and corrective actions faster than if they work in isolation. Collaborative and social technologies help reduce time delays in design and production.
Innovation	People working collaboratively can come up with more innovative ideas for products, services, and administration than the same number working in isolation from one another. Advantages to diversity and the "wisdom of crowds".
Customer service	People working together using collaboration and social tools can solve customer complaints and issues faster and more effectively than if they were working in isolation from one another.
Financial performance (profitability, sales, and sales growth)	Because of all the above, collaborative firms have superior sales, sales growth, and financial performance.

2.20 Tools for Collaboration and Social Business

A collaborative, team-oriented culture will not produce benefits without information systems in place to enable collaboration and social business.

Hundreds of tools are designed to deal with the fact that, to succeed in our jobs, we must depend on one another - our fellow employees, customers, suppliers, and managers.

Some high-end tools like IBM Lotus Notes are expensive, but powerful enough for global firms.

Others are available online for free (or with premium versions for a modest fee) and are suitable for small businesses. Some of these tools are as follows:

E-mail and Instant Messaging (IM)

E-mail and instant messaging (including text messaging) have been major communication and collaboration tools for interaction jobs.

Their software operates on computers, cell phones, and other wireless handheld devices and includes features for sharing files as well as transmitting messages.

Many instant messaging systems allow users to engage in real-time conversations with multiple participants simultaneously.

In recent years, e-mail use has declined, with messaging and social media becoming preferred channels of communication.

Wikis

Wikis are a type of Web site that makes it easy for users to contribute and edit text content and graphics without any knowledge of Web page development or programming techniques.

The most well-known wiki is Wikipedia, the largest collaboratively edited reference project in the world. It relies on volunteers, makes no money, and accepts no advertising.

Wikis are very useful tools for storing and sharing corporate knowledge and insights. Enterprise software vendor SAP AG has a wiki that acts as a base of information for people outside the company, such as customers and software developers who build programs that interact with SAP software.

In the past, those people asked and sometimes answered questions in an informal way on SAP online forums, but that was an inefficient system, with people asking and answering the same questions over and over.

Virtual Worlds

Virtual worlds, such as Second Life, are online 3-D environments populated by “residents” who have built graphical representations of themselves known as avatars.

Organizations such as IBM and Insead, are using this virtual world to house online meetings, training sessions, and “lounges.”

Real-world people represented by avatars meet, interact, and exchange ideas at these virtual locations using gestures, chat box conversations, and voice communication (which require microphones).

2.21 Collaboration and Social Business Platforms

There are now suites of software products providing multi-function platforms for collaboration and social business among teams of employees who work together from many different locations.

The most widely used are Internet-based audio conferencing and videoconferencing systems, online software services such as Google Apps/Google Sites, cyberlockers, corporate collaboration systems such as Lotus Notes and Microsoft SharePoint, and enterprise social networking tools such as Salesforce Chatter, Microsoft Yammer, Jive, and IBM Connections and SmartCloud for Business.

Google Apps/Google Sites and Cloud Collaboration Services

One of the most widely used "free" online service for collaboration is Google Apps/Google Sites. Google Sites allows users to quickly create online group-editable Web sites.

Google Sites is one part of the larger Google Apps suite of tools. Google sites users can design and populate Web sites in minutes and can, without any advanced technical skills, post a variety of files including calendars, text, spreadsheets, and videos for private, group, or public viewing and editing.

Google Apps work with Google Sites and include the typical desktop productivity office software tools (word processing, spreadsheet, presentation, contact management, messaging, and mail).

Google Drive is an example of a cloud-based **cyberlocker**. Cyberlockers are online file-sharing services that allow users to upload files to secure online storage sites from which the files can be shared with others.

Google Drive offers 5 free gigabytes of online storage, with additional monthly charges for more storage up to 26 terabytes.

This service works on multiple operating systems, browsers, and mobile devices. Users can create and edit some types of documents online, synchronize these files with all their devices, and share them with other people.

Google Docs is built into Google Drive, enabling users to work in real-time on documents, spreadsheets, and presentations and receive notifications when there are comments.

Other cyberlocker services used for collaboration include Dropbox and Microsoft SkyDrive, with both free and paid services, depending on the amount of storage space required.

Users can synchronize their files stored online with their local PCs and many other kinds of devices, with options for making the files private or public and sharing them with designated contacts.
Microsoft SkyDrive offers 7 gigabytes of free online storage for Office documents and other files and works with Microsoft's Web versions of Word, Excel, PowerPoint, and OneNote called Office Web Apps.

Dropbox (offering 2 gigabytes of free storage) itself does not include tools for document creation and editing.

Table 11: Google Apps/Google Sites Collaboration Features

Google Apps/Google Sites Capability	Description
Google Calendar	Private and shared calendars; multiple calendars.
Google Gmail	Google's free online e-mail service, with mobile access capabilities
Google Talk	Instant messaging; text, voice, and voice chat
Google Docs	Online word processing, electronic presentation software, spreadsheets; drawings; online editing, sharing, publishing
Google Sites	Team collaboration sites for sharing of documents, schedules, calendars, searching documents; creation of group wikis
Google Drive	Offers 5 free gigabytes of online storage for 30 types of documents as well as images and HD video; users can create and edit some types of documents online and synchronize these files with all their devices; ability to view, comment, or edit files based on different usage rights and to keep the files private

Microsoft SharePoint
Microsoft SharePoint is a browser-based collaboration and document management platform, combined with a powerful search engine that is installed on corporate servers.

SharePoint has a Web-based interface and close integration with everyday tools such as Microsoft Office desktop software products. SharePoint software makes it possible for employees to share their documents and collaborate on projects using Office documents as the foundation.

SharePoint can be used to host internal Web sites that organize and store information in one central workspace to enable teams to coordinate work activities, collaborate on and publish documents, maintain task lists, implement workflows, and share information via wikis and blogs.

Users can control versions of documents and document security. Because SharePoint stores and organizes information in one place, users can find relevant information quickly and efficiently while working together closely on tasks, projects, and documents. Enterprise search tools help locate people, expertise, and content.

Lotus Notes

Lotus Notes was an early example of groupware, a collaborative software system with capabilities for sharing calendars, collective writing and editing, shared database access, and electronic meetings, with each participant able to see and display information from others and other activities.

Notes software installed on desktop or laptop computers obtains applications stored on an IBM Lotus Domino server. Lotus Notes is now Web-enabled with a scripting and application development environment so that users can build custom applications to suit their unique needs.

Notes software installed on the user's client computer allows the machine to be used as a platform for e-mail, instant messaging (working with Lotus Sametime), Web browsing, and calendar/resource reservation work, as well as for interacting with collaborative applications.

Today, Notes also has capabilities for blogs, microblogs, wikis, RSS aggregators, help desk systems, voice and videoconferencing, and online meetings.

Large firms adopt IBM Lotus Notes because Notes promises high levels of security and reliability, and the ability to retain control over sensitive corporate information.

The software provides a central document repository with full version control for all company documentation which includes written documents, spreadsheets, images, PDF files, and e-mails. Users can find the latest version of a document with a single search.

Two related IBM Lotus products provide more specialized teamwork and social networking tools and can access information from Lotus Notes.

IBM Lotus Quicker helps teams of people share documents and information using team spaces, content libraries, discussion forums, and wikis. IBM Connections supports internal corporate

social networking with capabilities for searchable profiles, communities, blogs, activities, wikis, and forums.

Enterprise Social Networking Tools

The tools we have just described include capabilities for supporting social business, but there are also more specialized social tools for this purpose, such as Salesforce Chatter, Microsoft's Yammer, Jive, and IBM Connections.

Enterprise social networking tools create business value by connecting the members of an organization through profiles, updates, and notifications, like Facebook features, but tailored to internal corporate uses.

IBM recently introduced a set of social business tools running on a cloud platform called SmartCloud for Social Business, featuring user profiles, communities, e-mail, instant messaging, Web meetings, calendars, personal dashboards, and file sharing.
Table 12 provides more detail about these internal social capabilities.

Enterprise Social Networking Software Capabilities

Social software capability	Description
Profiles	Ability to set up member profiles describing who individuals are, educational background, interests. Includes work-related associations and expertise (skills, projects, teams).
Content sharing	Share, store, and manage content including documents, presentations, images, and videos.
Feeds and notifications	Real-time information streams, status updates, and announcements from designated individuals and groups.
Groups and team workspaces	Establish groups to share information, collaborate on documents, and work on projects, with the ability to set up private and public groups and to archive conversations to preserve team knowledge.
Tagging and social bookmarking	Indicate preferences for specific pieces of content, like the Facebook-Like button. Tagging lets people add keywords to identify content they like.
Permissions and privacy	Ability to make sure private information stays within the right circles, as determined by the nature of relationships. In enterprise social networks, there is a need to establish who in the company has permission to see what information.

The social software creates a "virtual water cooler" environment where people can talk about what's going on in an informal way yet have formal documentation to keep track of best practices.

Place (location) also inhibits collaboration in large global or even national and regional firms. Assembling people for a physical meeting is made difficult by the physical dispersion of distributed firms (firms with more than one location), the cost of travel, and the time limitations of managers.

The collaboration and social technologies we have just described are ways of overcoming the limitations of time and space. Using this time/space framework will help you to choose the most appropriate collaboration and teamwork tools for your firm.

Note that some tools are applicable in more than one time/ place scenario. For example, Internet collaboration suites such as Lotus Notes have capabilities for both synchronous (instant messaging, electronic meeting tools) and asynchronous (e-mail, wikis, document editing) interactions.

2.22 Networking and Communication

Running a business or working in an organisation cannot succeed without networks.

You need to communicate rapidly with your customers, suppliers, and employees. Until about 1990, businesses used the postal system or telephone system with voice or fax for communication.

Today, employers and your employees use computers, e-mail and messaging, the Internet, cell phones, and mobile computers connected to wireless networks for this purpose. Networking and the Internet are now nearly synonymous with doing business.

Firms in the past used two fundamentally different types of networks: telephone networks and computer networks. Telephone networks historically handled voice communication, and computer networks handled data traffic.

Telephone networks were built by telephone companies throughout the twentieth century using voice transmission technologies (hardware and software), and these companies almost always operated as regulated monopolies throughout the world.

Computer networks were originally built by computer companies seeking to transmit data between computers in different locations.

Computer networks have expanded to include Internet telephone and video services. Increasingly, all these voice, video, and data communications are based on Internet technology.

Both voice and data communication networks have also become more powerful (faster), more portable (smaller and mobile), and less expensive.

Increasingly, voice and data communication, as well as Internet access, are taking place over broadband wireless platforms, such as cell phones, mobile handheld devices, and PCs in wireless networks.

2.23 Review Questions

1a) Given the increased impact of computer technology to modern business operation organization now processes their transaction data on “real time” or on-line basis.
Required:

i. With reference to a big retail store operating many branches, explain how the technique of on line processing can be achieved.
ii. With reference to a commercial bank with many branches, explain how real time data processing can be applied.

1b) The development of an effective information system can be described as a lifecycle in view of the important stages that have to be considered.

2a. Information technology has pervaded every aspect of human business activity. Discuss its impact in the financial sector of Nigeria

b. Distinguish between a probabilities system and an Adaptive system

MODULE 3

3.00 ELECTRONIC BUSINESS AND CLOUD COMPUTING

3.01 Learning Outcomes

On successful completion of this module, students should be able to:

i. Appraise the applications of internet, intranet and extranet in business operations;

ii Evaluate the operations of electronic business and governance (e-governance);

iii Deconstruct the different types of electronic commerce models;

iv. Analyse dynamism and operations of cloud computing.

3.02 The Internet: New Information Infrastructure for the Digital Organisation

The **Internet** is a global system of interconnected computer networks that use the standard Internet protocol suite (TCP/IP) to link several billion devices worldwide.

It is an international *network of networks* that consists of millions of private, public, academic, business, and government packet switched networks, linked by a broad array of electronic, wireless, and optical networking technologies.

The Internet carries an extensive range of information resources and services, such as the inter-linked hypertext documents and applications of the World Wide Web (WWW), the infrastructure to support email, and peer-to-peer networks for file sharing and telephony.

The internet has become the world's most extensive, public communication system that now rivals the global telephone system in reach and range.

It is also the world's largest implementation of client/server computing and internetworking, linking millions of individual networks all over the world.

This global network of networks began in the early 1970s as a US Department of Defense network to link scientists and university professors around the world.

Most homes and small businesses connect to the internet by subscribing to an Internet Service Provider.

An **Internet service provider (ISP)** is a commercial organization with a permanent connection to the Internet that sells temporary connections to retail subscribers.

Glo1, Hyperia, Swift, Smile, iconnect, MainOne etc are ISPs in Nigeria. EarthLink, NetZero, AT&T, Time Warner are ISPs in U.S.A. Individuals also connect to the Internet through their business firms, universities, or research centers that have designated Internet domains.

There are a variety of services for ISP Internet connections. Connecting via a traditional telephone line and modem, at a speed of 56.6 kilobits per second (Kbps) used to be the most common form of connection worldwide, but it has been largely replaced by broadband connections. Digital subscriber line, cable, and satellite Internet connections provide these broadband services.

Digital subscriber line (DSL) technologies operate over existing telephone lines to carry voice, data, and video at transmission rates ranging from 385 Kbps all the way up to 40 Mbps, depending on usage patterns and distance.

Cable Internet connections provided by cable television vendors use digital cable coaxial lines to deliver high-speed Internet access to homes and businesses. They can provide high-speed access to the Internet of up to 50 Mbps, although most providers offer service ranging from 1 Mbps to 6 Mbps.

In areas where DSL and cable services are unavailable, it is possible to access the Internet via satellite, although some satellite Internet connections have slower upload speeds than other broadband services.

We all use the Internet and many of us cannot do without it. It has become an indispensable personal and business tool. But what exactly is the internet? How does it work, and what does Internet technology has to offer for business?

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The Internet has become the world's most extensive, public communication system that now rivals the global telephone system in reach and range.

3.03 The Internet/Intranet/Extranet

Internet Services

A client computer connecting to the Internet has access to a variety of services. These services include e-mail, chatting and instant messaging and electronic discussion groups, Telnet, File Transfer protocol (FTP) and the Web.

Each internet service is implemented by one or more software programs. All the services may run on a single server computer or different services may be allocated to different machines.

E-mail enables messages to be exchanged from computer to computer with capabilities for routing messages to multiple recipients, forwarding messages and attaching text documents or multimedia files to messages.

Most e-mail today is sent through the internet. The cost of e-mail is far lower than equivalent voice, postal or overnight delivery costs, making the internet a very inexpensive and rapid communication medium.

Most e-mail messages arrive anywhere in the world in a matter of seconds.

Nearly 90% of the World's workplaces have employees communicating interactively using **chat** or instant messaging tools.

Chatting enables two or more people who are simultaneously connected to the internet to hold live, interactive conversations.

Many online retail businesses offer chat services on their Web sites to attract visitors, to encourage repeat purchases and to improve customer service.

Instant messaging is a type of chat service that enables participants to create their own private chat channels.

The internet messaging alerts the user whenever someone on his or her private list is online so that the user can initiate a chat session with other individuals.

Instant messaging systems for consumers include Yahoo messenger, Google Talk and Windows messenger.

Organizations concerned with security use proprietary communications and messaging systems such as **IBM Sametime**.

Newsgroups are worldwide discussion groups posted on internet electronic bulletin boards on which people share information and ideas on a defined topic, such as radiology or rock bands.

Anyone can post messages on these bulletin boards for others to read. Many thousands of groups exist that discuss almost all conceivable topics.

Employee use of e-mail, instant messaging and the internet is supposed to increase worker productivity, but the accompanying Interactive Session on Management shows that this may not always be the case.

Many company managers now believe they need to monitor and even regulate their employees' online activity. But is this ethical?

Although there are some strong business reasons why organizations may need to monitor their employees' e-mail and web activities, what does this mean for employee privacy?

The **World Wide Web** and the Internet function together but are not the same thing. The World Wide Web functions as the part of the Internet accessible to users.

The Internet serves as a vast electronic communications network and the World Wide Web makes navigation on the Internet easier by utilizing hypertext links and graphical user interfaces between different addresses on computers around the world.

Think of the Internet as providing the foundation and structure while the Web uses the Internet to provide communications, information and access to all sorts of digital services.

Characteristics of the Internet

I. *Network Nature*
The Internet is a network, which made up of many other networks

ii. *Extensibility*
It is extremely extensive as it functions globally; it has a very high coverage

iii. *Decentralization*
Functionally, the Internet is decentralized by design as each Internet computer otherwise known, as the host is independent

iv. *Independence*
Users of the Internet decide what Internet service to use and which local service to make available to the worldwide Internet community.

v. *Accessibility*
The Internet is easily accessible through different means such as:

a. On line services e.g., America Online

b. Commercial Internet Service providers (ISP)s

vi. Informative

Interactive documents can also be obtained through the Internet. Therefore, it provides a means for information sharing and retrieval

vii. *Functions*

The Internet provides a variety of functions as it consists of many parts. E.g. the Worldwide Web (www), electronic mail (email), FTP and Usenet.

Some Benefits of the Internet

There is no doubt that Internet technology has several benefits. No organization should be left out of this global village. Internet services provide instantaneous responses and are available 24 hours of the day and throughout the week.

Access to branches or head office of a financial institution can thus be enhanced.

You can use E-mail distribution for public relation activities, and most of your pursuits with World Wide Web (www) may influence the image of your institutions in the business world.

A computer systems analyst observed that you could communicate with anyone, anywhere in the world.

It means that on your computer terminal in Jos, Nigeria, you can communicate with/to someone or persons in other continents and get an instant response (depending on whether or not the recipient is logged on).

It certainly costs less than phoning or sending fax. Internet provides very effective search utilities to locate stored information on millions of computers around the world.

Most institutions have become aware that they must adapt to changing technology or be left behind. Many organizations are now making formal plans to keep track of technology and implement it in their competitive strategies.

There is an overriding change in information technology on whose importance business executives, academicians and technologists all agree. The explosive growth of the Internet and related technologies and applications is revolutionizing the way businesses are operated and people work. There is no doubt that Internet technology has several benefits. No organization should be left out of this global village. Internet services provide communication facilities with anyone anywhere in the world.

It means that on your computer terminal in your locality, you can communicate with anyone in other continents and get an instant response (depending on whether or not the recipient is logged on).

It also certainly costs less than phoning or sending fax. Internet provides very effective search utilities to locate store information on millions of computers around the world.

Dissemination of all kinds of Data and Information

To the profit-making organizations, perhaps one of the major successful services the Internet is providing is the reduction of the cost of international telephone calls, and of course, reduction in the telephone bills at the end of each billing period.

In other words, Internet can save communication costs, since it is cheaper and faster than making an international call or sending fax.

Advertisement of Services and Products to the World

Through the Internet, banks for example, can let people all over the world know of the existence of their services and products at cheaper costs and in seconds.

Proper Market Positioning

The web site also offers visitors to the site the opportunity of being fully informed of the various services of the organization. Majority if not all International organizations in developed nations, offer some form of services on the Internet, no matter how minor.

Organizations wishing to transact business with another one can be displayed on the Internet. Such organizations may include the following:

i. Manufacturers, exporters, importers and distributors.

ii. Stock exchange commission agents.

iii. Freight clearing and forwarding agents.

iv. Other international companies.

Internet Can Enhance Profit-Making and Future Growth

Doing business through the Internet certainly can lead to increase in profitability and future growth and development of such organization.

Internet can enlarge an organization's market without building new offices and has the potential for full-fledged distribution channels of the business. This will save cost.

For instance, respected international industry analyst, Booz Allen and Hamilton calculated that banks would save enormous costs in the long run if they embrace high technology today.

Moreover, electronic banking sites will cost at most, a couple of thousand dollars to build compared to the millions, which will be spent on erecting or leasing buildings. On-line banks need only one presence in the Internet to service the whole world.

This also costs only a small fraction of the traditional overheads of staffing, security expenses and diverse office accessories.

Banking over the Internet, for instance, has proved to be a great asset to customer whose schedules often do not permit visits to banks during normal operating hours.

The business solution provided by the Internet, allows investors make choices that are more informed for their financial futures while the expanded audience provided through the Internet exposure also allows organizations advertise to wide target audience.

Library Resource

With the Internet, Libraries can access programs, retrieve documents, papers, journals, periodicals, books, exchange information and send mails.

With the resources on the Internet, Librarians and information specialists can verify bibliographic information, locate an obscure file or paper or a library user and compile bibliographies in libraries locally or internationally. Librarians can also verify new titles and even place orders from publishing houses.

The Internet, no doubt, is a very important tool at the disposal of Librarians and users of Libraries.

For the following purpose, it is advisable for Librarians and the user of libraries to patronize Internet service. As an expert system, the Internet provides access to experts and specialists in hundreds and thousands of specialized areas of human endeavour.

Libraries can now collect news and facts that can be stored in their computers for reference purposes. Librarians can use the Internet as an effective communication device to communicate with their colleagues and professional bodies.

Libraries can utilize the Internet on-line. Library catalogues are also accessible to readers and users. Electronic journals and newsletters can now be downloaded for the benefit of researchers. There is an added advantage of providing up-to-date journals without having to pay hard currencies to procure them.

Communication

The Internet is mostly used for communication in the form of electronic mail (e-mail) that permits the transmission and receipts of messages.

Each of the millions of e-mail accounts on the Internet has a unique address code, which ensures that messages are sent to the correct location. Arrival at the location can take place in minutes, or hours, after sending depending on their size, complexity and the distance and the route they travel.

On arrival, they are stored in the e-mail account of the recipient until they are accessed, read, saved or disposed of.

Information Gathering

The World Wide Web (WWW) is an excellent source of information. If information transfer was the fundamental idea behind the beginnings of the Internet, the World Wide Web has done much to reduce the mystery of the Internet and transform it into a useable resource.

The web page is the latest search tool on the Internet and has become the most popular way of locating and retrieving information. Information is available on the web on any imaginable topic. The web page can browse through a list of subject headings to get an idea of what is available on the net.

A web is a program that cross-references, links and retrieves data from computers around the world using hypertext.

This allows you to move within documents, from one document to another or to a document held on another computer without having to turn pages or log out and then log into another computer. These moves are seamless and achieved by using a mouse to click on highlighted words or graphics.

Dangers of Internet

There is hardly anything invented by man, no matter its level of perfection that is without some flaws. Because of its free and open nature, some people place pornographic, sexually explicit and demonic materials on Web Sites. Children have been lured away from home through such materials. Other people have contracted funny marriages with people they have met only on the Internet.

E-mail is also being used as a tool for harassment, and bullying. This is more widespread in the developed countries than in Nigeria".

Terrorism on the Internet is an emotive and all-encompassing term, covering everything from economic espionage by governments and crackers, with on-line services to disseminate information by established terrorist groups, which are working to overthrow governments across the globe, to giving schoolchildren on Internet, the rudimentary bomb-making instructions.

In addition, in the developing countries, the problem of erratic power supply, ineffective and inadequate telecommunication systems are obstacles to effective utilization of Internet facilities. These issues must be addressed.

It is currently nearly impossible not to be exposed in some way to the Internet. The fact is that, the Internet is available to us as users of technology, and it will have a substantial impact on the way we do things day by day. WEB has spread like bush fire and now circles the world!

Internet Addressing and Architecture

The Internet is based on the TCP/IP networking protocol suite. Every computer on the Internet is assigned a unique **Internet Protocol (IP) address,** which currently is a 32-bit number represented by four strings of numbers ranging from 0 to 255 separated by periods. For instance, the IP address of www.microsoft.com is 207.46.250.119.

When a user sends a message to another user on the Internet, the message is first decomposed into packets using the TCP protocol. Each packet contains its destination address.

The packets are then sent from the client to the network server and from there on to as many other servers as necessary to arrive at a specific computer with a known address. At the destination address, the packets are reassembled into the original message.

The Domain -Name System

Because it would be incredibly difficult for Internet users to remember strings of 12 numbers, the **Domain Name System (DNS**) converts domain names to IP addresses.

The **domain name** is the English-like name that corresponds to the unique 32-bit numeric IP address for each computer connected to the Internet.

DNS servers maintain a database containing IP addresses mapped to their corresponding domain names. To access a computer on the Internet, users need only specify its domain name.

DNS has a hierarchical structure. At the top of the DNS hierarchy is the root domain.

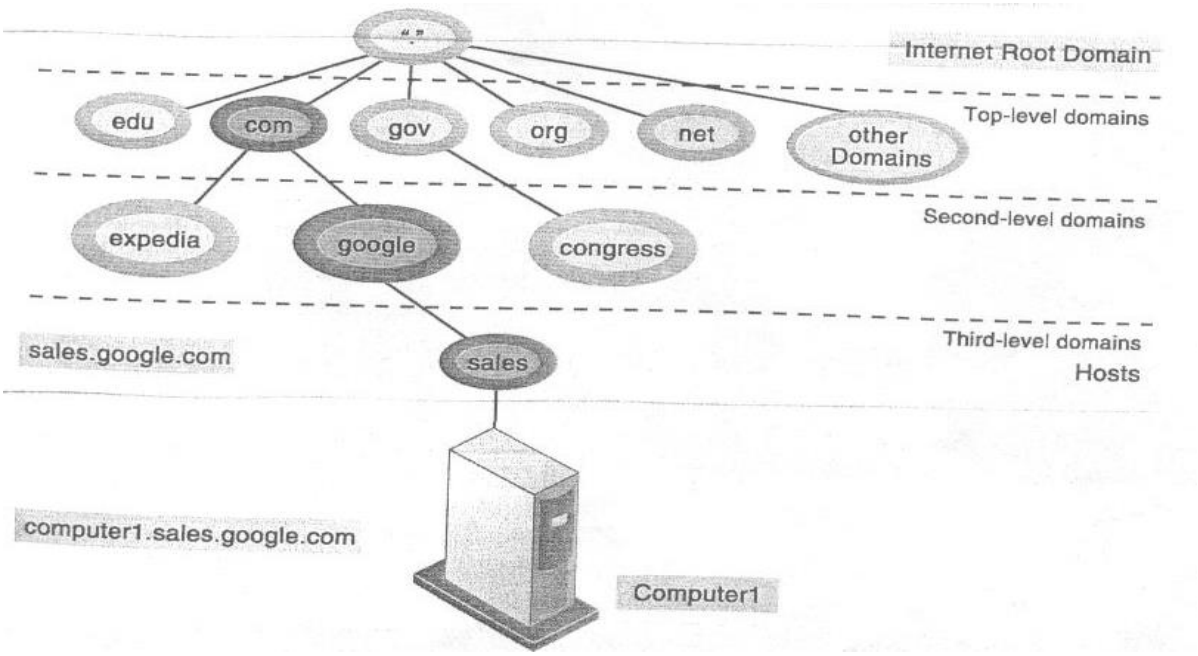
The child domain of the root is called a top-level domain, and the child domain of a top-level domain is called is a second- level domain.

Top-level domains are two- and three-character names you are familiar with from surfing the Web, for example, .com, .edu, .gov, and the various country codes such as *.ca* for Canada or *.it* for Italy or *.ng* for Nigeria.

Second-level domains have two parts, designating a top-level name and a second-level name - such as buy.com, nyu.edu, or amazon.ca.

A host name at the bottom of the hierarchy designates a specific computer on either the Internet or a private network.

figure 3.01: The Domain Name System



Source:

Domain Name System is a hierarchical system with a root domain, top-level domains, second-level domains, and host computers at the third level.

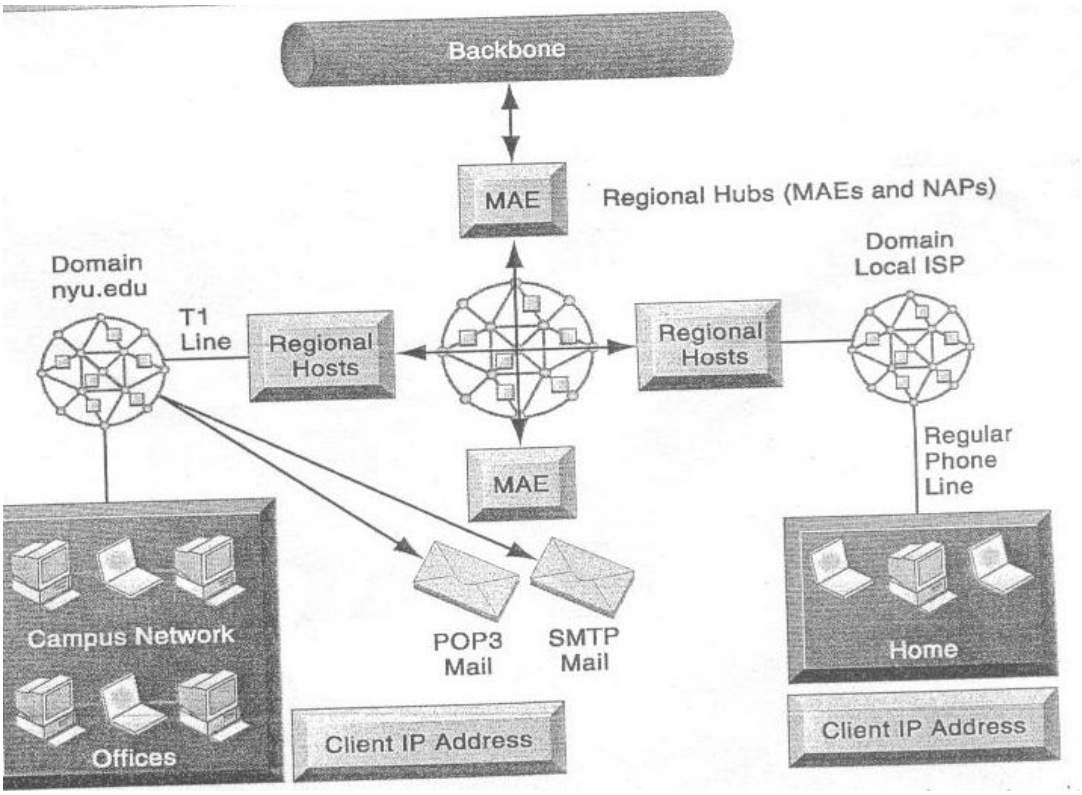
The most common domain extensions currently available and officially approved are shown in the following list. Countries also have domain names such as .uk, .au, and .fr (United Kingdom, Australia, and France, respectively), and there is a new class of "internationalized" top-level domains that use non-English characters

.com	Commercial organizations/businesses
.edu	Educational institutions
.gov	government agencies
.mil	U.S. military
.net	Network computers
.org	Nonprofit organizations and foundations
.biz	Business firms
.info	Information providers

Internet Architecture and Governance

Internet data traffic is carried over transcontinental high-speed backbone networks that generally operate in the range of 45 Mbps to 2.5 Gbps. These trunk lines are typically owned by long-distance telephone companies (called *network service providers*) or by national governments.

FIGURE 3.02: INTERNET NETWORK ARCHITECTURE



The Internet backbone connects to regional networks, which in turn provide access to Internet service providers, large firms, and government institutions.

Network access points (NAPs) and metropolitan area exchanges (MAEs) are hubs where the backbone intersects regional and local networks and where backbone owners connect with one another.

Local connection lines are owned by regional telephone and cable television companies that connect retail users in homes and businesses to the Internet.

The regional networks lease access to ISPs, private companies, and government institutions.

Each organization pays for its own networks and its own local Internet connection services, a part of which is paid to the long-distance trunk line owners.

Individual Internet users pay ISPs for using their service, and they generally pay a flat subscription fee, no matter how much or how little they use the Internet.

A debate is now raging on whether this arrangement should continue or whether heavy Internet users who download large video and music files should pay more for the bandwidth they consume.

No one "owns" the Internet, and it has no formal management. However, worldwide Internet policies are established by several professional organizations and government bodies, including the Internet Architecture Board (IAB), which helps define the overall structure of the Internet; the Internet Corporation for Assigned Names and Numbers (ICANN), which assigns IP addresses; and the World Wide Web Consortium (W3C), which sets Hypertext Markup Language and other programming standards for the Web.

These organizations influence government agencies, network owners, ISPs, and software developers with the goal of keeping the Internet operating as efficiently as possible. The Internet must also conform to the laws of the sovereign nation-states in which it operates, as well as the technical infrastructures that exist within the nation-states.

Although in the early years of the Internet and the Web there was very little legislative or executive interference, this situation is changing as the Internet plays a growing role in the distribution of information and knowledge, including content that some find objectionable.

The Future Internet: IPv6 and Internet2

The Internet was not originally designed to handle the transmission of massive quantities of data and billions of users. Because many corporations and governments have been given large blocks of millions of IP addresses to accommodate current and future workforces, and because of sheer Internet population growth, the world is about to run out of available IP addresses using the old addressing convention.

The old addressing system is being replaced by a new version of the IP addressing schema called **IPv6** (Internet Protocol version 6), which contains 128-bit addresses (2 to the power of 128), or more than a quadrillion possible unique address.

IPv6 is not compatible with the existing Internet addressing system, so the transition to the new standard will take years.

Internet2 is an advanced networking consortium representing over 350 U.S. universities, private businesses, and government agencies working with 66,000 institutions across the United States and international networking partners from more than 50 countries.

To connect these communities, lnternet2 developed a high-capacity 100 Gbps network that serves as a testbed for leading-edge technologies that may eventually migrate to the public

Internet, including telemedicine, distance learning, and other advanced applications not possible with consumer-grade Internet services.

The fourth generation of this network is being rolled out to provide 8.8 terabits of capacity.

The Internet So Far

As a further development, the Internet was also adopted by educational and research institutions. Presently, it is now being used as a means of communication by trade industries, corporations and even in homes.

A great number of countries are now connected for the exchange of news, opinions and data through web servers. Today there are huge millions of Internet users all over the world, while still millions more are itching to be connected

The Intranet

Intra connotes within, while net is a short form for network. Therefore, Intranet refers to a less extensive network system, as it does not involve the outside or external connectivity.

By way of definition, an intranet could be said to be a kind of network that is privately owned and which like the internet, makes use of transmission control protocols (TCP) / internet protocols (IP), HTTP, but for internal use and not for the public.

Just as you can view text and graphics on the World Wide Web, download software or send and receive e-mail, so you can do the same within an organization on an internal network, using the same tools and techniques.

Access of this is controlled by the organization that owned it and is restricted to the employees of that organization.

An Intranet is a private, corporate network based on the same technology as that of the Internet. It can act as a feed for the organization's web site but is also an important way of sharing knowledge among employees.

Information is held on a server and any computer attached to it can access all or some of the information.

These computers may all be on the same geographical site or may be spread across regional, national or international boundaries. Usually they will all be owned by the same organization.

The Intranet could have some of the following content:

- Telephone lists.
- Employees' handbook.

- Induction material.
- Organization's memo.
- Policies and Procedures.
- A suggestion boxes.
- Frequently asked questions by stakeholders.
- Press release and incidents of press reporting and so on.

It also has the following advantage for any organization, be it private or public sector.

The advantages are:

Characteristics of the Intranet

I. Network Nature

The Intranet is just a small network of its own, it does not comprise of very many other networks. Its network is suited specially to meet the organization's needs.

ii. Extensibility

The Intranet is extremely less extensive as compared to the Internet. Its network is usually not connected to the Internet, as its general purpose is to share private (Confidential) information across an organization.

iii. Centralization / Independence

The functional control of the intranet revolves around the management of the organization and each host may not be independent wherever it is. The independence level is often limited.

iv. Accessibility

The intranet is only accessible to members of the private organization. It is restricted to internal use and is not accessible by the public.

v. Informative

It certainly provides a medium for the exchange of ideas, data and information as well, although it is for restricted users.

vi. Functions

The sites within the intranet are usually like the Internet. The intranet provides a wide variety of functions, which in this case, would also be peculiar to the organizations. For example, it provides such services as exchange of electronic mail (email), sending of files (FTP), browse webs (www) pages and connects to any other computer (telnet)

Advantages of the Intranet over the Internet

I. All data can be stored centrally.

ii. Control is aided, and data/information are better secured.

iii. Allows for easier maintenance.

The Extranet

The Extranet is like the intranet in that it provides for the exchange of ideas, data and information with reference to a particular organization, but contrary to the Intranet, it communicates these to external users.

Therefore, an Extranet can be defined as a private network that uses the internet protocols and the public telecommunication system to share the information, data and operations of a business with users outside the business such as vendors, suppliers or customers.

There may be some categories of people outside the organization, for example, suppliers, key customers, partners or groups of associated stakeholders who may be given access to certain part of the Intranet designed specifically for them. This part of the system is referred to as an Extranet.

3.04 E-Business, E-Commerce, and E-Government

Systems and technologies are transforming firms' relationships with customers, employees, suppliers, and logistic partners into digital relationships using networks and the Internet.

So much business is now enabled by or based upon digital networks that the terms "electronic business" and "electronic commerce" are used frequently.

Businesses are becoming E-Business enterprises. The Internet and Internet-like networks: inside the enterprise (intranets) and between an enterprise and its trading partners (extranets) have become the primary information technology infrastructure that supports the business operations of many companies.

E-Business enterprises rely on such technologies to:

a. Re-engineer and revitalize internal business processes;
b. Implement Electronic Commerce (E-Commerce) systems among businesses and their customers and supplies;
c. Promote enterprise collaboration among business teams and workgroups.

Thus, E-Business in this context can be defined as the use of Internet technologies to internet-work and empower business processes, electronic commerce, and enterprise communication

and collaboration within a company, and with its customers, suppliers, and other business stakeholders.

Enterprise collaboration systems involve the use of groupware tools to support communications, co-ordination and collaboration among members of network teams and work groups.

An E-Business enterprise depends on the Internet, Intranets, Extranets and other networks to implement such systems.

For example, employees and external consultants may form a Virtual Team that uses a corporate intranet and extranet for electronic mail, video-conferencing, electronic discussion groups and web pages or work-in-progress information to collaborate on business projects.

Electronic business, or **e-business**, refers to the use of digital technology and the Internet to execute the major business processes in the enterprise. E-business includes activities for the internal management of the firm and for coordination with suppliers and other business partners. It also includes **electronic commerce**, or **e-commerce**.

E-commerce is the part of e-business that deals with the buying and selling of goods and services over the Internet. It also encompasses activities supporting those market transactions, such as advertising, marketing, customer support, security, delivery, and payment.

The technologies associated with e-business have also brought about similar changes in the public sector. Governments on all levels are using Internet technology to deliver information and services to citizens, employees, and businesses with which they work.

The Internet might have remained a text-based realm, the province of academicians and researchers, had it not been for the contributions of Tim Berners-Lee.

He was the computer scientist who came up with the coding system (Hypertext Markup Language - HTML), Linkages, and addressing scheme (URLs) that debuted in 1991 as the graphical and multimedia World Wide Web.

It is hard to overstate the impact of the global system he created, writes Time Technology writer Joshua Quittner. He took a powerful communications system (the Internet) that only the elite could use and turned it into a mass medium.

The arrival of the Web quickly led to e-commerce, or electronic commerce; the buying and selling of products and services through computer networks.

Indeed, online shopping is growing even faster than the increase in computer use, which has been fuelled by the falling price of personal computers.

Electronic commerce is the buying and selling, marketing and servicing of products, services, and information over a variety of computer networks.

An E-business enterprise uses the Internet, Intranets, Extranets, and other networks to support every step of the commercial process.

This might include everything from advertising, sales, and customer support on the World Wide Web, to Internet security and payment mechanisms that ensure completion of delivery and payment processes.

For example, electronic commerce systems include Internet websites for online sales, extranet access of inventory databases by large customers, and the use of corporate Intranets by sales representatives to access customer records for customer relationship management.

Among the best-known e-firms are bookseller Amazon.Com; auction network eBay; and Priceline, which lets you, name the price you are willing to pay for airline tickets and hotel rooms. Probably the foremost example of e-commerce is Amazon.com.

In 1994, seeing the potential for electronic retailing on the World Wide Web, Jeffrey Bezos left a successful career on Wall Street to launch an online bookstore called Amazon.com.

In addition, he appreciated that there would be opportunities to obtain demographic information about customers to offer personalized services.

For example, Amazon.Com could let customers know of books that might be of interest to them. Such personalized attention is difficult for traditional bookstores.

Finally, Bezos saw that there could be a good deal of online interaction; customers could post reviews of books they read and could reach authors by e-mail to provide feedback.

All this was made possible not only by the Web, but by the recording of information on giant databases.

Amazon.Com sold its first book in July 1995 and by early 2000 had 1.1 million customers and a market capitalization of $ 18.3 billion, with Bezos owning about a third of that. The firm also had expanded into the online retailing of Music CDs, Toys, Electronics, Drugs, Cosmetics, Pet Supplies, and other goods and into online auctions.

Old Economy "brick and mortar" companies have since followed Amazon into the online sector. The local government can get out of this syndrome.

Below is a sample of the E-commerce applications of several top-rated companies. Notice the broad range of products and services that these successful companies offer.

This should give you a good idea of how versatile Internet technologies are as an information technology platform on which to base a variety of E-business strategies. Now let us look in more detail on how a company is using the Internet for electronic commerce. Notice the range of products and services they offer to their online customers.

E-Commerce	Site Markets	Types of Products
Amazon.com	Business-to-consumer	Physical goods: books, Electronics, music, videos, toys, home improvement Information content: articles, chats Services: auctions, gift services
Barnes	Business-to-consumer	Physical goods: books, and noble.com software, magazines. Information content: articles, chats Services: Product recommendations, Northern Light search service.
EBay.com	Consumer-to-consumer,	Services: auction specialist
CVS.com	Business-to-consumer	Physical goods: health, beauty, wellness products; greeting cards Services: ordering and shipment of prescription drugs and other products, Kodak photo services
Drugstore.com	Business-to-consumer	Physical goods: health, beauty, wellness products Services: ordering shipment of prescription drugs and other products
Cisco-com	Business-to-consumer	Physical goods: computer Web-based networking products Information content: company-related Services: international product ordering, distribution.
Etrade	Business-to-consumer	Information content: stock quotes, investment information Services: financial services
Fidelity.com	Business-to-consumer	Information content: stock quotes, investment information Services: financial investments.

Like many other companies, American Airlines offers a popular website (www.aa.com) that propelled them into electronic commerce on the Internet.

First, American Airline analyzed the compelling business reasons for a business website.

Would it save money, improve customer service, build customer loyalty, shorten time to market, or transform distribution channels?

Then, they decided to build a website that their customers would find useful, move them into E-commerce, and reduce the company's customer service costs.

American Airlines spends millions of dollars each year to staff their toll-free customer service telephone systems.

A large percentage of calls are not from customers wanting to book flights. Instead, many calls are from people wanting information such as how to get to the airport, how to travel with a pet, or whether they can take their skis along on a flight.

American Airline realized that many of their regular customers have computers at work or at home that were connected to the Internet. They assumed correctly that most of those customers would rather get the information they needed directly from the Web than call in and probably wait in line for answers.

So, American's top-rated website, posts travel-related information, such as airport layouts and logistics, aircraft seating charts, listings of in-flight movies, city ticket office locations, and flight arrival and departure times.

Frequent fliers can also check the status of their accounts. Then in a major move into full E-commerce, American Airline added online booking and electronic ticketing, so their customers can make and pay for flight reservations on the Web.

E-Government refers to the application of the Internet and networking technologies to digitally enable government and public sector agencies' relationships with citizens, businesses, and other arms of government.

In addition to improving delivery of government services, e-government makes government operations more efficient and empowers citizens by giving them easier access to information and the ability to network electronically with other citizens.

For the most part, this means transactions that occur over the Internet and the Web. Commercial transactions involve the exchange of value (e.g., money) across organizational or individual boundaries in return for products and services.

E-commerce began in 1995 when one of the first Internet portals, Netscape. com accepted the first advertisements from major corporations and popularized the idea that the Web could be used as a new medium for advertising and sales.

No one envisioned at the time what would turn out to be an exponential growth curve for e-commerce retail sales, which doubled and tripled in the early years.

E-commerce grew at double-digit rates until the recession of 2008-2009 when growth slowed to a crawl. In 2009, e-commerce revenues were flat not bad considering that traditional retail sales were shrinking by 5 percent annually.

In the U.S.A, e-commerce during the recession was the only stable segment in retail. Some online retailers forged ahead at a record pace: Amazon's 2009 revenues were up 25 percent over 2008 sales.

Despite the continuing slow growth in 2012, the number of online buyers increased by 5 percent to 150 million, and the number of online retail transactions was up 7 percent. Amazon's sales grew to $48 billion in 2011, up an incredible 41 percent from 2010.

Mirroring the history of many technological innovations, such as the telephone, radio, and television, the very rapid growth in e-commerce in the early years created a market bubble in e-commerce stocks. Like all bubbles, the "dot-com" bubble burst (in March 2001).

Many e-commerce companies failed during this process. Yet for many others, such as Amazon, eBay, Expedia, and Google, the results have been more positive: soaring revenues, fine-tuned business models that produce profits, and rising stock prices. By 2006, e-commerce revenues returned to solid growth, and have continued to be the fastest growing form of retail trade in the United States, Europe, and Asia.

- Online consumer sales grew to an estimated $362 billion in 2012, an increase of more than 15 percent over 2010 (including travel services and digital downloads), with 150 million people purchasing online and an additional 34 million shopping and gathering information but not purchasing.

- The number of individuals of all ages online in the world expanded to over 400 million in 2012, up from 447 million in 2004. In the world, over 2.3 billion people are now connected to the Internet. Growth in the overall Internet population has spurred growth in e-commerce.

- B2B e-commerce-use of the Internet for business-to-business commerce and collaboration among business partners expanded to more than $4.1 trillion.

The e-commerce revolution is still unfolding. Individuals and businesses will increasingly use the Internet to conduct commerce as more products and services come online and households switch to broadband telecommunications.

More industries will be transformed by e-commerce, including travel reservations, music and entertainment, news, software, education, and finance. Table 15 highlights these new e-commerce developments.

Table 15 THE GROWTH OF E-COMMERCE

BUSINESS TRANSFORMATION
• E-commerce remains the fastest growing form of commerce when compared to physical retail stores, services, and entertainment.
• Social, mobile, and local commerce have become the fastest growing forms of e-commerce.
• The first wave of e-commerce transformed the business world of books, music, and air travel. In the second wave, nine new industries are facing a similar transformation scenario: marketing and advertising, telecommunications, movies, television, jewelry and luxury goods, real estate, online travel bill payments, and software.
• The breadth of e-commerce offerings grows, especially in the services economy of social networking, travel, information clearinghouses, entertainment, retail apparel, appliances, and home furnishings.
• The online demographics of shoppers broaden to match that of ordinary shoppers.
• Pure e-commerce business models are refined further to achieve higher levels of profitability, whereas traditional retail brands, such as Sears, JCPenney, L.L. Bean, and Walmart, use e-commerce to retain their dominant retail positions.
• Small businesses and entrepreneurs continue to flood the e-commerce marketplace, often riding on the infrastructures created by industry giants, such as Amazon, Apple, and Google, and increasingly taking advantage of cloud-based computing resources.
• Mobile e-commerce begins to take off in the United States with location-based services and entertainment downloads including e-books, movies, and television shows.
TECHNOLOGY FOUNDATIONS
• Wireless Internet connections (Wi-Fi, WiMax, and 3G/4G smartphones) grow rapidly.
• Powerful smartphones, tablet computers, and mobile devices support music, Web surfing, and entertainment as well as voice communication. Podcasting and streaming take off as mediums for distribution of video, radio, and user-generated content.
• The Internet broadband foundation becomes stronger in households and businesses as transmission prices fall.
• Social networking software and sites such as Facebook, MySpace, Twitter, LinkedIn, and thousands of others become a major new platform for e-commerce, marketing, and advertising.
• New Internet-based models of computing, such as smartphone apps, cloud computing, software as a service (SaaS), and Web 2.0 software greatly reduce the cost of e-commerce Web sites.
NEW BUSINESS MODELS EMERGE
• More than half the Internet user population has joined an online social network,

contribute to social bookmarking sites, create blogs, and share photos. Together these sites create a massive online audience as large as television that is attractive to marketers.

- The traditional advertising industry is disrupted as online advertising grows twice as fast as TV and print advertising; Google, Yahoo, and Facebook display nearly 1 trillion advertisements a year.
- Newspapers and other traditional media adopt online, interactive models but are losing advertising revenues to the online players despite gaining online readers.

- Online entertainment business models offering television, movies, music, sports, and e-books surge, with cooperation among the major copyright owners in Hollywood and New York and with Internet distributors like Apple, Amazon, Google, YouTube, and Facebook.

3.05 Characteristics of E-Commerce

Why has e-commerce grown so rapidly? The answer lies in the unique nature of the Internet and the Web. The Internet and e-commerce technologies are much more rich and powerful than previous technology revolutions like radio, television, and the telephone.

The unique features of the Internet and Web as a commercial medium are the reason for the success of E-Commerce as follows:

Ubiquity

In traditional commerce, a marketplace is a physical place, such as a retail that you visit to transact business. E-commerce is ubiquitous, meaning that it is available just about everywhere, always.

It makes it possible to shop from your desktop, at home, at work, or even from your car using smart phones. The result is called a marketplace - a marketplace extended beyond traditional boundaries and removed from a temporal and geographic location.

From a consumer point of view, ubiquity reduces transaction costs - the costs of participating in a market. To transact business, it is no longer necessary that you spend time or money traveling to a market, and much less mental effort is required to make a purchase.

Global Reach

E-commerce technology permits commercial transactions to cross cultural and national boundaries far more conveniently and cost effectively than is true in traditional commerce. As a result, the potential market size for e-commerce merchants is roughly equal to the size of the world's online population (estimated to be more than 2 billion).

In contrast, most traditional commerce is local or regional - it involves local merchants or national merchants with local outlets. Television, radio stations and newspapers, for instance, are primarily local and regional institutions with limited, but powerful, national networks that can attract a national audience but not easily cross-national boundaries to a global audience.

CHARACTERISTICS OF E-COMMERCE TECHNOLOGY

E-commerce Technology dimension	Business significance
Ubiquity: Internet/Web technology is available everywhere at work, at home, and elsewhere via desktop and mobile devices Mobile devices extend service to local areas and merchants;	The marketplace is extended beyond traditional boundaries and is removed from a temporal and geographic location. "Marketspace" anytime, is created; shopping can take place anywhere. Customer convenience is enhanced, and shopping costs are reduced.
Global reach: The Technology reaches across national boundaries, around the earth.	Commerce is enabled across cultural and national boundaries seamlessly and without modification. The marketspace includes, potentially, billions of consumers and millions of businesses worldwide.
Universal Standards: There is one set of technology standards, namely Internet standards.	With one set of technical standards across the globe; disparate computer systems can easily communicate with each other.
Richness: Video, audio, and text messages are possible.	Video, audio, and text marketing messages are integrated into a single marketing message and consumer experience.
Interactivity: The technology works through interaction with the user.	Consumers are engaged in a dialog that dynamically adjusts the experience to the individual and makes the consumer a co-participant in the process of delivering goods to the market.
Information Density: The technology reduces information costs and raises quality.	Information processing, storage, and communication costs drop dramatically, whereas currency, accuracy, and timeliness improve greatly. Information becomes plentiful, cheap, and more accurate.
Personalization/Customization: The technology allows personalized messages to be delivered to individuals as well as groups.	Personalization of marketing messages and customization of products and services are based on Individual characteristics.
Social Technology: The technology supports content generation and social networking.	New Internet social and business models enable user content creation and distribution and support social networks.

One strikingly unusual feature of e-commerce technologies is that the technical standards of the Internet and, therefore, the technical standards for conducting e-commerce are universal standards.

They are shared by all nations around the world and enable any computer to link with any other Computer regardless of the technology platform each is using. In contrast, most traditional commerce technologies differ from one nation to the next.

For instance, television and radio standards differ around the world, as does Cell telephone technology.

The universal technical standards of the Internet and e-commerce greatly lower **market entry costs** - the cost merchants must pay simply to bring their goods to market. At the same time, for consumers, universal standards reduce search costs - the effort required to find suitable products.

Richness

Information **richness** refers to the complexity and content of a message. Traditional markets, national sales forces, and small retail stores have great richness: They can provide personal, face-to-face service using aural and visual cues when making a sale.

The richness of traditional markets makes them powerful selling or commercial environments.

Prior to the development of the Web, there was a trade-off between richness and reach: The larger the audience reached the less rich the message.

The Web makes it possible to deliver rich messages with text, audio, and video simultaneously to large numbers of people.

Interactivity

Unlike any of the commercial technologies of the twentieth century, except for the telephone, e-commerce technologies are interactive, meaning they allow for two-way communication between merchant and consumer.

Television, for instance, cannot ask viewers any questions or enter into conversations with them, and it cannot request that customer information be entered into a form.

In contrast, all these activities are possible on an e-commerce Web site. Interactivity allows an online merchant to engage a consumer in ways similar to a face-to-face experience but on a massive, global scale.

Information Density

The Internet and the Web vastly increase information density - the total amount and quality of information available to all market participants, consumers, and merchants alike.

E-commerce technologies reduce information collection, storage, processing, and communication costs while greatly increasing the currency, accuracy, and timeliness of information.

Information density in e-commerce markets make prices and costs more transparent. **Price transparency** refers to the ease with which consumers can find out the variety of prices in a market; **cost transparency** refers to the ability of consumers to discover the actual costs merchants pay for products.

There are advantages for merchants as well. Online merchants can discover much more about consumers than in the past.

This allows merchants to segment the market into groups that are willing to pay different prices and permits the merchants to engage in **price discrimination** - selling the same goods, or nearly the same goods, to different targeted groups at different prices.

For instance, an online merchant can discover a consumer's avid interest in expensive, exotic vacations and then pitch high-end vacation plans to that consumer at a premium price, knowing this person is willing to pay extra for such a vacation.

At the same time, the online merchant can pitch the same vacation plan at a lower price to a more price-sensitive consumer. Information density also helps merchants differentiate their products in terms of cost, brand, and quality.

Personalization/Customization

E-commerce technologies permit personalization: Merchants can target their marketing messages to specific individuals by adjusting the message to a person's clickstream behavior, name, interests, and past purchases.

The technology also permits **customization** - changing the delivered product or service based on a user's preferences or prior behavior.

Given the interactive nature of e-commerce technology, much information about the consumer can be gathered in the marketplace now of purchase.

With the increase in information density, a great deal of information about the consumer's past purchases and behavior can be stored and used by online merchants.

The result is a level of personalization and customization unthinkable with traditional commerce technologies. For instance, you may be able to shape what you see on television by selecting a channel, but you cannot change the content of the channel you have chosen.

Social Technology: User Content Generation and Social Networking
In contrast to previous technologies, the Internet and e-commerce technologies have evolved to be much more social by allowing users to create and share with their personal friends (and a larger worldwide community) content in the form of text, videos, music, or photos.

Using these forms of communication, users can create new social networks and strengthen existing ones.

All previous mass media in modern history, including the printing press, use a broadcast model (one-to-many) where content is created in a central location by experts (professional writers, editors, directors, and producers) and audiences are concentrated in huge numbers to consume a standardized product.

The new Internet and e-commerce empower users to create and distribute content on a large scale, and permit users to program their own content consumption. The Internet provides a unique many-to-many model of mass communications.

E-Government
Electronic Government is the operation of Government activities and processes, using information technology tools.

Today, in developed countries, every aspect of government activity is computerized. From records of childbirth, to death of citizens, to movement of citizens, to Taxation (called E-Taxation), to car registration, Healthcare, Customs, Immigration, Land administration and every process of government activities and administration are being computerized; this is called

Smart Government.
It is taking advantage of the benefits of information technology.

Key Concepts in E-Commerce: Digital Markets and Digital Goods in a Global Marketplace The location, timing, and revenue models of business are based in some part on the cost and distribution of information.

The Internet has created a digital marketplace where millions of people all over the world are able to exchange massive amounts of information directly, instantly, and for free.

As a result, the Internet has changed the way companies conduct business and increased their global reach.

The Internet reduces information asymmetry. An **information asymmetry** exists when one party in a transaction has more information that is important for the transaction than the other party.

That information helps determine their relative bargaining power. In digital markets, consumers and suppliers can "see" the prices being charged for goods, and in that sense digital markets are said to be more "transparent" than traditional markets.
For example, before auto retailing sites appeared on the Web, there was a significant information asymmetry between auto dealers and customers.

Only the auto dealers knew the manufacturers' prices, and it was difficult for consumers to shop around for the best price.

Auto dealers' profit margins depended on this asymmetry of information. Today's consumers have access to a legion of Web sites providing competitive pricing information.

Thus, the Web has reduced the information asymmetry surrounding an auto purchase. The Internet has also helped businesses seeking to purchase from other businesses reduce information asymmetries and locate better prices and terms.

Digital markets are very flexible and efficient because they operate with reduced search and transaction costs, lower **menu costs** (merchants' costs of changing prices), greater price discrimination, and the ability to change prices dynamically based on market conditions.

In **dynamic pricing**, the price of a product varies depending on the demand characteristics of the customer or the supply situation of the seller.

For instance, online retailers from Amazon to Walmart change prices on many products based on time of day, demand for the product, and user's prior visits to their sites.
These new digital markets may either reduce or increase switching costs, depending on the nature of the product or service being sold, and they may cause some extra delay in gratification.

Unlike a physical market, you can't immediately consume a product such as clothing purchased over the Web (although immediate consumption is possible with digital music downloads and other digital products.)

Digital markets provide many opportunities to sell directly to the consumer; bypassing intermediaries, such as distributors or retail outlets.

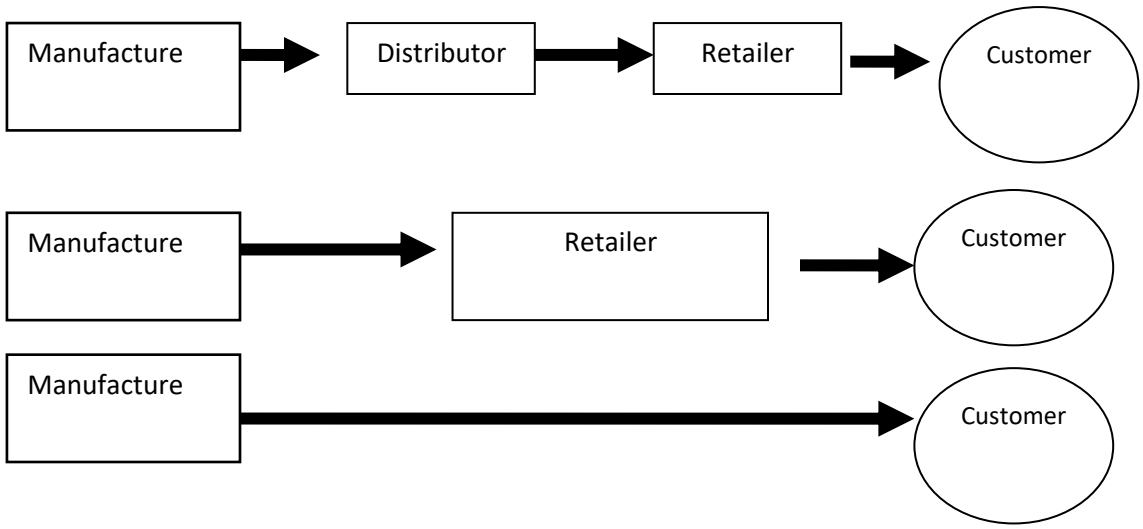
Eliminating intermediaries in the distribution channel can significantly lower purchase transaction costs. 'To pay for all the steps in a traditional distribution channel, a product may have to be priced as high as 135 percent of its original cost to manufacture.

How much savings does this result into, from eliminating each of these layers in the distribution process.

By selling directly to consumers or reducing the number of intermediaries, companies can raise profits while charging lower prices.
The removal of organizations or business process layers responsible for intermediary steps in a value chain is called **disintermediation.**

Disintermediation is affecting the market for services. Airlines and hotels operating their own reservation sites online earn more per ticket because they have eliminated travel agents as intermediaries. summarizes the differences between digital markets and traditional markets.

Figure 3.03: THE BENEFITS OF DISINTERMEDIATION TO THE CONSUMER



The typical distribution channel has several intermediary layers, each of which adds to the final cost of a product. Removing layers lowers the final cost to the consumer.

Digital Markets Compared to Traditional Markets

	Digital markets	Traditional markets
Information asymmetry	Asymmetry reduced	Asymmetry high

Search costs	Low	High
Transaction costs	Low (sometimes virtually nothing)	High (time, travel)
Delayed gratification	High (or lower in the case of a digital good)	Lower: purchase now
Menu costs	Low	High
Dynamic pricing	Low cost, instant	High cost, delayed
Price discrimination	Low cost, instant	High cost, delayed
Market segmentation	Low cost, moderate precision	High cost, less precision
Switching costs	Higher/lower (depending on product characteristics)	High
Network effects	Strong	Weaker
Disintermediation	More possible/likely	Less possible/unlikely

3.06 Digital Goods

The Internet digital marketplace has greatly expanded sales of digital goods. **Digital goods** are goods that can be delivered over a digital network.

Music tracks, video, movies, software, newspapers, magazines, and books can all be expressed, stored, delivered, and sold as purely digital products.

Today, all these products are delivered as digital streams or download, while their physical counterparts decline in sales.

In general, for digital goods, the marginal cost of producing another unit is about zero (it costs nothing to make a copy of a music file).

However, the cost of the original first unit is relatively high—in fact, it is nearly the total cost of the product because there are few other costs of inventory and distribution.

Costs of delivery over the Internet are very low, marketing costs often remain the same, and pricing can be highly variable. (On the Internet, the merchant can change prices as often as desired because of low menu costs.)
The impact of the Internet on the market for these kinds of digital goods is nothing short of revolutionary, and we see the results around us every day.

Businesses dependent on physical products for sales - such as bookstores, music stores, book publishers, music labels, and film studios - face the possibility of declining sales and even destruction of their businesses.

Newspapers and magazines subscriptions to hard copies are declining, while online readership and subscriptions are expanding.

E-commerce: Business and Technology

E-Commerce is a fascinating combination of business models and new information technologies. Let's start with a basic understanding of the types of e-commerce, and then describe e-commerce business and revenue models.

Table 19: HOW THE INTERNET CHANGES THE MARKETS FOR DIGITAL GOODS

	Digital goods	**Traditional Goods**
Marginal cost/unit	Zero	Greater than zero, high
Cost of production	High (most of the cost)	Variable
Copying cost	Approximately zero	Greater than zero, high
Distributed delivery cost	Low	High
Inventory cost	Low	High
Marketing cost	Variable	Variable
Pricing	More variable (bundling, random pricing games)	Fixed, based on unit costs

3.07 Types of E-Commerce Platforms

There are many ways to classify electronic commerce transactions - one is by looking at the nature of the participants.

The major electronic commerce categories are discussed below.

1. B2B e-commerce

B2B (Business to Business) e-commerce is simply defined as e-commerce between companies. This is the type of e-commerce that deals with relationships between and among businesses.

About 80% of e-commerce is of this type, and most experts predict that B2B e-commerce will continue to grow faster than the B2C segment. The B2B market has two primary components: e-frastructure and e-markets. E-frastructure is the architecture of B2B, primarily consisting of the following:

- logistics - transportation, warehousing and distribution (e.g., Procter and Gamble);
- application service providers - deployment, hosting and management of packaged software from a central facility (e.g., Oracle and Linkshare);

- outsourcing of functions in the process of e-commerce, such as Web-hosting, security and customer care solutions (e.g., outsourcing providers such as eShare, NetSales, iXL Enterprises and Universal Access);

- auction solutions software for the operation and maintenance of real-time auctions in the Internet (e.g., Moai Technologies and OpenSite Technologies);

- content management software for the facilitation of Web site content management and delivery (e.g., Interwoven and ProcureNet); and

- Web-based commerce enablers (e.g., Commerce One, browser-based, XML-enabled purchasing automation software).

E-markets are simply defined as Web sites where buyers and sellers interact with each other and conduct transactions.

The more common B2B examples and best practice models are IBM, Hewlett Packard (HP), Cisco and Dell. Cisco, for instance, receives over 90% of its product orders over the Internet.

Most B2B applications are in the areas of supplier management (especially purchase order processing), inventory management (i.e., managing order-ship-bill cycles), distribution management (especially in the transmission of shipping documents), channel management (i.e., information dissemination on changes in operational conditions), and payment management (e.g., electronic payment systems or EPS).

eMarketer projects an increase in the share of B2B e-commerce in total global e-commerce from 79.2% in 2000 to 87% in 2004 and a consequent decrease in the share of B2C e-commerce from 20.8% in 2000 to only 13% in 2004

2. B2C e-commerce

Business-to-consumer e-commerce, or commerce between companies and consumers, involves customers gathering information; purchasing physical goods (i.e., tangibles such as books or consumer products) or information goods (or goods of electronic material or digitized content, such as software, or e-books); and, for information goods, receiving products over an electronic network.

It is the second largest and the earliest form of e-commerce. Its origins can be traced to online retailing (or e-tailing).

Thus, the more common B2C business models are the online retailing companies such as Amazon.com, Drugstore.com, Beyond.com, Barnes and Noble and ToysRus. Other B2C examples involving information goods are E-Trade and Travelocity.

The more common applications of this type of e-commerce are in the areas of purchasing products and information, and personal finance management, which pertains to the management of personal investments and finances with the use of online banking tools (e.g., Quicken).

B2C e-commerce reduces transactions costs (particularly search costs) by increasing consumer access to information and allowing consumers to find the most competitive price for a product or service.

B2C e-commerce also reduces market entry barriers since the cost of putting up and maintaining a Web site is much cheaper than installing a "brick-and-mortar" structure for a firm.

In the case of information goods, B2C e-commerce is even more attractive because it saves firms from factoring in the additional cost of a physical distribution network.

Moreover, for countries with a growing and robust Internet population, delivering information goods becomes increasingly feasible.

3. B2G e-commerce

Business-to-government e-commerce or B2G is generally defined as commerce between companies and the public sector.

It refers to the use of the Internet for public procurement, licensing procedures, and other government-related operations. This kind of e-commerce has two features: first, the public sector assumes a pilot/leading role in establishing e-commerce; and second, it is assumed that the public sector has the greatest need for making its procurement system more effective.

Web-based purchasing policies increase the transparency of the procurement process (and reduce the risk of irregularities). To date, however, the size of the B2G e-commerce market as a component of total e-commerce is insignificant, as government e-procurement systems remain undeveloped.

4. C2C e-commerce

Consumer-to-consumer e-commerce or C2C is simply commerce between private individuals or consumers.

This type of e-commerce is characterized by the growth of electronic marketplaces and online auctions, particularly in vertical industries where firms/businesses can bid for what they want from among multiple suppliers. It perhaps has the greatest potential for developing new markets.

This type of e-commerce comes in at least three forms:

- Auctions facilitated at a portal, such as eBay, which allows online real-time bidding on items being sold in the Web;

- Peer-to-peer systems, such as the Napster model (a protocol for sharing files between users used by chat forums similar to IRC) and other file exchange and later money exchange models; and

- Classified ads at portal sites such as Excite Classifieds and wanted, Pakwheels.com (an interactive, online marketplace where buyers and sellers can negotiate and which features “Buyer Leads & Want Ads”).

Consumer-to-business (C2B) transactions involve reverse auctions, which empower the consumer to drive transactions.

A concrete example of this when competing airlines gives a traveler best travel and ticket offers in response to the traveler’s post that she wants to fly from New York to San Francisco.

There is little information on the relative size of global C2C e-commerce. However, C2C figures of popular C2C sites such as eBay and Napster indicate that this market is quite large. These sites produce millions of dollars in sales every day.

Advantages of C2C sites

Consumer to consumer ecommerce has many benefits. The business model of C2C is very interesting.

The primary benefit which consumers get is reduction in cost as compared to buying space of them adds on other ecommerce sites which seem to be quite expensive.

People interested in selling their items can post their respective items for free or with minimal charge depending on the c2c website.

This leads to formation of a profitable customer base. C2C websites form a perfect platform for buyers and sellers who wish to buy and sell products of similar interest. This leads to increase in visitor to customer conversion ratio.

Another benefit is that business owners can easily afford the low cost of maintaining C2C websites and earn good profits instead of buying or hiring a shop which could cost a lot.

Another major plus point these websites have is that personal items like watch, shoes etc can be purchased and sold with ease which is not in case of other types of ecommerce.

Disadvantages of C2C sites

There are a couple of disadvantages to these types of sites as well. Doing transaction on these types of websites requires co-operation between the buyer and seller. It has been noted many times that these two do not co-operate with each other after a transaction has been made.

They do not share the transaction information which may be via credit or debit card or internet banking. This can result in online fraud since the buyer and seller are not very well versed with each other.

This can lead to lawsuit being imposed on either ends or also on the site if it has not mentioned the disclaimer in its terms and conditions.

This may also hamper the c2c website's reputation. Companies which handle consumer to consumer ecommerce websites seem to have becoming very cautious to prevent online scams.

m-commerce

M-commerce (mobile commerce) is the buying and selling of goods and services through wireless technology-i.e., handheld devices such as cellular telephones and personal digital assistants (PDAs). Japan is seen as a global leader in m-commerce.

As content delivery over wireless devices becomes faster, more secure, and scalable, some believe that m-commerce will surpass wireline e-commerce as the method of choice for digital commerce transactions.

This may well be true for the Asia-Pacific where there are more mobile phone users than there are Internet users.

Industries affected by m-commerce include:

- **Financial services**, including mobile banking (when customers use their handheld devices to access their accounts and pay their bills), as well as brokerage services (in which stock quotes can be displayed and trading conducted from the same handheld device);

- **Telecommunications**, in which service changes, bill payment and account reviews can all be conducted from the same handheld device;

- **Service/retail**, as consumers are given the ability to place and pay for orders on-the-fly; and

- **Information services**, which include the delivery of entertainment, financial news, sports figures and traffic updates to a single mobile device.17

Forrester Research predicts US$3.4 billion sales closed using PDA and cell phones by 2005.

Forces Fueling E-Commerce

There are at least three major forces fueling e-commerce: economic forces, marketing and customer interaction forces, and technology, particularly multimedia convergence.

Economic forces: One of the most evident benefits of e-commerce is economic efficiency resulting from the reduction in communications costs, low-cost technological infrastructure, speedier and more economic electronic transactions with suppliers, lower global information sharing and advertising costs, and cheaper customer service alternatives.

Economic integration is either external or internal. External integration refers to the electronic networking of corporations, suppliers, customers/clients, and independent contractors into one community communicating in a virtual environment (with the Internet as medium).

Internal integration, on the other hand, is the networking of the various departments within a corporation, and of business operations and processes. This allows critical business information to be stored in a digital form that can be retrieved instantly and transmitted electronically.

Internal integration is best exemplified by corporate intranets. Among the companies with efficient corporate intranets are Procter and Gamble, IBM, Nestle and Intel.

Market forces Corporations are encouraged to use e-commerce in marketing and promotion to capture international markets, both big and small. The Internet is likewise used as a medium for enhanced customer service and support.

It is a lot easier for companies to provide their target consumers with more detailed product and service information using the Internet.

Components of a typical successful e-commerce transaction loop

E-commerce does not refer merely to a firm putting up a Web site for selling goods to buyers over the Internet.

For e-commerce to be a competitive alternative to traditional commercial transactions and for a firm to maximize the benefits of e-commerce, several technical as well as enabling issues must be considered.

A typical e-commerce transaction loop involves the following major players and corresponding requisites:

The *Seller* should have the following components:

- A corporate Web site with e-commerce capabilities (e.g., a secure transaction server);
- A corporate intranet so that orders are processed in an efficient manner; and
- IT-literate employees to manage the information flows and maintain the e-commerce system.

Transaction partners include:

- Banking institutions that offer transaction clearing services (e.g., processing credit card payments and electronic fund transfers);
- National and international freight companies to enable the movement of physical goods within, around and out of the country.

  For business-to-consumer transactions, the system must offer a means for cost-efficient transport of small packages (such that purchasing books over the Internet, for example, is not prohibitively more expensive than buying from a local store); and

- Authentication authority that serves as a trusted third party to ensure the integrity and security of transactions.

Consumers (in a business-to-consumer transaction) who:

- Form a critical mass of the population with access to the Internet and disposable income enabling widespread use of credit cards; and
- Possess a mindset for purchasing goods over the Internet rather than by physically inspecting items.

Firms/Businesses (in a business-to-business transaction) that together form a critical mass of companies (especially within supply chains) with Internet access and the capability to place and take orders over the Internet.

Government, to establish:

- A legal framework governing e-commerce transaction (including electronic documents, signatures, and the like); and
- Legal institutions that would enforce the legal framework (i.e., laws and regulations) and protect consumers and businesses from fraud, among others.

And finally, *the Internet*, the successful use of which depends on the following:

- A robust and reliable Internet infrastructure; and
- A pricing structure that doesn't penalize consumers for spending time on and buying goods over the Internet (e.g., a flat monthly charge for both ISP access and local phone calls).

For e-commerce to grow, the above requisites and factors must be in place. The least developed factor is an impediment to the increased uptake of e-commerce.

For instance, a country with an excellent Internet infrastructure will not have high e-commerce figures if banks do not offer support and fulfillment services to e-commerce transactions.

In countries that have significant e-commerce figures, a positive feedback loop reinforces each of these factors

Internet relevance to e-commerce

The Internet allows people from all over the world to get connected inexpensively and reliably.

As a technical infrastructure, it is a global collection of networks, connected to share information using a common set of protocols.

Also, as a vast network of people and information, the Internet is an enabler for e-commerce as it allows businesses to showcase and sell their products and services online and gives potential customers, prospects, and business partners access to information about these businesses and their products and services that would lead to purchase.

Before the Internet was utilized for commercial purposes, companies used private networks-such as the EDI or Electronic Data Interchange-to transact business with each other. That was the early form of e-commerce.

However, installing and maintaining private networks was very expensive. With the Internet, e-commerce spread rapidly because of the lower costs involved and because the Internet is based on open standards.

Importance of intranet for a business engaging in e-commerce

An intranet aids in the management of internal corporate information that may be interconnected with a company's e-commerce transactions (or transactions conducted outside the intranet).

Since the intranet allows for the instantaneous flow of internal information, vital information is simultaneously processed and matched with data flowing from external e-commerce

transactions, allowing for the efficient and effective integration of the corporation's organizational processes.

In this context, corporate functions, decisions and processes involving e-commerce activities are more coherent and organized.

The proliferation of intranets has caused a shift from a hierarchical command-and-control organization to an information-based organization. This shift has implications for managerial responsibilities, communication and information flows, and workgroup structures.

3.08 Other Benefits of e-Commerce

E-commerce serves as an "equalizer". It enables start-up and small- and medium-sized enterprises to reach the global market.

However, this does not discount the point that without a good e-business strategy, e-commerce may in some cases discriminate against SMEs because it reveals proprietary pricing information.

A sound e-business plan does not totally disregard old economy values. The dot-com bust is proof of this.

E-commerce makes "mass customization" possible. E-commerce applications in this area include easy-to-use ordering systems that allow customers to choose and order products according to their personal and unique specifications.

For instance, a car manufacturing company with an e-commerce strategy allowing for online orders can have new cars built within a few days (instead of the several weeks it currently takes to build a new vehicle) based on customer's specifications.

This can work more effectively if a company's manufacturing process is advanced and integrated into the ordering system.

E-commerce allows "network production." This refers to the parceling out of the production process to contractors who are geographically dispersed but who are connected to each other via computer networks.

The benefits of network production include: reduction in costs, more strategic target marketing, and the facilitation of selling add-on products, services, and new systems when they are needed.

With network production, a company can assign tasks within its non-core competencies to factories all over the world that specialize in such tasks (e.g., the assembly of specific components).

- **Business-to-consumer (B2C):** electronic-commerce involves retailing products and services to individual shoppers. BarnesandNoble.com, which sells books, software, and music to individual consumers, is an example of B2C e-commerce.

- **Business-to-business (B2B):** electronic commerce involves sales of goods and services among businesses. ChemConnect's Web site for buying and selling chemicals and plastics is an example of B2B e-commerce.

- **Consumer-to-consumer (C2C):** electronic commerce involves consumers selling directly to consumers. For example, eBay, the giant Web auction site, enables people to sell their goods to other consumers by auctioning their merchandise off to the highest bidder, or for a fixed price. OLX is the most widely used platform used by consumers to buy from and sell directly to others.

Another way of classifying electronic commerce transactions is in terms of the platforms used by participants in a transaction. Until recently, most e-commerce transactions took place using a personal computer connected to the Internet over wired networks.
Several wireless mobile alternatives have emerged: smartphones, tablet computers like iPads, and dedicated e-readers like the Kindle using cellular networks, and smartphones and small tablet computers using Wi-Fi wireless networks.

The use of handheld wireless devices for purchasing goods and services from any location is termed **mobile commerce** or **m-commerce**.

Both business-to-business and business-to-consumer e-commerce transactions can take place using m-commerce technology.

E-Commerce Business Models
Changes in the economics of information have created the conditions for entirely new business models to appear, while destroying older business models.

All, in one way or another, use the Internet to add extra value to existing products and services or to provide the foundation for new products and services.

Portal

Portals are gateways to the Web and are often defined as those sites which users set as their home page. Some definitions of a portal include search engines like Google and Bing even if few make these sites their home page.

Portals such as Yahoo, Facebook, MSN, and AOL offer powerful Web search tools as well as an integrated package of content and services, such as news, e-mail, instant messaging, maps, calendars, shopping, music downloads, video streaming and more, all in one place. Initially, portals were primarily 'gateways" to the Internet.

Today, however, the portal business model provides a destination site where users start their Web searching and linger to read news, find entertainment, meet other people, and be exposed to advertising.

Portals generate revenue primarily by attracting very large audiences, charging advertisers for advertisement placement, collecting referral fees for steering customers to other sites charging for premium services.

Although there are hundreds of portal/search engine sites, the top four portals (Yahoo, Facebook, MSN, and AOL) gather more than 95 percent of the Internet portal traffic because of their superior brand recognition.

Table 20: INTERNET BUSINESS MODELS

Category	Description	Examples
E-tailer	Sells physical products directly to consumers or to individual businesses.	Amazon RedEnvelope.com
Transaction broker	Saves users money and time by processing online sales transactions and generating a fee each time a transaction occurs.	ETrade.com Expedia
Market creator	Provides a digital environment where buyers and sellers can meet, search for products, display products, and establish prices for those products. Can serve consumers or B2B e-commerce, generating revenue from transaction fees.	eBay Priceline.com Olx.com
Content provider	Creates revenue by providing digital content, such as news, music, photos, or video, over the Web. The customer may pay to access the content, or revenue may be generated by selling advertising space.	WSJ.com GettyImages.com iTunes.com Games.com

Community Provider	Provides an online meeting place where people with similar interests can communicate and find useful information.	Facebook Google+ iVillage, Twitter
Portal	Provides initial point of entry to the Web along with specialized content and other services.	Yahoo Bing Google
Service provider	Provides Web 2.0 applications such as photo sharing, video sharing, and user-generated content as services. Provides other services such as online data storage and backup.	Google Apps Photobucket.com Dropbox

3.09 E -tailer

Online retail stores, often called **e-tailers,** come in all sizes, from giant Amazon to tiny local stores that have Web sites.

An e-tailer is similar to the typical bricks-and-mortar storefront, except that customers only need to connect to the Internet to check their inventory and place an order.

The value proposition of e-tailers is to provide convenient, low-cost shopping 24/7, offering large selections and consumer choice. Some e-tailers, such as Walmart.com or Staples.com, referred to as "bricks-and-clicks," are subsidiaries or divisions of existing physical stores and carry the same products.
Others, however, operate only in the virtual world, without any ties to physical locations. Amazon, BlueNile.com, and Drugstore.com are examples of this type of e-tailer.

Several other variations of e-tailers — such as online versions of direct mail catalogs, online malls, and manufacturer-direct online sales — also exist.

Content Provider

While e-commerce began as a retail product channel, it has increasingly turned into a global content channel. "Content" is defined broadly to include all forms of intellectual property.

Intellectual property refers to all forms of human expression that can be put into a tangible medium such as text, CDs, or DVDs, or stored on any digital (or other) media, including the Web. Content providers distribute information content, such as digital video, music, photos, text, and artwork, over the Web.

The value proposition of online content providers is that consumer can find a wide range of content online, conveniently, and purchase this content inexpensively, to be played, or viewed, on multiple computer devices or smartphones.

Providers do not have to be the creators of the content (although sometimes they are, like Disney.com), and are more likely to be Internet-based distributors of content produced and created by others.

For example, Apple sells music tracks at its iTunes Store, but it does not create or commission new music.

The phenomenal popularity of the iTunes Store, and Apple's Internet- connected devices like the iPhone, iPod, and iPad, has enabled new forms of digital content delivery from podcasting to mobile streaming.

Podcasting is a method of publishing audio or video broadcasts via the Internet, allowing subscribing users to download audio or video files onto their personal computers or portable music players.

Streaming is a publishing method for music and video files that flows a continuous stream of content to a user's device without being stored locally on the device.

Transaction Broker

Sites that process transactions for consumers normally handled in person, by phone, or by mail are transaction brokers. The largest industries using this model are financial services and travel services.

The online transaction broker's primary value propositions are savings of money and time, as well as providing an extraordinary inventory of financial products and travel packages, in a single location.

Online stock brokers and travel booking services charge fees that are considerably less than traditional versions of these services.

Market Creator

Market creators build a digital environment in which buyers and sellers can meet, display products, search for products, and establish prices.

The value Proposition of-online market creators are that they provide a platform where sel1ers can easily display their wares and where purchasers can buy directly from sellers.

Online auction markets like eBay and Priceline are good examples of the market creator business model.

Another example is Amazon's Merchants platform (and similar programs at eBay) where merchants can set up stores on Amazon's Web site and sell goods at fixed prices to consumers.

This is reminiscent of open air markets where the market creator operates a facility (a town square) where merchants and consumers meet.

Service Provider

While e-tailers sell products online, service providers offer services online. There's been an explosion in online services. Web 2.0 applications, photo sharing, and online sites for data backup and storage all use a service provider business model.

Software is no longer a physical product with a CD in a box, but increasingly software as a service (SaaS) that you subscribe to online rather than purchase from a retailer, or an app that you download.

Google has led the way in developing online software service applications such as Google Apps, Google Sites, Gmail, and online data storage services.

Community Provider

Community providers are sites that create a digital online environment where people with similar interests can transact (buy and sell goods); share interests, photos, videos; communicate with like-minded people; receive interest-related information; and even play out fantasies by adopting online personalities called avatars.

The social networking sites Facebook, Google +, Tumblr, LinkedIn, and Twitter; online communities such as iVillage; and hundreds of other smaller, niche sites such as Doostang and Sportsvite all offer users community-building tools and services.

Social networking sites have been the fastest growing Web sites in recent years, often doubling their audience size in a year.

However, they are struggling to achieve profitability.

3.10 Use of Electronic Business and Electronic Commerce

While some use e-commerce and e-business interchangeably, they are distinct concepts. In e-commerce, information and communications technology (ICT) is used in inter-business or inter-

organizational transactions (transactions between and among firms/organizations) and in business-to-consumer transactions (transactions between firms/organizations and individuals).

In e-business, on the other hand, ICT is used to enhance one's business. It includes any process that a business organization (either a for-profit, governmental or non-profit entity) conducts over a computer-mediated network. A more comprehensive definition of e-business is:

"The transformation of an organization's processes to deliver additional customer value through the application of technologies, philosophies and computing paradigm of the new economy."

Three primary processes are enhanced in e-business:

1. **Production processes**, which include procurement, ordering and replenishment of stocks; processing of payments; electronic links with suppliers; and production control processes, among others;

2. **Customer-focused processes**, which include promotional and marketing efforts, selling over the Internet, processing of customers' purchase orders and payments, and customer support, among others; and

3. **Internal management processes**, which include employee services, training, internal information-sharing, video-conferencing, and recruiting. Electronic applications enhance information flow between production and sales forces to improve sales force productivity.

Workgroup communications and electronic publishing of internal business information are likewise made more efficient.

Is the Internet economy synonymous with e-commerce and e-business?
The Internet economy is a broader concept than e-commerce and e-business. It includes e-commerce and e-business.

The CREC (Center for Research in Electronic Commerce) at the University of Texas has developed a conceptual framework for how the Internet economy works. The framework shows four layers of the Internet economy-the three mentioned above and a fourth called intermediaries

How is e-commerce helpful to the consumer?
In C2B transactions, customers/consumers are given more influence over what and how products are made and how services are delivered, thereby broadening consumer choices. E-commerce allows for a faster and more open process, with customers having greater control.

E-commerce makes information on products and the market readily available and accessible, and increases price transparency, which enable customers to make more appropriate purchasing decisions.

How are business relationships transformed through e-commerce?
E-commerce transforms old economy relationships (vertical/linear relationships) to new economy relationships characterized by end-to-end relationship management solutions (integrated or extended relationships).

How does e-commerce link customers, workers, suppliers, distributors and competitors?
E-commerce facilitates organization networks; wherein small firms depend on "partner" firms for supplies and product distribution to address customer demands more effectively.

To manage the chain of networks linking customers, workers, suppliers, distributors, and even competitors, an integrated or extended supply chain management solution is needed.

Supply chain management (SCM) is defined as the supervision of materials, information, and finances as they move from supplier to manufacturer to wholesaler to retailer to consumer.

It involves the coordination and integration of these flows both within and among companies.

The goal of any effective supply chain management system is timely provision of goods or services to the next link in the chain (and ultimately, the reduction of inventory within each link).

There are three main flows in SCM, namely:

- The product flow, which includes the movement of goods from a supplier to a customer, as well as any customer returns or service needs;

- The information flow, which involves the transmission of orders and the update of the status of delivery; and

- The finances flow, which consists of credit terms, payment schedules, and consignment and title ownership arrangements.

Some SCM applications are based on open data models that support the sharing of data both inside and outside the enterprise, called the extended enterprise, and include key suppliers, manufacturers, and end customers of a specific company.

Shared data resides in diverse database systems, or data warehouses, at several different sites and companies.

Sharing this data “upstream” (with a company’s suppliers) and “downstream” (with a company’s clients) allows SCM applications to improve the time-to-market of products and reduce costs.

It also allows all parties in the supply chain to better manage current resources and plan for future needs

3.11 Technologies Used for Electronic Business and Electronic Business Models

A business model is a specific method of conducting business that generates enough revenue to sustain a business successfully. Many electronic business models are based on profitable traditional business models while being adapted slightly for the online environment.

Electronic business models often take the form of direct sales, services, advertising or the sharing of knowledge and skills, but according to a July 2010 article in The Wall Street Journal, many electronic businesses use a mix of models to get the best results from fast-moving consumer desires.

Direct Sales

Direct sale is an electronic business model that involves selling products through a website or online marketplace such as eBay. Retail-style shopping websites can be programmed to process orders 24 hours a day without physical sales or service staff.

Some retail websites package and ship orders during regular business hours from their own warehouses while others outsource fulfillment to a third party in a drop-shipping arrangement.

The retail business model also works well for digital goods such as electronic books or software as fulfillment is provided automatically through a website download.

Services

Service-based electronic business models include freelance writing, research and fact-checking, website design, video production, customer service, reminder services and virtual assistants.

Service-based business models are ideal in an electronic environment because communication can be facilitated through email or instant messaging services, and the services can be rendered through those same mediums or through an electronic work desk on a corporate website.

Advertising

Advertising is a flexible electronic business model that can be executed in several ways. Businesses can choose to be an online publisher of free content, for example, and sell advertising space on or within their content similar to what traditional magazines and newspapers do.

According to Digital Enterprise, the online publishing model opens subscription revenue options because companies can charge fees to access some or all the content they produce.

Affiliate marketing is another type of advertising business model frequently used online. Businesses recommend or mention specific products related to their content and if readers purchase products through the links provided, the business earns commissions from each sale.

Knowledge

Knowledge-based electronic business models often involve consulting, mentoring or teaching through an online website, chat service or email.

Some consultants and mentors offer private individual sessions with their clients through email or Internet telephones while others share their knowledge and training through teleconferences or discussion boards.

Knowledge-based businesses commonly deliver much of their materials automatically through pre-recorded videos and audios, and written documentation that can be accessed for a fee through a private membership website.

3.12 Cloud Computing

Cloud computing is a model of computing in which computer processing, storage, software, and other services are provided as a pool of virtualized resources over a network, primarily the internet.

These “clouds” of computing resources can be accessed on an as-needed basis from any connected device and location.

3.13 Cloud Computing Platform

In cloud computing, hardware and software capabilities are a pool of virtualized resources provided over a network, often the Internet. Businesses and employees have access to applications and IT infrastructure anywhere, at any time, and on any device.

The U.S. National Institute of Standards and Technology (NIST) define cloud computing as having the following essential characteristics:

- **On-demand self-service:** Consumers can obtain computing capabilities such as server time or network storage as needed automatically on their own.
- **Ubiquitous network access:** cloud resources can be accessed using standard network and internet devices, including mobile platforms.

- **Location-independent resource pooling:** Computing resources are pooled to serve multiple users, with different virtual resources dynamically assigned according to user demand. The user generally does not know where the computing resources are located. **Figure 3.04**
- **Rapid elasticity**: Computing resources can be rapidly provisioned, increased, or decreased to meet changing user demand.

- **Measured service:** Charges for cloud resources are based on amount of resources used.

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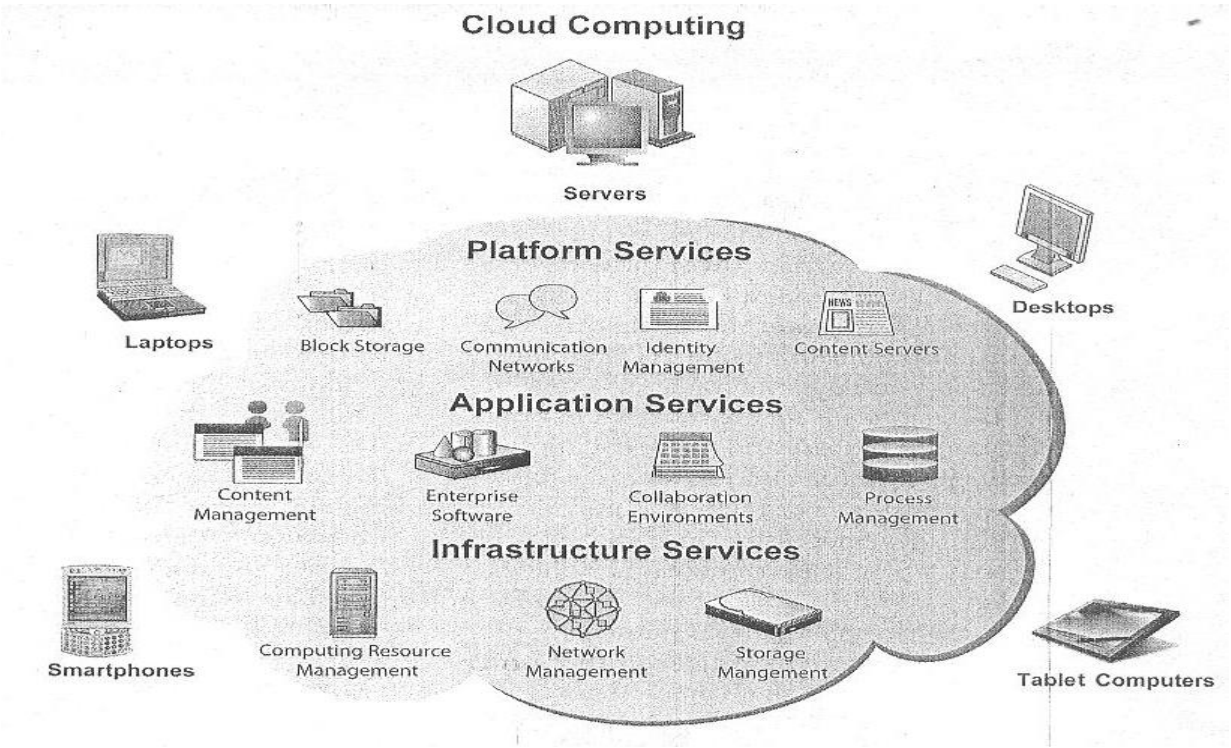


Cloud computing consists of three different types of services:

• **Cloud infrastructure as a service:**
Customers use processing, storage, networking, and other computing resources from cloud service providers to run their information systems.

For example, Amazon uses the spare capacity of its IT infrastructure to provide a broadly-based cloud environment selling IT infrastructure services.

These include its Simple Storage Service (S3) for storing customers' data and its Elastic Compute Cloud (EC2) service for running their applications. Users pay only for computing and storage capacity they use.

- **Cloud platform as a service:** Customers use infrastructure and programming tools supported by the cloud service provider to develop their own applications.

  For example, IBM offers a Smart Business Application Development & Test service for software development and testing on the IBM Cloud.

  Another example is Salesforce.com, which allows developers to build applications that are hosted on its servers as a service.

- **Cloud software as a service:** Customers use software hosted by the vendor on the vendor's cloud infrastructure and delivered over a network.

  Leading examples are Google Apps, which provides common business applications online and Salesforce.com, which also leases customer relationship management and related software services over the Internet.

  Both charge users an annual subscription fee, although Google Apps also has a pared-down free version. Users access these applications from a Web browser, and the data and software are maintained on the providers' remote servers.

A cloud can be private or public.

A public cloud is owned and maintained by a cloud service provider, such as Amazon Web Services, and made available to the public or industry group.

A **private cloud** is operated solely for an organization. It may be managed by the organization or a third party and may exist on premise or off premise. Like public clouds, private clouds can allocate storage, computing power or other resources seamlessly to provide computing resources on an as-needed basis. Companies that want flexible IT resources and a cloud service model while retaining control over their own IT infrastructure are gravitating toward these private clouds. Since organizations using public clouds do not own the infrastructure, they do not have to make large investments in their own hardware and software.

Instead, they purchase their computing services from remote providers and pay only for computing power they use (**utility computing**) or are billed on a monthly or annual subscription basis. The term **on-demand computing** has also been used to describe such services. Cloud computing has some drawbacks. Unless users make provisions for storing their data locally, the responsibility for data storage and control is in the hands of the provider. Some companies worry about the security risks related to entrusting their critical data and systems to an outside vendor that also works with other companies.

Companies expect their systems to be available 24/7 and do not want to suffer any loss of business capability if cloud infrastructures malfunction. Another limitation of cloud computing is that users become dependent on the cloud computing provider. Nevertheless, the trend is for companies to shift more of their computer processing and storage to some form of cloud infrastructure. Cloud computing is more immediately appealing to small and medium-sized businesses that lack resources to purchase and own their own hardware and software.

However, large corporations have huge investments in complex proprietary systems supporting unique business processes, some of which give them strategic advantages. The cost savings from switching to cloud services are not always easy to determine for large companies that already have their own IT infrastructures in place. Corporate data centers typically work with an IT budget that accounts for a mix of operational and capital expenses. Pricing for cloud services is usually based on a per-hour or another per-use charge.

Even if a company can approximate the hardware and software costs to run a specific computing task on premises, it still needs to figure in how much of the firm's network management, storage management, system administration, electricity, and real estate costs should be allocated to a single on-premises IT service. An information systems department may not have the right information to analyze those factors on a service-by-service basis.

Large firms are most likely to adopt a **hybrid cloud** computing model where they use their own infrastructure for their most essential core activities and adopt public cloud computing for less-critical systems or for additional processing capacity during peak business periods. Cloud computing will gradually shift firms from having a fixed infrastructure capacity toward a more flexible infrastructure, some of it owned by the firm, and some of it rented from giant computer centers owned by computer hardware vendors.

3.14 Characteristics of Cloud Computing

Cloud technology is in the news quite often these days, but it still seems to be mysterious and confusing to the non-techie crowd. Cloud options are enticing various industries across the board, which is why it's important to know its essential characteristics as a software offering.

Here are the five main characteristics that cloud computing offers businesses and organizations today.

1. **On-demand capabilities:** A business will secure cloud-hosting services through a cloud host provider which could be your usual software vendor.

You have access to your services and you have the power to change cloud services through an online control panel or directly with the provider.

You can add or delete users and change storage networks and software as needed.

Typically, you are billed with a monthly subscription or a pay-for-what-you-use scenario. Terms of subscriptions and payments will vary with each software provider.

2. **Broad network access:** Your team can access business management solutions using their smartphones, tablets, laptops, and office computers. They can use these devices wherever they are located with a simple online access point.

   This mobility is particularly attractive for businesses so that during business hours or on off-times, employees can stay on top of projects, contracts, and customers whether they are on the road or in the office.

   Broad network access includes private clouds that operate within a company's firewall, public clouds, or a hybrid deployment.

3. **Resource pooling:** The cloud enables your employees to enter and use data within the business management software hosted in the cloud at the same time, from any location, and at any time.

   This is an attractive feature for multiple business offices and field service or sales teams that are usually outside the office.

4. **Rapid elasticity:** If anything, the cloud is flexible and scalable to suit your immediate business needs. You can quickly and easily add or remove users, software features, and other resources.

5. **Measured service:** Going back to the affordable nature of the cloud, you only pay for what you use. You and your cloud provider can measure storage levels, processing, bandwidth, and the number of user accounts and you are billed appropriately.

   The amount of resources that you may use can be monitored and controlled from both your side and your cloud provider's side which provides transparency.

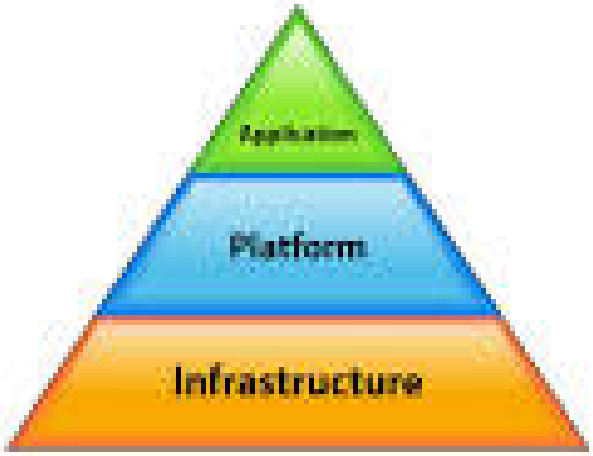
Infrastructure, Platform and Application (Software Service) Layers of the Cloud Pyramid

The main premise behind the choice of a pyramid is to think about building a structure, where each layer is built upon the next, potentially, creating a larger whole.

While each layer can be somewhat dependent upon each other and directly related, they do not require interdependence.

In fact, each layer can, and does exist on its own. You can, for example, build a Cloud Application on top of a Cloud Platform or Cloud Infrastructure, but the building process primarily works from the ground up. The inverse is not possible (e.g., building a Cloud Platform on top of a Cloud Application).

There are other ways to describe this hierarchy as simple layers or interconnecting circles, but those don't necessarily convey the strength of the structure, or "infrastructure" in this case. We believe that the Cloud Pyramid encompasses this idea in a simple visual representation.



3.15 Private and Public Clouds

Private cloud is cloud infrastructure operated solely for a single organization, whether managed internally or by a third-party, and hosted either internally or externally.

Undertaking a private cloud project requires a significant level and degree of engagement to virtualize the business environment and requires the organization to reevaluate decisions about existing resources. When done right, it can improve business, but every step in the project raises security issues that must be addressed to prevent serious vulnerabilities. Self-run data centers are generally capital intensive. They have a significant physical footprint, requiring allocations of space, hardware, and environmental controls. These assets must be refreshed periodically, resulting in additional capital expenditures.

They have attracted criticism because users "still have to buy, build, and manage them" and thus do not benefit from less hands-on management, essentially "[lacking] the economic model that makes cloud computing such an intriguing concept".

A cloud is called a "public cloud" when the services are rendered over a network that is open for public use. Public cloud services may be free or offered on a pay-per-usage model.

Technically there may be little or no difference between public and private cloud architecture, however, security consideration may be substantially different for services (applications, storage, and other resources) that are made available by a service provider for a public audience and when communication is effected over a non-trusted network. Generally, public cloud service providers like Amazon AWS, Microsoft and Google own and operate the infrastructure at their data center and offer access only via Internet (direct connectivity is not offered).

Hybrid cloud

Hybrid cloud is a composition of two or more clouds (private, community or public) that remain distinct entities but are bound together, offering the benefits of multiple deployment models. Hybrid cloud can also mean the ability to connect, collocation, managed and/or dedicated services with cloud resources.

Gartner, Inc. defines a hybrid cloud service as a cloud computing service that is composed of some combination of private, public and community cloud services, from different service providers. A hybrid cloud service crosses isolation and provider boundaries so that it can't be simply put in one category of private, public, or community cloud service. It allows one to extend either the capacity or the capability of a cloud service, by aggregation, integration or customization with another cloud service. Varied use cases for hybrid cloud composition exist. For example, an organization may store sensitive client data in house on a private cloud application but interconnect that application to a business intelligence application provided on a public cloud as a software service.

This example of hybrid cloud extends the capabilities of the enterprise to deliver a specific business service through the addition of externally available public cloud services. Another example of hybrid cloud is one where IT organizations use public cloud computing resources to meet temporary capacity needs that cannot be met by the private cloud. This capability enables hybrid clouds to employ cloud bursting for scaling across clouds. Cloud bursting is an application deployment model in which an application runs in a private cloud or data center and "bursts" to a public cloud when the demand for computing capacity increases. A primary advantage of cloud bursting and a hybrid cloud model is that an organization only pays for extra compute resources when they are needed.

Cloud bursting enables data centers to create an in-house IT infrastructure that supports average workloads, and use cloud resources from public or private clouds, during spikes in processing demands.

Community cloud

Community cloud shares infrastructure between several organizations from a specific community with common concerns (security, compliance, jurisdiction, etc.), whether managed internally or by a third-party, and either hosted internally or externally. The costs are spread over fewer users than a public cloud (but more than a private cloud), so only some of the cost savings potential of cloud computing are realized.

Distributed cloud

Cloud computing can also be provided by a distributed set of machines that are running at different locations, while still connected to a single network or hub service. Examples of this include distributed computing platforms such as BOINC and Folding@Home. An interesting attempt in such direction is Cloud@Home, aiming at implementing cloud computing provisioning model on top of voluntarily shared resources.

Intercloud

The Intercloud is an interconnected global "cloud of clouds" and an extension of the Internet "network of networks" on which it is based. The focus is on direct interoperability between public cloud service providers, more so than between providers and consumers (as is the case for hybrid- and multi-cloud).

Multicloud

Multicloud is the use of multiple cloud computing services in a single heterogeneous architecture, to reduce reliance on any single vendor, increase flexibility through choice, mitigate against disasters, etc. It differs from hybrid cloud in that it refers to multiple cloud services rather than multiple deployment modes (public, private, and legacy).

3.16 Green Computing

Green computing or green IT refers to practices and technologies for designing, manufacturing, using, and disposing of computers, servers, and associated devices such as monitors, printers, storage devices, and networking and communications systems to minimize the impact on the environment. By curbing hardware proliferation and power consumption, virtualization has become one of the principal technologies for promoting green computing. Reducing' computer power consumption has been a very high "green" priority. Cutting power consumption in data centers has become both a serious business and environmental challenge.

3.17 Service Level Agreements (SLAs) for Cloud-Based I.T Resources

A service-level agreement is an agreement between two or more parties, where one is the customer and the others are service providers. This can be a legally binding formal or an informal "contract" (for example, internal department relationships). Contracts between the service provider and other third parties are often (incorrectly) called SLAs because the level of

service has been set by the (principal) customer, there can be no "agreement" between third parties; these agreements are simply "contracts." Operational-level agreements or OLAs, however, may be used by internal groups to support SLAs.

SLAs commonly include segments to address: a definition of services, performance measurement, problem management, customer duties, warranties, disaster recovery, and termination of agreement. To ensure that SLAs are consistently met, these agreements are often designed with specific lines of demarcation and the parties involved are required to meet regularly to create an open forum for communication. Contract enforcement (rewards and penalties) should be rigidly enforced, but most SLAs also leave room for annual revisitation so that it is possible to make changes based on new information.

SLAs have been used since late 1980s by fixed line telecom operators as part of their contracts with their corporate customers. This practice has spread such that now it is common for a customer to engage a service provider by including a service level agreement in a wide range of service contracts in practically all industries and markets. Internal departments (such as IT, HR, and real estate) in larger organizations have adopted the idea of using service-level agreements with their "internal" customers — users in other departments within the same organization.

One benefit of this can be to enable the quality of service to be benchmarked with that agreed to across multiple locations or between different business units. This internal benchmarking can also be used to market test and provide a value comparison between an in-house department and an external service provider. Service level agreements are, by their nature, "output" based – the result of the service as received by the customer is the subject of the "agreement."

The (expert) service provider can demonstrate their value by organizing themselves with ingenuity, capability, and knowledge to deliver the service required, perhaps in an innovative way. Organizations can also specify the way the service is to be delivered, through a specification (a service level specification) and using subordinate "objectives" other than those related to the level of service. This type of agreement is known as an "input" SLA. This latter type of requirement is becoming obsolete as organizations become more demanding and shift the delivery methodology risk on to the service provider.

TM Forum defines SLAs as expectations among two or more parties regarding service quality, priorities, and responsibilities.

The Cloud Standards Customer Council views cloud SLAs as written expectations for service between cloud consumers and providers. It provides guidance to decision makers on what to expect and what to be aware of as they evaluate and compare end user SLAs from cloud computing providers. The decision makers should also evaluate the SLAs that a cloud

computing provider has with vendors, enterprise data centers, network providers, and content providers.

An SLA is not a mandate when it's driven by a major reorganization, downsizing, service consolidation, or transition to a cloud services environment. It doesn't have the inputs from all pertinent parties that must be involved. An SLA is not a one-way solution. One party - the cloud service provider, for example - should not impose decisions about how things should be done, particularly when the other party - the cloud service customer, for example - has different expectations about how the SLA should be formulated.

An SLA isn't a quick solution. Rushing the process of negotiating the terms and conditions in the SLA doesn't give enough time for the parties to understand each other's expectations particularly when each party has a different perception of what a certain terminology stands for. Business intelligence analytics support decision making by managers and executives through delivery platform such as MIS, DSS and ESS. A business intelligence environment consists of hardware, software and management capabilities that vendors supplied and that firms developed.

These consist of data from the business environment, the business intelligence infrastructure, a business analytic tool set, managerial users and methods, a business delivery platform (MIS, DSS or) and user interface. The analytical functionalities that business intelligence deliver to achieve these are: production reports, parameterized reports; dashboards; adhoc queries, the ability to drill down to detailed views of data and the ability to model scenarios and create forecasts.

3.18 Review Questions

1a. Information technology has pervaded every aspect of human business activity. Discuss its impact in the financial sector of Nigeria

2. Distinguish between a probabilities system and an Adaptive system

MODULE 4

4.00 ENTERPRISE APPLICATION

4.01 Learning Outcomes

On successful completion of this module, students should be able to:

i. Evaluate how enterprise applications and resource planning drive the attainment of business objectives;
ii. Appraise how supply chain management systems coordinate planning, production and logistics with suppliers and customers;
iii. Comprehend how customer relationship management systems help achieve customer loyalty;
iv. Analyse the challenges posed by enterprise applications, business intelligence and business analytics support in decision making.

4.02 Enterprise Applications

Enterprise applications are systems that span functional areas and focus on executing business processes across the business firms and across all levels of management.

Organizations implement enterprise applications to gain efficiency in business processes, effectiveness in supply chain and an understanding of the need to get customer loyalty. Figure I show the components of enterprise applications.

4.03 ENTERPRISE RESOURCE PLANNING (ERP)

Enterprise resource planning (ERP) integrates all departments and functions throughout an organization into a single software system.

The system ensures that employees have access to Enterprise-wide information used to make decision.

An ERP system takes data from across the enterprise, consolidates and correlates it, and generates enterprise wise organizational reports.

The ERP system maintains a central database that draws data from and feeds data into applications throughout the organization. The core processes supported are as follows:

Financials

General ledger, assets accounting, cash management, accounts receivable and payable.

Production

Production planning, manufacturing process, workflow management, quality control, cost management, scheduling, capacity management.

Human resources
Payroll, training, benefits, personnel planning

Supply chain management
Inventory management, purchasing, supply chain planning, scheduling, Vendor evaluation.

Customer relationship management
Order management, pricing, sales planning, billing, commissions, and sales management.

The ERP system enables management to have access to current operating information enabling them to;

(i) Integrate customer and financial information;
(ii) Standardize manufacturing processes and reduce inventory;
(iii) Improve information for management decisions; and
(iv) Enable external connection with suppliers and customers' system with internal information.

Leading enterprises software vendors include SAP, Oracle, IBM, In for Global Solutions and Microsoft.

Implementing an ERP system implies changing processes because the companies must change the way they work to conform to the business processes defined by the ERP system.

This implementation strategy is usually adopted because rewriting some of the software to support the way the business processes work may involve extensive customization that can potentially degrade the system performance and compromise the information and process integration that are the main benefits of the system.

BENEFITS OF ERP
An ERP system allows a company to compete on a functional level by adopting an enterprise wise approach using the internet to connect all participants in the value chain.

The key business drivers of this system are changing business environment, e-commerce and increased competition supported by internet, database technology and availability of networks. The business value of ERP includes;

(i) Increasing operational efficiency;
(ii) Helping firms respond rapidly to customer requests for information and products; and
(iii) Providing valuable information for improving management decision making.

4.04 Supply Chain Management System

For most businesses the critical success factor is how to procure the right inputs, convert them into finished products using the right processes and identifying the right channels for the distribution of the finished goods.

For these reasons, tools that can help a company source raw material, manufacture products and distributes them to retailers and customers is a critical asset that must be soughted.

Supply chain consists of all parties involved in obtaining raw materials or a product. The basic supply chain activities include;

(i) Prepare to manage all resource required to meet demand;
(ii) Build relationship with suppliers to procure raw materials;
(iii) Manufacture products and create production schedules;
(iv) Delivery of goods to customers; and
(v) Support customers and product returns.

To automate these activities, companies are turning to systems that provide demand forecasting, inventory control, and information flows between suppliers and customers.

Such automated system can help all members of the supply chain have accurate and up-to-date information through dynamic information sharing about inventory levels, schedules, forecasts, and shipments that have far-reaching effect on the sourcing, manufacturing and distribution plans.

It can also be used to implement just-in-time manufacturing and inventory strategy and minimize bullwhip effect in which information about the demand for a product is distorted as it passes from one entity to another across the supply chain.

Information Systems and Supply Chain Management

Supply chain management system uses supply chain management software to automate the information flows between and among activities in a supply chain to maximize total supply chain effectiveness and corporate profitability.

Supply chain management system involves the use of internet, intranets, and extranets to streamline the movement of goods from production line into the hands of customers by organization.

The aim of supply chain management system is to create a fast, efficient and low-cost network of business relationship. Supply chain management software are offered by JDA software, SAP and Oracle.

Supply chain software is classified as follows;

(i) **Supply chain planning system:** this enables a firm to model its existing supply chain, generate demand forecasts for products and develop optimal sourcing and manufacturing plans. Such systems help make better decision such as;

(a) Determining how much of a specific product to manufacture in a given time;
(b) Establishing inventory levels;
(c) Determining where to store finished good, and
(d) Identifying the transportation mode to use for product delivery.

(ii) **Supply chain execution system:** this manages the flow of products through distribution centres and warehouses to ensure that products are delivered to the right locations in the most efficient system.

Business Value of Supply Chain Management Systems

A sizable proportion of the operating expenses for many companies represent the total supply chain costs.

Reducing supply chain costs through supply chain management systems has a major impact on firm profitability.

This is achieved through networked and integrated supply chain management system that matches demand with supply, reduce inventory levels, and improve delivery service and assets more effectively and efficiently.

4.05 Customer Relationship Management System

Successful businesses in today's competitive environment have had to become more customer-driven and make customer satisfaction their top priority. Knowing that your competitors are far not away from snatching your customers make businesses adopt customer-focused business strategies.

Customers are one of the businesses most valuable assets. Identifying their needs, striving to meet those needs and building strong loyal customers' relationship is a key competitive advantage. To build and nurture long-lasting relationship with customers, there is the need for firms to have accurate and timely businesses with different ways to relate with customers, it is difficult to integrate information from these different sources and to deal with large number of customers.

In such businesses the customer relationship processes are often spread into sales, services and marketing processes that hardly shares essential customer information. This is because they tend to be independent of each other rather than to be independent and cooperative. For example, the marketing unit will hardly have the information that accounting, and finance department have on customers and vice versa. Also, in organization with more than one product it is not uncommon to have information on the same customer organized based on products purchased rather than enterprise-wide information.

The need for businesses to coordinate all the business processes that deal with customers in sales, marketing and services have given rise to businesses to use customer relationship management systems (CRM), information on who are their customers and what are their needs. In large organisations, customer relationship systems use information systems to capture and integrate customers from all over the organization, consolidate the data, analyse the data and then distribute the result to various systems and customer touch point across the enterprise. A touch point is point of contact with the customers such as Twitter, Website, Wireless devices, Facebook, Service desk, or retail store.

CRM system consolidate customer information from many services and seek to answer such questions as: who is most loyal customer? who are our most profitable customers? and what do these profitable customers want to buy? From these questions, companies use CRM system to answer them, leading to designing policy on customer acquisition, retention and extension.

To drive CRM systems, CRM software with varying degree of functionalities are used to capture various interactions with customers, analyse them and link them to other major enterprise applications such as ERP and SCM systems. CRM systems provide software and online tools for:

(i) Sales force Automation: these modules in CRM software help sales staff increase their productivity by focusing sales on the most profitable customers.

(ii) Customer service: Customer service modules in CRM system provide information and tools that have capabilities for assigning and managing service requests such as help desks and call centres.

(iii) Marketing: these modules include tools for analyzing marketing and customer data, identifying profitable and unprofitable customers, and designing products and services to satisfy specific customer needs and interests.

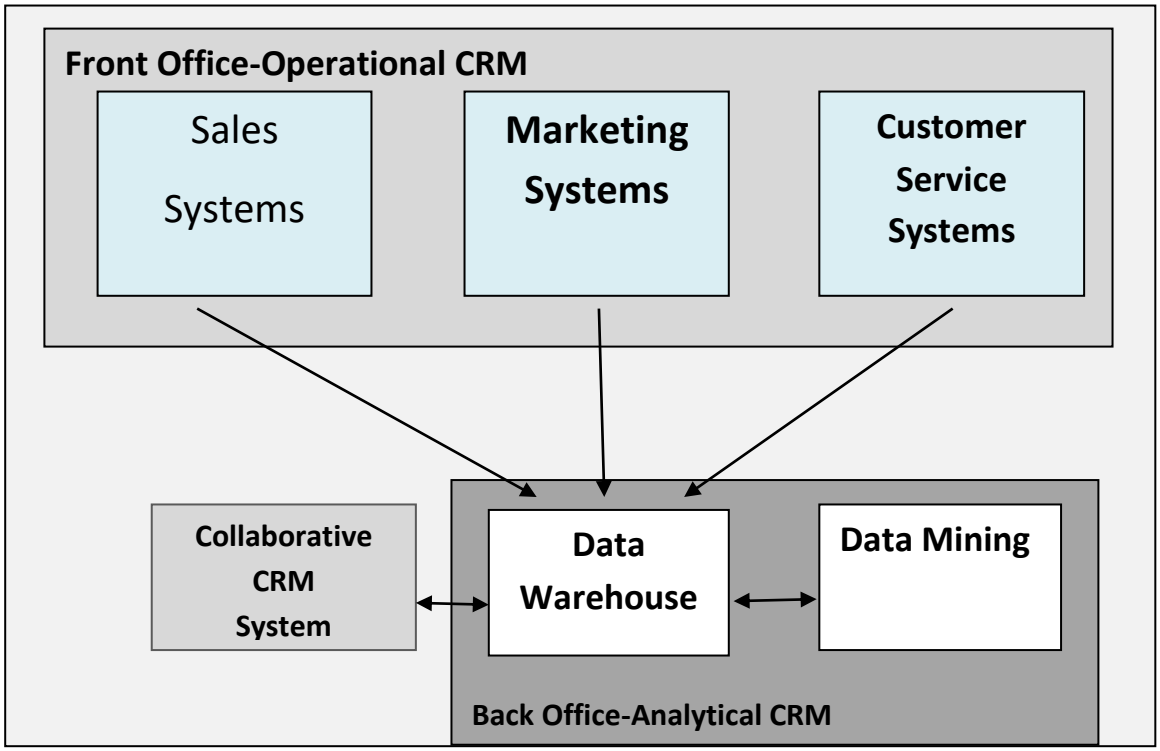
Components of CRM

The two primary components of CRM strategy are:

1. **Operational CRM**: This support transactional processing for day-to-day front-office operations that deals directly with the customers such as tools for sales force automation, call centres and customer service support, and marketing automation.

2. **Analytical CRM**: This is derived from data obtained from operational CRM system that have been organized in data warehouses for use in online analytical processing.

   Analytical CRM supports basic office operations and strategic analysis and include all systems that do not deal directly with the customers.



BUSINESS VALUE OF CUSTOMER RELATIONSHIP MANAGEMENT SYSTEMS

With a CRM system, an organisation can obtain an overview of the customer's products, preferences, account information and other customer information that enable the business to deliver customized product that ensure satisfaction that can add to sales and profits.

This is because effective customer relationship management systems lower the cost of customer acquisition, retention and extension.

4.06 Enterprise Applications Challenges

Many firms implement enterprise applications because of the immense benefits such system offered business organizations.

For example, implementing ERP systems allow a company to increase efficiency and services through the coordination of activities, decisions and knowledge.

CRM system allows a company to operate efficiently and effectively in supporting customer needs. Implementing SCM systems provide opportunity to improve visibility across supply chain and gain increased profitability.

But to obtain this value, companies face many challenges to effect the necessary changes in their processes to fit into the enterprise applications. These challenges include:

(i) Enterprise applications implementation is not only about replacement of a piece of technology with another but also organization process change. When organizational processes are adjusted to fit with the system it compels companies to make change to their processes to work with the software. Such sweeping changes impact strategy, Structure, people, culture and decision-making processes. This requires new organizational learning across the enterprise. Enterprise applications fundamentally changes the way the organization operates, potentially causing employees to accept new job functions and adjust to new business processes. Enterprise applications involve complex piece of software to purchase and implement.

Cost can include the software itself, hardware expenses as well as installation and implementation cost such as consulting charges and implementation training charges. This may pose considerable difficulties to many organizations.

(ii) Enterprise applications are system that span functional areas and focus on executing business processes across the entire. Revamping just a single business process is not a small task.

Having to revamp all the processes in an extended ERP system comprising business intelligence, customer relationship management and supply chain management beside the core business processes is an exceedingly difficult task but nonetheless required for the system to become effective.

4.07 Business Intelligence and Analytics

To improve business performance and decision making, business use their databases to track their operations as well as help managers make better decisions. Nowadays, data of most organization consist not only of transactional data that can fit into rows and columns of relational database managements systems but also obtained from web traffic, e-mail messages and data generated from sensors. The later data are called big data.

However, to derive business value from these data, organizations need new technologies and tools capable of analyzing these data. Business intelligence solution and analytics provide the required technology platform to analyse these data. Business intelligence is a term for data and software tools for organizing, analyzing and providing access to data to help managers and other users make informed decisions. On the other hand, business analytics is defined as the tools and techniques used for analyzing and understanding data. Analytic tools are used for determining relationships, trends and patterns.

Analytic information comprises all organizational information, and its purpose is to support the making of semi structured decisions. Analytical information includes transactional information

as well as market and industry information. Examples of analytical information are trends, relationships, sales product statistics and future growth projections. Analytical tools used for business intelligence analytics include;

Online Analytical processing (OLAP): OLAP supports multidimensional data analysis, enabling users to view the data in different ways using multiple dimensions for example, information on product, pricing, costs or time represents different dimension that can be obtained using a multidimensional data analysis.

Data mining: Data mining is the process of analyzing data to extract information not offered by the raw data alone. Data mining is more discovery-driven and provides insights into corporate data that cannot be obtained with OLAP.

Companies use data mining techniques to identify trends and improve forecasts. Data mining is used on structured data that is already residing in the firm's database. To perform analysis on text documents, PDFs and e-mails involve using text mining and Web mining.

Text mining is used to find trends and patterns on words and sentences while web mining is used to identify customer behaviour and website navigation. The common forms for mining structured and unstructured data are:

Cluster analysis: this technique is used to divide information sets into mutually exclusive groups that the members of each group are as close together as possible to one another and the different groups are as far apart as possible.

Statistical analysis: this performs such functions as information correlations, distribution and variance analysis.

It offers knowledge workers powerful statistical capabilities such that they can be able to build statistical models, examine the model's assumptions and validity.

Association detection: this reveals the relationship between variables along with the nature and frequency of the relationship.

Classification: classification recognizes pattern that describe the group to which an item belongs by examining existing items that have been classified by inferring a set of rules.

Sequences: in sequences, events are linked over time.

Both business intelligence and analytics are about integrating all information streams from a single enterprise-wise set of data and uses analytic tools to manipulate the information that can help managers make better decisions.

Business intelligence is used by different levels of management: lower operational management, middle management and senior management each of these groups has different need for information and business intelligence.

For instance, decision support for operational and middle management includes; management information system (MIS) and DSS, ESS supports senior management.

4.08 Business Intelligence Environment

Business intelligence environment deals with the requirements that must be in place for successful deployment of business intelligence.

These consist of hardware and software management capabilities that vendors supplied, and firms developed. The basic elements in business intelligence environment include:

Data from business: The existence of both structured and unstructured data from different sources that are well integrated form the basis for its analysis and usage for human decision making.

Business intelligence infrastructure: A set of analytic tools that capture all the relevant data needed to operate the business is a prerequisite for business intelligence.

One data may be stored in transactional data or contained and integrated into data warehouse or data marts.

Delivery platform: Business intelligence support decision making. Therefore, the results from business intelligence and analytics are delivered to managers and employees in variety of ways.

MIS, DSS and ESS that business intelligence supports deliver information and, knowledge to different people and levels in the organization.

Business analytics toolset: A set of software tools are used to analyse data and produce reports and respond to questions posed by managers

User interface: Business analytic software suites emphasize visual techniques and deliver reports on mobile devices because of the increase usage of mobile held devices as well as firms' web portal.

Business analytics software is also adding capabilities to post information on Twitters and Facebook to support decision making in an online group setting.

Managerial users and methods: Managers impose order of on the analysis of data using a variety of methods that define strategic business goals and specifying how progress will be measured to ensure that the focus is on the right matters.

4.09 Business Intelligence and Analytics Capabilities

The analytics functionalities that business intelligence system deliver to ensure reliable and prompt information about current operations, trends and changes across the enterprise for strategic decision making include:

- Production report;
- Parameterized reports;
- Dashboards
- Adhoc query/report creation
- Drill down
- Forecasts and models.

4.10 Review Questions

1. Enterprise Resource Planning (ERP) integrates all departments and functions throughout an organization into a single software system. The system ensures that employees have access to enterprise, consolidates and correlates it, and generate enterprise wise organizational reports. Discuss the core processes supported by ERP and the challenges posed by Enterprise

2. What are enterprise applications?

3. How do enterprise resource planning help businesses achieve operational excellence?

4. How do supply chain management systems coordinate planning, production and logistics with suppliers and customers?

5. How does customer relationship management systems help achieve customer loyalty?

6. What are the challenges posed by enterprise applications?

MODULE 5

5.00 SYSTEMS SECURITY AND CONTROL

5.01 Learning Outcomes

On successful completion of this module, students should be able to:

i. Appraise the requirements to protect information systems from destruction, error and abuse;
ii. Evaluate the business value of security and control along with its organizational and managerial framework;
iii. Assess the vulnerability of information systems to destruction and abuse;
iv. Deploy preventive maintenance of information systems to ensure quality services to customers;
v. Analyse how organizations can recover and restore critical functions and processes after disruption by disaster;
vi. Evaluate the tools and technologies for safeguarding information resources and quality;
vii. Assess the various types of computer audit and computer assisted audit techniques.

5.02 Introduction

This module focuses on how to secure your information systems. The widespread use of internet and the growth of networked economy have ensured that key business functions and processes have become interdependent and automatically exchange information within the firm and beyond. Because internet harbours many users, businesses are becoming more vulnerable to a variety of attacks against the information systems by both internal and external attacks. It is therefore imperative for you to be aware of these threats and appropriate counter measures.

5.03 Protecting Information Systems from Destruction, Error, and Abuse

The most important factor in protecting information systems from destruction, error, and abuse is laying foundation for systems security and control.

The impact of internet and growth of a networked economy have raised the concern for information risk and the need for businesses to take necessary measures to ensure adequate control and security of information systems. The need for adequate protection for information systems is anchored on the protecting of interest of those relying on information systems from harm or injury arising from failures of availability, confidentiality and integrity due to errors and omissions, fraud, and intentional damage.

With countries enacting laws on issues like intellectual property, copy right and personnel data companies are witnessing increase in commercial, completive and legislatives pressure for them to institute necessary security and control measures. This is because failures of availability, confidentiality and integrity can easily result in loss of revenue, damage to reputations and legal suits. It is therefore imperative for firms to take necessary steps to ensure protection of information assets by:

(i) Ensuring the integrity of their information systems;
(ii) Ensuring that information systems are available when required;
(iii) Preserving the confidentiality of data;
(iv) Ensuring conformity with the laws and regulations.

Security refers to the policies, procedure, and technical measures used to prevent unauthorized access, allegations, theft or physical damage to information system. Safeguards and controls are policies, procedure, mechanism of hardware or software that when effectively applied, served to minimize or avoid vulnerabilities to impending event that may allow harm to occur to a computer system. Vulnerability arises because of inadequate, ineffective or inefficient safeguards or controls that enable a threat to get through and damage information assets

5.04 Businesses Value of Security and Control

Systems that are unable to function because of security breaches, disasters, or malfunctioning technology can impact on a company's health. Conversely, information systems security and control provide management processes and technology that allow managers of firms to ensure business transactions can be trusted. For instance, systems usually hold confidential information on corporate operations that if placed in wrong hands could have negative effect on their survival and growth.

Hence, a sound security and control framework that protects business information assets can produce a high return on investment. Also, strong security and control can boost employee productivity and lower operational costs.

5.05 Information Systems Control

Information systems control are both manual and automated which are aimed to prevent detect and correct errors, controls irregularities, and omissions occurring in information systems areas and functional business areas.

Information systems control objectives include:

(i) System assets are safeguarded
(ii) System functionality is assured
(iii) System assurance is provided
(iv) System safety is guaranteed
(v) System reliability is assured
(vi) System serviceability is provided
(vii) System security is assured
(viii) Data integrity is maintained
(ix) System availability is assured
(x) System confidentiality is assured
(xi) System controllability is maintained
(xii) System maintainability is assured
(xiii) System usability is assured
(xiv) System effectiveness is ensured
(xv) System economy and efficiency are maintained
(xvi) System quality is maintained

5.06 Classification of Information Systems Controls

Information system controls consist of the following:

(i) **General controls**

These are sometimes referred to as information technology controls and deals with environment in which information system are developed, maintained and operated.

They are therefore concerned with the policies and procedures that help ensure the continued proper operation of computer information systems.

General controls include:

a. Software control: Monitor the use of system software and prevent or detect unauthorized access changes to software programs, system software and computer programs;

b. Hardware controls: physically secure it facilities and check

for malfunction of equipment.

c. Data security: Ensure that all data remain complete, accurate and valid during input, processing, storage and distribution;

d. Computer operations control: Oversee the work of the computer department to ensure that programmed procedures are consistently and correctly applied to the storage and processing of data.

e. Implementation controls: Ensure systems development process is properly managed and control;

f. Administrative controls: Establish and enforce standards, rules, policies and procedures to ensure compliance with general and application controls.

(ii) **Application controls**

Application controls are programmed procedures in application software and related manual procedures designed to ensure the completeness and accuracy of information processing of that application.

Application controls can be classified as:

a. *Input controls*: Input controls check data for accuracy and completeness when they enter the computer system. Input controls comprise: access control; terminal control; verification control; pre-input control; batch control, validity and posting check.

b. *Processing controls*: This establishes that data are complete and accurate during updating. It involves the use of check points, validation checks and exceptions reports.

c. *Output controls*: Output controls ensure that the result of computer processing is accurate, complete and property distributed.

Output controls involve reconciliation of output with input, maintenance of a list of authorized recipients of computer output, policy to regulate the number of copies to print.

5.07 Information Security Policy

Information security involves the protection of information from accidental and intentional misuse by persons inside and outside the organization. The objective of information security is to protect the interest of those relying on information and information systems from harm resulting from failures of availability, integrity and confidentiality. To ensure information systems security there is the need for firms to have effective controls to safeguard sensitive and critical information resources. This is because controls will be meaningless if they cannot be enforced to safeguard the identified risks.

This requires managers of firms to develop information systems security policy to provide framework for developing and enforcing controls. Information security policy consists of rules required to maintain information security. Its objective is to protect the information assets against all types of risks. If also ensures system conformity with laws and regulations, integrity of the data, confidentiality and availability. An information security plan details how an organization will implement the information security policies. The security policy drives other policies determining which members of the business have access to information assets and the acceptable use of the business's information resources.

An acceptable use policy (AUP) defines acceptable uses of the business's information resources and computing equipment. An AUP requires user to follow it to be provided access to corporate emails.

5.08 Computer Crime/Internet Attacks and Controls

Computer crime or fraud refers to using computer resources to engage in unauthorized or illegal acts. Also, a computer crime can be defined as an illegal action, in which the perpetrator uses special knowledge of computer technology. It includes such activities as:

- Stealing money by using computer to electronically divert funds.
- Using computer-based information system (CBIS) resources to falsify electronic data.
- Copying or using programs or data without authorization.
- Using technology resources to eavesdrop on networks not intended for one's use.

This is a growing threat caused by the criminal or irresponsible actions of a small minority of computer professionals and end users who are taking advantage of the widespread use of computers and information technology.

Computer criminals are of four types:

Employees

The largest category of computer criminals consists of those, with the easiest access to computers, namely, employees. Sometimes the employee is simply trying to steal something from the employer, e.g. equipment, software, electronic funds, proprietary information, or computer time.

Outside Users

Not only employees, but also some suppliers or clients, may have access to a company's computer systems. Like employees, these unauthorized users may obtain confidential passwords or find other ways of committing computer crimes.

Hackers and Crackers

Some people think of these two groups as being the same, but they are not. Hackers are people who gain unauthorized access to a computer system for the fun and challenge of it. Crackers do the same thing, but for malicious purposes. They may intend to steal technical information or to introduce what they call a bomb; a destructive computer program into the system.

Organized Crime

Organized crime has discovered that computers can be used just as legitimate business people use them, but for illegal purpose. For example, they are used for keeping track of stolen goods or illegal gambling debts. In addition, counterfeiters and forgers use microcomputers and printers to produce sophisticated-looking documents, such as cheques and driver's licenses.

Forms of Computer Crime

Computer crime can take various forms, as follows:

Damage

Disgruntled employees sometimes attempt to destroy computers, programs, or files. For example, in a crime known as the Trojan horse program, instructions can be written to destroy or modify software or data.

Theft

Theft can take many forms; of hardware, of software, of data, of computer time etc. Thieves steal equipments, of course, but there are also white-collar crimes. Thieves steal data in the form of confidential information such as preferred client lists. They also use (steal) their computer time to run another business.

Unauthorized copying, which is a form of theft of programs for personal gain is called software piracy.

Data Diddling/Unauthorized and Fraudulent amendments to Files

This involves performing unauthorized and fraudulent modification to data stored within the computer system.

The Trojan horse Technique

This is a block of criminal computer code, buried within an authorized program that performs unauthorized acts such as transferring money to a criminal's bank account.

Computer Viruses and Worms

Viruses are programs that "migrate" through networks and operating systems and attach themselves to different programs and databases.

A variant on the virus is the worm. This destructive program fills a computer system with self-replicating information, clogging the system so that its operations are slowed or stopped, thus stopping thousands of computers along it way.

A Computer Worm is also a program that attacks a computer server and network by copying and multiplying itself. It fills up the network or server, thereby creating a heavy traffic on the network, slows it down and eventually stops the entire system.

Viruses typically find their way into microcomputers through copied information on movable storage devices e.g. floppy disks and USB drive or programs downloaded.

Commercial and Industrial Espionage/Eavesdropping

The targets of the eavesdropper are protected/password files and accounts numbers. This allows one to observe transmissions intended for other people. Local Area Networking and other connectivity are vulnerable to eavesdropping. Another similar one is wiretapping.

Software Piracy

This refers to the unauthorized copying or use of programs. e.g. QPRO, PEACHREE, DECEASY etc. Professional thieves make hundreds of copies and sell them illegally.

- **Fraudulent Input**
- **Output Falsification**
- **Manipulation of Data and Codes**
- **Falsification or Deliberate Delays in processing list and balances.**

5.09 Combating Computer Fraud

Security is concerned with protecting information, hardware, and software. They must be protected from unauthorized use as well as from damages from intrusion, sabotage, and natural disaster.

Encrypting Message

Whenever information is sent over a network, the possibility of unauthorized access to it exists. The longer the distance the message must travel, the higher the security risk. For example, an e-mail message on LAN meets a limited number of users operating in controlled environments such as office. An e-mail message traveling across the country on the National Information Highway affords greater opportunities for the message to be intercepted.

Data Encryption security measure involves the use of special computer-generated coding techniques, to store data in a form that is unrecognizable to all users, save those with access control. The level of data encryption and the sophistication of the encryption software used, determines the overall safety of the system.

Restricting Access

Security experts are constantly devising ways to protect computer systems from access by unauthorized persons. Sometimes security is a matter of putting guards on company computer rooms and checking the identification of everyone admitted.

Backing up Data

Equipment can always be replaced. A company's data, however, may be irreplaceable. Most companies have ways of trying to keep software and data from being tampered with in the first place. They include careful screening of job applicants, guarding passwords, and auditing data and programs from time to time. The safest procedure, however, is to make frequent backups of data and to store them in remote locations.

Administrative Control

In addition to the above methods, an organization should try to ensure the following:

* Staff Integrity and Qualification.
* Segregation of Duties /Rotation of Duties.
* Good organization/Distribution of work.
* Physical access/fire precautions.

* Security planning and operating instructions.

The following controls can also be taken:

* Protect file integrity by Accounting Record Controls.

* Input Controls: Authorization, Approval, Control totals.

* Processing/Operating Controls e.g. Password System etc.

* Output controls; proper distribution to authorized persons.

* Monitor System transactions.

* Conduct frequent audits

* Educate people in security measures

* Educate people on ethical considerations.

5.10 Internet Attacks/Controls

a. INTERNAL ATTACKS
b. EXTERNAL ATTACKS
c. ACTIVE ATTACKS
d. PASSIVE ATTACKS

a. Passive Attacks

1. **Keystroke Loggers**
   These are actions of tracking (Logging) the keys struck on a keyboard, typically in a covert manner so that the person using the keyboard is unaware that their actions are being monitored. Thereafter, the keystrokes will be used by the attacker to access the system of the victim.

2. **Traffic/Network Analysis**
   This is the process of intercepting and examining messages in order to deduce information from the patterns in the communication so as to identify areas of weakness to attack a victim.

3. **Social Engineering**
   This is the art of gaining access to buildings, systems or data by exploiting human psychology rather than breaking in or using technical hacking techniques.

It is tricking someone into doing something or divulging sensitive information.

Types of Active Attacks

1. **Brute Force Attack**
   This is an attack that systematically checks all possible *keys* until the correct key is found to hack a system.

2. **Man-In-The-Middle Attack (MITM)**
   It is a form of active eavesdropping in which the attacker makes independent connections with the victims and relays messages between them, making them believe that they are talking directly to each other over a private connection, when in fact the entire conversation is controlled by the attacker.

3. **Port Scanning Attack**
   This is sending a message to each port, one at a time. The kind of response received indicates whether the port is used and can therefore be probed further for weaknesses. It helps the attacker find which ports are available to launch various attacks.

4. **Piggybacking Attack**
   PHYSICAL piggybacking is a method where an attacker slips behind a legitimate employee (who is cleared for access) and gaining access to a secure area that would usually be locked or need some type of security access to enter.

   ELECTRONIC piggybacking involves gaining access to a not properly terminated ID accessed system.

5. **War Driving Attack**
   This is the act of searching for WI-FI wireless networks that are typically unsecured by a person in a moving vehicle, using a portable computer, smartphone or PDA (Warwalking, War biking, War training etc)

6. **Denial of Service Attack (D.O.S)**

   This is the intentional disruption of service to a computer or network resources. E.g. consuming bandwidth, disk space etc.

   Its goal is to deny legitimate access to a particular resource.

7. **Dumpster Divers Attack**

This is the practice of sifting through commercial or residential trash to find items that have been discarded by their owners but that may prove useful to the dumpster diver for future attacks.

8. **Email Attacks**

- Email Spamming: Unsolicited bulk mail
- Email Spoofing: Impersonation of email address
- Email Bombing: Sending huge volumes of email to an address in an attempt to overflow its mailbox (D.O.S)
- Email Phishing: act of attempting to acquire sensitive information by masquerading as a trustworthy entity in an electronic communication.

Preventions and Controls

The first and most important control is PERIODIC SECURITY AWARENESS TRAINING.

Other controls are categorized as follows:

PHYSICAL ACCESS CONTROLS

1. Cypher Locks
2. Laser Rays
3. Fences
4. Security Doors and Guards
5. Dead Man Door (DMD)
6. Physical Access Restriction
7. Biometrics; *comprises methods for uniquely recognizing humans based on one or more intrisic physical or behavioural traits.*

   Examples are finger prints, the iris, body odour, walking gait etc. It is the strongest physical access control method in an organisation.

8. Shredding of unused Documents

9. Degaussing/Demagnetizing CDs and HDDs

10. Breaking up and burning of unused Compact Disks

LOGICAL ACCESS CONTROLS

1. Passwording

2. Data Encryption

3. Backups;

4. Hashing; *Bit of code that represents a larger string. Used to check file integrity.*

5. Firewalls; *software/hardware based. To keep network secure. To control the incoming and outgoing network traffic by analyzing the data packets and determining whether it should be allowed or not, based on a predetermined rule set.*

6. Digital Certificate: *An electronic card that establishes your credentials when doing business or other transactions on the web.*

   Digital Certificate is an "Electronic Passport" that allows a person, Computer or Organisation to exchange information securely over the internet using the Public Key Infrastructure (PKI). Can also be referred to as Public Key Certificate.

7. Digital Signature; *A code or verification used to uniquely identify you. By entering in certain information to validate yourself, the code is created, allowing it to be used instead of an actual signature.*

8. *Penetration Tests; method of evaluating the security of a computer system or network by simulating an attack from malicious outsiders and insiders.*

9. *Ethical Hacking; usually employed by an organisation that trusts the hacker to attempt penetrating networks and/or computer systems using the same methods hackers will use. This is for the purpose of finding and fixing computer/network security vulnerabilities.*

5.11 Electronic Evidence and Computer Forensics

Legal requirement may impose obligation on a firm following a discovery request for access to information that may be used as evidence in a form of digital data.
Such data are stored on portable devices, CDs, computer hard disk drives as well as in e-mail, instance messages and e-commerce transactions. Strong security, control and electronic records management imposes an obligation on firm in respond to legal actions to be able to ensure that:

(i) The cost of compliance is minimal to the firm and the data have not been corrupted or destroy and;
(ii) The electronic document retention policy is adequate and documents, e-mail, and other records are well organized and accessible.

Such retention policy creates a consciousness to preserve potential evidence for computer forensics. Computer forensics has been defined as the scientific collection, examination, authentication, preservation, and analysis of data held on, or retrieved from computer storage media in such a way that the information can be used as evidence in a court of law.

Computer forensics is also increasingly becoming a standard protocol in corporate internal investigations because of its focus on information security and assurance.

Computer forensics deal with the following problems:
(a) Recovering data from computes while maintaining evidential integrity.
(b) Adequately storing and handling recovered electronic data
(c) Fining material information in a large volume of data

(d) Presenting the information to a court of law.

5.12 Computer Audit Techniques

How does management know that information systems security and controls are effective? To answer this question, organizations must conduct comprehensive and systematic audits.

An I.T audit examines the firm's overall security environment as well as controls governing individual information systems. The auditor should trace the flow of sample transactions through the system and perform tests, using, if appropriate, automated audit software. The audit may also examine data quality.

Security audits review technologies, procedures, documentation, training, and personnel. A thorough audit will even stimulate an attack or disaster to test the response of the technology, information systems staff and business employees. The audit lists and ranks all control weaknesses and estimates the probability of their occurrences. It then assesses the financial

and organizational impact of each threat. Management is expected to devise a plan for countering significant weaknesses in controls.

The auditor's approach to a computerized system is not different from that of a manual or mechanical system. Computers and computer applications are widely used to support commercial activities in both large and small-scale business environments and functionalities.

One of the most important aspects of business data processing activities is the production of accurate and useful management information to assist all levels of management within the business, to maximize profit and minimize loss. One of the major control objectives of any business is that management uses information of optimal value, in terms of timelines, completeness, accuracy, consistency, clarity, conciseness, relevance, security and economy, in assisting them to meet the objectives.

This is also the main objective of computer auditing.

Electronic data processing auditing has two facets for an auditor:

i. Proper study and evaluation internal control

ii. Utilization of the computer to perform some audit work, which would have been performed manually.

Auditors approach to Computerized Systems

The nature of auditing approach to electronic data processing systems are:

a) Auditing round the computer or auditing without the computer.

b) Auditing through the computer or auditing with the computer.

Auditing round the computer entails the auditor looking at the input data, the machine produced error listings and the detailed printed output, but he ignores what goes on in between.

This method of EDP system auditing is not recommended.

Auditing through the computer entails the auditor, using the computer hardware and software to determine the reliability of operations that could be viewed with human eyes.

Auditing through the computer can be in either of the two ways:

(1) Using the hardware, the data processing programs and real or simulated data to operate under audit tasks.

(2) Using specialized programs to perform other audit tasks.

5.13 Computer Assisted Audit Tools (CAATs)

Computer assisted audit/assisted tools/techniques (CAAT) are invaluable for compiling evidence during IS audits. The auditor will find several advantages of using CAAT in the analytical audit procedure. These tools can execute a variety of automated compliance tests and substantive tests that would be nearly impossible to perform manually.

These specialized tools may include multifunction audit utilities, which can analyze logs, perform vulnerability tests, or verify specific implementation of compliance in a system configuration compared to intended controls.

CAATs include the following types of software tools and techniques:

- Host evaluation tools to read the system configuration settings and evaluate the host for known vulnerabilities
- Network traffic and protocol analysis using a sniffer
- Mapping and tracing tools that use a tracer-bullet approach to follow processes through a software application using test data
- Testing the configuration of specific application software such as a SQL database
- Software license counting across the network
- Testing for password compliance on user login accounts

Many CAATs have a built-in report writer that can generate more than one type of predefined report of findings on your behalf.

Numerous advantages may exist, but they come at a cost. These expert systems may be expensive to acquire. Specialized training is often required to obtain the skills to operate these tools effectively. A significant amount of time may be required to become a competent CAAT operator.

Some of the concerns for or against using CAAT include the following:

- Auditor's level of computer knowledge and experience
- Level of risk and complexity of the audit environment
- Cost and time constraints
- Specialized training requirements
- Speed, efficiency, and accuracy over manual operations
- Need for continuous online auditing
- Security of the data extracted by CAAT

When auditing complex information systems, IS auditors often need to obtain sample data from systems with a variety of operating systems, database management systems, record layouts, and processing methods.

Auditors are turning to computer-assisted audit techniques (CAATs) to help them examine and evaluate data across these complex environments.

CAATs help IS auditors by making sampling easier and by capturing data that has varying degrees of persistence in an organization's application environment.

TYPES OF CAATS

Generalized Audit Software (GAS)

These are tools specifically designed for the auditors. Facilitates and automate the testing of 100% of a population. It focuses auditors attention on specific areas or transactions which are of higher risk. eg. Audit Command Language (ACL).

This is used to directly read and access data from database platforms and flat files. They can independently and directly acquire sample data from databases, which they can then analyze on a separate system. Generalized audit software can *select samples, select data, and perform analysis on data*. This can help the auditor better understand key data sets in a system, enabling him to determine the integrity and accuracy of a system.

The PRIMARY use of (GAS) is to:

- Test 100% population of transaction
- Focus attention of the auditor on areas of higher risk
- Test controls embedded in programs.
- Test unauthorized access to data.
- Extract data of relevance to the audit.
- Reduce the need for transaction vouching

When using CAATs, auditors need to document the evidence they obtain from systems and be able to link it to business transactions. Often, auditors will have to obtain several other items, including:

Audit hooks

These are embedded in application systems to function as RED flags and to induce internal auditors to act before an error or irregularities gets out of hand.

They are special audit modules placed in key points in an application and are designed to trigger if a specific audit exception or special condition occurs.

This can alert auditors of the situation, permitting them to decide whether additional action is required.

System Control Audit Review File and Embedded Audit Modules (SCARF/ EAM) This is a complex technique of online auditing technique. It involves embedding audit software modules within the application system to provide continous monitoring of system's transactions.

Here, special audit software modules are embedded in the application; these modules perform continuous auditing and create an independent log of audit results.

Integrated Test Facility (ITF)
ITF is used to process test data in a live environment as a means of verifying processing accuraccy.

Its advantage is that periodic testing does not require seperate test process.

This permits test transactions to be processed in a live application environment. A separate test entity is required, however, so that test data does not alter financial or business results (because the test data does not present actual transactions).

Continuous and intermittent simulation (CIS)
Here, the application will contain an audit software module that examines online transactions.

When a transaction meets audit criteria, the transaction is processed by the application and is also processed by a parallel simulation routine, and the results of the two are compared.

These results are logged so that an auditor may examine them later and decide whether any action is required based upon the results.

Snapshots
This identifies the state of a system at a particular point in time.

This technique involves the use of special audit modules embedded in an online application that samples specific transactions.

The modules make copies of key parts of transactions, often by copying database records and storing them independently.

This allows an auditor to trace specific transactions through an application to view the state of transactions as they flow through the application.

Online inquiry

Here, an auditor can query the application and/or its database to retrieve detailed information on specific transactions or groups of transactions.

The auditor most-often has an intimate knowledge of transaction and data structures to make use of this technique.

5.14 Disaster Recovery Planning

If you run a business, you need to plan for vents, such as power outages, floods, earthquakes, or terrorist attacks that will prevent your information systems and your business from operating.

Disaster recovery planning devises plans for the restoration of computing and communications services after they have been disrupted.

Disaster recovery plans focus primarily on the technical issues involved in keeping systems up and running, such as which files to back up and the maintenance of backup computer systems or disaster recovery services.

Business continuity planning focuses on how the computer can restore business operations after a disaster strike.

The business continuity plan identifies critical business processes and determines action plan for handling mission-critical functions if systems go down.

Business managers and information technology specialists need to work together on both types of plans to determine which systems and business processes are most critical to the company.

They must conduct a business impact analysis to identify the firm's most critical systems and the impact a systems outage would have on the business.

Management must determine the maximum amount of time the business can survive with its systems down and which parts of the business must be restored first.

5.15 Quality Control and Quality Assurance

In addition to implementing effective security and controls, organizations can improve system quality and reliability by employing software metrics and rigorous software testing. Software metrics are objective assessments of the system in the form of quantified measurements.

Ongoing use of metrics allows the information systems department and nd users to jointly measure the performance of the system and identify problems as they occur.

Examples of software metrics include the number of transactions that can be processed in a specified unit of time, online response time, the number of payroll checks printed per hour, and

the number of known bugs per hundred lines of program code. For metrics to be successful, they must be carefully designed, formal, objective and used consistently.

Early, regular and thorough testing will contribute significantly to system quality. Many view testings as a way to prove the correctness of work they have done. In fact, we know that all sizable software is riddled with errors, and we must test to uncover these errors.

Good testing begins before a software program is even written by using a **walkthrough** – a review of a specification or design document by a small group of people carefully selected based on the skills needed for the objectives being tested.

Once developers start writing software programs, coding walkthroughs also can be used to review program code. However, code must be tested by computer runs. When errors are discovered, the source is found and eliminated through a process called **debugging.**

5.16 Tools and Technologies for Safeguarding Information Resources

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

Identity Management and Authentication

Midsize and large companies have complex It infrastructures and many different systems, each with its own set of users.

Identity management software automates the process of keeping track of all these users and their system privileges, assigning each user a unique digital identity for accessing each system.

It also includes tools for authenticating users, protecting user identities, and controlling access to system resources.

To gain access to a system, a user must be authorized and authenticated. Authentication refers to the ability to know that a person is who he or she claims to be. Authentication is often established by using passwords known only to authorized users.

New authentication technologies such as tokens, smart cards and biometric authentication have also recently emerged.

Firewalls, Intrusion Detection Systems and Antivirus Software

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

Firewalls

Firewalls prevent unauthorized users from accessing private networks. A firewall is a combination of hardware and software that controls the flow of incoming and outgoing traffic.

It is generally placed between the organization's private internal networks and distrusted external networks, such as the internet, although firewalls can also be used to protect one part of an origination's network from the rest of the networks.

The firewall acts like a gatekeeper who examines each user's credentials before access is granted to a network. The firewall acts as a gatekeeper who examines each user's credentials before access is granted to a network. The firewall identifies names, IP addresses, applications and other characteristics of incoming traffic.

It checks this information against the access rules that have been programmed into the system by the network administrator. The firewall prevents unauthorized communication into and out of the network.

Intrusion Detection Systems

In addition to firewalls, commercial security vendors now provide intrusion detection tools and services to protect against suspicious network traffic and attempts to access files and databases. Intrusion detection systems feature full-time monitoring tools placed at the most vulnerable points or 'hot spots' of corporate networks to detect and deter intruders continually.

The system generates an alarm if it finds a suspicious or anomalous event. Scanning software looks for patterns indicative of known methods of computer attacks such as bad passwords, checks to see if important files have been removed or modified, and sends warnings of vandalism or system administration errors.

Monitoring software examines events as they are happening to discover security attacks in progress. The intrusion detection tool can also be customized to shut down a particularly sensitive part of a network if it receives unauthorized traffic.

Antivirus and Antispyware Software

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

Unified Threat Management Systems

To help organizations reduce costs and improve manageability, security vendors have combined into a single appliance various security tools, including firewalls, virtual private network, intrusion detection systems and Web content filtering and antispam software.

These comprehensive security management products are unified threat management (UTM) systems. Although initially aimed at small and medium-sized organisations, UTM products are available for all sizes of networks.

5.17 Review Question

1. The internet, being the global network of computing resources, forms the ever-expanding information super-highway for the benefits of a business system. However, it also poses very grave danger to such business, some of which are **e-mail attacks**. Identify these e-mail attacks, their uniqueness and list at least seven types of **internet attacks** to a business.

2. Clearly and expressly discuss the different types of Attacks that may be found within the internet.

MODULE 6

6.00 EMERGING ISSUES IN INFORMATION AND COMMUNICATION TECHNOLOGY

6.01 LEARNING OUTCOMES

On successful completion of this module, students should be able to:

- Appreciate the enormous breakthroughs in the world of ICT
- Appraise the impact of this new technologies as they affect the accounting profession
- Learn how to apply these new technologies to the preparation and presentation of financial statements

6.02 INTRODUCTION

"The concept of digitizing everything is becoming a reality. Automation, artificial intelligence, IoT, machine learning and other advanced technologies can quickly capture and analyze a wealth of data that gives us previously unimaginable amounts and types of information to work from. Our challenge becomes moving to the next phase—changing how we think, train and work using data—to create value from the findings obtained through advanced technologies."

Brian Householder, President and Chief Operating Officer, Hitachi Vantara

The fourth industrial revolution, a term coined by Klaus Schwab, founder and executive chairman of the World Economic Forum, describes a world where individuals move between digital domains and offline reality with the use of connected technology to enable and manage their lives. (Miller 2015, 3). The first industrial revolution changed our lives and economy from an agrarian and handicraft economy to one dominated by industry and machine manufacturing. Oil and electricity facilitated mass production in the second industrial revolution. In the third industrial revolution, information technology was used to automate production. Although each industrial revolution is often considered a separate event, together they can be better understood as a series of events building upon innovations of the previous revolution and leading to more advanced forms of production.

6.03 BLOCKCHAIN FUNDAMENTALS FOR ACCOUNTING AND FINANCE PROFESSIONALS

Throughout time, the information and communication technology has undergone numerous transformations for facilitating easier, quicker, efficient and secure sharing and exchange of data, information, and funds in assorted ways. With the emergence of the Internet, digital communications emerged, empowering all forms of data and information interchange through online transactions, such as financial transactions for making payments and receiving funds. The entire transactional and communication system goes through a trusted intermediary which not only guarantees safe and secure delivery, but in case of financial transactions, ensures accurate changes being reflected in multiple accounts.

This trusted party is questionable in case of any failures in updating data, delays in delivery or fraud. But with just a single network controller multiple questions arise:

a. What if this trusted party becomes rogue and cannot be trusted?
b. What if it is hacked and an attacker gets hold of all the data? This intermediary here acts as a single point of failure.
c. Each time an intermediary is used, additional delay in communication occur. Why not communicate peer-to-peer?
d. The authenticity and validation of each transaction is very important, but can the intermediary be trusted?

The solution to all the above problems is provided by the blockchain, the underlying technology invented by Satoshi Nakamoto (considered a pseudonym) in introducing the first ever decentralized cryptocurrency called as 'Bitcoin'

Bitcoin exchange and transfer occur by means of a shared distributed ledger, which records the details of every transaction occurred among the network participants without involving any trusted centralized party. The single copy of the ledger resides in synchronization with all the involved parties, thus reducing the risk of a single point of failure.

6.04 BUSINESS ANALYTICS AND ARTIFICIAL INTELLIGENCE FOR FINANCIAL SERVICES

Every aspect of human life has been impacted by technology in one way or the other. Some of these technologies come with frenzy hypes and then quietly fade away. Others are utterly transformative and fundamentally change our world and the way we live in it (e.g. the

internet). We are in the era of datafication as almost everything we do these days leaves a digital footprint. It is difficult to recall a topic that received so much hype as broadly and as quickly as big data. While barely known a few years ago, big data is one of the most discussed topics in business today across industry sectors. The term is often used synonymously with related concept such as Business Intelligence (BI) and Data Mining. It is true that all three terms is about analyzing data and in many cases advanced analytics. But big data concept is different from the two others when data volumes, number of transactions and the number of data sources are so big and complex that they require special methods and technologies in order to draw insight out of data

The amount of data being generated or created by our activities will continue to increase. How we analyze them and make use of the information obtained is what big data analytics is all about. When people talk about big data, they refer to the exponential explosion in the amount of data we are generating in this digital age as well as our increasing ability to analyze and gather insights from that data. Data brings incredible opportunities to better understand our world and change the way we live in it.

Artificial Intelligence (AI) is all around us; in our mobile phones, watches, cars, home appliances, in our dining and retail experiences, in our offices, in public services, throughout media and beyond. The growing hype surrounding AI's advancement in recent years has led to several observers making damning claims about how AI will soon take over multitudes of jobs, rendering a big percentage of the current workforce jobless.

That may be somewhat of an overstatement because at present, the part of human intelligence that AI is, is actually only a prediction. Prediction is a critical component of AI and is the reason why AI is so powerful today. While AI has not yet reached the level of replacing human intelligence completely, this could still be a possibility in the future as the capabilities of AI are being improved upon[1]. What we need now is to cut through the AI-hype by bringing across a clear definition of what AI is and how it will partner human intelligence in revolutionizing accounting reporting processes.

Before touching upon how artificial intelligence can disrupt the accounting reporting, it is imperative to understand its working and origin. Artificial Intelligence was coined by computer scientist, John McCarthy in 1955. To John McCarthy, "Artificial Intelligence is the science and engineering of making intelligent machines, especially intelligent computer programs". Wikipedia defines it as intelligence exhibited by machines. *Colloquially, the term "artificial intelligence" is applied when a machine mimics "cognitive" functions associated with the human mind such as "learning and problem solving*".

In simple words, Artificial Intelligence is the learning power of machine from its own past experience. That is data feed and decision taken by it in the past. It is not a new concept but gained momentum due to availability of resources and exponential increase in computing power. Directly or indirectly, we encounter Artificial Intelligence but not aware how it affects and assists our work. For example, computer showing trends and materials by itself based on past research, visual assistant, alarm systems, climate control and chat boots.

Main Features

- **Data Ingestion:** It stores vast amount of data
- **Adaptive/Learning:** Depending on the situation and decision made in the past, it tries to adapt itself to the new scenario
- **Unbiased:** processing information and reasoning to arrive at a particular decision is unbiased.

Artificial Intelligence can be classified as structural or non-structural depending on the functionality of the machine. Structural Artificial Intelligence is unable to learn from itself rather it works on defined patterns. Non-structural Artificial Intelligence or neutral network as it is called has the ability for rationalize.

What is Artificial Intelligence?

Russell and Norvig use AI as a term describing machines which mimic human cognitive functions like “learning” and “problem solving”. Where the word AI is used, the term “Machine Learning (ML)” is likely to be found close by too. ML, a subfield of AI and the driver of most of AI’s recent progress, is defined today as the use of techniques that enables computers to learn and continuously improve without being explicitly programmed. In essence, AI and ML (in their current form) consist of techniques which learn to recognize patterns in order to make predictions that facilitate decision-making.

Going deeper with AI and ML has also brought forth more sophisticated techniques like Natural Language Processing (NLP) which combines learning with linguistics, allowing for intelligent analysis of written languages. Advanced AI and ML systems have also allowed machines to produce more accurate results than humans, particularly for areas which involve repetitive work.

The growing hype of AI is therefore not without legitimacy. AI systems are promising and powerful decision tools for organisations across different industries to adopt. But before looking into how they can be implemented, it is important to identify the fundamental trends that allow for AI to be feasibly adopted.

Trend-Enablers of Artificial Intelligence[2]

For AI to gain a strong foothold in today’s world rather than fizzing out several times throughout the several decades before, it leans heavily on four trend-enablers: ABCD.

Availability of Affordable and Powerful Machines. Rapid technological advancement has opened the doors for exponential growth of computing power. This has been accompanied with tumbling costs of computing. While some technology observers claim that Moore’s Law2 is dead or will reach its limits by 2020, the phenomenon where higher computing power follows lowering computing costs is very much alive.

Back to when the hype of AI manifested mainly in science fiction films and TV shows, the cost of large-scale implementation made it infeasible and impracticable. The IBM 3380, in 1980, was the first hard disk drive to have a storage capacity of 1 gigabyte (GB) and had to be housed in a cabinet, making the 250kg device almost as big as a refrigerator. Contrast that with the first commercially available 1-terabyte (TB) SD card (just slightly bigger than a $1 coin) released by Lexar in January 2019 and it is obvious how readily available storage space is. Even though the Lexar 1TB costs US$500, high by today’s standards, that is less than 0.5% of the IBM 3380 which cost upwards of US$100,000.

Enhanced computing power also comes in the form of drastically improved processing speed. These days technology experts have noted that what might have taken weeks to process a

decade ago, took just hours five years ago and can now be done in minutes. Affordability, portability and speed are why AI has now become readily available to businesses for implementation, adoption and use.

Better Algorithms for Use. Much like computing power, AI techniques and algorithms have also seen great improvement in recent times. With multitude of research poured into evolving and advancing the fundamental algorithms behind AI, there is now a whole suite of AI techniques which can be used to solve a variety of different problems. A growing community of developers continuously revise and refine these algorithms while also consolidating them into packages that are accessible for free through open-source programming languages like R and Python.

In the past, programming and coding was seen as extremely technical and even agonizing to do. But today, R and Python's plethora of libraries and packages of AI and ML, coupled with developer communities such as GitHub and Stack Overflow (among many others) have opened the gates for businesses to pick and choose AI algorithms suited for their work.

Cloud Computing has given AI a platform to shine by providing improved accessibility that goes beyond hardware and device storage. Companies have begun migrating to cloud-based platforms so as to run operations directly from the cloud without being bogged down by physical limitations. Cloud providers like Google Cloud integrates AI and ML services into application programming interfaces (APIs) that allow for businesses to develop customized solutions to their problems or for their clients. Cloud platforms also make data storage, computing power and Graphic Processing Units (GPU) scalable, thereby enabling AI and ML algorithms to work more efficiently without the restrictions of on-site hardware. Deep learning using Neural Networks have proven to work at least 10 times faster with cloud-based GPU acceleration as compared to the regular computer processing units (CPU).

Data is Everywhere. Traditionally, data collected for analysis have primarily been numerical and structured. The boom and influx of Big Data, supplemented by the growing number of social media platforms has led to an unprecedented "hunger" for data of all sorts, including images, text and videos. These kinds of data are unstructured and was previously not thought of as usable for analytics or AI and ML. However, Big Data storage systems, whether physical or cloud-based, have now allowed for the storage of unstructured data as well as the processing of these data. A good example is Apache Hadoop, a powerful analytics engine for Big Data. With these ABCD trend-enablers, AI is now well-positioned to completely revolutionize the accounting industry and change the way that accountants work.

The automation capability of AI systems has led to a strong emphasis on the manual tasks they are able to complete in a speedier fashion. This intimidates many professionals including accountants and lawyers because a big part of their work is indeed manual. While these manual tasks are important, the professional aspect of their work involves adherence to codes of conduct, ethical and moral obligations as they apply professional judgment which they are

legally bounded to. Instead of threatening their livelihoods, AI and ML have the capability of assisting accountants with a portion of their work so that they are freed up to focus on fulfilling the accounting profession's purpose.

Rather than replace human accountants, AI and ML become colleagues to their human counterparts and help to get the job done in the most effective and best way possible. The more pertinent question is how can AI partner human intelligence and work together?

Should Accountants be Fearful of Artificial Intelligence Invasion?

Back in 2013, a University of Oxford study by Frey and Osbourne suggested that the accounting profession is among the most at risk of being replaced by AI, largely because of the heavy task-based jobs accountants do. There is some truth in this because AI and ML systems will in the coming years begin to take over an increasing number of tasks from humans. Administrative tasks that are manual and arduous are most definitely going to be fully taken on by AI and ML simply because machines are faster and more efficient than people.

Instead of painting such a grim picture on the future of the accounting profession, this is actually a good thing! In fact, it has been a long time coming and accountants should look forward to this day when they are finally liberated from laborious and boring tasks allowing them to now focus fully on adding and delivering more value to businesses, which is at the core of what they do.

Partners at Work

With AI systems improving rapidly, the rush for everyone to adopt it is unprecedented. Its high accuracy and efficiency in calculations is way ahead of what humans are capable of. *Yet, AI cannot replicate human intelligence completely*. While AI and ML techniques can mimic the human cognitive ability of learning and recognizing patterns, the human intuition combined with logical reasoning that can respond well to complexity and ambiguity have yet to be replicated. This is the reason why AI is unable to fully capture context and string together pieces of physical, visual, behavioural, psychological, emotional information and connect them all together like humans do so spontaneously.

Specifically, within the accounting profession, the approach to the partnership of accountants and AI begins with knowing the strengths of AI and ML techniques. At present, they are able to reliably handle and process voluminous data while also ensuring that there is continuous monitoring so as to learn from new data and errors.

While AI and ML techniques are powerful, models trained on a specific dataset often run the risk of over fitting and hence not generalizable to new data. Even with the influx of Big Data, data quality can be a big problem leading to a "garbage in garbage out" scenario where poor-

quality data leads to results that are unusable. Most of these models are prediction-based ones meaning that their predictive performance and accuracy may vary. *Accountants must also recognize that statistical models and mathematics formulae are the foundation of AI and ML models and this in itself is a limitation because some business problems cannot be easily solved simply by mathematical computations. Only after weighing the strengths and limitations of AI and ML that human accountants are ready to work hand in hand with AI accountants*.

Adopting AI systems will not be the first time in history that accountants have made use of technology to help them do a better job of providing financial information to users, which ultimately is their main objective. Using AI will help achieve this objective through data-driven decision making, data analytics to derive actionable insights and freeing up accountants to work on value-adding tasks rather than being swamped by tedious grunt work.

AI and ML can be implemented in accounting projects involving fraud detection, forecasting and prediction (of cash flows, inventory and revenue), rules identification to improve process automation, full-scale audits (without the need for sampling) and more.

To put it simply, AI is a branch of computer science that deals with the creation of, and research on, humanlike intelligence in machines. AI has been talked about since at least the 1950s, but recent technological developments in both computing and software power have led to significant progress in the development of the field. While high profile events (such as the defeat of the Go world champion by an AI called DeepMind) have received much of the press, it is the less newsworthy, simpler and more focused technologies that are beginning to have a significant impact on business processes.

Recently AI has taken on a much broader meaning and now acts somewhat as shorthand for a range of different technologies and techniques that represent the current leading edge of computerization and Automation. There are a number of ways to classify different types and techniques of AI. However, the majority of AI in current space is so called narrow or task focused AI. The types of AI are;

- AI that provides computers with knowledge – such as machine learning and expert systems
- AI that helps computers to recognise text or images – such as computer vision and natural language processing
- AI that helps computers create images or text – such as artificial creativity and natural language generation
- AI that helps computers copy a task – such as robotic process automation.

Uses for AI

Many of the current applications of AI revolve around sourcing and structuring of data, implementation of complex rules/processes, or the combination of the two. Even in these situations, it may not be the AI that drives all the benefits. In fact, many of the benefits of AI stem not from the AI itself, but from process and procedure reform as part of more narrow deployment of AI.

Sourcing and Structuring of Data

The amount of data in the world is growing, with predictions that it will reach 164 zettabytes by 2051. However, much of that data is unstructured (up to 80 percent), and this means that the data is not presented in a uniform way to provide important context. Many business processes, including advanced analytics and management information systems, need structured data to identify drivers of performance, make predictions, and identify potential relationships. Systems, therefore, have been developed to source and structure unstructured data, many of which use AI to automate the process.

AI to Apply Rules and Process

When experts undertake an analysis of what makes up a typical job role or process, they invariably discover that a significant proportion of that role or process is actually a series of repetitive tasks. Often these tasks are the application of a series of rules (e.g. here are our lending criteria, does the applicant match them?) or processes (e.g. take expense, check the signature matches the authorization levels). Given the repetitive nature of this type of task, it is an ideal candidate for automation by AI. An AI process system will often undertake the task more quickly, more consistently and to a higher standard than a human operator.

The nature of these systems means that the combination of a human and an AI may lead to optimum efficiency and flexibility. Whilst these two categories of use are relatively simplistic they are important first steps in getting AI into the everyday world and therefore much of our focus.

AI and the Application of Judgement

Ultimately, many would like to use AI to automate human judgement, but this is tricky, and the line between true judgement, and the application of sets of complex rules in a way that mimics judgement is not clear. However, what is clear is that there are limited examples of judgement focused AI in real-world application. This is perhaps a reflection of the fact that it is not the technology alone which drives adoption, it is also about trust and control. Many of the areas where there might be value in AI making judgement are areas where society values oversight and ownership by a human who can be called to account. Therefore, there is a need for AI to build trust before it can be applied to true judgement. It is perhaps only when this trust in AI exists that the transformative power of AI will be felt.

Application of Artificial Intelligence in Reporting

Reporting is a mechanism to create trust and transparency in a company's financial position and performance in an efficient manner. It does this through the rules, regulations, assurance requirements and communications practice which are focused on the annual report and other regulatory documents. While the reporting process is both highly complex and effective, there are challenges. *Three specific challenges that we use to explore the potential for AI are:*

• *The efficiency of recording and aggregating transactions, across multiple entities, and then turning that data into an external communication;*

• *The efficiency and effectiveness of providing internal or external assurance over the resulting communication; and*

• *The effectiveness of consuming the information reported by, and about, the company and translating information into insight and ultimately into action.*

AI does not operate in a vacuum. In order to be adopted for reporting, technologies don't just have to solve specific issues, they must also align with wider demands from preparers, users and others.

AI and Production of Report

Reporting and underlying accounting processes are often complex and time consuming. There is potentially the need to record transactions on several systems, aggregate and consolidate the resultant information, and make adjustments, apply judgement and develop estimates. The resulting accounting information then needs to be translated into an external annual report and be supported by relevant narrative. All this needs to happen within a short time frame and in a way that is cost effective, easy to operate and which minimizes the risk of error or mistake.

Two places that AI might be used to help solve problems in the production of accounting and reports are in the efficiency of recording and processing of external transactions and the translation of those transactions into external communications[6].

Transaction processing – A significant proportion of the work of a typical back-office finance function is the routine recording, managing, matching and processing of transactional and other information. Companies need this work done as efficiently as possible and this has led many to outsource business processes or create shared service centres. However, AI can provide an alternative to the outsourcing of such activities. Processes like expenses or accounts payable could use a combination of Optical Character Recognition (OCR, a way for a computer to recognise letters and numbers within an image) to make sense of the unstructured receipts or invoices efficiently. RPA could then post the resulting data into underlying accounting or other systems. Once processed, algorithms (trained using expert systems or machine learning) might

then undertake a quality review, cross-check to other data sources or systems to conclude on the validity of the transaction and flag issues to a human for further follow up. It is not just in the initial processing where AI can be of use; turning the transaction data into accounting data usually involves the classification of an entry. AI systems could auto-classify an entry with an initial category or suggest it to a human user. This might be bespoke to the company, or powered by data from large groups of users (such as is being provided by many cloud accounting tools). The analysis of the data might also be assisted by AI with the automation of Management Information (MI) reporting, ratio and exception analysis. Many of those who are implementing AI in search of efficiency are focusing on specific elements or processes that are easy to automate and are compatible with the current control framework. However, given the overall capacity of AI, wholesale redesign of the entire end-to-end finance process may ultimately lead to the most effective outcomes.

Annual Report Creation –Where organisations have already undertaken basic automation of transactions and MI, further and more complex processes could be considered for the application of AI. The process of creating an annual report is complex, time consuming and not always efficient, and AI could assist. In preparing a report, RPA could provide an ideal technology to create elements of the draft annual report, taking the previous year's report, rolling forward the prior-period numbers, mapping the current period and sending this to the accounting system. AI could help in producing the report by sending out notifications to section owners or perhaps using NLP, (a way to obtain meaning from text and speech) to source material from the company's public statements and MI. Once the report has been finalized, AI could then be used to autotag the accounts with MI tags or XBRL tags to allow onward analysis. AI can also help in to make corporate communications effective by using sentiment analysis to consider how the report will be read. It might also suggest alternative wording to better match management's intention.

Because the reporting process is entity-specific and only happens infrequently, some may consider that it is not suitable for automation. However, standardized off-the-shelf AI building blocks could be used to construct a process that works with only limited entity tweaks, especially where companies have already begun to digitize.

AI and Distribution of Report

Annual reports and other outputs from the reporting process are just the tip of the iceberg of internal data, transactions, consolidations, estimates and judgements made across multiple entities. The resulting aggregate annual report is of value when it can be trusted. Trust is created through compliance with standards, laws and regulation. Compliance is assessed (to some extent) through internal and external assurance and governance processes. However, the modern business is complex and traditional methods of attaining assurance can be costly and may not be efficient or timely, potentially impacting the overall promptness of the resulting

document. AI might be used to help provide assurance on compliance with rules, both internally and externally, in an efficient and effective way.

Inside-out Assurance (efficient)

Auditors (both internal and external) obtain comfort over a consolidated annual report, specific entity report, balances or process by undertaking testing. Typically, comfort is obtained through audit tests of relevant controls and substantive testing of transactions and balances. Testing is undertaken on a sample basis as it is impractical to review all transactions, due to the limitation of the human team to physically review each transaction and follow-up on exceptions. AI, however, potentially provides a different way of approaching the problem. AI combined with data analytics tools might allow 100 percent of certain balances to be rechecked or recomputed and connections to external data sources such as bank or investment feeds could also match and confirm transactions. Another example might see NLP combined with OCR and algorithms to read contracts, invoices and other documents and recheck classification decisions or perhaps identify key terms. AI is good at looking for patterns and therefore could be used to identify fraud or error, either historically or proactively. AI has applications across an audit and could replace individual elements of audit processes or, once trusted by regulators, clients and auditors themselves could be connected together to automate the less judgemental elements of the entire audit.

Outside-in Assurance (effective)

By their very nature, audit and board reviews of reporting are focused on a company's internal records. Both auditors and boards will seek external confirmation of specific elements or facts as part of the validation and review process. However, AI could provide new ways of obtaining comfort on a company's communication. For example, an audit committee that wants to consider if the annual report is fair, balanced and understandable could use textual or sentiment tools to support their review. A board wanting to challenge culture or customer disclosure could use AI tools to source and analyse external opinion such as Glassdoor™ or Twitter™. Other data sources obtained and analysed by AI, such as credit card transactions, web-traffic and shipping activity might highlight areas where the external indicators don't match the company's internal perspective. These types of tools would not just be the remit of boards but could also be used by external auditors or regulators to build up a perspective on an organisation that went alongside more traditional sources of assurance. However, caution is required. As with all analysis, the validity of the result depends upon the validity of the input and AI does not compensate for poor data.

Businesses are complex, as is the data that flows from them. Obtaining comfort over the data is part art and part science. Whilst certainly AI will play a role in both internal and external audit processes in the future, the overall complexity and uniqueness of each business requires a Human plus AI approach for the foreseeable future.

AI and Consumption of Report

The investment industry has long been a user of algorithms, bots and other AI to execute trades much more quickly than a human. However, it is not in trading that the real changes for investors will occur, it is in the process of effectively consuming information. At the heart of the investment process there is a need to effectively understand the past, current and likely future performance and position of a company, as this forms the basis of the investment decision. Traditionally investors' understanding has been obtained through analysis of companies' own public disclosures (across a range of documents such as the annual report, presentations etc). However, the amount of information about all aspects of our lives is growing exponentially, and this is also true for information about companies. The information that a company publicly discloses is only a small historic slither of potential investment-relevant data. Investors have therefore increasingly looked at alternative data sources for insight into the likely future performance of a business, in real-time. The scope and nature of alternative data is potentially very wide; from satellite images of farms to credit card and social media data. This wide pool however, leaves investors with an issue; how can the data be managed, its credibility judged and the data be made useful, so that real investment-contextual insight can be obtained and actioned? Many investment organisations and their data providers view AI as a potential solution to the challenges of collecting, collating and creating actionable insight from data.

Creating an Insight Engine

The first stage of creating actionable insight is to gather together the relevant data. AI can assist here as web crawlers and other bots (small programmes) can source alternative data sets from across the web. RPA can also be used to take standardized data sets (such as government economic reports or structured reports) and process them into a database. Once the data is gathered AI can then undertake additional analysis. Techniques such as data mining and sentiment analysis can be used to identify key words, phrases or overall tone which might match with a specific characteristic such as indicators of credit worthiness. More recently deep learning and machine learning techniques have been used to identify patterns between future events (such as credit default) and management disclosures. Such models might also make connections between government data or social media data and specific future events. The resulting analysed data will then either be fed into a wider model or flagged to a human analyst for further consideration and possible investment decision.

The investment process is dependent upon the effectiveness of ingestion and analysis of lots of information in relatively short time frames. The time constraints and the requirement to deliver better insight at scale and for low cost make for an attractive AI use case. The process and information sources are also relatively structured and standardized, which further enhances the case for AI. However, what one investor can do, so can others. Over the longer-term, the

commoditization of AI within the investment analysis sector could erode any competitive advantage from using AI and/or alternative data.

Taking company data from across an organisation, aggregating it into a single communication, then distributing it to an audience of investors who want to analyse it and combine it with other external information is complex. Because it is complex, it typically involves large numbers of people at each stage. AI provides opportunities to drive efficiency in what we do now and enhance effectiveness by doing things differently.

Key uses for AI in each stage include:

Production – AI can enhance efficiency by replacing mechanistic human processing of underlying transactions and transforming that data into accounting and management information; ultimately feeding into annual reports.

Distribution – AI can support auditors and boards in the internal and external validation processes needed to ensure that the annual report is credible and compliant in an efficient and effective way.

Consumption – Investors are already using AI to enhance effectiveness of investment analysis by extracting meaning and value, not only from company reporting, but also from various sources of alternative data.

Whilst each of the use cases are independent they all rely on two things; quality data and a mix of accounting, technology and governance skills. Many of the use cases for AI need data in order to make them work. The use cases we have considered in this paper point to the same conclusion; quality data is important. The need for data in an AI-based economy has led to a number of governmental and industry initiatives which consider questions around access to data, structuring, privacy and bias.

In the world of AI, data has value; but structured data has even more value. When thinking about reporting many of the distribution and consumption use cases are using data sources that are digital by design. However, the information a company reports from its reporting process is not digital and in fact is still predominately paper-based. To facilitate the use of reporting information, data that is required to be made publicly available could be done so in a way that is open, structured and allows for low cost aggregation and reuse. Preparers, users and regulators could discuss how to embed the principles of openness, structure and reuse into new and existing corporate reporting requirements.

Many of the current AI use cases revolve around bolting AI on to existing processes. This is not surprising as it represents the continuation of well understood and controlled processes. However, many of the most interesting opportunities around doing things more effectively need the rethinking of processes with AI in mind. This mixing of skills is difficult and often relies

on external consultants to provide the additional perspectives needed within a finance or governance project. But ultimately, we need to embed the expertise of AI directly into governance, finance, boards, advisors and regulators through training and development.

Advisors, professional bodies, tech firms and regulators should continue to work together to embed key AI skills into those current training and development programmes to upskill those already in the work place.

Boards might also consider how they are going to meet the challenges that AI brings either through bringing AI focused individuals into the boardroom, or through wider training. For AI, as with many of the new technologies today, new ways of working are needed. All stakeholders need to work together to understand how reporting empowered by AI needs to evolve to ensure that quality, trusted reporting output is maintained and enhanced.

6.05 CYBERSECURITY AND SUPPLY CHAIN

High-profile companies are increasingly being devastated by cyber-attacks that cause financial losses and that damage their brand reputation. Organisations are struggling to protect the confidentiality, availability and integrity of data. Information security has become more complex due to innovations involving big data storage, predictive analytics, and the use of cloud-based solutions. Electronic tools such as e-sourcing and automated procure-to-pay systems complicate matters further. Over and above all of this, there is the people problem. There are many weak links in the supply chain including importers, foreign manufacturers, agents, transport companies and third-party logistics service providers. Hackers, whose main objective seems to hold organisations to ransom, can infiltrate any of these layers.

The Key Risks

Cyber-attacks do not always come through the front door. Businesses depend on trusted relationships with their third-party suppliers and service providers. Many of these are vital suppliers of components and maintenance; others are providers of professional services such as marketing, accounting and I.T. Many cyber-attacks come through these backdoors.

Third Party Suppliers

Your company may have a cyber-security risk strategy but what about your key suppliers that can access your systems? Smaller companies contracted to larger companies are often targeted because they are more vulnerable. A niche company supplying vital goods or services may have an access to important information and only have a very immature approach to data security.

The next problem is your suppliers' suppliers, also called tier 2 suppliers. You may have addressed security weaknesses in your own proprietary software but the problem may lie with your solutions providers. Poor information security practices by lower-tier suppliers can sink companies. It is estimated that over a third of corporate IT breaches are via third-party suppliers.

Cyber-attacks can lead to intellectual property breaches, sub-standard or interrupted operations, sensitive data custody breaches, and decreases in service level to final customers.

Software Solutions Providers

Cyber-attacks can be delivered through counterfeit hardware or software that is embedded with malware. Supply chain functions are often outsourced in an attempt to reduce infrastructure costs – these are the ones that require extra diligence. Website builders and data aggregators are a risk as well as "watering holes", where the attacker guesses or observes which websites are vulnerable and infects one or more of them with malware.

Lack of Awareness Among Employees

Education and training are recommended for both own employees and those of key suppliers. Bring your own device (BYOD) facilities in the supply chain can cause major security issues especially with mobile devices. The level of malware protection and detection performed on these devices is usually inadequate. Job roles re-opening up in cybersecurity, there are not enough trained people available yet. "Phishing" has become commonplace, this includes attempts to acquire usernames, passwords and credit card details via email for fraudulent purposes. **"Cybersecurity is never just a technology problem, it's a people, processes and knowledge problem."** National Institute of Standards and Technology (NIST).

Mitigating the Risks

As well as financial losses and brand damage, cyber-attacks, can lead to intellectual property breaches, sensitive data custody breaches, and decreases in service level to final customers. Improving the quality of the relationships amongst all members of the supply chain is important for improving cybersecurity. Here are a few ways to stay safe:

- Create a cyber-crisis team to be first responders. Re-arrange resources and develop contingency plans thereafter
- Train people to follow security procedures and educate them about the risks
- Improve processes e.g. due diligence for new suppliers must assess cyber risk upgrade internal technology. Tight guidelines for supplier access are a strong defense

Cyber Resilience

The phrase cyber-resilience in supply chains has been coined to explain what is still to be achieved in the process of mitigating risks. Companies must invest in supply chain capabilities to withstand and identify potential cyber-attacks. Many cyber-attacks remain unreported. There have been some visible many recent examples of cyber breaches.

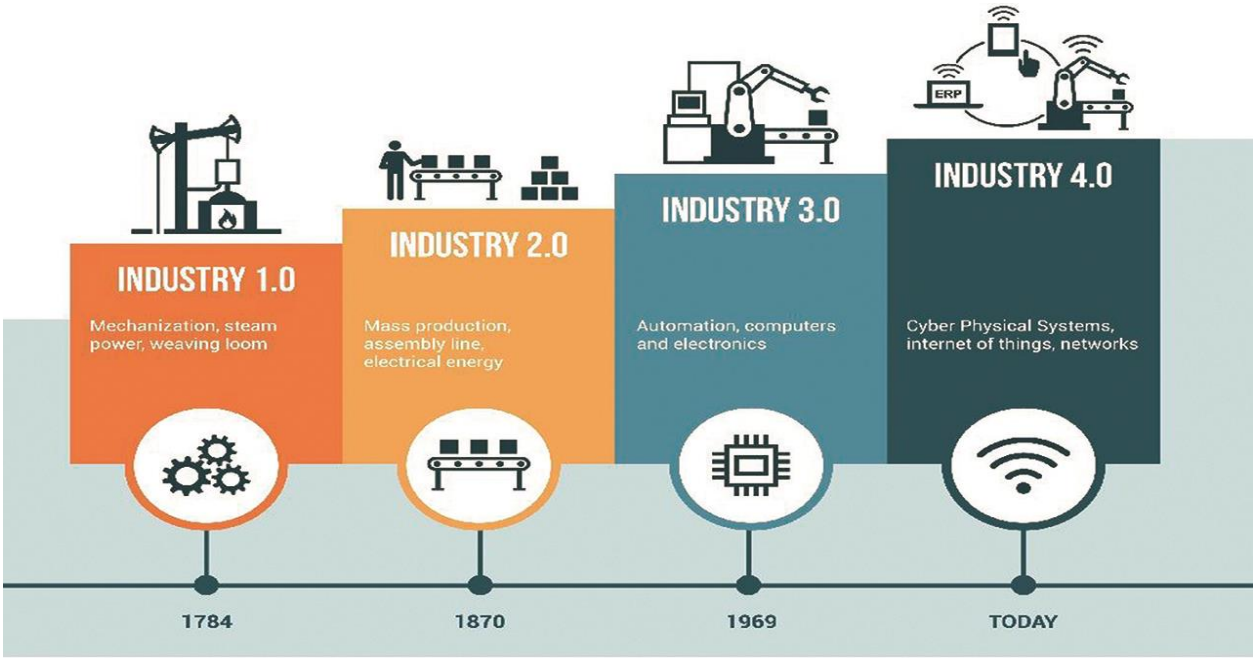
Ransomware Halted Maersk's Supply Chain

NotPetya malware hit global businesses in approximately 59 countries in late June 2017, an attack which prevented one of the largest container shippers, Maersk Line, from taking new orders. The attack came at a vulnerable time which the company was upgrading its automated order entry system. Maersk was forced to halt operations in some of the 76 ports in those 59 countries. Inaction by senior management is compounded by the increasing complexity of global supply chains. Many businesses will not even realise the level of access that their supply chain has. Key suppliers should be on their risk dashboards.

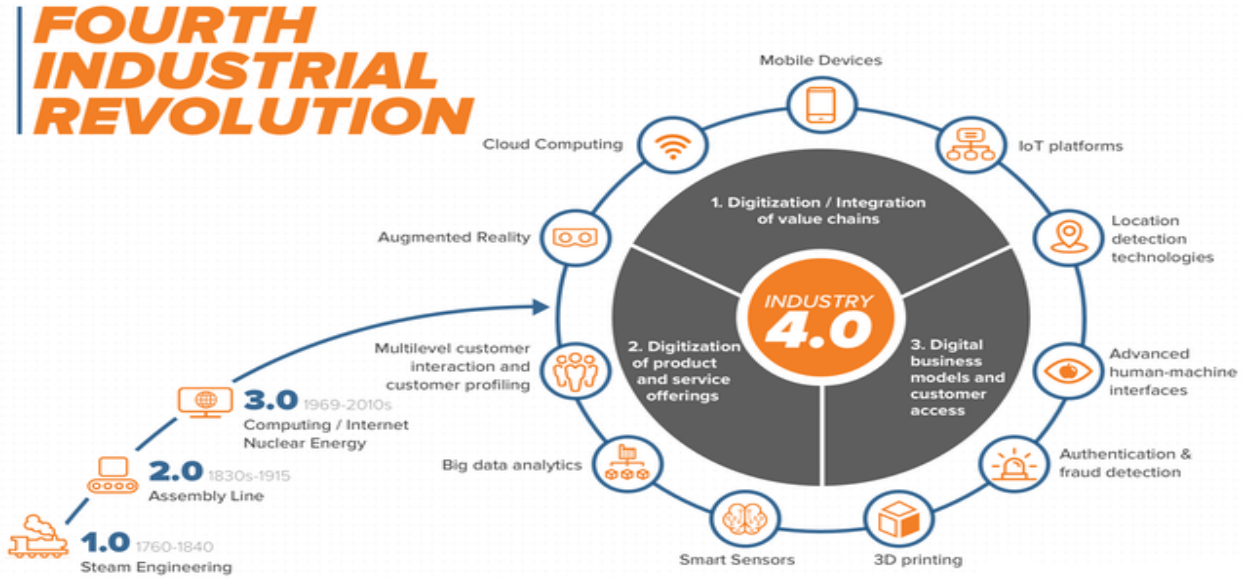
6.06 SYSTEMS AND TECHNOLOGIES FOR GOVERNANCE AND OVERSIGHT: THE FOURTH INDUSTRIAL REVOLUTION

Industry 4.0 signifies the fourth in a series of industrial revolutions, which are characterised by their ability to transform economies, jobs and even society itself through the introduction of new technologies and processes. Beginning in the late 18th century with the advent of steam power and the invention of the power loom, the first industrial revolution ushered in

mechanisation and radically changed how goods were manufactured. In the late 19th century, electricity and assembly lines made mass production possible, giving rise to the second revolution. Many cite the third revolution as beginning in the 1970s, when advances in computing enabled us to program machines and networks, powering automation



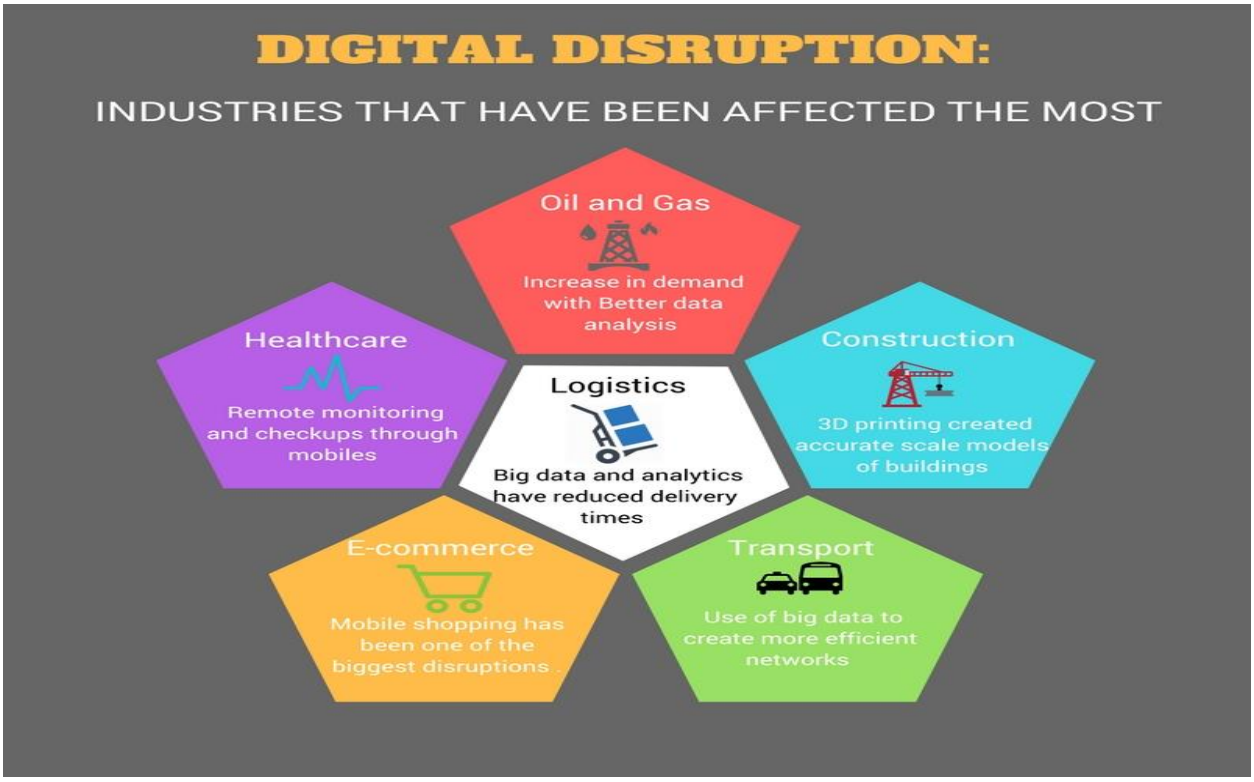
Definitions for Industry 4.0 abound, but the change it portends at its core is the marriage of physical and digital technologies such as analytics, artificial intelligence, cognitive technologies and the internet of things (IoT). The Fourth Industrial Revolution can be defined as the revolutionary change that occurs when IT proliferates in all industries, that is, the primary, secondary, and tertiary industries. In other words, it is a result of the horizontal expansion of IT. Industry 4.0 can herald greater opportunities than any that came before it. And greater risks.



MAJOR TECHNOLOGICAL DISRUPTIONS WITH DIGITALIZATION

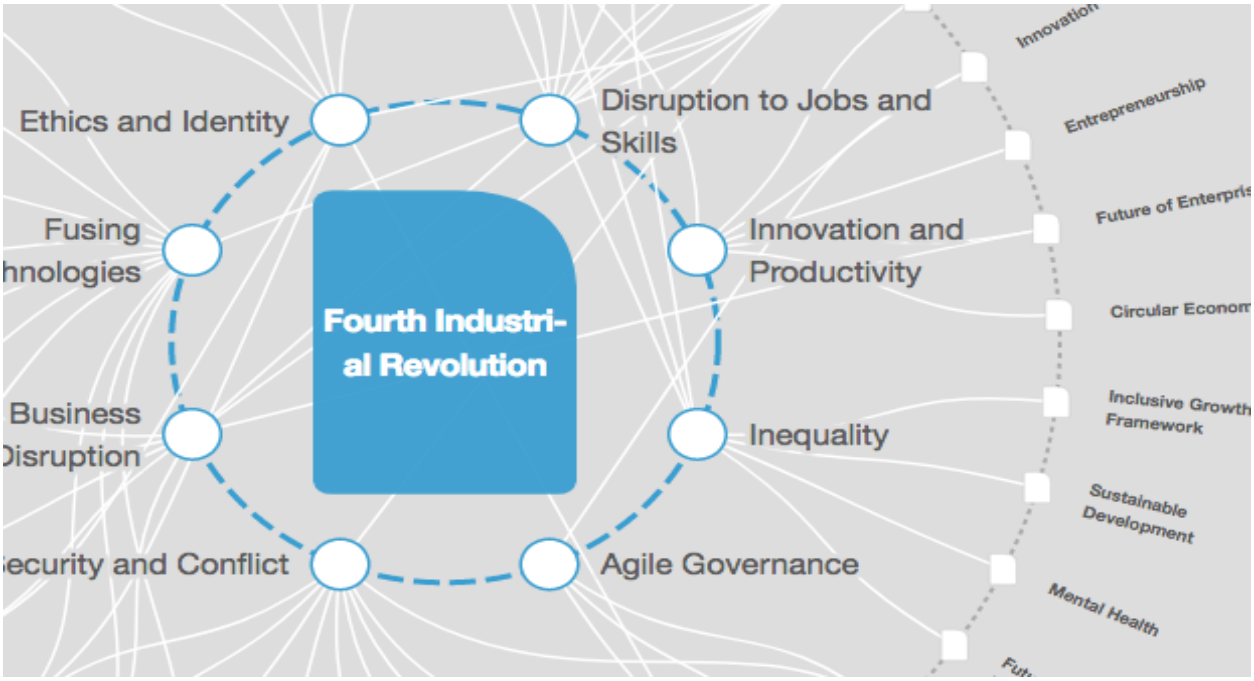
The amalgamation (technology fusion between artificial intelligence and robotics will generate completely new production processes in manufacturing and services with lower resource intensity (basically labor). Digitalization technologies will massively enter all sectors and will generate new services and a closer interaction with customers. Again, efficiency will be affected positively and many physical products will be displaced by digital products (e.g., newspapers become digital, transport services are no longer required with data transfer, 3D-printing technologies, etc.).

New bio-based materials and energy sources will replace oil-based materials and energy sources. The so-called knowledge-based bioeconomy is required to return to a sustainable development path. Also, consumers will play an important role in the Fourth Industrial Revolution because, in particular, digitalization technologies will allow for an evolution of a sharing economy (e.g., concerning mobility, food, tools, etc.).



DIGITAL AGE WITH INTERNET OF THINGS, OR INDUSTRIAL INTERNET

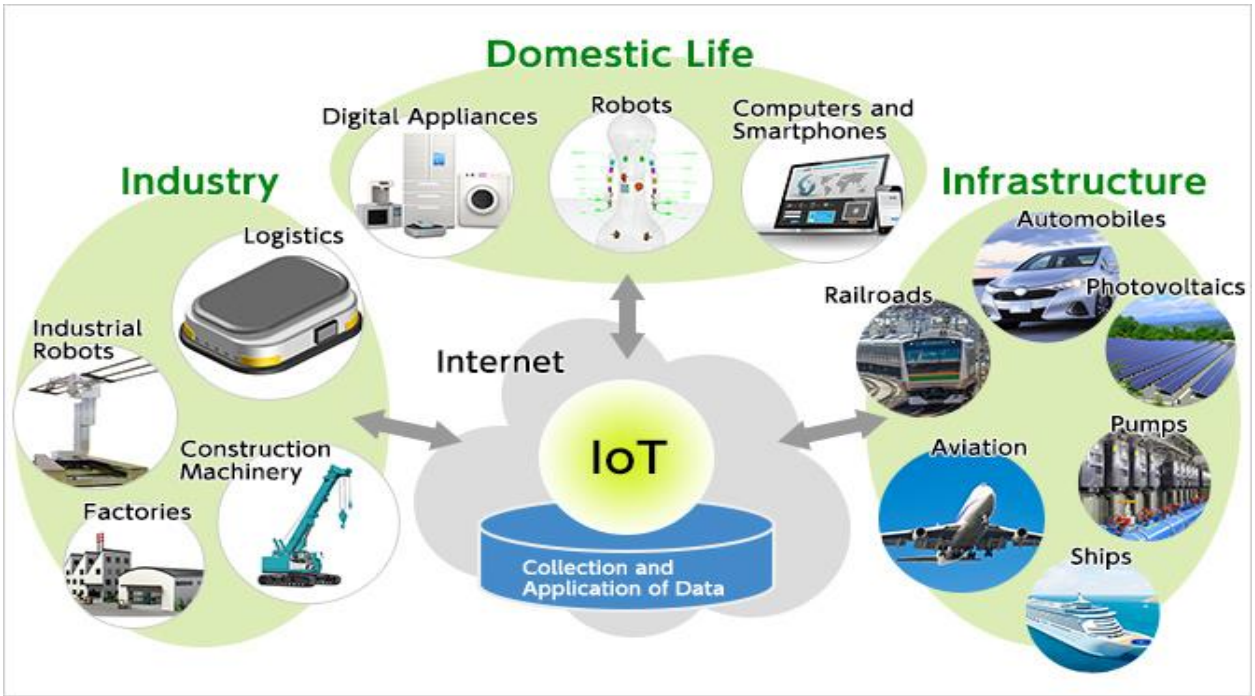
Various interchangeable labels have been coined and used to describe the innovations of today's new socioeconomic era, such as the Digital Age, the Fourth Industrial Revolution, the Internet of Things/Everything, or the Industrial Internet. Two main drivers of the Fourth Industrial Revolution can be recognized, on the one hand, the development of industries from the pre- to the post- Fordism era, and on the other hand, the development of the internet or 'digital world', i.e., all applications and infrastructures related to the Web. These innovations will increasingly transform how organizations and institutions do businesses, operate their productions, affect society, and make their ecological footprint as well as how people live their lives.



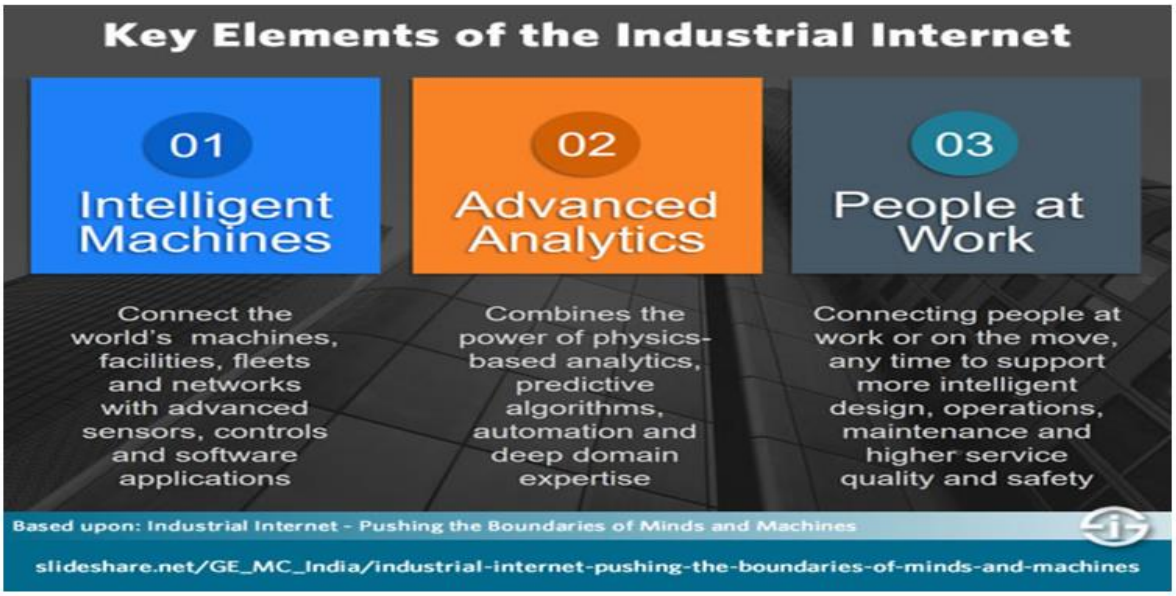
OPPORTUNITIES OF THE FOURTH INDUSTRIAL REVOLUTION

Reduce barriers between inventors and markets due to new technologies such as 3D printing for prototyping.

Innovative technologies will integrate different scientific and technical disciplines. Key forces will come together in "a fusion of technologies that is blurring the lines between physical, digital, and biological spheres." (Schwab 2015) This fusion of technologies goes beyond mere combination. Fusion is more than complementary technology, because it creates new markets and new growth opportunities for each participant in the innovation. It blends incremental improvements from several (often previously separated) fields to create a product



Robotics can and will change our lives in the near future. Technically robots are automated motorized tools. They cook food, play our music, record our shows, and even run our cars. But we just do not see it because robots do not have a face, we to whom we can talk or a butt we can kick. (Tilden) Consequently, robots have the potential to improve the quality of our lives at home, work, and many other places. Customized robots will create new jobs, improve the quality of existing jobs, and give people more time to focus on what they want to do.



Increasing trends in artificial intelligence point to significant economic disruptions in the coming years. Artificial systems that rationally solve complex problems pose a threat to many kinds of employment, but also offers new avenues to economic growth

The Internet of things (IoT) is the Internetworking of physical devices. Typically, the IoT is expected to offer advanced connectivity of devices, systems, and services that goes beyond machine-to-machine (M2M) communications and covers a variety of protocols, domains, and applications.

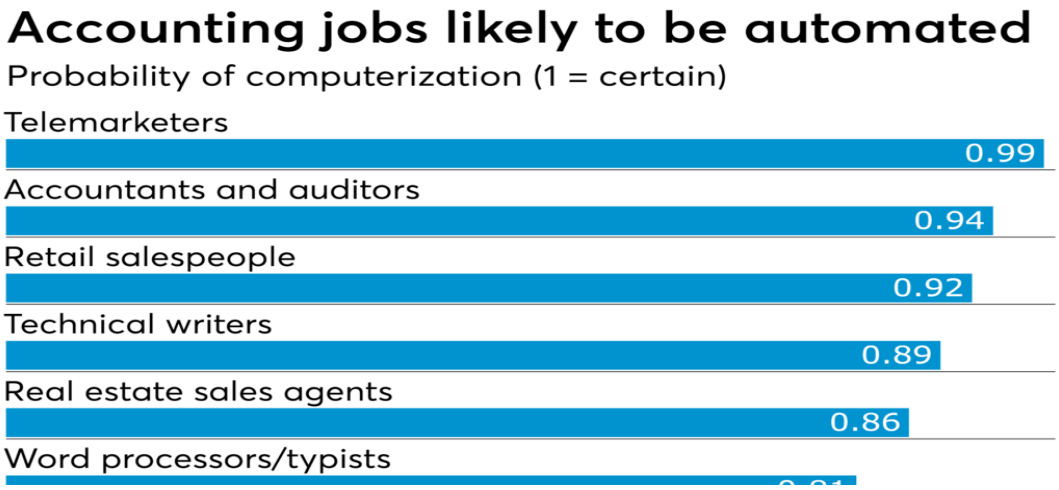
THE FOURTH INDUSTRIAL REVOLUTION AND THE ACCOUNTANCY PROFESSION

ONCE THE DRUMBEAT CHANGES, THE DANCE STEPS WILL CHANGE. Technology is disrupting the Financial Sector and the Accounting Profession. A key benefit of technological developments is the removal of the need for slow, manual processes, enabling accountants to spend more time on adding value to the business.

Also, cloud technology has lowered the infrastructure support costs for organisations. New technology allows a greater analysis of business drivers, using insight and actionable analytics to achieve a competitive advantage.

Accountants are therefore moving away from bookkeeping and stewardship to become strategic business partners. Routine and process-driven roles will decrease while roles which require thinking outside the box will be in demand.

Accountants have grasped this “inexorable tide” of technology overall, but the challenge lies in completing day jobs in time to deliver the change of the future. Many people’s daily routines are so hectic, that even thinking about different ways of working is impossible



Most accountants have come round to the idea that change needs to happen, but the delivery of change is still in its infancy. Some customers also still need persuading that technology is the way forwards. They need to remember that their competitors are using technology to drive growth, so they must too.

Technology has enabled finance teams to do three key things at pace: produce and create value, shape how it is done, and tell the story of how it is achieved. In the past, finance was focused only on cost, whereas now it can contribute value creation and value preservation.

In particular, accountants can make use of software-as-a-service (SAAS) technology, which allows access to individual applications and is hosted on the cloud. As well as lowering infrastructure costs, set-up costs are cheaper and the speed of implementation is greatly improved.

Cloud technology is also secure and allows seamless updates to be performed. The level of insight which can be obtained from it far surpasses anything that is possible on an On-Premise system and any changes, such as adding new companies, can be almost instantaneous

6.07 SYSTEMS AND TECHNOLOGIES FOR ENGAGEMENTS

The term Systems of Engagement is widely credited to Geoffrey Moore, who wrote one of the most influential books regarding the topic of innovation – “Crossing the Chasm.”

In his paper “Systems of Engagement and the Future of Enterprise IT,” Moore stated that IT departments needed to shift from building systems of record to the new social, mobile systems

of engagement, and that the next trillion dollars of IT spend would go into managing the needs of this new user-centric world.

Since the publishing of Moore's paper in 2011, the term and its assertions have been widely accepted by the technology community with various attributes being identified - e.g. not like the systems of record; focused on people and not the process; harnesses mobile, social, cloud and big data technologies - but no firm definition of the term has been provided. If Enterprise IT is going to spend the next trillion dollars in building these Systems of Engagement, then we need to take a shot at defining it:

'a system of engagement is a system where engagement primarily powers the system (not the record).'

The applications we use to operate our businesses can be divided into two categories; Systems of Record and Systems of Engagement.

Systems of Record are the enterprise level applications that run our business (financials, manufacturing, CRM, HR). They must be stable and provide a 360° view of the business. These systems are process oriented and are the repository for the information we need to make prudent fact-based decision.

Systems of Engagement are people-focused applications that are designed to equip and enable customers, partners and employees with the tools they need to interact with the business. Systems of Engagement overlay and complement Systems of Record and harness any number of technologies including mobile, social, cloud and big data innovation.

They give us the ability to win, serve and retain customers through exceptional digital experiences delivered where they work and live. In the age of the customer, businesses are reallocating more resources than ever before to improve their Systems of Engagement to meet the needs, goals and ambitions of their customers. We've even found that some Systems of Engagement, as they mature, can evolve into de facto Systems of Record.

Reasons for change

As businesses grow, many find themselves in the position that their applications don't fit their needs as well as they once did. There are any number of reasons for this. They can range from increased reporting needs in the System of Record to a new service offering that isn't accounted for in the engagement systems.

The most common reasons stakeholders consider modernizing a System of Record are:

- Improving the availability of skilled support resources who are versed in their new technology platforms, or
- Improving the user experience (UX), or
- Adding new features to automate manual processes, or
- Adding analytics and business intelligence capabilities, or

- Reducing operating costs for aging technology, or
- Reducing support costs.

Businesses build Systems of Engagement with the customer in mind. Web services, mobile, analytics, CRM, and loyalty programs are all examples and since they're customer-centric they must continually evolve to improve customer experience. The most common reasons Systems of Engagement are changed are:

- Customer behavior shifts, or
- New opportunities arise, or
- The user experience gets stale, or
- The business's needs expand or shift, or
- New technologies/platforms emerge and old one's sunset.

6.08 SYSTEMS AND TECHNOLOGIES FOR INTERPRETATION

The translation of written language, the translation of spoken language and interpreting have traditionally been separate fields of education and expertise, and the technologies that emulate and/or support those human activities have been developed and researched using different methodologies and by different groups of researchers.

With the advent of new technology, interpreters can work remotely, deliver interpreting on many devices (phones, tablets, etc.), and manage multiple bookings with ease. Still, interpreting is a human activity and has resisted complete automation. While Skype Translator and similar applications support fully automated interpretation—with the help of voice recognition and machine translation—for business purposes there is no replacement for human interpreters.

The translation of written language, the translation of spoken language, and interpreting have traditionally been separate fields of education and expertise, and the technologies that emulate and/or support those human activities have been developed and researched with different methodologies and by different groups of researchers. A recent increase in synergy effects between these well-established fields has begun to blur the boundaries. However, this section will adhere to the three-fold distinction and begin by giving an overview of key concepts in relation to written-language translation and technology, including computer assisted translation (CAT) and fully automatic machine translation (MT) in section 1.1. This will be followed by an overview of spoken-language translation and technology in section 2.2, where a distinction will be made according to whether the translation product is in a written form (speech-to-text translation, STT) or in a spoken form (speech-to-speech translation, SST). The key concepts of ICT-supported interpreting, which is currently separate from the technological

developments in written- and spoken-language translation, will be outlined in section 1.3, followed by an overview of current usages of translation and interpreting technologies in section 1.4.

6.08.1 Written-language translation and technology

There is a great range of MT systems, based on different philosophies and computer algorithms, with different advantages and disadvantages, but a feature they all share is that they are normally used as fully automatic devices, translating a source text into a target language without human intervention. In contrast to this, human translation, or for short simply translation, is an exclusively human activity without intervention by machines or collaboration between humans and machines, other than interaction with a word processor and perhaps the use of electronic dictionaries.

In between these two extremes of translating a source text into a target language, there is a plethora of tools and workbenches available that support human translators in their translation tasks (cf. http://en.wikibooks.org/wiki/CAT-Tools). Depending on the extent to which computers or humans are in the centre of the translation task, a more fine-grained distinction exists between CAT and human assisted machine translation (HAMT). Using a computer (typically a PC) to draft or format a translation is not normally considered to be a kind of CAT, even though, in a strict sense, this usage of the term would be justified. As the term is commonly used, CAT implies at least the use of electronic mono- or bilingual dictionaries, terminologies, collocation or (bi-)concordance tools, and typically translation memories. In more sophisticated versions of HAMT, an MT system would be at the core of the translation process. As the accuracy and speed of computational devices is increasing, novel forms of human-machine interaction in translation, such as interactive translation assistance, usage of multiple modalities, integration of written and spoken language, gesture and handwriting recognition, optical character recognition (OCR), speech synthesis, etc. are being explored and likely to become part of professional translation environments in the near future. These tools can—at least in principle—be combined in almost any configuration. In practice a number of workbenches exist to facilitate and support the human translation processes in various different ways.

Translation memory systems (TMs) are often used as a synonym for CAT tools. TMs do not translate by themselves. Rather, they retrieve close matches of a source-language string from a bilingual database (a so-called translation memory) and display the translation(s) associated with the retrieved segments to a translator for him/her to adjust. For this to be possible, a translation memory of aligned translations first has to be created on a segment-by-segment basis. A number of alignment tools are available to carry out this process either interactively or fully automatically. A TM also computes the similarity between the sentence to be translated and similar source-language sentences in the translation memory. The comparison is mostly

based on orthographic similarity. The assumption is that similar source sentences have similar translations so that the translator can select and adapt a translation of a similar source segment. Indeed, translators are often paid by the degree of similarity: 100% identical segments are considered to require no work on the part of the translator and are therefore often not paid at all. Given the increased quality of MT system output, the use of fully automatic translation is constantly growing. Unlike TMs, MT systems generate 'proper' translations from source texts, often based on carefully selected and tuned resources. However, depending on the expected quality of the translation product, post-editing of MT output (PEMT) is often necessary to bring the raw MT output in line with the intended purpose of the translation and to erase major translation errors and flaws that would hinder or inhibit the comprehension of the translated text. A number of MT post-editing platforms have emerged recently to facilitate this process. Like TM systems they show each source-text segment together with its MT output for post-editing (O'Brien et al. 2014). Post-editors usually receive a translation brief specifying the intended audience and the expected quality of the final translation product. Given the tremendous variety of resources used in an MT system—including bilingual dictionaries, phrase translations and their source-target alignments etc.—integrated MT post-editing platforms are being developed that facilitate interactive human intervention by supporting post-editors in selecting from alternative partial translations, tracing partial translations, visualizing confidence scores etc.

6.08.2 Spoken-language translation and technology

With regard to spoken-language translation, technological developments are still in their infancy. Automatic spoken-language translation systems are a concatenation of automatic speech recognition (ASR) and machine translation (MT) systems with an optional speech synthesis system for spoken target-language output. Transcribed speech (i.e. the output of ASR systems) differs significantly from written text. ASR output therefore requires a number of additional modifications to be suitable input for MT systems. Some of the characteristic features of spoken language, i.e. hesitations (hmm, uh, etc.), discourse markers ("well", "you know"), self -corrections ("it is- it was ..."), repetitions and incomplete sentences produce ill-formed text that may be difficult to understand even for human readers. In addition, as ASR systems (seek to) generate a faithful transcript of the spoken words, the transcribed output also lacks segmentation and punctuation marks, making it difficult to determine when a sequence ends and is "ready" to be translated. This creates problems for MT systems which normally expect well-formed and sentence-segmented written input text. A number of operations are thus necessary to reformat and map the output of the ASR system to fit the input requirements of MT systems. Most currently available speech translation systems operate in a consecutive fashion whereby a speaker inputs an utterance, the system processes and translates the spoken signal and outputs the translation either in written form (speech-to-text translation, STT) or

spoken form (speech-to-speech translation, SST). There are only few speech translation systems that simultaneously translate unsegmented, continuous speech (Cho et al. 2014).

6.08.3 ICT-supported Interpreting

Whilst SST is still scarce, the evolution of communication and information technologies (ICT) has created ample opportunities for distance communication in real time and has led to ICT-supported human interpreting as an alternative to delivering human interpreting services onsite. On the one hand, mobile and internet telephony has facilitated conference calls with participants in two or more locations. On the other hand, videoconferencing has established itself as a tool for verbal and visual interaction in real time, including between two or more sites. Regarding the underlying technology, telephone-based and videoconference-based/video-mediated interpreting are the two established methods of ICT-supported interpreting today. Two main uses can be distinguished on the basis of the physical or geographical distribution of the participants, including the interpreter. One of these, remote interpreting (RI), is the use of communication technologies to gain access to an interpreter in another room, building, town, city or country. In this setting, a telephone line or videoconference link is used to connect the interpreter to the primary participants, who are together at one site. RI by telephone is often called telephone interpreting or over-the-phone interpreting. RI by videoconference is often simply called remote interpreting in relation to spoken-language interpreting. In sign-language interpreting, the term video remote interpreting has established itself. RI can be used in connection with simultaneous, consecutive and dialogue interpreting. The second method has emerged from the demand for interpreting in telephone calls or videoconferences between parties at different sites who do not share the same language, i.e. for interpreter-mediated telephone or videoconference communication (e.g. bilingual or multilingual virtual meetings, bail hearings by video link between courts and prisons, doctor-patient phone calls or video links). In this setting, the interpreter is either co-located with one of the parties or at a separate site. The latter configuration leads to a multi-point telephone or videoconference connection. The method of interpreting required in this setting can be termed teleconference interpreting to cover both telephone and videoconference communication. However, the terms telephone interpreting and videoconference interpreting have also been used here (Braun 2015, Braun & Taylor 2012, Rosenberg 2007, Mouzourakis 2006). Remote and teleconference interpreting have different underlying motivations but overlap to a certain extent, most notably in multi-point telephone or videoconferences. In the conference interpreting market, this combination is on the rise due to an increasing number of webinars and other events with distributed participants, and has become known as webcast interpreting. It was included as a new category in the AIIC 2012 conference interpreter survey (AIIC 2014). Webcast interpreting involves conference interpreters working in a team for remote audiences while being remote from each other rather than sharing a booth. The connection can be telephone- or videoconference-based.

Video Remote Interpreting (VRI)

VRI allows interpreters to work from call centers and their home offices. Remote interpreters have zero travel costs and can provide services on a per-minute basis instead of half-day blocks, making it practical for short sessions. VRI is a good solution for schools, business meetings, medical and hospital appointments, and other similar settings. VRI solutions are essentially web conferencing technology with some added functionality. There are many VRI options available, some of which are open to any translation company willing to invest while others are proprietary.

6.09 SYSTEMS AND TECHNOLOGIES OF RECORDING

Emerging information technologies, such as the Internet, decision support systems, and computer-based patient records (CPRs), do not merely afford the possibility of enhanced performance but participate in an "intellectual partnership." In this partnership, the human being and the computer are viewed as dynamically interacting, resulting in distributed performance. This interaction can be understood in terms of learning, involving the division of labor and the development of a subtle interdependence over time.

In considering the impact of this partnership, we can distinguish between "effects with" and "effects of" technology. *Effects with* refers to changes in intellectual performance while people learn and interact with technologies, whereas *effects of* refers to enduring changes resulting from human interaction with technology, even when people are away from machines.[1] The enduring effects can result in significant changes in performance.

Numerous cognitive and social challenges are involved in understanding and engineering an effective use of emerging technology in the workplace.[2] In recent years, cognitive science research has made progress in understanding learning processes and skill acquisition in complex technology-based domains. Advances in the use of information technology are rapidly changing the way we think, reason, make decisions, and interact with others. The CPR can be considered a tool that aids the mind and, as such, a "cognitive artifact."[3] Beyond merely extending human memory, these artifacts or tools affect human reasoning in ways that may be subtle, yet profound.

Issues related to the complex interaction among health care workers and emerging information technologies are rapidly coming to the fore in the field of medical informatics. To date, impressive information technologies have been developed in medicine, ranging from advanced decision support tools to CPR systems. As cognitive artifacts, such systems have the potential to greatly enhance and extend human capabilities by providing health care workers with access to the latest information and assistance in performing complex cognitive tasks, including medical diagnosis and treatment planning.

Although considerable effort has been expended in the development of these technologies, far less work has been devoted to examining their effects on the basic cognitive processes involved in health care. Numerous outcome-based evaluations in medical informatics have focused on assessing the effects of the introduction of information systems on predefined outcome

variables,[4] such as patient mortality and cost of health care. The effects of systems on complex decision processes and human knowledge organization has remained to be more fully explored.[5] Previously, we have argued for the need for in-depth analysis that focuses on detailing the actual use of such systems by health care workers as they solve complex problems.[6]

Cognitive artifacts that directly interact with users to aid and provide advice in medical reasoning include decision support and expert systems.[7–8] However, an emerging class of information tools may have a more subtle yet equally important effect on user interaction and reasoning in health care. This class includes systems designed to facilitate electronic retrieval and access to information and provide links to other medical information systems. Evidence indicates that in professional domains, such as medicine, such tools may transform human cognition and activity in important, unexpected ways.[9]

The CPR system is one example of such a system.[10] Computer-based patient record systems are designed to allow physicians to directly enter patient data, findings, and notes into a computer system that may be linked to hospital-wide databases and decision support systems. The objectives of implementing such systems include replacing hand-written paper-based records with CPRs to improve access to information and quality of health care decision making. However, use of these systems may also affect, in unanticipated ways, fundamental cognitive processes involved in health care.

6.10 EMERGING SERVICES, TECHNOLOGIES AND INNOVATION (CRYPTOCURRENCY ETC.)

Technologies of the Fourth Industrial Revolution1 are blurring the lines between the physical, digital and biological spheres of global production systems. The current pace of technological development is exerting profound changes on the way people live and work. It is impacting all disciplines, economies and industries, perhaps none more so than production, including how, what, why and where individuals produce and deliver products and services. However, amid overcharged media headlines and political and social landscapes, business and government leaders find it difficult not only to have an accurate understanding of where these technologies can create real value, but also to successfully focus on the appropriate and timely investments and policies needed to unlock that value. To address some of these issues and shed light on technology's impact on global production systems, the World Economic Forum introduced the System Initiative on Shaping the Future of Production at the beginning of 2016. This white paper summarizes the key insights and understanding of the five technologies with the greatest impact on the future of production, and the role of government, business and academia in developing technology and innovation. The insights are based on more than 90 interviews with chief operations, technology and information officers of companies developing and implementing in-scope technologies across 12 industries. The findings were validated through discussions with over 300 business leaders, policy-makers and academics conducted in six regional workshops.

The current pace of technological development is exerting profound changes on the way people live and work. It is impacting all disciplines, economies and industries, perhaps none more than production, and how, what, why and where individuals produce and deliver products and services. Production activities, defined as the full chain to "source-make-deliver-consume-reintegrate" products and services, will be altered and extended in ways that are difficult to fully envisage – from origination of inputs, product design and manufacturing, to distribution, customer/ consumer use and elements of the circular economy/return/ reuse. Breakthroughs in key areas are revolutionizing the future of production, including artificial intelligence, robotics, the internet of things, autonomous vehicles, 3D printing, nanotechnology, biotechnology, materials science, energy storage and quantum computing

What is Cryptocurrency?

A cryptocurrency is a digital or virtual currency designed to work as a medium of exchange. It uses cryptography to secure and verify transactions as well as to control the creation of new units of a particular cryptocurrency. Essentially, cryptocurrencies are limited entries in a database that no one can change unless specific conditions are fulfilled.

There have been many attempts at creating a digital currency during the 90s tech boom, with systems like Flooz, Beenz and DigiCash emerging on the market but inevitably failing. There were many different reasons for their failures, such as fraud, financial problems and even frictions between companies' employees and their bosses.

Notably, all of those systems utilized a Trusted Third Party approach, meaning that the companies behind them verified and facilitated the transactions. Due to the failures of these companies, the creation of a digital cash system was seen as a lost cause for a long while.

Then, in early 2009, an anonymous programmer or a group of programmers under an alias Satoshi Nakamoto introduced Bitcoin. Satoshi described it as a 'peer-to-peer electronic cash system.' It is completely decentralized, meaning there are no servers involved and no central controlling authority. The concept closely resembles peer-to-peer networks for file sharing.

One of the most important problems that any payment network has to solve is double-spending. It is a fraudulent technique of spending the same amount twice. The traditional solution was a trusted third party - a central server - that kept records of the balances and transactions. However, this method always entailed an authority basically in control of your funds and with all your personal details on hand.

In a decentralized network like Bitcoin, every single participant needs to do this job. This is done via the Blockchain - a public ledger of all transaction that ever happened within the network, available to everyone. Therefore, everyone in the network can see every account's balance.

Every transaction is a file that consists of the sender's and recipient's public keys (wallet addresses) and the amount of coins transferred. The transaction also needs to be signed off by the sender with their private key. All of this is just basic cryptography. Eventually, the transaction is broadcasted in the network, but it needs to be confirmed first.

Within a cryptocurrency network, only miners can confirm transactions by solving a cryptographic puzzle. They take transactions, mark them as legitimate and spread them across the network. Afterwards, every node of the network adds it to its database. Once the transaction is confirmed it becomes unforgeable and irreversible and a miner receives a reward, plus the transaction fees.

Essentially, any cryptocurrency network is based on the absolute consensus of all the participants regarding the legitimacy of balances and transactions. If nodes of the network disagree on a single balance, the system would basically break. However, there are a lot of rules pre-built and programmed into the network that prevents this from happening.

Cryptocurrencies are so called because the consensus-keeping process is ensured with strong cryptography. This, along with aforementioned factors, makes third parties and blind trust as a concept completely redundant.

What can you do with cryptocurrency

Buy goods

In the past, trying to find a merchant that accepts cryptocurrency was extremely difficult, if not impossible. These days, however, the situation is completely different.
There are a lot of merchants - both online and offline - that accept Bitcoin as the form of payment. They range from massive online retailers like Overstock and Newegg to small local shops, bars and restaurants. Bitcoins can be used to pay for hotels, flights, jewelery, apps, computer parts and even a college degree.

Other digital currencies like Litecoin, Ripple, Ethereum and so on aren't accepted as widely just yet. Things are changing for the better though, with Apple having authorized at least 10 different cryptocurrencies as a viable form of payment on App Store.

Of course, users of cryptocurrencies other than Bitcoin can always exchange their coins for BTCs. Moreover, there are Gift Card selling websites like Gift Off, which accepts around 20 different cryptocurrencies. Through gift cards, you can essentially buy anything with a cryptocurrency.
Finally, there are marketplaces like Bitify and OpenBazaar that only accept cryptocurrencies.

Invest

Many people believe that cryptocurrencies are the hottest investment opportunity currently available. Indeed, there are many stories of people becoming millionaires through their Bitcoin

investments. Bitcoin is the most recognizable digital currency to date, and just last year one BTC was valued at $800. In November 2017, the price of one Bitcoin exceeded $7,000.

Ethereum, perhaps the second most valued cryptocurrency, has recorded the fastest rise a digital currency ever demonstrated. Since May 2016, its value increased by at least 2,700 percent. When it comes to all cryptocurrencies combined, their market cap soared by more than 10,000 percent since mid-2013.

However, it is worth noting that cryptocurrencies are high-risk investments. Their market value fluctuates like no other asset's. Moreover, it is partly unregulated, there is always a risk of them getting outlawed in certain jurisdictions and any cryptocurrency exchange can potentially get hacked.

If you decide to invest in cryptocurrencies, Bitcoin is obviously still the dominant one. However, in 2017 its share in the crypto-market has quite dramatically fallen from 90 percent to just 40 percent. There are many options currently available, with some coins being privacy-focused, others being less open and decentralized than Bitcoin and some just outright copying it.
While it's very easy to buy Bitcoins - there are numerous exchanges in existence that trade in BTC - other cryptocurrencies aren't as easy to acquire. Although, this situation is slowly improving with major exchanges like Kraken, BitFinex, BitStamp and many others starting to sell Litecoin, Ethereum, Monero, Ripple and so on. There are also a few other different ways of being coin, for instance, you can trade face-to-face with a seller or use a Bitcoin ATM.

Once you bought your cryptocurrency, you need a way to store it. All major exchanges offer wallet services. But, while it might seem convenient, it's best if you store your assets in an offline wallet on your hard drive, or even invest in a hardware wallet. This is the most secure way of storing your coins and it gives you full control over your assets.

As with any other investment, you need to pay close attention to the cryptocurrencies' market value and to any news related to them. Coinmarketcap is a one-stop solution for tracking the price, volume, circulation supply and market cap of most existing cryptocurrencies.

Depending on a jurisdiction you live in, once you've made a profit or a loss investing in cryptocurrencies, you might need to include it in your tax report. In terms of taxation, cryptocurrencies are treated very differently from country to country. In the US, the Internal Revenue Service ruled that Bitcoins and other digital currencies are to be taxed as property, not currency. For investors, this means that accrued long-term gains and losses from cryptocurrency trading are taxed at each investor's applicable capital gains rate, which stands at a maximum of 15 percent.

Mine

Miners are the single most important part of any cryptocurrency network, and much like trading, mining is an investment. Essentially, miners are providing a bookkeeping service for their respective communities. They contribute their computing power to solving complicated cryptographic puzzles, which is necessary to confirm a transaction and record it in a distributed public ledger called the Blockchain.

One of the interesting things about mining is that the difficulty of the puzzles is constantly increasing, correlating with the number of people trying to solve it. So, the more popular a certain cryptocurrency becomes, the more people try to mine it, the more difficult the process becomes.

A lot of people have made fortunes by mining Bitcoins. Back in the days, you could make substantial profits from mining using just your computer, or even a powerful enough laptop. These days, Bitcoin mining can only become profitable if you're willing to invest in an industrial-grade mining hardware. This, of course, incurs huge electricity bills on top of the price of all the necessary equipment.

Currently, Litecoins, Dogecoins and Feathercoins are said to be the best cryptocurrencies in terms of being cost-effective for beginners. For instance, at the current value of Litecoins, you might earn anything from 50 cents to 10 dollars a day using only consumer-grade hardware.

But how do miners make profits? The more computing power they manage to accumulate, the more chances they have of solving the cryptographic puzzles. Once a miner manages to solve the puzzle, they receive a reward as well as a transaction fee.

As a cryptocurrency attracts more interest, mining becomes harder and the amount of coins received as a reward decreases. For example, when Bitcoin was first created, the reward for successful mining was 50 BTC. Now, the reward stands at 12.5 Bitcoins. This happened because the Bitcoin network is designed so that there can only be a total of 21 mln coins in circulation.

As of November 2017, almost 17 mln Bitcoins have been mined and distributed. However, as rewards are going to become smaller and smaller, every single Bitcoin mined will become exponentially more and more valuable.

All of those factors make mining cryptocurrencies an extremely competitive arms race that rewards early adopters. However, depending on where you live, profits made from mining can be subject to taxation and Money Transmitting regulations. In the US, the FinCEN has issued a guidance, according to which mining of cryptocurrencies and exchanging them for flat currencies may be considered money transmitting. This means that miners might need to comply with special laws and regulations dealing with this type of activities.

Accept as payment (for business)

If you happen to own a business and if you're looking for potential new customers, accepting cryptocurrencies as a form of payment may be a solution for you. The interest in cryptocurrencies has never been higher and it's only going to increase. Along with the growing interest, also grows the number of crypto-ATMs located around the world. Coin ATM Radar currently lists almost 1,800 ATMs in 58 countries.

First of all, you need to let your customers know that your business accepts crypto coins. Simply putting a sign by your cash register should do the trick. The payments can then be accepted using hardware terminals, touch screen apps or simple wallet addresses through QR codes.
There are many different services that you can use to be able to accept payments in cryptocurrencies. For example, CoinPayments currently accepts over 75 different digital currencies, charging just 0.5 percent commission per transaction. Other popular services include Cryptonator, CoinGate and BitPay, with the latter only accepting Bitcoins.

In the US, Bitcoin and other cryptocurrencies have been recognized as a convertible virtual currency, which means accepting them as a form of payment is exactly the same as accepting cash, gold or gift cards.

For tax purposes, US-based businesses accepting cryptocurrencies need to record a reference of sales, amount received in a particular currency and the date of transaction. If sales taxes are payable, the amount due is calculated based on the average exchange rate at the time of sale.

Legality of cryptocurrencies

As cryptocurrencies are becoming more and more mainstream, law enforcement agencies, tax authorities and legal regulators worldwide are trying to understand the very concept of crypto coins and where exactly do they fit in existing regulations and legal frameworks.

With the introduction of Bitcoin, the first ever cryptocurrency, a completely new paradigm was created. Decentralized, self-sustained digital currencies that don't exist in any physical shape or form and are not controlled by any singular entity were always set to cause an uproar among the regulators.

A lot of concerns have been raised regarding cryptocurrencies' decentralized nature and their ability to be used almost completely anonymously. The authorities all over the world are worried about the cryptocurrencies' appeal to the traders of illegal goods and services. Moreover, they are worried about their use in money laundering and tax evasion schemes.
As of November 2017, Bitcoin and other digital currencies are outlawed only in Bangladesh, Bolivia, Ecuador, Kyrgyzstan and Vietnam, with China and Russia being on the verge of banning them as well. Other jurisdictions, however, do not make the usage of cryptocurrencies illegal as of yet, but the laws and regulations can vary drastically depending on the country.

Most common cryptocurrencies

- **Bitcoin**: The first ever cryptocurrency that started it all.

- **Ethereum**: A Turing-complete programmable currency that lets developers build different distributed apps and technologies that wouldn't work with Bitcoin.

- **Ripple**: Unlike most cryptocurrencies, it doesn't use a Blockchain in order to reach a network-wide consensus for transactions. Instead, an iterative consensus process is implemented, which makes it faster than Bitcoin but also makes it vulnerable to hacker attacks.

- **Bitcoin Cash:** A fork of Bitcoin that is supported by the biggest Bitcoin mining company and a manufacturer of ASICs Bitcoin mining chips. It has only existed for a couple of months but has already soared to the top five cryptocurrencies in terms of market cap.

- **NEM:** Unlike most other cryptocurrencies that utilize a Proof of Work algorithm, it uses Proof of Importance, which requires users to already possess certain amounts of coins in order to be able to get new ones. It encourages users to spend their funds and tracks the transactions to determine how important a particular user is to the overall NEM network.

- **Litecoin**: A cryptocurrency that was created with an intention to be the 'digital silver' compared to Bitcoin's 'digital gold.' It is also a fork of Bitcoin, but unlike its predecessor, it can generate blocks four times faster and have four times the maximum number of coins at 84 mln.

- **IOTA:** This cryptocurrency's breakthrough ledger technology is called 'Tangle' and it requires the sender in a transaction to do a Proof of Work that approves two transactions. Thus, IOTA has removed dedicated miners from the process.

- **NEO**: It's a smart contract network that allows for all kinds of financial contracts and third-party distributed apps to be developed on top of it. It has many of the same goals as Ethereum, but it's developed in China, which can potentially give it some advantages due to improved relationship with Chinese regulators and local businesses.

- **Dash:** It's a two-tier network. The first tier is miners that secure the network and record transactions, while the second one consists of 'masternodes' that relay transactions and enable InstantSend and PrivateSend type of transaction. The former is significantly faster than Bitcoin, whereas the latter is completely anonymous.

- **Qtum**: It's a merger of Bitcoin's and Ethereum's technologies targeting business applications. The network boasts Bitcoin's reliability, while allowing for the use of smart contracts and distributed applications, much how it works within the Ethereum network.

- **Monero**: A cryptocurrency with private transactions capabilities and one of the most active communities, which is due to its open and privacy-focused ideals.

- **Ethereum Classic:** An original version of Ethereum. The split happened after a decentralized autonomous organization built on top of the original Ethereum was hacked.

How to store

Unlike most traditional currencies, cryptocurrencies are digital, which entails a completely different approach, particularly when it comes to storing it. Technically, you don't store your units of cryptocurrency; instead it's the private key that you use to sign for transactions that need to be securely stored.

There are several different types of cryptocurrency wallets that cater for different needs. If your priority is privacy, you might want to opt for a paper or a hardware wallet. Those are the most secure ways of storing your crypto funds. There are also 'cold' (offline) wallets that are stored on your hard drive and online wallets, which can either be affiliated with exchanges or with independent platforms.

How to buy

There are a lot of different options when it comes to buying Bitcoins. For example, there are currently almost 1,800 Bitcoin ATMs in 58 countries. Moreover, you can buy BTC using gift cards, cryptocurrency exchanges, investment trusts and you can even trade face-to-face.

When it comes to other, less popular cryptocurrencies, the buying options aren't as diverse. However, there are still numerous exchanges where you can acquire various crypto-coins for flat currencies or Bitcoins. Face-to-face trading is also a popular way of acquiring coins. Buying options depend on particular cryptocurrencies, their popularity as well as your location.

6.11 REVIEW QUESTIONS

- What is the difference between Strong **Artificial Intelligence** and Weak **Artificial Intelligence**?
- Why is the management and regulation of information technology a challenge for governments and businesses?

RECOMMENDED FURTHER READINGS

The Digital Flood: Diffusion of Information Technology across the United States, Europe, and Asia By James W. Cortada Oxford University Press, 2012

Computers, Phones, and the Internet: Domesticating Information Technology By Robert Kraut; Malcolm Brynin; Sara Kiesler Oxford University Press, 2006

The Digital Condition: Class and Culture in the Information Network By Rob Wilkie Fordham University Press, 2011

Accelerating Democracy: Transforming Governance through Technology By John O. McGinnis Princeton University Press, 2013

Information Technology Can Drive Transformation: IT Can Modify Management and Business Processes, Alter Inter-Organizational Relationships, and Extend Our Concept of Community-Particularly for Our People-Oriented Institutions, Such as Health Care
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The Digital Hand: How Computers Changed the Work of American Public Sector Industries By James W. Cortada Oxford University Press, 2004

Business, Information Technology and Society By Stephen D. Tansey Routledge, 2003

Information Technology, Corporate Productivity, and the New Economy By Dennis McGinn; Stephan Kudyba; Romesh Diwan Quorum Books, 2002

Information Technology and Development: A New Paradigm for Delivering the Internet to Rural Areas in Developing Countries By Jeffrey James Routledge, 2004

Introduction to Information Systems (2nd Edition)
Jan 20, 2014 by Patricia Wallace

Introduction to Information Systems: People, Technology and Processes (3rd Edition)
Jan 23, 2017 by Patricia Wallace
Introduction to Information Systems: Supporting and Transforming Business
Nov 11, 2013 by R. Kelly Rainer and Brad Prince

Human Resource Information Systems: Basics, Applications, and Future Directions
Aug 10, 2017 by Michael J. Kavanagh and Richard D. Johnson

Related Web Links:

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Communications: http://www.totaltele.com/
Technology in Business: http://www.biztechmagazine.com/
Cybersecurity: http://www.phrack.org (this e-zine is very popular with hackers)
Accounting: https://www.accountingtoday.com/
Database Management: http://www.oracle.com/technetwork/oramag/magazine/
Information Systems Security: http://www.iso27001security.com/html/forum.html