IT1103 – Information Systems and Technologies

BIT – 1ST YEAR – SEMESTER 1
University of Colombo School of Computing

Student Manual

Lesson 1:

Introduction to Information Systems

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Duration: 8 hrs ()

Instructional Objectives

Students will be able to:

- Distinguish data from information and describe the characteristics used to evaluate the quality of data
- Identify system concepts and describe various types of systems
- Name the components of an information system and describe several system characteristics
- Identify and describe the activities of an Information System
- Identify and describe the components of a computer based information system
- Identify the basic types of business information systems
- Discuss the role of IS in business and the management challenges
- Discuss why it is important to study and understand information systems

Overview:

Information Systems exist in our environment with or without our knowledge. Sometimes, we do not recognize a particular thing as an information system and they appear as a good or service in the neighborhood. For example, a bus timetable or train timetable which you must know if you are planning to use the public transport service to travel regularly or occasionally. These timetables provide information which is very useful to a particular local community and they are some form of output of a particular system maintained in a bus or railway company. It is important to mention that computers are not essential to produce these outputs (i.e. bus/train timetables) or maintain such a system (i.e. a transport system) in an organization. However, if computers are used in a system, they will definitely add value to the system.

Question: How computers could add a big value to a system maintained by a transport company?

Answer: One example would be time taken to produce a report which presents the schedule and actual transport offered by the company during a particular period of a day. The management may want to see this report several times a day but may not be possible if the company maintains a manual way of recording their services and producing an output. In fact, it will be hard to get a daily report in the early morning when the company starts the business. A clerk who works in this transport company, may request another half a day to produce the report by analyzing records of previous day.

In the module of Information Systems and Technologies, we will study details of Information Systems and how information technology is used to make these information systems an effective to tool for all those people who are interested in it.

NOTE: Those who are interested in an information system are identified as stakeholders of an information system.

In this section, we will learn the basic components of information systems, types of available information systems, the role of information systems in business, the managerial challenges and the importance of studying about information systems.

1 Introduction to Information Systems

1 Information Concepts

In this sub-section, we will discuss basic concepts behind the process of converting data into information. it is data which will be converted to information by carrying out several activities to make them useful in the decision making. However, very often the meaning of these two terms causes confusion.

1.1 Data vs. Information

1.1.1 What is Data?

It is a set of facts which describes a particular thing in the real world. It may represent a single value or multiple values. For example, marks of a particular subject of a student in a class represent a single value data. At the same time, such a mark may exist with marks of other students who took that subject. In order to add the value for these marks, it may be necessary to access data of other facts such as students' name, index number and year of examination etc.

More examples of Data in different contexts:

- In a company: employee's name, number of hours worked in a week, inventory part numbers, sales orders
- In environment: Rainfall data, temperature data,

1.1.2 What is Information ?

Sometimes it is difficult to distinguish data and information. Information is a kind of data which will be very useful for decision making in different contexts. Simply, it has more value than data to understand a particular context.

For example, a teacher may want to know how many students have obtained marks above 50 in a particular subject. He/she may also want to know the student who obtained the highest mark in the classroom. In such a situation, the teacher has to analyze data about student marks together with their identification numbers.

More examples of Information in different contexts:

In a company: monthly salary of an individual in the salary slip, total sales in a particular month of the company, etc.

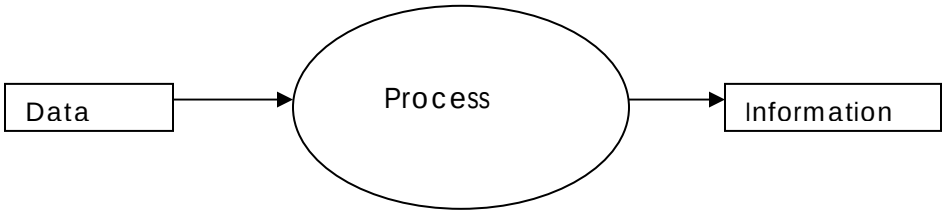
In environment: Monthly report of rainfall, temperature analysis report of each part of the country during a particular year.

In personal life: Total expenses in a particular month,

1.1.3 Process of converting from data to information

Data can be converted into information by carrying out some series of activities on data. These activities involve some mathematical operations and/or tabulation operation. Process describes this series of activities.

Information can be considered as an artifact in a particular context similar to other **artifacts.** These artifacts are useful to carry out **some other activities in**. For example (E.g. A), furniture is built using wood as raw material. The wood is produced using timber in trees. Interestingly, timber cannot be directly used to produce furniture and it must be converted to intermediate state called wood. This process requires specific knowledge which describes rules, guidelines and procedures.



Knowledge for the Process:

According to example mentioned above (E.g. A), rules and procedures define knowledge required for the process. Knowledge is the body of rules, guidelines and procedures used to select, organize and manipulate data to make it suitable for a specific task.

Before selecting some data to be processed, they could be examined to find out their relevance or validity. Such examination is a prefix of the process. In order to improve the value of information, the output of processed data will be organized with respect to some relationship to improve its value.

1.1.4 Types of Data and Information:

Data and information can be categorized based on their representation for the human processing. Following table summarizes the four main types of data together with examples.

Data/Information Type Name	**Representation**
Alpha Numeric Data	Numbers, Letters and Other Characters
Image Data	Graphic, Images and Pictures
Audio Data	Sound, Noise or tones
Video Data	Moving Images or Pictures

1.2 The characteristics of Valuable Information

The value of information depends on their usefulness in the decision making process. This value can be judged based on a set of features that can be identified in the information. They are as follows:

Accurate: Accurate information is error free. Errors could be occurred due to different reasons. If there is some problem in the knowledge required for the process, output

(information) may have errors. At the same time, if input (data) contains some errors, the output will not be accurate. This is known as garbage in garbage out (GIGO). Inaccurate information is not error free.

Complete: Complete information contains all the important facts to make clear decisions. For example, an investment report may present all possible benefits and profits without details of cost that will be required.

Economical: Information should also be relatively economical. Decision makers must always balance the value of information with the cost of producing it. For example, if collecting the data takes lots of resources and time, it is not economical.

Flexible: Flexible information can be used for a variety of purposes. For example, Information on how much inventory is on hand for a particular part can be for

- a sales representative to determine the sales plan
- a production manager to identify possible constraints for the production
- a financial executive to calculate the current assets figures of inventory

Reliable: Reliability of information describes the correctness of the information. If there are any problems with respect to correctness of data, it will definitely affect the reliability of information. For example, if the reliability of data collection method is poor, it will directly affect the information that will be produced.
For example, prediction of prices based on rumors (not past variance information), is not reliable.

Relevant: The relevance of information is determined based on the usefulness of information with respect to the decision making process. For example (E.g.A),, a drop in timber prices cannot be used to predict the price fluctuation in computers.

Simple: Simplicity in the representation of information is also a very useful feature utilized to improve the usability of information in the decision making process. Too many information could affect the simplicity in the presentation. Therefore it is better to provide interactive customization to determine simplicity. Providing too many information is known as information overloading.

Timeliness: Decisions should be made at the right time to achieve effectiveness. Timely information refers to providing information at the right time. For example, if you can get to know today's weather forecast before you leave home, you can decide whether to bring an umbrella or not.

Verifiable: If it is possible to confirm the reliability of the information about its correctness (validate), it becomes verifiable Information. If you are not sure about a particular information (say foreign news) heard from a radio channel, you can search about it using Internet.

Accessible: Accurate information plays a major roll in the decision making process of any organization. Therefore it is essential to be able to access the Correct/ relevant information by authorized personnel at the right time to meet their needs.

Secure: the value of information could be lost due to issues such as unauthorized user access or intentionally damaging its existence. Therefore, it is important to make steps to protect valuable data and information. For example, use of passwords to protect data and information.

It is important to note that the values of these quality attributes may vary from one piece of information to another. It affects their usefulness in the decision making process. For example, at the Stock Exchange, information about market forecast may not be very accurate but if the timeliness is poor, the total value of information will be very poor.

1.3 The Cost and Value of Information

1.3.1 Cost of Information

It is necessary to spend time and other resources to produce information from data and, maintain them until it is used in the decision making process. Sometimes, the cost of information is calculated based on the resources consumed to produce it. Following four cost categories are identified based this.

(a) cost of acquiring data
(b) cost of maintaining data
(c) cost of generating information and
(d) cost of communicating information

When information is produced, if we want to achieve higher/better values for the relevant features of information (described in section 1.1.2), it may be necessary to spend more resources. As a result, the cost of information will be increased. For example, the costs are higher for more reliable accurate systems than the systems with relatively low accuracy. However, if the overall cost of information is very high, the users may not use/produce such information.

1.3.2 Value of information

The value of information is calculated with respect to its usage in decision making and return on benefits due to the decision taken. Therefore, the cost of information has to be deducted from the benefits in order to calculate the value of information.

For example, someone wants to invest in stock market but he/she is not familiar with the business procedure, he can then recruit an assistant to evaluate stock market conditions to determine an investment plan. This assistant will have to gather stock market information and generate reports to according his clients requirements. However, if the return of investment is not significant with respect to cost incurred to produce the investment plan, it is worthless to recruit an assistant for this activity. In other words, the value of investment plan is very low.

2 System and modeling concepts

2.1 What is a system?

A system is a collection of components which work together to achieve a specific goal. These components are connected to maintain communication when they work together .

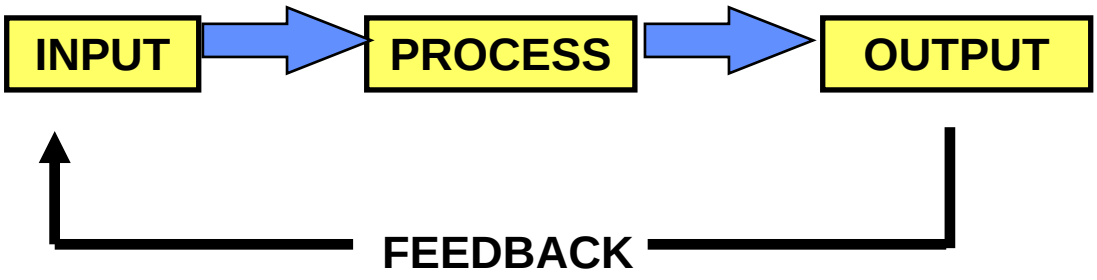
However, they have independent functionalities. Therefore, each component is another system, named as a subsystem, which carries out tasks to achieve some objectives of the original system.

Example 1: The Human Body
Our human body is a complex system which contains several components which acts as subsystems. The human body consists of complex muscle, bone, respiratory, digestive and circulatory subsystems, each providing a specific task of the overall system.
Let's consider one such subsystem, respiratory which provides oxygen to human body. Some components of the respiratory subsystem such as nasal passages, lungs etc. can be considered as a subsystem. On other hand, respiratory system communicates with digestive system as two independent components of human body.

Example 2: A School
A particular school can be considered as a component of education system in this country (a university may be another one). At the same time, a school itself is a complete system that includes a principal, teachers, equipment and classrooms which are its components. Viewing complex systems as a collection of subsystems may help us handle complexity and improve our understanding of the system.

2.2 System components and concepts

In abstract terms, a system consists of three main components and few communication links. They are Input, Process and Output. Feedback is one communication link.

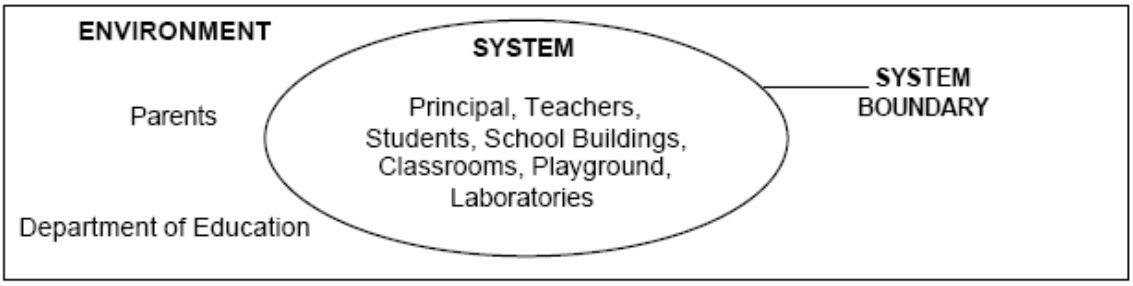


System boundary defines the scope of the system with respect to the environment it operates. Simply, it defines the system by distinguishing it from everything else in the environment.

Example 1: The Scope of a School System

We can identify goals, input, processing and output of a school system as follows:

System:	School
Goal:	Educate students
Input:	Children, Teachers, Principal, Resources
Processing:	Teaching and learning
Output:	Educated students



A school (viewed as a system) illustrating the system boundary

Input: dirty car, water, cleaning ingredients, time, energy, skill, knowledge
Processing mechanism: select the cleaning options: wash only/wash with wax/ wash with wax/ and hand dry
Feedback: your assessment of how clean the car is
Output: clean car

System types:

Considering various features, we can classify systems into different categories as follows:

- Simple or complex
- open or closed
- stable or dynamic
- adaptive or non-adaptive
- permanent or temporary

System Type	Characteristics	
Simple vs. Complex	**Simple** Has few components, and their relationship or interaction between elements is uncomplicated and straightforward. **Example:** A "well" is a simple system that provides water.	**Complex** Has many elements that are highly related and interconnected. **Example:** A water management and distribution facility of a country which contains many elements such as dams, water tanks, distribution centers etc., is a complex system.
Open vs. Closed	**Open** Interacts with its environment. Example: The human body is an open system. The human body interacts with the environment through the 5 senses.(eyes, ears, nose, tongue and skin)	**Closed** Has no Interaction with the environment. Example:We can consider the process of marking examination scripts as a closed system. The department of examination along with many marking panels gets together and evaluates the students' scripts. This system has no interaction with the environment.

Stable vs. Dynamic	**Stable** Undergoes very little change over time. **Example:** The Judiciary System of a country can be classified as a stable system. The Judiciary System consists of courts, judges, laws, a judiciary process, etc. which does not change rapidly over time.	**Dynamic** Undergoes rapid and constant change over time. **Example:** We can consider the human body as a dynamic system. The human body undergoes rapid and constant change (e.g. heart rate, blood pressure etc.)
Adaptive vs. Non-adaptive	**Adaptive** Is able to change in response to changes in the environment. **Example:** We can classify the human body as an adaptive system as the human body is able to change in response to changes in the environment. For example, when we feel hot, the body sweats and cools us.	**Non-adaptive** Is not able to change in response to changes in the environment. **Example:** We can consider a building as a non-adaptive system. The building is i**nanimate** entity and does not respond to changes in the environment.
Permanent vs. Temporary	**Permanent** Exists for a relatively long period of time. **Example:** We can consider a "Hospital" as a permanent system as it exists for a long period of time.	**Temporary** Exists only for a relatively short period of time. **Example:** We can consider the manufacturing of lanterns for Wesak as a temporary system. The lanterns are constructed and sold by a company/group of people during the months of April and May which is relatively a short period of time when compared to a factory that produces goods throughout the year.

2.3 System performance and standards

Whether a system works properly, can be identified by evaluating its performance. System performance can be measured in various ways. Two important indicators in the system performance are efficiency and effectiveness.

Efficiency: measure of what is produced divided by consumed (output/input)
It may range from 0 to 100 percent

Example: The efficiency of a motor is the energy produced (in terms of work done) divided by the energy consumed (in terms of electricity or fuel). Some motors have an efficiency of 50 percent or less because of the energy lost to friction and heat generation.

Efficiency is a relative term used to compare systems.

Example: a gasoline engine is more efficient than a steam engine because, for the equivalent amount of energy input (gas or coal), the gasoline engine produces more energy output.

Effectiveness: extent to which system attains its goals or objectives. It can be computed by dividing the goals/objectives actually achieved by the total of the stated or expected goals/objectives of the system.

> **Example:** A company may have a objective to reduce damaged parts by 100 units. A new control system may be installed to help achieve this objective. Actual reduction in damaged parts, however, is only 85 units. The effectiveness of the control system is 85 percent (85/100 = 85%).

Effectiveness, like efficiency, is a relative term used to compare systems.

System performance standard: A specific objective of the system.

The system performance standard is defined considering both effectiveness and efficiency of the system since the goal of a system is usually defined considering both these factors. The status of the system (whether it is good or bad) is then described with respect to this standard.

> **Example:** A system performance standard for a particular marketing campaign might be to have each sales representative sell $100,000 of a certain type of product each year

A system performance standard for a certain manufacturing process might be to have no more than 1 percent defective parts:

- *Once standards are established, system performance is measured and compared with the standard. Variances from the standard are determinants of system performance.*

2.4 System variables and Parameters

Some parts of a system are under direct management control, while others are not. This is measured with respect to values in the system variable and parameters.

System variable - item controlled by decision-maker
Example: The price a company charges for its product is a system variable because it can be controlled.

System parameter - value that cannot be controlled
Example: the cost of a raw material.
The number of pounds of a chemical that must be added to produce a certain type of plastic is a quantity or value that is not controlled by management; it is controlled by the laws of chemistry.

2.5 Modeling a System

Many things in the real world are complex and dynamic and hard to understand. In such cases, we use a mechanism called modeling to simplify presentation of such things. It is then easier to understand, to test their effects and different relationships.

A model can be described as an abstraction or approximation that is used to represent reality. Good models enable us to explore and gain improved understanding of real-world situations. This is not a new technique. Even ancient people had used diagrams as models to present things.

Examples of models:
A written description of a battle
A physical mock-up of an ancient building
The use of symbols to represent money, numbers
Mathematical relationships

Today, scientists, engineers, managers and other professionals use different models to understand complex problems and to present different solutions. In the context of organizations, managers and decision makers use models to help them understand what is happening in their organizations and make better decisions.
In general, models can be classified into various types as **narrative, physical, schematic and mathematical**.

Narrative Model:
A narrative model is based on words, spoken or written.
Both verbal and written descriptions of reality are considered narrative models.
In an organization, reports, documents and conversations concerning a system are all important narratives
Computers can be used to develop narrative models.
Example: word processing

Physical Model:
A physical model is a tangible representation of reality.
Many physical models are computer designed or constructed.

Schematic Model:
A schematic model is a graphical representation of reality.
Graphs, charts, figures, diagrams, illustrations, and pictures are all types of schematic models.
Schematic models are used extensively in developing computer programs and systems.

Mathematical Model:
A mathematical model is an arithmetic representation of reality. Computers excel at solving mathematical models.

Examples:
Retail chains have developed mathematical models to identify all the activities, effort, and time associated with planning, building, and opening a new store so that they can forecast how long it will take to complete a store.

A mathematical model developed to determine the total cost of a project.

TC = (V)(X) + FC where
TC = total cost
V = variable cost per unit
X = number of units produced
FC = fixed cost

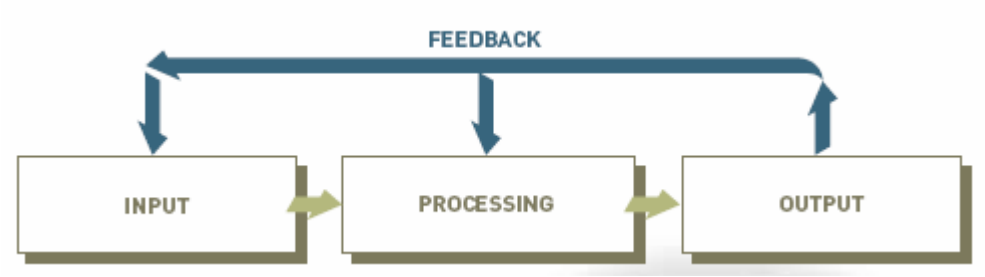
When a model is developed, it is important to maintain its accuracy to use the model effectively for problem solving. Otherwise the solutions obtained through the model may not

be valid. Models are usually based on assumptions and if they are not realistic assumptions, it leads to inaccuracy. Therefore, the potential users should clearly understand these assumptions.

3 Information Systems

3.1 What is an Information System

An information system (IS) is a set of interrelated elements or components that collect (input), manipulate (process) and store, and disseminate (output) data and information and provide a feedback mechanism to meet an objective. Hence Information system consists of four main components, namely input, processing, output and feedback. Their relationship is illustrated in the figure below.



This feedback mechanism is very important since it provides to improve the quality of processing as well as the input. Every system including Information system, has a goal to be achieved to fulfill the need of the organization. As a result of this mechanism, organizations can achieve their goals, such as increasing profits or improving customer service.

3.2 Main Components of an Information System

In this section, we will discuss details of main components of Information system described in section 3.1.

Input
Input describes activities to produce raw materials which will enter into a system from the environment. In information systems, it includes activities of gathering and capturing raw data that should be processed.

Input to a system could take a manual or automated method. For example, a scanner at a grocery store that reads bar codes and enters the grocery item and price into a computerized cash register is a type of automated input. Generally, both automated and manual methods of input are active. When the bar code reader fails to identify the item, cashier can enter the code using the keyboard. Regardless of the input method, accurate input is critical to achieving the desired output.

Processing
In information systems, processing part involves converting or transforming input data into useful outputs by making calculations, comparisons and arranging raw data. Sometimes, processing involves storing data for future use. This is a critical part in an information system, and it can be done manually or with the assistance of a computer.

Output
In information systems, output involves producing documents and reports using results of the processing activity. For example, pay slip of each employee prepared based on the company format, reports of total pay to the management, reports to third parties such as Labor Department (EMF contribution), Inland Revenue Department (Income tax employees).

In some cases, the output of a system could become an input to another system. Often, output from one system can be used as input to control other systems or devices.
The salesperson, customer, and furniture designer can go through several design iterations to meet the customer's needs. Special computer programs and equipment create the original design and allow the designer to rapidly revise it. Once the last design mock-up is approved the computer creates a bill of materials that goes to manufacture to produce the order.

Output can be produced in different ways using different devices such as display screens, printers etc. It can also be a manual process involving handwritten reports and documents.

Feedback
In information systems, feedback is a kind of output that is used to make changes to input or processing activities. For example, errors or problems might make it necessary to correct input data or changes to the logic of the process.

Feedback is also very important component for managers and decision makers.

3.3 Computer based Information Systems

3.3.1 A computer-based information system (CBIS) is a single set of hardware, software, databases, telecommunications, people, and procedures that are configured to collect, manipulate, store, and process data into information.

All these components of CBIS define the business's technology infrastructure since it forms the foundation of organizations information systems.

Lets identify these components in detail.

3.3.2 Hardware
Computer equipment used to perform input processing and output activities.

Hardware components can also categorize based on the input, processing and output activities. Other than main computer system unit, all other hardware devices are known as peripherals.

- **Input devices**

Input devices are used to input data that will be processed by the Information System. They are connected to computers directly to pass data. Most common input devices are keyboard and mouse.

Here is the list of common input devices:
The keyboard
The mouse.
Other pointing devices,

Scanning devices,
Magnetic ink character readers,
Smart cards
Optical cards,
Sensors,
Digital cameras etc.

- **Processing devices**

Processing devices include the central processing unit (CPU) and main memory. They are inside the system unit.

Lets identify CPU and main memory:

CPU

This has several components and the processor is most important component. It is generally considered as the "brain of a computer". It does exactly what the name implies, process data based on the given instructions. As a result of this processing, input data will be changed. Speed is the most important parameter in a processor and it is very important for the faster processing of complex data like video images.
Simply, if the speed is low, the computer will be slow.

The Main/Primary Memory

Also know ans the Primary memory is directly accessible by the processing unit of the computer. You can store and retrieve data much faster with primary memory compared to secondary memory.
We will discuss about the processor and the primary memory in detail in Chapter 3.

- **Output devices**

Results after processing the data, can be stored in the computer or it can be taken out from the information system. Results are known as output and devices which facilitates distributing of the output is known as output devices.

Depending on the requirements of the organization output may be produced on printed paper, visual screen or any other format (non-permanent ways, e.g. a file of data).

Output Type	Output Device
Printed on a paper	Printers, plotters
Visual Display	Monitor
Audio	Speakers
Video	Monitor + speakers
Software Object	Secondary storage devices, - Floppy Disk, Flash disks

3.3.3 Software

Software consists of computer programs that govern the operation of the computer. It can be described as the digital instruction set to a computer. CPU needs software to control its functions as well as to process the input data. Without software computers are dead

hardware. It is the component which gives the computer the power to act as an intelligent machine.

Software is normally classified into two components called application software and system software.

Example: MS Windows is a system software which control devices including the CPU. MS Word is an application software which facilitates users to use computers as word processors.

Application Software

An **Application Software** also is known as an application package, is a set of programs designed to carry out operations for a specified purpose or task.

Example:

Microsoft Office (MS Office). It consists of several applications which usually are very useful to carry out activities in an office environment.

An Accounting Package
It may help an account division to carry out all its activities including payroll of employees in the organization.

System Software

It generally performs tasks of controlling devices attached to a computer system. It gives life to hardware devices. Simply, hardware devices together with system software provide the infrastructure to run/execute application software. Simply, Application software cannot be run without having system software.

Some software communicates with hardware devices to coordinate activities. E.g. print drivers. You have to install these drivers to connect to a computer.

System Software allows application software to be run on the computer with less time and effort. Most important system software of a computer is its operating system. A computer cannot work without an operating system. It controls all hardware devices and other system software, plus facilitation to run a particular application software.

Example: Microsoft windows, Linux, Unix

3.3.4 Databases

A database is an organized collection of data and information in an organization.
Data and information are critical for problem solving and decision-making in an organization. Hence, most managers and executives consider a database to be the most valuable and important part of a computer-based information system.

We use special application software to create databases. We call these software as "Database Management Systems" DBMS.

Examples: Access, DBASE.

3.3.5 Telecommunications, Network and Internet:

Communication is described as transmission (i.e. both sending and receiving)of messages between two parties. We can use electronic medium to this activity. For example, using a telephone we can communicate with someone far away.
Telecommunications is described as the electronic transmission of signals (i.e. data, voice, messages) for communications.
Telecommunications enable organizations to connect with their branches, customers and other parties to set up advanced business environment. For example, you can use a telephone to book a cab service.

What is the Internet?
The Internet is defined as a network of networks.
The first letter of Internet, I, is always capital letter. It is huge resource and no one owns it as a private property.

Do you know what a network is?
A network is a group of computers inter-connected through a physical cable. Some computers in this network act like leaders and we call them servers. Other computers are called clients.

When the geographical area of the network is not very large, we call them as LAN (Local Area Network). On the other hand, WAN (Wide Area Network) is a network which is spread in a large geographical area, sometimes connecting several offices/branches of an organization.
By connecting computers to each other, we can communicate with one another and share resources of computers (e.g. data files, programs, physical devices like printers)

Today, Information Systems heavily depend on all these telecommunication, network and Internet infrastructures. Due to the developments in telecommunications, organizations have access to wide variety of services irrespective of location and time.

3.3.6 People

Computer based Information systems (CBIS) are designed and developed by a group of people to another set of people who will use it to do some tasks. Therefore, the role of people is very significant. We can identify four types of groups who are considered the key stakeholders of a CBIS.

They are:

- End Users – people who use an information system or the information produced by a CBIS. Most end users consist of knowledge workers, a term that is used to describe a group of people who spend most of their time communicating and collaborating in teams and workgroups. They create, use and distribute information.
  (e.g. employees in an organization, customers).
- Clients – who are spending money to develop a CBIS for an organization
  (e.g. managers of the organization)
- Developers – who will design and develop CBIS according to requirements of an organization
  (e.g. software engineers/developers in IT department or software house/company)

- Development Managers – those who are undertaking the contract to develop CBIS and manage the development work using developers
  (e.g. managers in IT dept. of an organization or managers of software house/company)

3.3.7 Procedures

Development of a CBIS is not an easy thing. We need to use an engineering approach to develop such a thing. (e.g. it is like building a big building or bridge, only difference is we cannot physically see it like a bridge)

After developing a CBIS, it must be used according to some procedures to utilize it to achieve your objective. Once you have a car, you must know how to drive it as well as basic procedures to maintain it. Information systems are like that. These procedures include the strategies, policies, methods, and rules for using a Computer-based information system.

Methods describe the steps to be followed to perform a certain task. E.g. When you want to take a print out of your transactions in your savings account from the banking Information System, you must know the method to do it. At the same time, you must have authority to do so, as others may not be allowed to see details in your savings account except bank staff.
Procedures may include policies of the organization. For example, a policy may describe which groups of users have access to a certain database.

3.4 Activities of an Information System

Basic information processing activities that take place in an information system include input of data resources, processing of data into information, output of information products, storage of data resources and control of system performances.

3.4.1 Input of Data Resources

Data about business transactions and other events must be captured and prepared for processing by the input activity. Input typically takes the form of data entry activities such as recording and editing. End users typically enter data directly into a computer system, or record data about transactions on some type of physical medium such as a paper form. This usually includes a variety of editing activities to ensure that they have recorded data correctly. Once entered, data may be transferred onto a machine readable medium such as a magnetic disk until processing takes place.

For example, data about sales transactions can be recorded on source documents such as paper sales order forms (a source document is the original formal record of a transaction). Alternately, sales persons can capture sales data using the computer keyboard or optical scanning devices (ie. input devices).
Methods such as optical scanning and displays of menus, prompts, and fill-in the-blanks formats make it convenient for the end user to enter data correctly into an information system. Therefore, these methods also increase the efficiency of the input activity.

3.4.2 Processing of Data into Information

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

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

3.4.3 Output of Information Products

The goal of information systems is the production of appropriate information products for end users. Information products in various forms is transmitted to end users and made available to them in the output activity. Common information products include messages, reports, forms, and graphic images which may be provided by video displays, audio responses, paper products, and multimedia depending on the requirement of the end user of the system. We routinely use the information provided by these products as we work in organizations and live in society.

For example, in order to check the performance of a Sales Executive, a Sales Manager may print a sales report, accept a computer-produced voice message by telephone, and view a video display of an executive carrying out a sales presentation.

3.4.4 Storage of Data Resources

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

3.4.5 Control of System Performance

An important information system activity is the control of system performance. An information system should produce feedback about its input, processing, output, and storage activities. This feedback must be monitored and evaluated to determine if the system is meeting established performance standards. Then appropriate system activities must be adjusted so that proper information products are produced for end users.
For example, a manager may discover that in a sales report which lists monthly and yearly sales of the organization up to two years, the total monthly sales of year one does not add up to the total sales of the same year.

This might mean that data entry or processing procedures need to be corrected. Then changes would have to be made to ensure that all sales transactions would be properly captured and processed by a sales information system.

3.5 Trends in Business Information Systems

Until the 1960s the most information systems played a minor role carrying out simple transactions processing, record keeping, accounting and other data processing activities. Transaction Processing Systems (TPS) are necessary for data processing activities that result from business transactions. For example, to register customer orders, to produce payroll checks and produce invoices.

Then another role was added as the concept of Management Information Systems (MIS). MIS provide reports and displays for specific time periods. These reports are designed for managers responsible for specific functions or processes in a firm. These reports enable managers to control their area of responsibility. MIS typically provide with standard reports generated daily with data and information from the TPS.

By the 1970s, it was evident that the pre-specified information products produced by such management information systems were not adequately meeting many of the decision making needs of management. So the concept of Decision Support Systems (DSS) was born. A DSS goes beyond the traditional MIS and provide support for non-routine decisions or problems. It analyses the information already captured by TPSs and MISs in order to support unstructured and semi structured decision making at various levels. Such a system can help you budget for your sales team over the next quarter, considering the current sales forecast. In the 1980s, several new roles for information systems appeared.

Firstly, the rapid development of micro computer processing power, application software packages, and telecommunication networks gave birth to the phenomenon End User Computing. They are CBIS that directly support both the operational and managerial applications of end users.

Secondly, it became evident that most top corporate executives did not directly use either the reports of management IS or analytical capabilities of DSS. Therefore, the concept of Executive Information Systems (EIS) was developed. EIS provides support for the long term strategic view that senior executives need to take of the business. These systems provide easy access to summarized company data, taking into consideration the external information such as competitor, industry and economy at large.

Thirdly, another breakthrough occurred in the development and application of artificial intelligence (AI) techniques to business information systems. AI's are based on artificial intelligence and carries out functions normally associated with human intelligence, for example, reasoning, inference learning and problem solving. Robotics is an area of artificial intelligence in which machines take over complex, dangerous, routine or boring tasks, such as welding car frames or assembling computer systems and components.

Furthermore, Expert systems (ES) and other knowledge based systems form a new role for information systems. ES provide expert advice and act as expert consultants to users. Examples include credit application advisor and diagnostic maintenance system.

An important new role of information systems appeared in the 1980s and continued through the 1990s. This is the concept of a strategic role for information systems, sometimes called as Strategic Information Systems (SIS). SIS are Information systems that provide a firm with competitive products and services that give it a strategic advantage over its competitors in

the market place. Also, IS promotes business innovation, improve business processes and build strategic information resources for a firm.

Finally, the rapid growth of the Internet in the 1990s and other interconnected global networks, changed the capabilities of information systems in business at the beginning of 21st century. Internet based e-commerce and mobile commerce systems are becoming common place in the operations and management of today's business enterprise. E-commerce involves any business transaction executed electronically between parties such as companies (business to business, B2B), consumers and other consumers (consumer to consumer), companies and consumer(B2C), business and the public sector and consumers and the public sector.

Although e-commerce is mostly associated with web shopping, major volume of e-commerce and its fastest growing segment is business to business (B2B) transactions that make purchasing easier for companies.

The trends discussed above are depicted in figure A.

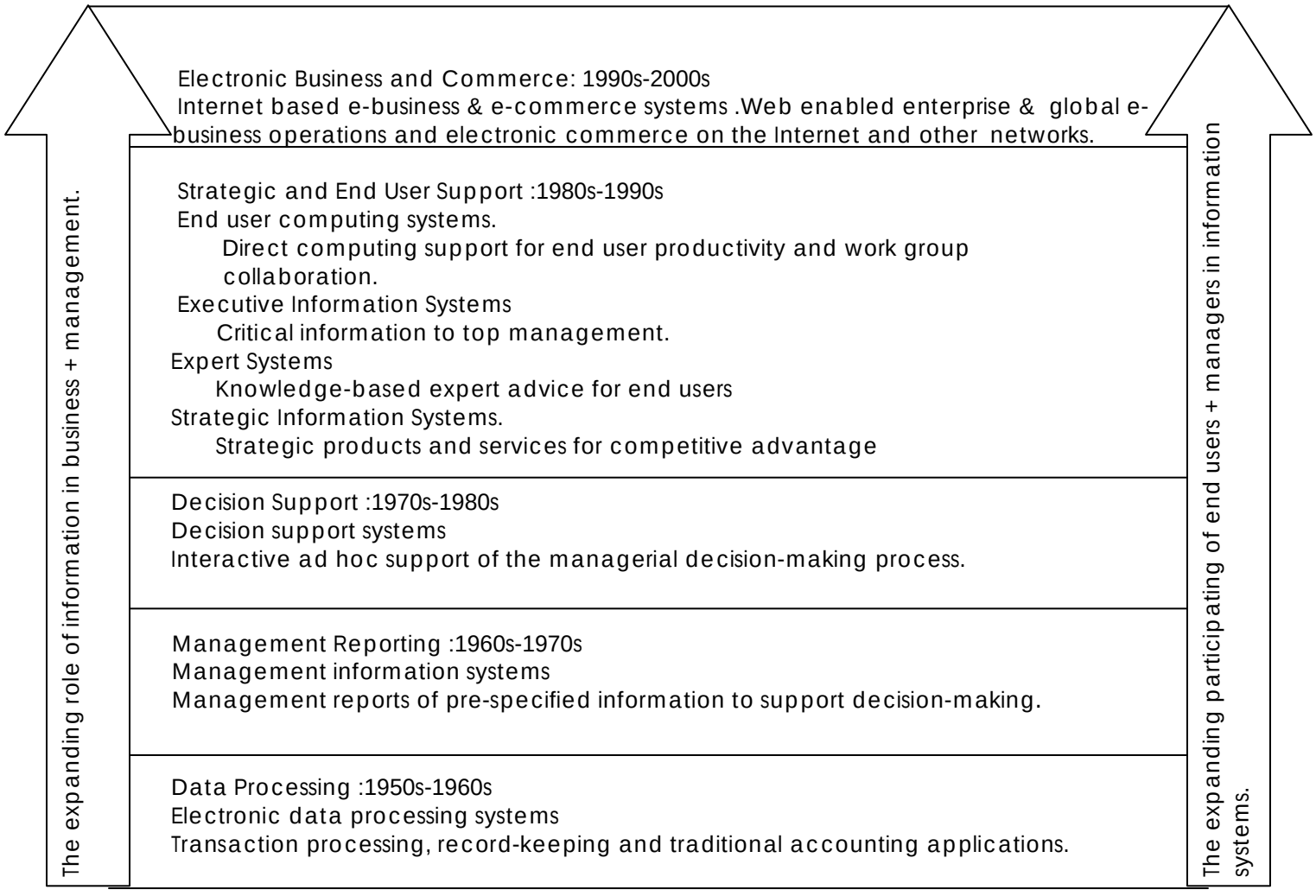


Fig. A. Expanding Roles of IS

4 The Role of IS in Business and Managerial Challenges

4.1 The Fundamental Roles of IS in Business

There are three fundamental reasons for all business applications of information technology. They are found in the three vital roles that information systems can perform for a business enterprise.

- Support its business processes and operations.
- Support decision making by its employees and its managers
- Support its strategies for competitive advantage

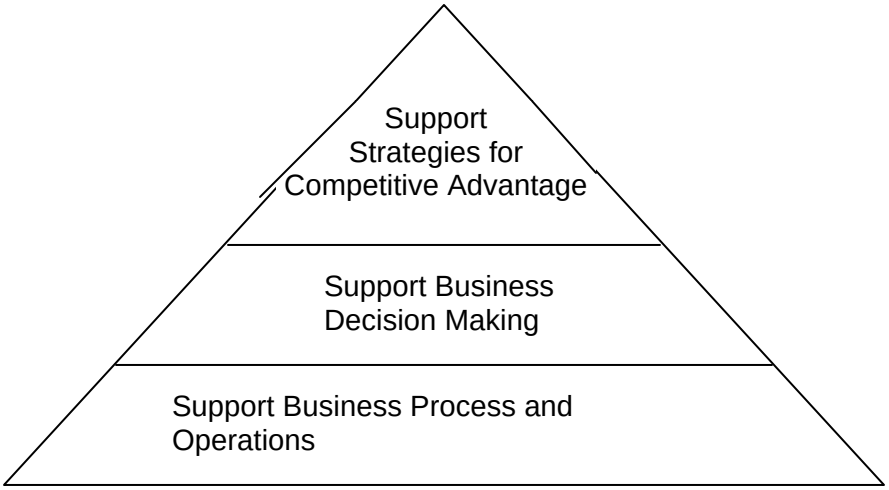


Figure B: illustrates three major roles of business applications of information systems.

For example, lets consider these three roles in a retail store.

Support Business Processes: most retail stores now use computer based information systems to help them record customer purchases, keep track of the inventory, buy new merchandise, pay employees and evaluate sales trends.

Support Decision making: CBIS allow management to make decisions on what lines of merchandise is required or should be discounted and which areas need investments.

Support Competitive Advantage: Gaining a strategic advantage over competitors requires innovative use of IT.
For example, store management might make a decision to install touch-screen kiosks in all of their stores, with links to their e-commerce website for online shopping. This might attract new customers and build customer loyalty because of the ease of shopping and buying merchandise provided by such information systems. Therefore, strategic information systems can help provide products and services that give a business a competitive advantage over its competitors.

4.1.1 Information Systems In the Functional Areas of Business

Studies have shown that the involvement of managers and decision makers in all aspects of information systems is a major factor for organizational success, including higher profits and lower costs.
Information systems are used in all functional areas and operating divisions of business.

The principal business functions are;

- Sales and Marketing: ensuring that the firms products meet the needs of the marketplace, developing a market for those products, providing them at the right time for the right price.
- Production: creating or adding value by producing goods or offering services. In firms that produce goods, the production function is known as manufacturing.
- Accounting and Finance: managing the funds of the enterprise.
- Human Resources: developing the personnel of the firm.

Let's consider application of information systems in these functional areas of a business.

Sales and Marketing: to develop new goods and services (product analysis), determine the best location for production and distribution facilities (place or site analysis), determine the best advertising and sales approaches (promotion analysis),and set product prices to get the highest total revenues (price analysis).

Manufacturing: to process customer orders, develop production schedules, control inventory levels, and monitor product quality.
In addition, information systems are used for product design. Applications used include Computer-Assisted Design *CAD). Others include manufacturing of items using Computer-Assisted Manufacturing *or CAM),and integration of multiple machines or pieces of equipment using computer-integrated manufacturing ,or CIM.

Finance and Accounting: to forecast revenues and business activity, determine the best sources and uses of funds, manage cash and other financial resources, analyze investments, and perform audits to make sure that the organization is financially sound and that all financial reports and documents are accurate.

Human Resource Management: to screen applicants, administer performance tests to employees, monitor employee productivity, and more.

4.1.2 Information Systems in Industry

Information systems are used in almost every industry or field.

The airline industry employs Internet auction sites to offer discount fares and increase revenue.

Investment firms use information systems to analyze stocks, bonds, options, the future market, and other financial instruments, as well as to provide improved services to their customers.

Banks use information systems to help make sound loans and good investments, as well as to provide online check payment for account holders.

The transportation industry uses information systems to schedule trucks and trains to deliver goods and services at the lowest cost.

Publishing companies use information systems to analyze markets and to develop and publish newspapers, magazines, and books.
Healthcare organizations use information systems to diagnose illnesses, plan medical treatment, track patient records, and bill patients.

Retail companies are using the Web to take customer orders and provide customer service support. Further, they use information systems to help market products and services, manage inventory levels, control the supply chain, and forecast demand.

Power management and utility companies use information systems to monitor and control power generation and usage.

Professional services firms employ information systems to improve the speed and quality of services they provide to customers.

Management consulting firms use intranets and extranets to provide information on products, services, skill levels, and past engagements to its consultants.
Apart from business organizations, non-governmental organizations as well as Government organizations use information systems to streamline its operations in order to achieve efficiency and effectiveness.

4.2 Managerial Challenges of IT

As discussed in the above sections, it is evident that Computer based information systems (CBIS) provide many capabilities to enhance the business activities of an organization. However, there are many challenges faced by mangers of IT-IS.
As a prospective manager or user of IS, it is important to understand the difficulties that can be presented by the use of information technology in order to confront and overcome these difficulties.

Success and Failure with IT
CBIS,though heavily dependent on information technologies, are designed, operated and used by people in a variety of organizational settings and business environments. Information systems and their technologies must be managed to support the business strategies, business processes, and organizational structures and culture of a business enterprise. Therefore, success of such a system should not only be measured by terms of efficiency (based on cost, time and use of information resources). It should also be measured by terms of effectiveness in supporting the business strategies, enabling business processes, enhancing its organizational structures and culture and increasing the customer and business value of the enterprise.

However, IS can be mismanaged or misapplied creating both technical problems as well as disastrous failures.
For example it is documented that many of the Enterprise Resource Planning (ERP) system implementations has ended up in failures as many of the professionals do not take into consideration factors such business processes and cultural change that takes place due to the introduction of these systems.

IS Solution Development Challenges

Development of successful information systems to a business problem is a major challenge faced by the professionals. If the developed system does not support the requirement of the organization, the purpose of developing such a system would be completely lost. IS professionals are responsible for proposing or developing of new or improved information technologies for the company. Typically, a systematic development process is used to develop most IS. The stages followed in the process is depicted in fig. x.
In this process, end users and information specialists design information system applications based on an analysis of the business requirements of an organization.
Examples of other activities include investigating the economic or technical feasibility of a proposed application, acquiring and learning how to use the software required to implement the new system, and making improvements to maintain the business value of the system. The development process will be discussed in detail in chapter 7 and 8.

Challenges of Ethics and IT
IS professional need to address ethical responsibilities generated by the use of information technology. For example, they need to address questions such as what uses of information technology might be considered harmful, improper to other individuals or to the society? what is the proper business use of the Internet and an organization's IT resources? what does it take to be a responsible end user of IT? what action should be taken to address computer crime ? etc. These are some of the ethical dimensions discussed in detail in chapter 9.

Human Resources Challenges
Success or failure of an organization largely rest on the human resources of the organization. Recruiting staff with proper qualifications is a problem faced by many IS managers today. One reason for this is the rapidly changing technological and business developments.

5 Importance of Learning Information Systems

Information systems are used in almost every imaginable career area.

- Sales representatives use information systems to advertise products, communicate with customers, and analyze sales trends.
- Managers use them to aid them in decision making, such as deciding to build a new manufacturing plant or research a new cancer drug.
- Corporate lawyers use information systems to develop contracts and other legal documents for their firm.
- From a small music store to huge multinational companies, businesses of all sizes could not survive without information systems to perform various activities of business functions such as accounting and finance.
- Why learn about information systems? What is in it for you? Regardless of your chosen career, you will find that information systems are indispensable tools to help you achieve your career aspirations.

5.1 Computer and Information Systems Literacy

I
n the twenty-first century, business survival and prosperity continue to become more difficult. In addition, business issues and decisions are becoming more complex and must be made faster.
Whatever career path you take, an understanding of information systems will help to cope, adapt, and prosper in this challenging environment.
To meet these personal and organizational goals, you must acquire **both computer literacy and information systems literacy.**

Computer literacy is the knowledge of computer systems and equipment and the way they function. It stresses the knowledge of equipment and devices (hardware), programs and instructions (software), databases, and telecommunications.

Information systems literacy goes beyond the knowledge of the fundamentals of computer systems and equipment. It can involve knowledge of how and why people (managers, employees, stockholders, and other individuals) use information technology; knowledge of organizations, decision-making approaches, management levels, and information needs; and knowledge of how organizations can use computers and information systems to achieve their goals.
Knowing how to deploy transaction processing, management information, decision support, and special-purpose systems to help an organization achieve its goals is a key aspect of information systems literacy. In short, information literacy means the ability to solve problems, taking advantage of information technology and networks.

Examples:
As a computer literate person you may be able to select the personal computer equipmeny you need, carry out preparation of your assignments with suitable software and use the Internet to communicate with your friends.
Knowing how to use hardware and software to increase profits, cut costs, improve productivity, and increase customer satisfaction is an example of information systems literacy.

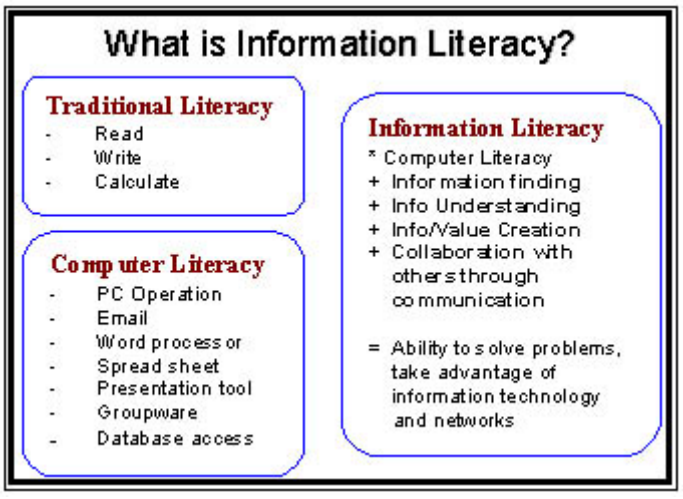


Figure C: Information Literacy

5.2 Information Systems Careers

Information systems personnel typically work in an IS department. They may also work in other functional departments or areas in a support capacity. In general, IS personnel are charged with maintaining the broadest perspective of organizational goals. IS personnel operate as an internal consultant to all functional areas of the organization, being knowledgeable and competent in bringing the power of IS to bear throughout the organization.

For most medium-to large-sized organizations, information resources are typically managed through an IS department. In smaller businesses, one or more people may manage information resources, with support from outside services—outsourcing1. Outsourcing is also popular with larger organizations.

In a typical IS department the head of the department is known as the Chief Information Officer (CIO)/IT Director and reports to the Chief Executive Officer (CEO).
As shown in Figure below, the IS organization has three primary responsibilities:

operations,
systems development, and
support.

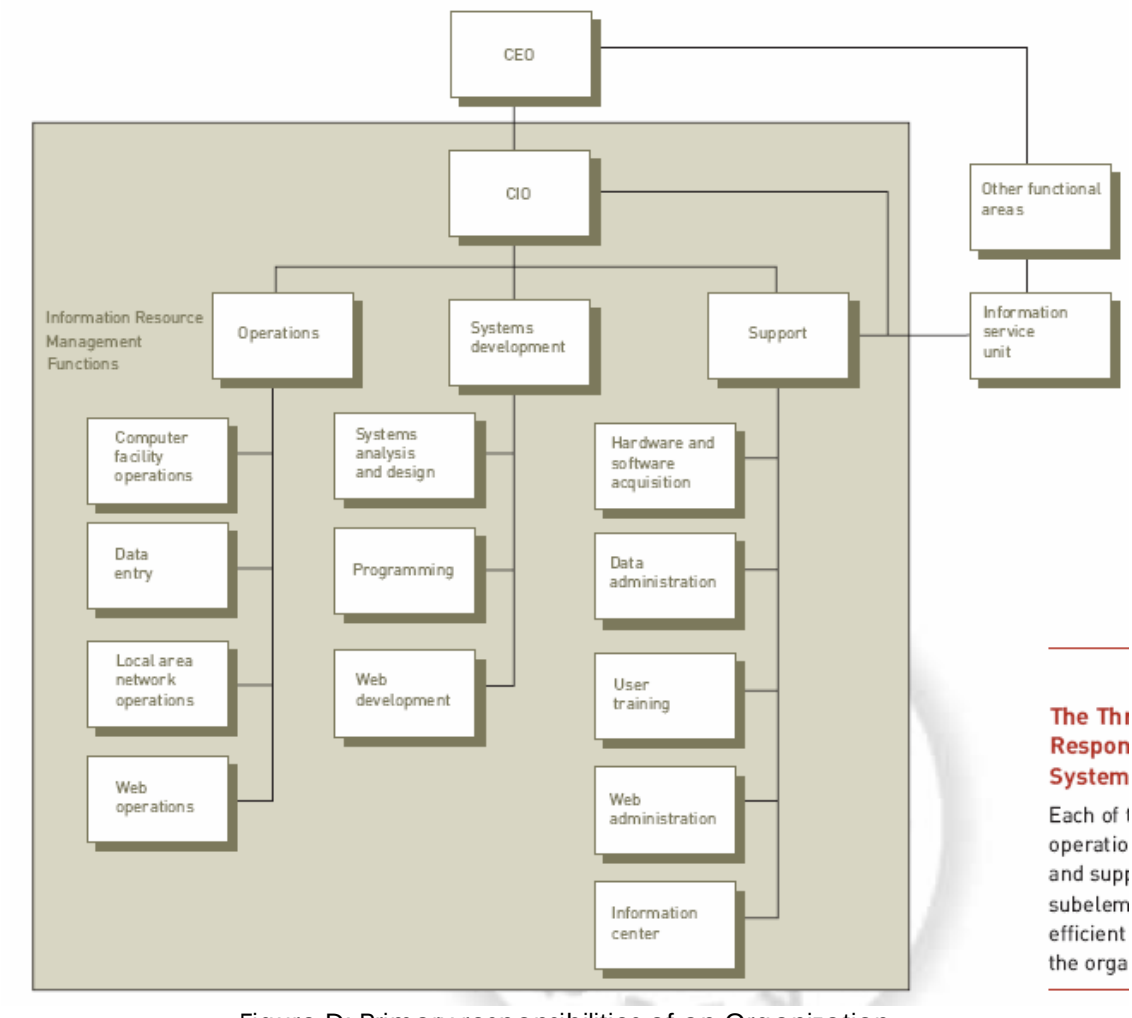


Figure D: Primary responsibilities of an Organization

[1] Outsourcing – contracting with outside professional services to meet specific business needs.

Operations

The operations component of a typical IS department focuses on the use of information systems in corporate or business unit computer facilities.
It tends to focus more on the efficiency of IS functions rather than their effectiveness.
The primary function of a system operator is to run and maintain IS equipment.
System operators are responsible for starting, stopping, and correctly operating computer systems, networks, tape drives, disk devices, printers, and so on.
Other operations include scheduling, hardware maintenance, and preparation of input and output.

Data-entry operators convert data into a form the computer system can use.
They may use terminals or other devices to enter business transactions, such as sales orders and payroll data. Increasingly, data entry is being automated—captured at the source of the transaction rather than being entered later.
In addition, companies may have local area network and Web or Internet operators who are responsible for running the local network and any Internet sites the company may have.

Systems Development

The systems development component of a typical IS department focuses on specific development projects and ongoing maintenance and review.

System development includes system analysts and programming staff.
The role of a systems analyst is multifaceted. Systems analysts help users determine what outputs they need from the system and construct the plans needed to develop the necessary programs that produce these outputs.
Systems analysts then work with one or more programmers (team work) to make sure that the appropriate programs are purchased, modified from existing programs, or developed. The major responsibility of a computer programmer is to use the plans developed by the systems analyst to develop or adapt one or more computer programs that produce the desired outputs.
The main focus of systems analysts and programmers is to achieve and maintain IS effectiveness.

With the dramatic increase in the use of the Internet, intranets, and extranets, many companies have Web or Internet developers who are responsible for developing effective and attractive Internet sites for customers, internal personnel, suppliers, stockholders, and others with a business relationship with the company.

Support

The support component of a typical IS department focuses on providing user assistance in the areas of hardware and software acquisition and use, data administration, user training and assistance, and Web administration.

Because IS hardware and software are costly, especially if purchase mistakes are made, the acquisition of computer hardware and software is often managed by a specialized support group.

This group sets guidelines and standards for the rest of the organization to follow in making purchases.
Gaining and maintaining an understanding of available technology, evaluation of these technologies, as well as vendor relationship management is an important part of the acquisition of information systems.
A database administrator focuses on planning, policies, and procedures regarding the use of corporate data and information.
For example, database administrators develop and disseminate information about the corporate databases for developers of IS applications.
In addition, the database administrator is charged with monitoring and controlling database use.

User training is a key to get the most from any information system.
The support area insures that appropriate training is available to users.
Training can be provided by internal staff or from external sources.

For example, internal support staff may train managers and employees in the best way to enter sales orders, to receive computerized inventory reports, and to submit expense reports electronically.
Companies also hire outside firms to help train users in other areas, including the use of word processing, spreadsheets, and database programs.

Web administration is another key area of the support function.
With the increased use of the Internet and corporate Web sites, Web administrators are sometimes asked to regulate and monitor Internet use by employees and managers to make sure that it is authorized and appropriate.
Web administrators also are responsible for maintaining the corporate Web site.

The support component typically operates the information center.
An information center provides users with assistance, training, application development, documentation, equipment selection and setup, standards, technical assistance, and troubleshooting.

Other IS Careers

Apart from careers associated with a typical IS department in an organization, IS personnel can work for consulting firms such as IBM and EDS. Other jobs include working in IT education, Sales/Marketing of IT services among others.

Skills Required by IS Personnel

The type of skills required by an IS personnel may vary depending on their job description. However, generally, in addition to technical skills, IS personnel need to develop written and verbal communication skills, leadership skills, inter-personal skills, analytical and administration skills among others. As most careers related to IS involves considerable amount of team work, it is important to acquire skills required to work efficiently and effectively in a group/team.

According to George Voutes, enterprise technology programs manager for Deutsche Asset Management Technology, "We have to get away from strict programming and systems development. Those are skills to get into the field, but we have to train our technology people more like business people and arm them with strong communications skills."