



IT1105 – Information Systems and Technology

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

Student Manual

Lesson 1:

Introduction to Information Systems

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Duration: 6 hrs

Instructional Objectives

Students will be able to:

- Distinguish data from information
- Describe the characteristics used to evaluate the quality of information
- Identify system concepts
- Describe the components of an information system
- Describe the components of a computer based information system
- Identify the role of IS in business
- Describe the importance of studying information systems
- Identify Information Systems careers

1: Introduction to 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 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 importance of studying about information systems and IS careers.

1.1 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.

1.1.1 Data vs. Information

1.1.1.1 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,

1.1.1.2 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,

1.1.1.3 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**. 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.

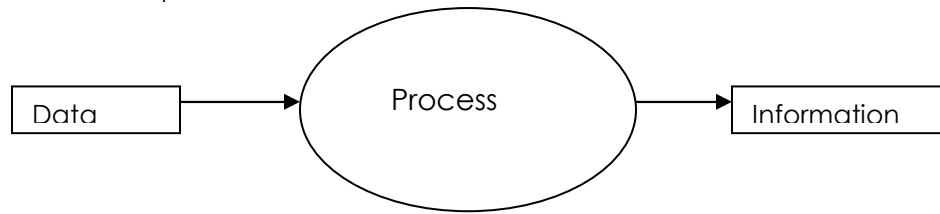


Figure 1.1: Conversion of Data to Information

Knowledge for the Process:

According to the 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.

1.1.1.4 Types of Data and Information:

Data and information can be categorized based on their representation for the human processing. Table 1.1 summarizes the four main types of data together with examples.

Table 1.1: Types of Data

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

1.1.2 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 occur 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).

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 the Internet.

Accessible: Accurate information plays a major role 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.

1.1.3 The 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 according to his clients requirements. However, if the return on 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.

1.2 Information System

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.

1.2.1 System Concepts and Components

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.

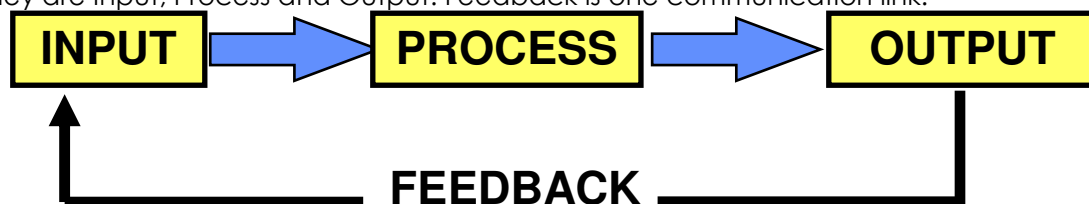


Figure 1.2: Components of a System

Example : Car Wash (System Components)

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 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 : The Scope (System Boundary) 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

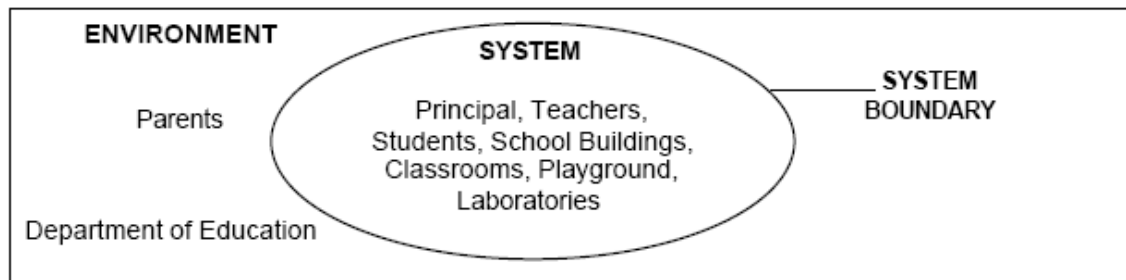


Figure 1.3: A school (viewed as a system) illustrating the system boundary

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

Table 1.2: System Types and Characteristics

System Type	Characteristics	
Simple vs. Complex	<p>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.</p>	<p>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.</p>

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.
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.

1.2.2 Main Components of an Information System

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 figure 1.4.

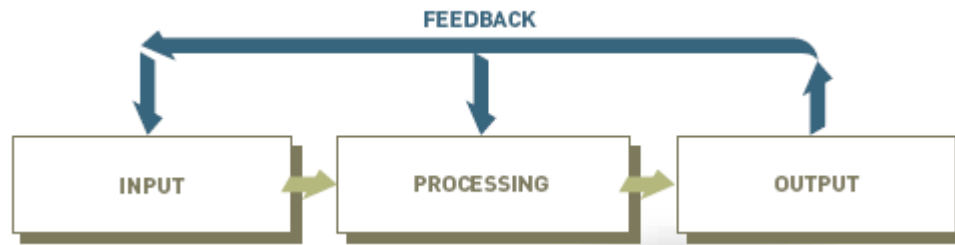


Figure 1.4: Components of an Information System

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.

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 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) and 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 the ordered products.

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.

1.2.3 Computer Based Information Systems

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 organization's information systems.

Lets identify these components in detail.

1.2.3.1 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 the 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, mouse, Magnetic ink character readers (MICR), scanners etc.

We will discuss about some input devices in Lesson 2.

- **Processing devices**

Processing devices include the central processing unit (CPU) and main memory. They are inside the system unit. The role of the CPU and memory is briefly described in Lesson 3.

- **Output devices**

Results after processing the data, can be stored in the computer or it can be taken out from the information system. These results are known as "output" and the devices which facilitate distributing of the output is known as output devices. Commonly used output devices are the monitor and the printer. We will discuss about some output devices in Lesson 3.

1.2.3.2 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. Software 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

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. Application software cannot run without having system software. 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 facilitates running of application software.

Example: Microsoft Windows, Linux, Unix

1.2.3.3 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. More details are discussed in Lesson 3.

Examples: Access, DBASE.

1.2.3.4 Telecommunications, Network and the 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.

Do you know what a network is?

A computer network is a group of computers that are connected to each other for the purpose of communication. 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.

1.2.3.5 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)

1.2.3.6 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 the objectives. 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.

1.3 The Role of IS in business

There are 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

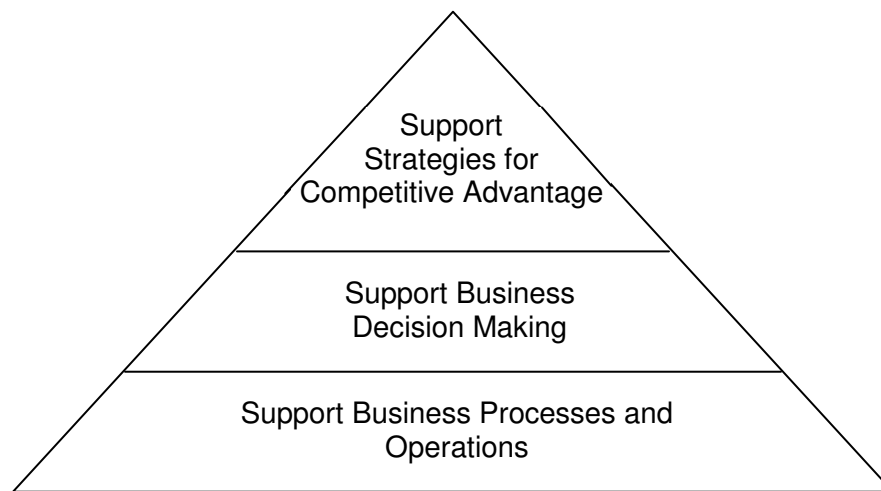


Figure 1.5: Major roles of information systems in business organizations

For example, let's consider these three roles in a retail store.

Support Business Processes and operations: 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. Systems such as Transaction Processing Systems (TPS), Management Information Systems (MIS) and systems related to e-business/e-commerce enable organizations to carry out business processes.

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. Systems such as MIS and Decision Support Systems (DSS) help organizations to carry out this task.

We will discuss about different IS in Lesson 5.

Support Competitive Advantage: Gaining a strategic advantage over competitors requires innovative use of IT. We will discuss this in Lesson 4.

1.4 Importance of Learning Information Systems

1.4.1 Why Learn IS

The role of IS in the businesses demonstrates the importance of learning IS. Furthermore, 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.



1.4.2 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 responsible for 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—this is known as 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 1.6, the IS organization has three primary responsibilities: operations, systems development, and support.

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.

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. In addition, companies may have operational staff to handle the network related aspects of an organization.

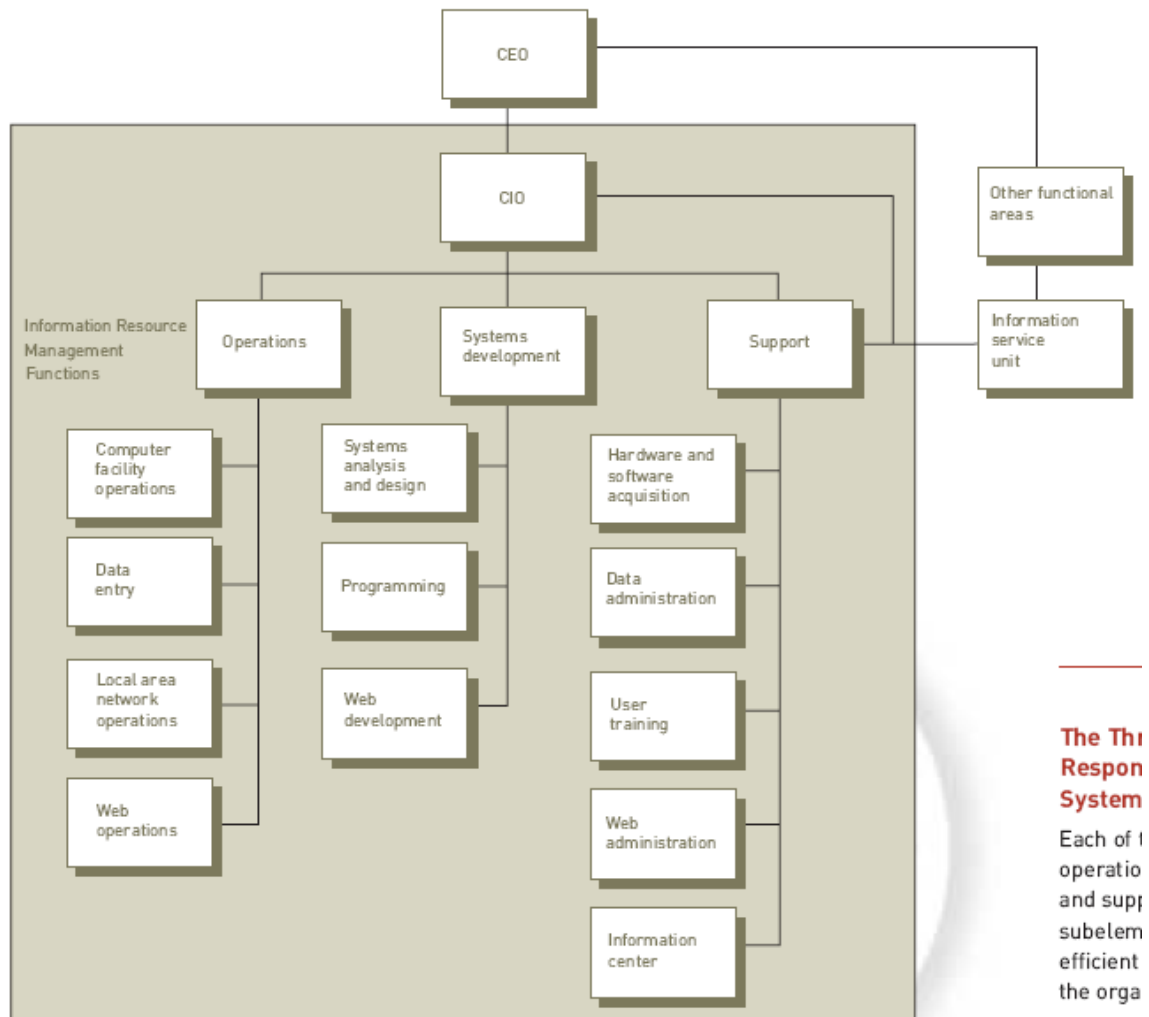


Figure 1.6: Primary responsibilities of IS personnel

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. 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. 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.

In addition, the database administrator is charged with monitoring and controlling database use.

As user training is a key to get the most from any information system and the support area ensures that appropriate training is available to users.

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 Ernst & Young. 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.