

## Unit 2: Foundation concepts: The components of IS

### System Concepts: A Foundation

- System concepts underlie all business processes, as well as our understanding of information systems and technologies.
- System concepts help us understand:
  - **Technology:** Computer networks are systems of information processing components that use a variety of hardware, software, data management, and telecommunications network technologies.
  - **Applications:** E-business and e-commerce applications involve interconnected business information systems.
  - **Development:** Developing ways to use information technology in business includes designing the basic components of information systems.
  - **Management:** Managing information technology emphasizes the quality, strategic business value, and security of an organization's information systems.

### What Is a System?

- A system is defined as a set of interrelated components, with a clearly defined boundary, working together to achieve a common set of objectives by accepting inputs and producing outputs in an organized transformation process.
- Systems have three basic functions:
  - **Input** involves capturing and assembling elements that enter the system to be processed. For example, raw materials, energy, data, and human effort must be secured and organized for processing.
  - **Processing** involves transformation processes that convert input into output. Examples are manufacturing processes, the human breathing process, or mathematical calculations.
  - **Output** involves transferring elements that have been produced by a transformation process to their ultimate destination. For example, finished products, human services, and management information must be transmitted to their human users.

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

### Feedback and Control

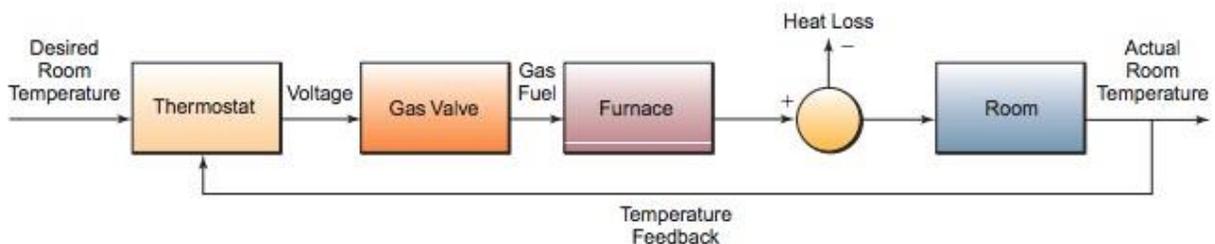
- The system concept becomes even more useful by including two additional elements: feedback and control. A system with feedback and control functions is sometimes called a cybernetic system, that is, a self-monitoring, self-regulating system.
  - **Feedback** is data about the performance of a system. For example, data about sales performance are feedback to a sales manager. Data about the speed,

altitude, attitude, and direction of an aircraft are feedback to the aircraft's pilot or autopilot.

- **Control** involves monitoring and evaluating feedback to determine whether a system is moving toward the achievement of its goal. The control function then makes the necessary adjustments to a system's input and processing components to ensure that it produces proper output. For example, a sales manager exercises control when reassigning salespersons to new sales territories after evaluating feedback about their sales performance. An airline pilot, or the aircraft's autopilot, makes minute adjustments after evaluating the feedback from the instruments to ensure that the plane is exactly where the pilot wants it to be.

**Example:** Figure below illustrates a familiar example of a self-monitoring, self-regulating, thermostat-controlled heating system found in many homes; it automatically monitors and regulates itself to maintain a desired temperature.

**FIGURE 1.17** A common cybernetic system is a home temperature control system. The thermostat accepts the desired room temperature as input and sends voltage to open the gas valve, which fires the furnace. The resulting hot air goes into the room, and the thermometer in the thermostat provides feedback to shut the system down when the desired temperature is reached.



Another example is the human body, which can be regarded as a cybernetic system that automatically monitors and adjusts many of its functions, such as temperature, heartbeat, and breathing. A business also has many control activities. For example, computers may monitor and control manufacturing processes, accounting procedures help control financial systems, data entry displays provide control of data entry activities, and sales quotas and sales bonuses attempt to control sales performance.

### System characteristics

- A system does not exist in a vacuum; rather, it exists and functions in an environment containing other systems.
- If a system is one of the components of a larger system, it is a subsystem, and the larger system is its environment.
- Several systems may share the same environment. Some of these systems may be connected to one another by means of a shared boundary, or *interface*.
- A system that has the ability to change itself or its environment to survive is an *adaptive system*.

**Example:** Organizations such as businesses and government agencies are good examples of the systems in society, which is their environment. Society contains a multitude of such systems, including individuals and their social, political, and economic institutions. Organizations

themselves consist of many subsystems, such as departments, divisions, process teams, and other workgroups. Organizations are examples of open systems because they interface and interact with other systems in their environment. Finally, organizations are examples of adaptive systems because they can modify themselves to meet the demands of a changing environment.

**[multitude:** a large number of people or things]

Information systems are made up of interrelated components:

- People, hardware, software, peripherals, and networks.

They have clearly defined boundaries:

- Functions, modules, type of application, department, or end-user group.

All the interrelated components work together to achieve a common goal by accepting inputs and producing outputs in an organized transformation process:

- Using raw materials, hiring new people, manufacturing products for sale, and disseminating information to others.

Information systems make extensive use of feedback and control to improve their effectiveness:

- Error messages, dialog boxes, passwords, and user rights management.

Many information systems are designed to change in relation to their environments and are adaptive:

- Intelligent software agents, expert systems, and highly specialized decision support systems.

Information systems are systems just like any other system. Their value to the modern organization, however, is unlike any other system ever created.

## Components of Information Systems

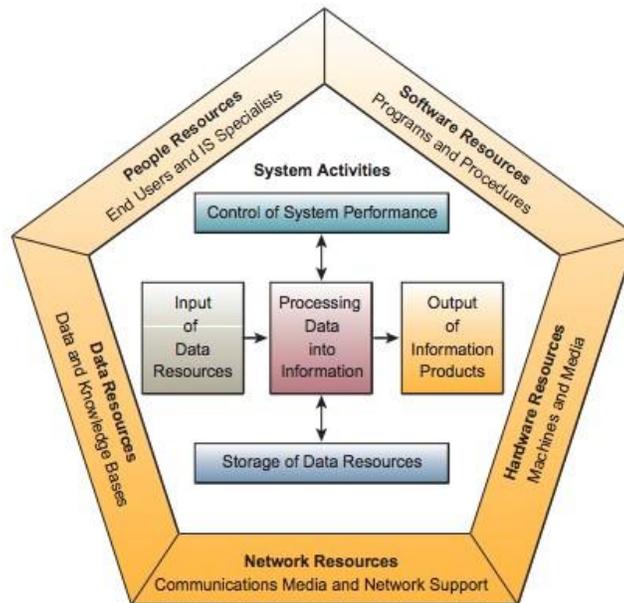


Fig: Components of Information Systems

- Figure above illustrates an information system model that expresses a fundamental conceptual framework for the major components and activities of information systems.
- An information system depends on the resources of people (end users and IS specialists), hardware (machines and media), software (programs and procedures), data (data and knowledge bases), and networks (communications media and network support) to perform input, processing, output, storage, and control activities that transform data resources into information products.
- This information system model highlights the relationships among the components and activities of information systems.
- It also provides a framework that emphasizes four major concepts that can be applied to all types of information systems:
  - People, hardware, software, data, and networks are the five basic resources of information systems.
  - People resources include end users and IS specialists, hardware resources consist of machines and media, software resources include both programs and procedures, data resources include data and knowledge bases, and network resources include communications media and networks.
  - Data resources are transformed by information processing activities into a variety of information products for end users.
  - Information processing consists of the system activities of input, processing, output, storage, and control.

## Information System Resources

- Our basic IS model shows that an information system consists of five major resources: **people, hardware, software, data, and networks.**

### 1. People Resources

- People are the essential ingredient for the successful operation of all information systems.
- These people resources include **end users** and **IS specialists**.

#### a. End users (also called users or clients)

- People who use an information system or the information it produces.
- They can be customers, salespersons, engineers, clerks, accountants, or managers and are found at all levels of an organization.
- In fact, most of us are information system end users. Most end users in business are knowledge workers, that is, people who spend most of their time communicating and collaborating in teams and workgroups and creating, using, and distributing information.

#### b. IS specialists

- are people who develop and operate information systems.
- They include systems analysts, software developers, system operators, and other managerial, technical, and clerical IS personnel.
- Systems analysts design information systems based on the information requirements of end users, software developers create computer programs based on the specifications of systems analysts, and system operators help monitor and operate large computer systems and networks.  
[**clerical:** concerned with or relating to work in an office, especially routine documentation and administrative tasks.]

### 2. Hardware Resources

- The concept of hardware resources includes all physical devices and materials used in information processing.
- Specifically, it includes not only machines, such as computers and other equipment, but also all data media, that is, tangible objects on which data are recorded, from sheets of paper to magnetic or optical disks.
- Examples of hardware in computer-based information systems are:
  - a. Computer systems**
    - which consist of central processing units containing microprocessors and a variety of interconnected peripheral devices such as printers, scanners, monitors, and so on.
    - Examples are handheld, laptop, tablet, or desktop microcomputer systems, midrange computer systems, and large mainframe computer systems.
  - b. Computer peripherals**
    - which are devices such as a keyboard, electronic mouse, trackball, or stylus for the input of data and commands, a video screen or printer for the output

of information, and magnetic or optical disk drives for the storage of data resources.

### 3. Software Resources

- The concept of software resources includes all sets of information processing instructions.
- This generic concept of software includes not only the sets of operating instructions called **programs**, which direct and control computer hardware, but also the sets of information processing instructions called **procedures** that people need.
- All information systems require software resources in the form of information processing instructions and procedures to properly capture, process, and disseminate information to their users.

The following are examples of software resources:

- **System software**, such as an operating system program, which controls and supports the operations of a computer system. Microsoft Windows and Unix are two examples of popular computer operating systems.
- **Application software**, which are programs that direct processing for a particular use of computers by end users. Examples are sales analysis, payroll, and word processing programs.
- **Procedures**, which are operating instructions for the people who will use an information system. Examples are instructions for filling out a paper form or using a software package.

### 4. Data Resources

- Data constitute valuable organizational resources.
- Data that previously were captured as a result of a common transaction are now stored, processed, and analyzed using sophisticated software applications that can reveal complex relationships among sales, customers, competitors, and markets.
- Data are the lifeblood of today's organizations, and the effective and efficient management of data is considered an integral part of organizational strategy.
- Data can take many forms:
  - **Alphanumeric data**: composed of numbers, letters, and other characters that describe business transactions and other events and entities.
  - **Text data**: consisting of sentences and paragraphs used in written communications.
  - **Image data**: such as graphic shapes and figures or photographic and video images.
  - **Audio data**: including the human voice and other sounds.
- The data resources of information systems are typically organized, stored, and accessed by a variety of data resource management technologies into:
  - Databases that hold processed and organized data.

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

### Data versus Information

- Data are raw facts or observations, typically about physical phenomena or business transactions. For example, a spacecraft launch or the sale of an automobile would generate a lot of data describing those events. More specifically, data are objective measurements of the *attributes* (the characteristics) of *entities* (e.g., people, places, things, events).
- Information as data that have been converted into a meaningful and useful context for specific end users.
- Thus, data are usually subjected to a value-added process (data processing or information processing) during which
  1. their form is aggregated, manipulated, and organized,
  2. their content is analyzed and evaluated, and
  3. they are placed in a proper context for a human user
- Data is **context independent**: A list of numbers or names, by itself, does not provide any understanding of the context in which it was recorded.
- For information, both the context of the data and the perspective of the person accessing the data become essential.
- The same data may be considered valuable information to one person and completely irrelevant to the next.
- Hence data is potentially valuable to all and information is valuable relative to its user.
- **Example**: Names, quantities, and dollar amounts recorded on sales forms represent data about sales transactions. However, a sales manager may not regard these as information. Only after such facts are properly organized and manipulated can meaningful sales information be furnished and specify, for example, the amount of sales by product type, sales territory, or salesperson.

### 5. Network Resources

- Telecommunications technologies and networks like the Internet, intranets, and extranets are essential to the successful e-business and e-commerce operations of all types of organizations and their computer-based information systems.

- Telecommunications networks consist of computers, communications processors, and other devices interconnected by communications media and controlled by communications software.
- The concept of network resources emphasizes that communications technologies and networks are fundamental resource components of all information systems.
- Network resources include:
  - **Communications media:** Examples include twisted-pair wire, coaxial and fiber-optic cables, and microwave, cellular, and satellite wireless technologies.
  - **Network infrastructure:** Examples include communications processors, such as modems and inter-network processors, and communications control software, such as network operating systems and Internet browser packages.

## Information System Activities

### 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 usually enter data directly into a computer system or record data about transactions on some type of physical medium such as a paper form.
- This entry includes a variety of editing activities to ensure that they have recorded the data correctly.
- Once entered, data may be transferred onto a machine readable medium, such as a magnetic disk, until needed for processing.
- For example, data about sales transactions may be recorded on source documents such as paper order forms. (*A source document is the original, formal record of a transaction.*)
- Alternatively, salespersons might capture sales data using computer keyboards or optical scanning devices; they are visually prompted to enter data correctly by video displays. This method provides them with a more convenient and efficient user interface, that is, methods of end-user input and output with a computer system. Methods such as optical scanning and displays of menus, prompts, and fill-in-the-blank formats make it easier for end users to enter data correctly into an information system.

### 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 also must be maintained by a continual process of correcting and updating activities.
- **Example:** Data received about a purchase can be:
  - added to a running total of sales results,
  - compared to a standard to determine eligibility for a sales discount,
  - sorted in numerical order based on product identification numbers,
  - classified into product categories (e.g., food and nonfood items),
  - summarized to provide a sales manager with information about various product categories, and finally ● used to update sales records.

### 3. Output of Information Products

- Information in various forms is transmitted to end users and made available to them in the output activity.
- The goal of information systems is the production of appropriate information products for end users.
- Common information products include messages, reports, forms, and graphic images, which may be provided by video displays, audio responses, paper products, and multimedia.
- For example, a sales manager may view a video display to check on the performance of a salesperson, accept a computer-produced voice message by telephone, and receive a printout of monthly sales results.

### 4. Storage of Data Resources

- Storage is the information system activity in which data are retained in an organized manner for later use.
- For example, just as written text material gets organized into words, sentences, paragraphs, and documents, stored data are commonly organized into a variety of data elements and databases.
- This organization facilitates their later use in processing or retrieval as output when needed by users of a system. *[In detail in chapter 5: Managing Data Resources]*
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### 4. 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 whether the system is meeting established performance standards.
- Then appropriate system activities must be adjusted so that proper information products are produced for end users.
- For example, a manager may discover that subtotals of sales amounts in a sales report do not add up to total sales. This conflict 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.

**FIGURE 1.21**  
Business examples of  
the basic activities of  
information systems.

Information System Activities
• <b>Input.</b> Optical scanning of bar-coded tags on merchandise.
• <b>Processing.</b> Calculating employee pay, taxes, and other payroll deductions.
• <b>Output.</b> Producing reports and displays about sales performance.
• <b>Storage.</b> Maintaining records on customers, employees, and products.
• <b>Control.</b> Generating audible signals to indicate proper entry of sales data.

### Recognizing Information systems

- As a business professional, we should be able to recognize the fundamental components of information systems we encounter in the real world. This demand means that we should be able to identify:
  - The people, hardware, software, data, and network resources they use.
  - The types of information products they produce.
  - The way they perform input, processing, output, storage, and control activities.
- This kind of understanding will help one be a better user, developer, and manager of information systems. This is important to our future success as a manager, entrepreneur, business professional, or modern business technologist.

### Assignment #2

1. What are the uses of feedback and control in system? Explain with one example.
2. What is MIS? Explain its advantages and limitations. Briefly explain the resources used on MIS.