Introduction to Systems Analysis and Design

Introduction to General Systems Theory

Objectives

- Define system
- Describe the elements of a system
- Explain the difference between control and feedback
- Explain the importance of control and feedback
- Distinguish between boundary and environment
- Describe the various types of systems
- Define *information system*
- Identify seven types of information system applications.

System

- A **system** is a group of interrelated components that function together to achieve a desired result. A system can also be defined as an orderly group of independent components linked together according to a plan to achieve a common objective.
- The function of a system is to receive **inputs** and transform these into **outputs**.
- Business systems usually have multiple goals such as profit or improving the quality of a product/service.
- Systems are therefore a group of interrelated or interacting elements forming a unified whole. Many examples of systems can be found in the physical and biological sciences, in modern technology, and in human society.

Examples of systems include a university system, business organization and the human body. The components of a university system include:

- Students
- Administrators
- Lecturers
- Support staff

All the above university system components work towards a common goal of molding the students into citizens who are morally upright and academically fit to meet the expectations of the community and a country at large.

The study of system concept has three basic implementations

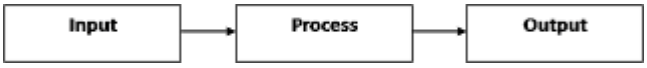
- A system must be designed to achieve a predetermined objective.
- Interrelationship and interdependence must exist among the components.
- The objective of the organization as a whole has a higher priority than the objective of its sub-system.

Characteristics of a System

- **Interdependent:** It means that part of the system depends on one another. One subsystem depends upon the input of another subsystem for proper functioning i.*e.,* output of one subsystem is the required input for another subsystem.
- **Interactive**: This refers to the manner in which each component functions with other component of the system.
- **Organized:** Organization implies structure and order. It is the arrangement of components that helps to achieve the objectives. Likewise, a system *i.e.,* a computer system is designed around an input device, a central processing unit, an output device and one or more storage units. When linked together, they work as a whole system for producing information.
- **Integrated:** Integration is concerned with how a system is tied together. It means that parts of the system work together within the system even though each part performs a unique function.
- Have common objective

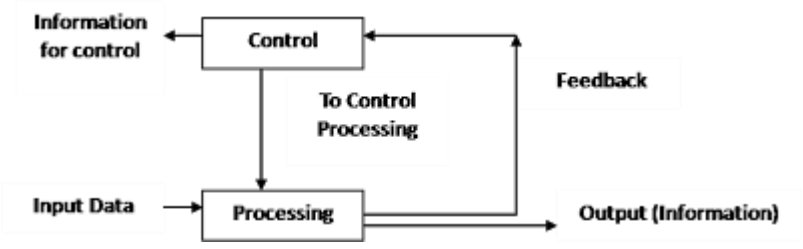
Elements of a System

There are generally three major elements in every system, namely input, processing and output.



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

- The objective of the system demands that some output is produced as a result of processing the suitable inputs.
- A well-designed system also includes an additional element referred to as '**control'** that provides a **feedback** to achieve desired objectives of the system.



4. **Feedback:** Feedback is data about the performance of a system. For example, data about sales performance is feedback to a sales manager.

5. **Control**: Control involves monitoring and evaluating feedback to determine whether a system is moving toward the achievement of its goal. The control function then makes necessary adjustments to a system's input and processing components to ensure that it produces proper output. For example, a sales manager exercises control when he or she reassigns salespersons to new sales territories after evaluating feedback about their sales performance.
6. **Boundary and Environment:** Every system has defined boundary within which its components operate. Any entity outside the defined boundary but which interacts with the system is part of the **system environment**. System environment provide the inputs and receive the outputs from the system. For example, in a university system the parents and the community provide input inform of students. The university molds the students and give back the graduates to the parents and the community.
7. **Subsystem:** A subsystem is a part of a larger system. Each system is composed of subsystems, which in turn are made up of other subsystems, each subsystem being delineated by its boundaries.
8. **Interfaces:** The inter connections and interactions between the subsystem are termed interface. The number of inter connections if all sub-systems interact is in general n(n-1)/2 each inter connections is a potential interface for communication among subsystems.

Types of Systems

Systems fall into a number of categories. We must therefore know beforehand what type of a system we are dealing with.

1. Open and Closed Systems

- An open system is one that interacts with the environment. A business organization is an open system because it exchanges men, material, money and information with the environment. An open system does not provide for its own control or modification thus it does not supervise itself. It needs to be supervised by people. For example, in the banking sector Automatic Teller Machines (ATM) must be feed with money from within the bank so that the customers can withdraw the money through the **ATM**. Some banks give a provision of depositing money by customer through the **ATMs.** These operations regulate the performance of system.
- A closed system is a system which is self-contained. It does not exchange material, information or energy with its environment. Closed systems are very rare and if they exist they will finally run down or become disorganized. In fact, what constitutes a closed system is very difficult to judge.

In organizations and in information systems we find systems that are relatively closed. A system is relatively closed if it has only well-defined inputs and outputs but is not subjected to disturbances from outside the system, for example a computer system.

2. Conceptual and Physical Systems

Systems can be abstract (conceptual or analytical) or physical (empirical).

- An abstract or conceptual system is an orderly arrangement of independent ideas. Conceptual systems are concerned with theoretical structures which may or may not have counterpart in

the real word. Thus conceptual systems are systems of explanation or ideas or constructs, for example, accounting systems.

- Physical systems are concrete operational systems made up of people, material, machines energy and other physical things. Physical systems can display activity or behaviour. Examples include business organizations, computer systems and Management Information Systems (MIS).

3. Deterministic and Probabilistic Systems

 A deterministic system operates in a predictable manner. If one knows the state of a system at a given point of time or can predict the next state without error, then it is a deterministic system but if one cannot predict the next state without an error then it is a probabilistic system. For example, in computer systems the outputs are deterministic while economic forecasting systems an inventory system are probabilistic.

4. Hard and Soft Systems

- Soft systems have got no clearly defined goals and objectives hence their performance cannot be precisely measured. For example, sales tracking system where sales performance depends on human factors such the prevailing conditions (availability of money, customers, and products) and human preferences.
- Hard systems are systems whose goals and objectives are clearly defined and the outcomes from the processes are predictable. For example, in a stock control system, it is possible to know exactly the stock levels, the reorder and profits can be accurately predicted if all the stock is sold.

A Framework for Systems Analysis and Design

Business information systems are developed by people, who are technically qualified, business-oriented, and highly motivated. Successful developers also must be good communicators with strong analytical and critical thinking skills.

Systems Analysis and Design

- Systems analysis and design is a step-by-step process for developing high-quality information systems.
- An **information system** combines information technology, people, and data to support business requirements. For example, information systems:
  - handle daily business transactions
  - improve company productivity, and
  - help managers make sound decisions.
- The IT department team includes systems analysts who plan, develop, and maintain information systems.
- **Information technology** (IT) is a contemporary term that describes the combination of computer technology (hardware and software) with telecommunications technology (data, image, and voice networks).
- **Information technology** (IT) can also be defined as a combination of hardware, software, and services that people use to manage, communicate, and share information.

Importance of IT in business

Business success depends on information technology.

- IT is driving a new digital economy, where advances in hardware, software, and connectivity can provide enormous benefits to businesses and individuals.
- Although economic trends affect IT spending levels, most firms give IT budgets a high priority, in good times or bad. This is because during periods of growth, companies cannot afford to lag behind the IT curve. Conversely, when the economy slows down, firms often use IT to reduce operating costs and improve efficiency.

An information system (IS)

- This is an arrangement of people, data, processes, and information technology that interact to collect, process, store, and provide as output the information needed to support an organization.
- Many organizations consider information systems to be essential to their ability to compete or gain competitive advantage.
- Most organizations have come to realize that all workers need to participate in the development of information systems.
- Therefore, Information system development is a relevant subject to you regardless of whether or not you are studying to become an information systems professional.

Information Systems Developers

- Traditionally, a company developed its own information systems, called in-house applications, or purchased systems called software packages from vendors.
- Today, the choice is much more complex. Options include Internet-based application services, outsourcing, custom solutions from IT consultants, and enterprise-wide software strategies.
- Regardless of the development method, launching a new information system involves risks as well as benefits.
    - o The greatest risk occurs when a company tries to decide how the system will be constructed before determining what the system needs to do.
    - o Instead of putting the cart before the horse, a company must begin by outlining its business needs and identifying possible IT solutions. Typically, this important work is performed by systems analysts and other IT professionals.
    - o A firm should not consider implementation options until it has a clear set of objectives. Later on, as the system is developed, a systems analyst's role will vary depending on the implementation option selected.

Information System Components

i. Hardware

- Hardware consists of everything in the physical layer of the information system. For example, hardware can include servers, workstations, networks, telecommunications equipment, fiber-optic cables, mobile devices, scanners, digital capture devices, and other technology-based infrastructure.
- As new technologies emerge, manufacturers race to market the innovations and reap the rewards. Hardware purchasers today face a wide array of technology choices and decisions.

ii. Software

- Software refers to the programs that control the hardware and produce the desired information or results. Software comprises of both **system software** and **application software**.
- System software manages the hardware components, which can include a single workstation or a global network with many thousands of clients. Either the hardware manufacturer supplies the system software or a company purchases it from a vendor. Examples of system software include the operating system, security software that protects the computer from intrusion, device drivers that communicate with hardware such as printers, and utility programs that handle specific tasks such as data backup and disk management. System software also controls the flow of data, provides data security, and manages network operations. In today's interconnected business world, network software is vitally important.
- Application software consists of programs that support day-to-day business functions and provides users with the information they require. Application software can serve one user or thousands of people throughout an organization. Examples of company-wide applications, called enterprise applications, include order processing systems, payroll systems, and company communications networks. On a smaller scale, individual users increase their productivity with tools such as spreadsheets, word processors, and database management systems.

iii. Data

- Data is the raw material that an information system transforms into useful information. An information system can store data in databases. By linking tables within the databases, the system can extract specific information.

iv. Processes

- Processes describe the tasks and business functions that users, managers, and IT staff members perform to achieve specific results.
- Processes are the building blocks of an information system because they represent actual day-to-day business operations.
- To build a successful information system, analysts must understand business processes and document them carefully.

v. People

- People who have an interest in an information system are called stakeholders.
  Stakeholders include the management group responsible for the system, the users (sometimes called end users) inside and outside the company who will interact with the system, and IT staff members, such as systems analysts, programmers, and network administrators who develop and support the system.
- Each stakeholder group has a vital interest in the information system, but most experienced IT professionals agree that the success or failure of a system usually depends on whether it meets the needs of its users. For that reason, it is essential to understand user requirements and expectations throughout the development process.

Understand the Business

- Computing professionals must understand a company's operations to design successful systems. Each business situation is different. For example, a retail store, a medical practice, and a hotel chain all have unique information systems requirements. Systems analysts use a process called **business process modeling** to represent company operations and information needs. Business process modeling requires a **business profile** and a series of models that document **business processes.**
    - A **business profile** is an overview of a company's mission, functions, organization, products, services, customers, suppliers, competitors, constraints, and future direction. Although much of this information is readily available, a systems analyst usually needs to do additional research and fact-finding. A business profile is the starting point for the modeling process.
    - A **business process** is a specific set of transactions, events, and results that can be described and documented.
- As the business world changes, systems analysts can expect to work in new kinds of companies that require innovative IT solutions, including Web-based systems that serve customers and carry out online transactions with other businesses.

Types of Information Systems

- Information systems come in all shapes and sizes. They are so interwoven into the fabric of the business systems they support that it is often difficult to distinguish between business systems and their support Information systems.
- In the past, IT managers divided systems into categories based on the user group the system served. Categories and users included **office systems** (administrative staff), **operational systems** (operational personnel), **decision support systems** (middle managers and knowledge workers), and **executive information systems** (top managers).
- Information systems can also be classified according to the functions they serve. There are seven types of information systems:
    i Transaction processing systems (TPS)
    ii Management information systems (MIS)
    iii Decision support systems (DSS)
    iv Executive Information Systems (EIS)
    v Expert systems (ES)
    vi Communications system and Collaboration systems
    vii Office automation systems

Transaction processing systems (TPS)

- Transaction processing system (TPS) is an information system that captures and processes data generated by day-to-day business operations.
- Examples of TP systems include customer order processing, accounts receivable, student registration and warranty claim processing.

Management information systems (MIS)

- A management information system is an information system application that provide for management oriented reporting. These reports are usually generated on a predetermined schedule and appear in a predefined format.
- Management Information systems (MIS) use the transaction data to produce information needed by managers to run the business.
- Examples of MIS are:
  - Inventory Reporting
  - Examination Analysis
  - Sales Forecasting
  - Sales Reporting
  - Financial Reporting
  - Salary Analysis

Decision Support System (DSS)

- DSS is an information system that either helps to identify decision-making opportunities or provides information to help make decisions.
- DSS help various decision makers identify and choose between options or decisions.

Executive Information System (EIS)

- EIS is an information system that supports the planning and assessment needs of executive managers.
- EIS are tailored to the unique information needs of executives who plan for the business and assess performance against those plans.

Expert Systems

- An expert system is an information system that captures the expertise of workers and then simulates that expertise to the benefit of non-experts.
- Expert systems capture and reproduce the knowledge of an expert problem solver or decision maker and then simulate the thinking of that expert.

Communications Collaborative Systems

- Communications collaborative system is an information system that enables more effective communications between workers, partners, customers, and suppliers to enhance their ability to collaborate.
- Communications collaborative system enhance communication and collaboration between people, both Internal and external to the organization.

Office Automation Systems

- Office Automation Systems an information system that supports the wide range of business office activities that provide for improved work flow between workers.
- Office automation systems help employees create and share documents that support day-to-day office activities.

Players in the Systems Game

Objectives

- Identify different types of *stakeholders* who use or develop information systems, and give examples of each.
- Define the unique role of *systems analysts* in the development of information systems.
- Identify those *skills* needed to successfully function as an information systems analyst.
- Describe current *business drivers* that influence information systems development Describe current *technology drivers* that influence information systems development.
- Briefly describe a simple *process* for developing information systems.

Introduction

- Many organizations consider information systems and information technology to be essential to their ability to compete or gain a competitive advantage.
- Most businesses realize that all workers need to participate in the development of information system – not just the IT specialists.

a) Stakeholder (Information Worker)

- A **stakeholder** or **information worker** is any person who has an interest in an existing or new information system. Stakeholders can be technical or non-technical.
- An Information Worker is a person who uses information to assist in making decisions or taking actions, or a person who creates information that informs the decisions or actions of others.
- The livelihood of the information worker depends on decision made from the information.
- Some information workers such a system analysts and programmers create information systems that process and distribute information. Others such as clerks, secretaries and managers primarily capture, distribute and use data and information.
- There are six groups of information workers and they include:

b) System owners

- System owners come from the ranks of the management. They are the information system's sponsors and chief advocates. They are usually responsible for funding the project to develop, operate and maintain the information system.
- For medium to large information systems the system owners are usually middle or executive managers. For smaller systems, the system owners may be middle managers or supervisors
- They own the system, set priorities, and determine policies for its use. In some cases system owners may also system users.
- They tend to be interested in how the system will return value or advantage to the business.

c) System users

- These are people who use or are affected by the information system on a regular basis; capturing, validating, entering, responding to, storing and exchanging data and information.

- Unlike system owners, system users tend to be less concerned with costs and benefits of the system and instead they are concerned with business requirements. Although users have become technology literate over the years, their primary concern is to get the job done.
- There are many classes of system users. Each class should be directly involved in any information system development project that affects them.

Internal Users

These are employees of the business for which an information system is built. They make up the largest percentage of information system users in most businesses. Examples include:

- Clerical and service workers who perform most of the day-to-day transaction processing in the average business. They process orders, invoices, payments etc.
- Technical and professional staff that perform highly skilled and specialized work. They include lawyers, accountants, engineers, market analysts etc.
- Knowledge workers whose responsibilities are based on a specialized body of knowledge.
- Supervisors, middle managers and executive managers who are decision makers

Remote and mobile users

 These are the employees of the business for which the information system is built. Unlike the internal users they are geographically separated from the business. Remote users are those who telecommute from home.

External users

 External users include customers and other businesses. Businesses are redesigning their information systems to directly connect to and interoperate with other businesses, trading partners, suppliers and customers.

d) System designers

They translate system users' business requirements and constraints into technical solutions. They design the computer files, databases, inputs, outputs, screens, networks and programs that will meet the system users' requirements. In most cases they may also be system builders. System designers include:

- **Database administrators** - specialists in database technologies who design and coordinate changes to corporate databases.
- **Network architects** - specialists in networking and telecommunications technologies, who design, Install, configure, optimize, and support local and wide area networks, including connections to the Internet and other external networks.
- **Web architects** - specialists who design complex Web sites for organizations, including public Web sites for the Internet, Internal Web sites for organizations (called intranets), and private business-to-business Web sites (called extranets).
- **Security experts** - specialists in the technology and methods used to ensure data and network security (and privacy).

e) System builders

- System builders construct the information system components based on the design specifications from the system designers.
- System builders include application programmers, system programmers, database programmers, network administrators etc.

f) IT vendors and consultants

Most information systems are dependent on information technology that must be selected, installed and customized, integrated into the business and technically supported. This technology is developed, sold and supported by IT vendors. They sell hardware, software and services to businesses for incorporation into their information.

g) System analysts

- A system analyst is a person responsible for the development of software and hardware solution to the efficient working of the organization.
- System Analysts study the environment and problems of an organization to determine whether a new information method can provide solution to the problem.
- System analysts understand both business and computing. The study business problems and opportunities and then transform business and information requirements of the business into the computer based information systems and computer applications that are implemented by various technical specialists including computer programmers.
- The main job of system analyst is to provide right type of information, in right quantity at the right time in post-effective manner to the management or the end user. Thus they facilitate the development of information systems and computer applications by bridging the communications gap that exists between nontechnical system owners and users and technical system designers and builders.
- A system analyst facilitates the study of the problems and needs of a business to determine how the business system and information technology can best solve the problems and accomplish improvements for the business. The product of this activity may be improved business processes, improved information systems, or new or improved computer applications or all the three.

Roles of System Analyst

1. **Defining IT requirements of organization:** The most important and difficult task of an analyst is to understand the organization's requirement's information. It includes interviewing users finding out what information is they are using in the current system.
2. **Gathering Data/Facts:** For gathering data or facts, written documents are important because these documents represent the formal information flow in the system. The analyst studies documents such as input forms, output records, invoices etc. to understand how data are passed and used in the present system.
3. **Analyzing the problem:** After gathering data or facts the analyst analyses the working of current system and find out to what extent it meets the user's needs.
4. **Setting priority amongst requirements:** In the organization there are many types of users, each user has different types of information needs. It may not be possible to satisfy the

requirements of everyone due to limited availability of resources so it is necessary to give priority. The priorities are set on the basis of urgency and importance of user's need.

5. **Problem solving:** The system analyst helps IT users to solve their information problems. In that role he must understand the problem and suggest solutions.
6. **Drawing specification:** The analyst obtains the input and output specification for optimal functioning of the system to be developed.
7. **Designing system:** Once the specifications are accepted by the management the analyst gets on to the design of the system. The analyst must be aware of the latest design tools for the system design so analyst also knows as architect.
8. **Evaluating system:** An analyst must critically test the performance of the designed system with specifications after it has been in use for a reasonable period of time.

Qualifications and Experience of a Systems Analyst

1. **Working experience of Information technology:** A system analyst is an agent of change. He/she is responsible for showing end-users and management how new technologies can benefit their business and its operations. The systems analyst must be aware of both existing and emerging information technologies.
2. **Computer programming experience and expertise:** System analysts must know how to program because they are the principal link between business users and computer programmers.
3. **General business knowledge:** Systems analysts are expected to immerse themselves in the business. They are expected to be able to specify and defend technical solutions that address the bottom-line value returned to the business. They should be able to communicate with business experts to gain knowledge of the problem and needs.
4. **Problem-solving skills:** System analysts must be able to take a large business problem, break down that problem into its component parts, analyze the various aspects of the problem, and then assemble an improved system to solve the problem.
5. **Interpersonal communication skills:** An analyst must be able to communicate effectively, both orally and in writing. They should seek help or training in business writing, technical writing, interviewing, presentations, and listening.
6. **Interpersonal relations skills:** The analyst may be the only person who sees the system as a whole. The analyst needs to exercise boldness. Interpersonal relation skills are also important because of the political nature of the systems analyst's job.
7. **Flexibility and adaptability:** No two systems development projects encountered by a systems analyst are identical. Each project offers its own unique challenges. There is no single, magical approach or solution applicable to systems development. Successful analysts recognize this and learn to be flexible and adapt to special challenges or situations.
8. **System analysis and design skills:** All systems analysts need thorough and ongoing training in systems analysis and design.
9. **Character and ethics:** The nature of the systems analyst's job requires a strong character and sense of ethics as they often encounter sensitive information when developing systems.

    - **Ethics** is a personal character trait in which an individual understands the difference between **right** and **wrong** and acts accordingly.

The Ten Commandments of Computer Ethics

1. Thou shalt not use a computer to harm other people.
2. Thou shalt not interfere with other people's computer work.
3. Thou shalt not snoop around in other computer people's files.
4. Thou shalt not use a computer to steal.
5. Thou shalt not use a computer to bear false witness.
6. Thou shalt not copy or use proprietary software for which you have not paid.
7. Thou shalt not use other people's computer resources without authorization or proper compensation.
8. Thou shalt not appropriate other people's intellectual output.
9. Thou shalt think about the social consequences of the program you are writing or the system you are designing.
10. Thou shalt always use a computer in ways that insure consideration and respect for your fellow human.