

CHAPTER – 1

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1.1 Overview

The Software Systems Development is different from other types of systems development.

The major factors which widen these differences are as follows:-

- a. The Software is an intangible product. It is to be conceived only conceptually until a very later stage of system development viz. the coding stage.
- b. Almost every software system being developed in the world is different from its predecessors in many aspects. Some of the aspects that change quite often are the business domain, the technology domain, and the process of software development.
- c. As a result of the above, it is very rare to find a software systems development professional working on very similar software development projects consecutively for a long time. In fact, if the developer was not required to work on a variety of software systems development projects, (s)he should introspect to assess his/her progress in the career and if needed, plan to improve future career opportunities at the earliest.
- d. The technological evolutions are much faster in software systems development area for last three decades, than any other area. The rate obsolescence is also very high. This has a major impact not only on the number of new software architectures evolving each year, but also the underlying ‘process’ of developing software systems is also evolving at equally fast rate.

1.2 Requirements of a Good Systems Analyst

There are several ways to define the systems analyst, but we choose the following for its simplicity.

A System Analyst is business professional, who uses the techniques of systems analysis and system design to solve business problems or to facilitate business to gain economically from new business opportunities using the information technology.

A good Systems Analyst is a precious asset of not only the systems development team, but also of the software development organization. (S)he is also an idol in the minds of the juniors and the colleagues and therefore, the future career growth is almost assured.

Therefore, cultivating one's career as a Systems Analyst is a systematic and self-managed investment for a better future of oneself and of the organization (s)he represents.

The central task of a systems analyst is to work on the assigned software system development project. However, a Systems Analyst does a lot of significant work beyond planning and developing programs.

(S)he has to involve her/(him)self into the business problems, understand the business strategic issues and recommend technological solution alternatives to the User organization to meet the business goals in spite of the given constraints of budget, time and quality. (S)he has to interact with Users at various levels and has to demonstrate him/(er)self as a 'solution' person to all of them for solving a wide range of business problems.

As a developer the Systems Analyst has to perform the following tasks:-

- A. The Systems Analyst has to gather information requirements of the new software system using various techniques.
- B. (S)he records the information requirements in the form of various models, such as Data Flow Diagrams (DFDs), Entity Relationship Diagrams(ERDs) or Class Diagrams etc. These models in the early stage of systems development help identify 'missing' details of requirements, recoding the detailed requirements for future use.
- C. Gathering various alternatives for technical environment of the organization for developing and implementing the new software system, comparing them to meet the organizational goals and recommend the best alternative(/s) to the Top Management.
- D. For continuing the system development further, the Systems Analysts acts as the main link between different development teams, such as Design Team and Testing Team. (S)he represents the User requirements domain in the software development project team and the Lead developer as seen by the User groups. S(he) is a Friend, a Philosopher and a Guide to the development teams for further tasks in designing, programming, testing and implementation.

The skills required by a Systems Analyst are listed in different categories as follows:-

- A. Technical Knowledge and Skills
- B. Business Knowledge and Skills

C. People Knowledge and Skills

D. Integrity and Ethics

We discuss them as follows:-

A. Technical Knowledge and Skills – They are as follows:-

- a. Though the systems analyst is not required to carry out programming, (s)he needs necessary technical expertise to guide and monitor the programming team on one side and to guide the Users on selecting appropriate technological alternatives for the new software system.
- b. Fundamental knowledge about the computer hardware, software, operating systems, database management systems, software development phase is required, recent trends and their comparison.
- c. The Systems Analyst should be well versed with the software system development techniques and tools, such as Integrated Development Environment (IDEs), CASE tools, and other system development tools.
- d. In order to complete specific system development activities, the Systems Analyst needs to know the techniques of project planning, systems analysis, system design, coding and testing , implementation and system support.

B. Business Knowledge and Skills – They are as follows:-

- a. The Systems Analyst should understand the business organization to be able to solve business problem. In general, therefore, (s)he is required to know, the User organization's activities and business processes, User organization's structure, Management Styles and Techniques of managing major functions of the organizations, such as Marketing, Finance, Manufacturing, Human Resource Development, Logistics and Distribution etc.
- b. The Systems Analyst should have the knowledge of the industry sector and of the commercial characteristics of that industrial sector, current trends and best business practices in that industry. Eg. Manufacturing industry is segmented broadly into chemical, pharmaceutical, engineering etc, the Services industry into hospitality (eg. hotels, etc.), health care (eg. hospitals, etc.), Tourism industry (eg. pilgrimage tourism, medical tourism, etc.), Financial Services industry (such as mutual funds, share trading etc.) etc. and retailing industry etc. A detailed and recent understanding of these industries would not only help to understand the

User's information requirements quickly but also help understanding the current situations well and recommending useful solution alternatives.

- c. The Systems Analyst should understand the specific company, as a User Organization as a whole. The systems analyst should know the business strengths (what it can do better than its competitors?), the organization's current strategies and policies, the traditions and values of the organizations, etc.
- d. The specific information required is who are the Users, their designations, primary responsibilities and role in the software development, etc. It takes very long to know about the organization, but more the Systems Analyst know ahead of time, more effective is the his/her planning.
- e. The Systems Analyst should also know, what is the role of the new software system in the current business strategy (eg. Central or Peripheral?) and what is the level of significance attached to this software development by the Top Management of the User company. (Highest priority, High, Medium or Low), What are the major business gains the company is aiming to achieve through the use of the new software development system)

C. People Knowledge and Skills: They are as follows:-

- a. A good Systems Analyst should have very strong people skills, since (s)he works with people of variety of profiles, and her(/is) success at work depends a lot upon them ie. (s)he works 'through' the people. Therefore, is important to understand how people think, learn, communicate, work at different levels and on variety of tasks, react to change.
- b. The systems analyst is required to be good at interpersonal skills, and communication skills to motivate people all over the project teams to cooperate with him(/er).
- c. The System Analyst is required to be influential person working through various hierarchies of the User organization and Development team.

D. Integrity and Ethics – These are very important aspects of the career of a Systems Analyst for assuring a long term success. Personal integrity of very high level is required. The Systems Analyst refers to very vital information sources while performing his(/er) work. It is important that (s)he follows the User companies privacy policies and procedures very strictly. Eg. certain information resources may be available only for reference and not for photocopying also. Any act of private information's piracy or theft or even any doubt related to that may harm the career of the Systems Analyst. Some information may be related to persons, such as their salary, medical history etc., it has to be kept confidential. The company

strategy and policies also need to be kept secret. The integrity and ethical norms are applicable not only for the duration of the software systems development, but also after it.

Having stated the characteristics of a good systems analyst, it is important to mention that not every one is a born System Analyst. However, with high desire to mould the career systematically and for long term benefits and pleasures of the successful career, a budding Systems Analyst can start cultivating his(er) career in this manner today. With regular review of the progress in becoming a good systems analyst and taking effective corrective action, over a period of time, one can become a good Systems Analyst.

Apart from a high value of job satisfaction, the growth path for a good system analyst is in several directions: a Business Analyst, a Project Manager or a Specialist in development, (such as QA, Training, Verification and Validation), etc. to name just few. So, these are some of the incentives for successful Systems Analyst.

Chapter 2:

SYSTEMS CONCEPTS

Learning Objectives

2. Systems concepts
 - 2.1. Systems Definition
 - 2.2. Business as a System
 - 2.3. Application Systems

Chapter Introduction

The current section viz. SECTION I – INTRODUCTION TO SYSTEM DEVELOPMENT, aims at introducing the concept of Systems Development. The Chapter 2: SYSTEMS CONCEPTS aims at introducing the readers to the word SYSTEM involved in it. We use the word system in day-to-day life in many different occasions.

Some of these are as follows:-

1. The transportation system in Mumbai is of a high quality.
2. The states of India, where education system has been implemented properly, they have done much progress in Industrialization. Taking the standard of living of these people to a new high.
3. There is a overall lack of awareness pollution control systems; we go to improve our standards of living on one side, but many times the same affects the pollution levels to disturb the balance of ecological systems of the world.
4. India is fast enhancing her business environment to suit strengthen Indian business systems to compete in the global business system, as a whole.
5. etc....

The aim of this chapter is to understand the meaning of word system in a more systematic manner. We refer to the above examples in our text that follows y their serial numbers, please note.

2.1 Career Benefits of learning System Concepts

From the examples above, the readers will appreciate that the word systems is used in several different contexts, including the title of this subject. Therefore, it is important for use to understand the meaning of this word in the studies of this subject.

Understanding the system concepts will not only help you to understand the meaning of these statements better, but it will also help you in many different ways, some of them are listed as follows:-

1. To identify the objective of the system – what the system is aimed at achieving.
2. To identify the components of the system
3. To identify what are the roles each component is performing in helping the overall system to achieve its common goal.
4. To identify how these components communicate with each other to work as a team.
5. To relate the knowledge of this system to a similar other system and thereby gain knowledge of that system faster. E.g. Your systematic knowledge of the road traffic system in Mumbai will help you to understand some aspects of the traffic system in any metro city in India or abroad, such as London, much faster than those who do not e.g. a child. This same is useful to a Systems Analyst in learning fast the global client's business systems faster, having a good knowledge of Indian business systems.
6. To identify the errors in newer Systems much faster. A systems developer familiar with a similar Indian business system can fast identify the errors in the errors in client's systems and recommend very useful advice very fast and thus can be seen as more efficient at work by the Clients and Superiors.

In short, the system concepts will help you fast understand the technological components of the new business system, the functioning of the Application Systems used to implement them, the steps involved in developing these application systems and also the management tasks of the development of these application systems in the respective business systems as a whole. These are all directly related to improving the performance of a systems developer at the work place.

2.2 What is a System?

A System is defined by many authors in many different ways. However, we will study the following definition here for simplicity.

A System is a group of elements working together to achieve a common Goal. These elements are related to each other in the work that they carry out and they communicate with each other in order to coordinate and control the delivery of the total work of the system. Further, a system is often a part of a larger system.

Many examples around us fulfill the requirements to be called as systems. Eg. A human body, the Universe are themselves systems. As mentioned above the road traffic system, the education system, the ecological system, global business systems, etc. are examples of the systems.

You will observe that all these systems meet the following characteristics, as mentioned in the definition above:-

1. The system works to achieve a common Goal. Eg. Goal of a traffic system is to facilitate road traffic with high safety and speed to all the road users equally in a fair manner.
2. The system has several components working together to contribute their respective part to meet the overall objective of the system. Together they all, the system is said to be working. Eg. Traffic system has the vehicle drivers, signals, traffic police etc., as elements of the system.
3. You will appreciate that, if any of the components is missing or not working as desired, it affects the performance of the system as a whole. Thus you will be able to identify all the necessary tasks that all the components together are required to perform, so that the entire system meets its goal. For a Systems Analyst, developing the skills to sufficiently detailing out the tasks to ensure that the overall functionality is built-in into the system, is very essential.
4. The system components communicate with each other. You will be able to identify what they communicate with each other (data), when (event), and what is the purpose of the communication, such as co-ordinate the work or Control the work etc.

eg. The traffic system uses traffic signals to control the safety of the traffic by shining colored lights, such as Red, Green and Yellow. These colors are data here. The Events in this case, are temporal, e.g. every one minute, say, the signal will change the color from Red to Green and vice versa, etc. The communication is between the vehicle drivers, who are elements of the traffic system wishing to cross the junction from one side with those on the other side of the junction. The signal acts as an interface system component between these groups of drivers.

5. The system itself is a part of another system, which performs a larger set of function completely encompassing the current system. Eg. The traffic system is a part of civil system in a City- the system which enables people to stay and progress in a City.

Thus the definition of a system helps us to see through the system elements and understand the interrelations between them to understand the overall working of a system. The same definition can be used to judge whether a given system is a system or not.

Also, the systems developers can use the same definition to identify the 'missing' elements of the system, so that the developer can 'add' these elements into the system to make it work completely. Eg. need to have a traffic signal at a busy junction in the City can be easily identified. A missing functionality in a system can be quickly identified, which is otherwise hidden very deeply.

This definition can also be used as a checklist to identify the component(/s) of a system, which are not performing as desired, given the undesired symptoms of the system. Eg. traffic-jam at a busy junction, can be attributed rightly and very quickly to a traffic signal not functioning today.

Thus the definition of a system provides a window to the system developer to his/her world of business application systems looking through which a learned view of the same system can be obtained very efficiently.

2.3 Is a Business a System?

Applying the definition of a system to any entity, it is very convenient to decide if that entity is a system or not. We will check, if a Business is a system or not using the same, here now.

Comparing the definition, with the Business, we have the following observations about the Business:-

1. The Business has a Goal to meet. Every business has a goal such as to be known as a company producing always the best quality of products, or as the company producing innovative products ahead of all other companies, or as the company producing the products at reasonable affordable costs, etc.
2. The Business is made of several elements. It takes help of various resources to achieve its goal, such as Human resources help to provide talent, the material resources help to produce the finished goods, the money, as a resource provides motivation for every one to work, etc. Also, a business has different teams of people working together to make the business a success, eg. Marketing helps ensuring customer satisfaction, Sales help getting orders for company's finished

goods, Manufacturing helps processing raw material to get the finished goods, etc. Thus for the Business to meet its Goal, it is necessary to divide the goal into parts and assign responsibilities to individual elements supplementing and completing the other elements, so that they all together can meet the Goal.

3. All these elements in the Business, constantly communicate with each other as a part of the routine, either to co-ordinate the work or control it. eg. a Customer places/ communicates the order of goods, which Manufacturing uses to prepare its production plan, the Purchase makes a payment to Suppliers for the raw material supplied, so that he will supply the same next time to ensure that the Manufacturing is able to start manufacturing as planned, etc. These were the examples of communication for the purpose of coordinating the work amongst the different elements of the Business, so that the overall Business can meet its Goal.
4. There are several communication for control in Business. A Sales Manager rewards the Sales Executive for his best performance in getting more orders for Sales. This communication motivates the Sales Executive to perform still better next time. Also, the same communication helps the other Sales Executives to keep that as a target for the next year for themselves. It helps them to perform to new higher. Together, all this helps the Company achieve its overall Goal much faster.
5. The Business system as a whole is made up of several systems as its component elements. eg. large Business organizations have Function based organization structure specializing in different aspects of Business activities, such as Marketing, Finance, Human Resource Development, Production, Logistics & Distribution, Systems, etc. All these can be called as subsystems, as they are also systems in their own terms, as well. But, just one of them is not capable of meeting the Business's goal on their own; they are dependent on each other and only when they all work together efficiently, the Business can achieve its Goal. Thus we can say that the Business is made of sub-systems.

Thus, the Business as a system meets all expectations of the definition of a system, as above. Therefore, a Business is a System.

2.4 Application Systems and Systems Concepts

Since Business is a System, as discussed above, can a Computer Application System developed or a Business, be called as a System? We will examine it as follows.

A Computer Application System is a system of software, hardware, and communication links, which exploits the computing power of a Computer System and 'applies' it to solving the business problem or to convert a business opportunity into economic gains.

Eg. a Payroll Application System uses the computing power of a computer system best to solve a business problem of calculating the salaries accurately, distributing the pay to right

employees, on time, etc. It is very easy, to examine that it a System in its defined sense as above.

As another example, a Customer Relationship Management (CRM) Application system is an application system, which facilitates the Business to gain from the new technological developments and allows to convert these gains to business profits. Thus, this application system provides the Business an opportunity for obtaining gains. It is very easy to show, that a CRM Application system is a System.

The Hardware system, Software System, Data Base Management System, and Communication and Networking Systems are subsystems of an Application System.

Thus an Application System is a System.

(On the similar lines, it is easy to demonstrate that the Operating System, Multimedia System - are also Systems).

Since the Application systems are systems, the systems concept can be used very effectively as a tools to understand the working of these systems, understanding the components and their working relationships, etc very fast.

Also, knowing one Application System in an organization system, the same knowledge can be systematically used to know more about the new application system. Thus this knowledge makes it possible to discover new knowledge horizons from what we know before. Thus a gradual progress is possible.

Knowing one application system helps the Systems Analyst to transfer that knowledge to learn the new application system. It helps the Systems Analyst, to ask limited few and right questions to the Users and still gain a detailed insight into the new Application System in a very short time. Thus, for a System Analyst it is important to acquire the skills of developing a 'systems' view of applications (s)he works on.

This is the basis of solving any business problem, like system analysis, using a systems approach.

2.4 Stages of a System

We mentioned above that, all the system components work as a team, to achieve a Goal. They do so, in the following 3 stages, as follows:-

1. Input Stage
2. Process Stage
3. Output Stage

A stage here consists of a set of activities performed by the elements of a system with a common objective for the stage.

2.4.1 Input Stage

Some components of the system, work to collect the input from the external environment and pass it to process further. Eg. road traffic system takes in passengers as input at the place of source of travel. An application system provides Data Entry screens for the User to enter the data, which is used as input for processing by the Application system, later on. The Manufacturing department accepts the raw material as input to the process of manufacturing.

Every system takes-in some input. Sometimes, the activities related to the capture of input may themselves be so complex, that a subsystem of the system, may be dedicated for the input task. Then, in that case, it is called as an input subsystem. The input capture steps may sometimes involve cleaning the input, arranging the input for processing and also converting it into a suitable form. Also, the data captured may be processed immediately or later on for further processing. Eg. A staircase, provided for passengers to climb up the upper deck of a double Decker bus. Some Computer Applications may have a subsystem, that is responsible only for capturing the input data, in cases such as data read from Scanner or a Bar Code Reader etc.

2.4.2 Process Stage

These are the core activities of the system, which typically convert the input to the output. Eg. a bus, which is a part of the traffic system, would take their passengers on board, to their place of destination. A Computer Application System would perform major data processing, such as analysis, categorization, summarizing, etc. as a part of process activities. The processing elements process the inputs based on certain rules. A software programmer works close to develop these rules by way of a program.

2.4.3 Output Stage

These activities carry out the results of the process stage to the environment. Eg. a Bus drops the passenger at the place of his destination. A Computer Application System presents results of the process stage in the form of a Report and/ or updating the master information, creating the log or displaying the error message etc.

Every system has some output. Sometimes, the activities related to the presentation of processing results may themselves be so complex, that a subsystem of the system, may be dedicated for the output stage. Then, in that case, it is called as an output subsystem. The output presentation steps may sometimes involve converting it into a suitable form and arranging the output of processing in a specific way to suit the presentation requirements.

Also, the data processed may be presented immediately or later on, Eg. A staircase, provided for passengers to climb down from the upper deck of a double Decker bus to get

down at the place of destination. Some Computer Application systems use dedicated display systems, such as high resolution graphic displays etc. responsible for user interface.

2.5 Other Components of a System

The System concepts become more useful to a system developer by introducing two more concepts, as follows:-

1. System Scope
2. System Boundary
3. System Interface

2.5.1 System Scope

Scope of a system is related to what a system does or what is the purpose of a system.

Eg. a City road traffic system is concerned with transporting goods and/or passengers within the city geography by road. This is called as a scope of that system. A Computer Application System for Payroll may be developed to process pay calculations at its core and related processing, such as printing pay-slips, statutory reports processing, and few other processing related to the same. This defines the scope of the system.

Scope, therefore, indicates the coverage of the system function. It is usually, in the context of the larger system as a whole. Eg. A Computer Application System may be dedicated to cater to the data processing needs only at the Factory of the organization. That implies just that.

2.5.2 Boundary

Boundary of a System indicates widest allowed scope of the system, so far its functionality is concerned. That means it demarks clearly, what is included 'in-side' the scope and 'what is not' included in the scope very clearly.

In case of the example of a Factory based Application System, the boundary makes it clear that any data processing outside this geographical area, even if it is of the same type, is not considered as part of that Application System.

So, many times, the system functionality is described in such a manner that the boundary starts where the scope ends. That also means that any thing beyond the stated boundary is 'beyond the scope' of the system. This also implies, that the concepts of system Scope and system Boundary are related so close that they appear as just lying back-to-back i.e. one implies the other.

2.5.3 Interface

A System Interface is a functional boundary of a system, which is shared with the functional boundary of another system. Eg. in case, of a road traffic system, the Title Board of the bus, which describes the Route of the Bus, is an interface between the Bus and the Pedestrians. The bus and the pedestrians are two subsystems of a larger Traffic system. The board acts as interface – informing the outsiders about the destination of the bus.

The Interface of a system, must be such that all the concerned systems must be able to process the same. Eg. the Board on the Bus, is expected to be on the place, where the outsiders can read, it should be in a language which they can understand, etc. Therefore, the interface must take into consideration characteristics of all the concerned systems into account.

In case, of a Computer Application System, the Interface is the functionality over which the other systems' functionality is overlapping. In this case, it includes the data exchanged across the Computer Application Systems.

2.5.4 Concepts of Scope, Boundary and Interface

The concepts of scope, boundary and Interface are so important in the system development tasks that they can make a difference of a-day-and-a-night, to a system development project. For a developer of a Computer Application System, it is very essential that the scope, boundary and the interface, if any of the Application is very well defined. In fact, in the initial stages of the Computer Application System development, the Systems Analyst ensures that the Users and the System Development team has a clear cut understanding of what the system functionality 'is', and what it 'is not' and 'where-and-how' of the current Computer Application System is expected to exchange the data with other Computer Application Systems. These are also called as External Interface definitions.

2.6 Summary:

The concept of Systems, seemingly not related to Computers directly and necessarily, but bears a strong co-relation with the Computer Application Systems. We learned the definition of a system, and the steps of how to examine whether a given system is a System.

We learned the three stages of Input, Process and Output. An Application System Developer can use these concepts effectively, to trace all the input data elements through the processing stage to the output data elements and vice-versa. This is an important technique used to check the Developer's understanding of the Application System, whether it is complete and correct.

This practice will help the Systems Analyst to 'problem components', 'missing components' or 'missing functionality' or 'erring functionality' in the Application Systems. Also, practicing this repeatedly, will help the Systems Analyst to widen his/her knowledge horizon fast, to learn other related systems in a systematic manner. What is required is to practice a systematic approach to systems development and leave away the ad-hoc practices of systems development far away. The Systems Analyst can walk up the ladder faster, if (s)he determines to be systematic in approach always in what (s)he does. It lays foundation for us to learn the System Development tasks of Analysis, Design and Implementation more effectively.