System Analysis and Design

Jalpa Poriya

What is System?

A system is an orderly grouping of interdependent components linked together according to a plan to achieve a specific objective.

For example : Computer System, Biological System, Hotel Management System, Business System, College Management System

The study of system concepts has three basic implications:

- A system must be designed to achieve a predetermined objective.
- Interrelationships and interdependence must exist among the components.
- The objectives of the organization have a higher priority than the objectives of its sub-systems.

Characteristics of System

1. Organization :
   - Organization implies structure and order.
   - It is the arrangement of components that helps to achieve predetermined objectives.
2. Interaction
   - Manner in which each component work with other component of system.
   - Example: Computer System
     - Keyboard or other input devices work on user input
     - CPU interacts with user input and prompt output with output device.

3. Interdependent

- Interdependence means how the components of a system depend on one another. Output of one sub-system is the required input for another sub-system.

4. Central Objective

- The objective of system must be central. It may be real or stated. It is not uncommon for an organization to state an objective and operate to achieve another.

Elements of a System

1. Input
2. Output
3. Control
4. Environment
5. Boundaries
6. Feedback

Outputs and Inputs:

- The main aim of a system is to produce an output which is useful for its user.
- Inputs are the information that enters into the system for processing.
- Output is the outcome of processing.

Processors:

The processor is the element of a system that involves the actual transformation of input into output. It is the **operational component** of a system.

Processors may modify the input either **totally** or **partially**, depending on the output specification.

Control:

The control element guides the system.

It is the **decision–making subsystem** that controls the pattern of activities governing input, processing, and output.

For Example: The behavior of a computer System is controlled by the Operating System and software. In order to keep system in balance, what and how much input is needed is determined by Output Specifications.

Environment:

The environment is the “supersystem” within which an organization operates.

It is the source of external elements that strike on the system.

It determines how a system must function.

For example, vendors and competitors of organization’s environment, may provide constraints that affect the actual performance of the business.

Boundaries and Interfaces:

A system should be defined by its boundaries. Boundaries are the limits that identify its components, processes, and interrelationship when it interfaces with another system.

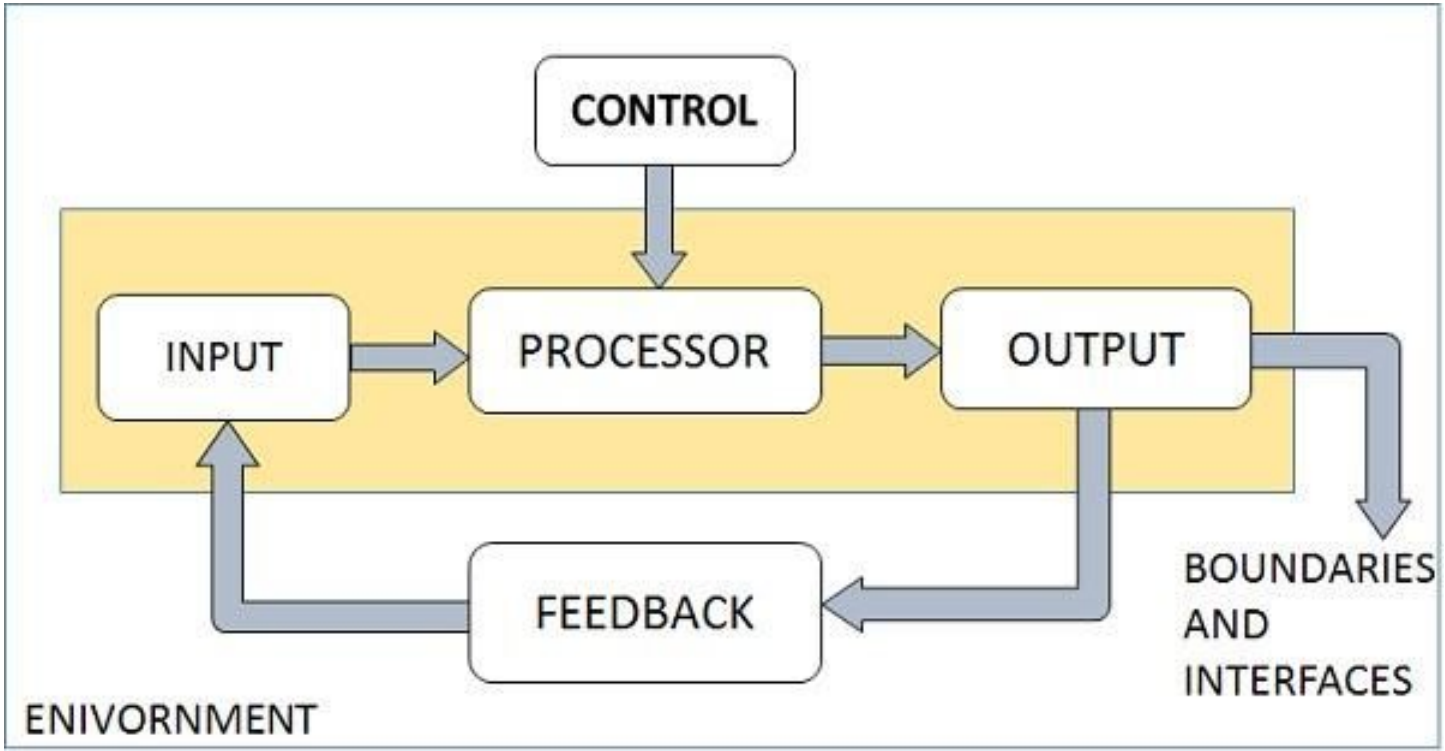
Feedback:

Feedback provides the control in a dynamic system.

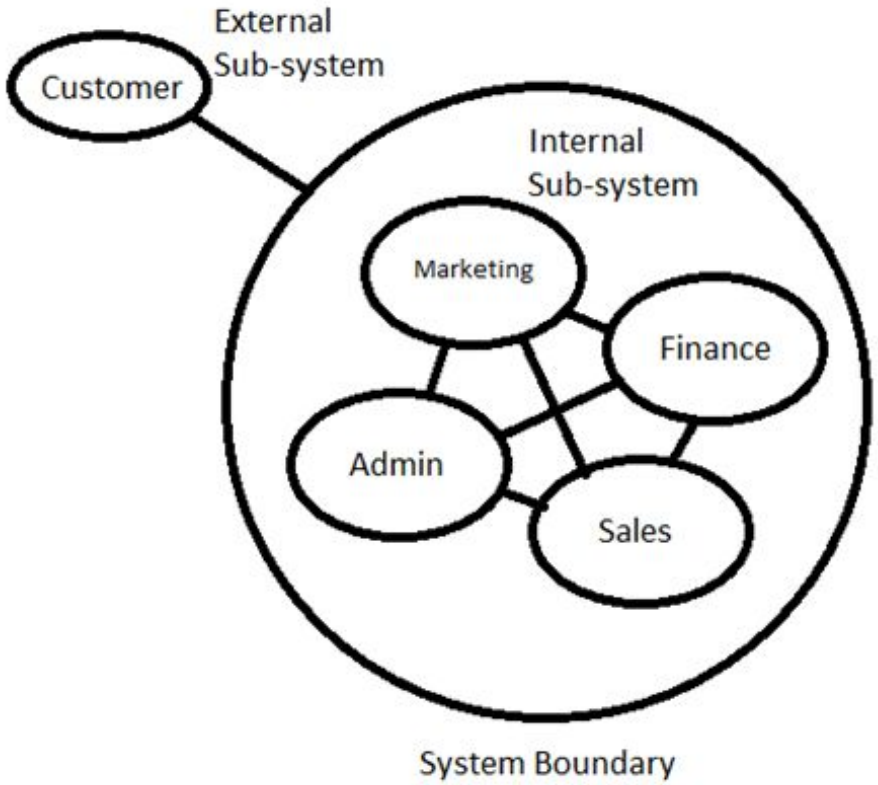
Positive feedback is routine in nature that encourages the performance of the system.

Negative feedback is informational in nature that provides the controller with information for action.

Diagram of System Elements



Example of Business System (Elements)



Types of System

1) Physical Systems
2) Abstract Systems
3) Open Systems
4) Closed Systems
5) Man-made Information Systems

Physical and Abstract Systems:

Physical systems are tangible entities. We can touch and feel them.

Physical System may be static or dynamic in nature.

- For example, desks and chairs are the physical parts of computer center which are static. A programmed computer is a dynamic system in which programs, data, and applications can change according to the user's needs.

Abstract systems are non-physical entities or conceptual that may be formulas, representation or model of a real system.

Open and Close System

An **open system** must interact with its environment.

It receives inputs from and delivers outputs to the outside of the system.

A **closed system** does not interact with its environment.

It is isolated from environmental influences. A completely closed system is rare in reality.

Man-made Information Systems:

This system includes hardware, software, communication, data, and application for producing information according to the need of an organization. Man-made information systems are divided into three types −

- **Formal Information System** − It is based on the flow of information in the form of memos, instructions, etc., from top level to lower levels of management.
- **Informal Information System** − This is employee based system which solves the day to day work related problems.
- **Computer Based System** − This system is directly dependent on the computer for managing business applications.
- For example, automatic library system, railway reservation system, banking system, etc.

Types of Information

A fair amount of data may be processed in manually, particularly when the organization is small and the amount of data to be processed is small.

For Example, A small grocery store owner

Owner would like to know:

- Stock need be re-ordered.
- Which items are sold fast so that he can order more and keep them in stock.
- Which bills send to customers remain unpaid beyond due date.
- Profit and loss account at the end of the year.

Information classified into the following categories

- Strategic Information
- Tactical Information (Management Information)
- Operational Information

- **Strategic Information:**
  - This is the information needed for long range planning and directing the course the business should take.
  - For example, store owner may like to decide whether to expand his business by stocking new varieties of items in his store.

- **Tactical Information**
  - This type of information is needed to take short range decisions to run the business efficiently.
  - For example, information of payments of bills by customers may be used to decide appropriate credit limits to be given to customers.

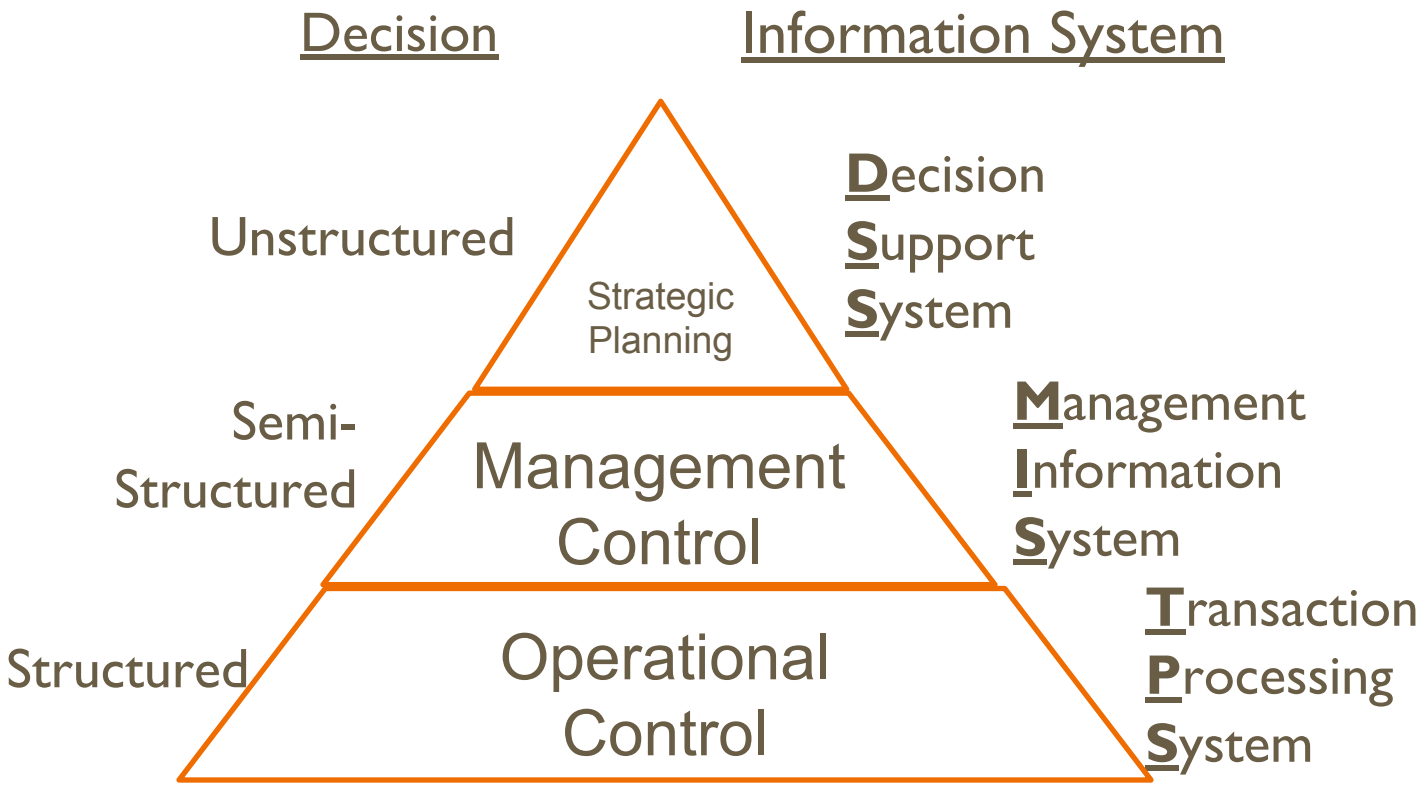
- **Operational Information**
  - This type of information is needed for day-to-day operations of a business organization.
  - For example, the list of items out of stock on a particular day would be used to trigger the action of ordering them.

Category of Information System

There are there types of Information System

- **Transaction Processing System (TPS)**
- **Management Information System (MIS)**
- **Decision Support System (DSS)**

The Pyramid Model of Information System



Decision Structure

- Structured Decision

  Made on regular basis

  All three components of decision – data, process and evolution – are determined.

- Example

  Attendance of Students

  In time and out time of faculty

- Semi-Structured Decision

  Having some agreement on the data, process and evaluation to be used, but some level of **human judgment is required**.

  - Example

    Salary calculation

    Student fees

- Unstructured Decision

  New Decision, New rules to follow.
  Based on manager's perception and judgment.
  Related to long-term strategy of the organization,
  Problems are non routine, critical Problem posses multiple solution, solution path.

- Example

  New course start

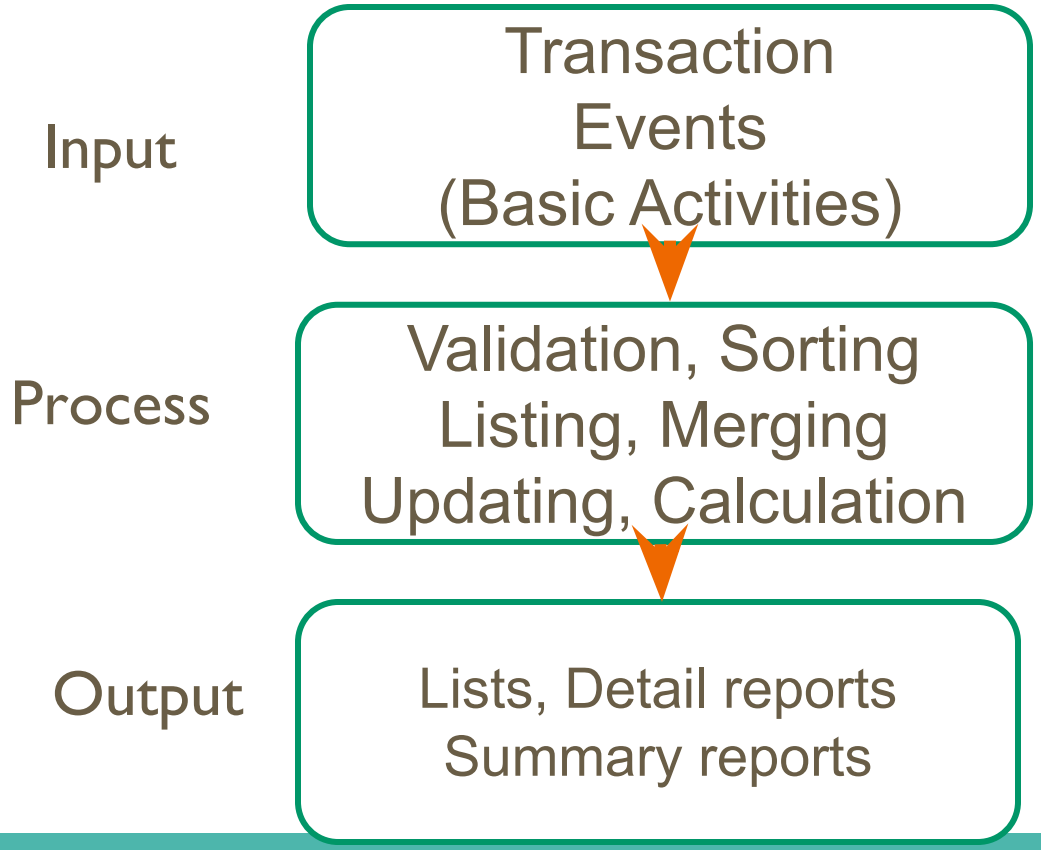
  New syllabus design

Transaction Processing System

- **Transaction Processing System are operational-level systems at the bottom of the pyramid.**
  - **There is a high volume of transaction**
  - **Each transaction is similar**
  - **The techniques of processing the transaction are well understood and can be described in detail.**
  - **TPS provide speed and accuracy.**
- **Transaction processing procedures are often called *standard operating procedures*.**

Transaction Processing Systems

Functions of a TPS



Example of TPS

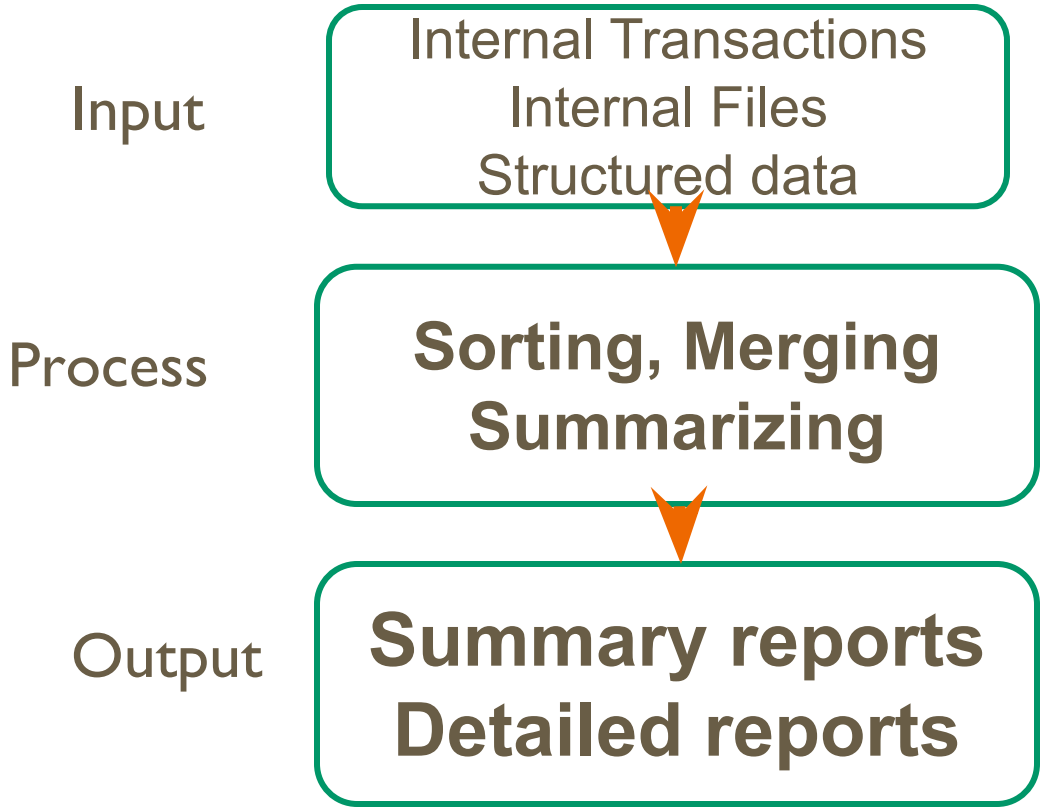
- Payroll systems (Employee management system)
- Order processing systems
- Reservation systems
- Stock control systems
- Banking System

Management Information System

- MIS are *management-level systems*.
- Used by middle managers to help ensure the smooth running of the organization in the short to medium term.
- System allows managers to evaluate an organization's performance by comparing current output with previous outputs.

Management Information System

MIS are built on the data provided by the TPS



Examples of MIS

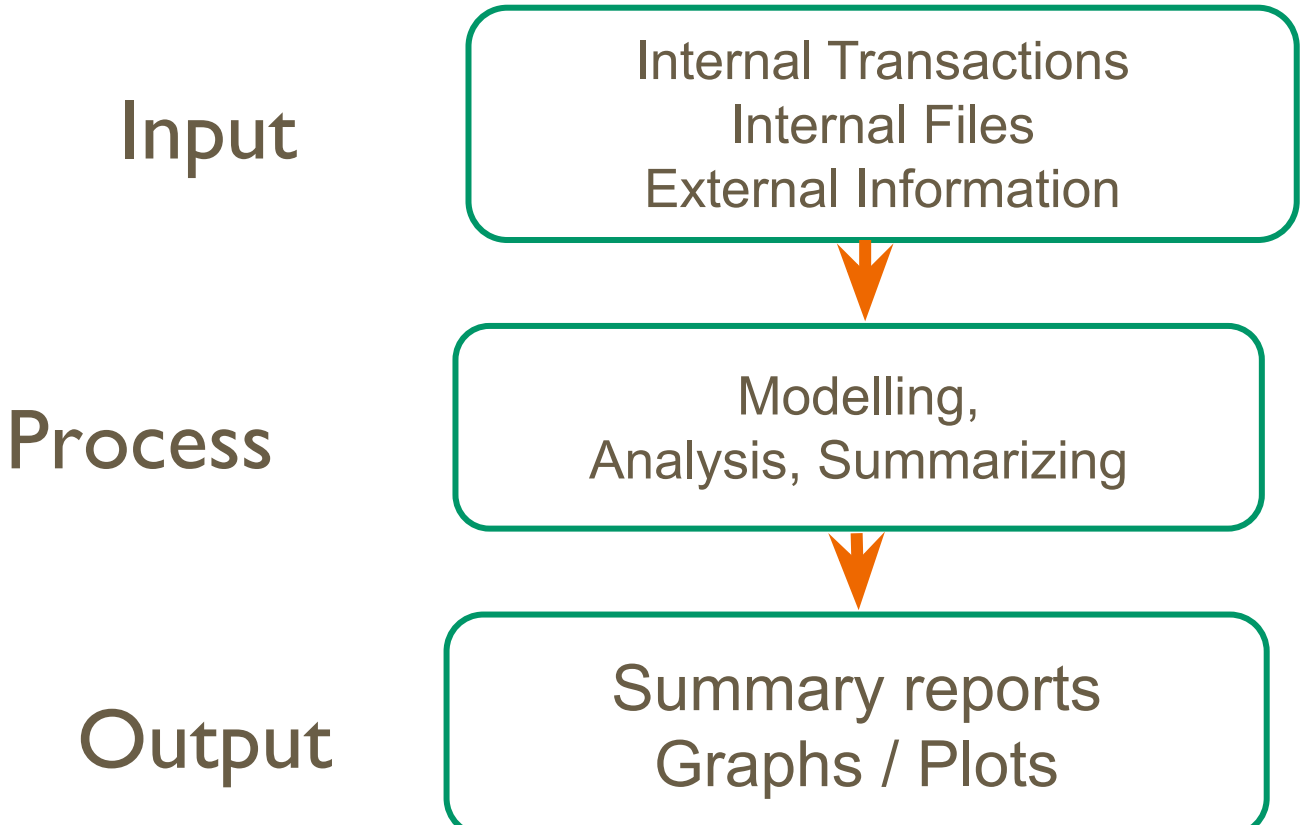
- Sales management systems
- Budgeting systems
- Management Reporting Systems

Decision Support Systems

- Some of the decisions that managers have to make are not of recurring nature.
- They may occur only once or may occur very infrequently.
- They are also unstructured or semi structured decisions.

Function of DSS

Depends on MIS & TPS



Some examples of DSS

- Logistics systems
- Financial Planning systems

System Analysis & Design

IMCA0303 / IMSC0303

Systems Development Strategies

There are three different approaches to the development of computer information systems :

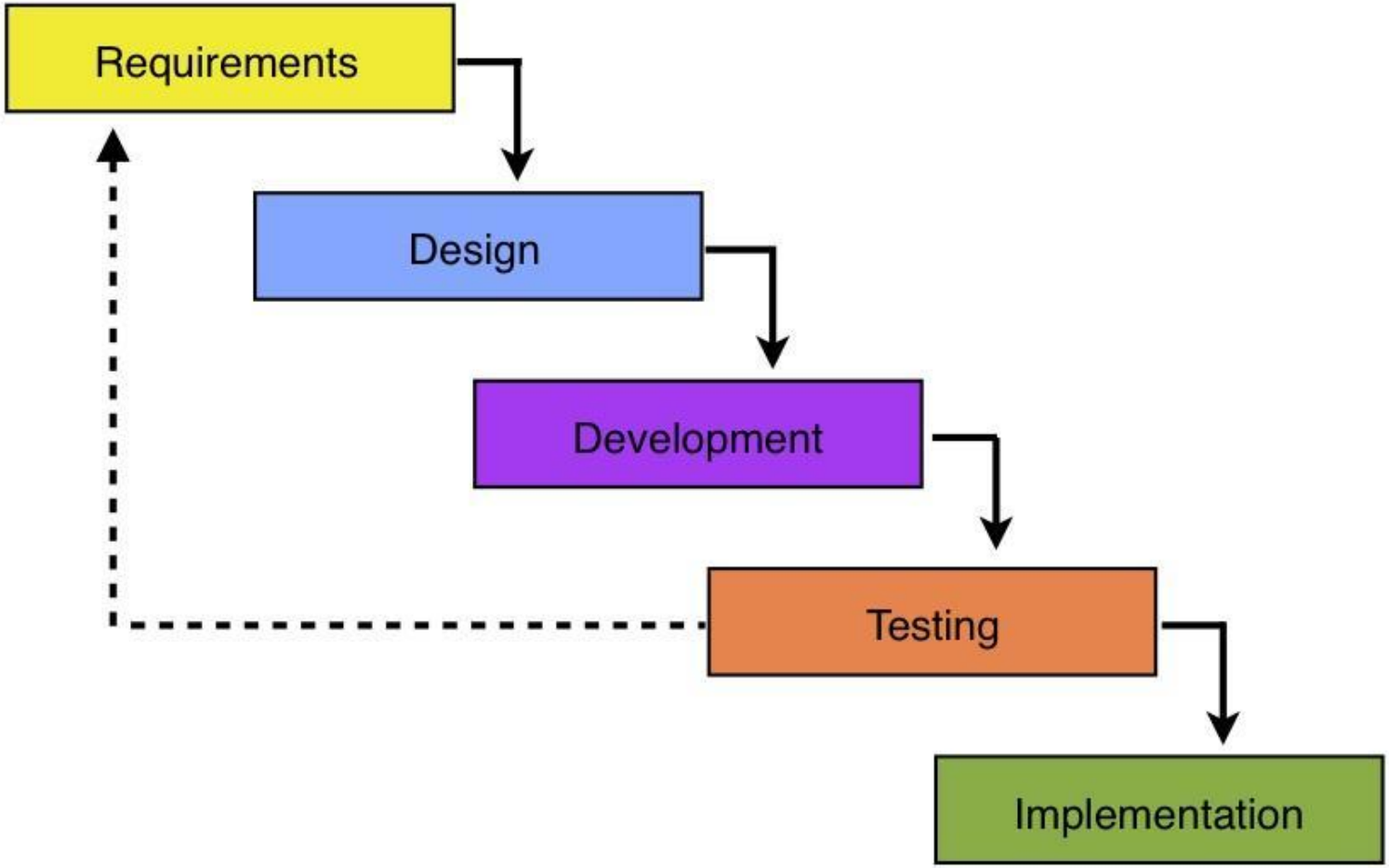
1. Systems Development Life Cycle method
2. Structured Analysis Development Method
3. Systems Prototype Method

System Development Life Cycle (SDLC)

It is a framework that describes the activity performed at each stages of a software project.

Phases of SDLC

1. Preliminary Investigation
2. System Requirement
3. Design of System
4. Development System
5. System Testing
6. Implementation


Requirements
Design
Development
Testing
Implementation

Phase 1 - Preliminary Investigation

- A request can be made for many reasons, but in each case someone initiates the request.

- Tasks
  - What is the problem in current system?
  - Determine if new system is needed
  - Weather an alternative system will solve problem
- Result
  - Need for improving the existing system is recognized

Phase 1 - Preliminary Investigation (cont.)

- When that request is made preliminary investigation begins.
- This activity has three parts
  - Request Clarification
  - Feasibility Study
  - Request Approval

Request Clarification

- Many request from the employees of organizations are not clearly stated.
- What originator wants.
- Project request must be clearly stated.

Feasibility Study

- Three aspects of feasibility Study
  - Economical Feasibility
  - Technical Feasibility
  - Operational Feasibility

Testing Project Feasibility

- Economical

- Technical

- Operational

Technical Feasibility [Can we build this system?]

- **Sources of Risks:**
- Users and Analysts lack of familiarity with the business application area.
- Lack of knowledge with technology
  - Have we used it before?, How new is it?
- Project Size
  - Number of people, time frame
- Compatible with existing systems
  - Does it have the capacity to meet our requirements of data storage, processing speed etc.?
- Does the necessary technology exist?
- Can it be acquired at affordable cost?
- Is it expandable in future?

Economic Feasibility [Should we build it?]

- Looks at the cost and benefit aspects of the system. We try to estimate the following :
  - The cost to conduct
    - Full investigation, Development, Hardware, Software, Training
- Assign values to costs and benefits.

Development Cost

- Development team salaries
- Consultant fees
- Development training
- Hardware and software
- Office space and equipment
- Data Conversion Costs

Operational Cost

- Software Upgrade
- Software Licensing Fees
- Hardware repair and upgrades
- Cloud storage fees
- Operational team salary
- Communication charges
- User tanning

Tangible Benefits

- Increased Sales
- Reduce Staff
- Reduce Inventory

Intangible Benefits

- Increased market share
- Increased brand recognition
- Improve customer services

Operational Feasibility [If we build it, will they operate?]

- It asks whether the system will work successfully or not. The answer will be obtained by answering few questions like :
  - Is there sufficient support of the management? Of the users?
  - Are users interested in a change looking at the existing system?
  - Have the users been involved in planning?
  - Will the proposed system do any harm due to poorer results in any specific area, loss of control, loss of accessibility, loss of information, lowering of performance in certain area?
  - Do the users feel insecurity of job or loss of their importance?

Economical Feasibility

- Are there sufficient benefits in creating the system to make the costs acceptable?

Technical Feasibility

- Can the work for the project be done with current equipment, existing software technology?
- If new technology required, what is the possibility that it can be developed?
- Is reliable technology and training available?

Operational Feasibility

- Will manager and user support it?
- Will the system be used if it is developed and implemented?

Result of Feasibility Study

- Problems is clearly stated.
- Feasibility report is created
- Management recommend top alternative based upon:
  - System fits into the organization
  - Flexibility for the future.
  - Costs vs. benefits

Request approval

- Not all requested projects are feasible.
- Those projects that are feasible should be put into a schedule.
- In some cases development can start immediately.
- If system staff are busy on other ongoing project management decide which project is most important and schedules them accordingly.

Phase 2 - Determination of System Requirements

- This is the step which is also called detailed investigation.
- The **systems analyst** working closely with the employees and managers studies the detailed working of the business process.

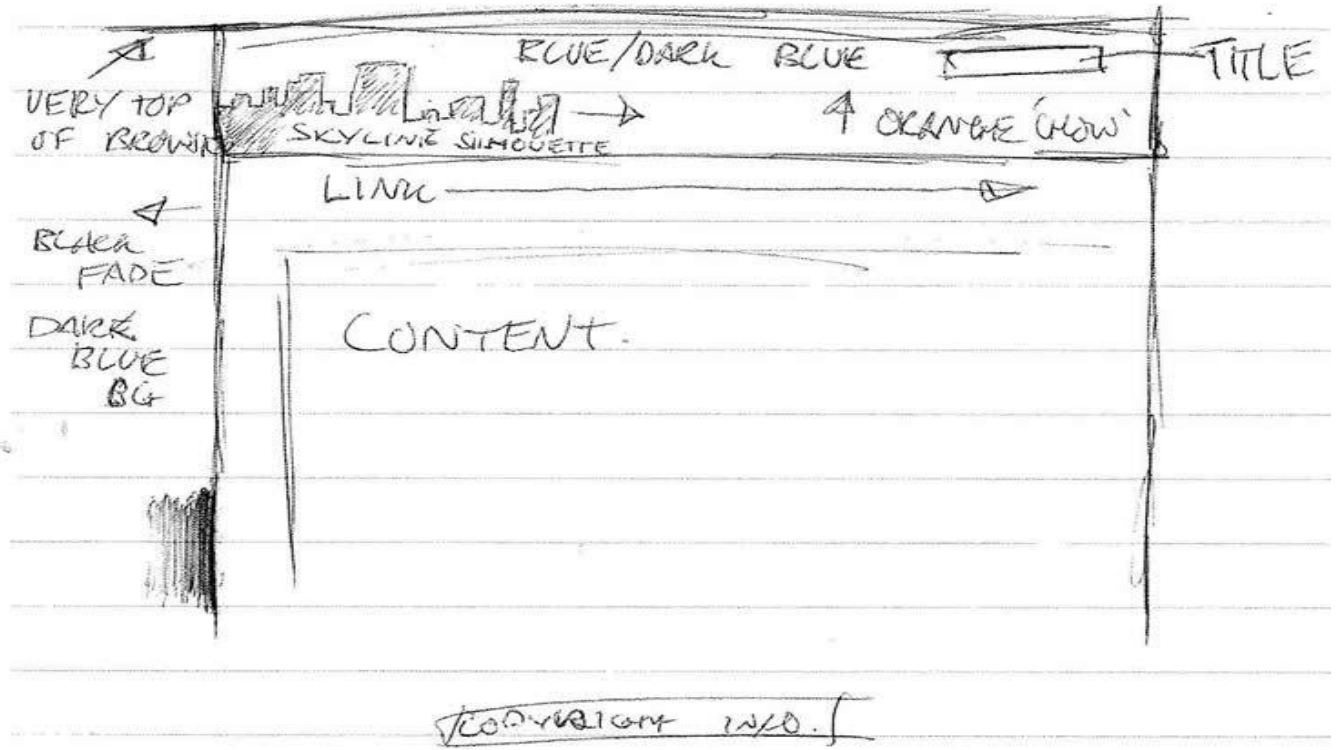
- How analysis done
  - Personal interview
  - Questionnaire
  - Study of manuals and reports
  - Collection and study of forms and documents
- Analyst studies
  - Controls
  - Response times
  - Input / output methods etc.

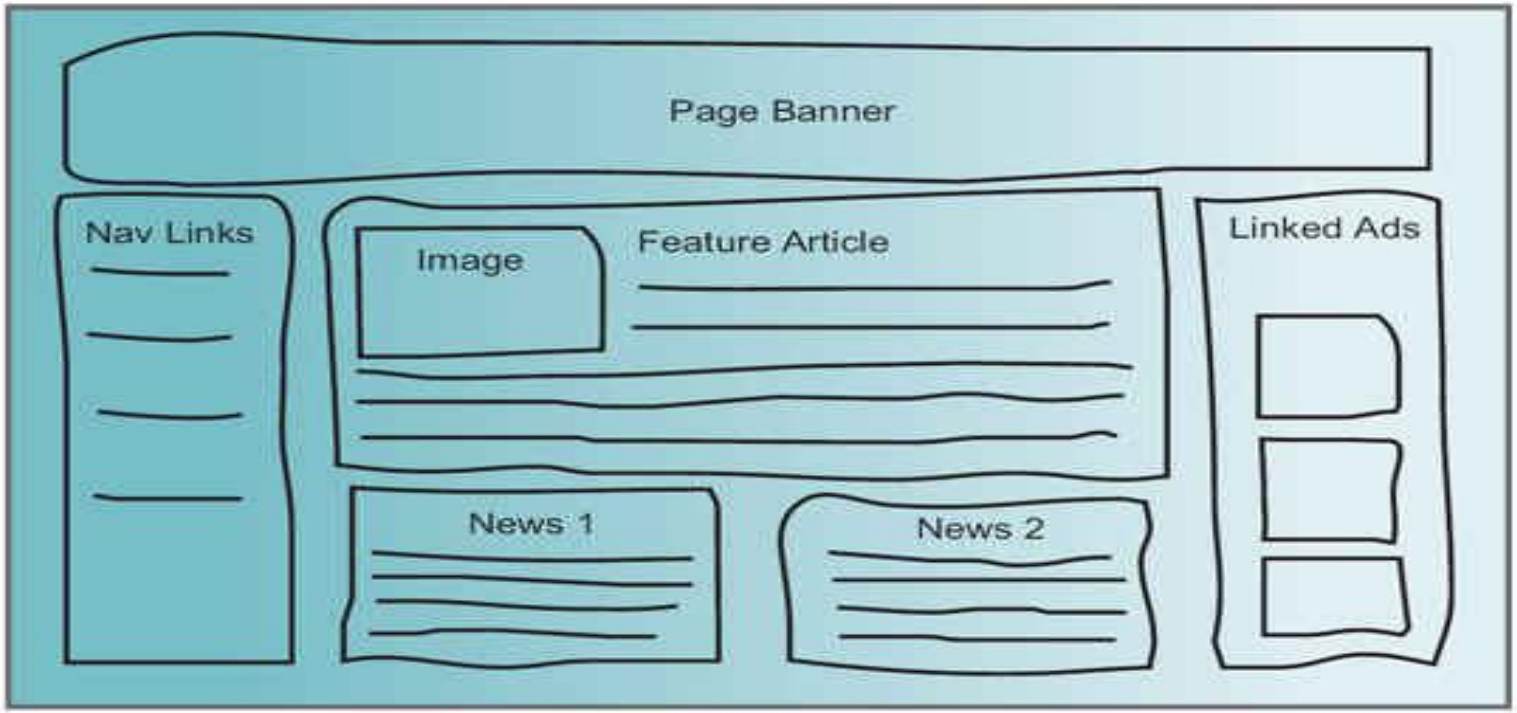
Phase 3 - Design of System

- This phase identify how a system will meet the requirement identified during system analysis.
- Step 1
  - System Analyst begin the design process by identifying reports and other outputs the system will produce.

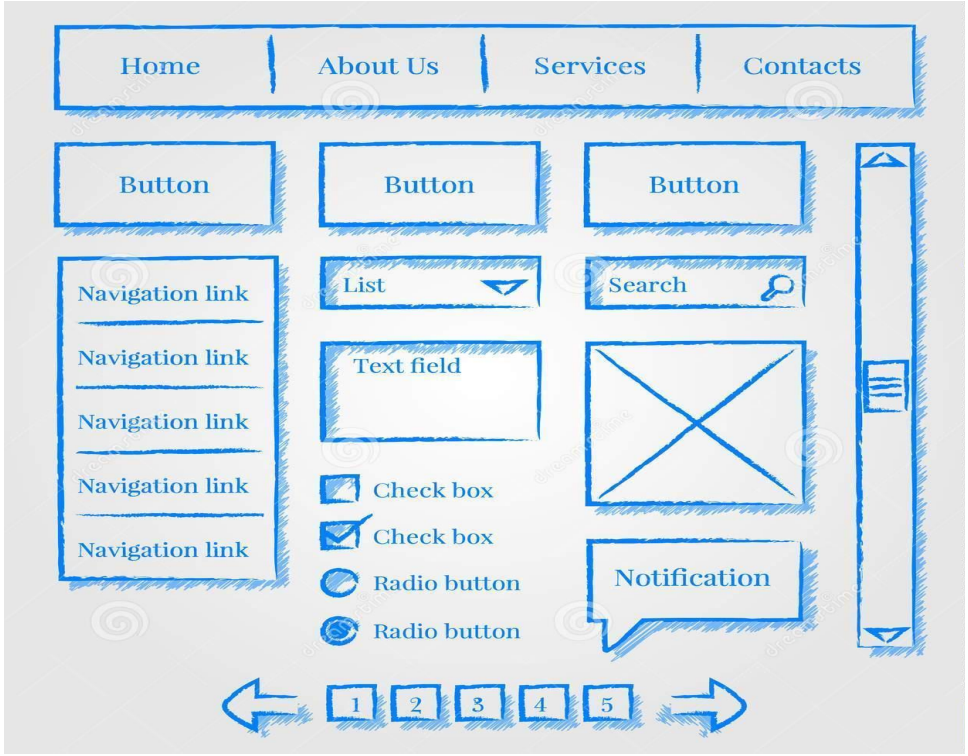
- Step 2
  - Designers sketch the form or display as they expect it to appear when the system is complete.
  - This may be done on paper or on a computer display, using one of the automated system design tools available.

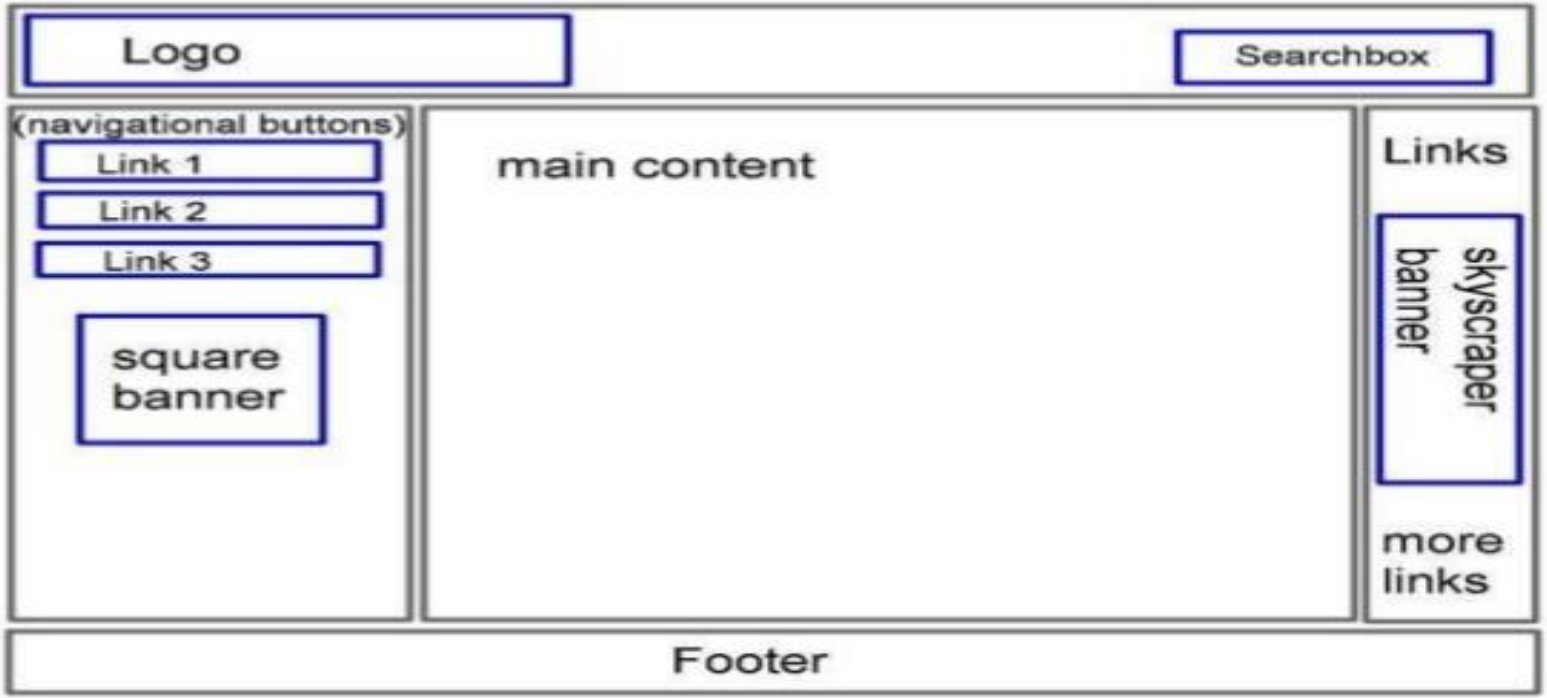
Blueprint of On paper design



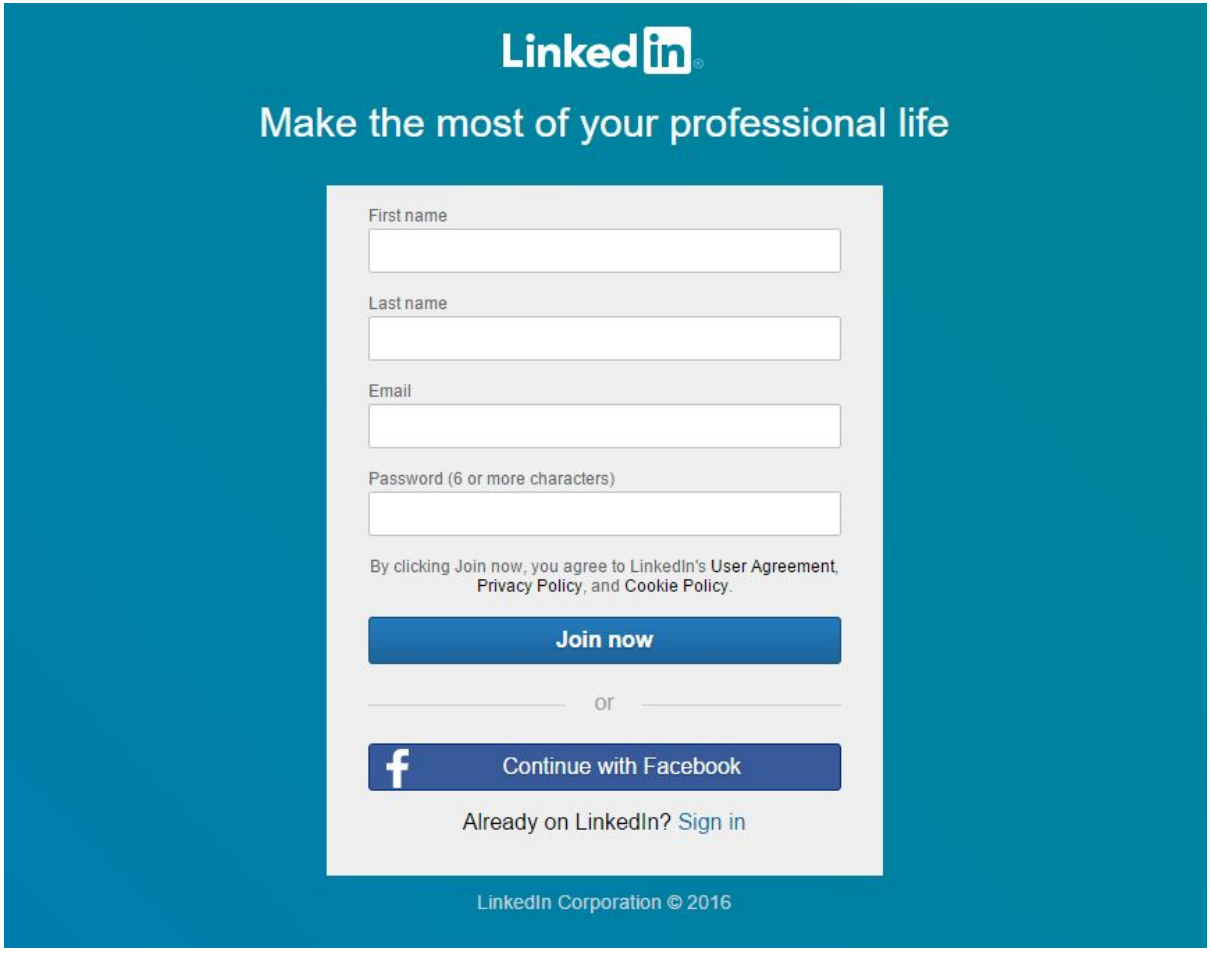

Page Banner
Nav Links
Image
Feature Article
Linked Ads
News 1
News 2

Blueprint of Design tools




Logo
Searchbox
(navigational buttons)
Link 1
Link 2
Link 3
square banner
main content
Links
skyscraper banner
more links
Footer

Final result (after development)



- Step 3:
  - The system designer also describes the data to be input, calculated, or stored.
- Step 4:
  - The detailed design information is passed on to the programming staff so that software development can begin.

- Step 4:
  - Designer select file structures and storage devices, such as magnetic disk, magnetic tape, or even paper file.
  - The procedures they write tell how to process the data and produce the output

- Step 5:
  - As programming start, designer are available to answer questions, clarify fuzzy areas, and handle problem that confront the programmers when using the design specifications.

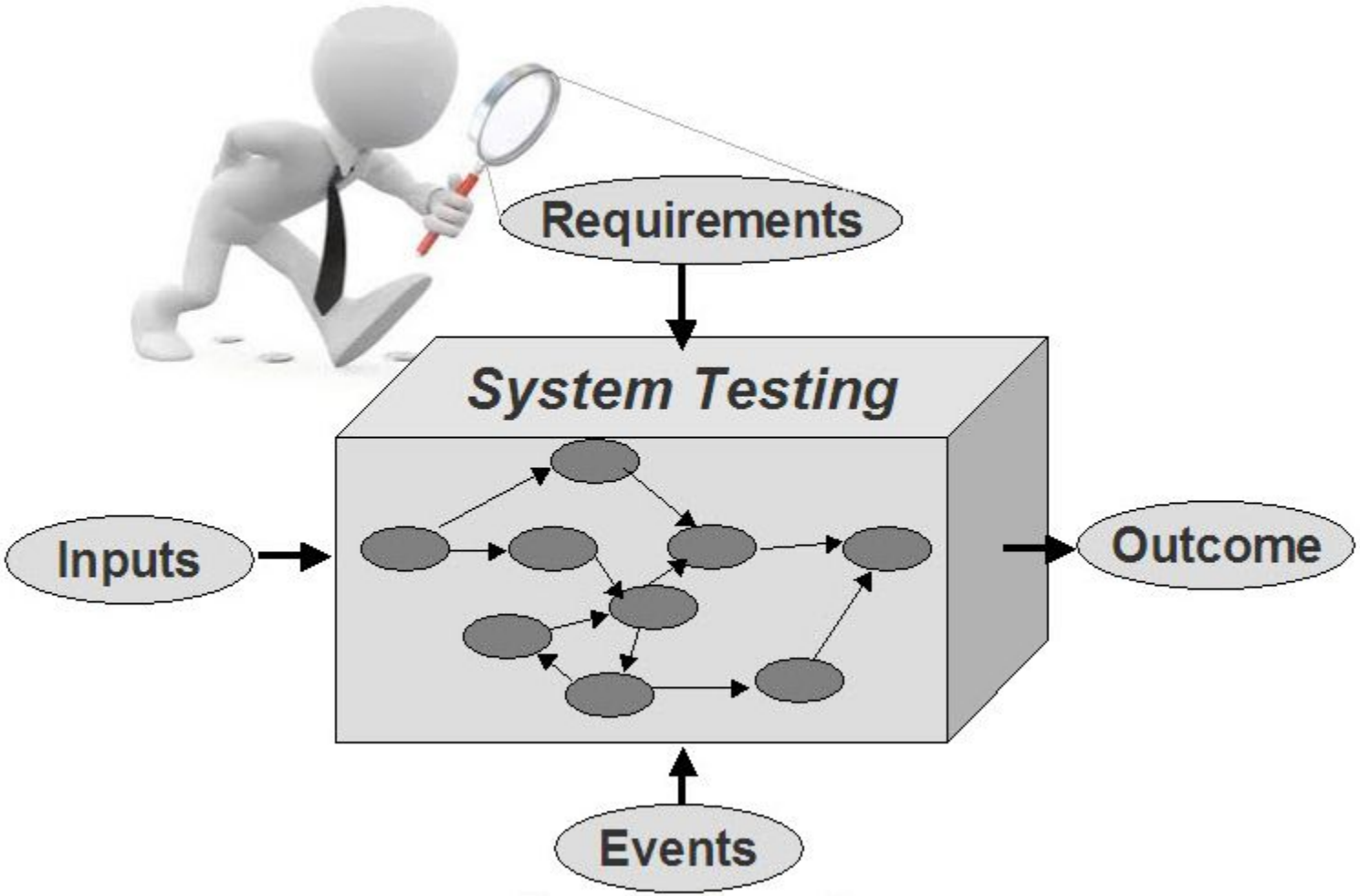
Phase – 4 Development of Software

- In large organization
  - computer programmer are part of the permanent professional staff.
- In small organization
  - Outside programming services may be keep on a contract basic.

- Programmers are also responsible for documenting the program it will explain – Why certain procedure are coded in specific ways
- Document Demo
- Document Demo

Phase 5 – System Testing

- Why System Testing?
  - It is preferable to discover any surprises before the organization implements the system and depends on it.
- What System Tester do?
  - The system is do experiments to ensure that the software are does not fail.


Requirements
System Testing
Inputs
Outcome
Events

- How System Testing Done?
  - In may organizations, system testing done by persons (Testers) or with software (Testing Tools) other then those who develop system to ensure more complete and unbiased testing and more reliable software

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They have different path for the same GOAL, To improve Quality.

Phase 6 – Implementation

- Implementation Process
  - Train user: System personnel/staff/employee check out and put new equipment into use
  - Install new application
  - Construct or add any files of data needed to use it.

Structured Analysis Development method (SADM)

- Some information systems are large and complex.
- The SADM is aimed at overcoming the difficulty through. Partitioning the system into components and Constructing a model of the system.

SADM (continue)

- It allows individuals to see logical elements apart from the physical components it uses (computer, memory etc.)

Module division of Easy Education Management System

Personal Information Management System (PIMS)

- Student Registration/ Admission, Personal Information, Guardian Information, Employee/ Stuff Registration (Personal Information, Academic Information, Professional Information, Skills/ Training Information)

Attendance

- Holiday Setup, Student Attendance, Employee / Stuff

Result

- Student Exam Setup, Student Exam Result Entry

Reports

- Student Daily Attendance
- Student's Result
- Employee/ Staff Attendance
- Student Details
- Student List Report (For Each Class)
- Class Wise Student Routine
- Employee details Report
- Employee/ Stuff List
- All Income By Date
- Head Wise Income By Month
- Head Wise Monthly Income by Financial Year
- All Expense By Date
- Head Wise Expense By Month
- Head Wise Monthly Expense By Year

Elements of SADM

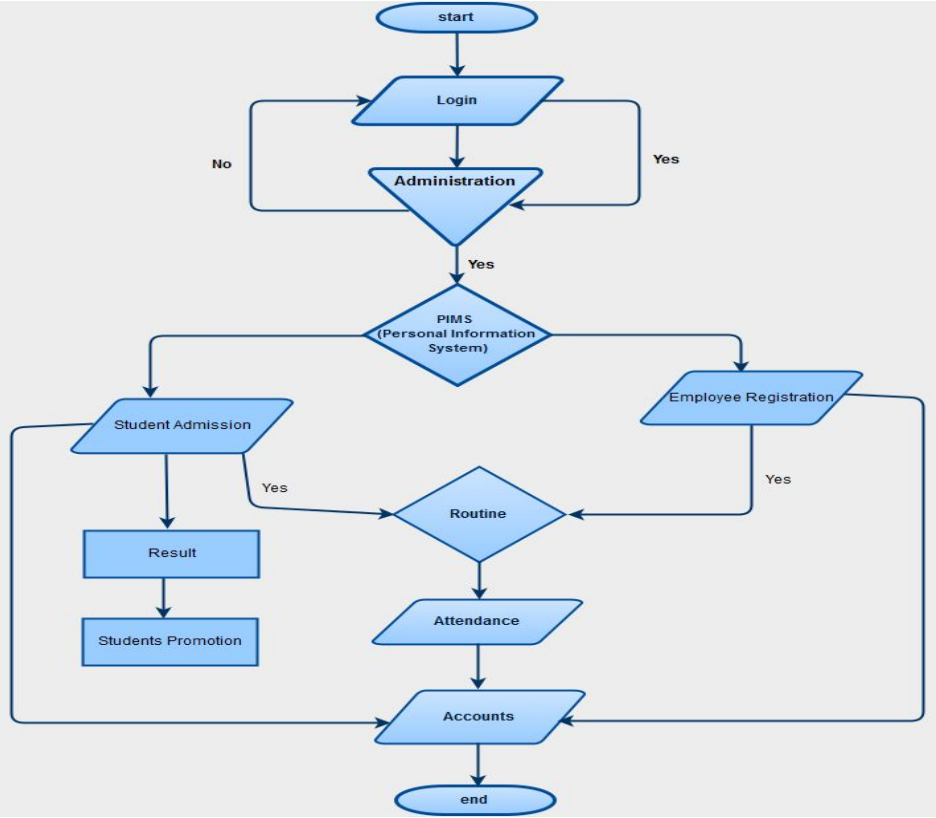
1. Graphical Description
2. Data Flow Diagram
3. Data Dictionary

Elements of Structured Analysis

1. Graphic Description

- **Instead of words structured analysis uses symbols or icons to create graphic model of the system.**
- **Graphics models show details of the system without introducing manual or computer processes, tape or disk, or program or operating procedures.**

Example of Graphical Description



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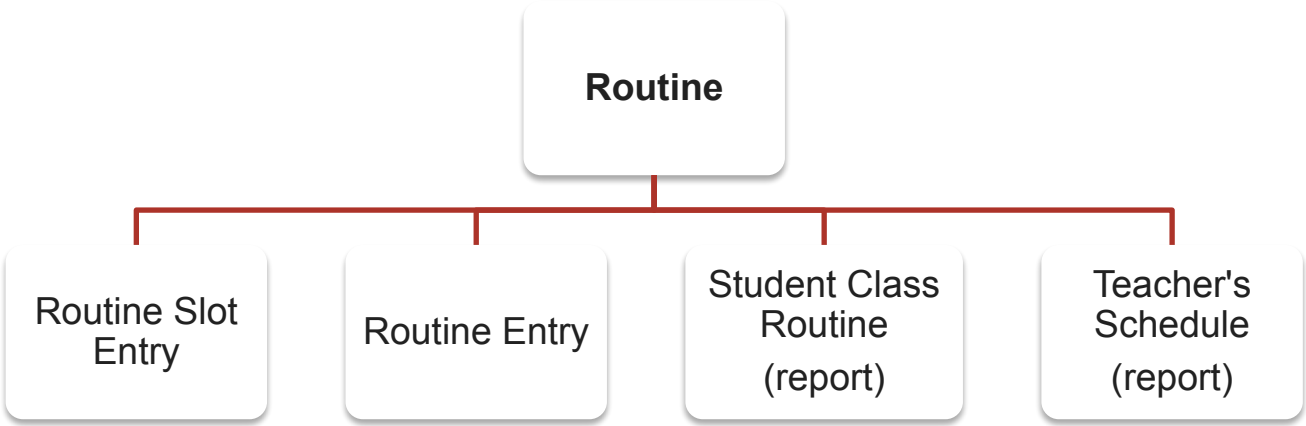


2. Data Flow Diagram (DFD)

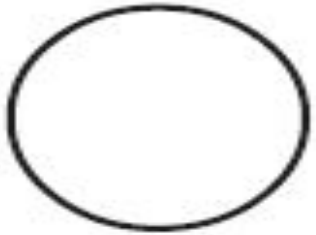
- **Developing a description of the system using structured analysis.**
- **It follows a top-down process.**
- **Each process can be broken down into a yet more detailed data flow diagram.**

Symbols of DFD

- **EXTERNAL ENTITY:**
  - An External Entity is a source and/or destination of data, for the system under consideration.

Symbols of DFD

- **PROCESS:**
  - A process represents some amount of work being performed on data.



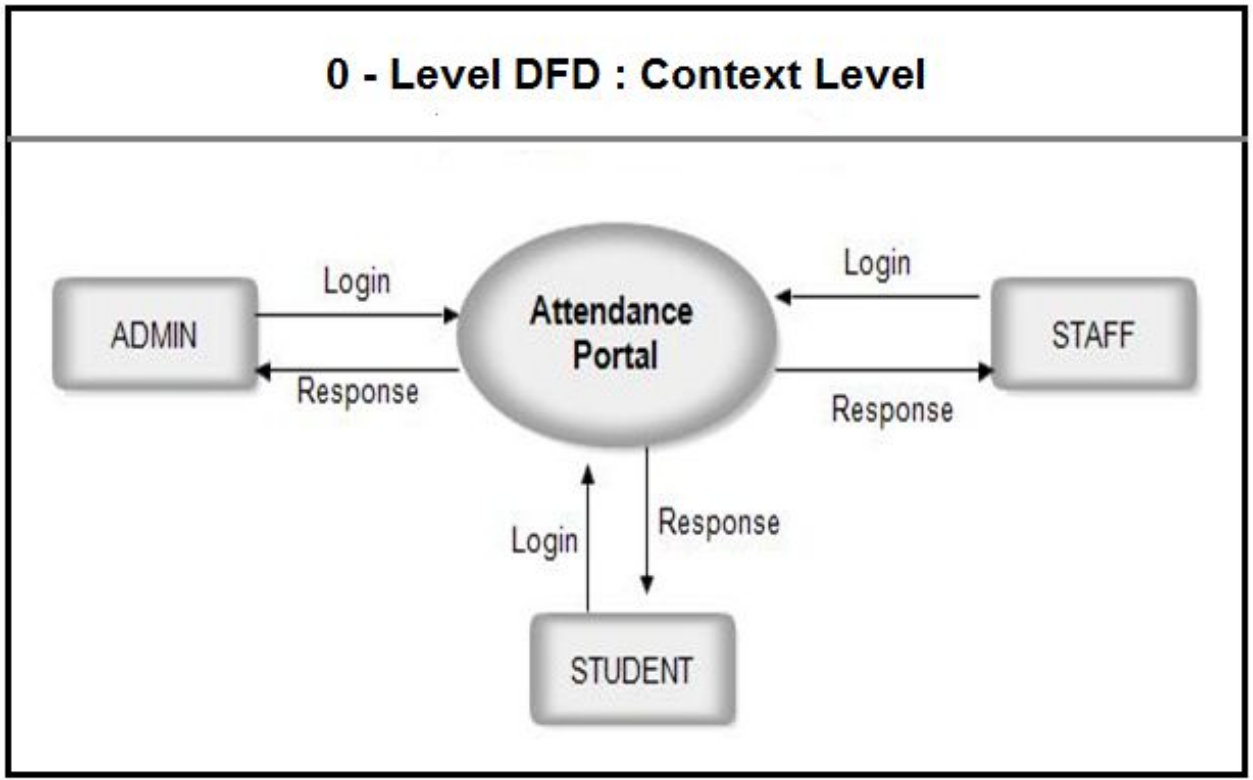
Symbols of DFD

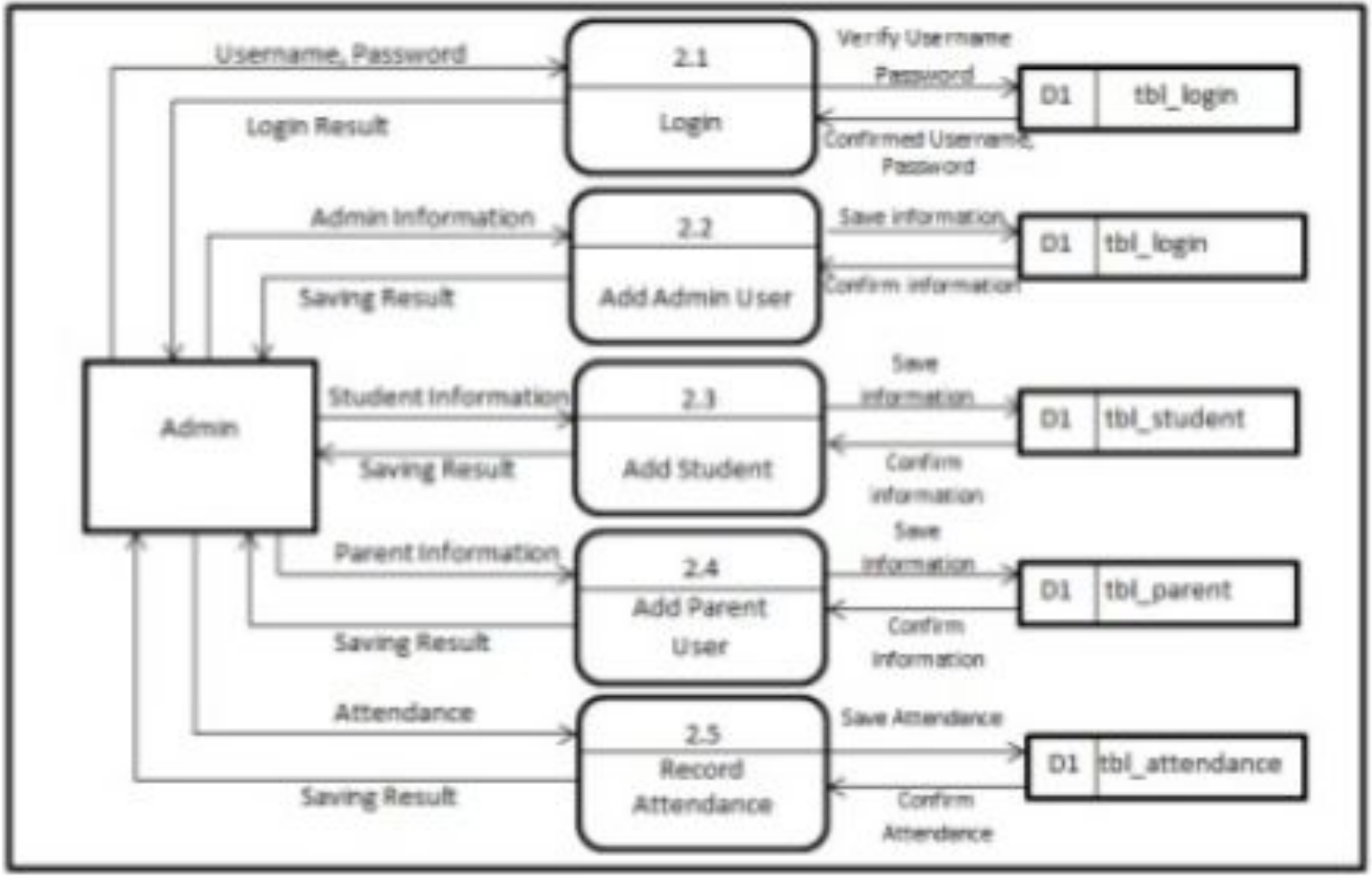
- **DATA FLOW:**
  - A data flow portrays an interface among different components in a DFD.

Symbols of DFD

- **DATA STORE:**
  - If there is a logical requirement for the data to be stored, it is held in a data store.

Example of DFD (0TH Level)




Username, Password
Login Result
2.1
Login
Verify Username
Password
Confirmed Username, Password
D1
tbl_login
Admin Information
Saving Result
2.2
Add Admin User
Save information
Confirm information
D1
tbl_login
Admin
Student Information
Saving Result
2.3
Add Student
Save information
Confirm information
D1
tbl_student
Parent Information
Saving Result
2.4
Add Parent User
Save information
Confirm Information
D1
tbl_parent
Attendance
Saving Result
2.5
Record Attendance
Save Attendance
Confirm Attendence
D1
tbl_attendance

3. Data Dictionary

- **All definition of elements in the system are described in detail in data dictionary.**

Sr. No.	Data Name	Description	Type	Length
1	Acc_ID	Unique Id for user	Int	5
2	Acc_No	Account number of user	String	12
3	Name	Name of account holder	String	20

Data Dictionary – Example

File Name	Field Size	Data Type	Data Format	Description	Example
Student_ID	6	Text	LLLNNN	Student ID	STU001
First_Name	15	Text	-	Student Name	Dave
Surname	30	Text	-	Student Surname	Citizen
D.O.B	8	Text	DD/MM/YY	Student D.O.B (Date of Birth)	13/05/19
Address	40	Text	----------	Student Address	73 Derp Rd
Gender	1	Yes/No Boolean	F/M	Student Gender	Male

System Prototype Method

- **The system prototype method involves the user more directly in the analysis and design experience than does the SDLC or SADM.**
- **What is a prototype?**
  - **A prototype is a working system that is developed to test ideas and assumptions about the new system**

- **Reason for System prototyping**
- **Reason 1:**
    - **Information requirements are not always well defined**
- **Reason 2:**
    - **Developers have neither information nor experience**
- **Reason 3:**
    - **High-cost or high-risk situations in which the proposed designed is new and untested those system are regularly evaluated through prototypes**

- Once the prototype is ready there are 4 alternatives available :
  - **The prototype is redeveloped. Complete redevelopment.**
  - **It is implemented as complete system.**
  - **The project is abandoned.**
  - **Another prototyping series is begun.**

Tools for System Development

- Analysis Tools
  - Data Collection Tools
  - Charting Tools
  - Dictionary Tools

Tools for System Development

- Design Tools
  - Layout Tools
  - Specification Tools (for documentation)

- Development Tools
  - Software Engineering Tools
  - Code Generators
  - Testing Tools