Chapter 1 - Overview of Information System

Data, Information, and Knowledge

Data are the raw facts about people, places, events, and things that are of importance in an organization.

Information is the data that has been processed or reorganized into a more meaningful form for someone.

Knowledge is the data and information that is further refined based on the facts, truths, beliefs, judgments, experiences, and expertise of the recipient.

Types of Information

Information is an organizational resource which must be managed as carefully as other resources. The three levels of information in organizations are:

Strategic information

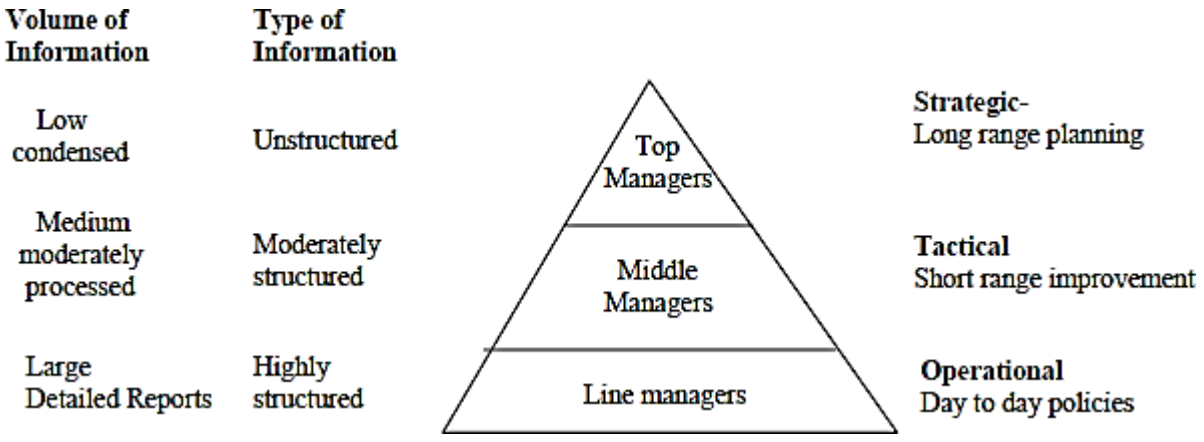
It relates to long-term planning policies and upper management.

Tactical information

It helps middle management and department heads in policy implementation and control.

Operational information

It is daily information needed to operate the business.



Why Information System?

Information systems are needed due to following benefits:

- Added value to products (goods or services)
- Better service advantage

- Competitive
- Fewer errors
- Greater accuracy
- Higher- quality products
- Improved communications
- Increased efficiency
- Increased productivity
- More efficient administration
- Reduced operation requirements
- Reduced operation casts
- Superior financial decision making
- Superior control over operations
- Superior managerial decision making

Role of Information System

Information system deals with data of the organizations. The purposes of Information system are to process input, maintain data, produce reports, handle queries, handle on line transactions, generate reports, and other output. These maintain huge databases, handle hundreds of queries etc. The transformation of data into information is primary function of information system.

These types of systems depend upon computers for performing their objectives. A computer based business system involves six interdependent elements. These are hardware (machines), software, people (programmers, managers or users), procedures, data, and information (processed data). All six elements interact to convert data into information. System analysis relies heavily upon computers to solve problems. For these types of systems, analyst should have a sound understanding of computer technologies.

Information systems are needed when timely processing for fast action is needed, same data has to be processed in different ways and when organizations require innovative processing.

Organizations and Information System

An information system (IS) 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.

Organizations are complex systems composed of interrelated and interdependent subsystems. Organizational subsystems are said to be interrelated and interdependent when a change in one subsystem affects other subsystems. An organizational boundary separates the system from its environment. System and subsystem boundaries and environments impact on information system analysis and design.

Levels of Organization:

Executive Level

Strategic planning and responses to strategic issues occur here. Executive decisions are usually unstructured and are made using information consolidated internal and external information

Managerial Level

Monitoring and controlling of operational activities and executive information support occur here. Managerial decisions are usually semi-structured and are made using procedures and ad hoc tools

Operational Level

Day-to-day business processes and interactions with customers occur here. Operational decisions are usually structured and are made using established policies and procedures

Types of Computer-based Information Systems and Systems Development

Information systems differ in their business needs. Also depending upon different levels in organization information systems differ.

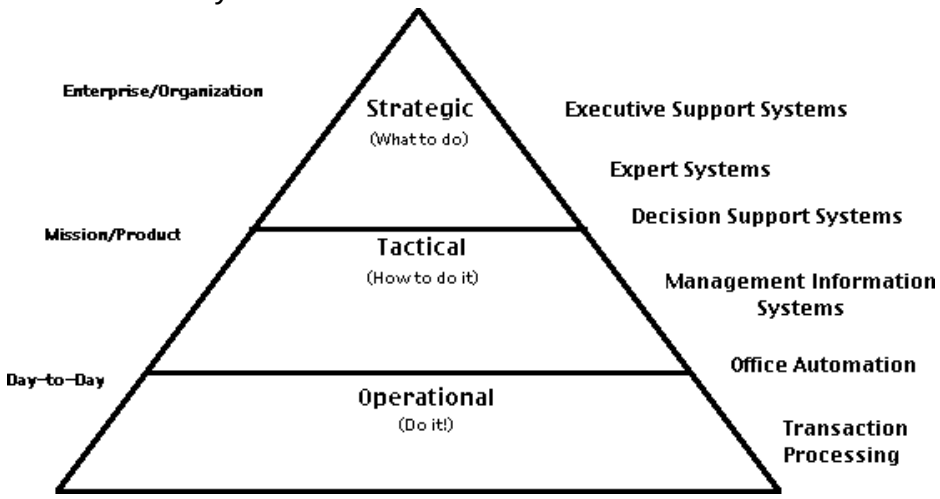


Figure: Relation of information systems to levels of organization

Some major information systems are:

- Office automation Systems
- Transaction processing Systems
- Management information Systems
- Decision support Systems
- Expert Systems
- Executive Support Systems

Office Automation Systems (OAS)

Office automation system is a collection of software and hardware products that increase productivity within the office setting.

Office automation systems are among the newest and most rapidly expanding computer based information systems. They are being developed with the hopes and expectations that they will increase the efficiency and productivity of office workers, typists, secretaries, administrative assistants, staff professionals, managers and the like. Many organizations have taken the First step toward automating their offices.

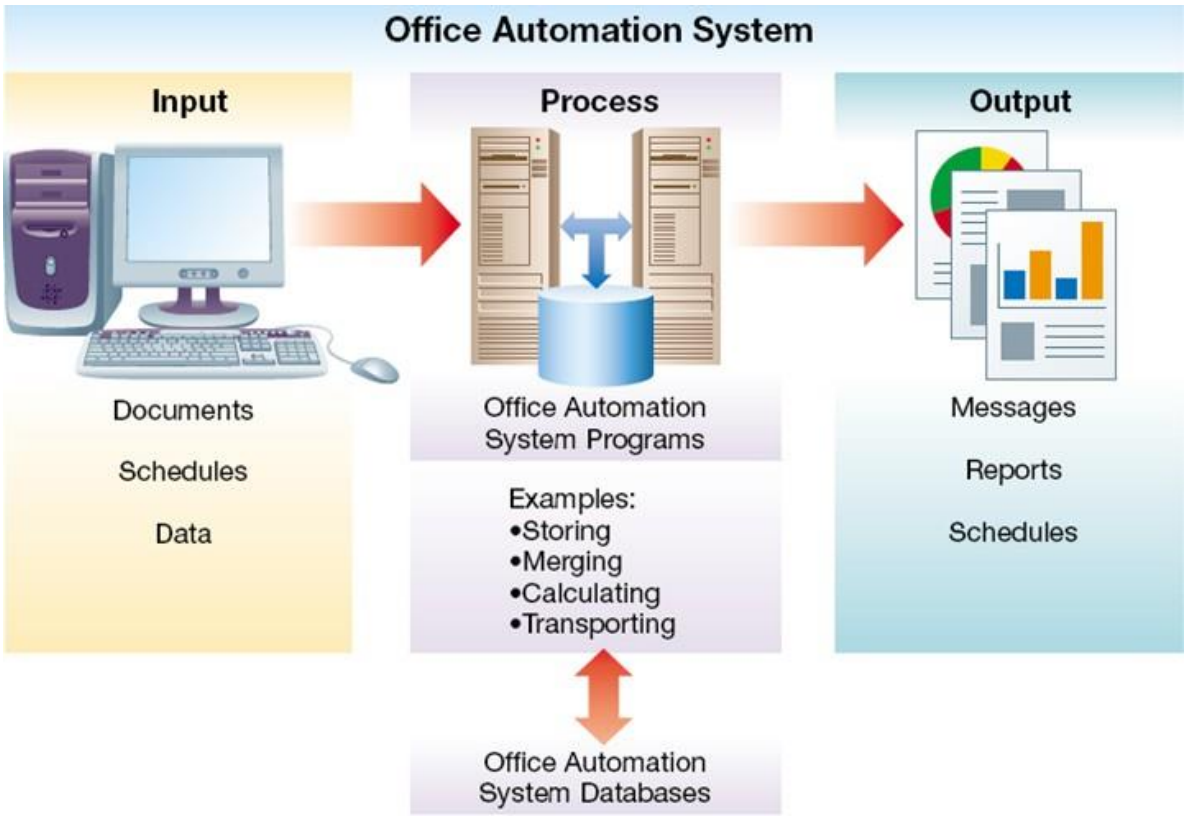


Figure: Office Automation Systems

Often this step involves the use of word processing equipment to facilitate the typing, storing, revising and printing of textual materials. Another development is a computer based communications system such as electronic mail which allows people to communicate in an electronic mode through computer terminals. An office automation system can be described as a multi-function, integrated computer based system that allows many office activities to be performed in an electronic mode.

The activities supported by these kinds of systems include:

- *Scheduling Resources*
  Examples: electronic calendars with resource management (equipment, facilities, etc.)

- *Document Preparation*
  Examples: software (word processing and desktop publishing); hardware (printers)
- *Communicating*
  Examples: e-mail, voice mail, videoconferencing and groupware

Transaction Processing Systems (TPS)

TPSs are a special class of information systems designed to process business events and transactions.

They are aimed at improving the routine business activities on which all organizations depend. They substitute computer based processing for manual procedure. TPS assists in carrying out the day-to-day, high volume activities / transactions of the organization. These transactions are processed using standard operating procedures. There are hardly any exceptions to these procedures. These routines are embedded in the computer programs that control the entry of data, processing of details, storage, and presentation of data and information.

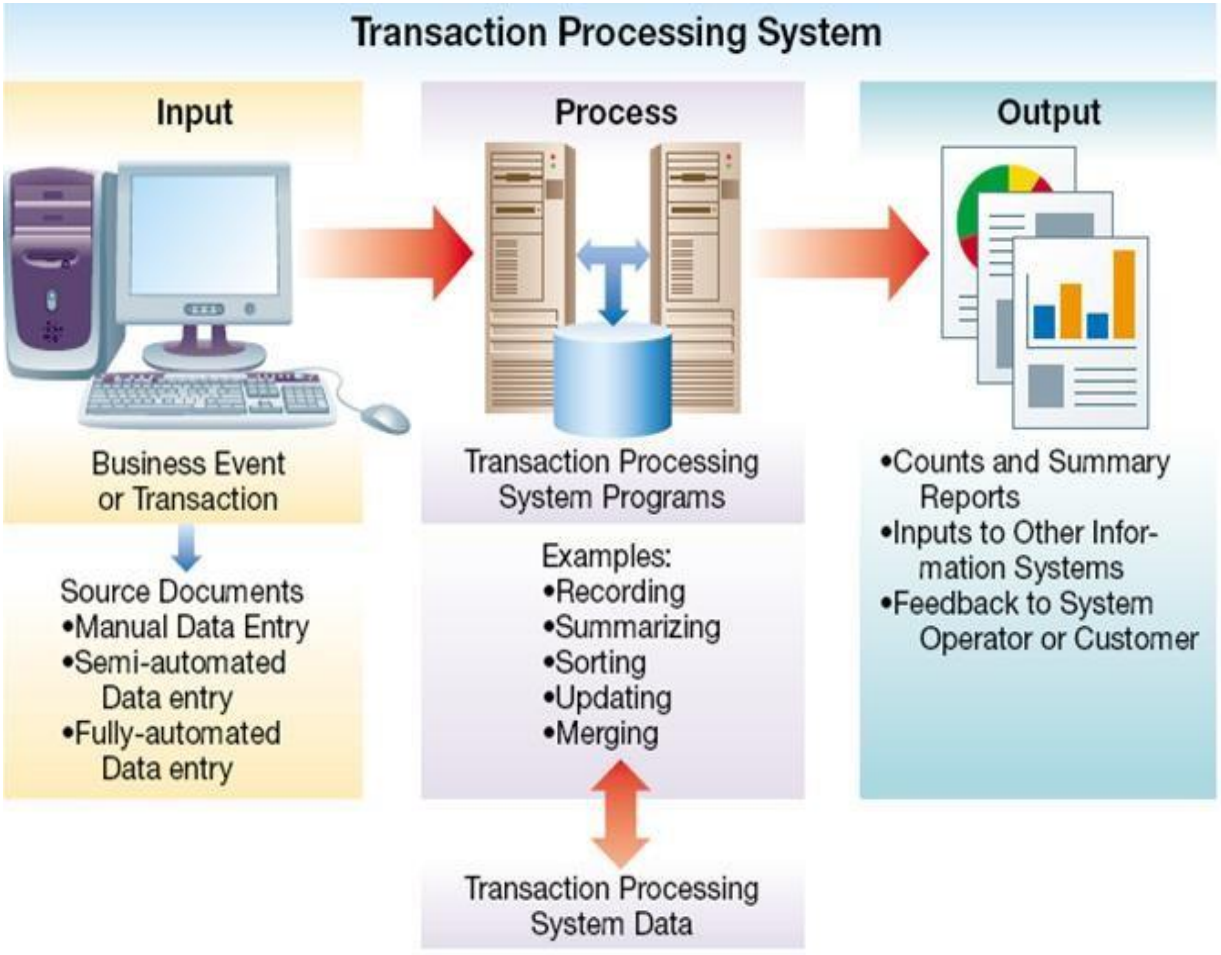


Figure: Transaction Processing Systems

This provides high speed and accurate processing of record keeping of basic operational processes. These include calculation, storage and retrieval. Transaction processing systems provide speed and accuracy, and can be programmed to follow routines functions of the organization.

Example: TPS includes Airline Reservation Systems, Banking Systems, job scheduling systems and queue monitoring system on a typical shop floor, Processing of orders etc.

Management Information Systems (MIS)

MISs is used by managerial employees to support recurring decision making in managing a function or the entire business.

These systems assist lower management in problem solving and making decisions. They use the results of transaction processing and some other information also. It is a set of information processing functions. It should handle queries as quickly as they arrive. An important element of MIS is database.

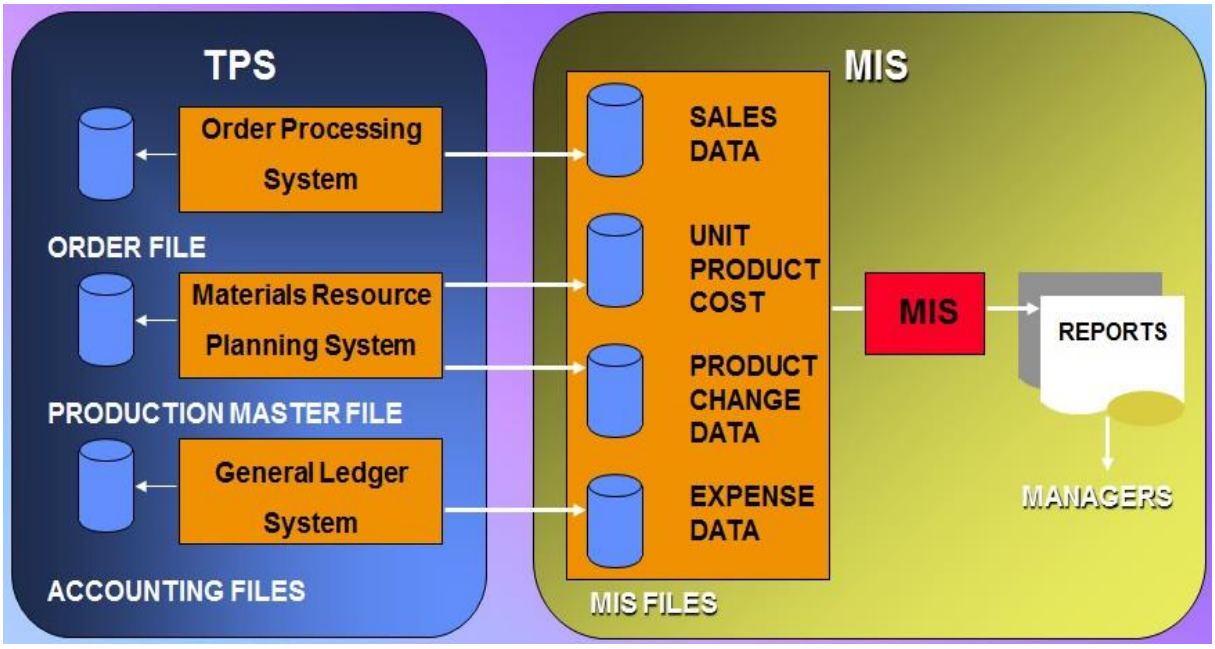


Figure: Management Information System

The information required at this level is used for making short term decisions and plans for the organization. Information like sales analysis for the past quarter/yearly production details etc. fall under this category. Management information system (MIS) caters to such information needs of the organization. Due to its capabilities to fulfill the managerial information needs of the organization, Management Information Systems have become a necessity for all big organizations. And due to its vastness, most of the big organizations have separate MIS departments to look into the related issues and proper functioning of the system.

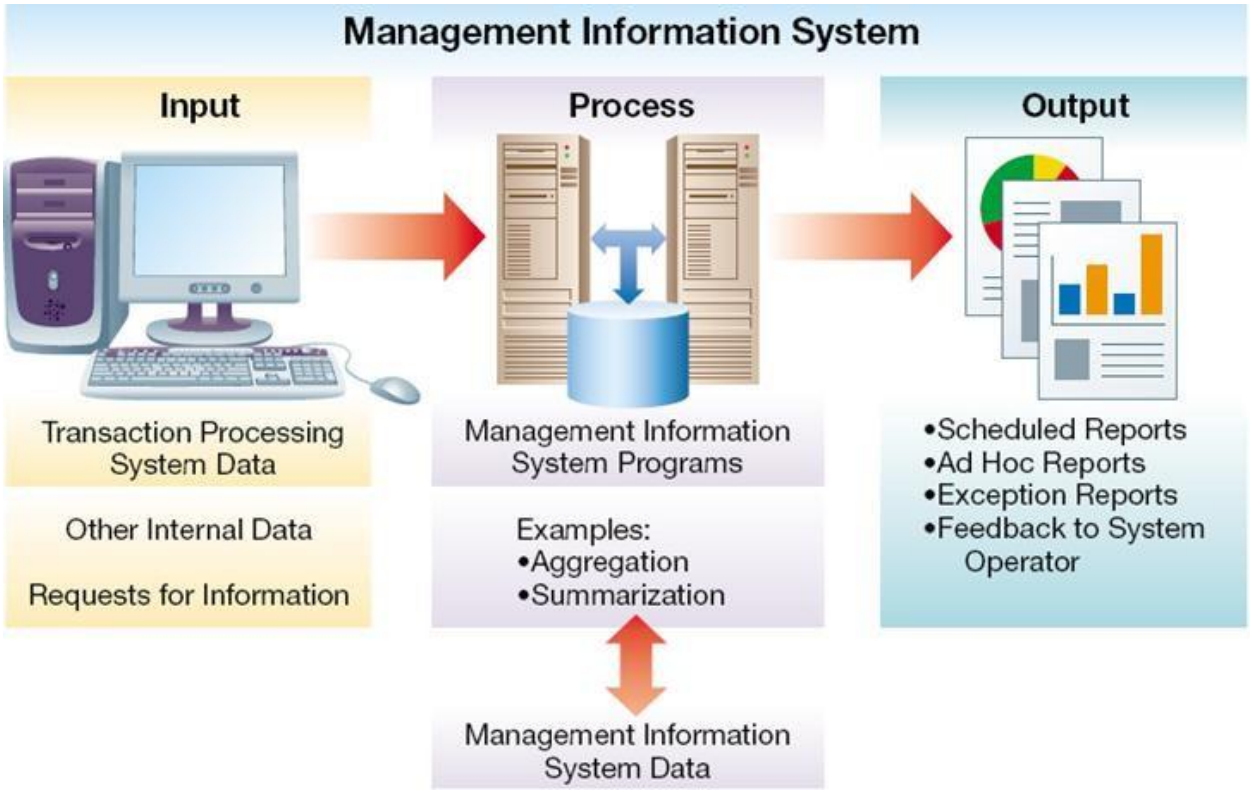


Figure: Management Information Systems

MIS deals with supporting well-structured decision situations. MIS aims at improving operational efficiency. It utilizes transaction data obtained as the result of transaction processing, however MIS may also use other information that is developed internally and from outside the organization. This information is often represented as the tactical information. In a MIS the typical information requirement can be anticipated.

MIS helps in studying the decisions taken, the factors leading to a specific decision, and in developing reports that are useful in formulating future decisions (Demand reports, Exceptional Schedule reports).

Example: Annual Budgeting, Payroll System, Sales Order System and Personnel management system

Decision Support Systems (DSS)

DSS are special-purpose information systems designed to support managerial-level employees in organizational decision making.

DSS is an organized collection of people, procedures, databases, and devices used to support problem-specific decision making. These systems assist higher management to make long term decisions. These type of systems handle unstructured or semi structured decisions. A decision is considered unstructured if there are no clear procedures for making the decision and if not all the factors to be considered in the decision can be readily identified in advance.

DSS are aimed at assisting managers who are faced with unique (non-recurring) and unstructured decision problems. DSS supports managers who are responsible for strategic planning and who take decisions based on long range considerations. DSS aids in decision-making in those situations where either information is not readily available or the information needs are difficult to predict.

DSS is tool that aids in the process of decision-making but it cannot take decisions. A manager in addition to the information gained by DSS relies on his experience and intuition.

Example: A DSS that facilitates use of simulation and what if mechanism for forecasting customer preferences about a product in the forthcoming decade.

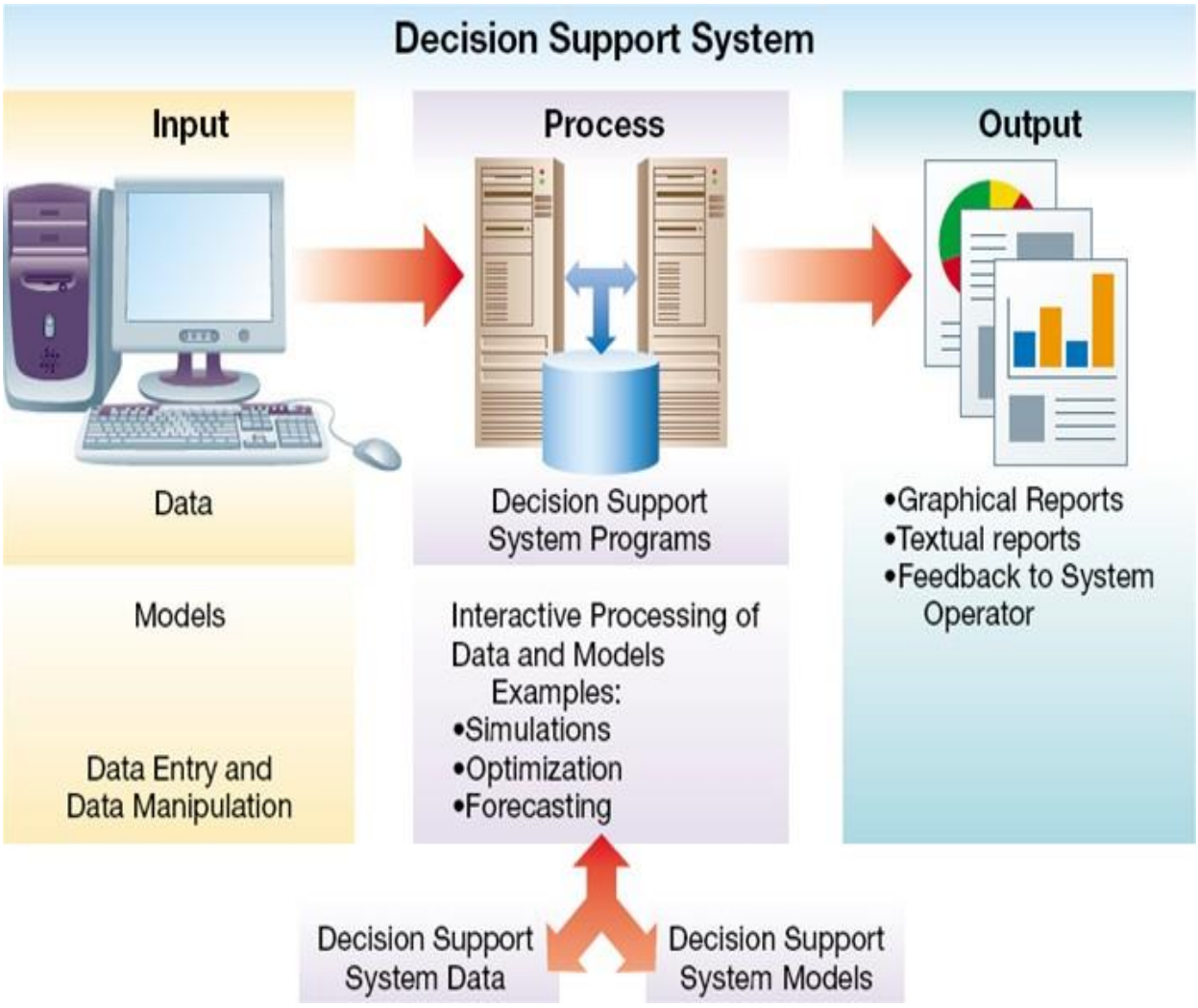


Figure: Decision Support Systems

Some common DSS are:

Area	Common DSS Models
Accounting	Cost analysis, discriminant analysis, break-even analysis, auditing, tax computation and analysis, depreciation methods, budgeting
Corporate Level	Corporate planning, venture analysis, mergers and acquisitions
Finance	Discounted cash flow analysis, return on investment, buy or lease, capital budgeting, bond refinancing, stock portfolio management, compound interest, after-tax yield, foreign exchange values
Marketing	Product demand forecast, advertising strategy analysis, pricing strategies, market share analysis, sales growth evaluation, sales performance
Personnel	Labor negotiations, labor market analysis, personnel skills assessment, employee business expense, fringe benefit computations, payroll and deductions
Production	Product design, production scheduling, transportation analysis, product-mix inventory level, quality control, learning curve, plant location, material allocation, maintenance analysis, machine replacement, job assignment, material requirement planning
Management Science	Linear programming, decision trees, simulation, project evaluation and planning, queuing, dynamic programming, network analysis
Statistics	Regression and correlation analysis, exponential smoothing, sampling, time-series analysis, hypothesis testing

Expert Systems (ES)

ES are special-purpose systems used by operational level employees to make decisions usually made by more experienced employees or an expert in the field.

Expert system is a programmed decision–making information system that captures and reproduces the knowledge and expertise of an expert problem solver, managers, technicians etc. It replicates decision making process. It is actually a knowledge based system that describes the way an expert would approach the problem. It imitates the logic and reasoning of the experts within their respective fields. It is a branch of artificial intelligence (AI) and is also called knowledge-based systems.

ES is an information system that can function as a consultant to a problem solver, not only to by suggesting to a solution but also by explaining the line of reassuring that leads to the solution as what a human expert can do.

These systems use inference engines that match facts and rules, sequence questions for the user, draw a conclusion, and present the user a recommendation

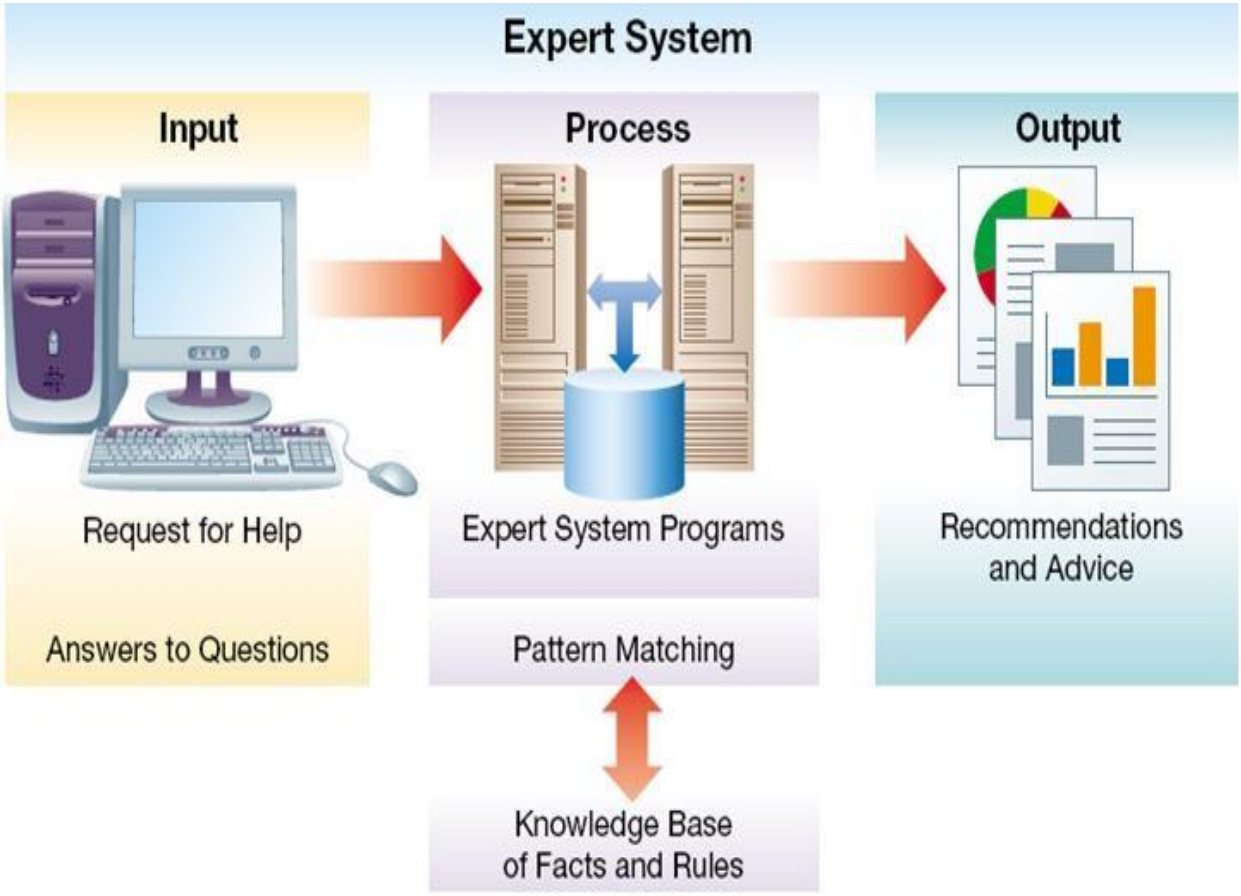


Figure: Expert Systems

These systems support many activities including:

- Medical Diagnosis
- Machine Configuration
- Financial Planning
- Software Application Assistance (help wizards)

Executive Support Systems (ESS)

Executive Support Systems also called as Executive Information Systems (EIS) are special purpose information systems to support executive decision-making. It is used primarily by top management.

It is a user friendly, interactive system, and almost intuitive to use; it has excellent menus and graphic capabilities designed to meet the information needs of top management engaged in long range planning, crisis management, and other strategic decisions. Such systems assist in the making of decisions that require an in depth understanding of the firm and of the industry in which the firm operates.

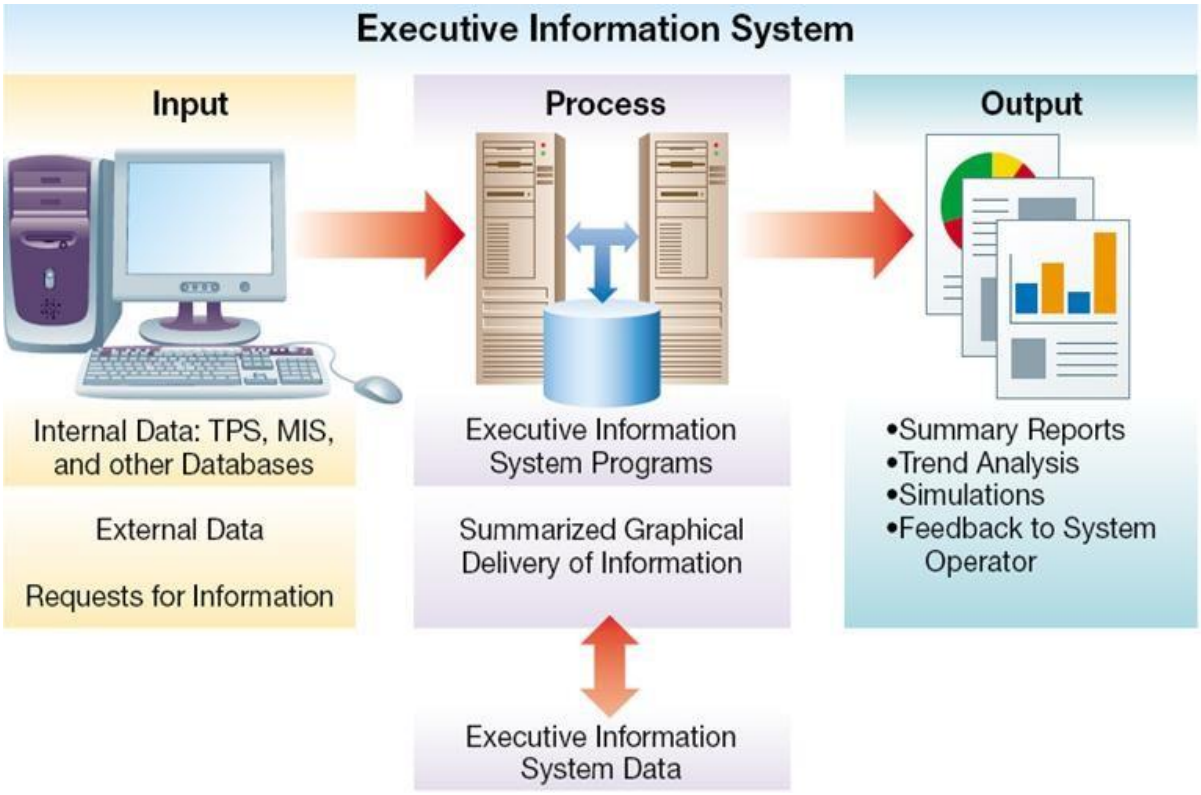


Figure: Executive Support Systems

Another special characteristic of an ESS is its drill down capability, which is the ability of the system to provide information at any level of detail desired by the decision maker. For example, the CEO of a company may want the monthly sales of Product X for the entire company. Next, the CEO may want a breakdown of sales figures on a regional basis or on a store wide basis. The drill down facility can provide both.

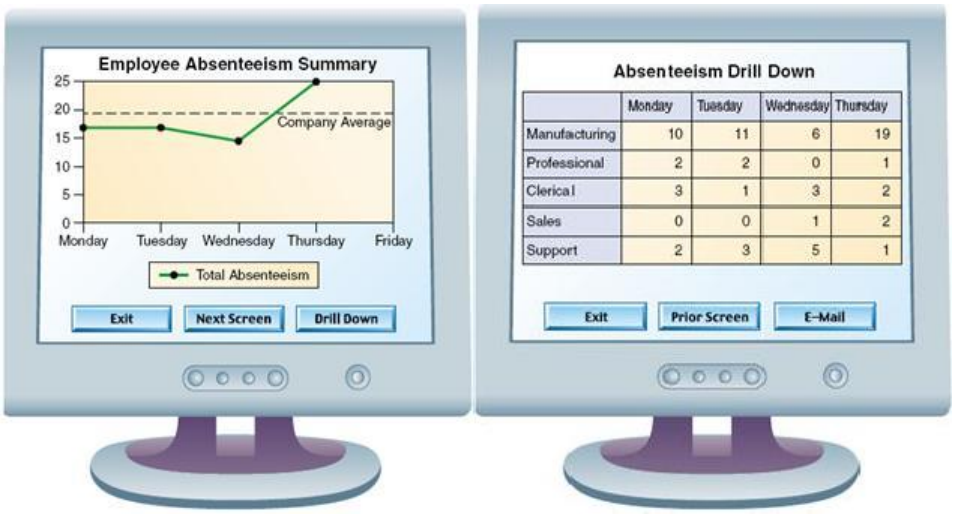


Figure: (A) Graphical Summary, (B) Data Drill Down

The activities supported by these kinds of systems include:

- Executive Decision Making
- Long-range Strategic Planning
- Monitoring of Internal and External Events
- Crisis Management
- Staffing and Labor Relations

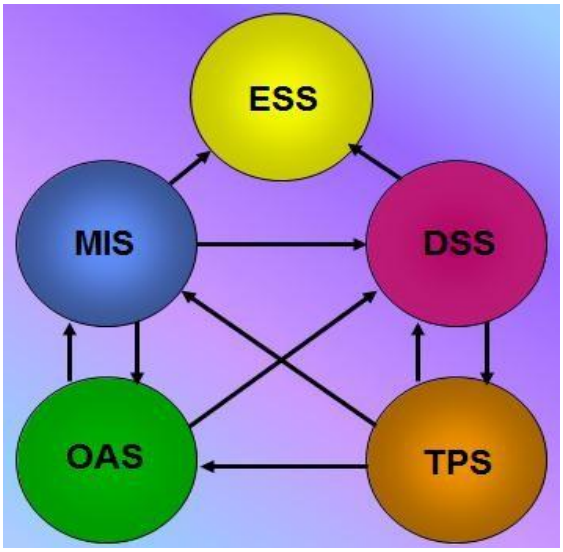


Figure: Interrelationships among systems

Managers Decision Making and Information Systems

Managers at different levels in an organization make different kinds of decisions. An increasing no. of managers relies on computers and information systems to make decisions. However, the kind of information necessary to support their decisions is also different. Accordingly, different types of information systems that are designed to meet the various information needs of managers are Transaction Processing Systems, Management Information Systems, Intelligent Support Systems, Office Automation Systems, etc.

System Analysis and Design (SAD)

Computers are fast becoming our way of life and one cannot imagine life without computers in today's world. You go to an airport for airplane reservation, you want to web site a ticket for a cinema, you go to a library, or you go to a bank, you will find computers at all places. Since computers are used in every possible field today, it becomes an important issue to understand and build these computerized systems in an effective way.

Building such systems is not an easy process but requires certain skills and capabilities to understand and follow a systematic procedure towards making of any information system

The *Systems Analysis and Design* (SAD) is the process of developing Information Systems (IS) that effectively use hardware, software, data, processes, and people to support the company's business objectives.

System Development Life cycle (SDLC)

New information systems are created when existing systems do not adequately meet the needs of users of the information system, or when there is a need that could be met by an information system. The success of a new system depends upon how well the problem is understood, how the system is designed, how it is tested, evaluated and maintained over time.

The Systems Development Life Cycle (SDLC), or Software Development Life Cycle in systems engineering, information systems and software engineering, is the process of creating or altering systems, and the models and methodologies that people use to develop these systems. The concept generally refers to computer or information systems.

SDLC is the series of steps used to manage the phases of development for an information system. It is a common methodology for system development in all approaches. It is sometimes referred to as traditional SDLC.

It consists of six phases:

- Project Identification and Selection
- Project Initiation and Planning
- Analysis
- Design
- Implementation
- Maintenance

The first two phases are business analysis which results in conceptual solution. Every organization has its own life cycle model with more than these mentioned phases. The phases listed don't mean to come one to another serially.

(1) Project Identification and Selection

It is the first phase of the SDLC in which an organization's total information system needs are identified, analyzed, prioritized, and arranged. This phase helps to translate the needs into a development schedule. It also helps organization to determine whether or not resources should be dedicated to a project.

(2) Project Initiation and Planning

It is the second phase of the SDLC in which a potential information systems project is explained and an argument for continuing or not continuing with the project is presented. In this phase a detailed plan is also developed for conducting the remaining phases of the SDLC for the proposed system. It is actually a formal preliminary investigation of the problem at hand.

(3) Analysis
It is the third phase of the SDLC in which the current system is studied and alternative replacement systems are proposed.

In this phase following things are analyzed:
- Determine requirements
  - Study current system
  - Structure requirements and eliminate redundancies
- Generate alternative designs
- Compare alternatives
- Recommend best alternative

(4) Design
It is the fourth phase of the SDLC in which the description of the recommended solution is converted into logical and then physical system specifications.

Logical Design
In logical design, the requirement specifications are converted into independent computer platform design models. It includes external design, internal design and conceptual design.

Physical Design
In physical design, logical designs are converted into technical based design specifications.

(5) Implementation
It is the fifth phase of the SDLC in which the information system is coded, tested, installed, and supported in the organization.

(6) Maintenance
It is the final phase of the SDLC in which an information system is systematically repaired and improved.

Alternatives to Systems Analysis and Design

Joint Application Design (JAD):
Joint Application Design (JAD) is a structured process in which users, managers and analysts work together for several days in a series of intensive meetings to specify or review system requirements. It is a management process - a people process - which allows IS to work more effectively with users in a shorter time frame. Because of bringing the people directly affected by the system in one place and time, time and organizational resources are better managed. Also, group members develop a shared understanding of what the system is supposed to do.

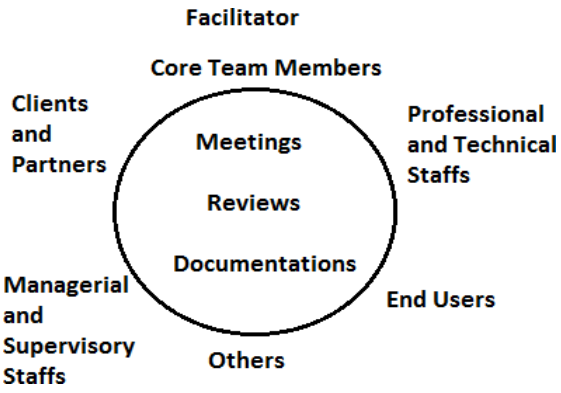


Figure: Joint Application Design (JAD) Model

Joint Application Design (JAD) was developed by Chuck Morris of IBM Raleigh and Tony Crawford of IBM Toronto in the late 1970's.

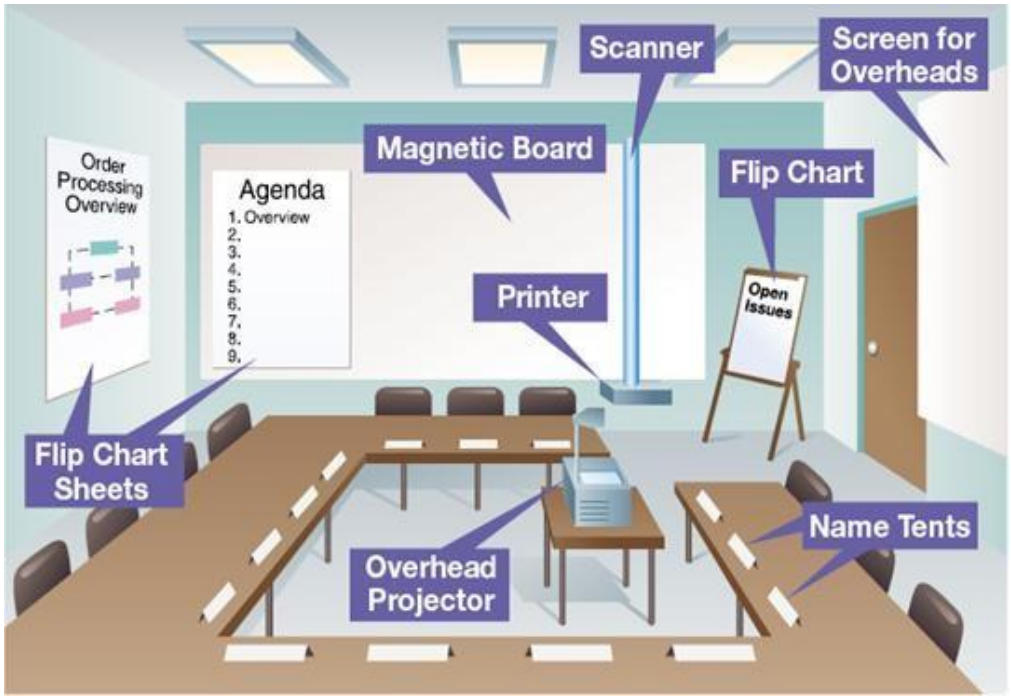


Figure: A JAD Room

The JAD process also includes approaches for enhancing user participation, expediting development, and improving the quality of specifications. It consists of a workshop where "knowledge workers and IT specialists meet, sometimes for several days, to define and review the business requirements for the system." The attendees include high level management officials who will ensure the product provides the needed reports and information at the end. This acts as "a management process which allows Corporate Information Services (IS) departments to work more effectively with users in a shorter time frame."

Rapid Application Design (RAD):

Rapid application development (RAD) is a software development methodology that uses minimal planning in favor of rapid prototyping. The "planning" of software developed using RAD is interleaved with writing the software itself. The lack of extensive pre-planning generally allows software to be written much faster, and makes it easier to change requirements. The fundamental principle of any RAD methodology is to delay producing detailed system design documents until after user requirements are clear.

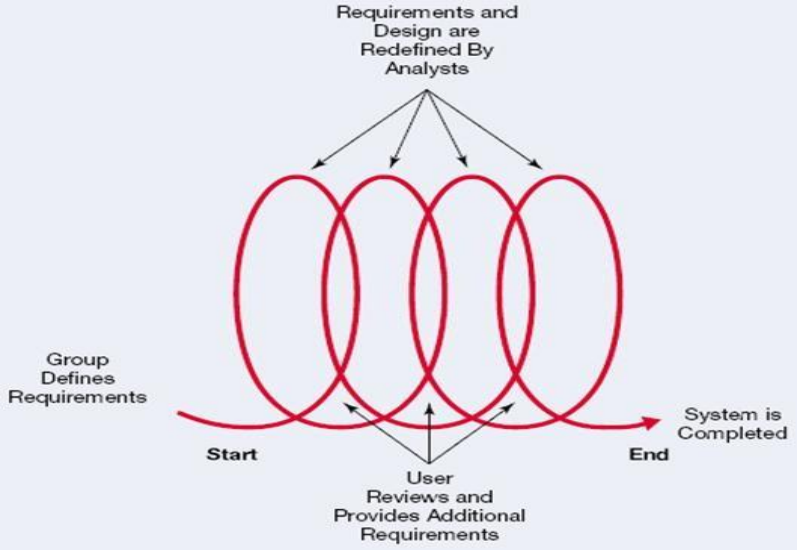


Figure: Iterative refinement in RAD

According to Whitten (2004), it is a merger of various structured techniques, especially data-driven Information Engineering, with prototyping techniques to accelerate software systems development. It is a merger of various other technologies from structure design i.e. it involves JAD, Prototyping, CASE tools and code generators.

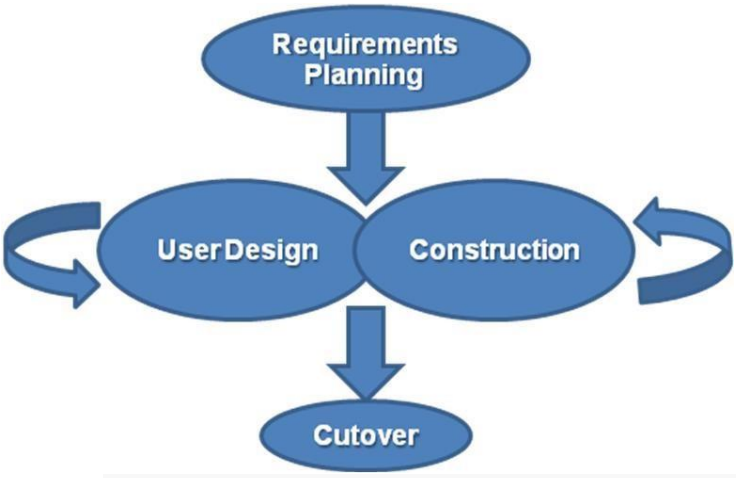


Figure: Rapid Application Development (RAD) Model

The development process starts with the development of preliminary data models and business process models using structured techniques. In the next stage, requirements are verified using prototyping, eventually to refine the data and process models. These stages are repeated iteratively; further development results in "a combined business requirements and technical design statement to be used for constructing new systems".

Prototyping:

Prototyping is an iterative process of systems development in which requirements are converted to a working system that is continually revised through close work between an analyst and users. Designing and building a scaled-down but functional version of a desired system is the process known as prototyping.

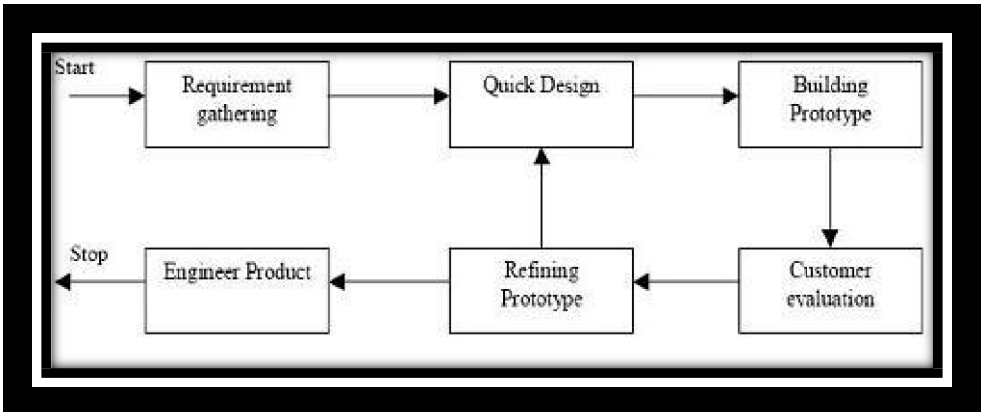


Figure: Prototyping Model

Prototyping is part of the analysis phase of the systems development life cycle. It is the process of building a model of a system. Prototyping comes in many forms - from low tech sketches to high tech operational systems using CASE (computer-aided software engineering) or fourth generation languages. During the analysis stage, prototyping can be used to replace or supplement logical modeling, particularly when the users are uncomfortable with abstract models.

Prototyping is a powerful, bottom up alternative or supplement to logical modeling. The basic idea is to build a reasonably complete, working, physical model (or prototype) of the system. Prototyping is an excellent tool when the requirements are highly uncertain or too abstract to specify, or when no comparable system has been previously developed. Generally, if reaching a solution calls for simulation, experimentation, or incremental evaluation, prototyping might be a reasonable choice.

Prototyping is an attractive idea for complicated and large systems for which there is no manual process or existing system to help determining the requirements. In such situations letting the client "plan" with the prototype provides invaluable and intangible inputs which helps in determining the requirements for the system. It is also an effective method to demonstrate the feasibility of a certain approach.

Object-Oriented Analysis and Design:
In object-oriented design, the processes, data and flows are combined into single entity called object. It helps in easy conversion from analysis to design models and supports multimedia. It is often called the third approach to systems development, after the process-oriented and data-oriented approaches.

Object-oriented analysis and design (OOAD) is a software engineering approach that models a system as a group of interacting objects. Each object represents some entity of interest in the system being modeled, and is characterized by its class, its state (data elements), and its behavior. Various models can be created to show the static structure, dynamic behavior, and run-time deployment of these collaborating objects. There are a number of different notations for representing these models, such as the Unified Modeling Language (UML).

Object-oriented analysis (OOA) applies object-modeling techniques to analyze the functional requirements for a system. Object-oriented design (OOD) elaborates the analysis models to produce implementation specifications. OOA focuses on what the system does, OOD on how the system does it.

Waterfall Model:
Waterfall Model is the most basic Life-Cycle model. It was developed by Winston Royce in the early 1970. The waterfall model is a sequential software development model in which development is seen as flowing steadily downwards (like a waterfall) through several phases. Each phase has a set of well-defined goals and activities. The important contribution of the waterfall model is for management. It enables management to track development progress.

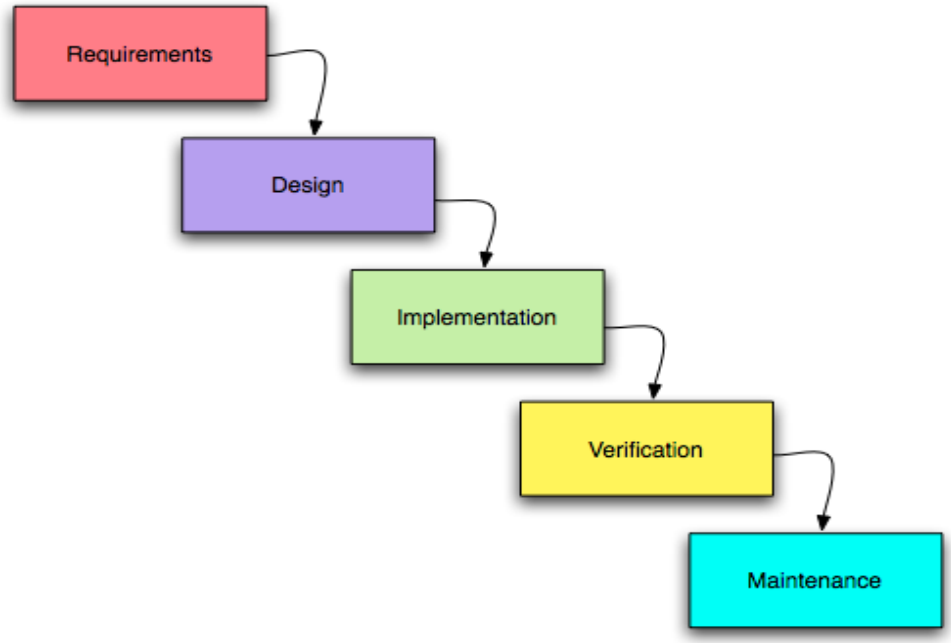


Figure: Waterfall Model

In Royce's original waterfall model, the following phases are followed in order:

- Requirements specification
- Design
- Construction (i.e. implementation or coding)
- Integration
- Testing and debugging (i.e. Validation)
- Installation
- Maintenance

Thus the waterfall model maintains that one should move to a phase only when it's preceding phase is completed and perfected. However, there are various modified waterfall models (including Royce's final model) that may include slight or major variations upon this process.

Spiral Model:

The spiral model is a software development process combining elements of both design and prototyping-in-stages, in an effort to combine advantages of top-down and bottom-up concepts. Also known as the spiral lifecycle model (or spiral development), it is a systems development method used in information technology. This model of development combines the features of the prototyping model and the waterfall model. The spiral model is intended for large, expensive and complicated projects.

The spiral model was defined by Barry Boehm in his 1986 article "A Spiral Model of Software Development and Enhancement". This model was not the first model to discuss iterative development.

The spiral model is based on continuous refinement of key products for requirements definition and analysis, system and software design, and implementation (the code). At each iteration, around the cycle, the products are extensions of an earlier product. This model uses many of the same phases as the waterfall model, in essentially the same order, separated by planning, risk assessment, and the building of prototypes and simulations.

Documents are produced when they are required, and the content reflects the information necessary at that point in the process. All documents will not be created at the beginning of the process, nor all at the end (hopefully). Like the product they define, the documents are works in progress. The idea is to have a continuous stream of products produced and available for user review.

The spiral lifecycle model allows for elements of the product to be added in when they become available or known. This assures that there is no conflict with previous requirements and design. This method is consistent with approaches that have multiple software builds and releases and allows for making an orderly transition to a maintenance activity. Another positive aspect is that the spiral model forces early user involvement in the system development effort.

For projects with heavy user interfacing, such as user application programs or instrument interface applications, such involvement is helpful.

Starting at the center, each turn around the spiral goes through several task regions:

- Determine the objectives, alternatives, and constraints on the new iteration.
- Evaluate alternatives and identify and resolve risk issues.
- Develop and verify the product for this iteration.
- Plan the next iteration.

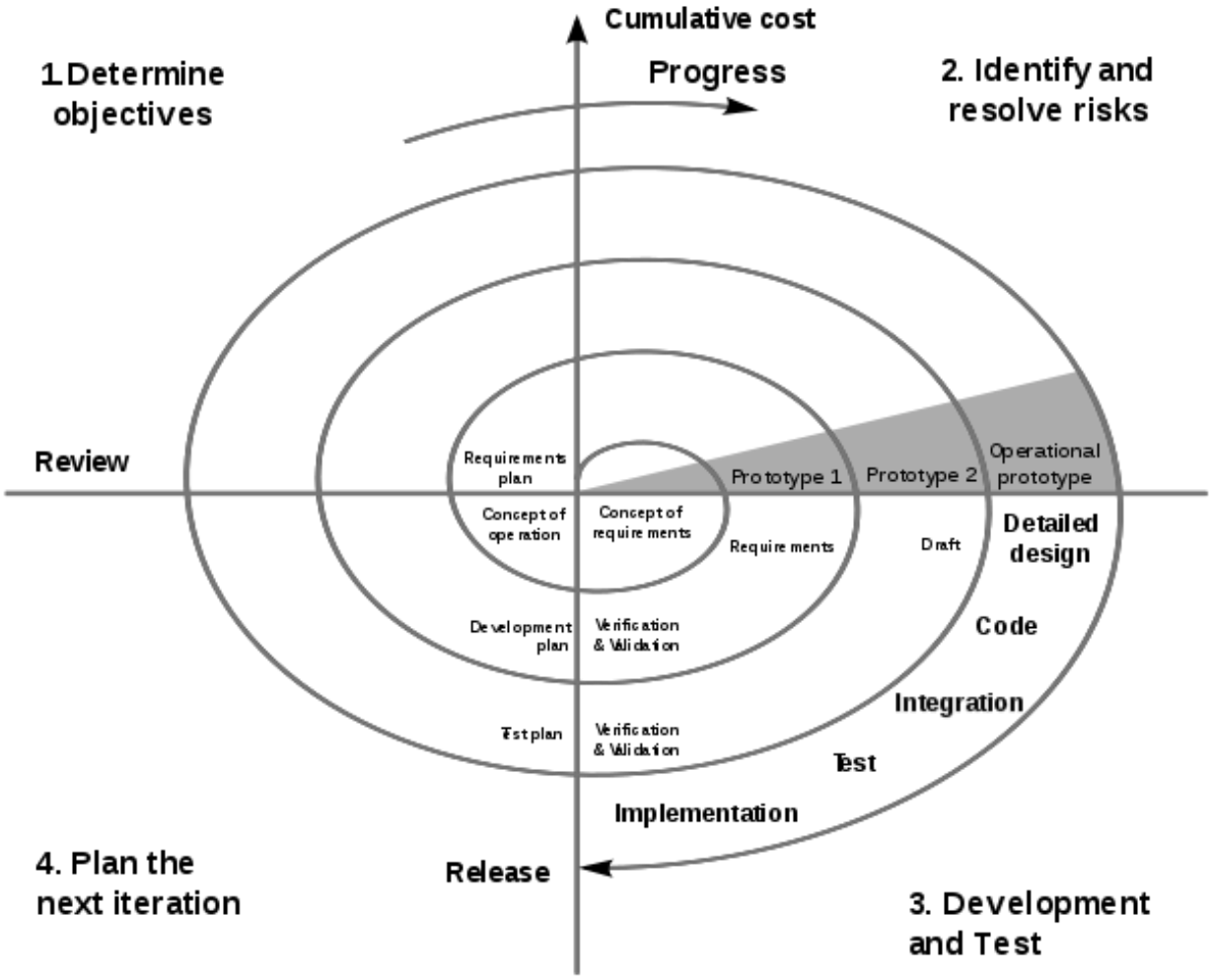


Figure: Spiral Model

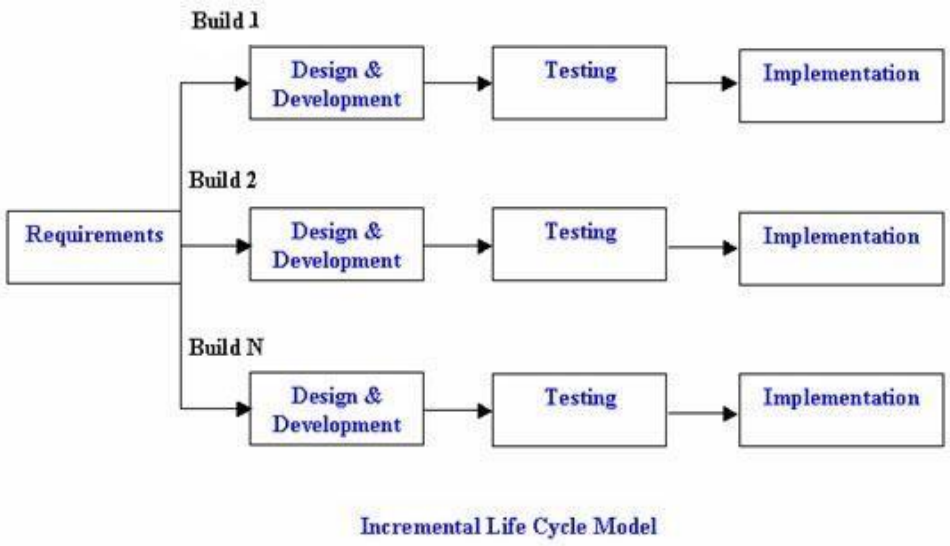
Incremental SDLC Model:

The incremental model is an intuitive approach to the waterfall model. Multiple development cycles take place here, making the life cycle a "multi-waterfall" cycle. Cycles are divided up into smaller, more easily managed iterations. Each iteration passes through the requirements, design, implementation and testing phases.

A working version of software is produced during the first iteration, so you have working software early on during the software life cycle. Subsequent iterations build on the initial software produced during the first iteration.

Advantages

- Generates working software quickly and early during the software life cycle.
- More flexible – less costly to change scope and requirements.
- Easier to test and debug during a smaller iteration.
- Easier to manage risk because risky pieces are identified and handled during its iteration.
- Each iteration is an easily managed milestone



Incremental Life Cycle Model

Disadvantages

- Each phase of an iteration is rigid and do not overlap each other.
- Problems may arise pertaining to system architecture because not all requirements are gathered up front for the entire software life cycle.

Assignments:

(1) Define a system. Explain the components of a system.
(2) Define information system and information technology.
(3) Why do you think that system analysis is the most essential phase of SDLC?
(4) Define software. Explain various attributes of software system.
(5) What is an SRS? Write the characteristics of SRS document.
(6) Define Functional and Non-functional requirements. Give examples.
(7) What qualities does the system analyst need to have?
(8) What do you understand by system development life cycle?
(9) Discuss the importance of system analysis and design in the development of a system?
(10) What is SDLC and also explain its various phases in details.
(11) List the phases of traditional waterfall model and explain each of them briefly.
(12) What is Agile Development Methodology? How is it different from that of Traditional Waterfall Model? Explain in detail.
(13) What is eXtreme Programming? Explain the concept of pair programming and refactoring.
(14) What is RAD? Under what circumstances, RAD model is appropriate to use?
(15) What is Spiral Model? Under what circumstances, Spiral Model is appropriate to use?
(16) What is CASE? How does it help improve quality, reduce cost and development time? Illustrate.
(17) Define prototype. List any three purposes of it.
(18) What is prototype model? Under what circumstances it beneficial to construct a prototype model? Does the construction of a prototype model always increase the overall cost of software development?
(19) Write the pros and cons of Prototyping model/RAD model/ Agile development model.
(20) List all categories of information systems. Explain each briefly.
(21) Explain the interrelationship among systems ***[TPS, MIS, DSS, and EIS].***
17) What type of information is required by the top level of management, and why?
18) What is OOAD? Compare traditional structured methodologies and object-oriented approaches for modeling and designing systems.

Presentation Topics on: *Agile Development Methodologies, eXtreme Programming, SOA, Enterprise Applications and CASE*

Gentle Advice:

Please go through your text books and reference books for detail study!!! Thank you all.