Chapter-4
Telecommunication

Telecommunication

'Communication of information by electronic means, usually over some distance'

Information Superhighway

High-speed digital telecommunications networks that is national or worldwide in scope and accessible by the general public rather than restricted to use by members of a specific organization or set of organizations such as corporation.

It has a profound impact on economic and social life in the 21st century

The information superhighway system would connect individuals, households, business, news and entertainment providers, government agencies, universities and other institutions and would support interactive voice, data, video and multimedia communications.

Telecommunication System

"... is a collection of compatible hardware and software arranged to communicate information from one location to another"

Telecommunications systems can transmit text, graphic images, voice or video information

Telecommunications System Components

- **Computers** to process information
- **Terminals** or any input/output devices that send or receive data
- **Communications channels** the links by which data or voice are transmitted between sending and receiving devices in a network. Communications Channels use various communications media
- **Communications processors**, such as modems, multiplexers, controllers and front-end processors, used for data transmission and reception
- **Communications software** that controls input and output activities and manages other functions of the communications network

Telecommunication System

Functions of Telecommunications Systems

In order to send and receive information from one place to another, a telecommunications system must perform a number of separate largely invisible functions.

SL	Functions	Definition
01	Transmission	Media, Networks and path
02	Interface	Path: between sender and receiver
03	Routing	Choosing the most efficient path
04	Processing	Providing the right message to the right receiver
05	Editorial	Checking for errors, format and editing
06	Conversion	Changing speeds and codes from one device to another
07	Control	Routing messages, polling receivers, providing network structure maintenance

Telecommunication

Protocols

Different components in a network can communicate by adhering to a common set of rules that enable them to "talk" to each other. This set of rules and procedures governing transmission between two points in a network is called a 'protocol'.

Principal functions of protocols

1. To identify each device in the communication path
2. To secure the attention of the other devices
3. To verify correct receipt of the transmitted message
4. To verify that a message requires retransmission because it cannot be correctly interpreted
5. And to perform recovery when errors occur

Types of Signals

Signals are represented in two ways…..

1. Analog signals &
2. Digital signals.

Analog signal

A continuous waveform that passes through a communications medium. Analog signals are used to handle voice communications.

Digital signal

A discrete rather than a continuous waveform. It transmits data coded into two discrete states: 1-bits and 0-bits, which are represented as ***on-off*** electrical pulses used for data communications.

All digital signals must be translated into analog signals before they can be transmitted in an analog system. The device that performs this translation is called ***modem***.

Types of Communications Channels

Guided Transmission Media (wire)

- Twisted-wire lines
- Coaxial cable
- Fiber optic cable

Unguided Transmission Media (wireless)

- Microwave systems
- Satellite transmission
- Cellular telephone

Twisted-Wire Lines

… Consisting of pairs of twisted copper wires. The oldest and relatively slow medium for data transmission. Telephone network is the major uses of twisted-wire. It is of two types e.g. **UTP** and **STP**

Guided Transmission Media

Coaxial Cable

… Consisting of thickly insulated copper wire, which can transmit a large volume of data than twisted wire can. It is a faster and more interference-free transmission medium. Example: cable television network.

Fiber Optic Cable

Fast, light and durable transmission medium consists of thousands of strands of ultra-thin glass fibers which are bound into cables. A fiber optic channel transmits voice or data communications by means of laser light beams flashing through tiny glass fibers no thicker than a human hair.

Considerably faster, lighter and more durable than wire media. It has higher bandwidth than copper and used for long distance transmission, much more reliable, lower attenuation and much more difficult to tap.

But more difficult to work with, more expensive and harder to install.

Unguided Transmission Media

Microwave Communications Links

A sending station communicates data (or voice conversations) to a receiving station in another location by broad-casting signals. Microwave sending and receiving station are located on the ground.

Satellite Transmission

Satellite communications provide relative data transmission over a network to a large number of geographically distributed sites. Not only textual data but image, voice and videos are transmitted over satellite. It can be achieved in two ways (1) Directly between end-users (2) or via a central or master station which relays the contents of communication to the destination.

Reliability: Availability rates above 99.5% and bit error rates are $\mathbf{10^{-7}}$ i.e. only one bit is error in every 1 crore bits transmitted.

Satellite data transmission has an advantage over microwave communications is that data can be transmitted over great distance without worry about obstruction. It is, however, a very expensive means of data communications and therefore, is used primarily by large international companies that need to communicate volumes of information between distant locations at high speeds.

Cellular Telephones

Cellular telephone (mobile) work by using radio waves to communicate with radio antennas (towers) placed within adjacent geographic areas called ***cells***.

VSAT

Very Small Aperture Terminal (VSAT)

End-user equipment used to receive and send data, images, voice and videos over the satellite network.

With a typical antenna size of 1.2 to 2.4 meters, a VSAT gives full access to a network which may comprise hundred or even thousands of nodes. VSAT networks are generally set up in one of the following three configurations;

Point to point network

It provides two-way communication between two VSATs located at remote sites.

Star Network

Star networks provide multipoint communication between a Master Earth Station (MES) or 'Hub' and VSATs located at multiple remote sites.

Mesh Networks

Provide direct communication between multiple VSATs located at different sites on the network. Aktel.

VSAT Network Access Scheme

FDMA (Frequency Division Multiple Access)

User shares the transponder by prior allocation of individual channels. Single Channel Per Carrier (SCPC) is a FDMA scheme in which the input data stream is used to modulate an RF (radio frequency) carrier and assigned dedicated carrier frequency to each client. *Broadband , Wacky-Talky*

TDMA (Time Division Multiple Access)

Each user is assigned the full bandwidth of the channel for a short period. Another user for the next period and so on. TDMA are used by Mesh Network. EPZ.

CDMA (Code Division Multiple Access)

Transmitted signals are 'spread' over a bandwidth. It gives access the data signal by combining with a code signal.

The codes allow individual codes to be distinguished from each other and thereby allow sharing of common frequency band. Motorola, City Cell etc.

FTDMA (Frequency-Time Division Multiple Access)

It is the combination of FDMA & TDMA. It allows maximum utilization of available bandwidth.

Comparison of telecommunications transmission media

Typical speeds and cost of telecommunications transmission media

SL	Medium	Speed	Cost
01	Twisted wire	300 BPS – 10 MBPS	Low
02	Microwave	256 KBPS – 100 MBPS	
03	Satellite	256 KBPS – 100 MBPS	
04	Coaxial Cable	56 KBPS – 200 MBPS	
05	Fiber Optic Cable	500 KBPS – 43 TBPS	High

BPS	Bits per second	KBPS	Kilobits per second
MBPS	Megabits per second	GBPS	Terabits per second

Characteristics of Communications Channels

The characteristics of the communications channel help determine the efficiency and capabilities of a telecommunications system. These characteristics include **the speed** of transmission, **the direction** in which signals may travel and **the mode** of transmission.

Transmission speed

Baud rate

A baud rate is a binary event representing a signal change from positive to negative or vise-versa that is used as a measure of transmission speed.

Bandwidth

The bandwidth is the difference between the highest and lowest frequencies that can be accommodated on a single channel.

The greater the range of frequencies the greater the bandwidth. Greater bandwidth determines the channel's telecommunications transmission capacity.

Characteristics of Communications Channels

Transmission Modes

There are several conventions for transmitting signals; these methods are necessary for devices to communicate when a character begins or ends.

Asynchronous Transmission: Low speed transmission of one character at a time over a line.

Synchronous Transmission: High speed simultaneous transmission of large volume of data.

Transmission Direction

Simplex transmission: In which data can travel only in one direction at all times. Radio and Television transmission. **(a → b)**

Half-Duplex Transmission: In which data can flow two ways but can travel in only one direction at a time. Wacky-Talky. **(a ⇆ b)**

Full-Duplex Transmission: In which data can travel in both directions simultaneously. Telephone, mobile etc. **(a ↔ b)**

Communications Processors

Communications processors support data transmission and reception in telecommunications network

Front-end Processor

Small computer (often a programmable minicomputer) dedicated to communications management and is attached to the main or host computer in a computer system. Performs special processing related to communications such as error control, formatting, editing, controlling, routing and speed and signal conversion. It takes some of the load of the host computer

Concentrator

A programmable telecommunications computer that collects and temporarily stores messages from terminals until enough messages are ready to be sent economically. The concentrator then "bursts" signals to the host computer

Controller

Often a specialized minicomputer, supervises communications traffic between the CPU and peripheral devices such as terminals and printers. The controller manages messages from these devices and communicates them to the CPU. It also routes output from the CPU to the appropriate peripheral device

Communications Processors

Multiplexer

A device that enables a single communications channel to carry data transmissions from multiple sources simultaneously. The multiplexer divides the communications channel so that it can be shared by multiple transmission devices

Modem

Modem is an abbreviation for Modulation/Demodulation. At the sending station, a modem ***modulates*** computer signals (convert digital signals into analog signals) and at the receiving station a modem ***demodulates*** analog signals (converts them back to computer signals) and vice versa

Telecommunication Software

Special TS is required to control and support the activities of a telecommunications network. This software resides in the host computer, front-end processor and other processors in the network. The principal functions of telecommunications software are network control, access control, transmission control, error detection/correction and security

Network Topologies

The shape or configuration of a network is called **Topology**. The three most common topologies are **STAR**, **BUS** and **RING**

Star Topology

Star network consists of a central host computer connected to a number of smaller computers or terminals. All communications between network devices must pass through the host computer

Merits: - Radiate out from a common point – Hub
- Can access the media independently
- Share the Hub's available bandwidth

Demerit: Communication in the network will come to a standstill if the host computer stops functioning

Bus Topology

Links a number of computers by a single circuit with all messages or signals broadcast to the entire network

Merits

- All nodes are interconnected, peer to peer, using a single open-ended cable
- If one of the nodes fails none of the other components in the network is affected

Network Topologies

Bus Topology

Demerit: Can support only a single channel

Targeted at home & small office environment

This topology is commonly used in Local Area Networks (LANs)

Ring Topology

Messages are transmitted from computer to computer, flowing in a single direction through a closed loop. The Ring network doesn't rely on a central host computer (like Star Network). Each computer operates independently so that if one fails communication through the network is not interrupted

A Ring Network is generally used to handle the exchange of information among computer users and facilities within a single organization or group of organizations

Communications Networks

There are five types of communication networks:

1. Private Branch Exchange (PBX)
2. Local Area Network (LAN)
3. Wide-Area Network (WAN)
4. Value-Added Network (VAN)
5. Metropolitan-Area Network (MAN)

Communications Networks

Private Branch Exchange

A PBX is a special purpose computer designed for handling and switching office telephone calls at a company site. Today's PBXs can carry both voice and data to create local networks. PBXs can also be used to switch digital information among computers and office devices

The advantages of digital PBXs

- That they utilize existing telephone lines and do not require special wiring
- A phone jack can be found almost anywhere in the office building

The primary disadvantage of PBXs

- That they are limited to telephone lines
- That they cannot easily handle very large volumes of data

Local Area Network (LANs)

A LAN that requires its own dedicated channels (usually telephone lines) and that encompasses a limited distance, usually one building or several buildings in close proximity

Example, business organization located in a single office building or factory and universities to link computer users located in different departments and divisions (IIUC)

Local Area Network (LAN)

Disadvantages of LANs

- More expensive to install than PBXs
- More inflexible
- Require new wiring each time of moving
- Require specially trained staff to manage and run

Four important criteria for evaluating LANs

- How flexible is the system (can new users be added, and how many?)
- What is the actual performance?
- What is the true cost of network including software implementation, training, network management and opportunity cost of use?
- How reliable will the system be in the various disturbances?

LAN is designed only for data communications are termed as ***Base band*** networks

Broadband - large capacity cable that can be divided into separate channels. It can carry data communications, television, telephone etc. on the same cable. More expensive than a base band & cost justified only where there is a consistently high volume of communications

Basic difference between LAN and PBX

- LAN carries only data where PBX carries both voice and data
- PBX uses the existing wiring of the telephone system where LAN is not the part of a telephone system and as such requires wiring

File Server, Network Operating System & Gateway

File Server

Computer in a network that stores various programmes and data files for uses of network. It determines access and availability in the network

Network Operating System

Special software that manages the file server in a LAN and routes and manage communications or the network

Gateway

The network connects the LAN to public networks, such as the telephone network or to other corporate networks so that the LAN can exchange information with networks external to it

A ***gateway*** is generally a communications processor that can connect dissimilar networks by translating from one set of protocols to another

Wide-Area Network (WAN)

WANs span broad geographical distances, ranging from several miles to across entire continents. It is consist of a variety of cables, satellite and microware technologies

Manufacturing firms, banks, retailers, transportation companies and government agencies use WANs to transmit and receive information among their employees, customers, suppliers and other organizations across cities, regions, countries or even the world

There are many methods to setup a WAN. Typically, they are direct distance dialing (DDD), through telephone department & a long-distance carrier, such as AT & T, wide-area telephone service (WATS) lines, leased lines and satellites

The main ***advantage*** of WANs over LANs is that they can link sites that are remotely located

Some ***challenges:*** First, managing WANs is a difficult task. Second, when things go wrong, it is difficult to identify the source of the problem. Third, it is expensive to maintain for a private WANs, or firms may not have the resources to manage their own WANs. In such instance, companies may choose to use commercial network services to communicate over long distance

VAN and MAN

Value-Added Network (VAN)

Value-Added Networks (VANs) are alternative to firms designing and managing their own networks. VANs are private, multi-path, data-only, third-party-managed networks that are used by multiple organizations on a subscription basis

The term value added refers to the extra 'value' added to communications by the telecommunications and computing services these networks provide to clients. Customers do not have to invest in network equipment and software because the costs of using the network are shared among many users

Metropolitan-Area Network (MAN)

MAN's cover an area of a typical city. They offer a simple and fast way to link different sites of an organization for exchange of information. MAN use technologies similar to LAN technologies

Chapter-7
Enhancing Decision Making

Classical Model of Management

It describes what manager do, was largely un-questioned for the more than 70 years since 1920's. Henry Foyol and other early writers first described this traditional description of management that focus on the five classical functions of managers as –

- **Planning**
- **Organizing**
- **Coordinating**
- **Deciding and**
- **Controlling**

Managerial Roles (Mintzberg)

Managerial Roles are expectation of the activities that manager should perform in an organization. Mintzberg classified managerial activities into 10 roles that fall into three categories.

- Interpersonal Role
- Informational Role and
- Decisional Role

Interpersonal Role:

Figureheads they represent their companies to the outside world.

Leaders to motivate, counsel and support subordinates.

Liaison between various levels of the organization.

Managerial Roles (Mintzberg)

Informational Role:

Managers act as the

Nerve centres receiving the most concrete, up-to-date information and distribute it to respective personnel. Managers are therefore

Disseminators and

Spokes persons for their organization.

Decisional Role:

Entrepreneurs by initiating new kinds of activities; they

Handle disturbances arising in the organization; they

Allocate resources to staff members and

Negotiate conflicts and mediate between conflicting groups in the organization.

Types of Decisions

According to Simon's classification, decisions may be either programmed or non-programmed. Other researchers refer to these types of decisions as unstructured and structured decision.

Unstructured decisions: Non-routine decisions in which the decision maker must provide judgement, evaluation and insight into the problem definition; there is no agreed upon procedure for making such decision.

Semi-structured decision: Decision where only part of the problem has a clear-cut answer provided by an accepted procedure.

Structured decision: decisions that are repetitive, routine and have a definite procedure for handling them.

Process or Stages of decision making (Simon)

Making decisions is not a single activity. This decision making process consists of 4 different stages. *Simon (1960)*

Intelligence identify the problems occurring in the organization. It indicates why, where and with what effects a situation occurs.

Design the individual designs possible solutions to the problem. These activities may require more intelligent so that manager can decide if a particular solution is appropriate.

Choice when the individual selects among the various solution alternatives.

Implementation when the individual puts the decision into effect and reports on the progress of the solutions.

Different level of Decision Making

Anthony (1965) grouped decision making in an organization into three categories: Strategic, Management and Operation Control. We include an additional one – Knowledge Level Decision Making.

Strategic Level: This level determined the long-term objectives, resources, plan and policies of an organization.

Management Control Level: This level monitors how efficiently or effectively resources are utilized and how well operational units are performing.

Knowledge Level: This level evaluates new ideas for products, services, ways to communicate new knowledge, ways to distribute information throughout the organization.

Operational Control Level: Determines how to carry out specific task set forth by strategic and middle management and establishing criteria for completion and resource allocation.

Chapter-8: Redesigning the Organization with Information Systems

⊡ Systems as planned organizational change

An information system is a socio-technical entity. Much more than involving new hardware and software. In the socio-technical philosophy;

We are redesigning the organization towards planned organizational change. So the people who work with it, must be considered

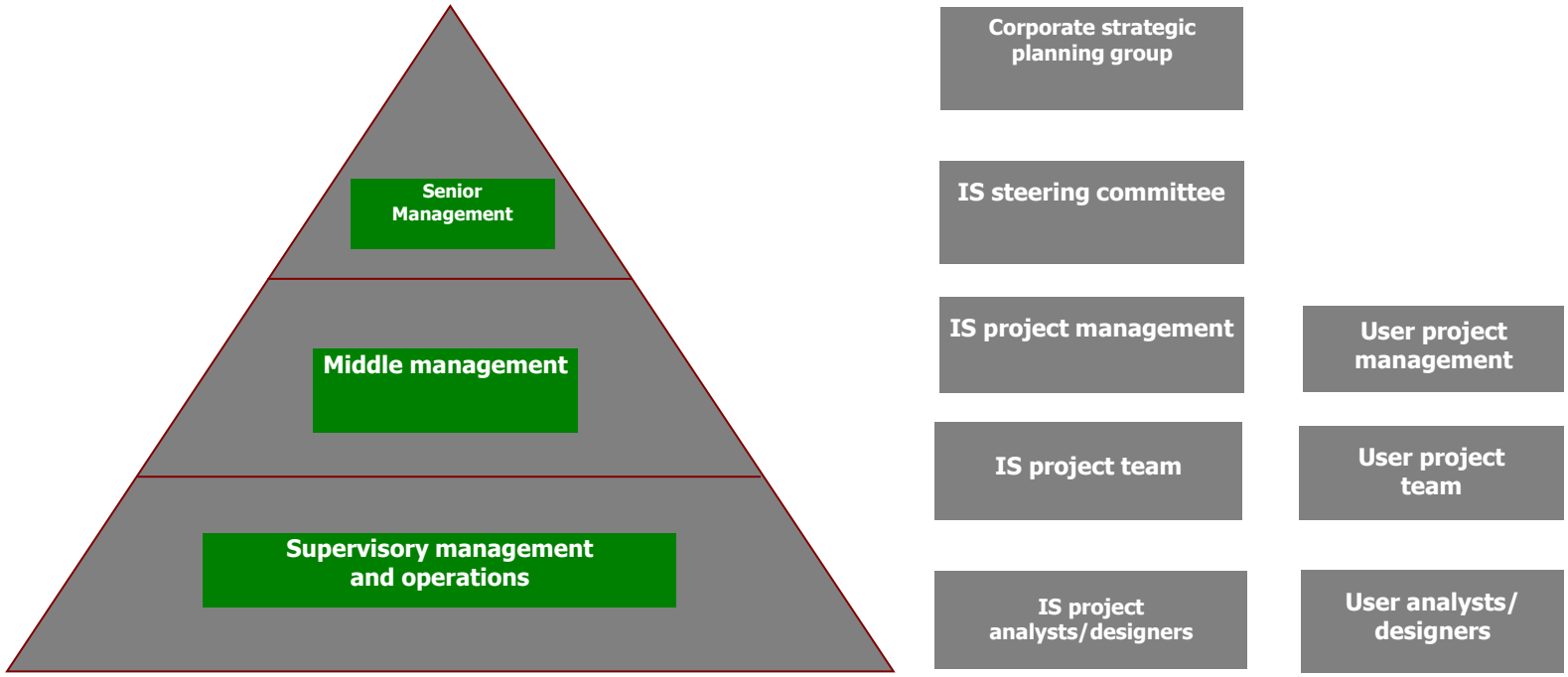
Systems can be technical successes but organizational failures. The responsibility of analysts and designers must ensure participation of the key members of the organization in the design process

(a) How is systems development managed?

The organization must develop a technique for ensuring that the most important systems are built first. Figure below shows the elements of a management structure for developing new systems.

Corporate strategic planning group - responsible for developing the strategic organization plan. Important functions are (1) to give overall strategic direction to the information systems area and (2) to educate senior management about the systems

Systems as planned organizational change



Information systems steering committee

Senior management group with direct responsibility for systems development and operation. Composed of division directors from the end-user and information systems areas. The steering committee reviews and approves plans for systems in all divisions. Increasingly, becoming a powerful gatekeeper of systems development

Systems as planned organizational change

Project management team **(**Next level of management), concerned with the management of specific projects. Generally, this is a small group of senior IS managers and end-user managers with responsibility for a single project

Project team is composed of the systems professionals (analysts and programmers) who are directly responsible for building the system. A typical project team consists of systems analysts, functional analysts (specialists from relevant business areas), application programmers and perhaps database specialists

This team is responsible for most of the development activities.

(b) Linking Information Systems to the Business Plan

Building new systems is an essential component of the organizational planning process. Organizations need to develop an information systems plan that supports their overall business plan

Information Systems Plan: A road map indicating the direction of systems development, the rationale, the current situation, the management strategy, the implementation plan and the budget

Contains a statement of corporate goals and specifies how information technology supports the attainment of those goals

Information Systems Plan

01	**Purpose of the plan**		**New Developments**
	• Overview of plan contents • Changes in firm's current situation • Firm's strategic plan • Current business organization • Management strategy		**New capabilities required** Hardware Software Database Telecommunications
02	**Strategic Business Plan**	**05**	**Management Strategy**
	• Current situation • Current business organization • Changing environments • Major goals of the business plan		Acquisition plans, Milestones and timing Organizational realignment, Internal reorganization Management controls, Major training initiatives Personnel strategy
03	**Current Systems**	**06**	**Implementation Plan**
	• Major systems supporting business functions • Major current capabilities Hardware Software Database Telecommunications • Difficulties meeting business requirements • Anticipated future demands		• Detailed implementation plan • Anticipated difficulties in implementation • Progress reports
04	**New Developments**		
	New system projects Project descriptions Business rationale		

Systems as planned organizational change

(c) Establishing Organizational Information Requirements

In order to develop an effective information systems plan, the organization must have a clear understanding of both its long and short-term information requirements. Two principal methodologies are

(1) Enterprise Analysis (business systems planning)

Analysis of organization-wide information requirements by looking at the entire organization in terms of organizational units, functions, processes and data elements;

Method used is to take a large sample of managers and ask them how they use information, where they get the information

One strength - it gives a comprehensive view of the organization and of systems/data

Another strength - it helps to produce an organizational consensus by involving a large number of managers and users of data

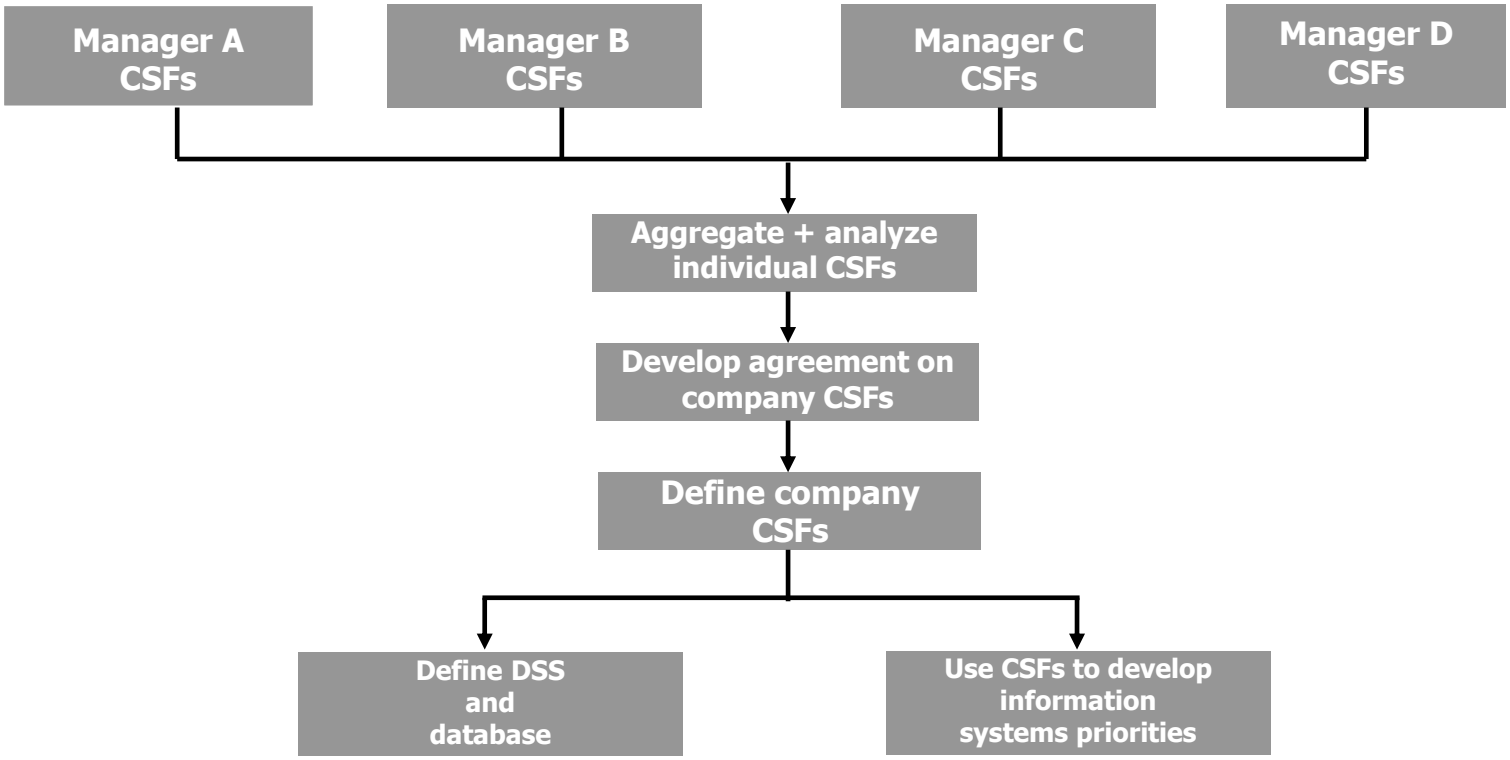
The weakness - it produces an enormous amount of data that is expensive to collect and difficult to analyze. Bias toward top management and data processing because interviews are conducted with senior or middle managers other than clerical workers

Establishing Organizational Information Requirements

(2) Critical Success Factors (Strategic Analysis)

A small number of easily identifiable operational goals shaped by the industry, the firm, the manager and the broader environment that are believed to assure the success of an organization. CSFs are used to determine the information requirements of an organization

The principal method used in CSF analysis is personal interviews – three or four – with a number of top managers to identify their goals and the resulting CSFs



Systems Development and Organizational Change

New ISs can be powerful instruments for organizational change. There are four kinds of structural organizational change which are enabled by information technology: automation, rationalization, re-engineering and paradigm shifts

Automation

The most common form of IT enabled organizational change is automation – 'using the computer to speed up the performance of existing tasks'.

Rationalization of procedures

A deeper form of organizational change – 'The streamlining of standard operating procedures, eliminating obvious bottlenecks, so that automation makes operating procedures more efficient'.

Business Re-Engineering

A more powerful type of organizational change, in which business processes are analyzed, simplified and redesigned

'The radical redesign of business processes, combining steps to cut waste and eliminating repetitive, paper-intensive tasks in order to improve cost, quality or service and to maximize the benefits of IT'

Business Process

A set of logically related tasks performed to achieve a defined business outcome. Examples: developing a new product, ordering goods from a supplier.

IT capabilities and their organizational impacts

SL	Capability	Organizational Impact/Benefit
01	Transactional	IT can transform unstructured processes into routinized transactions
02	Geographical	IT can transfer information with rapidity and ease across large distances, making processes independent of geography
03	Automational	IT can replace or reduce human labour in a process
04	Analytical	IT can bring complex analytical methods to bear on a process
05	Informational	IT can bring vast amounts of detailed information into a process
06	Sequential	IT can enable changes in the sequence of tasks in a process, often allowing multiple tasks to be worked on simultaneously
07	Knowledge Management	IT allows the capture and dissemination of knowledge and expertise to improve the process
08	Tracking	IT allows the detailed tracking of task status, inputs and outputs
09	Disintermediation	IT can be used to connect two parties within a process that would otherwise communicate through an intermediary (internal or external)

Overview of Systems Development

System Development

When managers and employees realize that the organization is not performing as well as expected or the organization should take advantage of new opportunities to perform more successfully

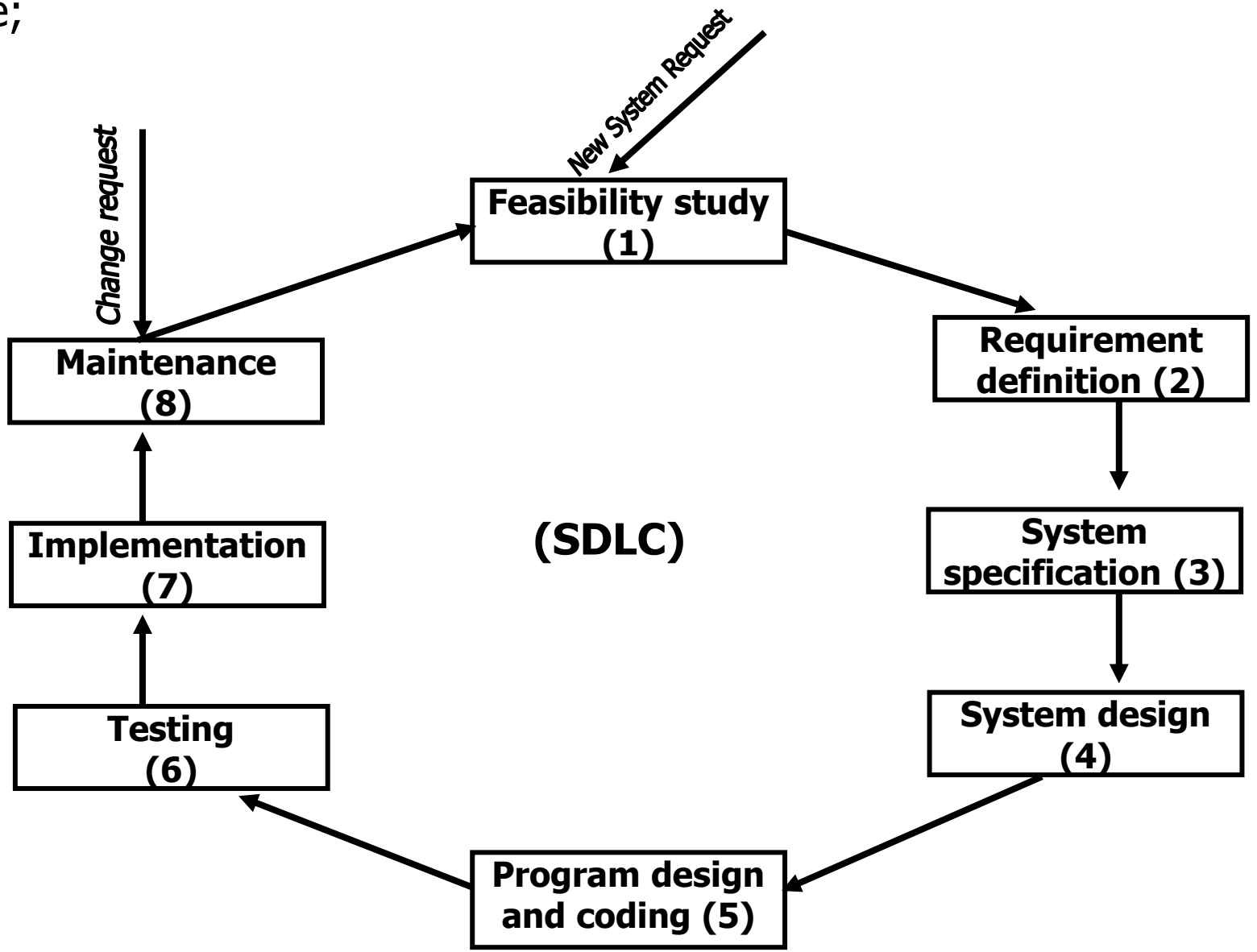
'Systems Development *– refers to all the activities that go into producing an information systems solution to an organizational problem or opportunity'*

SD is a structured kind of problem solving with distinct sequential activities. Such as……

Figure below illustrate the systems development process. Some of the activities may need to be repeated or some may be taking place simultaneously, depending on the approach to systems building

Not necessary that each activity involves interaction with the organization. Members of the organization participate in these activities and the systems development process creates organizational changes

Methodology: System Development Life Cycle (SDLC), can be employed to develop the system consisting of number of phases. These are;



System Development Life Cycle (SDLC)

Systems Analysis

System Analysis is the analysis of the problem that the organization will try to solve with an information system. It consists of defining the problem, identifying its causes, specifying the solution and identifying the information requirements

(1) Feasibility Study

In addition to suggesting a solution, systems analysis involves a feasibility study to determine whether that solution is feasible, or achievable, within the organization's resources and constraints. It also provides a clear statement of the purpose of the proposed system and its practicality both technically and commercially. Its three major areas

Technical feasibility: Determines whether a proposed solution can be implemented with the available hardware, software and technical resources

Economic feasibility: Determines whether the benefits of the proposed solution outweigh the costs

Operational feasibility: Determines whether a proposed solution is desirable within the existing managerial and organizational framework

System Development Life Cycle (SDLC)

(2) Requirement definition

Requirement definition provides a detailed and accurate description of the needs of the user, together with a prioritization of those needs

(3) System specification

It provides a complete description of the functionality of the proposed system. It describes ***what*** specifications are needed to be transformed

(4) System design

The objectives of this stage are transformation of the system specification **(***the* ***what*** **)** into an operational system design **(***the* ***how***). System design details how a system will meet the information requirements as determined by the systems analysis. Design is the overall plan or model for the system. Like the blueprint of a building or house, it consists of all the specifications that give the system its form and structure

Logical design lays out the components of the information system and their relationship to each other as they would appear to users

Physical design is the process of translating the abstract logical model into the specific technical design for the new system

System Development Life Cycle (SDLC)

Completing the systems development process

The remaining steps in the systems development process translate solution specifications established during systems analysis and design into a fully operational information system. These concluding steps consist of programming, testing, conversion and production & maintenance

(5) Program design and coding

This phase turns the selected system design into reality. It uses comprehensive software package that replace the existing manual system with integrated software system

(6) Testing

Testing is a prototype of the real system. It proves that the system meets every agreed user requirements within the operational parameter specified. ***"Will the system produce the desired results under known conditions?"***

System Development Life Cycle (SDLC)

(7) Conversion/Implementation

Implementation denotes the completion and ready for smooth installation of the system. It can be termed as changeover from the old system to the new one.

It answers the question, ***"Will the new system work under real conditions?"***.

Four conversion strategies are parallel strategy, direct cutover, pilot study, phased approach

(8) Maintenance

After successful installation of the system there may arise some change requests. Considering the environmental changes or new demands of users, the system is required to be modified. It includes changes in hardware, software, documentation or procedures to a production system to correct errors, meet new requirements or improve processing efficiency are termed **– *maintenance***

Figure-4: System Scope illustration of the necessary system boundary or problem domain for the proposed system