Presentation for

Course: CAD/CIM

Class: III -B.Tech- II SEMESTER (AERONAUTICAL ENGINEERING)

by

Dr. D. GOVARDHAN
Professor & Head
Department of aeronautical Engineering,
INSTITUTE OF AERONAUTCAL ENGINEERING

CAD/CAM means computer aided design, and computer aided manufacturing. This technology makes use of the computers to perform and/or maintain certain functions in the industries for design and manufacturing.

The utilization of CAD/CAM can be divided into 4 groups:

Group 1: It can be used to produce drawings and document drawings.

Group 2: It can be employed as a visual tool by generating shaded images and animated displays.

Group 3: It can be used to perform engineering analysis on geometric models like FEA.

Group 4: It can be used to perform process planning and generate NC part programmes

APPLICATIONS OF CAD/CAM

- To increase productivity of the designer
- To improve quality of the design
- To improve communications
- To create a manufacturing database
- To create and test tool paths and optimize them
- To help in production scheduling and MRP models
- To have effective shop floor control

Computer supports in the areas are :

- Computer aided design and drafting
- Computer aided engineering
- Computer aided manufacturing
- Computer aided process planning
- Computer aided tool design
- Computer aided NC part programming
- Computer aided scheduling
- Computer aided material requirement planning.

CAD/CAM

CAD/CAM : It is a technology concerned with the use of digital computers to perform certain functions in design and production.

This technology is moving in the direction of greater integration of design and manufacturing.

CAD can be define as the use of computer systems to assist in the creation, modification, analysis, or optimization of a design.

CAM can be defined as the use of computer systems to plan, manage, and control the operations of a manufacturing plant through either direct or indirect computer interface with the plant's production resources.

- The CAD hardware typically includes the computer, one or more graphics display terminals, keyboards, and other peripheral equipment.
- The CAD software consists of the computer programs to implement computer graphics on the system plus application programs to facilitate the engineering functions of the user company.
- The computer systems consist of the hardware and software to perform the specialized design functions required by the particular user firm

CAM APPLICATIONS:

1. Computer monitoring and control These are the direct applications in which the computer is connected directly to the manufacturing process for the purpose of monitoring or controlling the process.

   (i)NC Part programming, (ii) computer Automated process planning, (iv) computer-generated work standards, (v) Material requirement planning and (vi) Shop floor control.

2. Manufacturing support applications These are the indirect applications in which the computer is used in support of the production operations in the plant, but there is no direct interface between the computer and the manufacturing process.

PRODUCT CYCLE

Let us consider the manufacturing environment of a given product.

•How does the product idea originate?

•The market forces determine the need for a product.

•Demand and probable profitability

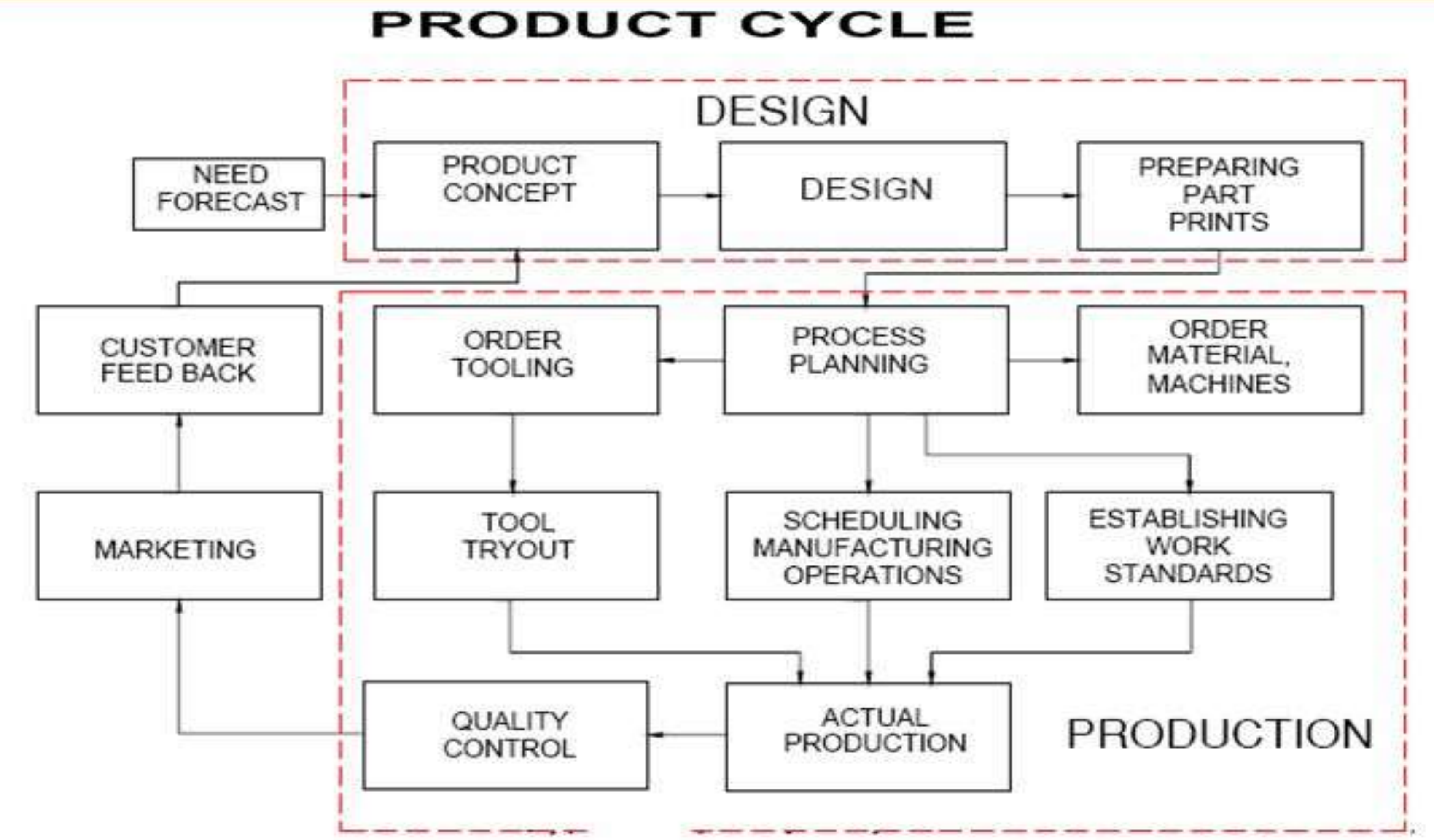
• Best designing and manufacturing the desired product.

The details of such a design and the subsequent manufacturing process are depicted in

(i) Fig. 1-2 for the traditional approach and

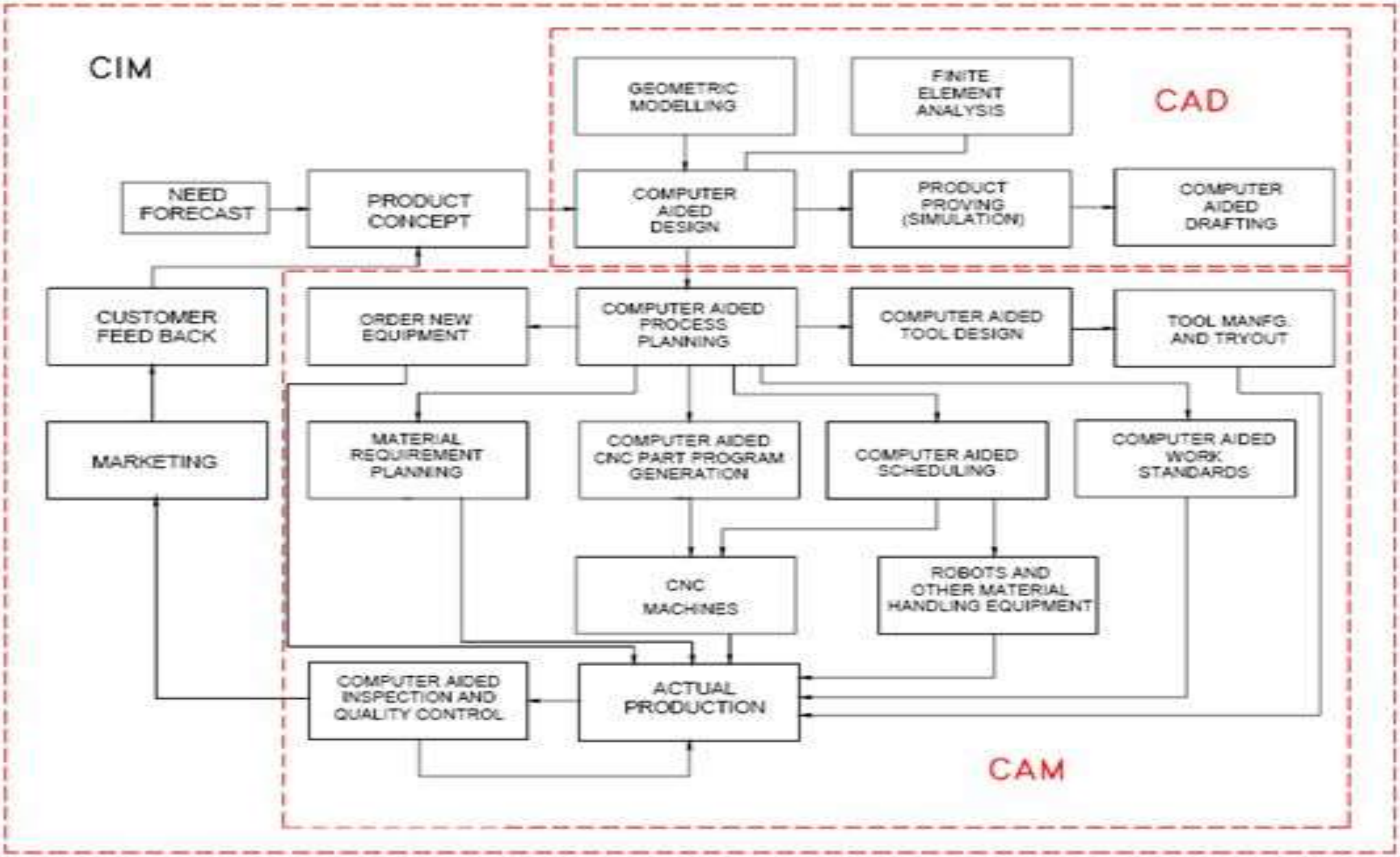
(ii) Fig. 1-3 for computer aided manufacturing

PRODUCT CYCLE - Traditional approach (Fig. 1-2)



PRODUCT CYCLE IN CONVENTIONAL ENVIRONMENT

PRODUCT CYCLE - CAD/CAM approach (Fig. 1-3)



PRODUCT CYCLE IN AN COMPUTERISED ENVIRONMENT

Computer Aided Design (CAD): Designer/Enginee

- Product functions
- Product Specifications
- Conceptual design
- Ergonomics and Aesthetics
- Standards
- Detailed standard
- Prototype Development
- Testing

- Simulation
- Analysis
- Strength
- Kinematics, Dynamics
- Heat, Flow
- Design for Manufacture
- Design for Assembly
- Drafting

Computer Aided Design (CAD): Manufacturing Engineering

- Process planning
- Process sheets
- Route sheets
- Tooling
- Cutting tools
- Jigs and Fixtures
- Dies and Moulds
- Manufacturing Information Generation
- CNC Part programmes
- Robot Programmes
- Inspection (CMM) programmes
- Production Organisation
- Bill of Materials
- Material Requirement Planning
- Production Planning
- Shop Floor Control Plant Simulation
- Packaging, Distribution and Marketing

Computer Aided Design (CAD): Automation

Automation is defined as the technology concerned with the application of complex mechanical, electronic, and computer-based systems in the operation and control of production.
It is the purpose of this section to establish the relationship between CAD/CAM and automation

Production activity: Divided into four main categories:

l. Continuous-flow processes

2. Mass production of discrete products

3. Batch production

4. Job shop production

Production activity: Four categories

1 **Continuous-flow processes**. Continuous dedicated production of large amount of bulk product.
Ex: chemicals, plastics, petroleum, and food industries.

2. **Mass production** of discrete products. Dedicated production of large quantities of one product (with perhaps limited model variations).
Ex: automobiles, appliances and engine blocks.

3 **Batch production**. Production of medium lot sizes of the same product. The lot may be produced once or repeated periodically. Examples: books, clothing and certain industrial machinery.

4 **Job-shop production**. Production of low quantities, often one of a kind, of specialized products. The products are often customized and technologically complex. Examples: prototypes, aircraft, machine tools and other equipment.

COMPUTERS, THE FOUNDATION OF CAD/CAM

THE CENTRAL AND ESSENTIAL INGREDIENT IS THE DIGITAL COMPUTER DUE TO PRESENCE OF

- HIGH SPEED PROCESS IMAGING,
- REAL – TIME PROCESS CONTROL
- INHERENT SPEED AND
- STORAGE CAPACITY

FOUNDATION FOR CAD/CAM

PERFORM MATHEMATICAL AND LOGIAL CALUCULATUINS

DATA PROCESSING FUNCTIONS IN ACCORDANCEWITH PRE-DETEMINED PROGRAM OF INSTRUCTION.

Hardware Components

COMPUTER IS TREATED AS HARDWARE AND IT CONSISTS OF THREE BASIC HARDWARE COMPONENTS:

- CPU
- MEMORY
- INPUT/OUTPUT DEVICES

CENTRAL PROCESSING UNIT (CPU): A HARDWARE COMPONENT THAT PERFORMS COMPUTING FUNCTIONS UTILIZING THE ALU, CONTROL UNIT, AND REGISTERS/.

CPU CONTAINSTWO SECTIONS (I) CONTROL UNIT AND (II) ALU

CONTROL UNIT:

CONTROLS ALL THE OPERATIONS,

I/O INFORMATION TO THE COMPUTER AND OUTSIDE WORLD

Hardware Components

MEMORY IS THE STORAGE UNIT.

STORED THE DATA AND CONVIENTELY TRANSFERRED TO ALU, I/O

FOR PROCESSING.

INPUT AND OUT PUT DEVICES:

- TO COMMUNICATE WITH OUTSIDE WORLD.
- EXTERNAL STORAGE UNITS: TAPES , DISCS.

Hardware Components

- TRANSPORT SIGNALS,
- COMMONDS.
- SEQUENTIALLY ACCESSES PROGRAM INSTRUCTIONS,
- DECODES THEM,
- COORDINATES FLOW OF DATA IN/OUT OF ALU,
- REGISTERS, PRIMARY AND SECONDARY STORAGE, AND
- VARIOUS OUTPUT DEVICES.

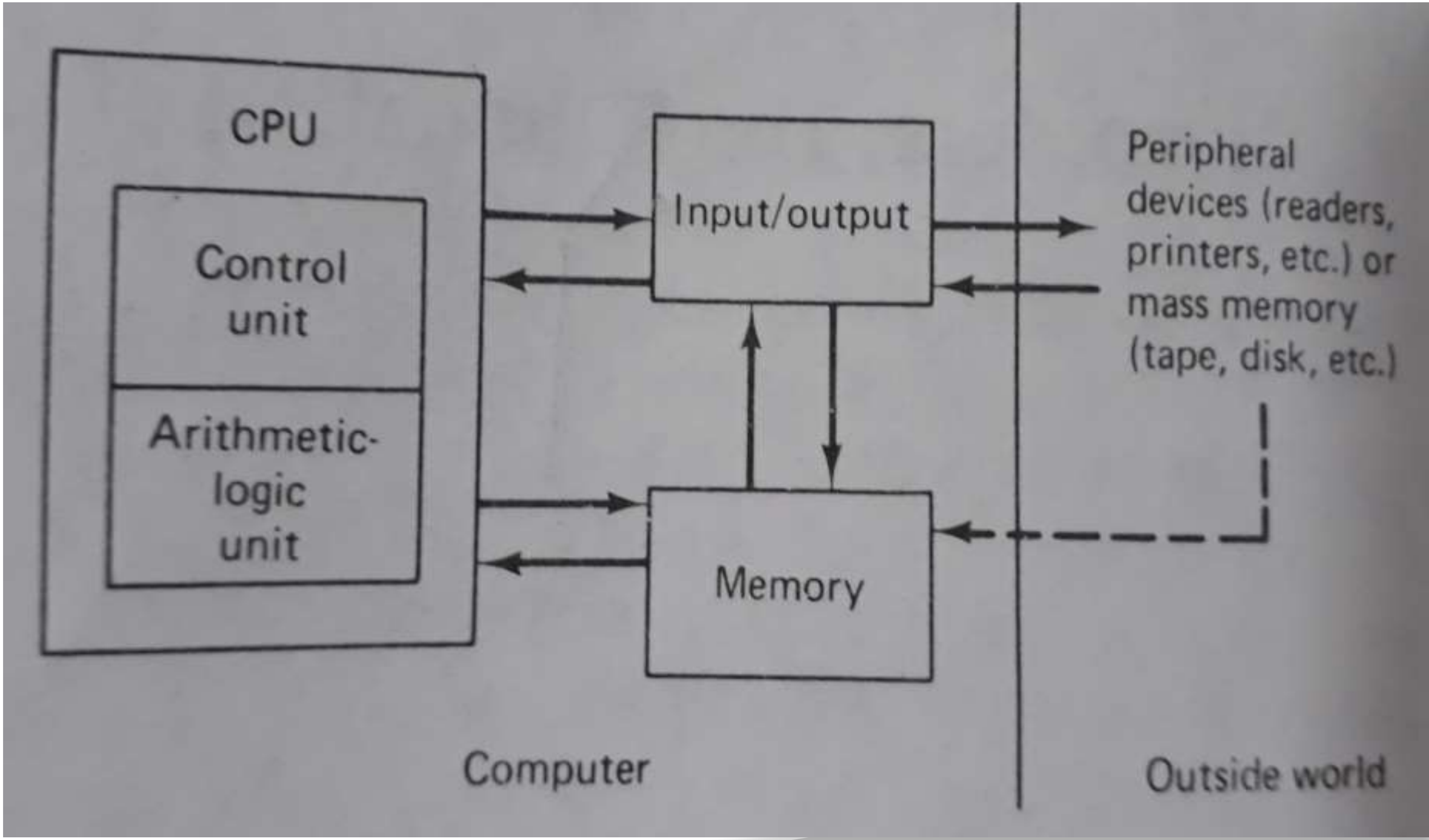
ARITHEMATIC/ LOGIC UNIT:

CONTROL UNIT DIRECTS THE ALU TO PERFORM

ARITHEMATIC CALUCULATION AND

LOGICAL COMPARISION /TRANFORMATION DATA

BASIC HARDWARE STRUCTURE OF DIGITAL COMPUTER



SOFTWARE:

Software are programs and instructions stored in memory or external storage unit which assigns computer to do various functions.

Computer execute the program through its ability and manipulate the data in the most elementary form like electrical signal or binary system

CENTRAL PROCESSING UNIT:

Central Processing Unit regulates the operations of all system components and performs the arithmetic and logical operations on the data. to complete these functions, the computer consists two operating units such as **Control unit and ALU** ,

- Control unit and ALU perform their functions by utilizes computer registers.
- Computer registers are small memory devices that can hold, receive and transfer data.
- Each register consists of binary cells to hold bits of data.
- No.of bits in the registers establishes the word length computer is capble of handling.

FUNCTIONS OF REGISTER UNITS

To accomplish a given sequence of programmed instructions, the functions of these registers units as follows.

Program Counter: hold the location for next instructions.

Instructions two types:

(i) operator (logical operation)

(ii) operand: the specify the data on which operation takes place.

Memory address register:

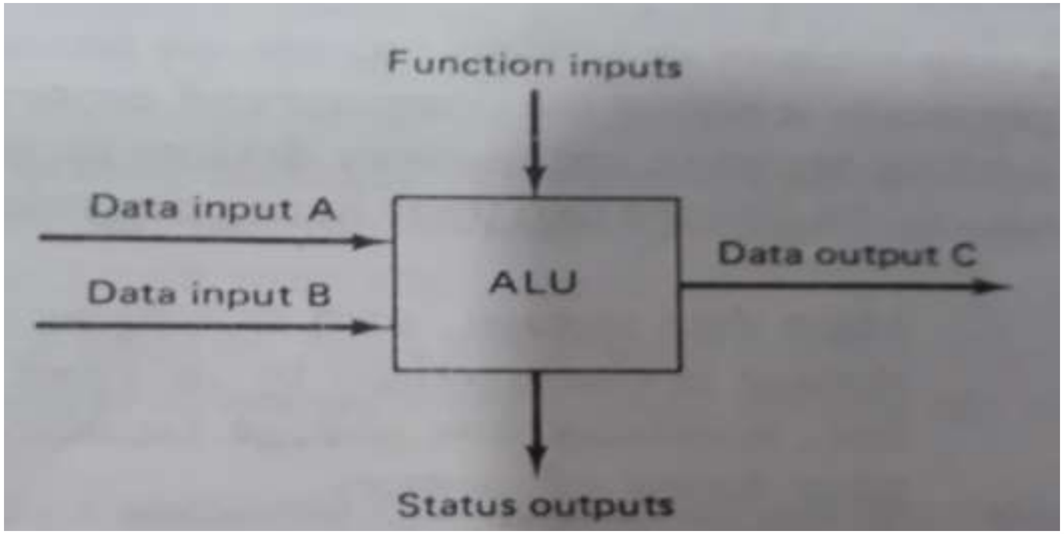
Instruction register: to hold the data for instructions

Accumulator: is the temporary storage register

Status register: to indicate the internal status of the CPU

FUNCTIONS OF REGISTER UNITS…cont

ARITHEMATIC – LOGIC COUNTER: For various calculations and manipulation of the data. The unit consists of two inputs for data, one input for functions input. status outputs is used to the set register and output data.



Typical configuration of Arithmetic –Logic unit

TYPES OF MEMORY

- Memory section consists of Binary storage
- Access time
- Store all instructions and data of program and CPU will transfer data and instructions to and fro while execution of program.

Computer Memories are classified in to two types:

a) **Main Memory** (Primary Storage): is three types

(i) **Main Data Storage**: magnetic core or solid state memory and its part of CPU.

(ii) **Control storage**: contain micro programs

(iii) **Local storage**

TYPES OF MEMORY…. Cont

(b) Auxiliary Memory (Secondary Storage): external to the computer and data files are not directly available to the cpu. there are two types of auxiliary memory .

(i) **Sequential Access Storage** for which high level of file activity not required and

(ii) Direct Access storage for which high level of file activity required

Types of Computer Systems

- **Personal computers (PCs)**
  Small, inexpensive, often called microcomputers
- **Network computers:** Used for accessing networks, especially the Internet
- **Workstations:** Fit between high-end microcomputers and low-end midrange
- **Midrange (or 'mini') computers:** Size of a three drawer file cabinet and accommodates several users at one time.
- **Mainframe computers :** Large and powerful, shared by hundreds concurrently.
- **Supercomputers:** Most powerful with fastest processing speeds.

Types of Computer Systems for CAD Application

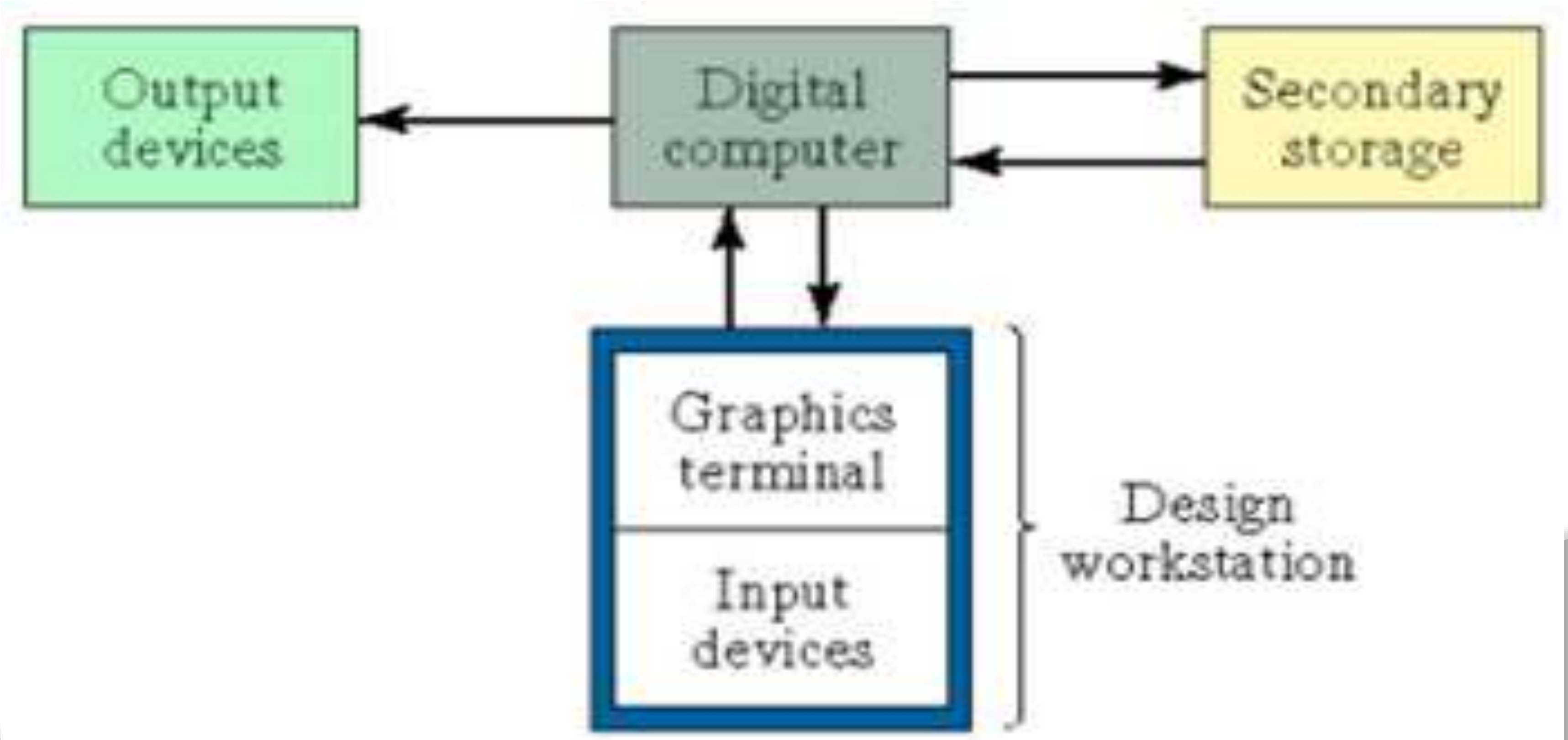
- The cad system are available in variety of sizes, configuration and capabilities.
- Select a cad system which has a capability of meeting the desired computational and graphic requirements.
- Engineering firms which are not involved in manufacturing or production will choose a system which is excessively used for design and drafting.
- A modern day CAD system is based in ICG interactive Computer Graphics
- Before ICG it was batch design process but the response is very slow in out put.

CAD SYSTEM CONSIST OF

1. A graphical terminal, 2. Operators input devices

3. One or more plotters and output devices

4. Central processing unit CPU and 5.Secondary storage



CAD WORK STATION

The CAD workstation is the system interface with the outside world. It represents a significant factor in determining how convenient and efficient it is for a designer to use the CAD system.

The workstation must accomplish five functions

l. It must interface with the central processing unit.

2. It must generate a steady graphic image for the user.

3. It must provide digital descriptions of the graphic image.

4. It must translate computer commands into operating functions.

5. It must facilitate communication between the user and the system.

COMPUTER GRAPHICS TERMINALS

- Nearly all computer graphics terminals available today use the cathode ray tube (CRT) as the display device.
- Television sets use a form of the same device as the picture tube.
- A heated cathode emits a high-speed electron beam onto a phosphor-coated glass screen.
- ‘ The electrons energize the phosphor coating, causing it to glow at the points where the beam makes contact.
- By focusing the electron beam, changing its intensity, and controlling its point of contact against the phosphor coating through the use of a deflector system, the beam can be made to generate a picture on the CRT screen.

COMPUTER GRAPHICS TERMINALS

Two basic techniques used in current computer graphics terminals for generating the image on the CRT screen. They are

l. Stroke writing: Stroke-writing technique include line drawing, random position, vector writing, stroke writing, and directed beam.

2. Raster scan: Raster scan technique include digital TV and scan graphics.

RASTER SCAN

- The stroke-writing system uses an electron beam which operates like a pencil to create a line image on the CRT screen.
- The image is constructed out of a sequence of straight-line segments. Each line segment is drawn on the screen by directing the beam to move from one point on the screen to the next, where each point is defined by its x and y coordinates.
- Although the procedure results in images composed of only straight lines, smooth curves can be approximated by making the connecting line segments short enough.
- In the raster scan approach, the viewing screen is divided into a large number of discrete phosphor picture elements, called pixels.

RASTER SCAN ..cont…1,

Each pixel on the screen can be made to glow with a different brightness. Colour screens provide for the pixels to have different colours as well as brightness.

During operation, an electron beam creates the image by sweeping along a horizontal line on the screen from left to right and energizing the pixels in that line during the sweep.

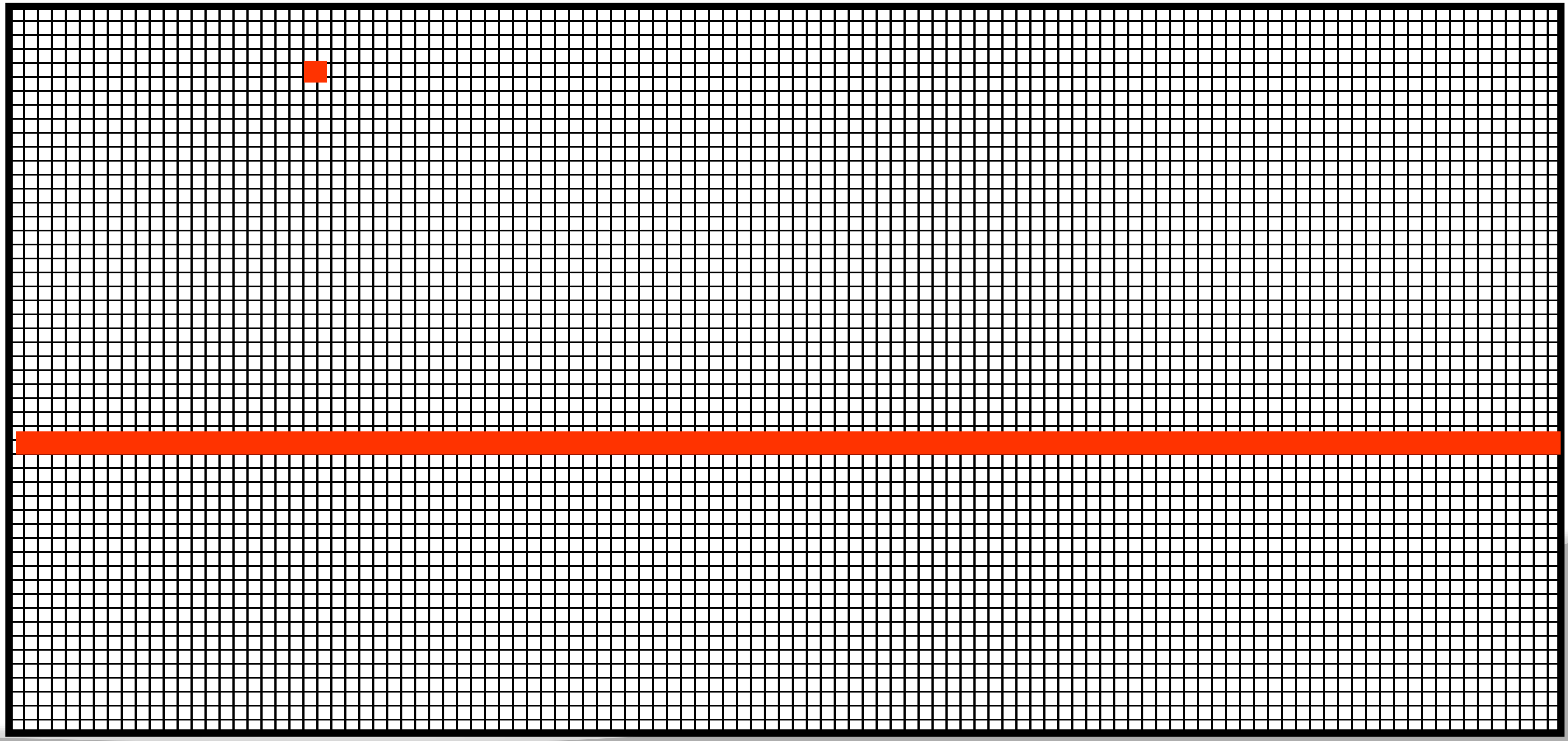
When the sweep of one line is completed, the electron beam moves to the next line below and proceeds in a fixed pattern as indicated in Figure. After sweeping the entire screen the process is repeated at a rate of 3O to 6O entire scans of the screen per second

Raster Scan Displays

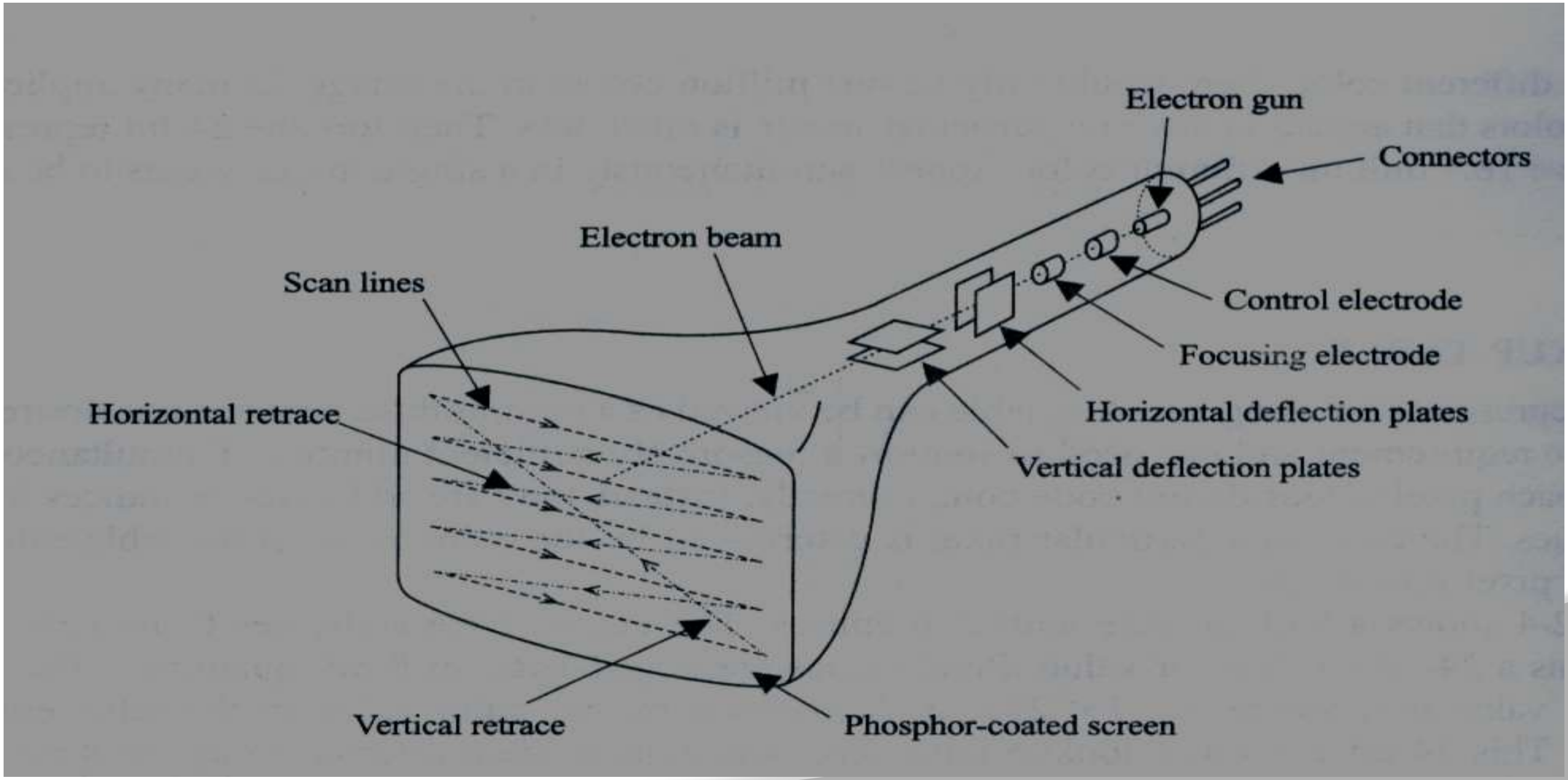
Raster: A rectangular array of points or dots

Pixel: One dot or picture element of the raster

Scan Line: A row of pixels



In a raster scan system, the electron beam is swept across the screen, one row at a time from top to bottom.

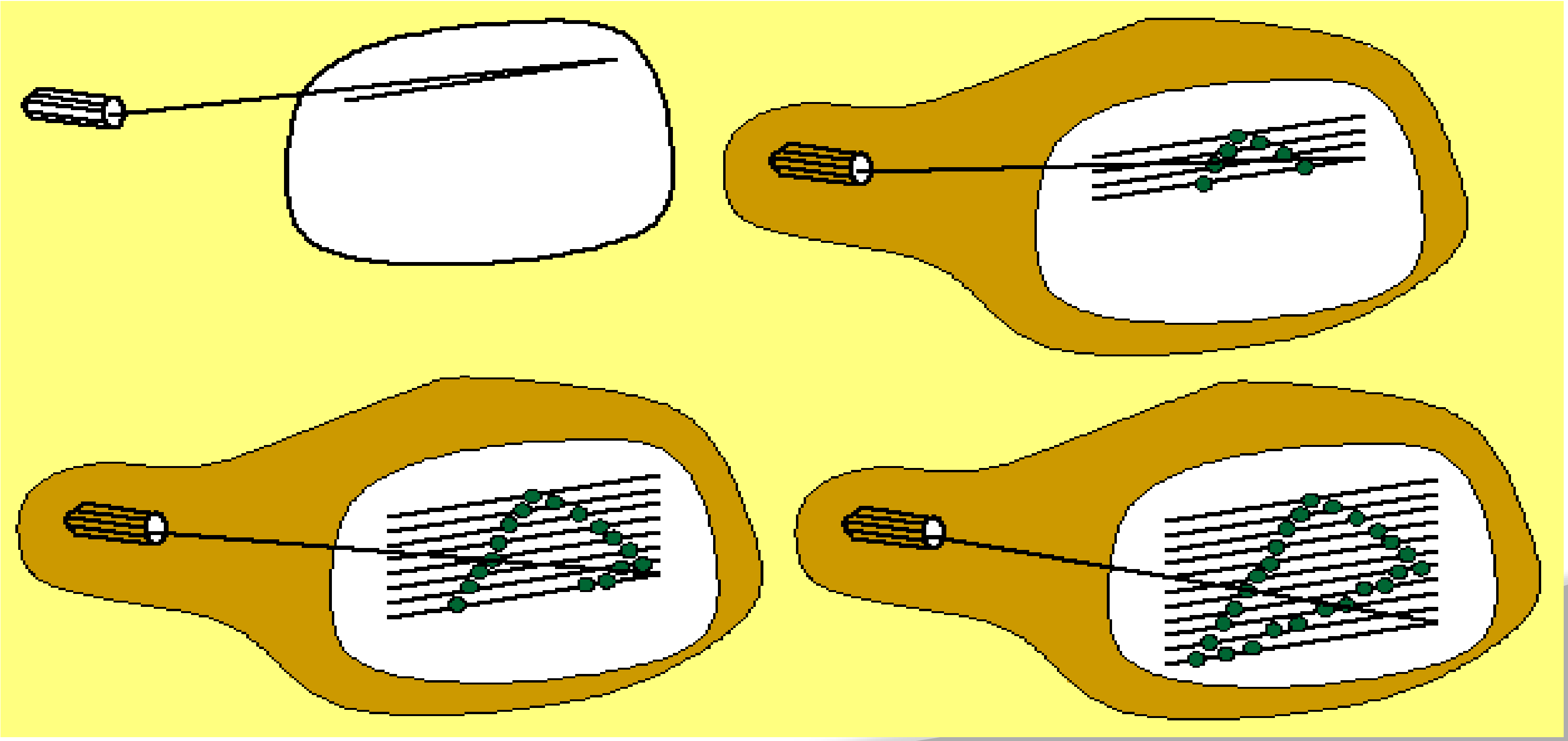


RASTER SCAN DISPLAYS

- As the electron beam moves across each row, the beam intensity is turned on and off to create a pattern of illuminated spots.
- Picture definition is stored in a memory area called the refresh buffer or frame buffer.
- Refresh buffer or frame buffer: This memory area holds the set of intensity values for all the screen points.

RASTER SCAN DISPLAYS

Stored intensity values then retrieved from refresh buffer and "painted" on the screen one row (scan line) at a time. Refreshing on raster scan displays is carried out at the rate 60 to 80 frame per second.



Graphics terminals for computer-aided design

Three types of graphics terminals, which seem to be the most important today in commercially available CAD systems.

l. Directed-beam refresh

2. Direct-view storage tube (DVST)

3. Raster scan (digital TV)

DIRECTED-BEAM REFRESH

The directed-beam refresh terminal utilizes the stroke-writing approach to generate the image on the CRT screen.

The image must be regenerated many times per second in order to avoid noticeable flicker of the image.

In order for the image to be continued, these picture tubes must be refreshed by causing the directed beam to retrace the image repeatedly

Early refresh tubes were very expensive. but the steadily decreasing cost of solid-state circuitry has brought the price of these graphics systems down to a level which is competitive with other types.

DIRECT-VIEW STORAGE TUBE (DVST)

DVST terminals also use the stroke-writing approach to generate the image on the CRT screen.

The term storage tube refers to the ability of the screen to retain the image which has been projected against it, thus avoiding the need to rewrite the image which has been projected against it constantly.

The penalty associated with the storage tube is that individual lines cannot be selectively removed from the image.

RASTER SCAN (DIGITAL TV)

- Raster scan terminals operate by causing an electron beam to trace a zigzag pattern across the viewing screen as described earlier.
- The operation is similar to that of a commercial television set. The difference is that a TV set uses analog signals originally generated by a video camera to construct the image on the CRT screen.
- While the raster scan ICG terminal uses digital signals generated by a computer.
- For this reason, the raster scan terminals used in computer graphics are sometimes called digital TVs.

DIFFERENCE BETWEEN DIRECTED-BEAM REFRESH, DVST AND RASTER SCAN DIGITAL TV

	Directed-beam refresh	DVST	Raster scan
Image generation	Stroke writing	Stroke writing	Raster scan
Picture quality	Excellent	Excellent	Moderate to good
Data content	Limited	High	High
Selective erase	Yes	No	Yes
Gray scale	Yes	No	Yes
Color capability	Moderate	No	Yes
Animation capability	Yes	No	Moderate

OPERATOR INPUT DEVICES

Operator input devices are provided at the graphics workstation to facilitate convenient communication between the user and the system.

Workstations generally have several types of input devices to allow the operator to select the various pre-programmed input functions.

These functions permit the operator to create or modify an image on the CRT screen or to enter alphanumeric data into the system.

This results in a complete part on the CRT screen as well as complete geometric description of the part m the CAD data base.

OPERATOR INPUT DEVICES

l. Cursor control devices

2. Digitizers

3. Alphanumeric and other keyboard terminals

•Thumb wheels

•Direction keys on a keyboard terminal

•Joysticks

•Tracker ball

•Light pen

•Electronic tablet/pen

DIGITIZERS

The digitizer is an operator input device which consists of a large, smooth board and an electronic tracking device which can be moved over the surface to follow existing lines.

The digitizer can be used to digitize line drawings. The user can input data from a rough schematic or large layout drawing and edit the drawings to the desired level of accuracy and detail.

The digitizer can also be used to freehand a new design with subsequent editing to finalize the drawing.

BUT LIMITED TO 2D DRAWINGS

KEYBOARD TERMINAL

The alphanumeric terminal is used to enter commands, functions, and supplemental data to the CAD system. This information is displayed for verification on the CRT or typed on paper.

The system also communicates back to the user in a similar manner. Menu listings, program listings, error messages, and so forth, can be displayed by the computer as part of the interactive procedure.

These function keyboards are provided to eliminate extensive typing of commands, or calculate coordinate positions, and other functions. The number of function keys varies from about 8 to 8O.

PLOTTERS AND OTHER OUTPUT DEVICES

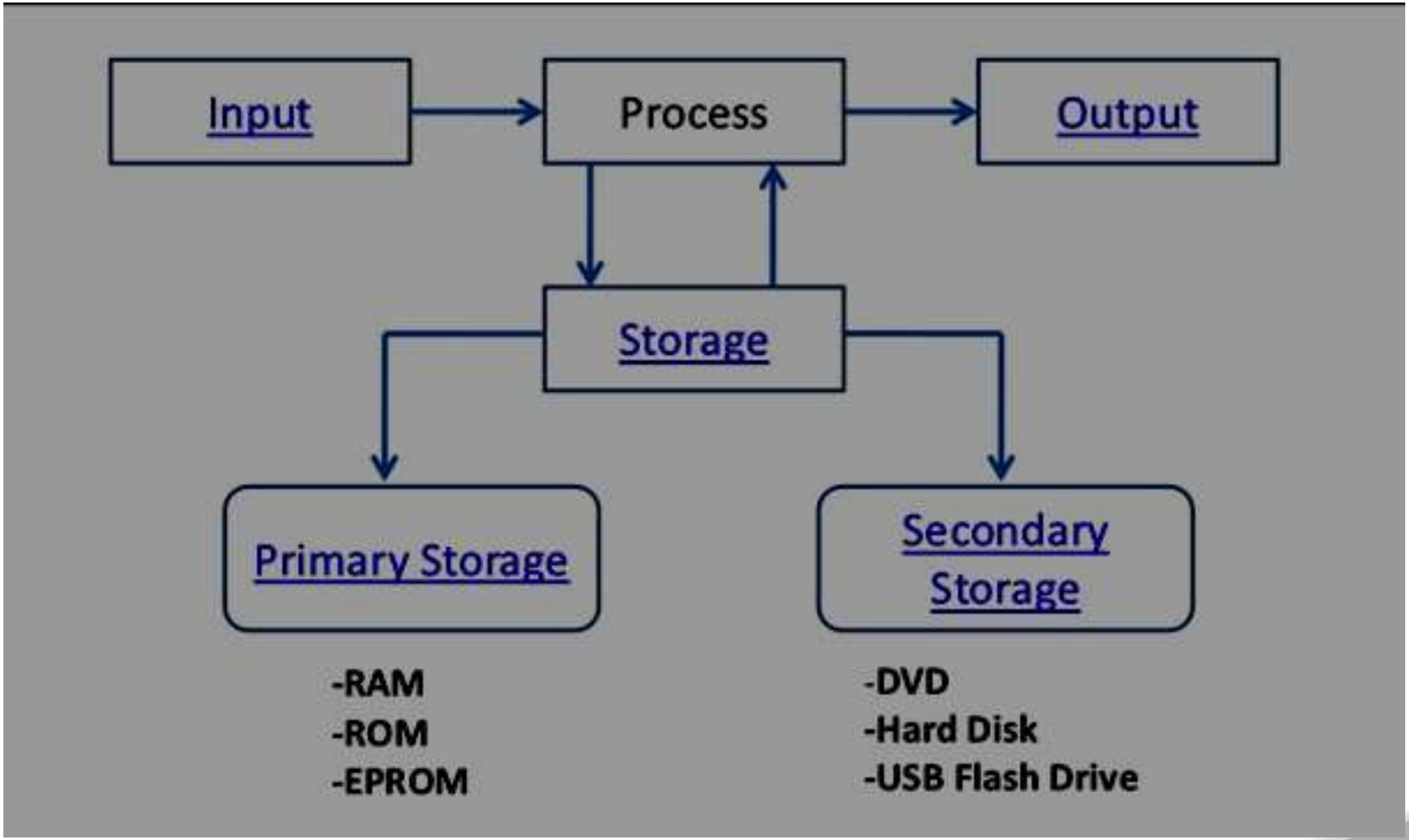
There are various types of output devices used in conjunction with a computer-aided design system. These output devices include:

Pen plotters

Hard-copy units

Electrostatic plotters Computer-output-to-microfilm (COM) units

Input/ Output devices of computer



INPUT DEVICES: GIVING COMMANDS

- **Input :** Data or instructions entered into a computer

  Input device: Hardware that gives users the ability to enter data and instructions into the computer's random access memory (RAM)

- **Keyboard**

  Most common input device—enables data and instruction entry through the use of a variety of keys

- **Enhanced keyboards**

  Additional keys, such as media control buttons to adjust speaker volume, or Internet control buttons that open e-mail, a browser, or a search window with a single keystroke

INPUT DEVICES: GIVING COMMANDS cont….

Key matrix: **Grid of circuits located under the keys**

Character map: **Chart that tells the processor what key has been pressed**

Wireless keyboards: **Connect to the computer through infrared (IR), radio frequency (RF), or Bluetooth connections**

ALTERNATIVE INPUT DEVICES INCLUDE:

- Microphones for speech or voice recognition
- Scanner for optical character recognition (OCR)
- Bar code reader
- Optical mark reader (OMR)
- Radio frequency identification (RFID reader)
- Magnetic-ink character recognition (MICR reader)
- Magnetic stripe care reader
- Biometric input device
- Digital cameras and digital video cameras
- Webcams

POINTING DEVICE

Pointing device:

Controls an on-screen pointer's movements

Pointer: On-screen symbol that signifies the command, input, or possible response

Biometric input device

Digital cameras

Digital video cameras

Webcams

OUTPUT DEVICES

Enable users to see, hear, or feel the end result of processing operations:

The two most popular output devices

1. **Monitors** (also called displays)
2. **Printers**

Types of monitors include:

- Cathode-ray tube (CRT),
- Liquid crystal display (LCD)

• LCD (flat-panel) displays (have a thin profile are used with newer desktops and notebooks),

•Have largely replaced CRT monitors

Monitors continued…

Resolution: Refers to the sharpness of an image

Number of pixels (picture elements) controls the resolution

Video Graphics Array (VGA): lowest resolution standard (640 × 480)

Extended Graphics Array (XGA): Most used by computers today (1024 × 768)

OUT PUT DEVICES Continued…

PRINTERS: Supply a hard copy of output displayed on a computer's monitor

Types include: Inkjet, Laser, Dot-matrix, Photo, Plotters

INKJET : Popular with home users, provide excellent images—made up of small dots

Advantages: Inexpensive
Generate professional color output

Disadvantages: Relatively slow

PRINTERS Continued…

LASER (Nonimpact): Use electrostatic reproductive technology to produce high-quality output

Advantages: High-resolution

Print faster than inkjet printers

Black-and-white printing costs less per page than inkjet printing

Disadvantages: Color laser printers more expensive

Dot-matrix (impact): Older, less popular, Used mostly for printing multipart forms and backup copies

Advantages: Able to print 3,000 lines per minute

Disadvantages: Poor print quality, Noisy

PRINTERS Continued…

PHOTO: Uses special ink and paper
Often are inkjet printers
Prints directly from a digital camera or memory card

PLOTTERS: Produce images through moving ink pens
Used for making oversized prints (i.e., maps, charts, blueprints)

Other output devices include:

Speakers
LCD projectors
DLP (digital light-processing) projectors
Multifunction devices

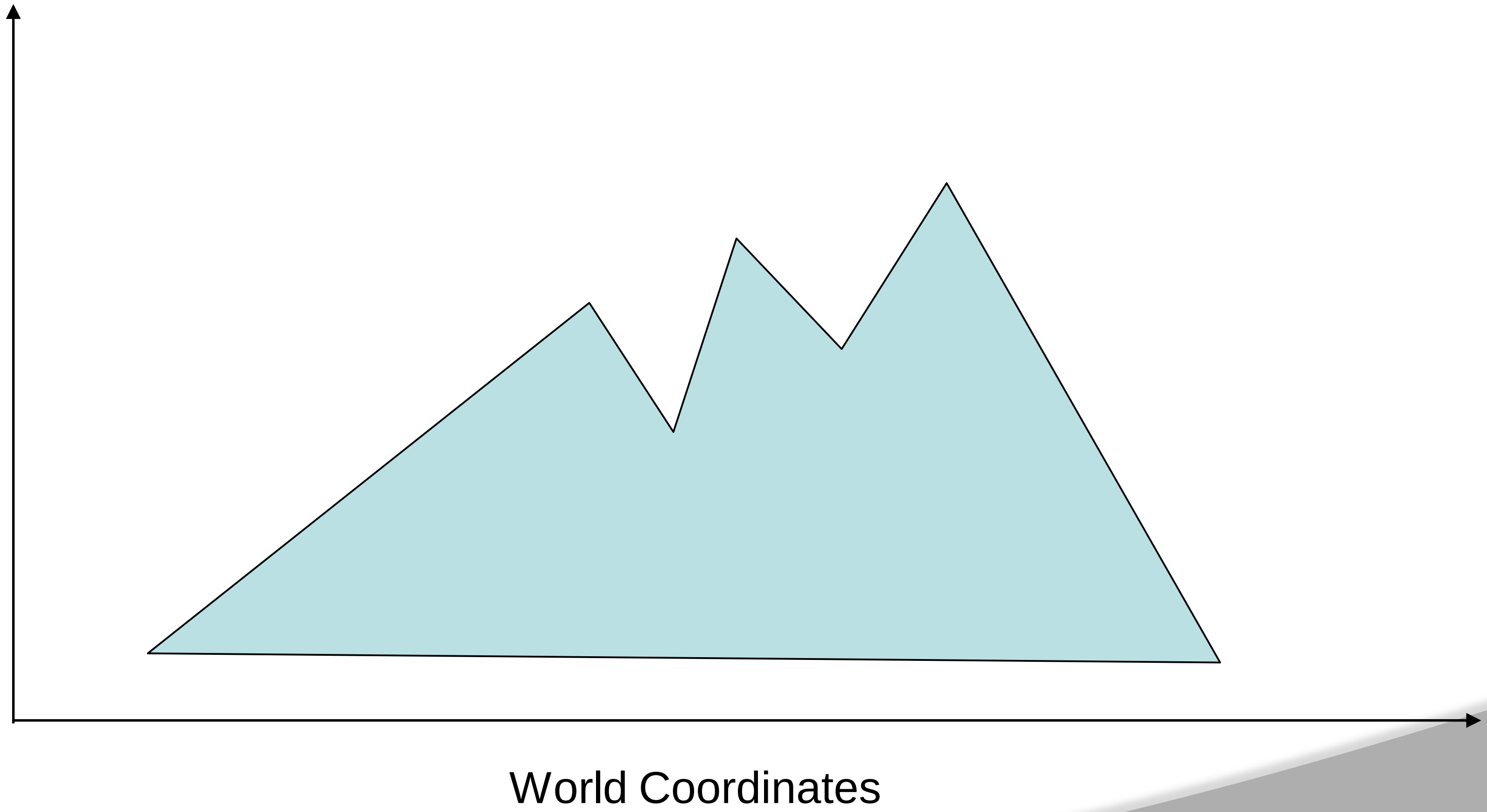
Translation, Scaling , Rotation

2D CLIPPING

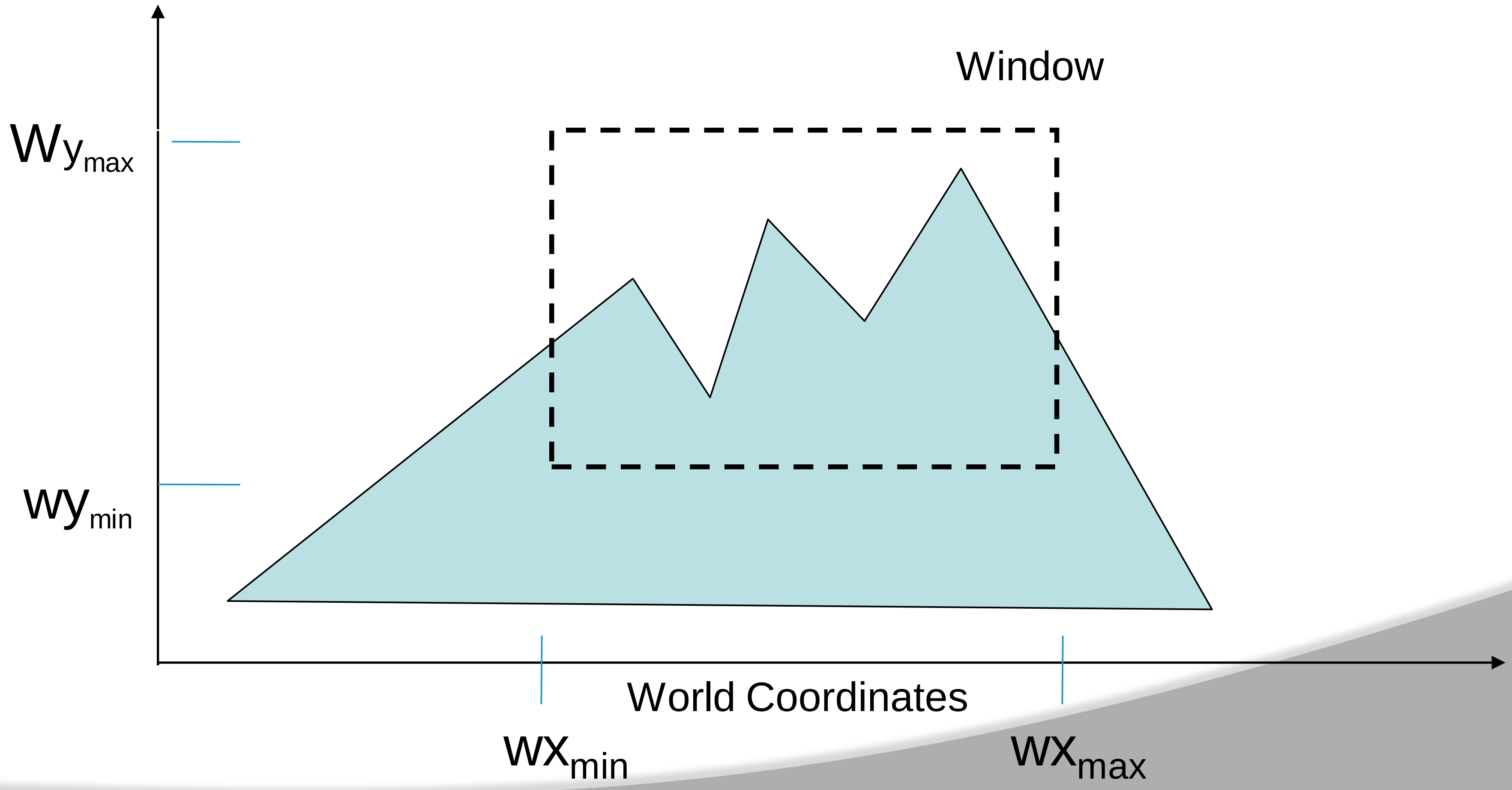
1. Introduction
2. Point Clipping
3. Line Clipping
4. Polygon/Area Clipping
5. Text Clipping
6. Curve Clipping

2D Clipping con't…

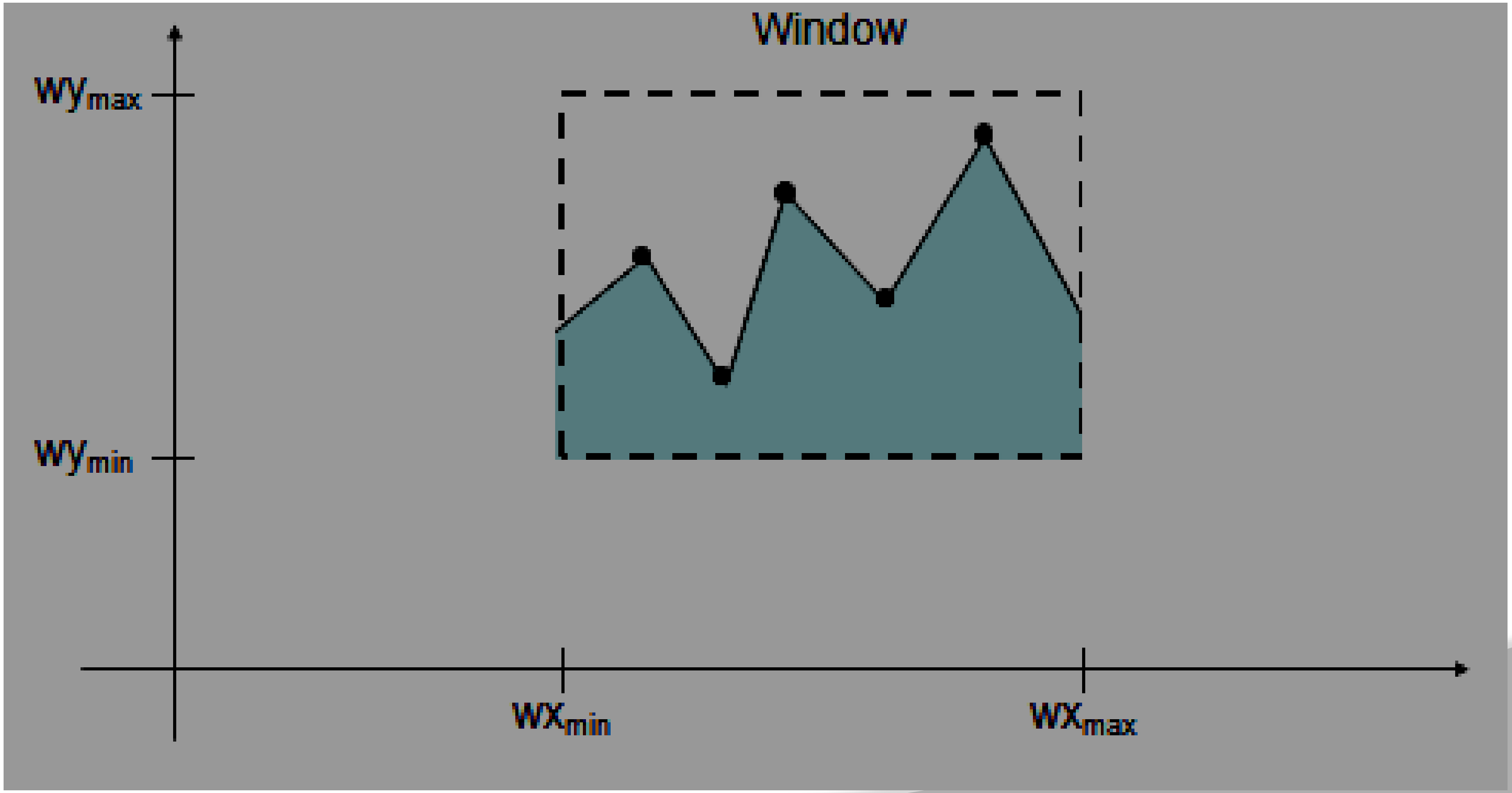
1. Introduction: A scene is made up of a collection of objects specified in world coordinates



When we display a scene only those objects within a particular window are displayed



Because drawing things to a display takes time we clip everything outside the window



Point Clipping

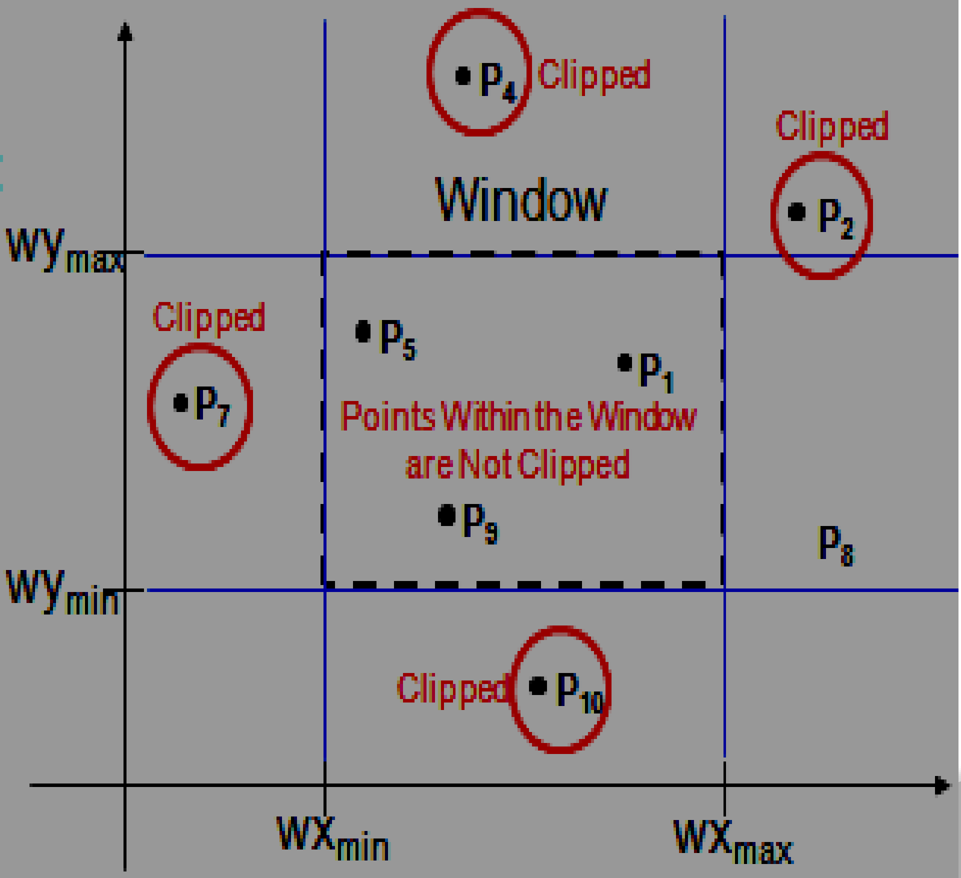
- Simple and Easy
- a point (x,y) is not clipped if:

$$wx_{min} \le x \le wx_{max}$$

&

$$wy_{min} \le y \le wy_{max}$$

- otherwise it is clipped



Geometric modeling is as important to CAD as governing equilibrium equations to classical engineering fields as mechanics and thermal fluids.

- Intelligent decision on the types of entities necessary to use in a particular model to meet certain geometric requirements such as slopes and/or curvatures.
- Interpretation of unexpected results
- Evaluations of CAD/CAM systems
- Innovative use of the tools in particular applications.
- Creation of new attributes, or modify the obtained models to
- Benefit new engineering applications.
- Understanding of terminology

UNIT – II
GEOMETRIC MODELING

GENERAL REQUIREMENTS

- Complete part representation including topological and geometrical data
- Geometry: shape and dimensions
- Topology: the connectivity and associativity of the object entities; it determines the relational information between object entities
- Able to transfer data directly from CAD to CAE and CAM.
- Support various engineering applications, such as mass properties, mechanism analysis, FEA/FEM and tool path creation for CNC, and so on.

BASIC GEOMETRIC MODELING TECHNIQUES

- WIREFRAME MODELING
- SURFACE MODELING

  Analytical Surface

  Free-form, Curved, & Sculptured Surface

- SOLID MODELING

  Constructive Solid Geometry (CSG)

  Boundary Representation (B-Rep)

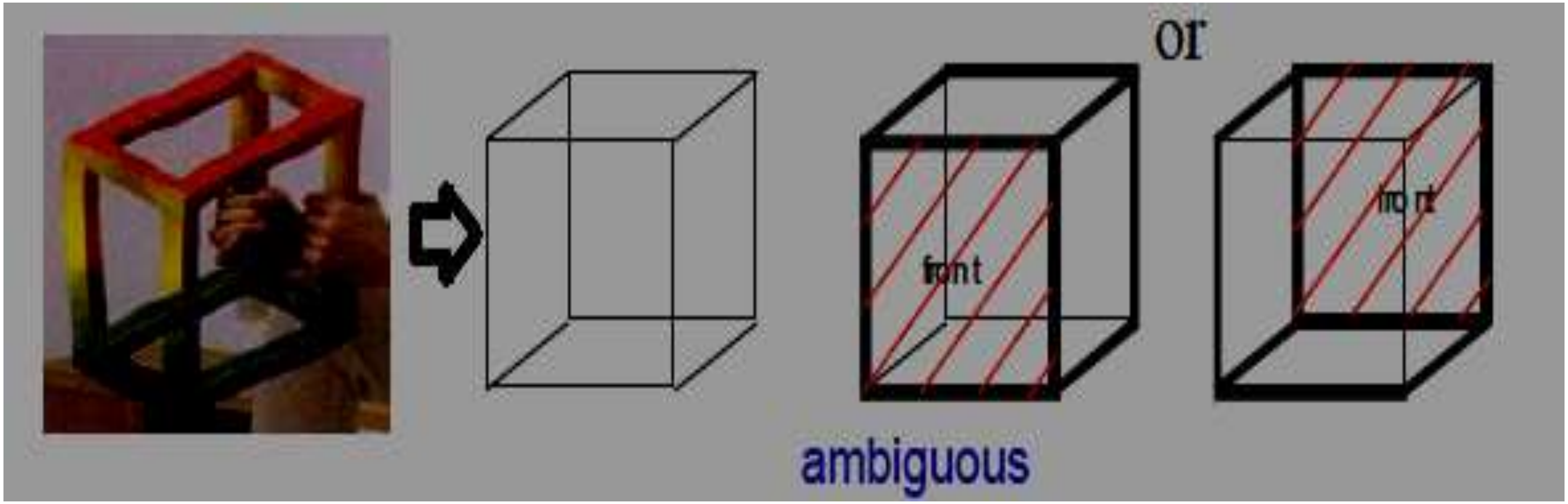
  Feature Based Modeling

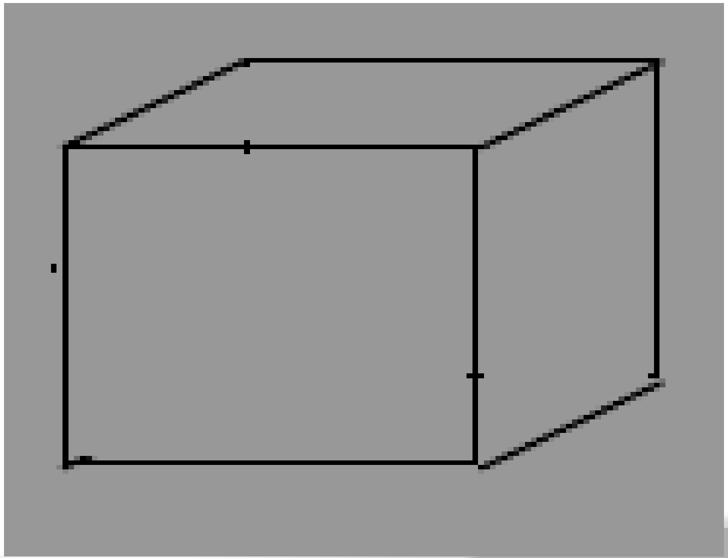
  Parametric Modeling

WIREFRAME MODELING

- Developed in 1960s and referred as “a stick figure” or “an edge representation”
- The word “wireframe” is related to the fact that one may imagine a wire that is bent to follow the object edges to generate a model.
- Model consists entirely of points, lines, arcs and circles, conics, and curves.
- In 3D wireframe model, an object is not recorded as a solid. Instead the vertices that define the boundary of the object, or the intersections of the edges of the object boundary are recorded as a collection of points and their connectivity.

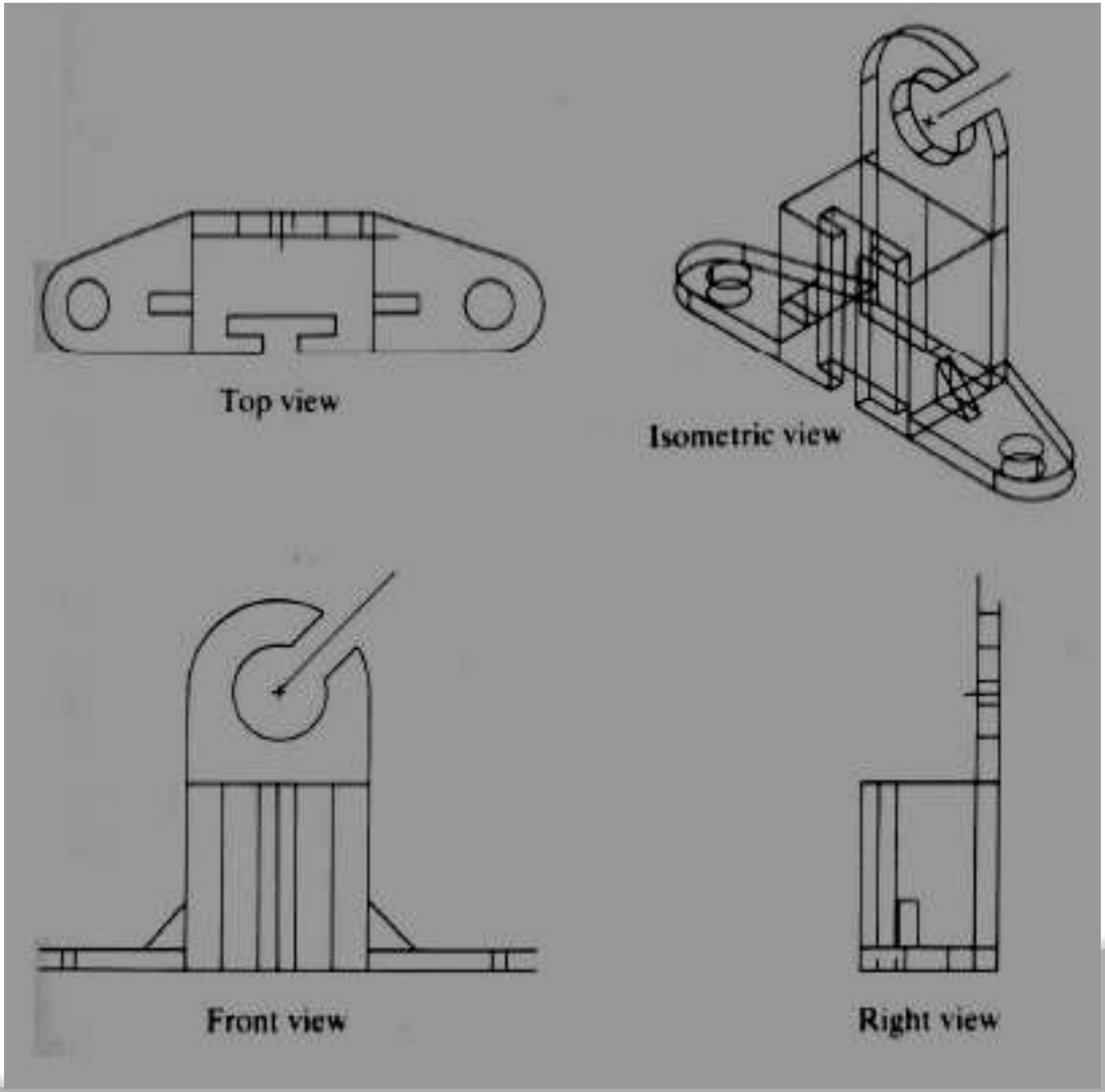
Wire frame model





Hidden line removal

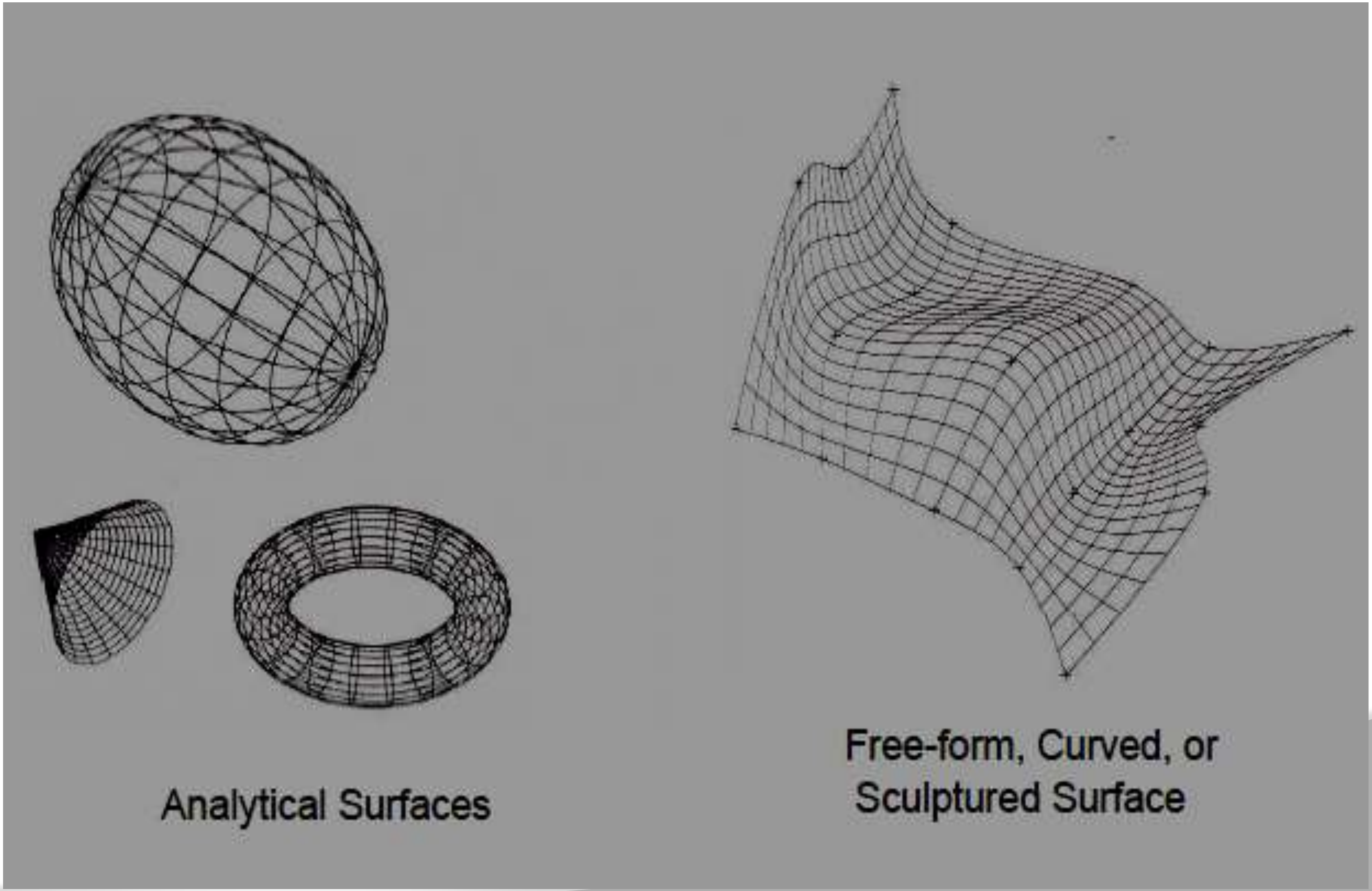
Example of wire frame model



SURFACE MODELING:

- A is a surface model consists of set of faces.
- A surface model consists of wireframe entities that form the basis to create surface entities.
- In general, a wireframe model can be extracted from a surface model by deleting or blanking all surface entities
- Shape design and representation of complex objects such as car, ship, and airplane bodies as well as castings
- Used to be separated, shape model are now incorporated into solid models (e.g. **CREO**)

EXAMPLES OF SURFACE MODELS



SOLID MODELING

- The boundary of the model separates the interior and exterior of the modeled object.
- The object is defined by the volume space contained within the defined boundary of the object.
- In general speaking, a closed boundary is needed to define a solid object.
- It is complete, valid, and unambiguous representation
  – points in space to be classified relative to the object, if it is inside, outside, or on the object

- store both geometric and topological information, two objects occupy the same space.
- improves the quality of design, improves visualization, and has potential for functional automation and integration.

Solid Modeling Advantages

Solid Modeling Support

- **Using volume information**

– weight or volume calculation, centroid, moments of inertia calculation,

– stress analysis (finite elements analysis), heat conduction calculations, dynamic analysis,

– system dynamics analysis

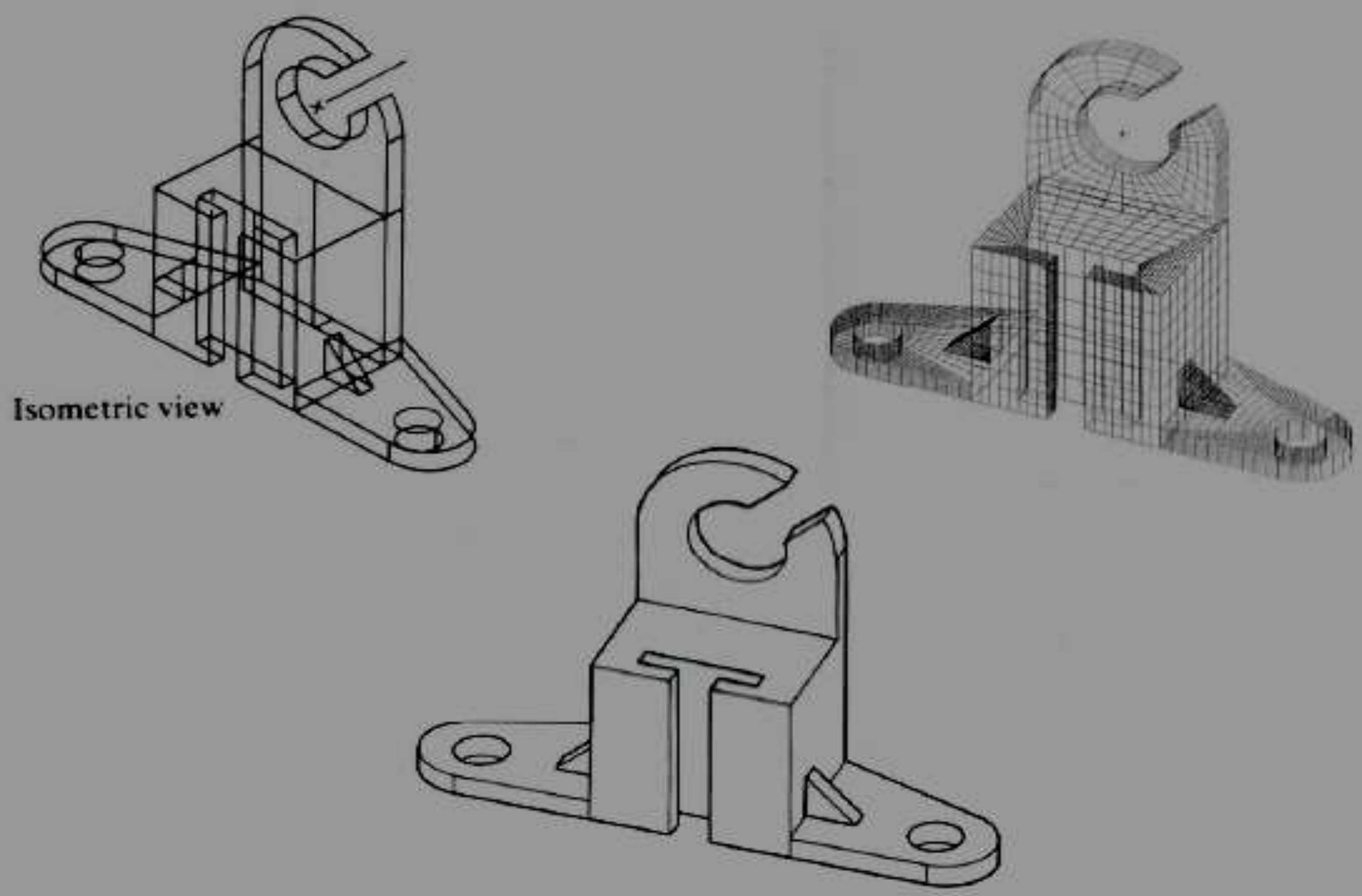
- **Using volume and boundary information**

– generation of CNC codes, and robotic and assembly simulation

Different Solid Modeling Techniques

- Constructive Solid Geometry (CSG)
- Sweeping
- Boundary Representation (B-Rep)
- Feature-Based Modeling - uses feature-based primitives to conduct a design
- Primitive Instancing - uses large numbers (200 - 300) of "primitives" to build object - used for programming NC machine tools (past)
- Cell Decomposition, Spatial Enumeration, Octree (connected cubes of varying size) – used for irregular objects, image processing, medical applications (CT)

SOLID MODEL

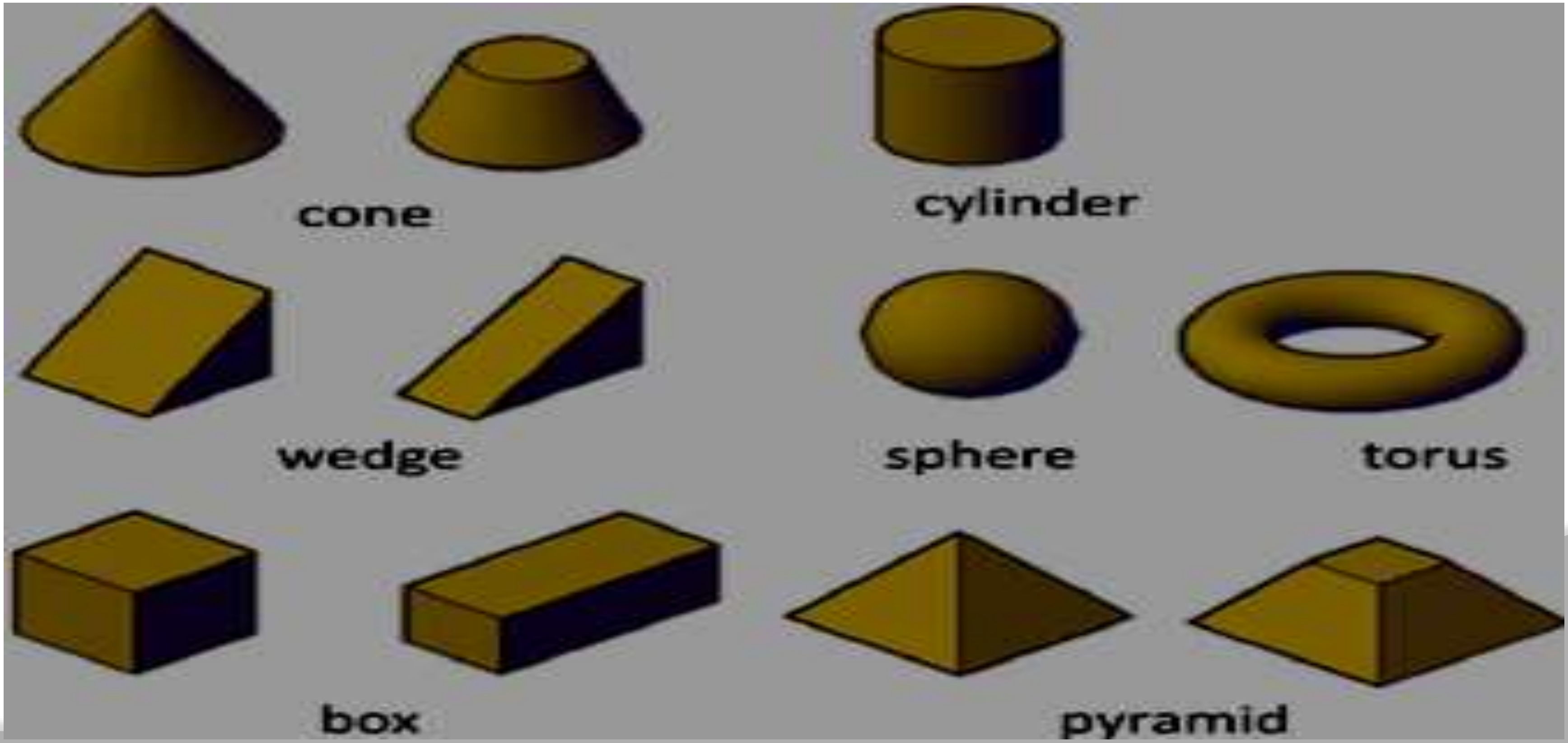


Information complete, unambiguous, accurate **solid model**

Constructive Solid Geometry (CSG)

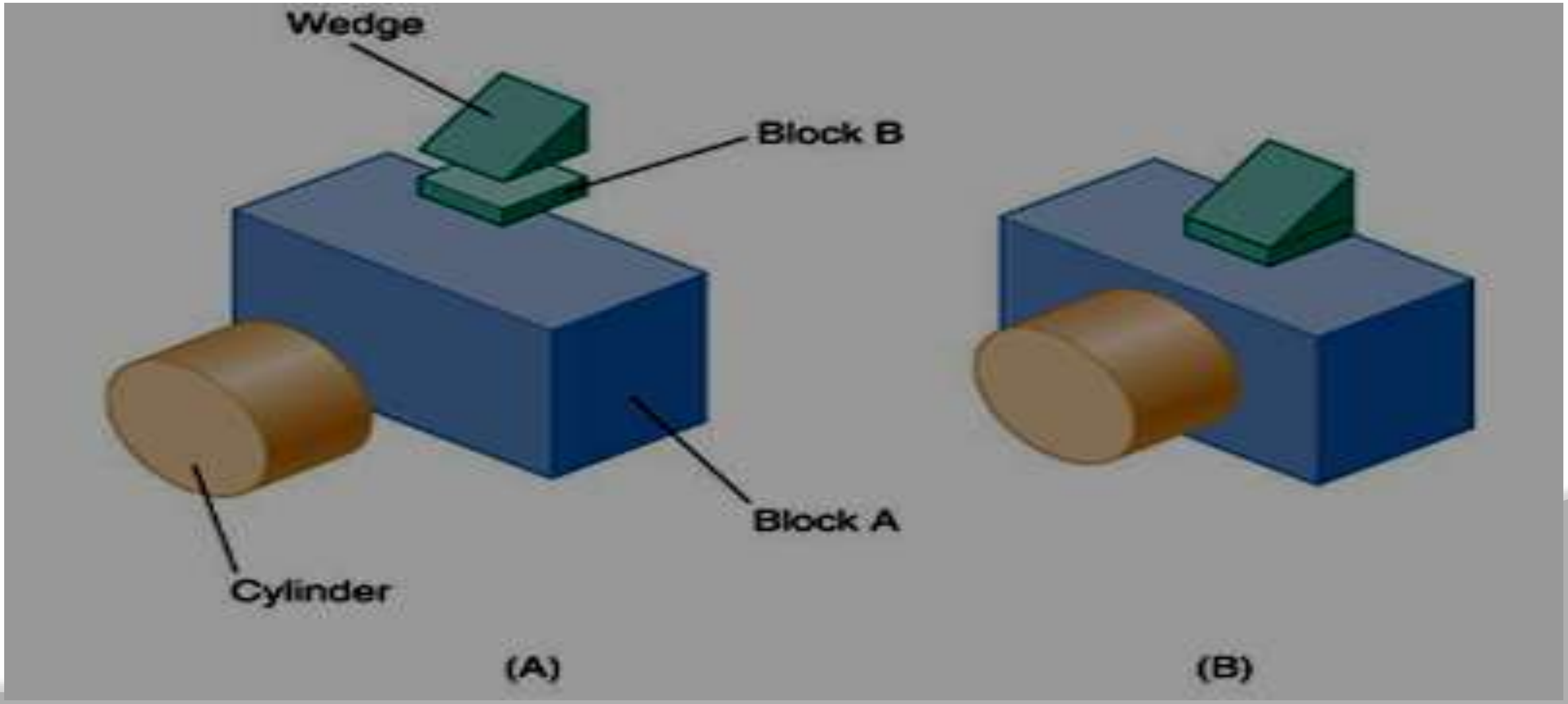
- Pre-defined geometric primitives
- Boolean operations
- CSG tree structure (building process/approach)

SOLID PRIMITIVES

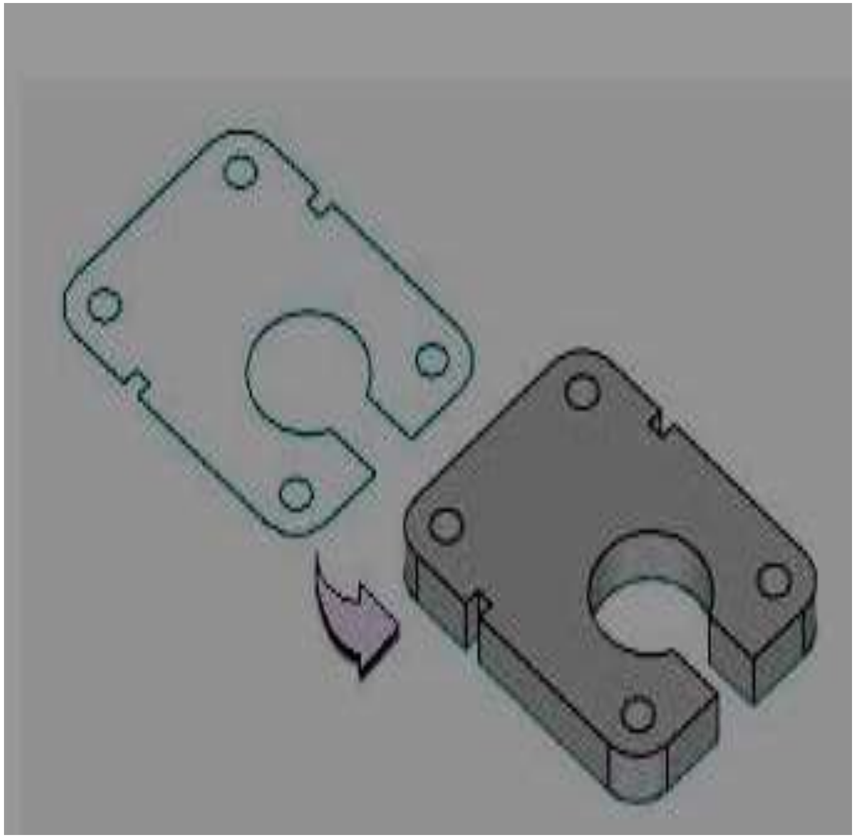


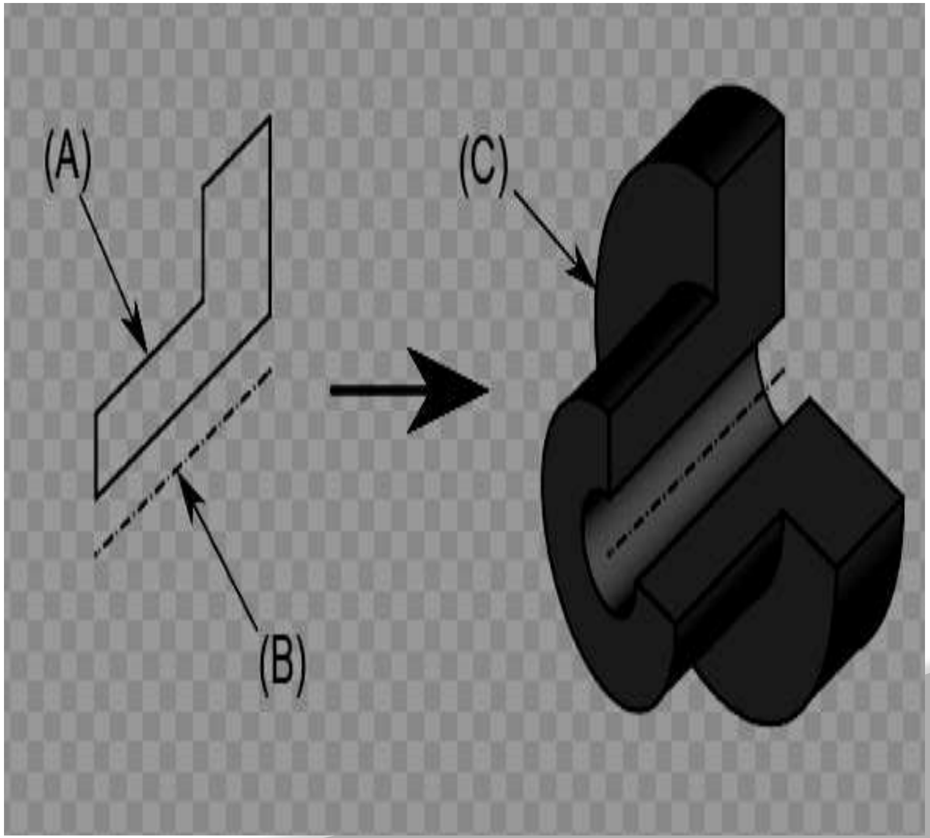
3 D CAD TYPES:

CSG MODELING: A collection of pre-defined (low level) geometric primitives and these are joined together to create more complex objects



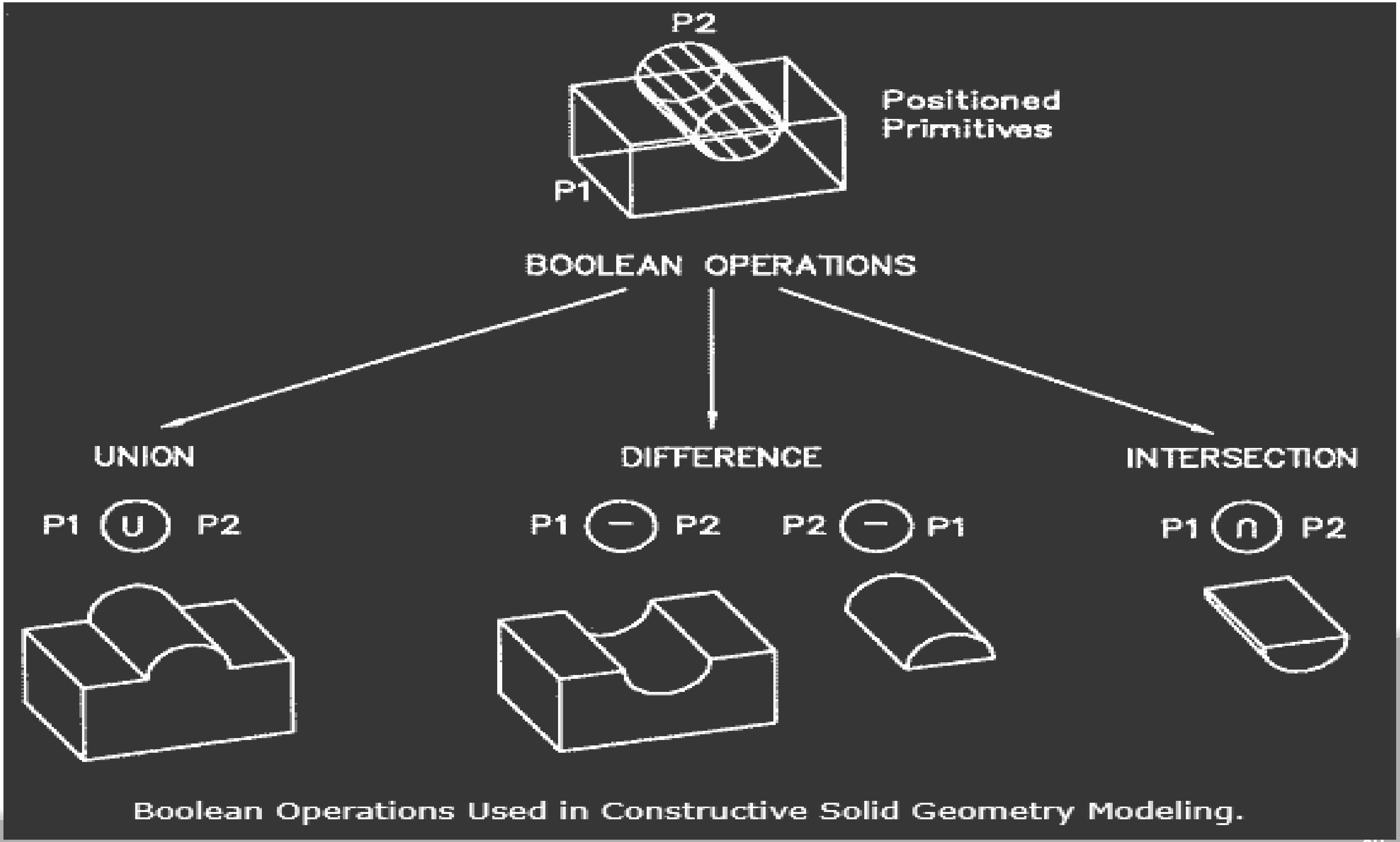
- **Sweeping** of a 2D cross-section in the form of extrusion and revolving are used to define the 3D shape (for uncommon shapes).





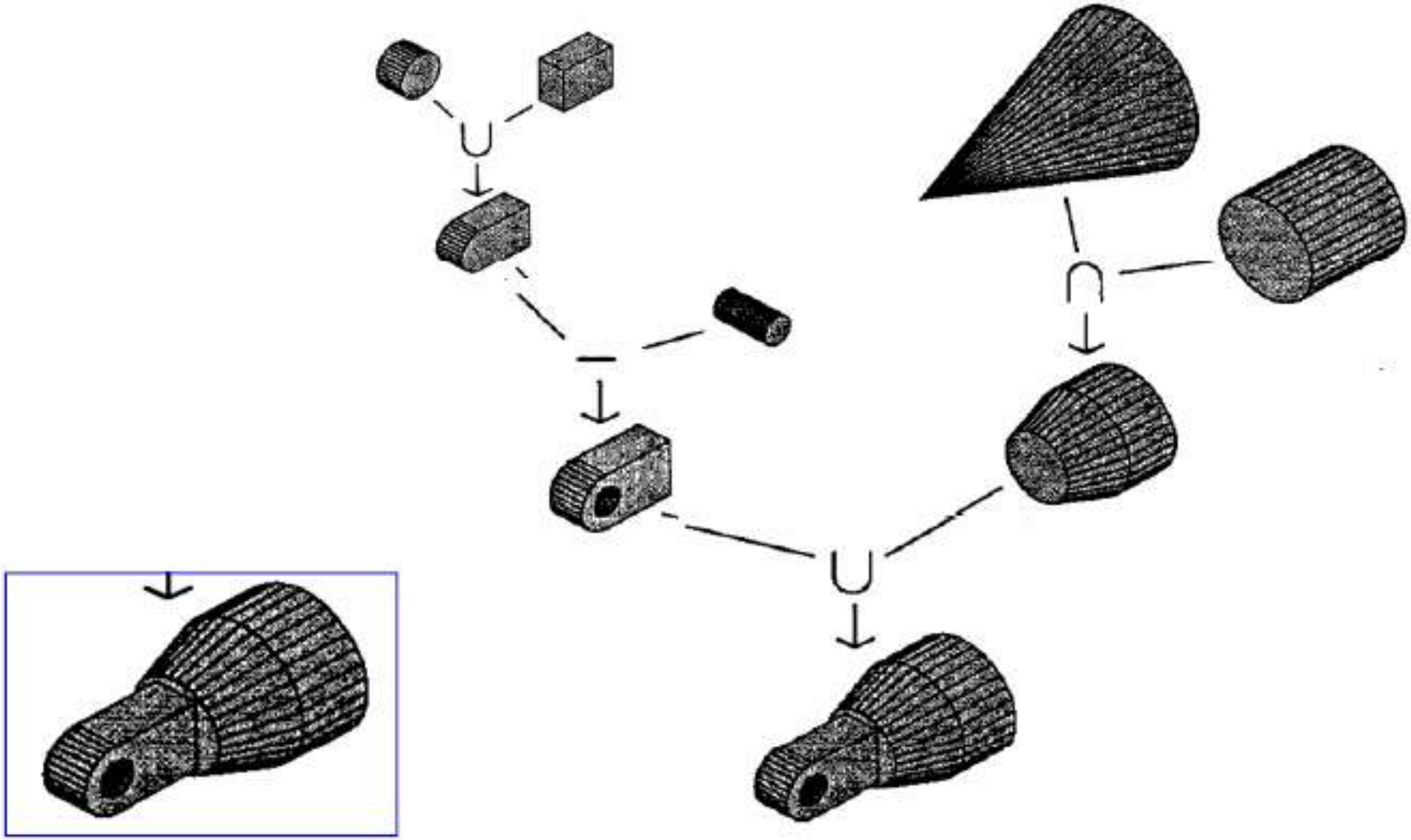
BOOLEAN OPERATIONS EX1

BOOLEAN OPERATIONS: 1.Union, 2. difference and 3.Intersection



BOOLEAN OPERATIONS EX2

CSG TREE



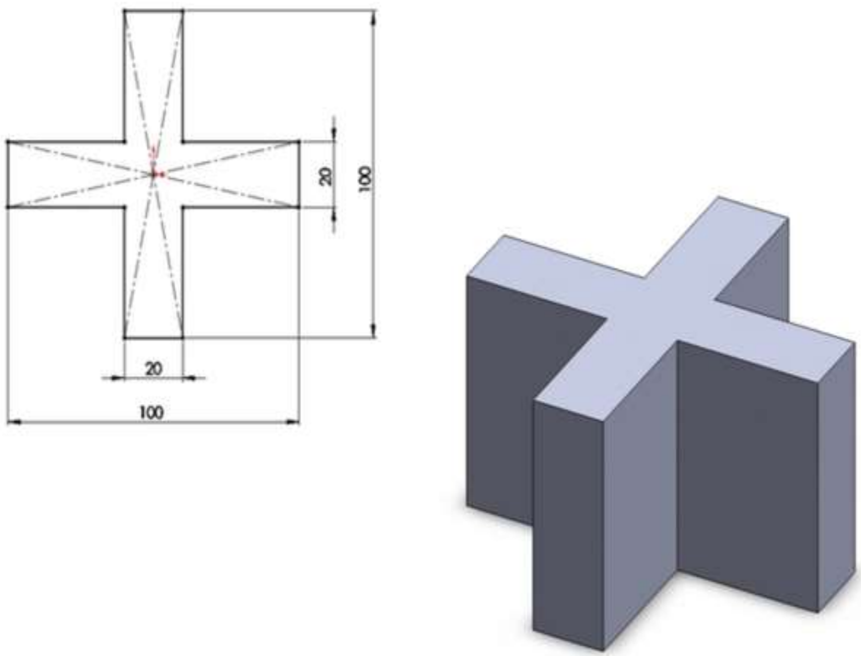
Sweeping

Sweeping can be carried out in two different forms:

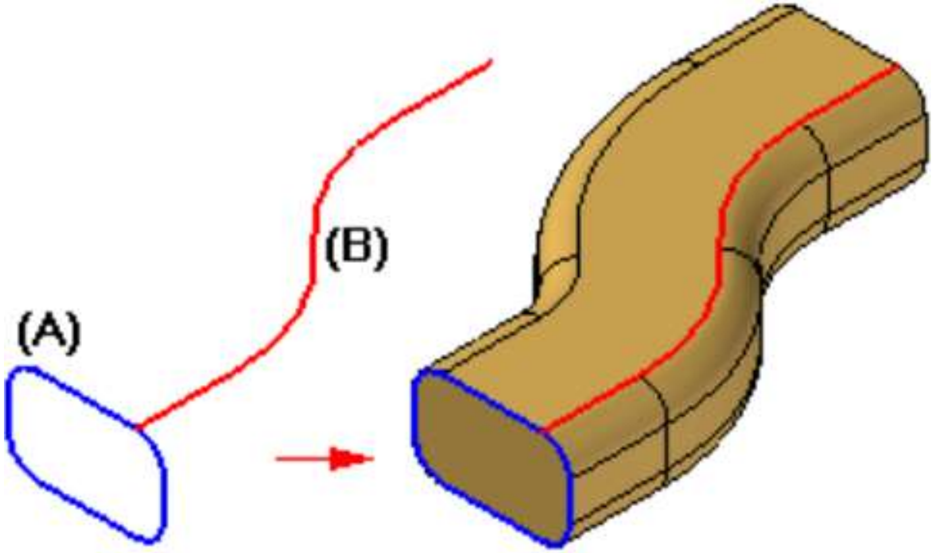
- Extrusion: To produce an object model from a 2D cross-section shape, the direction of extrusion, and a given depth.
  Advanced applications include curved extrusion guideline and varying cross sections.

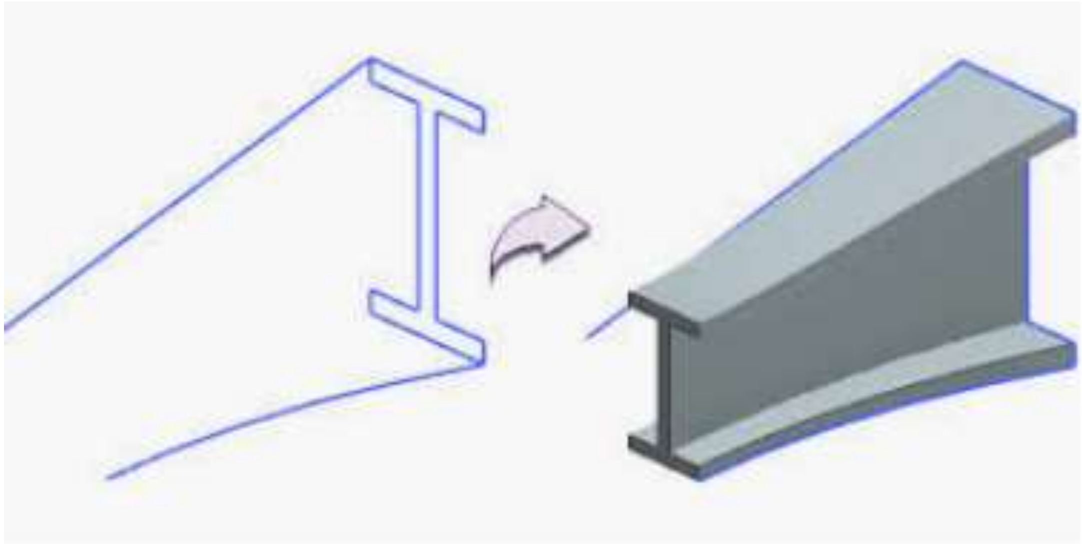
- Revolving - To produce a rotation part, either in solid or in shell shape. Revolving a 2D cross-section that is specified by a closed curve around the axis of symmetry forms the model of an axially symmetric object.

Sweeping is most convenient for solids with translational or rotational symmetry. Sweeping also has the capability to guarantee a closed object. Advanced: spatial sweeping; & varying cross-section



SWEEPING – ALONG GUIDE CURVE





BOUNDARY REPRESENTATION (B-REP)

Boundary representation: Often abbreviated as B-rep or BREP is a method for representing shapes using the limits. A solid is represented as a collection of connected surface elements, the boundary between solid and non-solid.

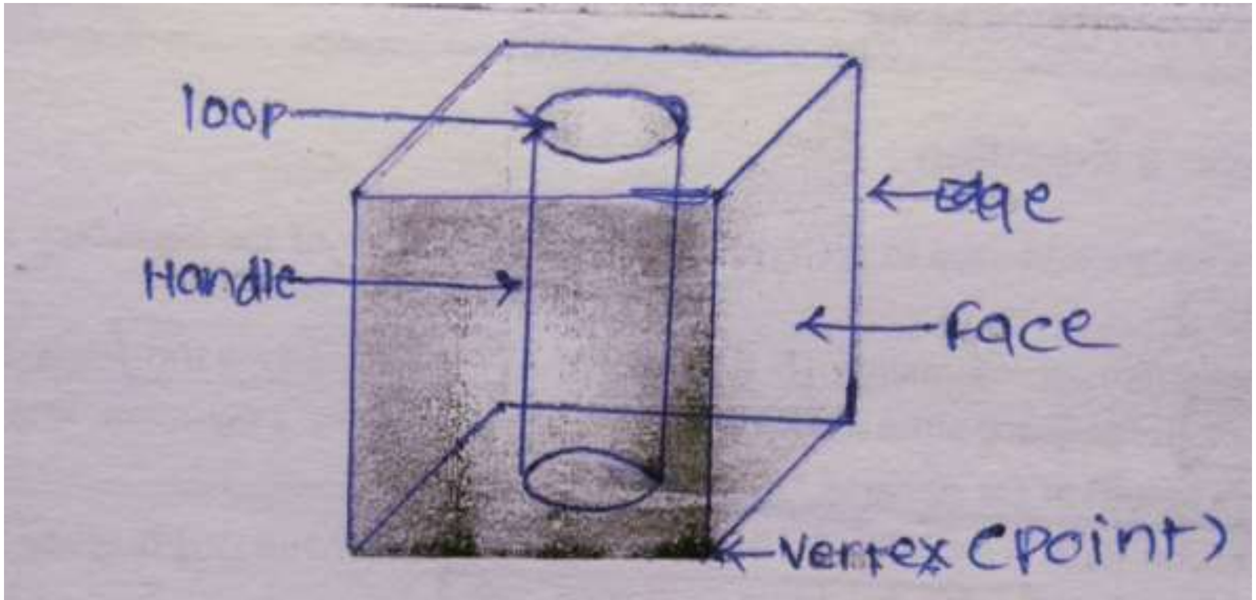


Fig. 5.4.1 : B-Rep Model of Object

A loop is a hole in a face. It is a two dimensional entity.

Boundary Representation (B-rep)

- The boundary representation method represents a solid as a collection of boundary surfaces.

- The database records both of the surface geometry and the topological relations among these surfaces.

- Boundary representation does not guarantee that a group of boundary surfaces (often polygons) form a closed solid. The data are also not in the ideal form for model calculations.

SUMMARY - GEOMETRIC MODELING

Geometric Modeling is a fundamental CAD technique. The capability of various CAD tools in geometric modeling is usually used as a crucial factor in tool selection.

- Wireframe models consist entirely of points, lines, and curves.
- Since wireframe models do not have "body knowledge", topological data are not needed in construction.
- Surface models store topological information of their corresponding objects.

- Both surface models and solid models support shading.
- Surface models is still ambiguous and thus cannot support a full range of engineering activities such as stress analysis
- Solid models have complete, valid and unambiguous spatial addressability.
- In general, a wireframe model can be extracted from a surface or a solid model.

.

WIREFRAME MODELING - ADVANTAGES

Advantages

- Simple to construct
- Does not require as much as computer time and memory as does surface or solid modeling (manufacturing display)
- As a natural extension of drafting, it does not require extensive training of users.
- Form the basis for surface modeling as most surface algorithms require wireframe entities (such as points, lines and curves)

Disadvantages

- The input time is substantial and increases rapidly with the complexity of the object
- Both topological and geometric data need to be user-input; while solid modeling requires only the input of geometric data.
- Unless the object is two-and-a-half dimensional, volume and mass properties, NC tool path generation, cross-sectioning, and interference cannot be calculated.

- **Advantages:** Less ambiguous
- Provide hidden line and surface algorithms to add realism to the displayed geometry
- Support shading
- Support volume and mass calculation, finite element modeling, NC path generation, cross sectioning, and interference detection. (when complete)

Disadvantages

- Require more training and mathematical background of the users Require more CPU time and memory
- Still ambiguous; no topological information
- Awkward to construct

CSG AND BREP-COMPARISON

1. CSG uses Euler operators in modeling.
2. CSG needs low storage due to the simple tree structure and primitives.
3. CSG primitives are constructed from the half-space concept.
4. Directed surfaces, Euler operations and Euler's law fundamentally distinguish the B-Rep from wireframe modeling.
5. Traditionally, CSG cannot model sculptured objects and thus is limited in modeling capability.

   (This is no longer true for Advanced CAD systems, such as CREO)

CSG AND BREP-COMPARISON

6. It is easier to convert a CSG model to a wireframe model than to convert a B-rep model to a wireframe model.
7. Because both CSG and B-rep use face direction (half-space or surface normal), they can have a full "body knowledge."
8. Generally speaking, most high-end CAD tools have the B- rep (or hybrid) method while most low-end tools rely heavily on the CSG method.

Two types of representation are

1. Parametric and
2. Non-parametric representation.

In parametric representation all variables (i.e., coordinates) are expressed in terms of common parameters. For example, a point can be expressed with respect to a parameter as

$$P(u) = [x(u), y(u), z(u)], \quad u_{\text{min}} \leq u \leq u_{\text{max}}$$

Non-parametric representation is the conventional representation as

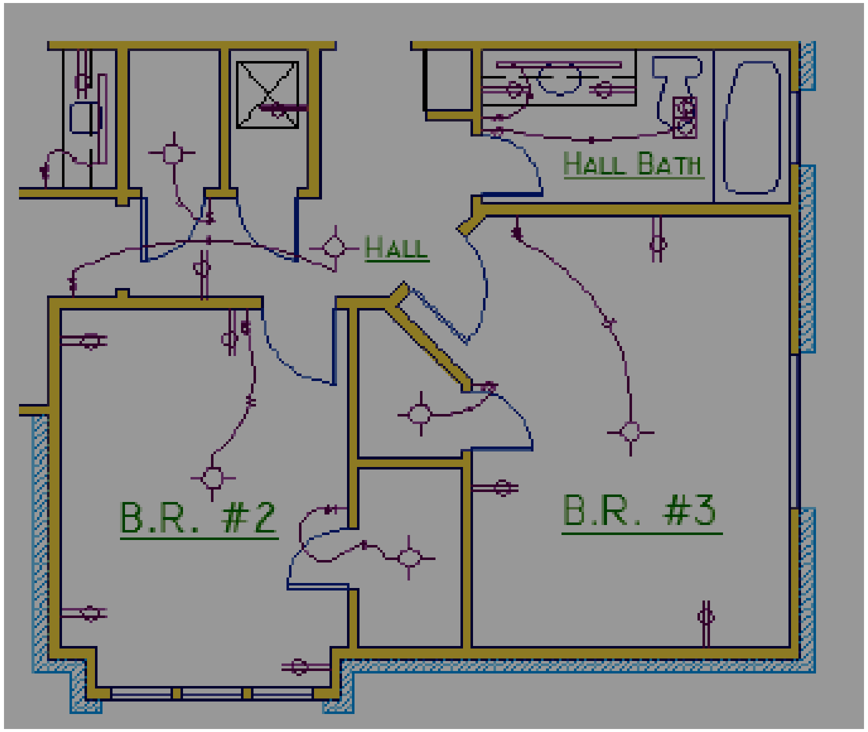
$$P = [x, y(x), z(x)]$$

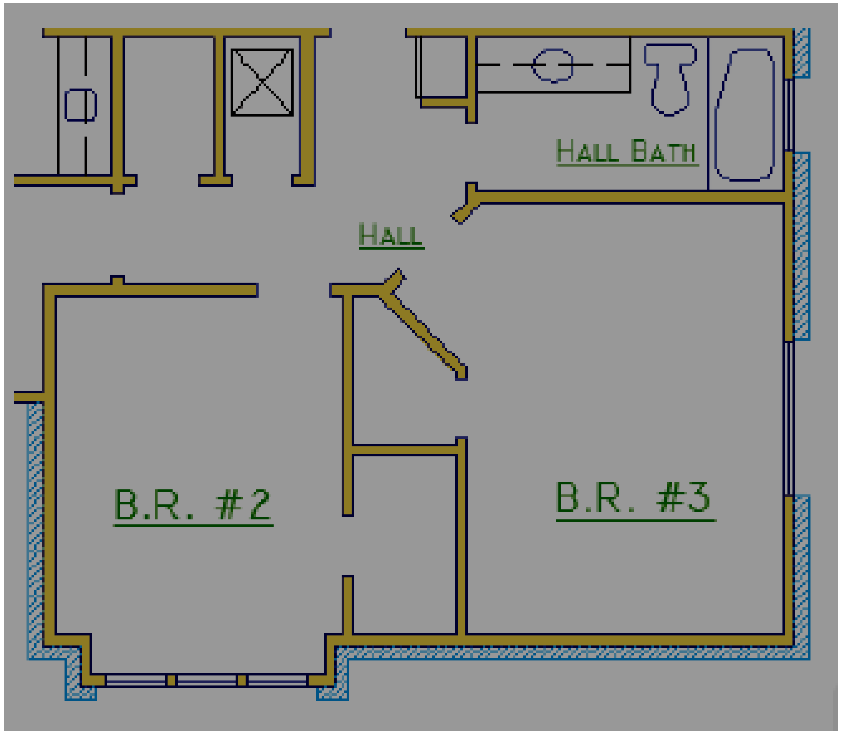
LAYERS

- Organize your drawing by assigning objects to layers.
- When a drawing becomes visually complex, can be hide some objects which are currently do not need to see.
- Can be assigned properties such as color and line type to individual objects, or as default properties assigned to layers.

LAYERS Cont …,

In the drawing below, the doors and electrical wiring were temporarily hidden by hiding their layers.





LAYERS STANDARDS

- It’s important to either establish or conform to a company-wide layer standard. With a layer standard, drawing organization will be more logical, consistent, compatible, and maintainable over time and across departments.

- Layer standards are essential for team projects.

- Create a standard set of layers and save them in a drawing template file, those layers will be available when started a new drawing, or to start working immediately.

- Additional information about drawing template files is presented in the Basics topic.

DISPLAY CONTROL COMMANDS

1. ZOOM: Increases or decreases the apparent size of objects in the current view port

2. PAN : Shifts the location of a view

3 REDRAW AND REGEN: Redraw refreshes the current view.

4. EDIT COMMANDS:

- Move (M+Enter)
- Rotate (RO+Enter)
- Copy (CO+Enter)
- Mirror (M+Enter)
- Stretch

- Scale (SC+Enter)
- Trim (TR+Enter)
- Extend (EX+Enter)
- Fillet (F+Enter)
- Extend EX+Enter)

- Fillet (F+Enter)
- Chamfer (CHA+Enter)
- Blend Curves
- Offset (O+Enter)

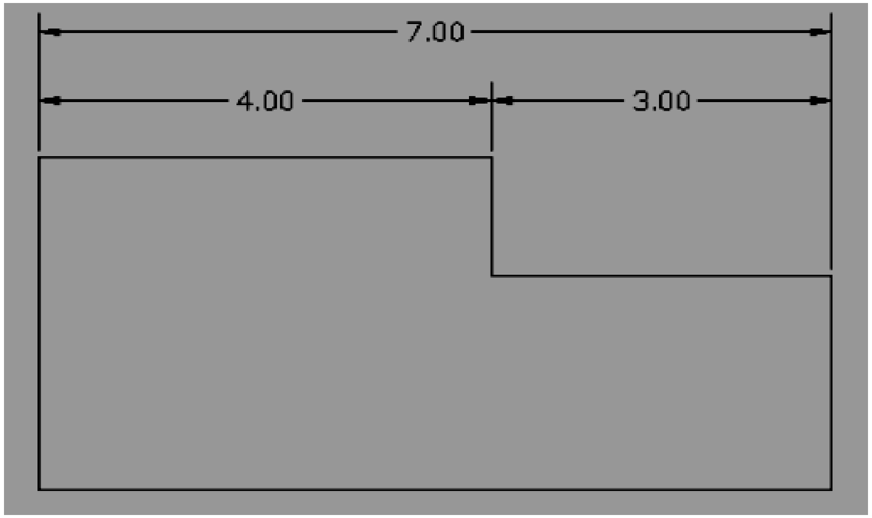
DISPLAY CONTROL COMMANDS

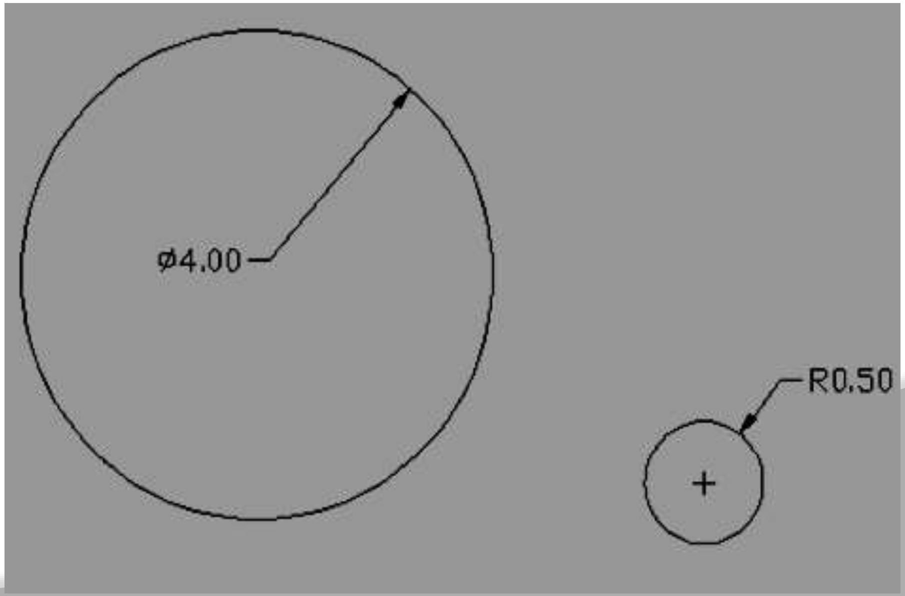
- Array (AR+Enter)
- Explode
- Lengthen
- Break (BR+Enter)
- Break at point
- Join (J+Enter)
- Edit Hatch
- Edit Array
- Edit Polyline (PEdit+Enter)
- Edit Spline
- Erase (E+Enter)

- Creates multiple types of dimensions within a single command session.

- When representing dimensioning the object the DIM command automatically previews a suitable dimension type to use.

- Select objects, lines, or points to dimension and click anywhere in the drawing area to draw the dimension.





UNIT – III
GROUP TECHNOLOGY, CAPP AND CAQC

GT is a manufacturing philosophy in which similar parts are identified and grouped together to take advantage of their similarities in design and production

Application of GT

- „ Plants using traditional batch production and „process type layout
- „ If the parts can be grouped into part families

„Implementation of GT

„Identify part families

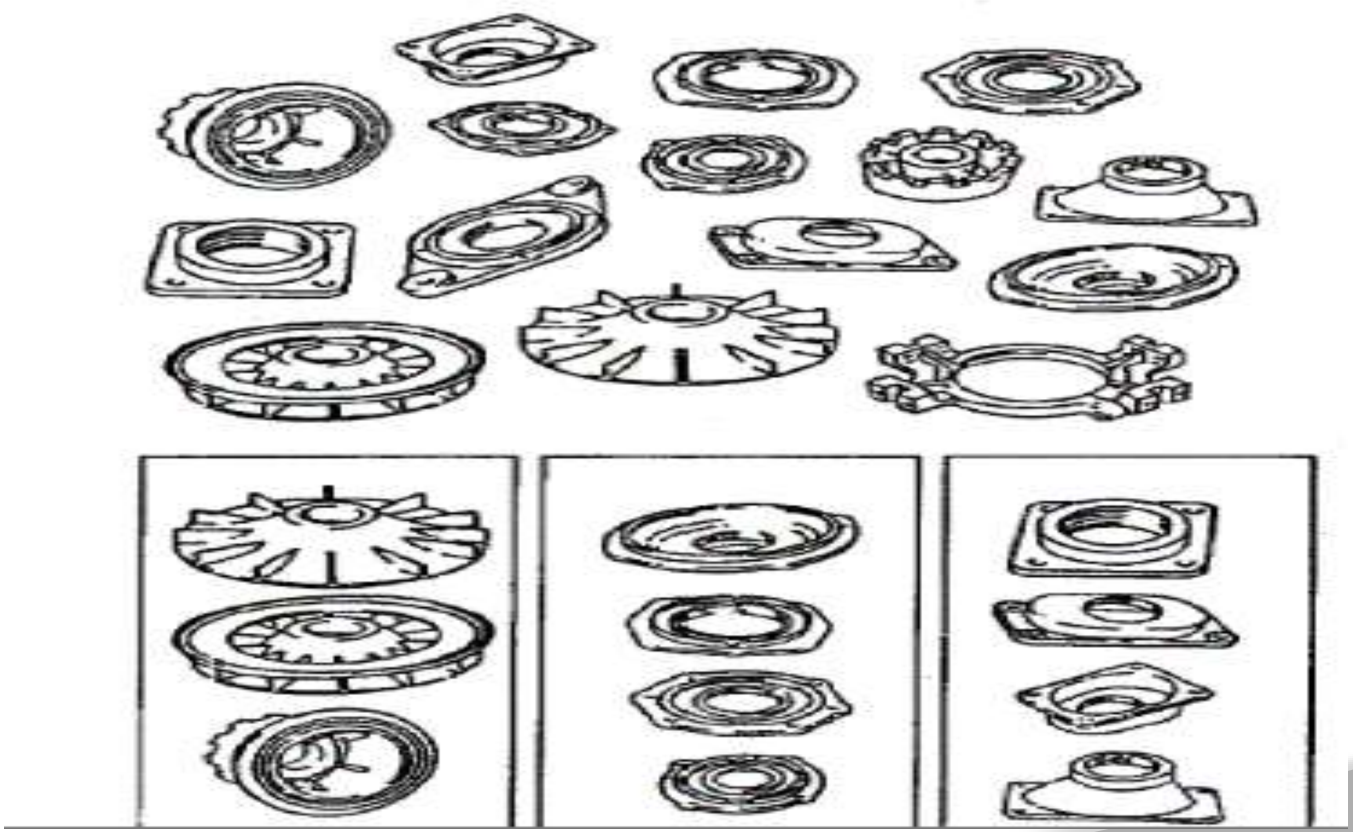
„Rearrange production machines into machine cells

- An approach to manufacturing in which similar parts are identified and grouped together in order to take advantage of their similarities in design and production
- Similarities among parts permit them to be classified into part families
- In each part family, processing steps are similar
- The improvement is typically achieved by organizing the production facilities into manufacturing cells that specialize in production of certain part families.

Part Family

- A group of parts that possess similarities in geometric shape and size, or in the processing steps used in their manufacture
- Part families are a central feature of group technology
- There are always differences among parts in a family
- But the similarities are close enough that the parts can be grouped into the same family

- **GT is a concept that seeks to take advantage of the design and processing similarities among the parts to be produced.**



PART FAMILY Cont …,

- There are three general methods for solving part families grouping. All the three are time consuming and involve the analysis of much of data by properly trained personnel.

- The three methods are:

  1.Visual inspection.

  2.Parts classification and coding.

  3.Production flow analysis.

VISUAL INSPECTION METHOD

- The visual inspection method is the least sophisticated and least expensive method.
- It involves the classification of parts into families by looking at either the physical parts or their photographs and arranging them into groups having similar features.

PARTS CLASSIFICATION AND CODING

- In parts classification and coding, similarities among parts are identified, and these similarities are related in a coding system.

- Two categories of part similarities can be distinguished:

  1. Design attributes, which concerned with part characteristics such as geometry, size and material.

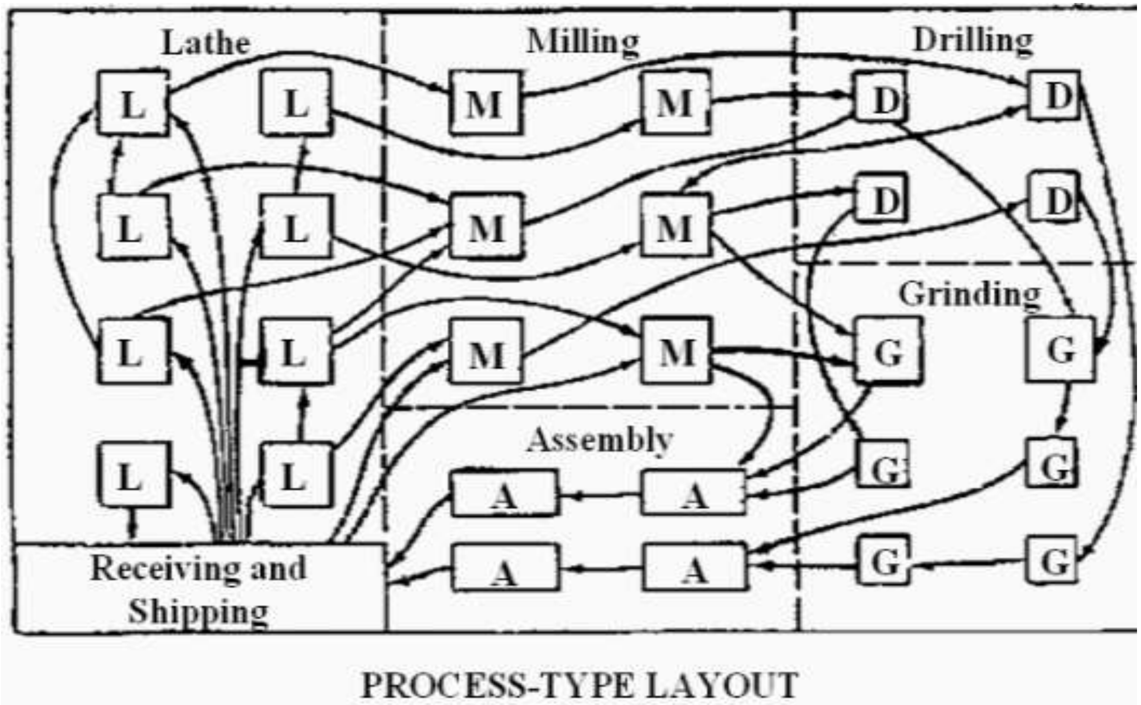
  2. Manufacturing attributes, which consider the sequence of processing steps required to make a part.

PRODUCTION FLOW ANALYSIS

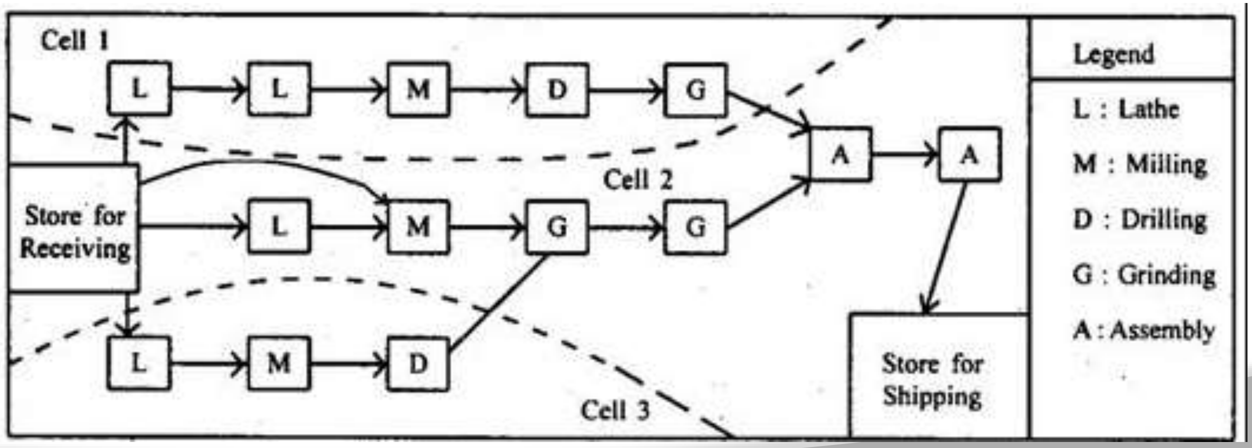
- Production flow analysis (PFA) is a method for identifying part families and associated machine groupings that uses the information contained on process plans rather than on part drawings.

- Workparts with identical or similar process plans are classified into part families. These families can then be used to form logical machine cells in a group technology layout.

- The procedure in production flow analysis must begin by defining the scope of the study, which means deciding on the population of parts to be analyzed.



Traditional functional layout of machine tools



- GT (Cellular) layout

COMPUTER-AIDED PROCESS PLANNING (CAPP)

- **CAPP** is the use of computer technology to aid in the process planning of a part or product in manufacturing.
- CAPP is the link between CAD and CAM in that it provides for the planning of the process to be used in producing a designed part
- Process planning is a production organization activity that transforms a product design into a set of instruction (sequence, machine tool setup etc.) to manufacture machined part economically and competitively

CAPP ROLES IN MANUFACTURING

- Used to develop a product manufacturing plan based on projected variables such as cost, lead times, equipment availability, production volumes, potential material substitution routings and testing requirements.
- CAPP is a decision-making process, it determines a set of instruction and machining parameters required to manufacture a part.
- Integrates and optimizes system performance for every product/component to ensure functionality aspect and design specifications meet requirements.

METHODS OF PROCESS PLANNING

a) The manual experience based planning method

- The manual experience based process planning is most widely used
- It is mainly based on a manufacturing engineer's experience and knowledge of production facilities, equipment, their capabilities, processes and tooling.

b) Computer Aided Process Planning

- Purpose of process planning is to translate the design requirements into manufacturing process details
- A system was developed in which design information is processed by the process planning system to generate manufacturing process details.

ADVANTAGES OF CAPP SYSTEMS OVER TRADITIONAL PROCESS PLANNING

1. Improves the productivity of process planners, reduces lead time, reduces planning costs, improves consistency of product quality and reliability.
2. Can be modified to suit specific needs.
3. Routing sheet can be prepared more quickly.
4. Other function such as cost estimating and work standards can be incorporated into CAPP.

COMPUTER AIDED PLANNING AND CONTROL,
SHOP FLOOR CONTROL
AND
INTRODUCTION TO FMS

SHOP FLOOR CONTROL

- Shop floor control Manages the detailed flow of materials inside the production facility.
- It Encompasses the principles, approaches and techniques needed to schedule, control, measure and valuate the effectiveness of production operations.
- Is an activity of production control one of the activity of process planning and control (PPC).
- To understand the significance of the shop floor control, it is essential to have the basic knowledge of various activities of PPC and their relations to shop floor control.

SHOP FLOOR CONTROL

It is defined as a system for utilizing data from the shop floor as well as data processing files to maintain and communicate status information on shop orders and work centre.

Shop floor control (SFC) is concerned with:

- The release of production orders to the factory.
- Monitoring and controlling the progress of the orders through the various work centres.
- Acquiring information on the status of the orders.
- Shop floor control deals with managing the work-in-process.

FUNCTIONS OF SHOP FLOOR CONTROL

The major functions of shop floor control are:

- Assigning priority of each shop order (Scheduling).
- Maintaining work-in-process quantity information (Dispatching).
- . Conveying shop-order status information to the office (Follow up).
- Providing actual output data for capacity control purposes.
- Providing quantity by location by shop order for work-in-process inventory and accounting purposes.
- Providing measurement of efficiency, utilisation and productivity of manpower and machines.

FUNCTIONS OF SHOP FLOOR CONTROL

The functions of : 1 Scheduling,

2. Dispatching and
3. Follow-up or Expediting.

Phases of SFC

The three important phases of SFC are:

1. Order release
2. Order scheduling and
3. Order progress.

It Depicts the three phases and their relationship to other functions in the production management system.

In a computer integrated manufacturing system these phases are managed by computer software.

INPUTS FOR SHOP FLOOR

(i) Authorization:

The authorization to produce from master schedule, which proceeds through MRP which generates work orders with scheduling information.

(ii) Engineering and manufacturing database:

Which contains engineering data such as the product design, component material specifications, bills of materials, process plans, etc. required to make the components and assemble the products. Database input provides the product structure and process planning information needed to prepare the various documents that accompany the order through the shop.

INPUTS FOR SHOP FLOOR

(iii) Order Scheduling

The two inputs required to the order scheduling are:

(a) The order release and

(b) The priority control information

It Priority control is used in production planning and control to denote the function that maintains the appropriate levels for the various production orders in the shop.

APPLICATIONS OF SHOP FLOOR

The order scheduling module is used to solve the following two problems in production controls:

(**i) Machine loading**:

Allocating orders to work centres is known as machine loading. The term shop loading is used when loading of all machines in the plant are done.

(ii) Job sequencing:

Determining the priority in which the jobs should be processed is termed as job sequencing.

Each work centre will have a queue of orders waiting to be processed. Queue problem are solved by job sequencing.

(iii) Priority sequencing rules (dispatching rules):

To establish priorities for production orders in the plant.

PROGRESS REPORT OF SHOP FLOOR

These reports indicate the performance of the shop during a certain time period (say, week or month in the master schedule).

- **Typical information listed in these reports include**
  How many orders were completed during the period,
  How many orders during the period were not completed.

- **Exception reports**:
  These reports indicate the deviations from the production schedule (e.g. overdue jobs), and similar exception information.

FORMS OF ORDER PROGRESS REPORTS FOR SHOP FLOOR

The three forms of order progress reports that are presented to production management are:

- Work order status reports :
  (i) Current status of each shop.
  (ii) Current work centre where each order is located, processing hours remaining before completion of each order,
  (iii) Whether the job is on-time or behind schedule and priority level.

INTRODUCTION TO FMS

Integrates all major elements of manufacturing into a highly automated system.

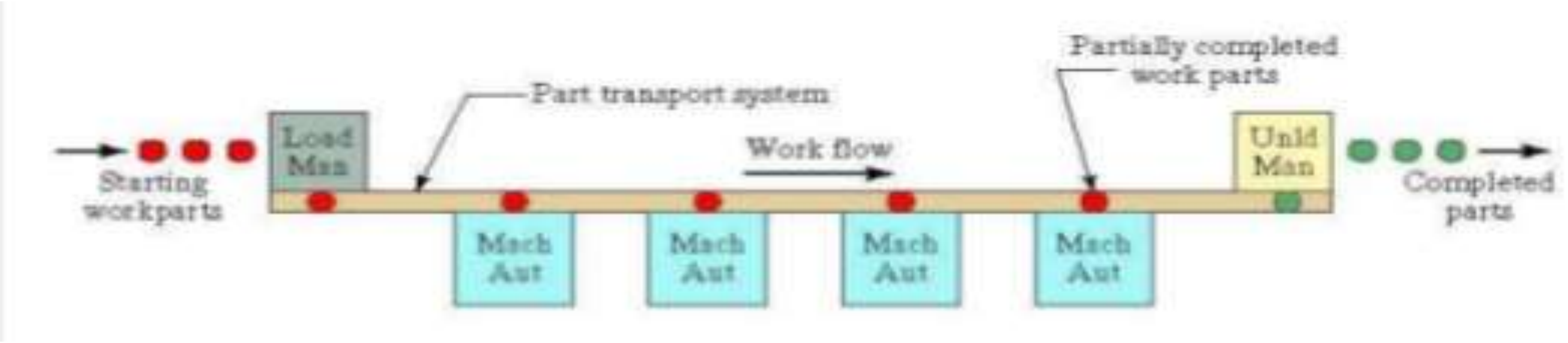
FMS consists a automated machine cells, interconnected with automated material handling system and storage system and all interfaced with a central computer.

TYPES OF LAYOUTS OF FMS:

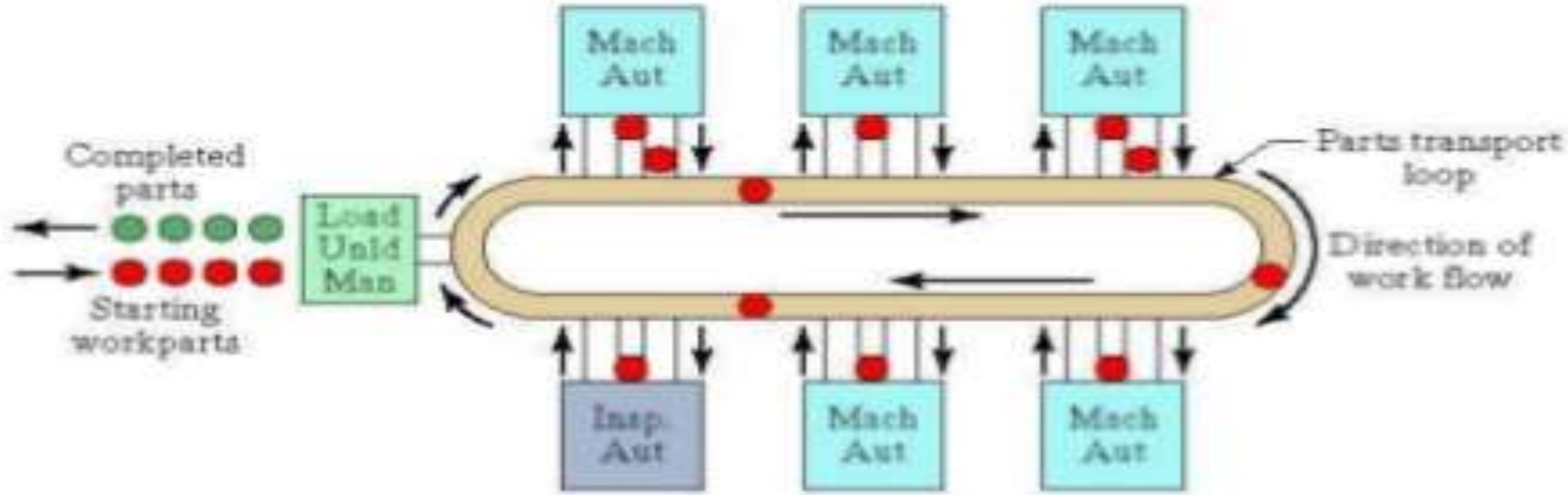
- Progressive or Line type,
- Loop type,
- Ladder type,
- Open field type.
- Robert centered type

TYPES OF LAYOUTS IN FMS

1. PROGRESSIVE OR LINE TYPE LAYOUT

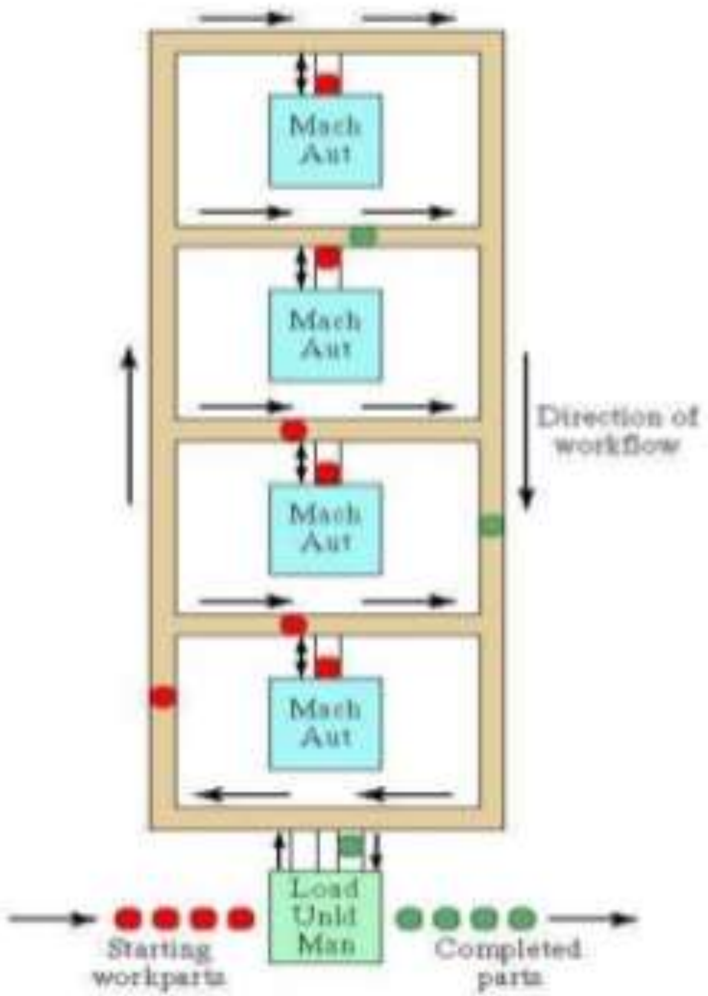


2. LOOP TYPE LAYOUT

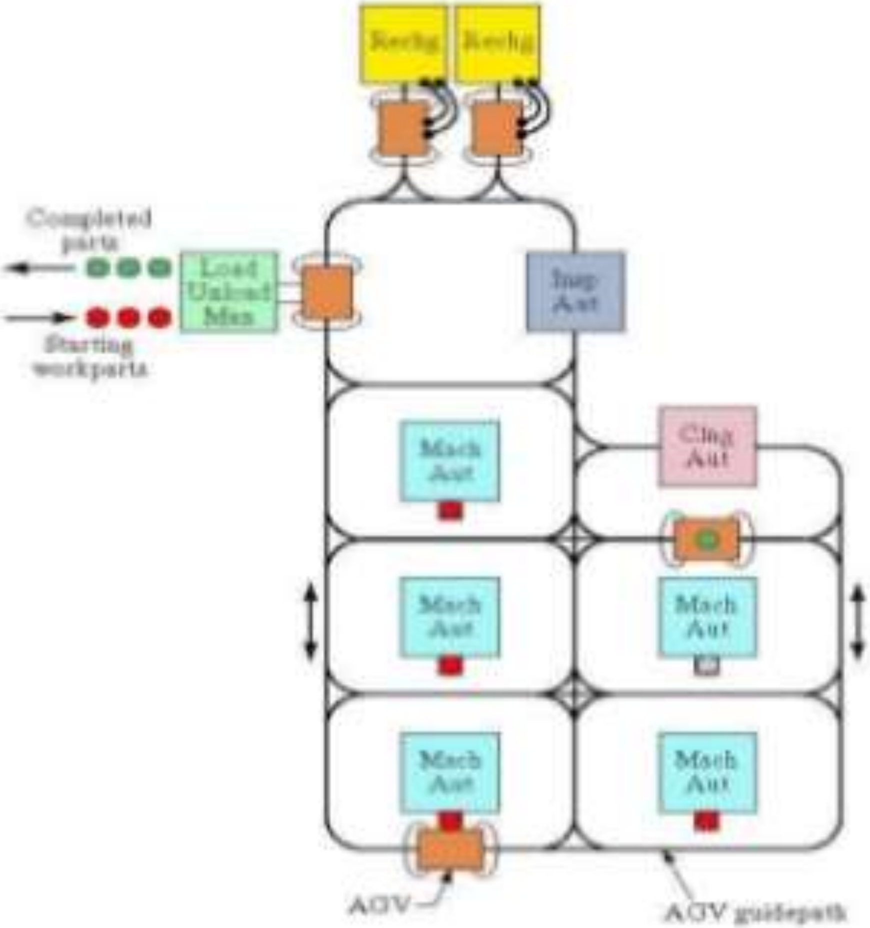


TYPES OF LAYOUTS IN FMS

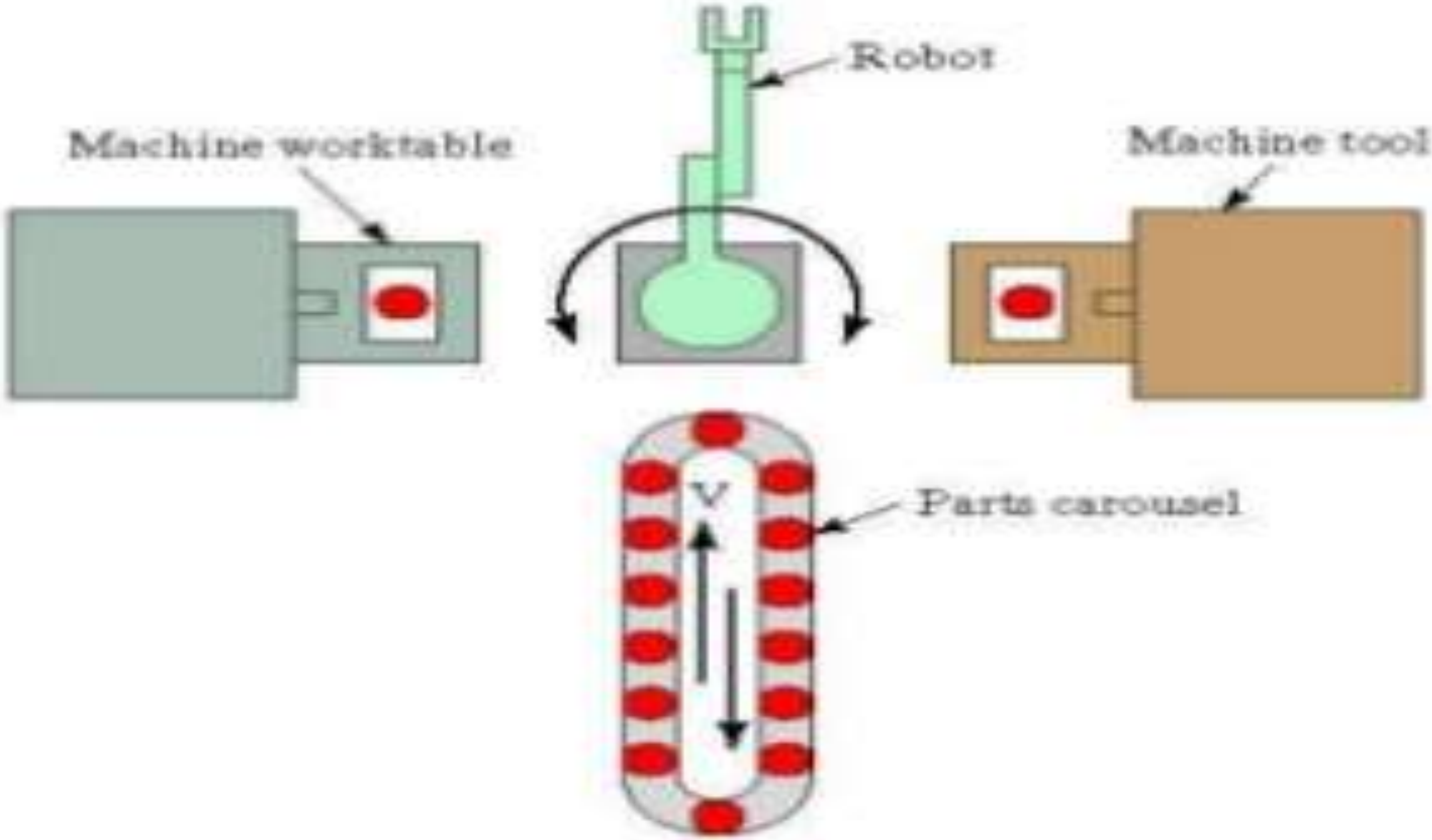
3. LADDER TYPE



4. OPEN FIELD TYPE.



5. ROBERT CENTERED TYPE



BENEFITS OF FMS

1) Parts can be produced randomly, in batch sizes as small as one, and at lower unit cost
2) Direct labor and inventories are reduced, to yield major savings over conventional systems
3) The lead times required for product changes are shorter
4) Production is more reliable, because the system is elf-correcting.
5) WIP inventories are reduced.

Implemented in Japan to eliminate the seven types of wastes.:

- Transportation
- Inventory
- Motion
- Waiting
- Overproduction
- Over processing
- Defects

COMPUTER AIDED PLANNING AND CONTROL AND COMPUTER MONITORING

INVENTORY MANAGEMENT SYSTEM

- An **inventory management system** is the combination of technology (hardware and software) and processes and procedures that oversee the monitoring and maintenance of stocked products, whether those products are company assets, raw materials and supplies, or finished products ready to be sent to vendors or end consumer
- The term Inventory Management refers to the process of supervising and controlling the stock items for a company.
- The inventory management ensures that the company always has the needed materials and products on hand while keeping the cost as low as possible. ... Quantities of finished products for sale.

TYPES OF INVENTORY

Inventory management is a technique of controlling, storing, and keeping track of your inventory items.

Inventory management is an essential component of supply chain management, as it regulates all the operations that are involved from the moment an item enters the store until it has been dispatched.

Generally, inventory types can be grouped into four classifications: raw material, work-in-process, finished goods, and MRO goods.

- Raw Materials. ...
- Work-in-process. ...
- Finished Goods. ...
- Transit Inventory.
- Buffer Inventory. ...
- Anticipation Inventory. ...
- Decoupling Inventory. ...
- Cycle Inventory.

Inventory Management- objectives:

- Minimize investments in inventory
- Meet the demand for products by efficiently organizing the production & sales operations

Costs of holding Inventory

- Inventory Carrying costs
- Opportunity costs of funds blocked
- shortage

Risk of holding inventory:

- Price decline
- Product Deterioration
- Product Obsolescence

TOOLS & TECHNIQUES OF INVENTORY MANAGEMENT/ CONTROLTYPES

- ABC Analysis
- Economic Ordering Quantity (EOQ)
- Order Point Problem
- Two Bin Technique
- VED Classification
- HML Classification
- SDE Classification
- FSN Classification
- Order Cycling System
- Just In Time (JIT)

Economic Ordering Quantity (EOQ):

- Level of Inventory at which Total Cost* of Inventory is minimum (*Ordering and Carrying Cost)

EOQ MODEL: Q = Square root of $(2UP/S)$

Q = Economic Order Quantity, U = Annual usage/demand

P = Cost of Placing an order,

S = Storage cost per unit per order

* Where Storage cost is given in % , it is always calculated by multiplying the % with the purchase price of raw material per unit, i.e Storage cost = % X Purchase price of raw material

BEHAVIOUR OF INVENTORY RELATED COSTS

Total Cost = Purchasing Cost + Ordering Cost + Inventory Cost

Purchasing Cost = (total units) x (cost per unit)

Ordering Cost = (number of orders) x (cost per order)

Inventory Cost = (average inventory) x (holding cost)

THE OPTIMAL QUANTITY TO ORDER

The main insight from EOQ is a tradeoff between holding costs and ordering costs

EOQ -EXAMPLE

A firm's annual inventory is 1,600 units. The cost of placing an order is Rs 50, purchase price of raw material/unit is Rs.10 and the carrying costs is expected to be 10% per unit p.a. Calculate EOQ?

U=1600, P= Rs. 50, S= .10 x Rs.10=Rs.1

$$EOQ = \sqrt{\frac{2 \times 1600 \times 50}{1}}$$

= 400 units

EOQ -EXAMPLE

- The JIT control system implies that the firm should maintain a minimal level of inventory and rely on suppliers to provide parts and components ‘just-in-time’ to meet its assembly requirements.

JIT also known as

- Zero Inventory Production Systems **(ZIPS)**,
- Zero Inventories**(ZIN)**,
- Materials as Needed **(MAN)**, or
- Neck of Time**(N0T)**

JIT Vs. JIC

- This may be contrasted with the traditional inventory management system which calls for maintaining a healthy level of safety stock to provide a reasonable protection against uncertainties of consumption and supply – the traditional system may be referred to as a **“just-in-case”** system.
- The **most commonly used tools** of inventory management in India are: **ABC analysis, FSN analysis and inventory turnover analysis.**

ABC ANALYSIS

CATEGORY	NO. OF ITEMS(%)	ITEM VALUE(%)	MANAGEMENT CONTROL
A	15	70 (HIGHEST)	MAXIMUM
B	30	20(MODERATE)	MODERATE
C	55	10(LEAST)	MINIMUM
TOTAL	**100**	**100**	

Production plan tends to be:

- Short time horizon
- More detailed product information
- More concern over capacity,
- Corporate plan
- Quasi-contract
- Updated regularly

MPS PROBLEMS:

- Overloaded
- Front end Loaded
- Unstable
- Incomplete
- Short Horizon

MRP ELEMENTS:

- Gross Requirements
- On-Hand Inventory
- Allocations
- Scheduled Receipts
- Net Requirements
- Planned and Order Releases
- Time-phasing
- Parent/Component

ADVANTAGES OF MRP

- Forward looking when planning (visibility). Useful simulator.
- Provides valid, credible priorities.
- Priorities reflect actual needs, not implied needs.
- Provides mangers with control over the execution system.

LIMITATIONS OF MRP

- Looks at materials, ignores capacity, shop floor conditions.
- Requires user discipline.
- Requires accurate information/data.
- Requires valid MPS.
- High volume production.

SHOP FLOOR CONTROL

Shop floor control deals with managing the work-in-process. **This consists of**

- The release of production orders to the factory,
- Controlling the progress of the orders through the various work stations
- Getting the current information of the status of the orders

This can be shown in the form of a factory information system. The input to the shop floor control system is the collection of production plans. These can be in the form of master schedule, manufacturing capacity planning and ERP data. The factory production operations are the processes to be controlled.

A typical shop floor control system consists of three phases. In a computer integrated manufacturing system these phases are managed by computer software.
These three phases connected with the production management is shown in figure..

Shop floor control:
The three phases of shop floor control
1. Order release
2. Order scheduling
3. Order progress

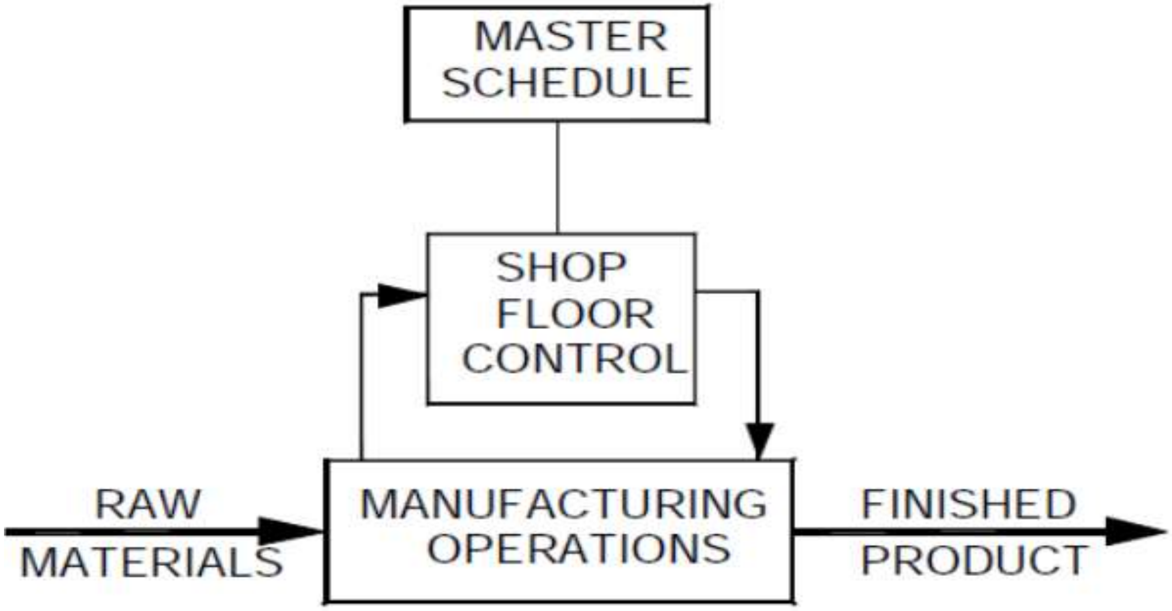


Figure: Factory information system

DOCUMENTS OF SHOP FLOOR ORDER

In today's implementation of shop floor control, these are executed by a combination of computers and human resources.

The shop floor order may consists of the following documents

(i) Route Sheet

(ii) Material requisition to draw necessary materials from the stores

(iii) Job cards or other means to report direct labour time given to the order.

(iv) Instructions to material handling personnel to transport parts between the work centres in the factory

(v) Parts list for assembly, in the case of assembly operations.

DATA REQUIRED TO SHOP FLOOR CONTROL

The data provide in shop floor are:

(i) To supply data to the order progress module in the shop floor control system.

(ii) To provide up to date information to the production supervisors and production control personnel.

.

(iii) To enable the management to monitor implementation of master schedule.

To carry out activity, the factory data collection system inputs the data to the computer system in the plant.

Types of Data Collection Systems: The shop floor data collection systems are classified into two groups

(i) On-line data collection systems

(ii) Off-line data collection systems

SHOP FLOOR CONTROL-DOCUMENTS Cont …,

In a typical factory which works on manual processing of data these documents move with the production order and are used to track the progress through the shop.

In a CIM factory, more automated methods are used to track the progress of the production orders.

The order release is connected with two inputs.

- Authorization proceeds through the various planning functions (MRP, capacity planning).
- These provide timing and scheduling information.
- The engineering and manufacturing database provides the product structure and process planning information needed to prepare the various documents that accompany the order through the shop.

TYPES OF PHASEDS IN SHOP FLOOR CONTROL

- A typical shop floor control system consists of three phases.
- In a computer integrated manufacturing system these phases are managed by computer software.

These three phases connected with the production management is shown in Figure.

- In implementation of shop floor control, these are executed by a combination of computers and human resources.

The following sections describe the important activities connected with this task.

PHASES IN SHOP FLOOR CONTROL

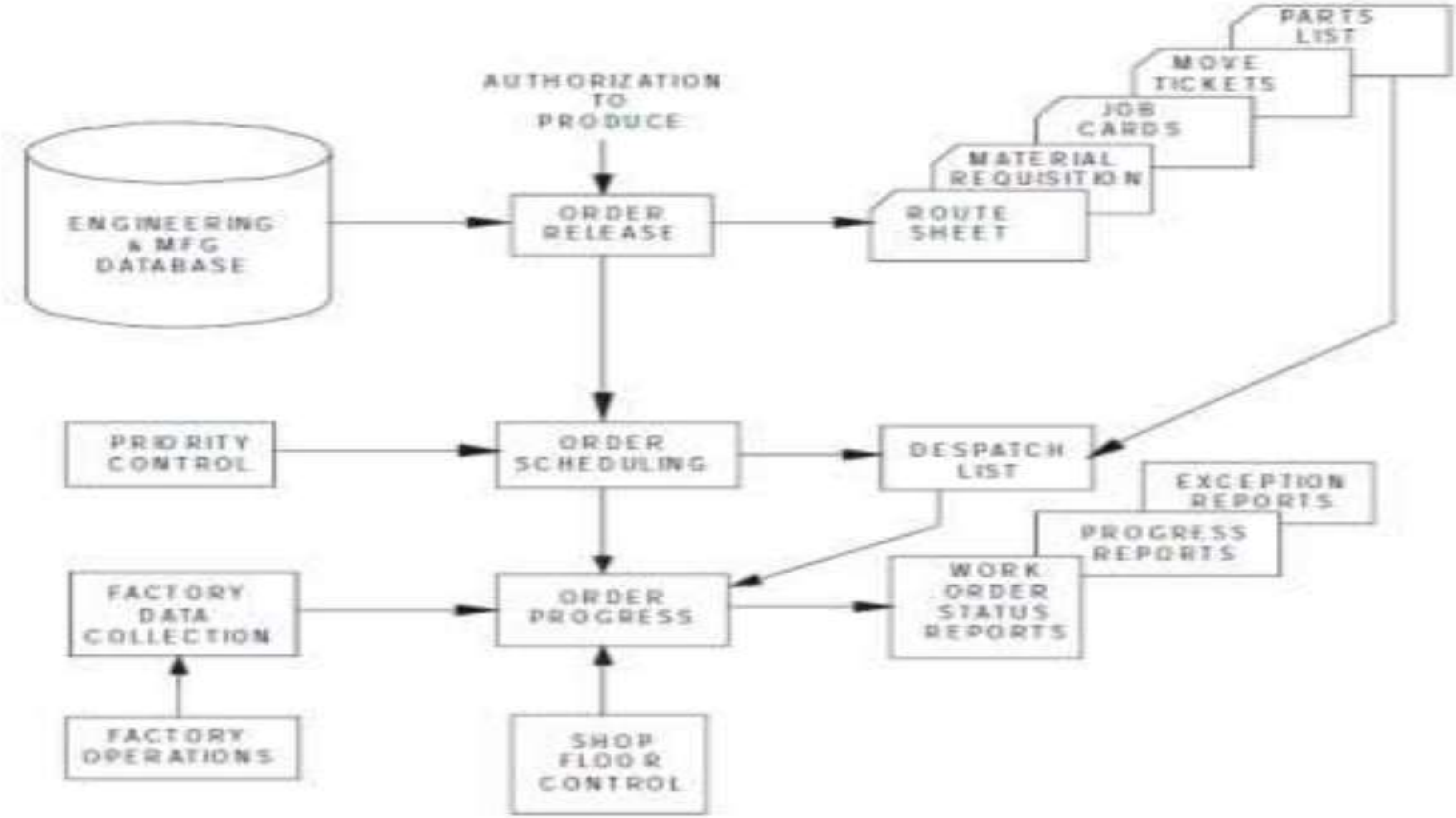


Fig. 27 Phases in Shop Floor Control

Production plan tends to be:

- Short time horizon
- More detailed product information
- More concern over capacity,
- Corporate plan
- Quasi-contract
- Updated regularly

MPS PROBLEMS:

- Overloaded
- Front end Loaded
- Unstable
- Incomplete
- Short Horizon

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- More detailed product information
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LEAN AND AGILE MANUFACTURING

Lean" and "agile" tend to be used interchangeably and are common in modern manufacturing, Lean and Agile emerged from starkly different contexts.

Lean Manufacturing it is a manufacturing based on the Toyota Production System, which was developed in Japan between 1948 and 1975.

Lean manufacturing is a business model and collection of tactical methods that emphasize eliminating non-value added activities (waste) while delivering quality products on time at least cost with greater efficiency.

Eliminate Waste 2. Build Quality In 3. Create Knowledge 4. Defer Commitment 5. Deliver Fast 6. Optimize the whole

The Lean methodology spread to other industries and is now a recognized approach to management

There are 8 types of waste in the Lean framework: Transport, inventory, motion, waiting, overproduction, over processing, defects, and unutilized talent.

Lean practitioners strive to do everything in the simplest way possible and by using the fewest resources possible.

For example, to reduce motion waste, a manufacturer might group all the machines, tools, and materials needed for a production step.

Thus, workers would not have to make unnecessary movements on the shop floor, such as walking to different stations or storage facilities to get what they need.

EAN AND AGILE MANUFACTURING Cont ..,

LEAN AND AGILE MANUFACTURING Cont ..,

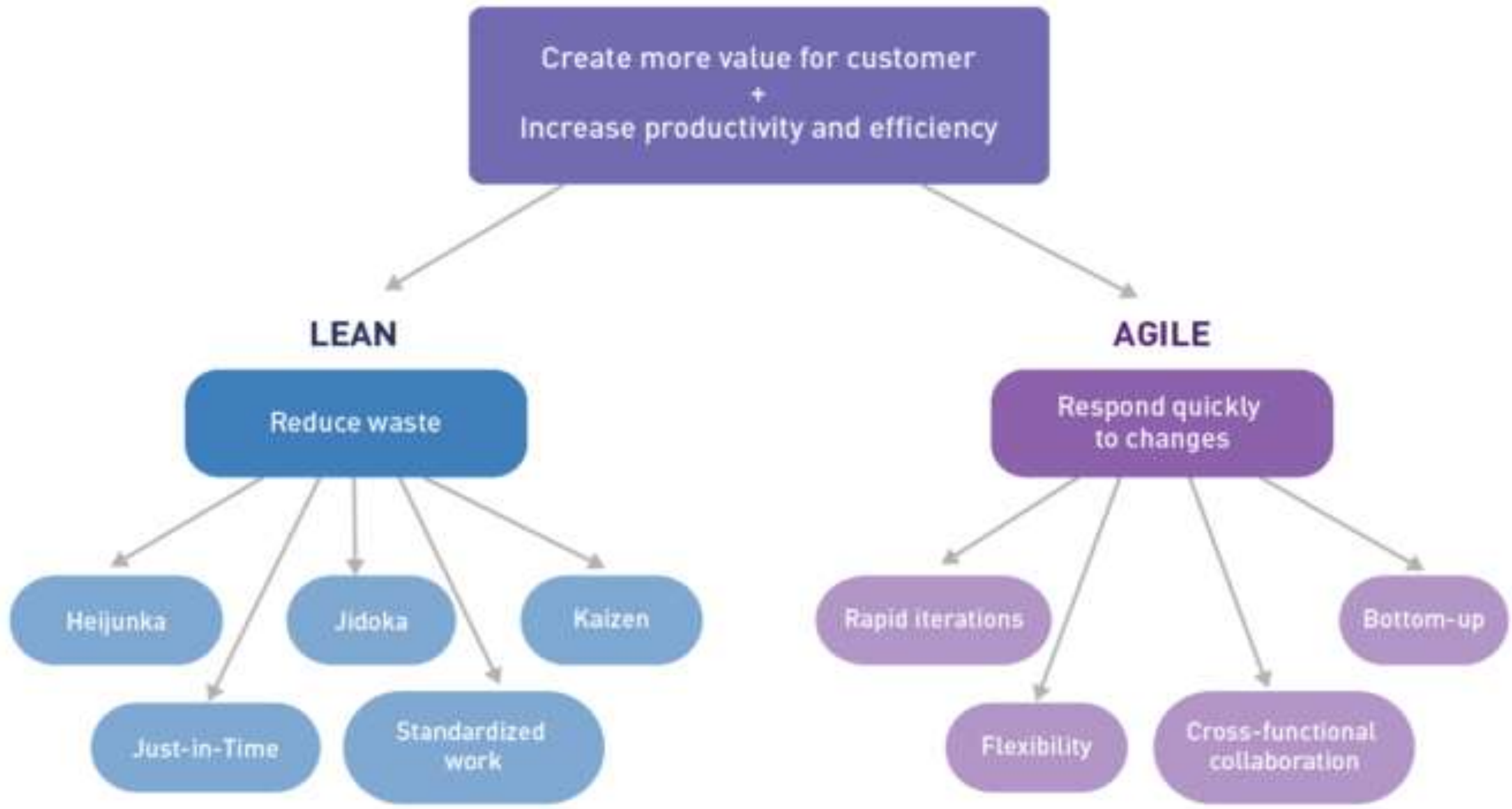
•Agile leverages changes in the environment to yield greater value. Agile manufacturers are flexible. They tend to be technology agnostic, and comfortable turning to new technological solutions for enduring challenges.

•For example, faced with a growing skilled labor shortage, an agile manufacturer might embrace technology to augment their training system.

•Rather than have experienced operators waste time supervising trainees – or have trainees follow complicated paper-based instructions.

•An agile manufacturer could use digital training programs, including digital work instructions, computer vision.

Different Principles of Lean and Agile Manufacturing apply to reach their goal



MONITORING SYSTEM

Monitoring is the regular observation and recording of activities taking place in a project or programme. ... Reporting enables the gathered information to be used in making decisions for improving project performance

Purpose of Monitoring: Monitoring is very important in project planning and implementation

A **production monitoring system** is a process that is designed to record the overall performance of the production line in real time. ...

The data that is collected by the monitoring system is used in improving the efficiency of the production line.

Monitoring is the regular observation and recording of activities taking place in a project or programme. It is a process of routinely gathering information on all aspects of the project.

Monitoring tools are used to continuously keep track of the status of the system in use, in order to have the earliest warning of failures, defects or problems and to improve them.

Monitoring also involves giving feedback about the progress of the project to the donors, implementors and beneficiaries of the project.

Reporting enables the gathered information to be used in making decisions for improving project performance.

MONITORING SYSTEM Cont….,

There are monitoring tools for servers, networks, databases, security, performance, website and internet usage, and applications

There are three basic categories of monitoring;

- Technical monitoring,
- Functional monitoring and
- Business process monitoring.

Purpose of Monitoring:

Monitoring is very important in project planning and implementation.

It is like watching where you are going while riding a bicycle; you can adjust as you go along and ensure that you are on the right track.

MONITORING SYSTEM Cont….,

Monitoring provides information that will be useful in:

- Analysing the situation in the community and its project;
- Determining whether the inputs in the project are well utilized;
- Identifying problems facing the community or project and finding solutions;
- Ensuring all activities are carried out properly by the right people and in time;
- Using lessons from one project experience on to another;

and Determining whether the way the project was planned is the most appropriate way of solving the problem at hand.

Production Monitoring System

Having accurate information at production level is crucial to drive manufacturing efficiency and lean and continuous improvement initiatives.

Plant Run provides a highly cost effective way of real-time production to enable

- Optimize the use of current capacity
- Reduce production costs
- Reduce inventory
- Increase visibility across departments
- Improve customer response time

PRODUCTION MONITORING SYSTEMS- BENEFITS

Benefits including..

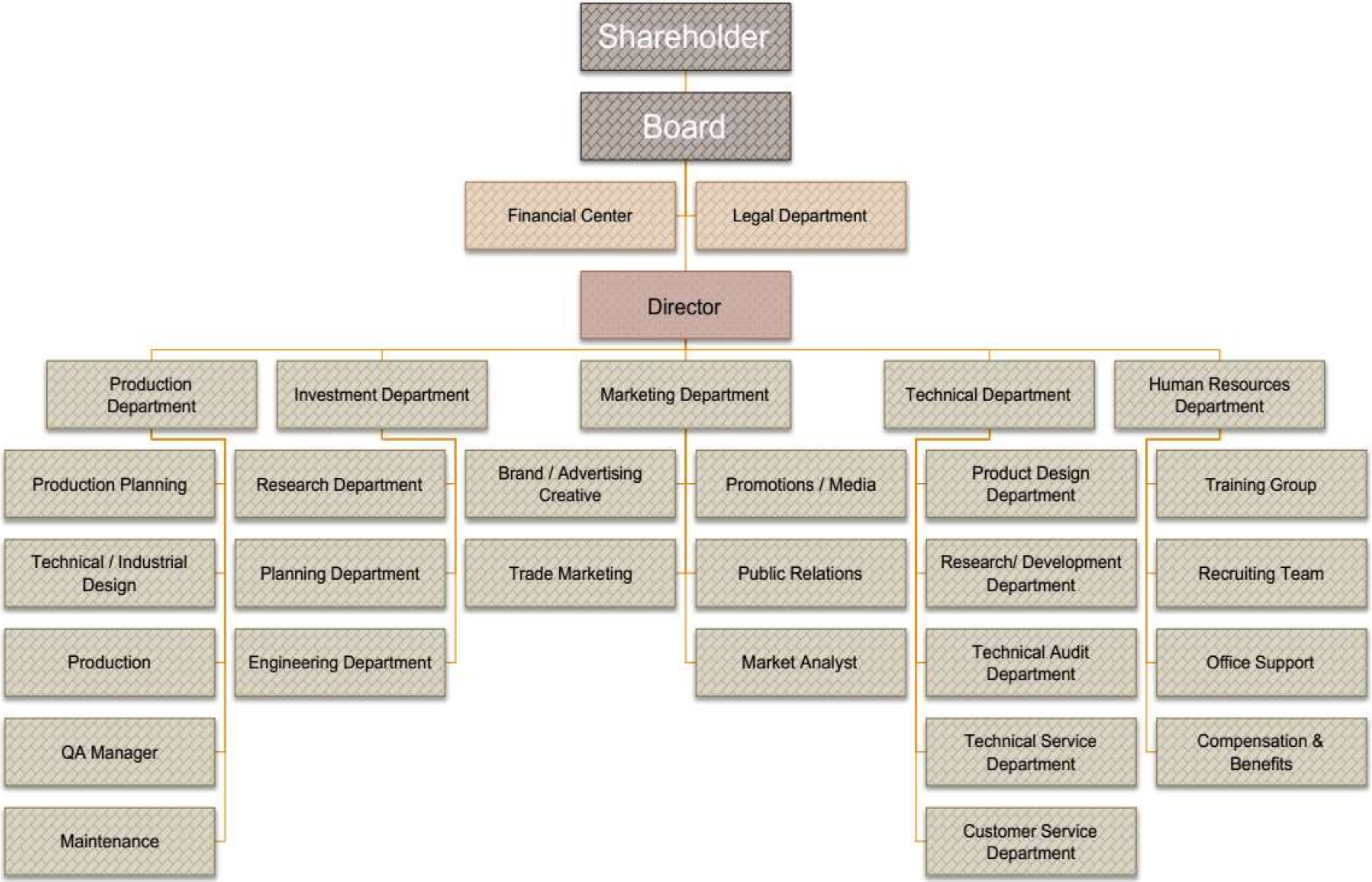
- Eliminates wasteful manual data collection and processing
- Connect to any type, make or age of machine or asset, production line, work cell, even manual processes
- Automatically calculate production output/efficiency
- Comprehensive reports built in Live production status on PC's, smart phones, large overhead screens etc
- Automated alert of production disturbances
- Live production dashboards
- Analysis tools highlight production losses
- Automated report generation and delivery
- Integration with ERP/MRP/MES for data exchange

APPLICATION OF MONITORING

Some of the many manufacturers that are all ready using Plant Run to improve production performance...

- Food Production Monitoring
- OEE and Production Monitoring,
- Metal Fabrication,
- Polymer Production monitoring

MANUFATURING ORGANIZATION CHART



PROCESS CONTROL STRATEGY:

Process Control is a primary goal-oriented function of management in an organisation.

It is a **process** of comparing the actual performance with the set standards of the company to ensure that activities are performed according to the plans and if not, then taking corrective action.

- Consideration should be given to improving the **control strategy** over the lifecycle.
- In response to assessment of data trends over time and other knowledge gained
- Continuous **process** verification is one approach that enables a company to monitor the **process** and make adjustments to

Type of process is controlling:

Feed forward, feedback and concurrent controls are types of management control techniques. Controlling helps the managers in eliminating the gap between organizations actual performance and goals.

Controlling is the process in which actual performance is compared with the company standards.

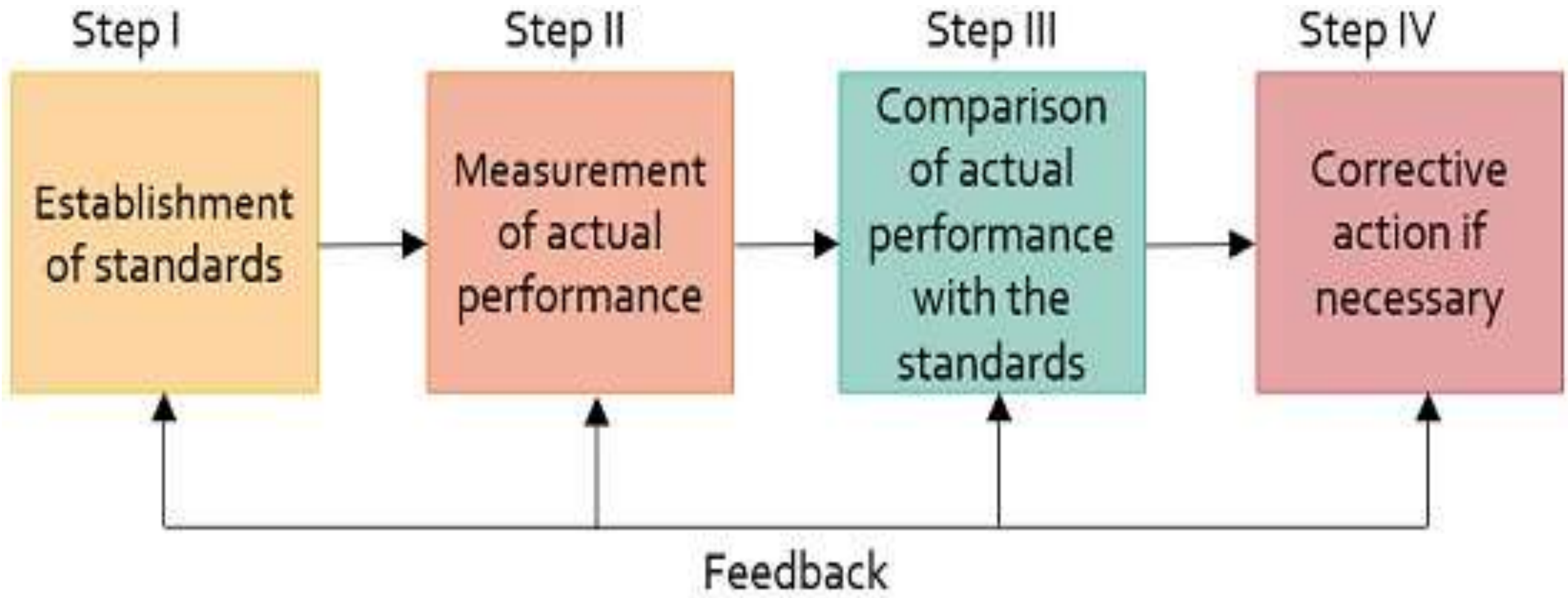
Main types of controls

There are three types of control:

Feedback Control: This process involves collecting information about a finished task, assessing that information and improvising the same type of tasks in the future.

Concurrent control: It is also called real-time control

Process of Controlling: involves the following steps shown in figure:



Controlling process thus regulates companies' activities so that actual performance conforms to the standard plan. An effective control system enables managers to avoid circumstances which cause the company's loss.

PROCESS CONTROL STRATEGY:

•**Establishing standards**:
Setting up of the target which needs to be achieved to meet organisational goals eventually.
Standards indicate criteria of performance and are two types.

(i) Quantitative standards are in terms of money.
(ii) Qualitative standards: includes intangible items

•**Measurement of actual performance**:
The actual performance is measured against the target

•**Comparison of actual performance with the standard**: This compares the degree of difference between the actual performance and the standard.

Taking corrective actions: It is initiated by the manager who corrects any defects in actual performance.

PROCESS CONTROL STRATEGY:

Types of control:There are three types of control viz.,
Feedback Control: This process involves collecting information about a finished task, assessing that information and improvising the same type of tasks in the future.
Concurrent control: It is also called real-time control. It checks any problem and examines it to take action before any loss is incurred. Example: control chart.
Predictive/ feedforward control: This type of control helps to foresee problem ahead of occurrence. Therefore action can be taken before such a circumstance arises.
In an ever-changing and complex environment, controlling forms an integral part of the organization.

ADVANTAGES OF PROCESS CONTROL

- Saves time and energy
- Allows managers to concentrate on important tasks. This allows better utilization of the managerial resource.
- Helps in timely corrective action to be taken by the manager.
- Managers can delegate tasks so routinely chores can be completed by subordinates.
- On the contrary, controlling suffers from the constraint that the organization has no control over external factors. It can turn out to be a costly affair, especially for small companies.

DIRECT DIGITAL CONTROL (DDC)

Direct Digital Control is a method of **process control** in which computer is an integral part of the loop. It essentially consists of microprocessor / pc / computer based controllers and the **control** logic is performed by software.

Direct digital control is the automated **control** of a condition or process by a **digital** device (computer). ...
All instrumentation is gathered by various analog and digital converters which use the network to transport these signals to the central **controller**.

Digital control is a branch of **control** theory that uses digital computers to act as system controllers. ...

DIRECT DIGITAL CONTROL (DDC) Cont…,

- **Digital** computer used to manipulate A/D conversion, D/A conversion, etc. without producing errors.
- **Control** actions: The manner in which the controller produces the control signal is called the **control action**. A controller compares the actual value of output with the reference input.
- **control** signal that will reduce the deviation to zero or to a small value.
- Direct Digital Controller is similar in function to a small **PLC**.
- A **PLC** (Programmable Logic Controller) is a much more versatile control system, capable of handling digital and analog inputs/outputs and is used for control of complicated