

CAD/CAM

Module-1

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Syllabus

MODULE – I (14 HOURS)

Fundamentals of CAD: Design process, Applications of computer for design, Creating the Manufacturing Database, The Design workstation, Graphical Terminal, Operator input Devices, Plotters and other devices, Central Processing Unit, Memory types.

What Is Design in Mechanical Engineering?

Design in mechanical engineering refers to creating, designing and building new machines that improve the efficiency of existing ones.

Some of the biggest human achievements, from smart cars to the international space station, were possible because of the innovative design and unique thinking of the world's top mechanical engineers.

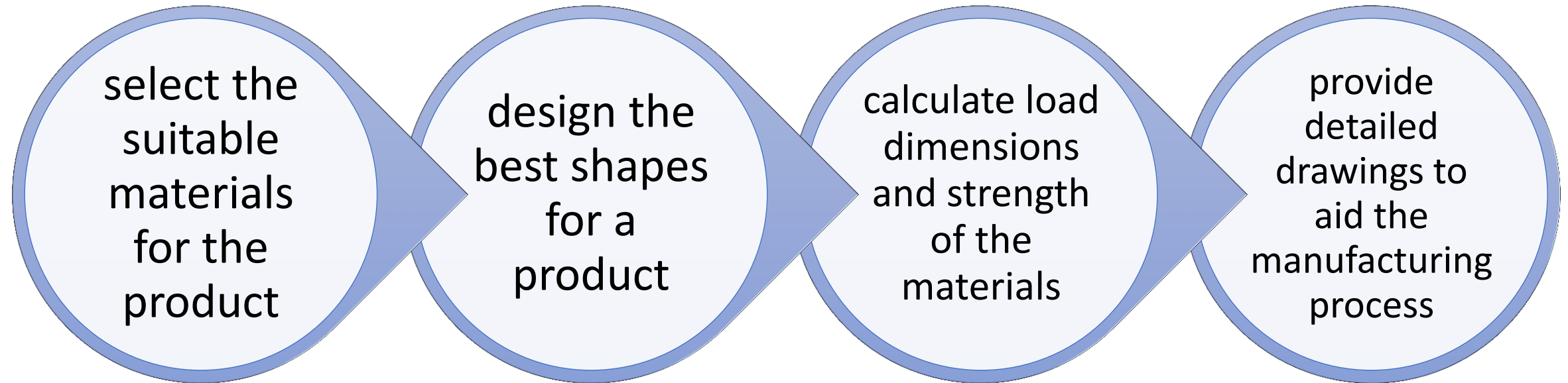
As a mechanical engineer working in design, you can create solutions to solve a specific problem or address a particular human need.

Basics of mechanical design

To design a component or product that is efficient, consider these three key factors:

- **Feasibility:** With feasibility, you can check if you are able to manufacture the product within the existing constraints.
- **Efficiency:** Efficiency helps you understand if your design can achieve the necessary objectives and goals.
- **Testing:** With testing, you are evaluating if the product meets the design criteria across scenarios.

Why is design important in mechanical engineering?



Introduction to CAD

- Computer Aided Design (CAD) is the use of computer software to design and document a product's design process.
- Computer Aided Design is a process of the use of digital computer or workstation for creation, modification, synthesis, analysis and optimization of design.
- Engineering drawing entails the use of graphical symbols such as points, lines, curves, planes and shapes.
- Computer Aided Design (CAD) involves any type of design activity which make use of the computer to develop, analyse or modify an Engineering Design.
- CAD systems working based on Interactive Computer Graphics (ICG).
- CAD uses the following:
 - Use of computers (hardware & software) for designing products
 - Numerical method, optimizations etc.
 - 2D/3D drafting
 - 3D modelling for visualization
 - Modeling curves, surfaces, solids, mechanism, assemblies, etc.

Interactive Computer Graphics (ICG)

- ICG is defined user – oriented systems in which the computer is employed to create, transform, and display data in the form of pictures or symbols.
- The User in the computer graphics design system is the designer, who communicates data and commands to the computer through any of several input devices.
- The computer communicates with the user via a Cathode Ray Tube (CRT).
- The designer creates an image on the CRT screen by entering commands to call the desired software sub - routines stored in the computer.
- In general, the image is constructed out of basic elements-points, lines, circles so on. All the drawings to be modified according to commands of the designer –enlarged, reduced size, moved to another location on the screen, rotated, and other transformations.
- The ICG System is a combination of hardware and Software. The hardware includes a Central Processing Unit, one or more workstations, and peripheral devices and such as printers, plotters and drafting tool or device. The software consist of the computer programs needed to implement graphics processing on the system. The software would typically include additional specialized application programs to accomplish the particular engineering functions required by the industrial customer

The reason for implementing CAD System

- Increase the Productivity

The designer to visualize the product and its component subassemblies and parts, reducing the time required in synthesizing, analyzing and documenting the design. This productivity improvement is not only based on lower design cost but also shorter project completion times.

- Improve the Quality

A CAD System permits a more thorough engineering analysis and a larger number of design alternatives can be investigated. Design errors also reduced through greater accuracy provided by the system.

- Improve Communications

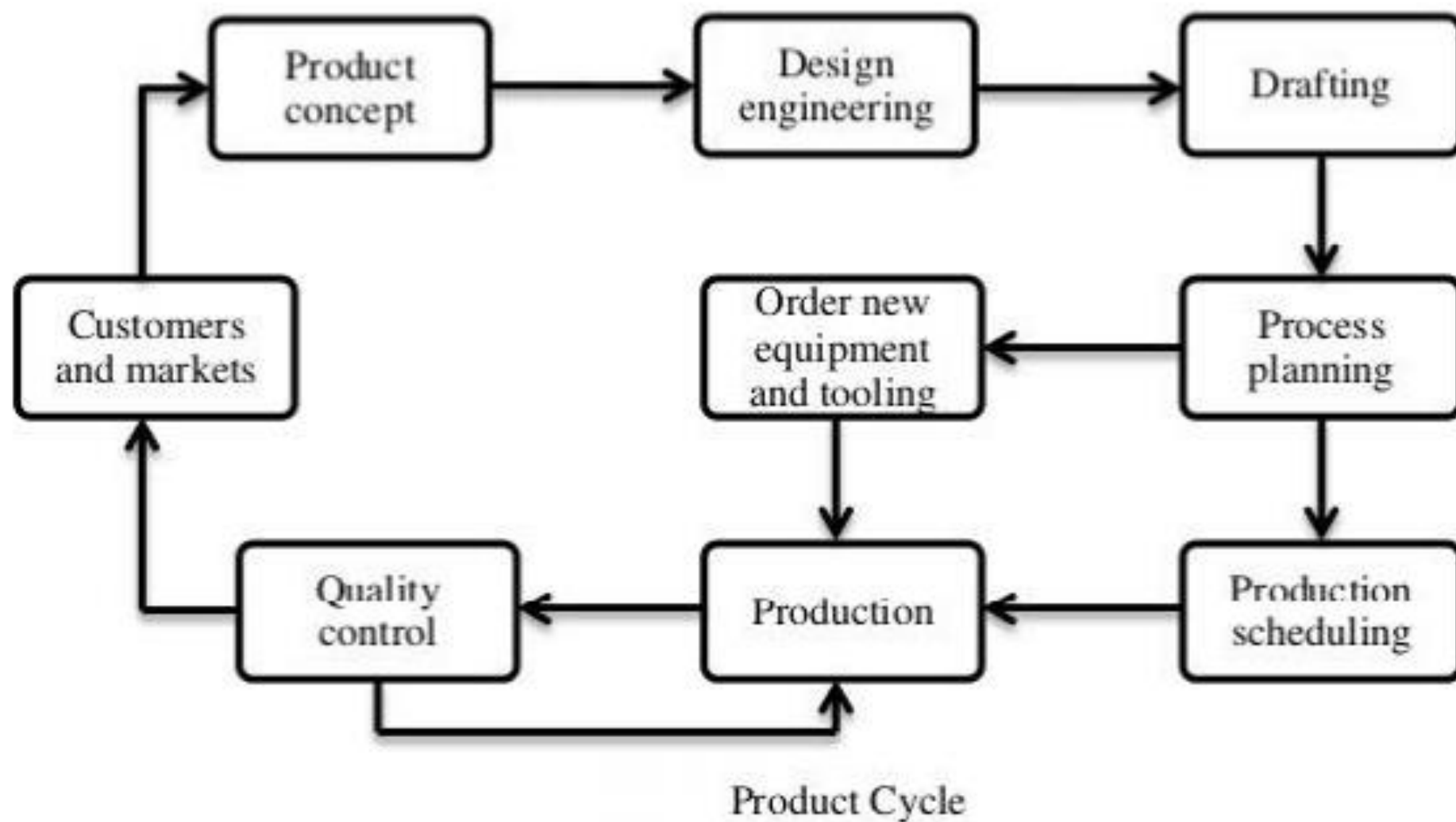
Use of a CAD system provides better engineering drawings, better documentation of the design, fewer drawing errors and greater legibility.

- Create data base for manufacturing

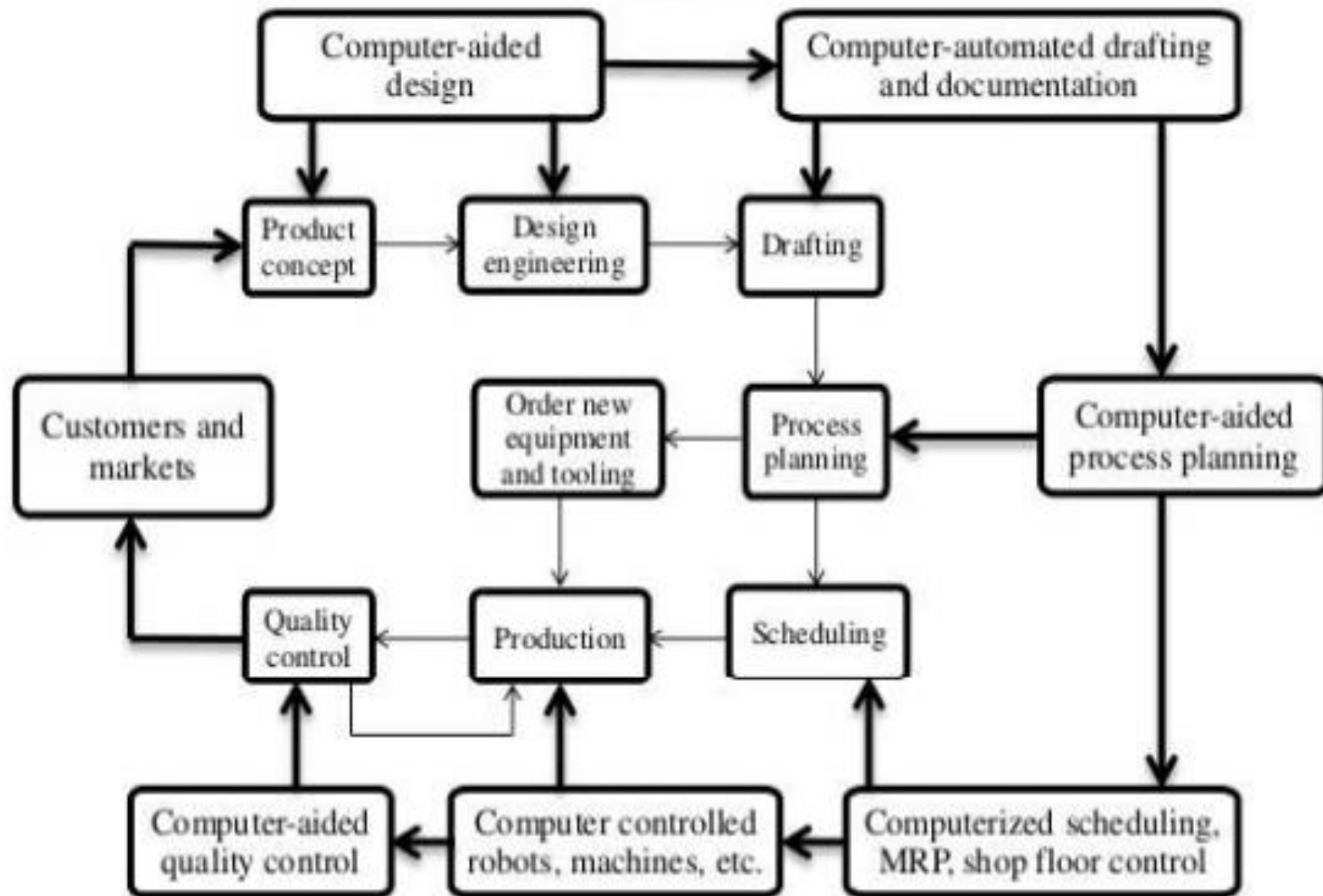
In the process of creating the documentation for the product designs such as geometrics and dimensions of the product and its components, bill of materials etc. are required data base to manufacture the product.

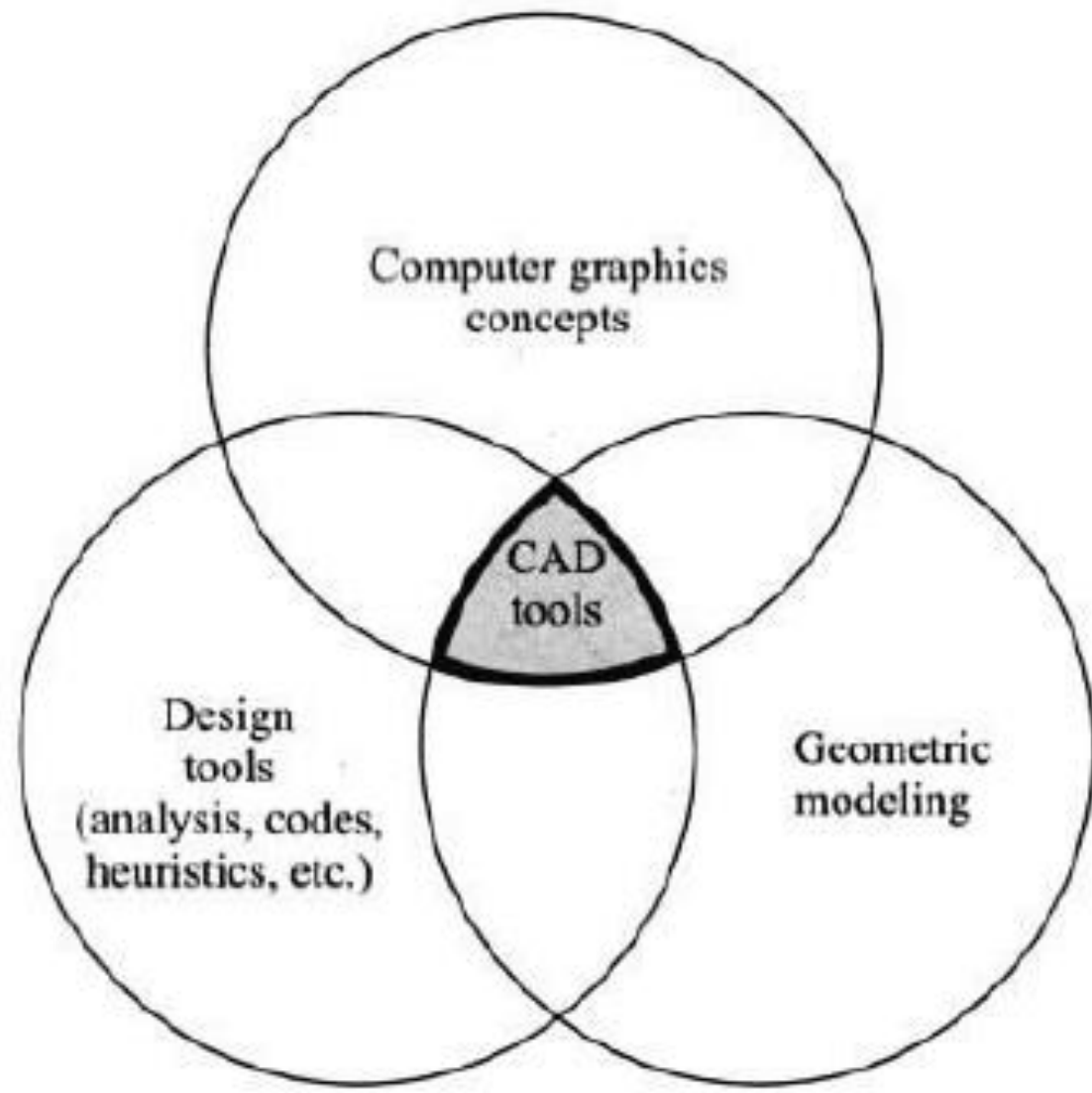
The Product Cycle

Various activities + functions = Product Cycle

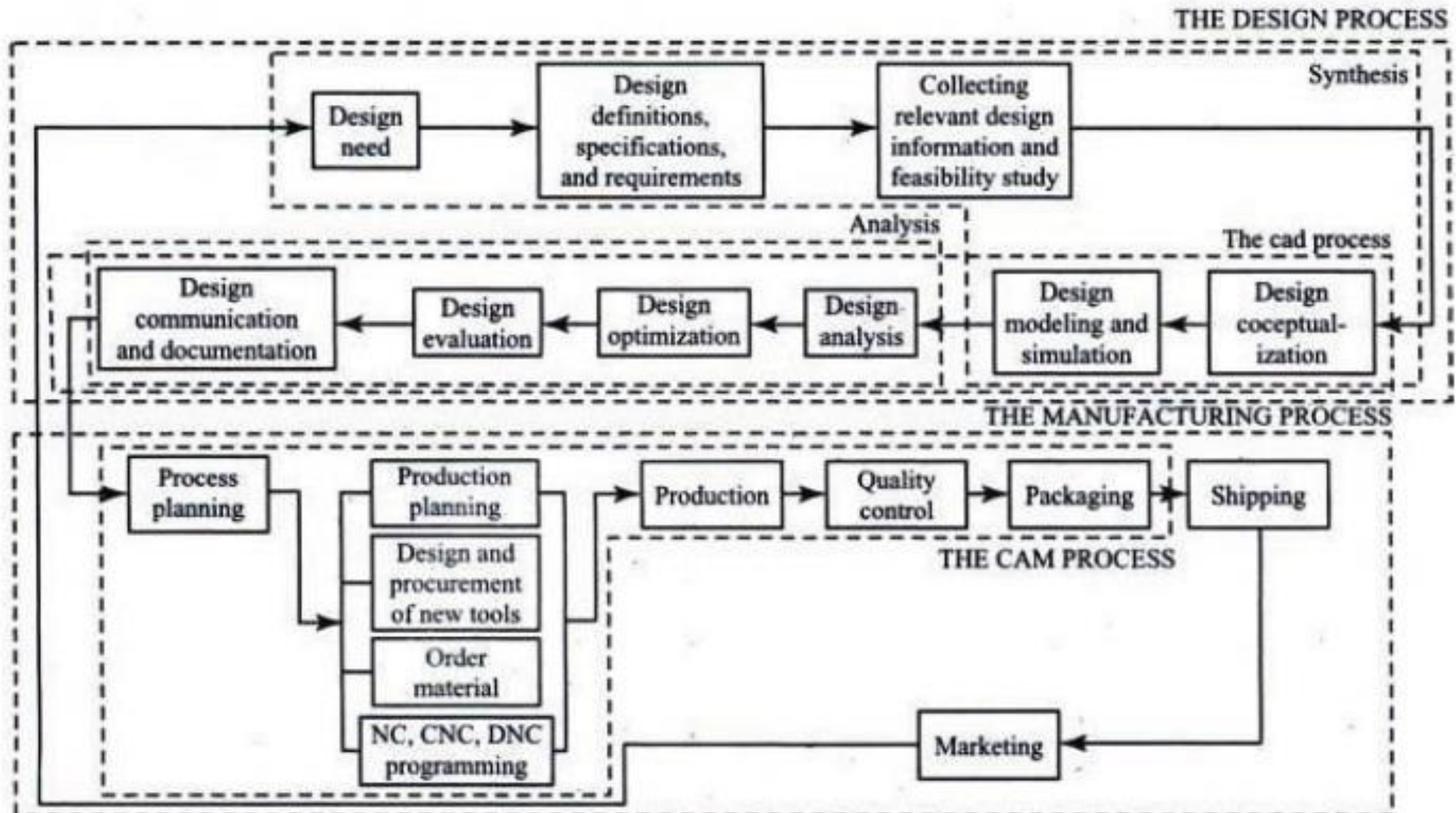


The Product Cycle & CAD/CAM



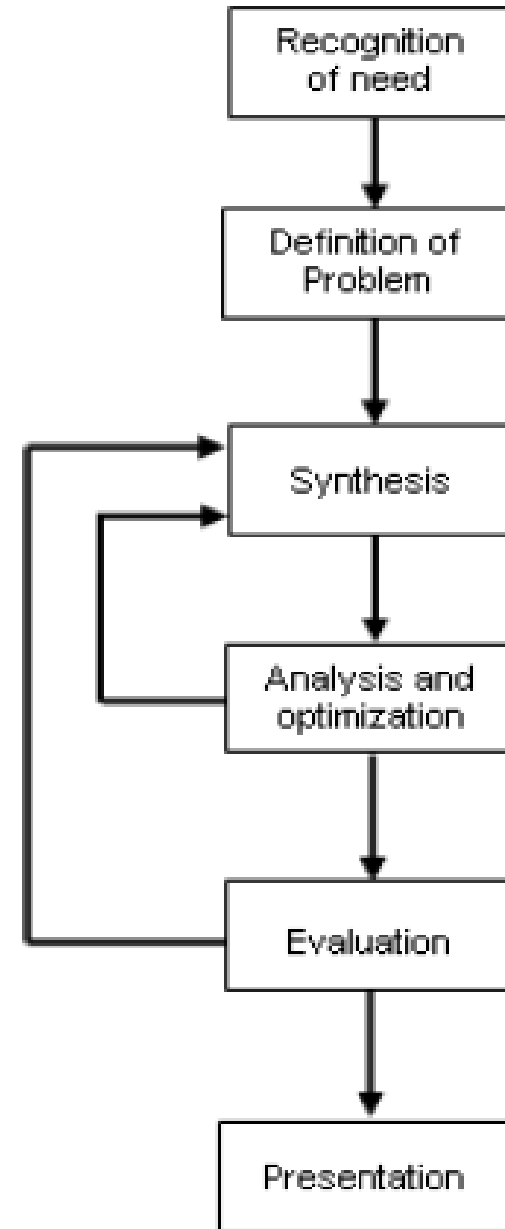


Typical Product Cycle



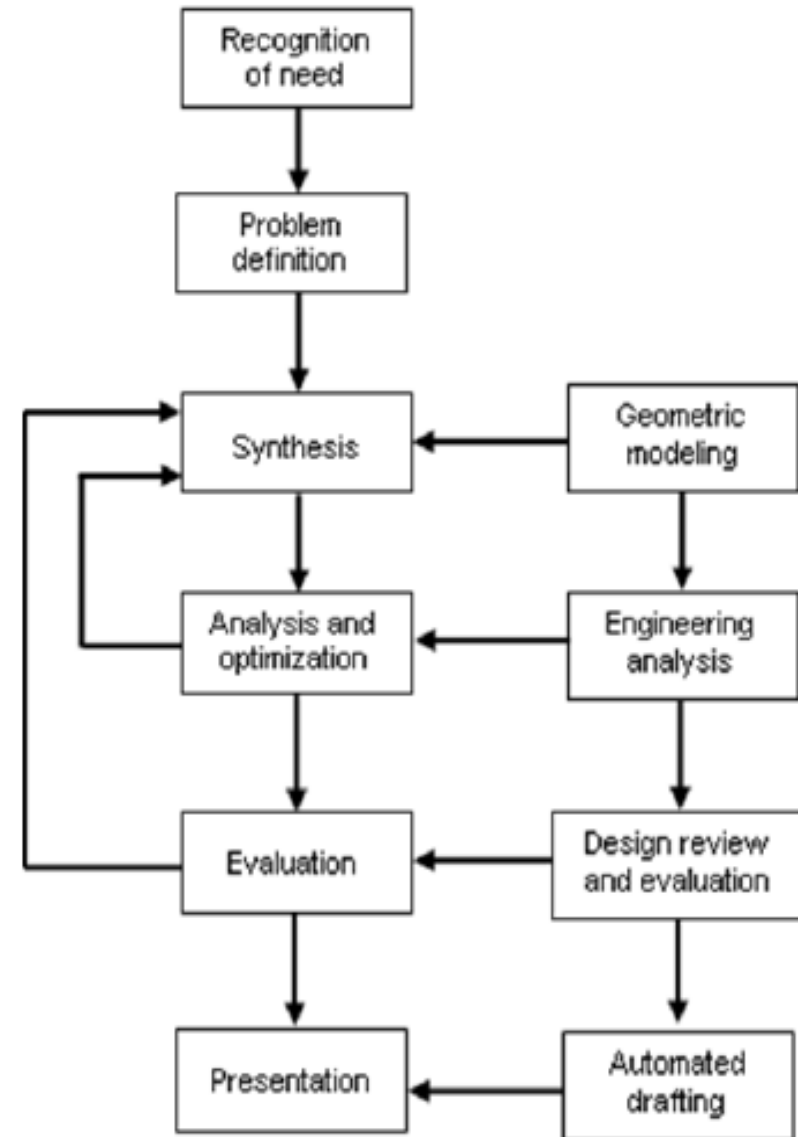
Design Process

- Recognition of need
- Definition of Problem
- Synthesis, Analysis and Optimization
- Evaluation
- Presentation.

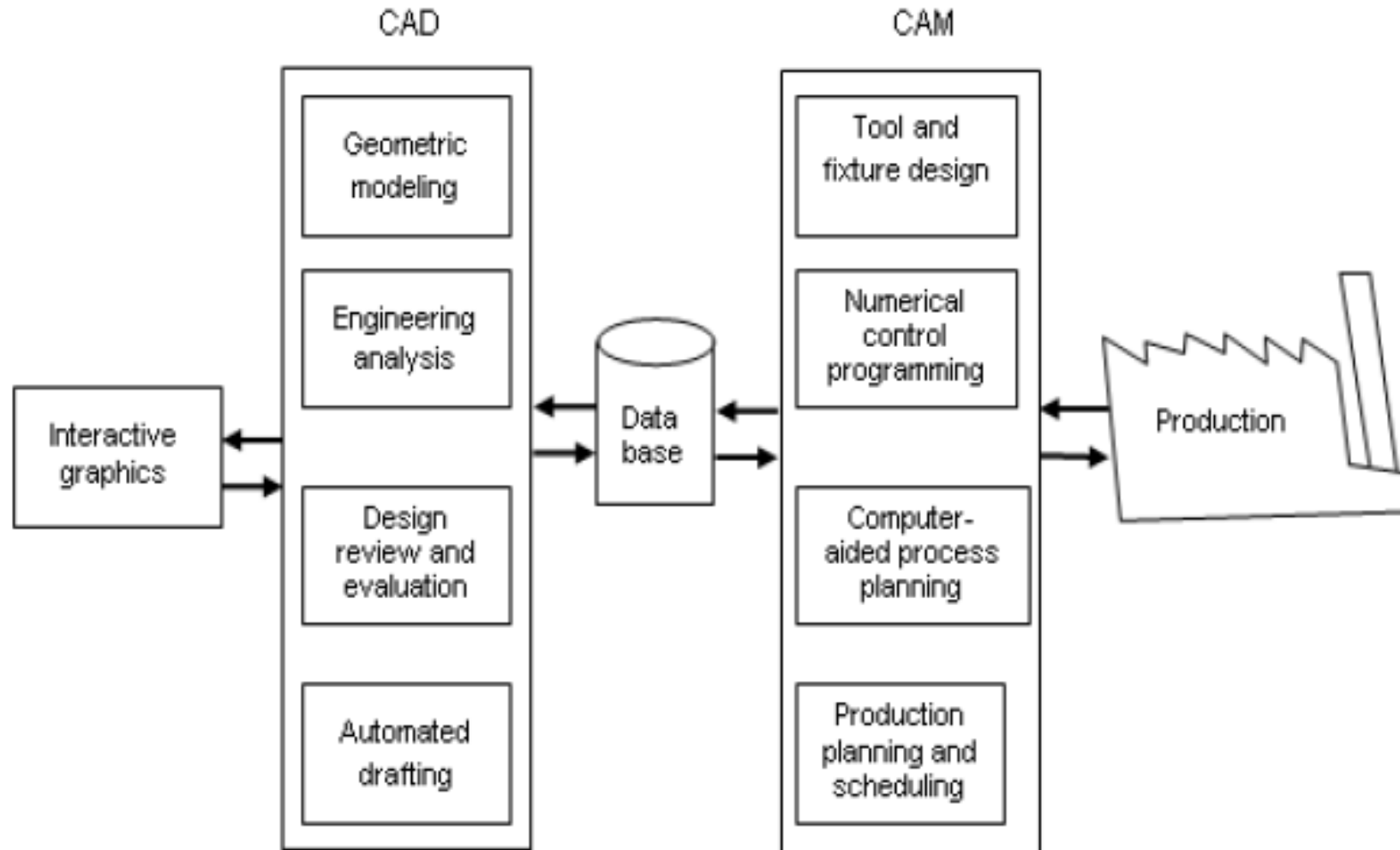


Application of Computers for Design

- Geometric Modelling
- Engineering Analysis
- Design Review and Evaluation
- Automated Drafting



Creating the manufacturing Data Base



Benefits of CAD

- Improved engineering productivity
- Shorter lead times
- Customer modifications are easier to make.
- Faster response to request for quotation
- Minimized transcription errors
- Improved accuracy of design
- Provide better functional analysis to reduce prototype testing
- Assistance in preparation of documentation
- Design have more standardization
- Better design provided
- Improved productivity in tool design
- Better knowledge of cost Provided

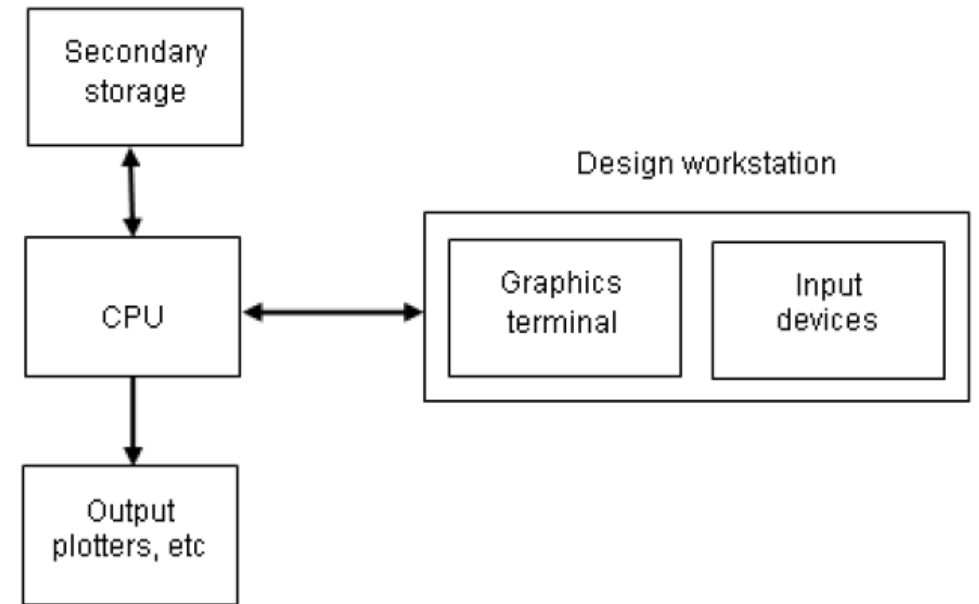
HARDWARE IN CAD - GRAPHIC DISPLAY DEVICES

- **Design Workstation**

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

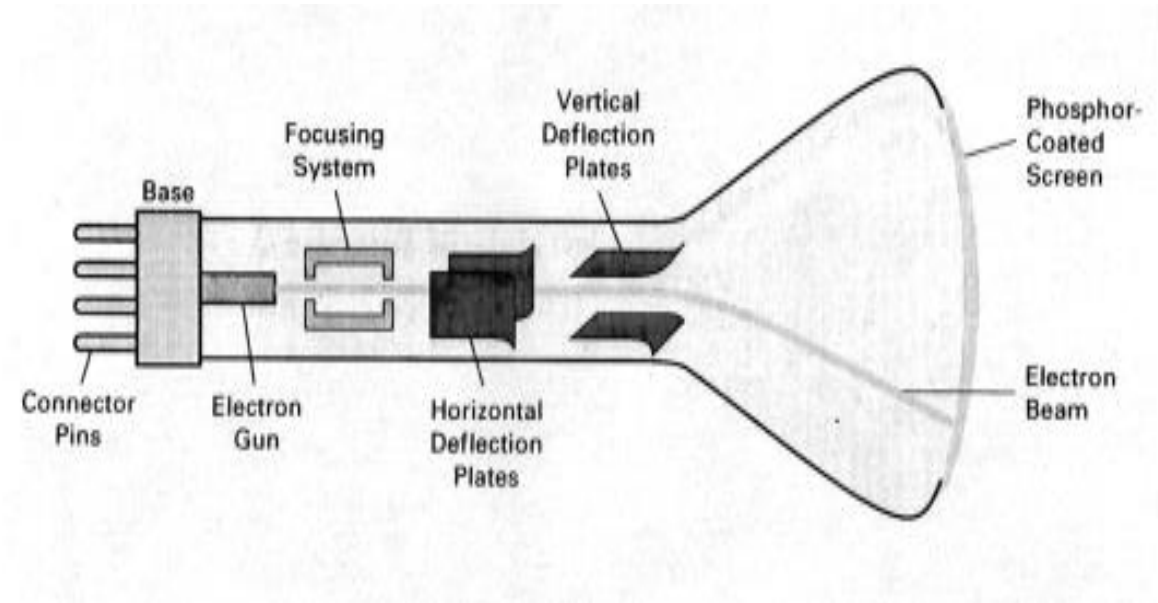
The workstation must accomplish the following functions

1. 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 in to operating functions.
5. It must facilitate communication between user and the system.



DISPLAY DEVICES

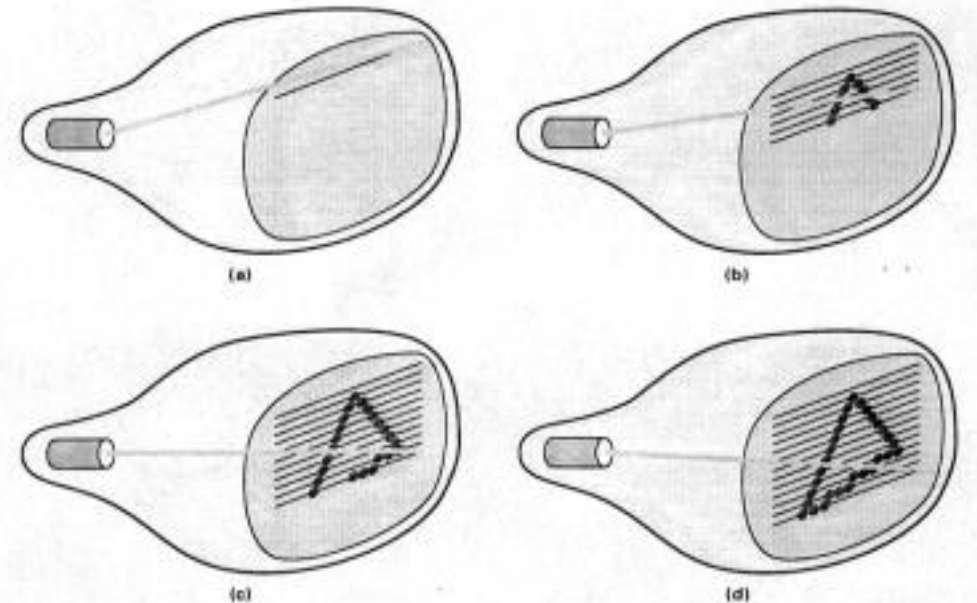
- Cathode Ray tube Graphic Display Systems (CRT's)
- A beam of electrons (cathode rays), emitted by an electron gun, passes through focusing and deflection systems that direct the beam towards specified position on the phosphor-coated screen.
- The phosphor then emits a small spot of light at each position contacted by the electron beam.
- By focusing electron beam, changing the intensity, and controlling its point of contact against the phosphor coating through the use of deflection system, the beam can be made to generate a picture in the screen.



DISPLAY DEVICES

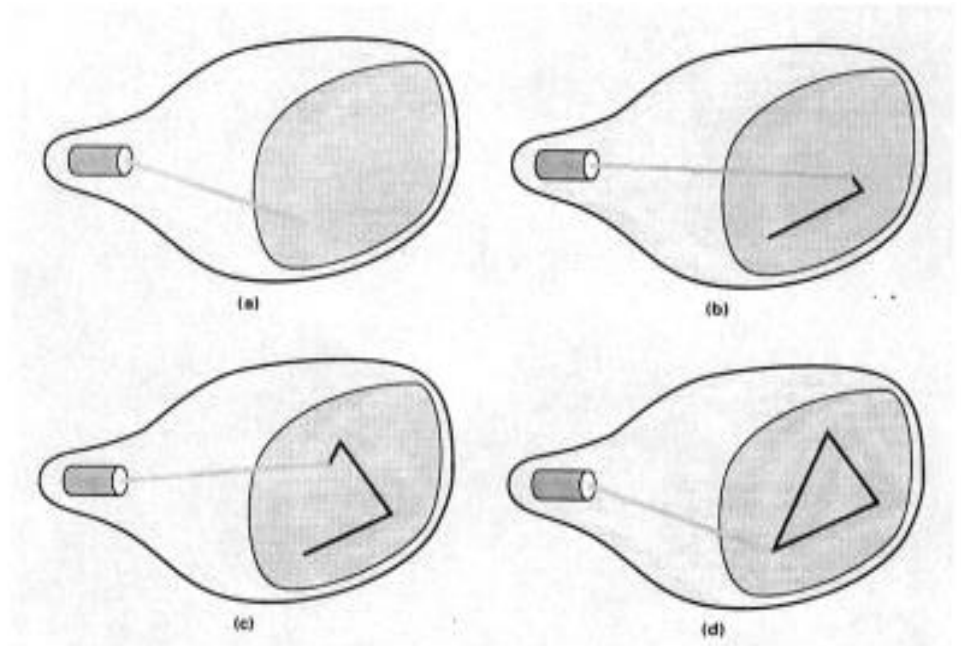
Raster-scan technique

- In a raster-scan system, the electron beam is swept across the screen, one row at a time from top to bottom.
 - 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 memory area called the refresh buffer or frame buffer. This memory area holds the set of intensity values for all the screen points.
 - Stored intensity values are then retrieved from the 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 of 60 to 80 frames per second.
 - Refresh rates are described in units of cycles per second, or Hertz (Hz), where a cycle corresponds to one frame.



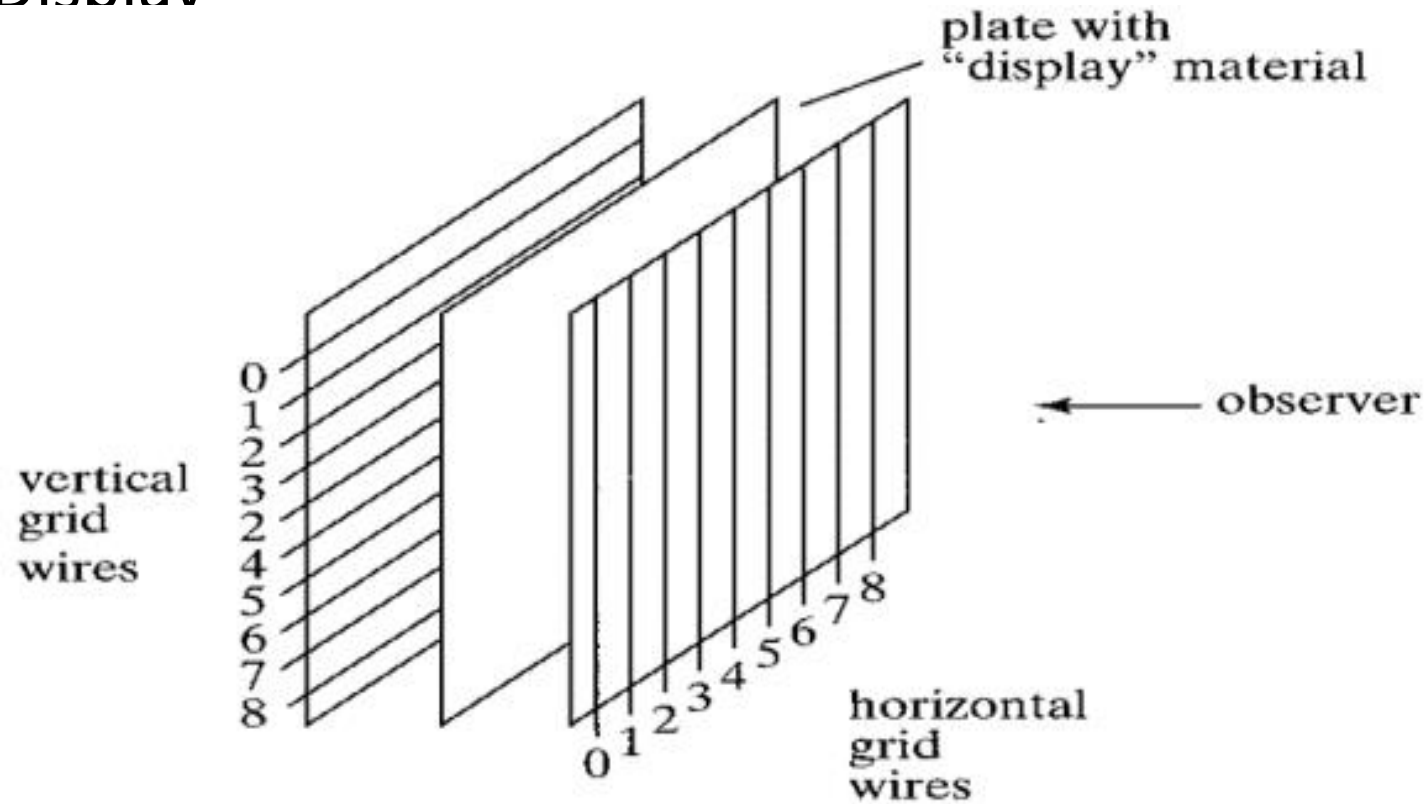
Random-scan technique(Stroke Writing)

- Random scan monitors draw a picture one line at a time and for this reason are also referred to as vector displays (or stroke-writing or calligraphic displays).
- Refresh rate on a random-scan system depends on the number of lines to be displayed. Picture definition is now stored as a set of line-drawing commands in an area of memory referred to as the refresh display file.



DISPLAY DEVICES

- Flat panel Display



INPUT DEVICE

Various devices are available for data input on graphics workstations.

Most systems have a keyboard and one or more additional devices specially designed for interactive input.

Logical and Locator Devices:

- Locator, to indicate a position and/or orientation.
- Pick, to select a displayed entity.
- To input a single value in the space of real numbers.
- Keyboard, to input a character string.
- Choice, to select from a set of possible actions or choices

INPUT DEVICES

- Mouse
- Joysticks
- Tracker ball



INPUT DEVICES

- Touch Panels
- Light Pens
- Keyboards



INPUT DEVICES

- Image Scanners



- Voice Systems



OUTPUT DEVICES

- Dot Matrix Printers



- Laser Printers



- Inkjet Printers

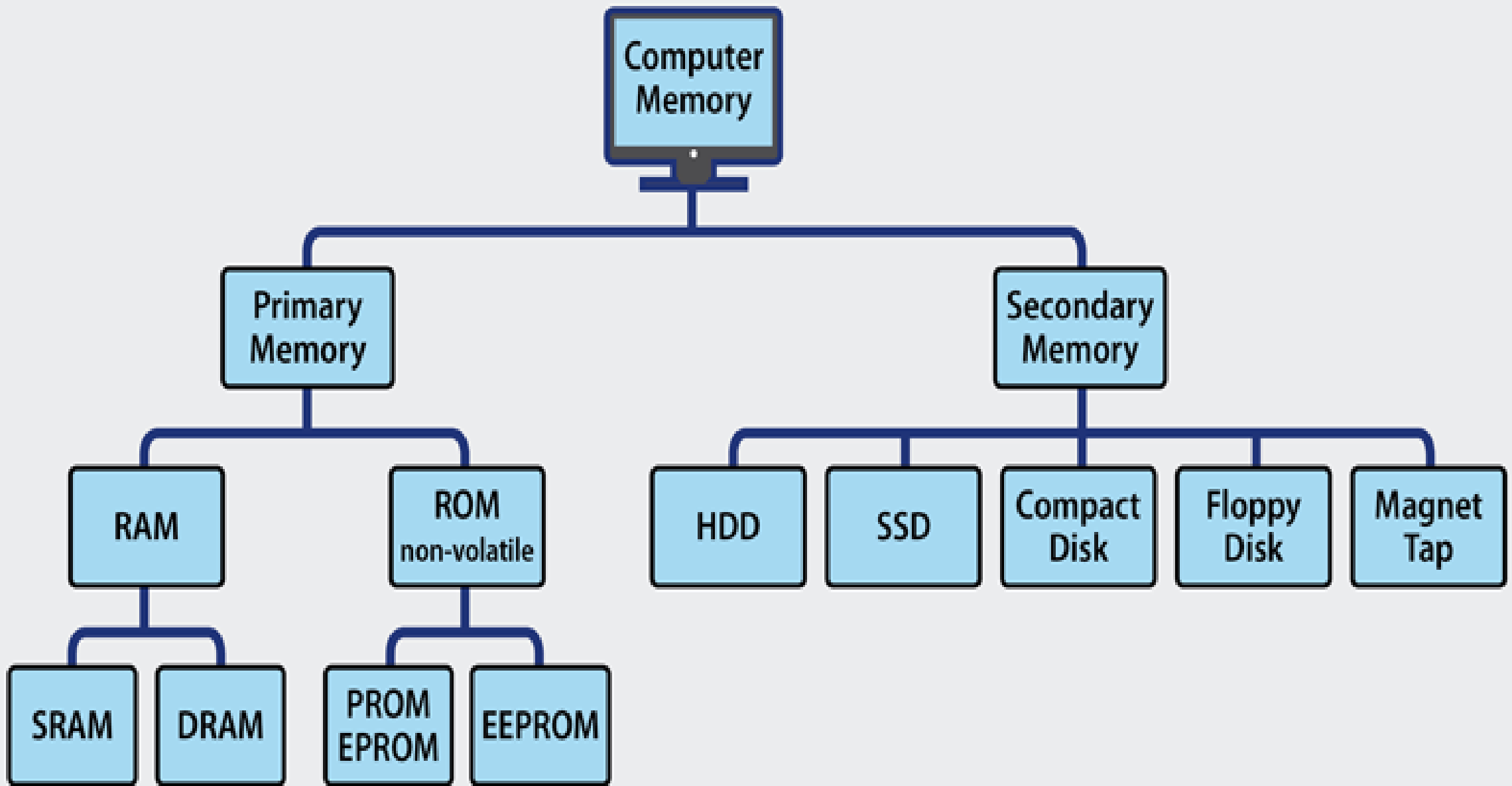


- Thermal Printers



Computer Memory

- Computer memory is any physical device capable of storing information temporarily, like RAM (random access memory), or permanently, like ROM (read-only memory).
- Memory devices utilize integrated circuits and are used by operating systems, software, and hardware.
- Each device in a computer operates at different speeds and computer memory gives your computer a place to quickly access data.
- If the CPU had to wait for a secondary storage device, like a hard disk drive, a computer would be much slower.



Memory Units

- Data in the computer's memory is represented by the two digits 0 and 1.
- These two digits are called Binary Digits or Bits.
- A bit is the smallest unit of computer's memory.
- Bits=0,1
 - 1 Byte= 8 bits(e.g,11001011)
 - 1 KB(kilobyte) = 1024 Bytes
 - 1 MB(megabyte) = 1024 KB
 - 1 GB(Gigabyte) = 1024 MB
 - 1 TB(Terabyte) = 1024 GB