IPE-419
Course: CIM

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1.

CAD/CAM & CIM

Manufacturing Support System

- The manufacturing support systems are the procedures and systems used by the firm to manage production and solve the technical and logistics problems associated with designing the products, planning the processes, ordering materials, controlling work-in-process as it moves through the plant, and delivering products to the customer
- So far automation has emphasized the flow of the physical product through the factory, the enterprise level is concerned more with the flow of information in the factory and throughout the firm.

Manufacturing Support System

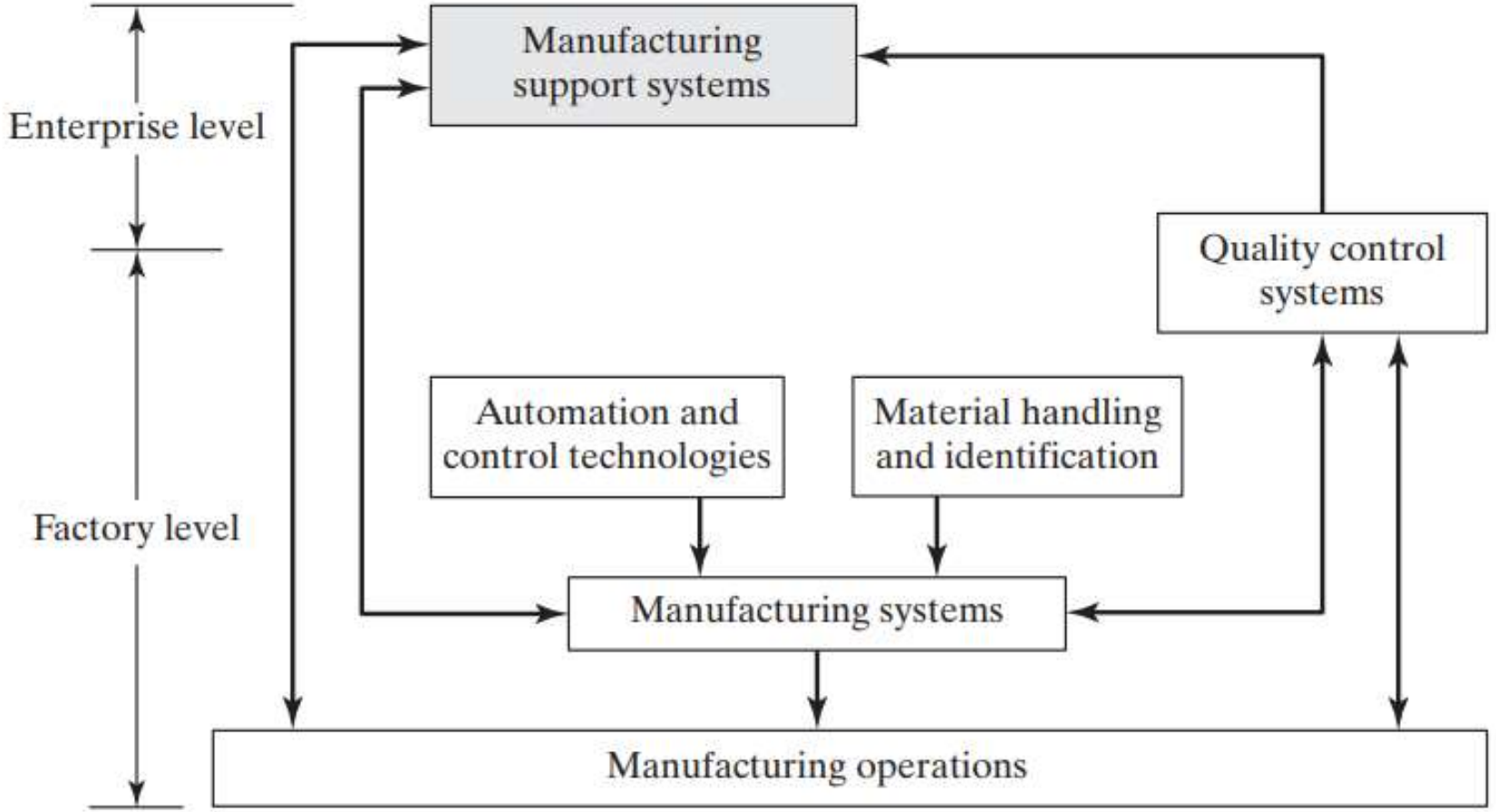


Figure 23.1 The position of the manufacturing support systems in the larger production system.

Product Design and CAD

- Significant of the cost is determined by Design.
- Design and manufacturing must be seamlessly integrated functionally, technologically and economically.
- Typical design process involves:
  - ✓ Recognition of need
  - ✓ Problem definition
  - ✓ Synthesis
  - ✓ Analysis and optimization
  - ✓ Evaluation
  - ✓ Presentation.

CAD/CAM and CIM

- CAD uses the computer to support the design engineering function, and CAM uses the computer to support manufacturing engineering activities.
- The combination CAD/CAM is symbolic of efforts to integrate the design and manufacturing functions of a firm into a continuum of activities rather than to treat them as two separate and disparate activities, as they had been considered in the past.
- CIM (computer-integrated manufacturing) includes all of CAD/CAM but also embraces the business functions of a manufacturing firm. CIM implements computer technology in all of the operational and information-processing activities related to manufacturing.

Computer Aided Design (CAD)

- CAD is the design activity that involves the effective use of the computer to create, modify, analyse, or document an engineering design.
- Geometric modelling, Engineering analysis, Design review and evaluation, Automated drafting
- It helps to
  - ✓ increase the productivity of the designer
  - ✓ improve the quality of the design
  - ✓ improve design documentation
  - ✓ create a manufacturing data base

Computer Aided Design (CAD)

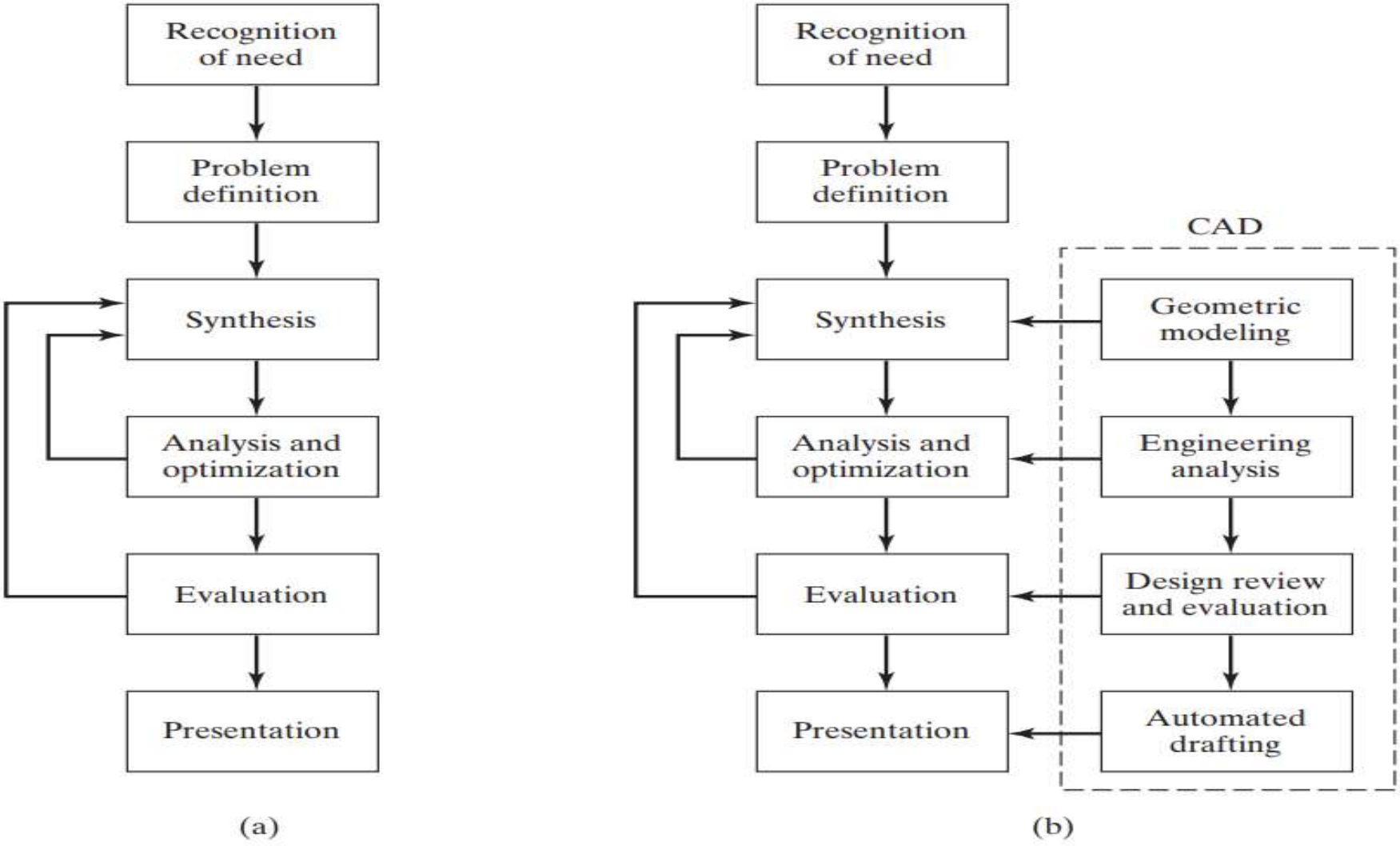
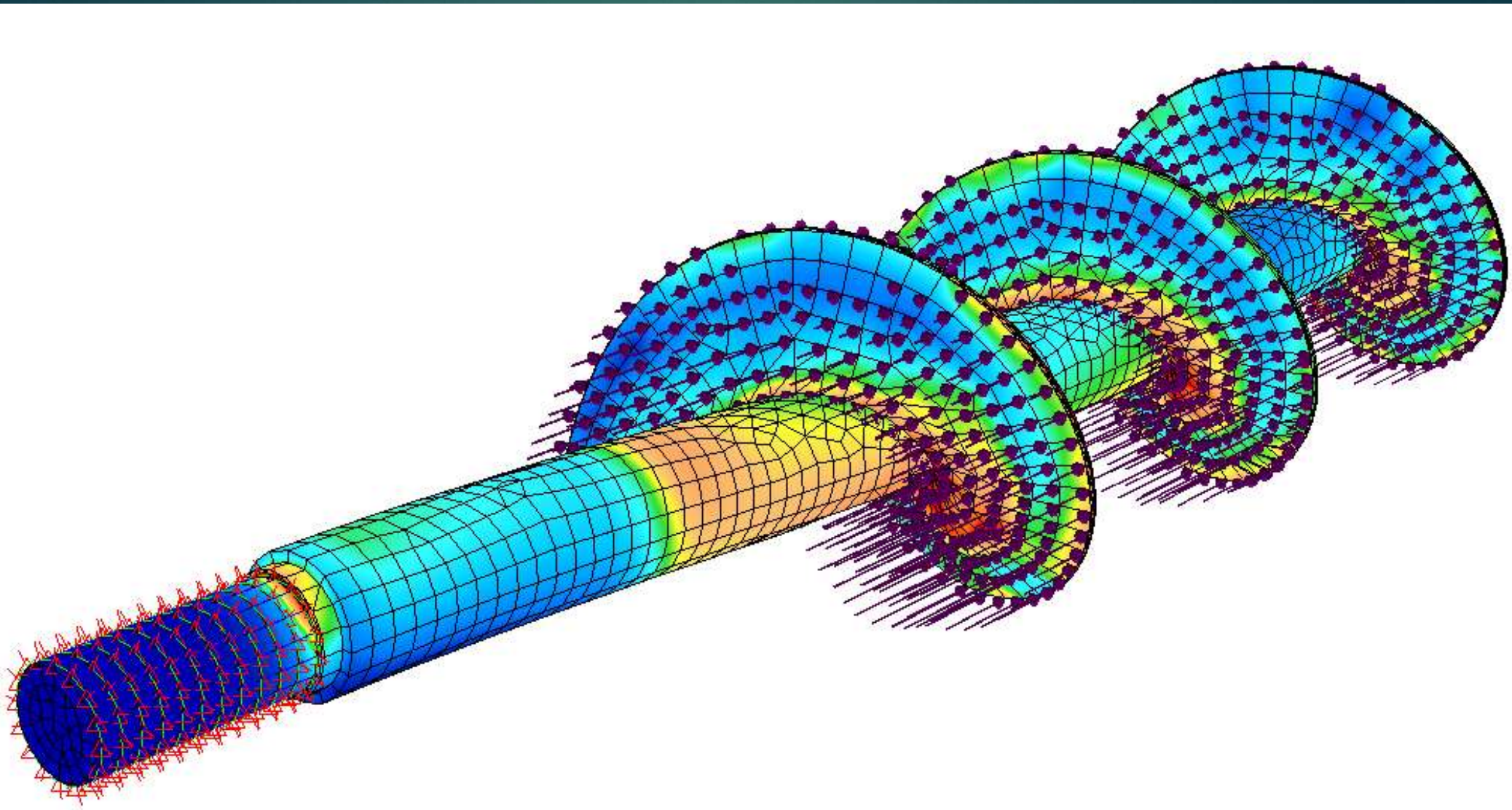


Figure 23.2 (a) Design process as defined by Shigley [13]. (b) The design process using computer-aided design (CAD).

Computer Aided Engineering (CAE)

- The term Computer Aid Engineering (CAE) is often used for engineering analyses performed by computer.
- The analysis may take the form of stress–strain calculations, heat transfer analysis, or dynamic simulation.
- The computations are often complex and time consuming, and before the advent of the digital computer, these analyses were usually greatly simplified or even omitted in the design procedure.
- Examples of engineering analysis software in common use on CAD systems include:
  - Mass properties analysis
  - Interference checking
  - Tolerance analysis
  - Finite element analysis
  - Kinematic and dynamic analysis.
  - Discrete-event simulation.

Computer Aided Engineering (CAE)



Design Evaluation and Review

- Automatic dimensioning
- Error checking.
- Animation of discrete-event simulation
- Plant layout design scores.
- prototyping

The traditional procedure in designing a new product includes fabrication of a prototype before approval and release of the product for production The prototype serves as the "acid test" of the design, permitting the designer and others to see. feel, operate, and test the product for any last-minute changes or enhancements of the design. Two approaches

- rapid prototyping and
- virtual prototyping,

Design Evaluation and Review

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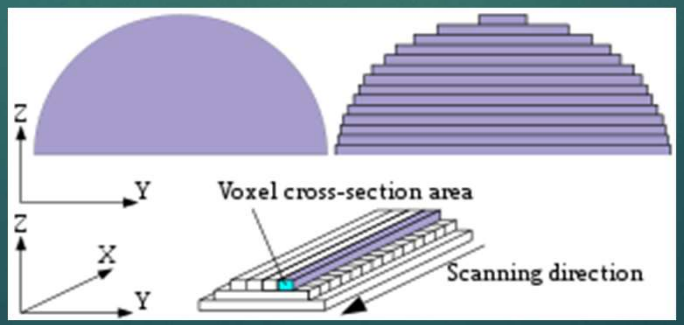
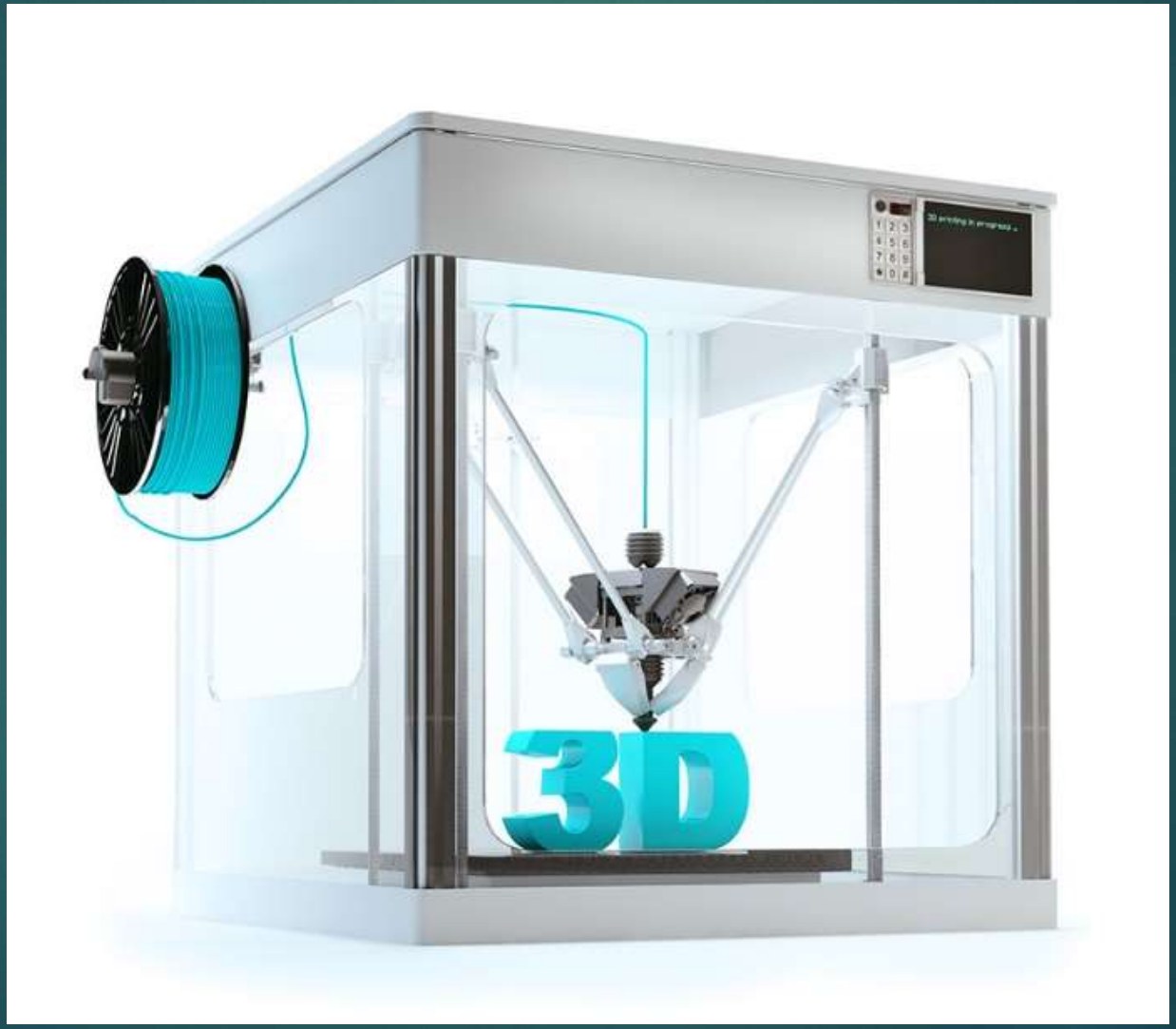
Design Evaluation and Review

- Rapid prototyping: The RP processes then fabricate the object by starting at the base and building each layer on top of the preceding layer to approximate the solid shape.
- There are a variety of layer-building processes used in rapid prototyping. One process, called stereolithography, uses a photosensitive liquid polymer that cures (solidifies) when subjected to intense light.
- Curing of the polymer is accomplished using a moving laser beam whose path for each layer is controlled by means of the CAD model. A solid polymer prototype of the part is built up of hardened layers, one on top of another. Another RP process, called selective laser sintering, uses a moving laser beam to fuse powders in each layer to form the object layer by layer; work materials include polymers, metals, and ceramics.
- When used to produce parts rather than prototypes, the term additive manufacturing is used for these processing technologies

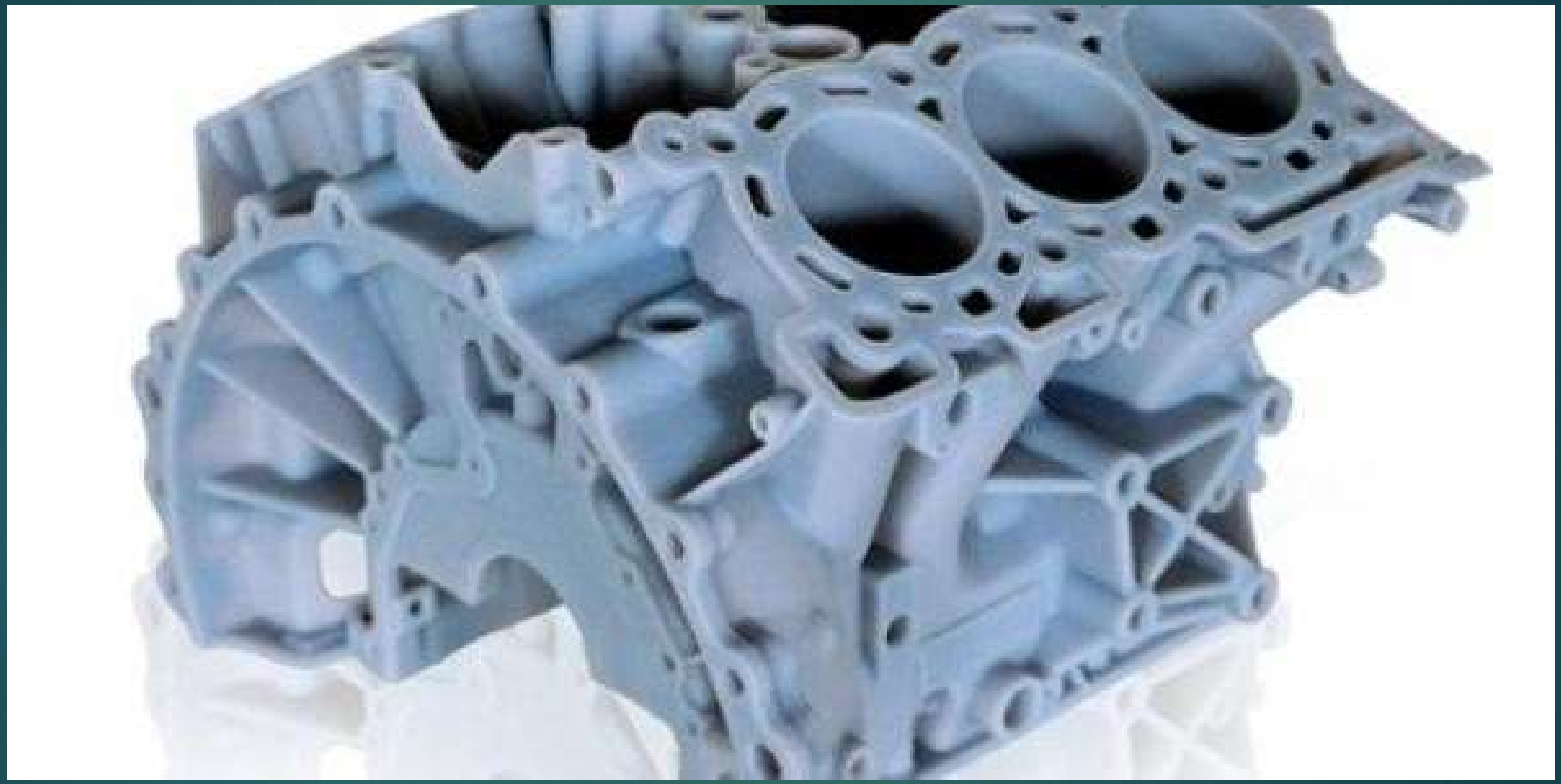


Design Evaluation and Review

- 3D Printing:



Design Evaluation and Review



Design Evaluation and Review

Virtual prototyping:

VR, AR etc.

Automated Drafting

- The fourth area where CAD is useful (step 6 in the design process) is presentation and documentation.
- CAD systems can be used to prepare highly accurate engineering drawings when paper documents are required.
- It is estimated that a CAD system increases productivity in the drafting function by about fivefold over manual preparation of drawings

CAM

- Applications of CAM can be divided into two broad categories: (1) manufacturing planning and (2) manufacturing control.

- Manufacturing planning-computer is used indirectly to support the production function, but there is no direct connection between the computer and the process.
  - Computer-aided process planning (CAPP)
  - Computer-assisted NC part programming
  - Computerized machinability data systems
  - Development of work standards
  - Cost estimating
  - Production and inventory planning
  - Computer-aided line balancing

CAM

Manufacturing control-concerned with developing computer systems to implement the manufacturing control function.

- Process monitoring and control-is concerned with observing and regulating the production equipment and manufacturing processes in the plant.
- Quality control-includes a variety of approaches to ensure the highest possible quality level
- Shop floor control-refers to production management techniques for collecting data from factory operations and using the data to help control production and inventory
- Inventory control-Inventory control is concerned with maintaining the most appropriate levels of inventory in the face of two opposing objectives: minimizing the investment and storage costs of holding inventory and maximizing service to customers
- Just-in-time production systems

CAD/CAM

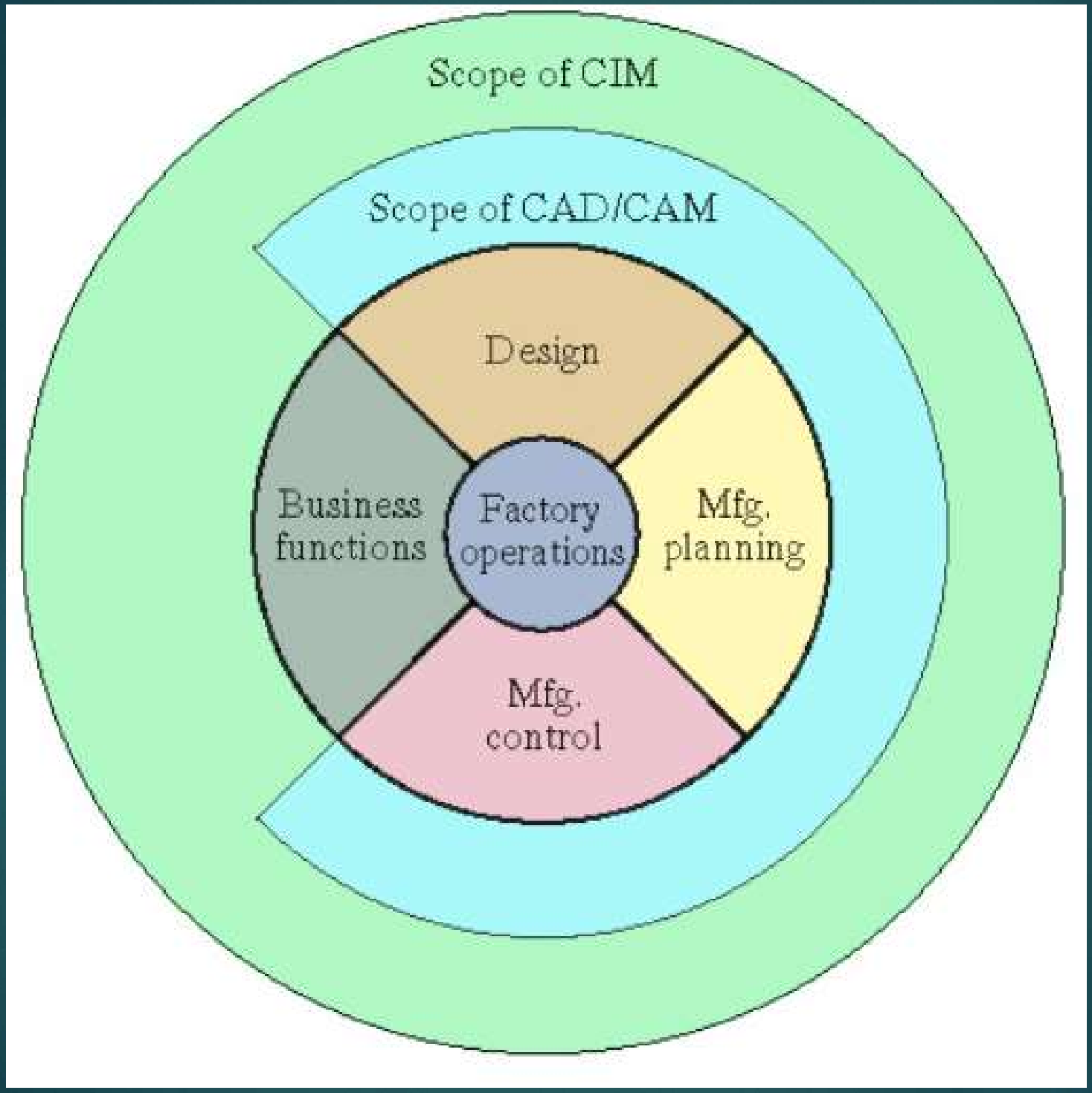
CAD/CAM is concerned with the engineering functions in both design and manufacturing. Product design, engineering analysis, and documentation of the design (e.g.. drafting) represent engineering activities in design. Process planning, NC part programming, and other activities associated with CAM represent engineering activities in manufacturing.

CAD/CAM denotes an integration of design and manufacturing activities by means of computer systems.

In the ideal CAD/CAM system, it is possible to take the design specification of the product as it resides in the CAD data base and convert it into a process plan for making the product. This conversion will be done automatically by the CAD/CAM system

CIM

- CIM includes all of the engineering functions of CAD/CAM, and firm's business functions that are related to manufacturing.
- The ideal CIM system applies computer and communications technology to all operational functions and information processing function in manufacturing from order receipt, through design and production, to product shipment.
- The CIM concept is that all of the firm's operations related to production are incorporated in an integrated computer system to assist, augment, and automate the operations.
- Output of one activity serves as the input to the next activity, through the chain of events that starts with the sales order and culminates with shipment of the product.

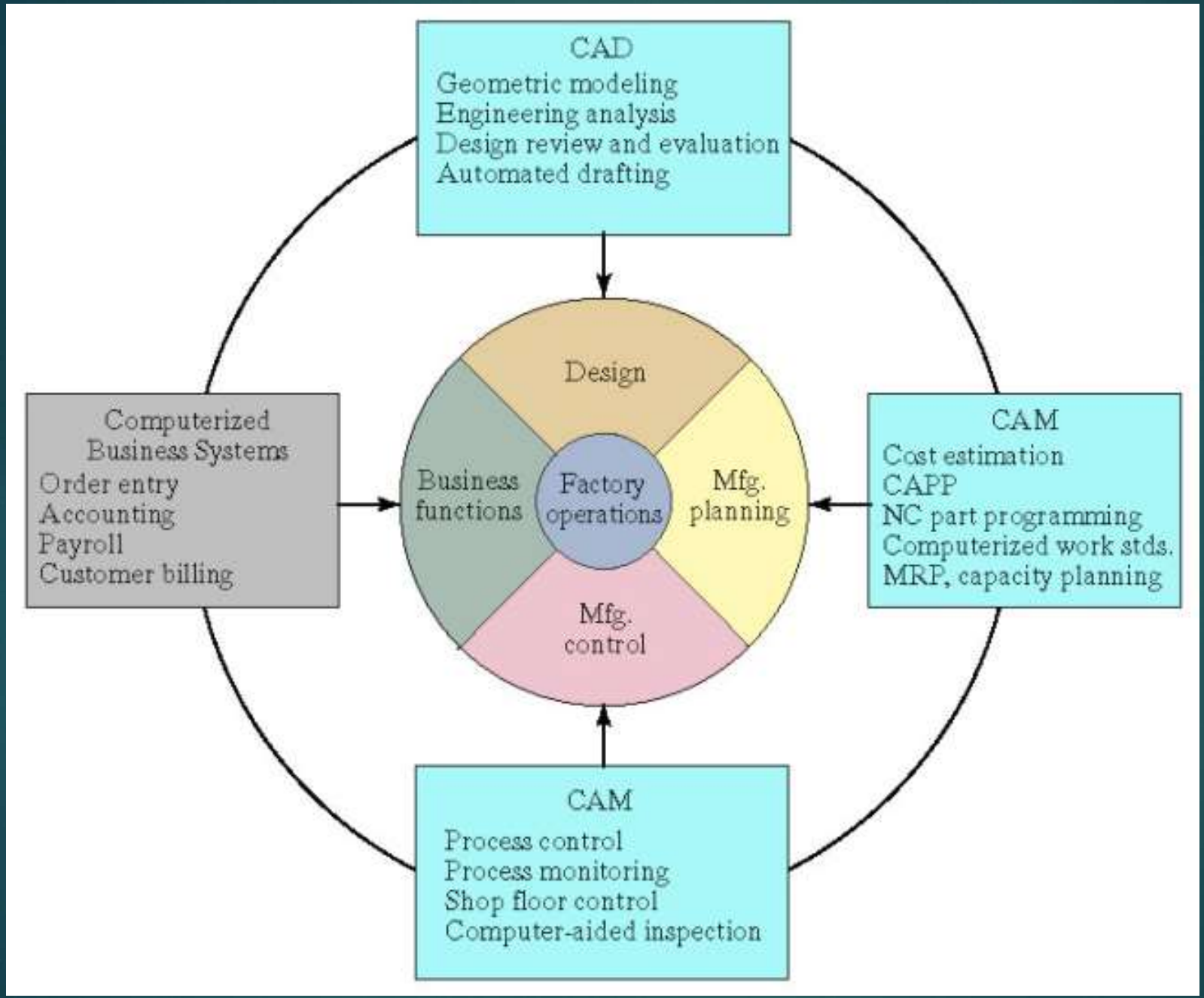

Scope of CIM
Scope of CAD/CAM
Design
Business functions
Factory operations
Mfg. planning
Mfg. control

CIM

- Customer orders are initially entered by the company's sales force or directly by the customer into a computerized order entry system. The orders contain the specifications describing the product.
- The specifications serve as the input to the product design department. New products are designed on a CAD system. The components that comprise the product are designed, the bill of materials is compiled, and assembly drawings are prepared.
- The output of the design department serves as the input to manufacturing engineering, where process planning. tool design, and similar activities are accomplished to prepare for production.

CIM

- The output from manufacturing engineering provides the input to production planning and control, where material requirements planning and scheduling are performed using the computer system.
- So it goes. through each step in the manufacturing cycle.
- Full implementation of CIM results in the automation of the information flow through every aspect of the company's organization.


CAD
Geometric modeling
Engineering analysis
Design review and evaluation
Automated drafting
Computerized Business Systems
Order entry
Accounting
Payroll
Customer billing
Design
Business functions
Factory operations
Mfg. planning
Mfg. control
CAM
Cost estimation
CAPP
NC part programming
Computerized work stds.
MRP, capacity planning
CAM
Process control
Process monitoring
Shop floor control
Computer-aided inspection

Thanks!

Any questions?

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