Introduction to Computer-Aided Design

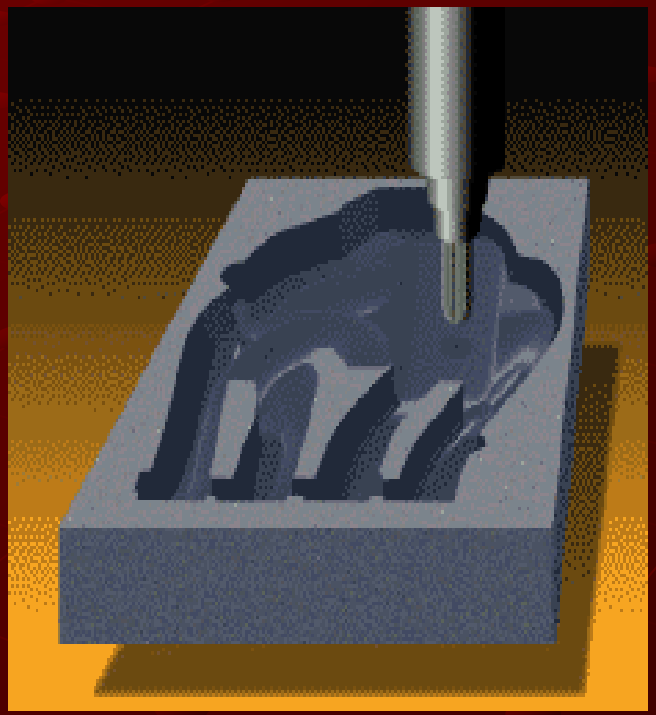
UNIT 1 & 2

Computer-Aided Design (CAD)

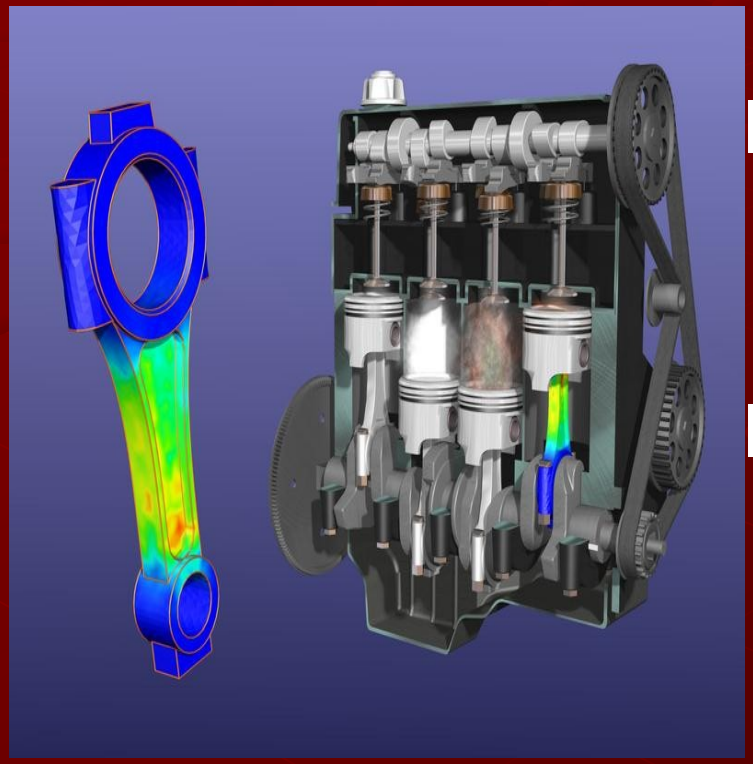
- Use of computer systems to assist in the creation, modification, analysis, and optimization of a design
- Typical tools:
  - Tolerance analysis
  - Mass property calculations
  - Finite-element modeling and visualization
- Defines the geometry of the design

Computer-Aided Manufacturing (CAM)

- Use of computer systems to plan, manage, and control manufacturing operations
- Direct or indirect computer interface with the plant's production resources
- Numerical control of machine tools
- Programming of robots



Computer-Aided Engineering (CAE)

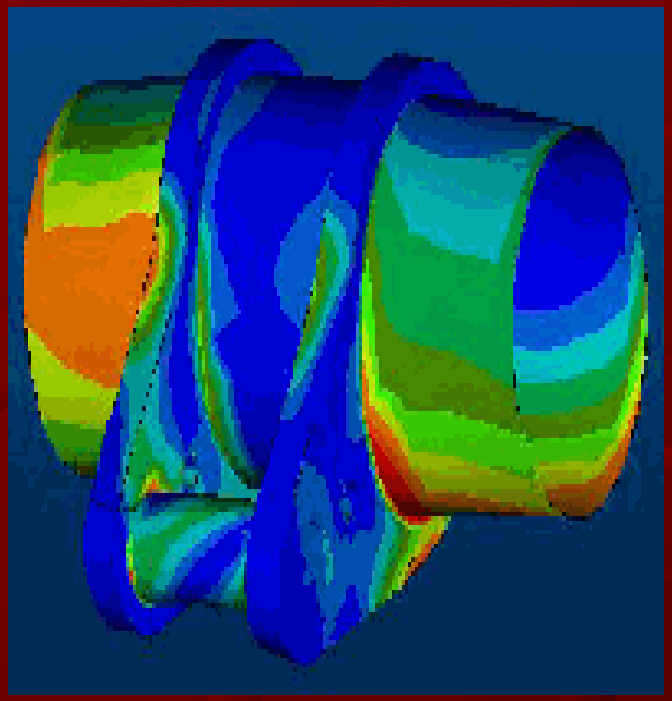


- Use of computer systems to analyze CAD geometry
- Allows designer to simulate and study how the product will behave, allowing for optimization
- Finite-element method (FEM)
  - Divides model into interconnected elements
  - Solves continuous field problems

Computer-Aided Design Process

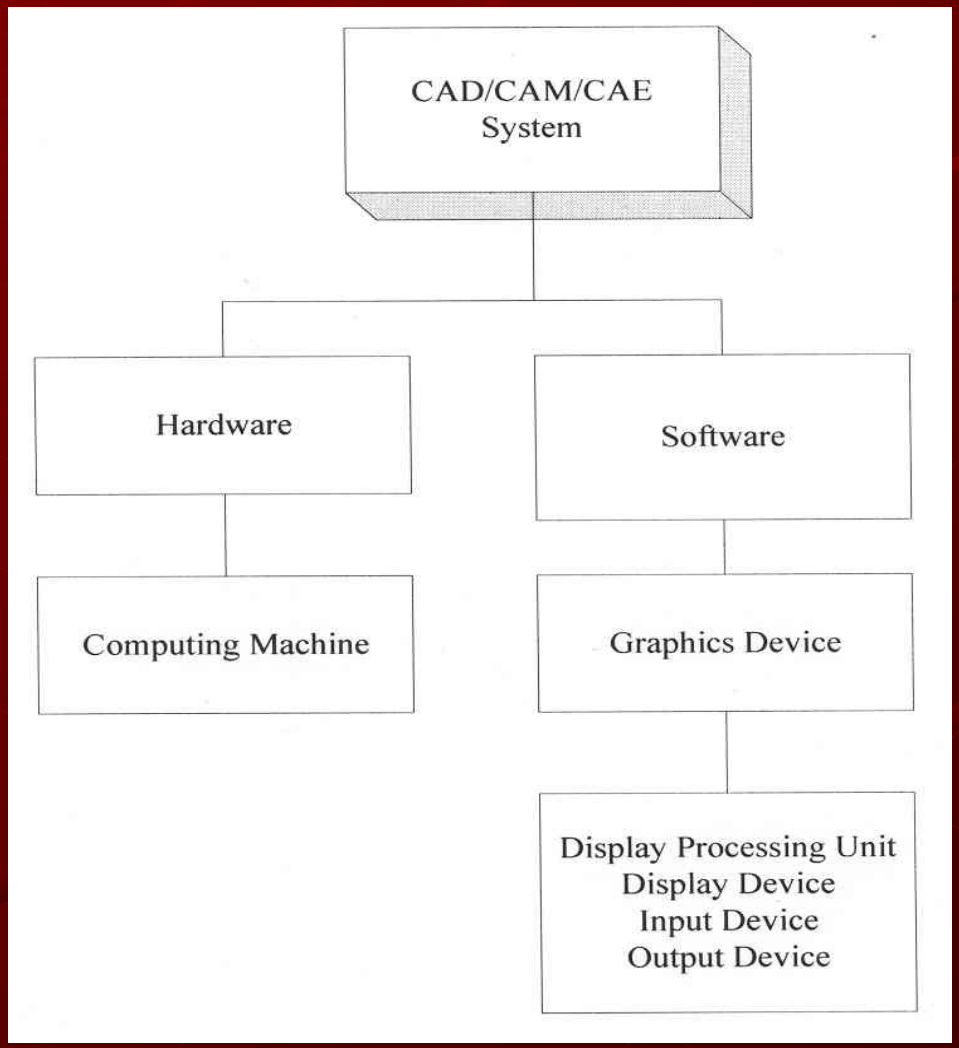
- Two types of activities: synthesis and analysis
- Synthesis is largely qualitative and hard to capture on computer
- Analysis can be greatly enhanced with computers
- Once analysis is complete, design evaluation- rapid prototyping
- Software packages for design optimization

Components of CAD/CAM/CAE Systems



- Major component is hardware and software allowing shape manipulation
- Hardware includes graphic devices and their peripherals for input and output operations
- Software includes packages that manipulate or analyze shapes according to user interaction

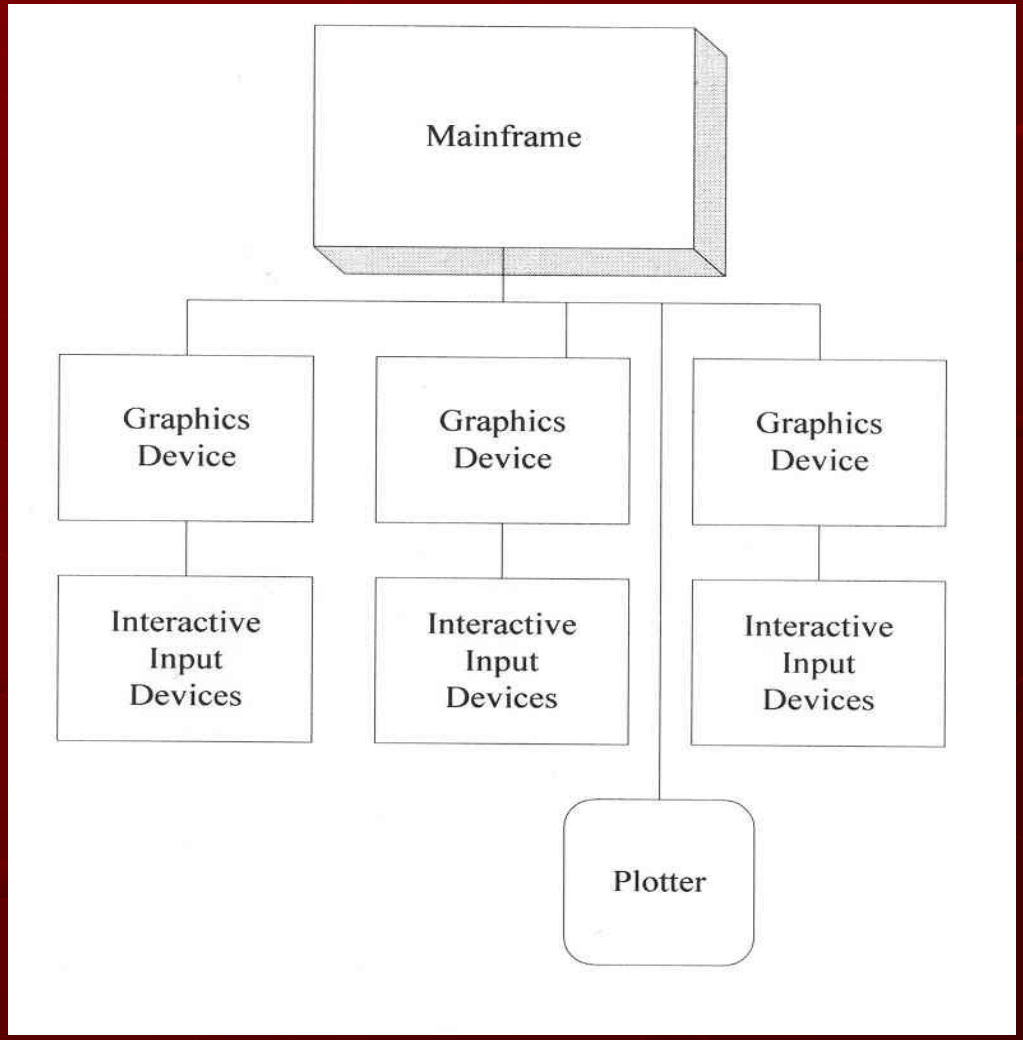
Components of CAD/CAM/CAE Systems



Hardware Components

- Graphic device is composed of a display processing unit, a display device, and one or more input devices
- Input devices:
  - Mouse
  - Space ball
  - Data tablet with a puck or stylus
  - Keyboard
- Output Devices:
  - Plotters
  - Color laser printers

Hardware Configuration #1



Hardware Configuration #1

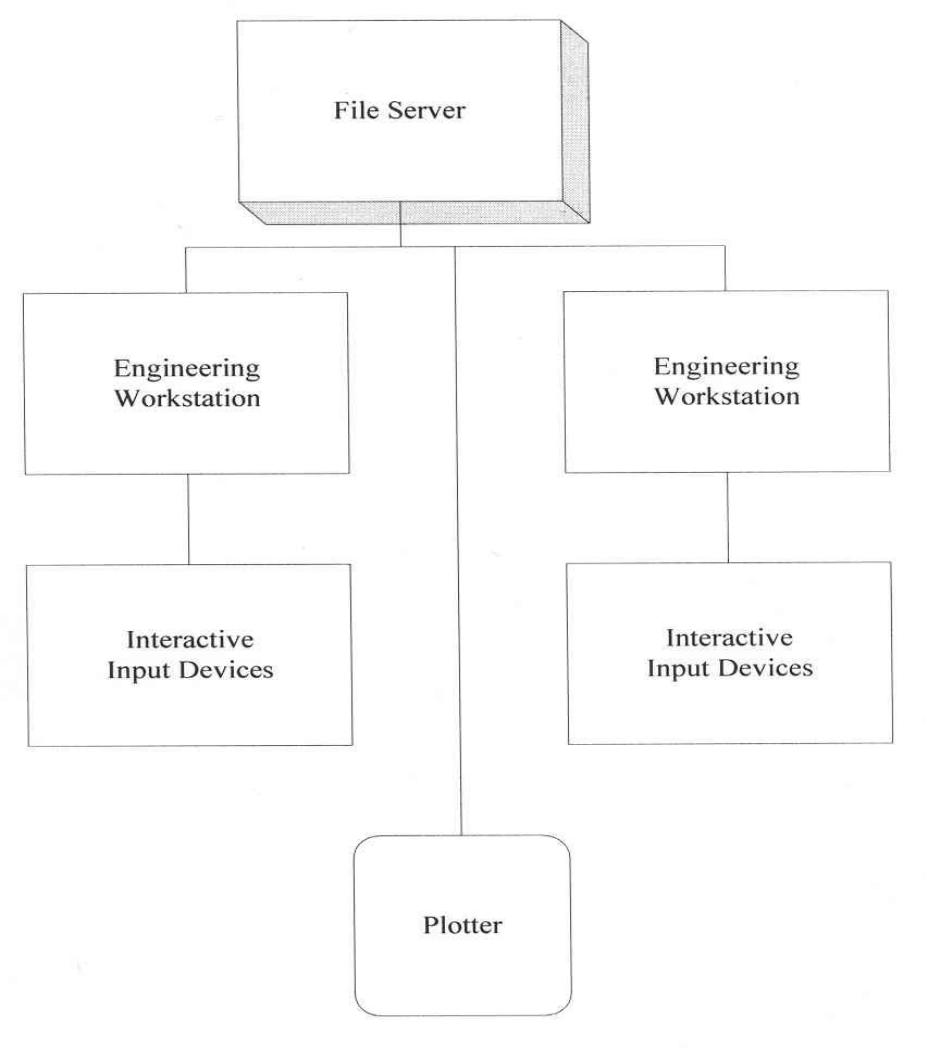
Requires a big initial investment for hardware and software

Slow system response times

Maintenance of mainframe is expensive

Updating operating systems is difficult

Hardware Configuration #2



Hardware Configuration #2

- Engineering workstations connected in a networked environment
- Widely used; trend toward distributed computing
- User can choose appropriate workstation on a task by task basis
- Initial investment is smaller than configuration #1

Hardware Configuration #3

Popular with small companies

Same as the second, except engineering workstations are replaced by personal computers running Microsoft Windows

Popular with companies whose main purpose is to generate drawings with their CAD/CAM/CAE systems

Distinction between configurations 2 and 3 becoming blurred as personal computers evolve

Software Components

- CAD software allows the designer to create and manipulate a shape interactively and store it
- CAM software plans, manages and controls the operations of a manufacturing site
- CAE software analyzes design geometry, allowing designer to study product behavior

Windows-Based CAD Systems

- User interface is similar to Windows
- Employs component technology, in which best key software elements are selected from among available software
- Use object-oriented technology, which modularizes the program
- Capable of either parametric or variational modeling
- Internet support

Rapid Prototyping

Rapid Prototyping has surgical applications

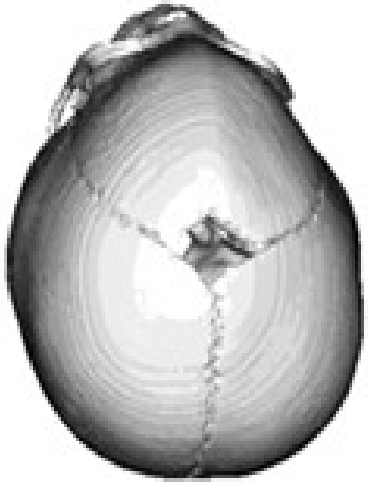
- Layer by layer fabrication of three-dimensional physical models from CAD
- Fast and inexpensive alternative for producing prototypes and functional models
- Build parts in thin layers
- Minimum operation time; typically runs unattended

Medical Modeling - Zcorp

INDUSTRIES: MEDICAL MODELING

Quickly get to know your patients

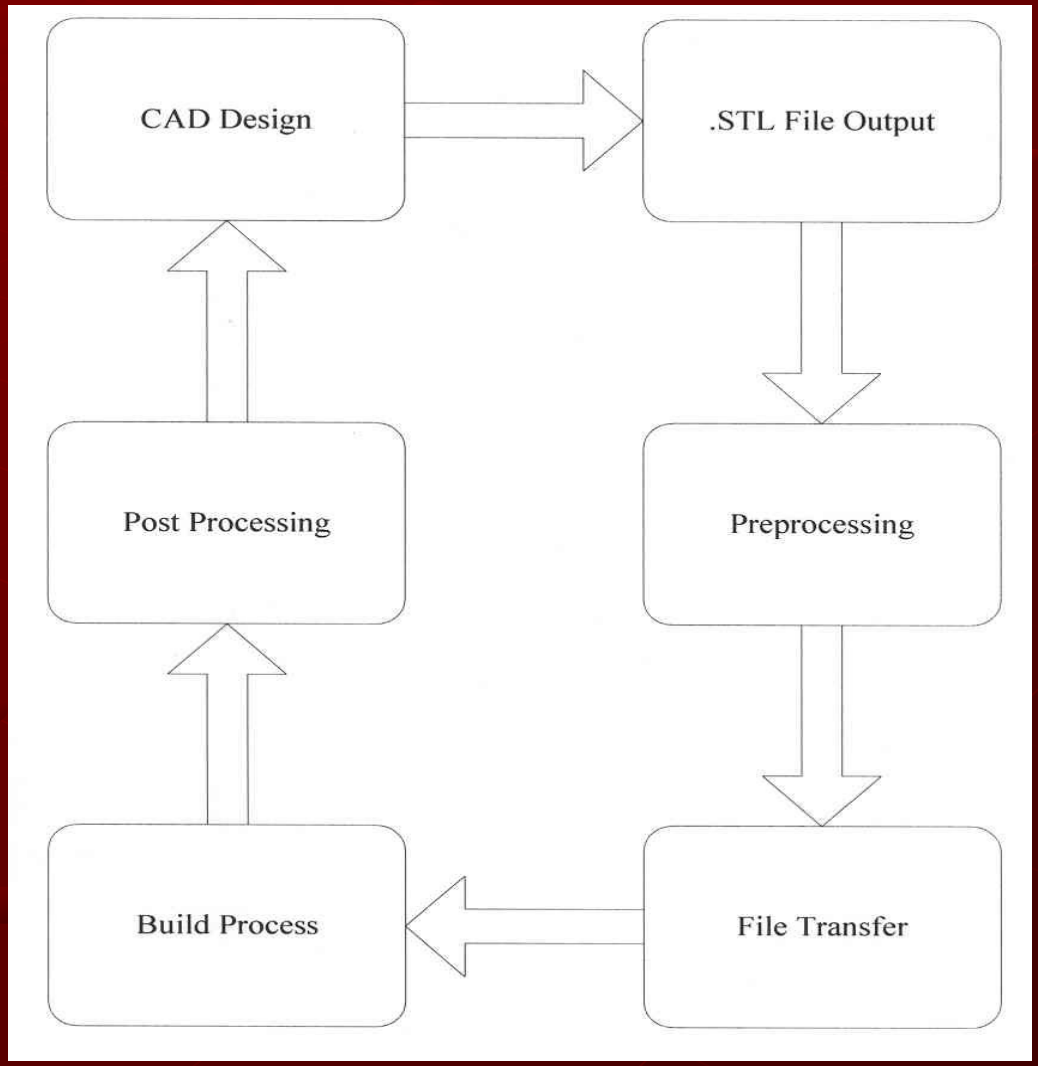
inside and out.



A 3D reconstruction of the patient's skull from the CT scan data.

A 3D physical model produced using Z Corp.'s 3D Printer.

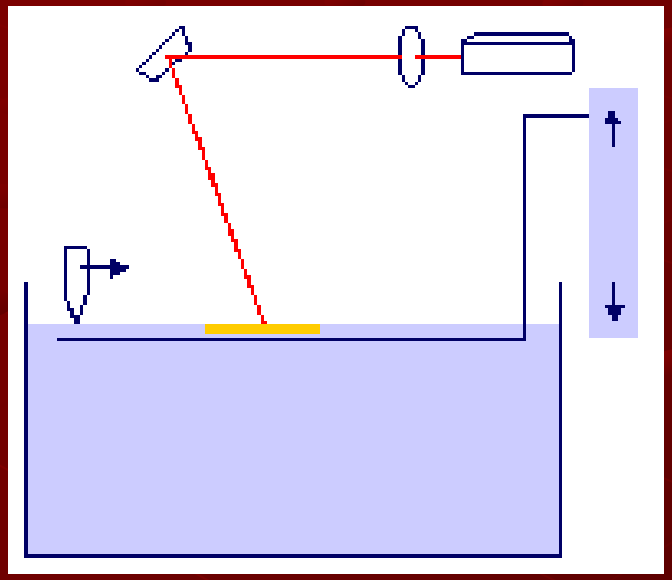
Rapid Prototyping Cycle



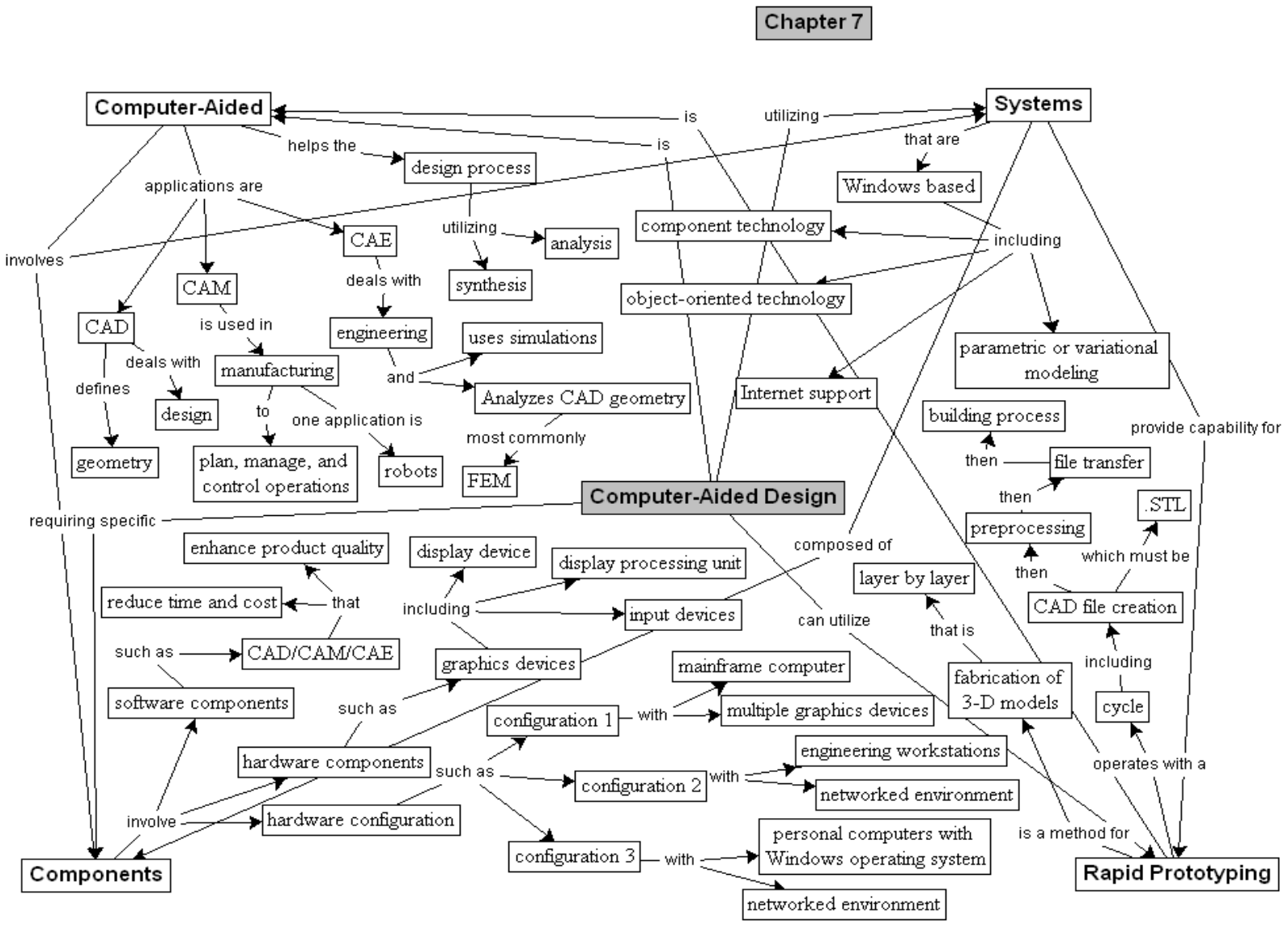
Rapid Prototyping Cycle

- .STL is standard file format for all U.S. rapid prototyping systems
- Preprocessing prepares .STL file for various rapid prototyping systems
- Build process can last from a few hours to several days
- Post processing: removal of part from machine, support removal, sanding

Rapid Prototyping Process (Damvig)



“A computer-controlled laser beam is scanned across the surface of a vat of liquid photopolymer, instantly solidifying the liquid at each point of contact. Using data generated from a CAD file, individual cross-sections of the three-dimensional geometry are solidified in turn to build up a solid part layer by layer. In this way even highly complex geometries can be built in a few hours without requiring any tools. “


Chapter 7
Computer-Aided
is
is
helps the
design process
applications are
involves
CAE
utilizing
analysis
synthesis
deals with
CAM
is used in
CAD
deals with
defines
design
geometry
manufacturing
to
plan, manage, and control operations
one application is
robots
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Rapid Prototyping
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that
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CAD/CAM/CAE
graphics devices
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such as
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configuration 1
with
multiple graphics devices
hardware components
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configuration 2
with
engineering workstations
networked environment
involve
hardware configuration
configuration 3
with
personal computers with Windows operating system
networked environment