ENGINEERING GRAPHICS

Lecture 1: Introduction to
Graphic Communication

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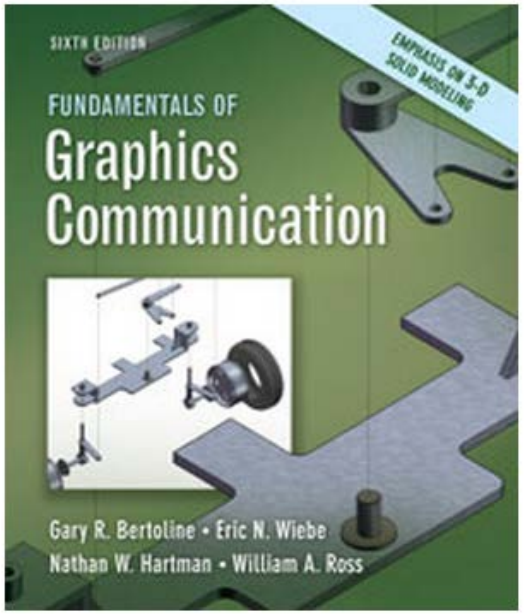


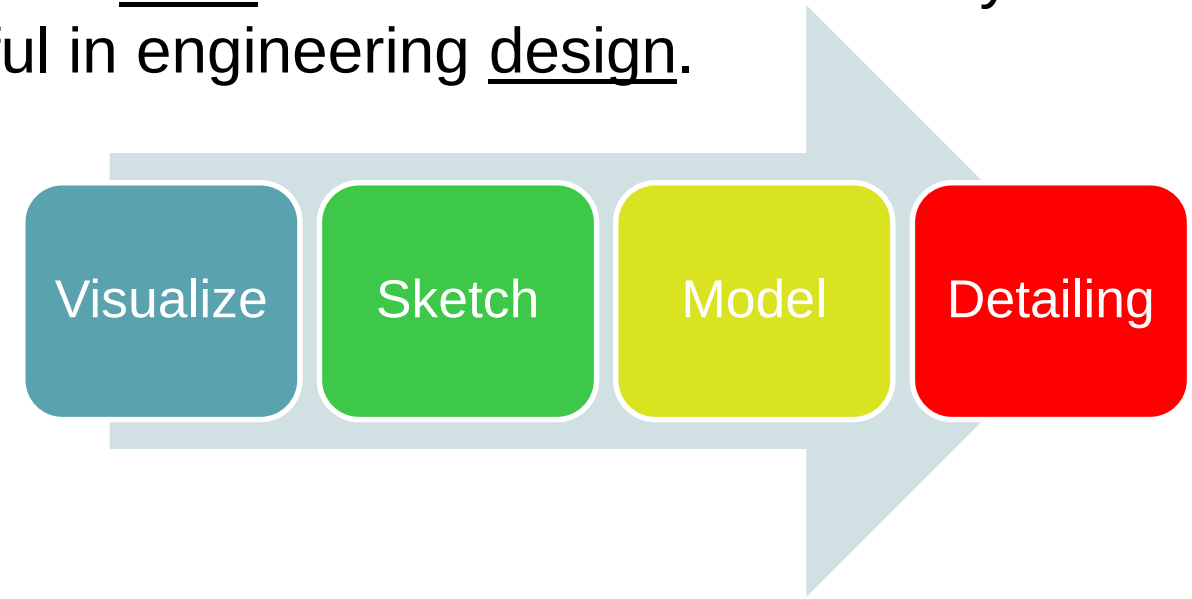
Overview

- Graphics Communication in the Design Process
- Engineering Design Process:
  - Ideation
  - Refinement
  - Design Review
  - Implementation
  - Product Data Control
- Conventions and Standards
- Graphics Communication Technologies – CAD

What is Graphics Communication?

An effective means of communicating technical ideas and problem solutions.

Graphics Communication involves using engineering drawings and models as a language, a clear, precise language with definite rules that must be mastered if you are to be successful in engineering design.



Engineering Design Process

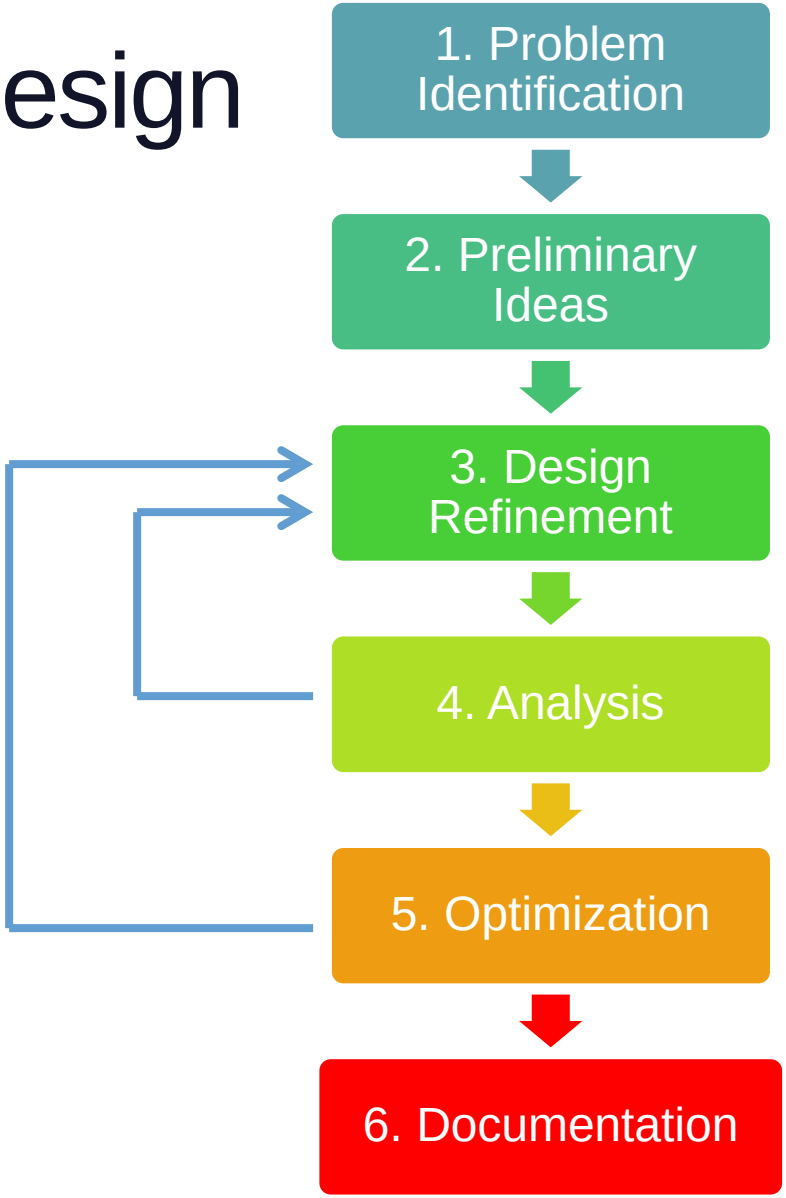
Engineering Design Process is one of the processes normally associated with the entire business or enterprise, from receipt of the order or product idea, to maintenance of the product, and all the states in between.

Three types of Graphic Engineering Design Processes:

- Linear Engineering
- Model-Centered Engineering Design
- Collaborative Engineering

Linear Engineering Design

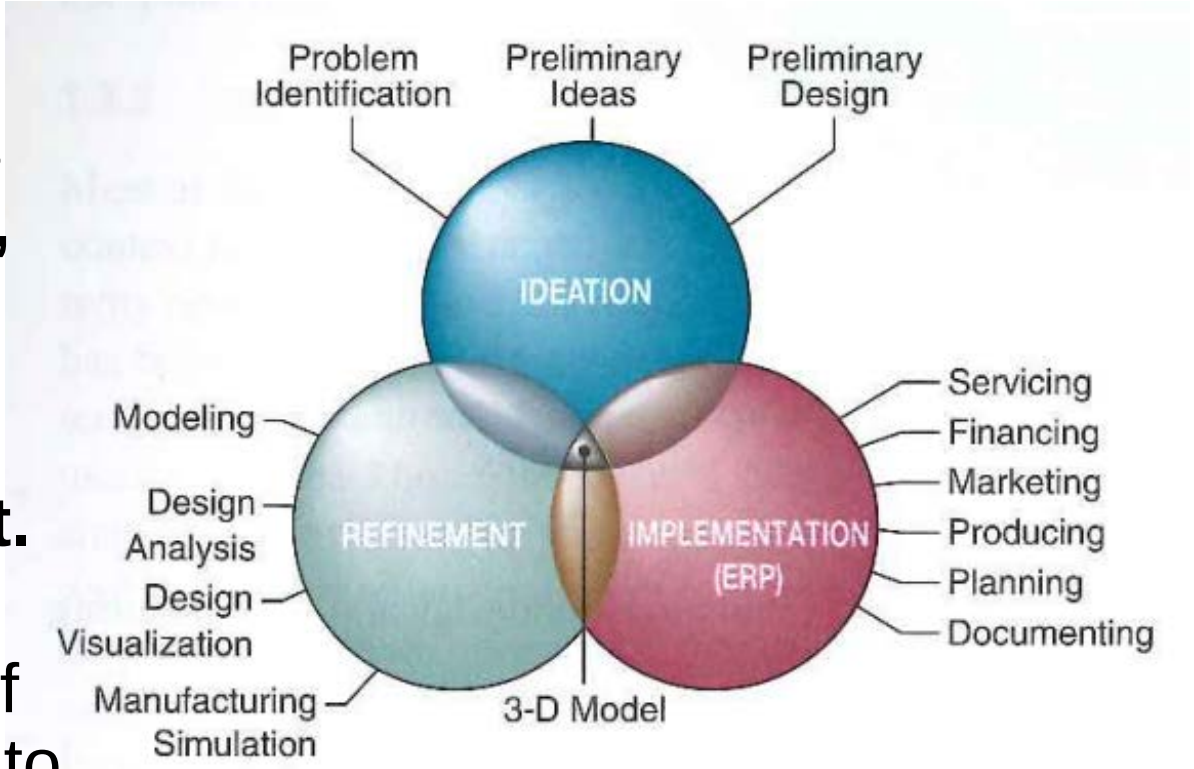
Linear Engineering Design is divided into to six-steps and moves sequentially; however if problems are encountered the process may return to a previous step. The repetitive process is called an iteration or looping.



Modeled – Centered Engineering Design

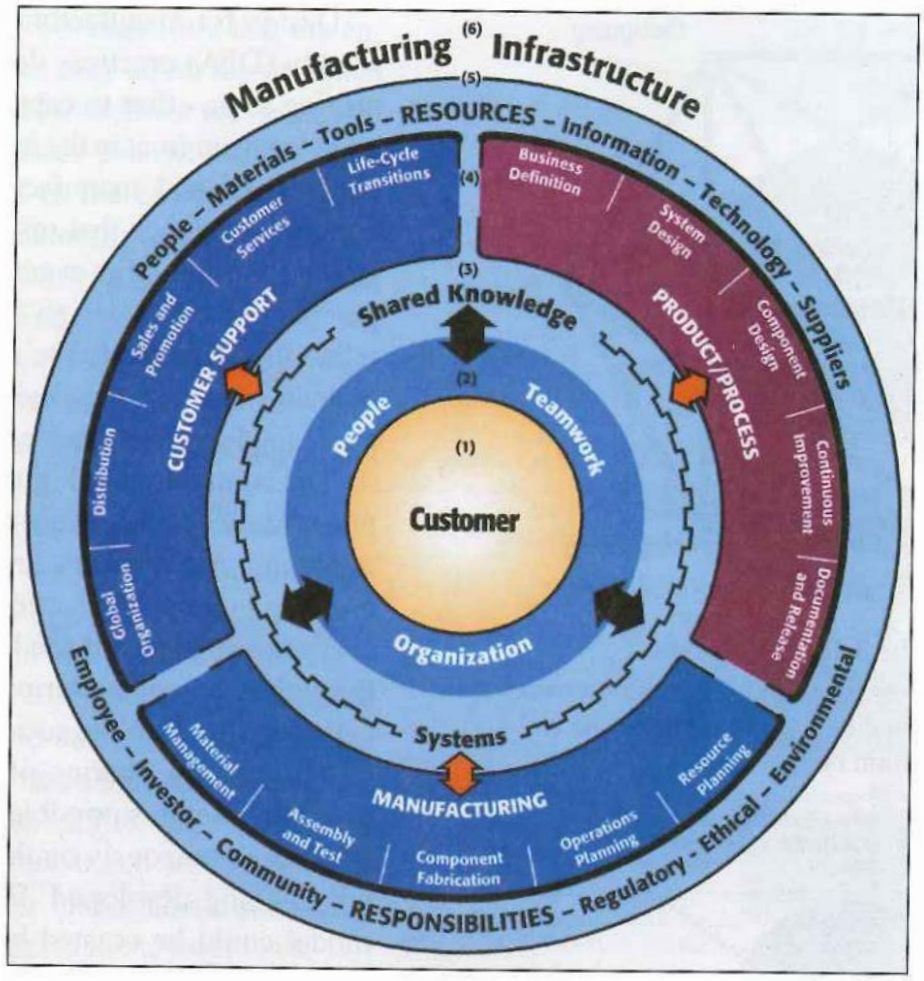
It is a non-linear team approach to design that brings together the input, processes, and output elements necessary to produce a product.

Generally executed in the final results of the design process to produce a product or system.



Collaborative Engineering Design

- Evolved from model-centered engineering.
- The development of e-mail, groupware, video conferencing, and chat rooms has been important in the development of collaborative engineering.
- **It is fundamentally a <u>product-centric</u> process that builds onto the mindset of highly effective collaboration about the <u>product</u> and its <u>manufacturing</u> and support processes.**



ENGINEERING DESIGN PROCESS

Ideation • Refinement • Design Review • Implementation • Product Data Control

Ideation

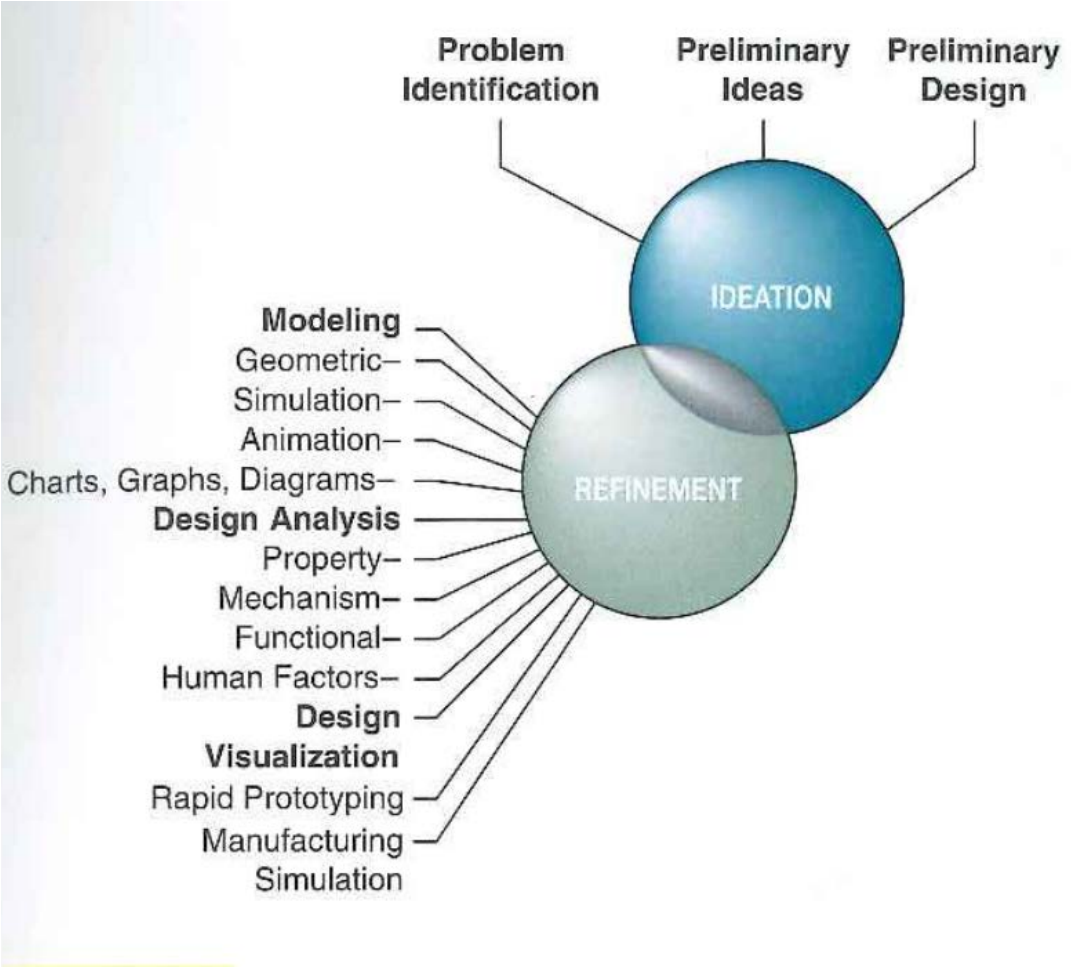
Structured approach to thinking for the purpose of solving a problem.

Problem Identification – is an ideation process which the parameters of the design project are set before an attempt is made to find the solution.

- Problem Statement
- Research
- Data Gathering
- Objectives
- Limitations
- Scheduling

Refinement

Repetitive (iterative or cyclical) process used to test the preliminary design, make changes if necessary, and determine if the design meets the goals of the project.



Refinement: Modeling

Process of representing abstract ideas, words, and forms, through the orderly use of simplified text and images.

Descriptive Model
Mathematical Model
Scale Model
Predictive Model
Real Model
VR Model

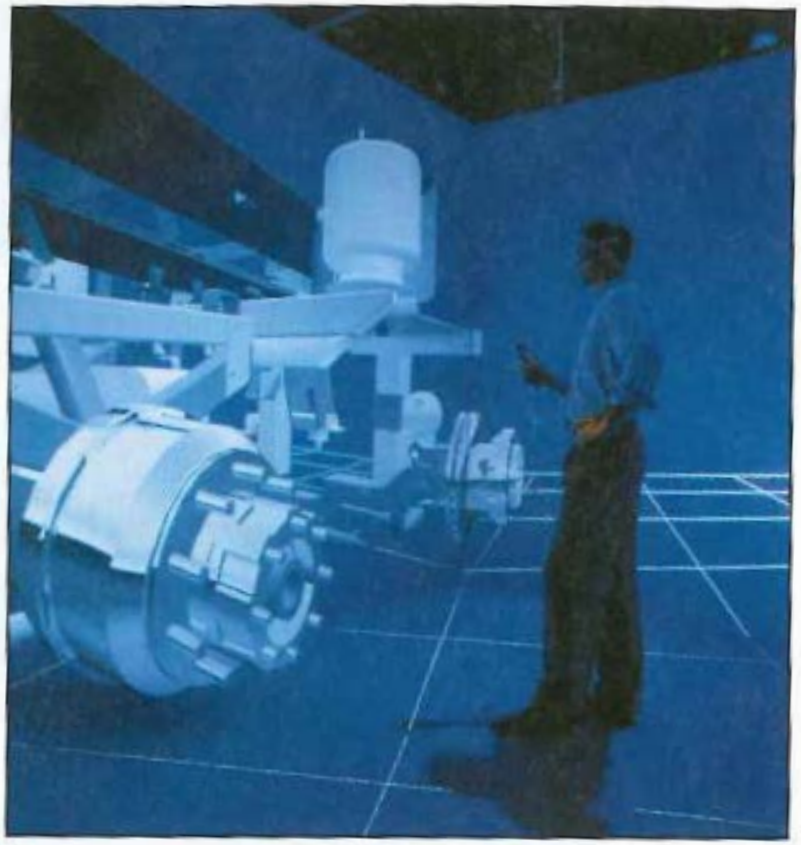
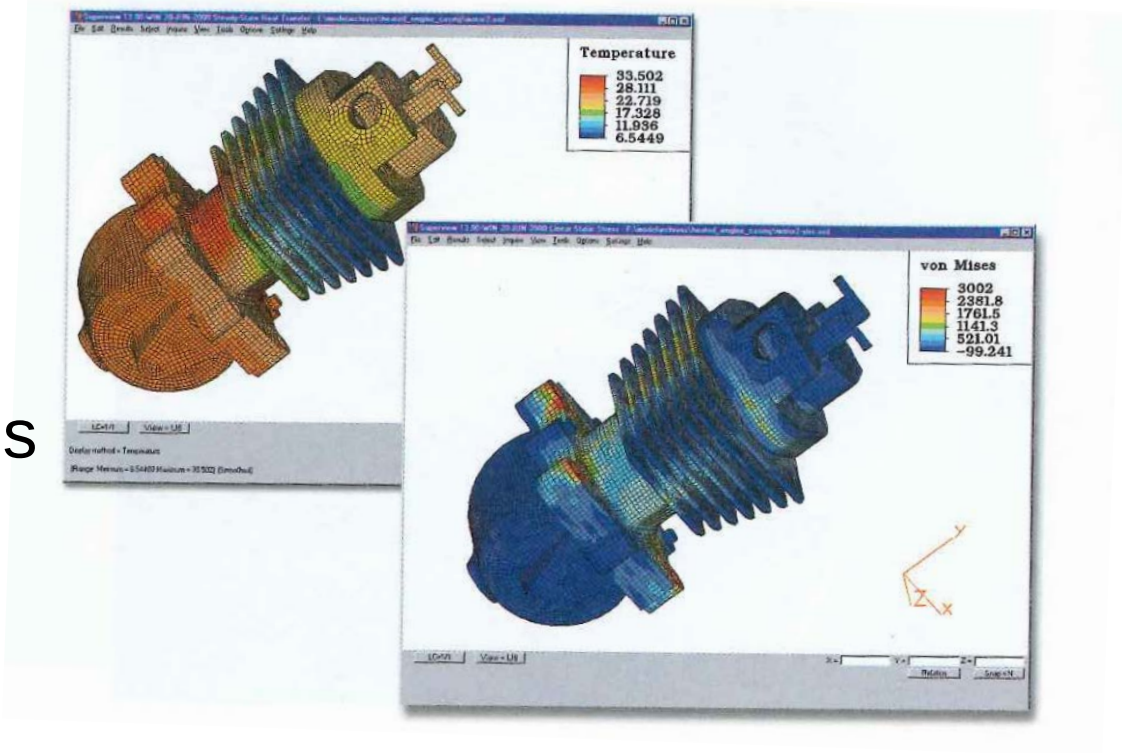


Figure 1.31 **Virtual reality technology**
This technology allows a more complete use of the senses to explore and evaluate design concepts.
(Courtesy of Fakespace Systems, Inc.)

Refinement: Design Analysis

It is the evaluation of a proposed design, based on the criteria established in the ideation phase.

Property Analysis
Mechanism Analysis
Functional Analysis
Human Factor Analysis
Aesthetic Analysis
Financial Analysis
Thermal Analysis



Refinement: Design Analysis

Figure 1.34 **Motion analysis**

A motion analysis of an assembly is determined using FEM.

(Courtesy of Algor, Inc.)

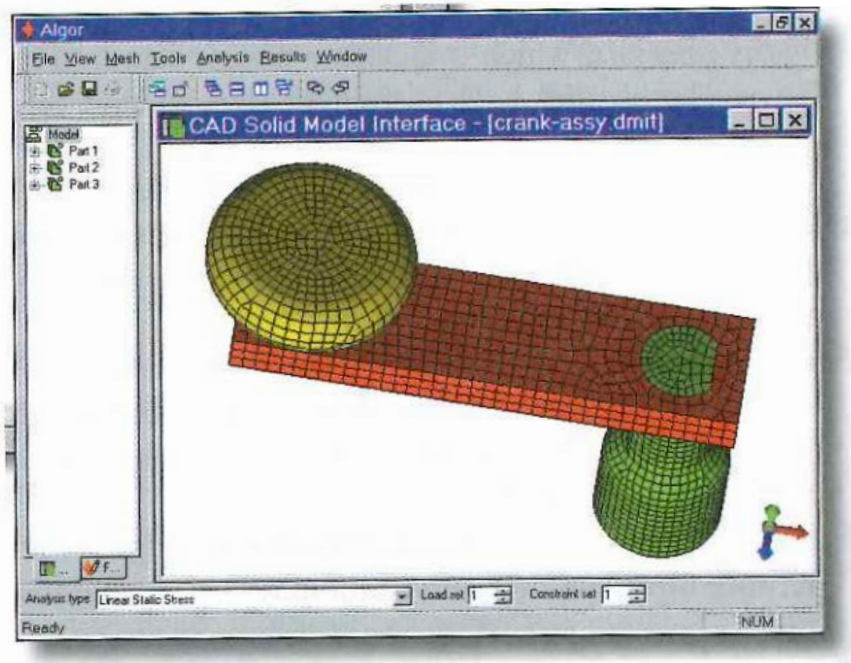


Figure 1.35 **Discretization**

Before a finite element analysis can be performed, the solid CAD model must be broken into smaller, discrete parts, using a process called discretization. Lines are added to the model after discretization to represent the boundaries of each discrete part of the model.

(Courtesy of Algor, Inc.)

Refinement: Design Analysis

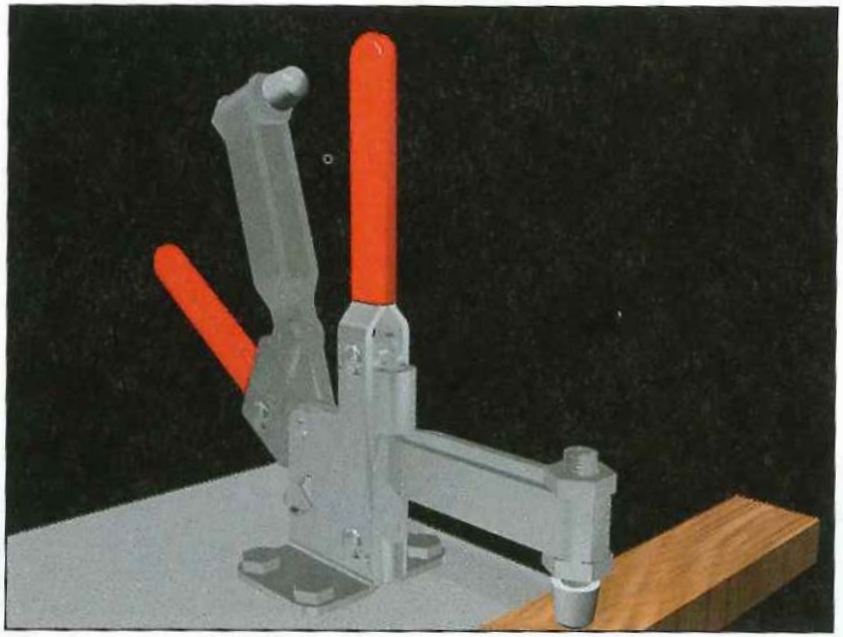


Figure 1.38 **Kinematic analysis**

The kinematic analysis of a mechanism is used to evaluate the range of motion during operation.

(© Gary Bertoline.)

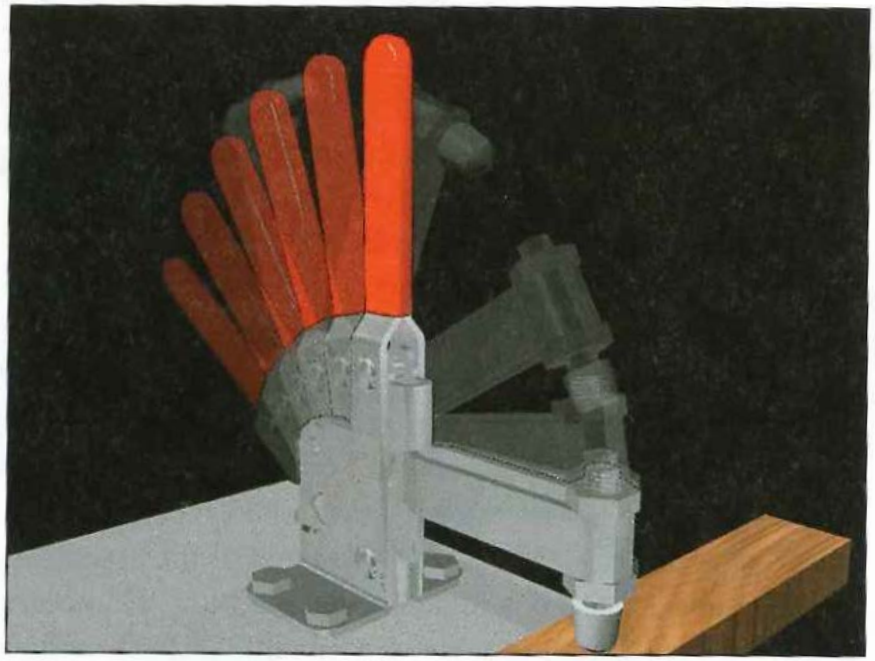


Figure 1.39 **Dynamic analysis**

This dynamic analysis of a clamp evaluates the forces involved with the movement of the mechanism.

(© Gary Bertoline.)

Design Review

Generally carried out through a formal meeting where the design team presents their progress to management.

The use of graphs, sketches, technical drawings, and 3-Models is generally used.

Implementation

This is the final phase in collaborative engineering design and is the process used to change the final design from an idea into a product, process, or structure.

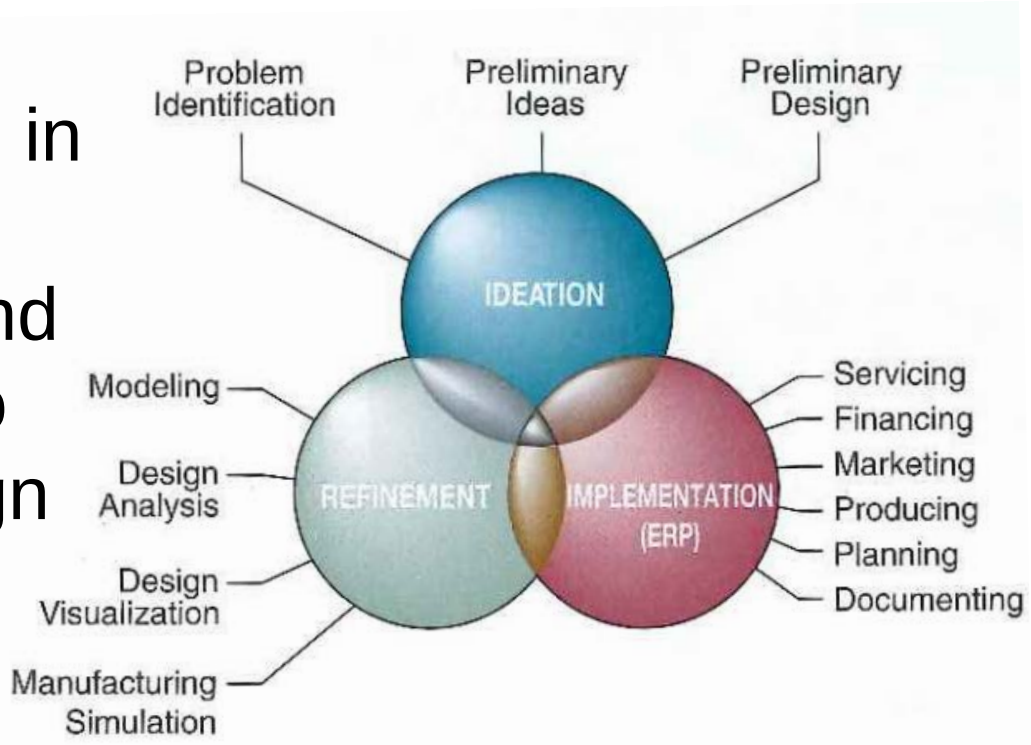


Figure 1.40 **Implementation process**

The implementation process includes nearly every phase of the business. In this phase of the design process, the final design moves from idea to final product.

Product Data Control

The management of ALL the information associated with the design, manufacture, and maintenance of a product. Information used for both current and future design efforts.

Product Data Management (PMD) is the name given to the specific computer-based tools and processed used to manage this information.

Graphics as a Language

ENGLISH

- Used to Communicate
- Alphabet
- Old English – Shakespeare
- New English – Clueless

ENGINEERING GRAPHICS

- Used to Communicate
- Alphabet
- Old Graphics – Paper and Pencil
- New Graphics – Computers

Standards and Conventions

Conventions – commonly are practices, rules, or methods. i.e. Multi-view Drawing

Standards – are sets of rules that govern how technical drawings are represented. i.e. American National Standards Institute (ANSI) specifications

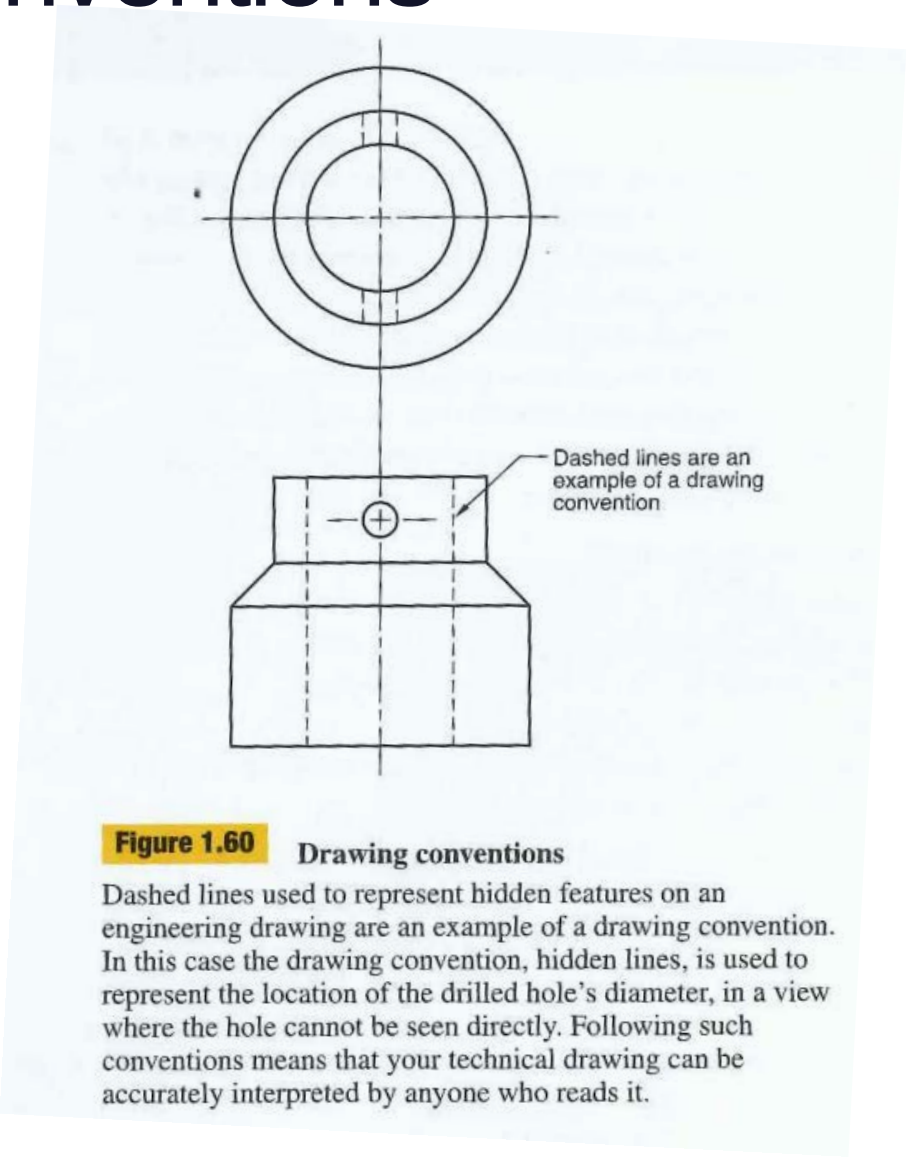


Figure 1.60 **Drawing conventions**

Dashed lines used to represent hidden features on an engineering drawing are an example of a drawing convention. In this case the drawing convention, hidden lines, is used to represent the location of the drilled hole's diameter, in a view where the hole cannot be seen directly. Following such conventions means that your technical drawing can be accurately interpreted by anyone who reads it.

Standards and Conventions

Engineering Graphics – The use of drawings in the engineering design process based on a system of well established rules and conventions that clearly conveys information about an object.

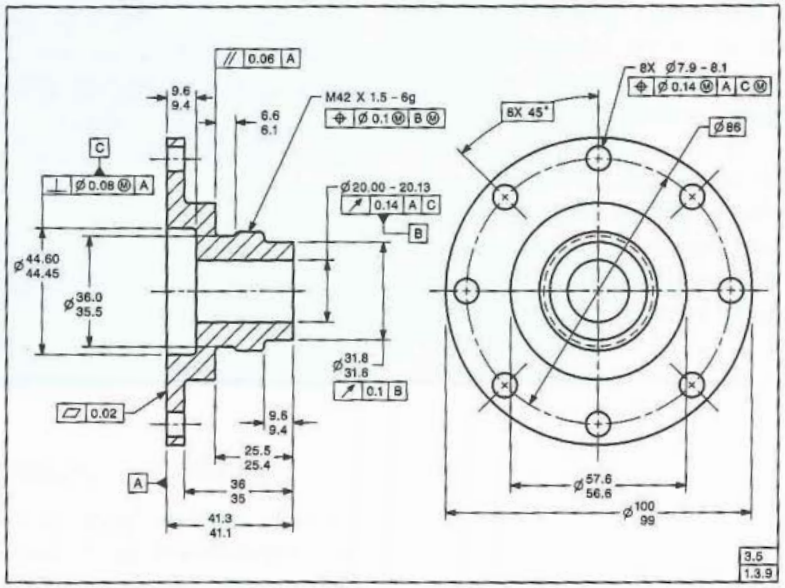


Figure 1.61 **Dimensioned mechanical drawing using ASME Y14.5M–1994 standards**

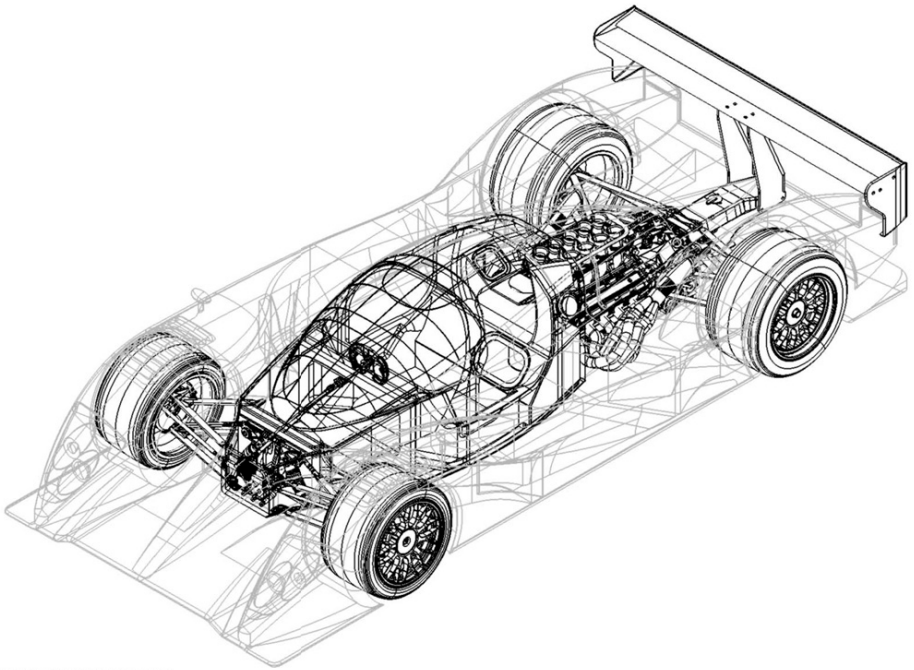
The dimension type, placement, size, and other factors are examples of standard drawing conventions. For example, one ASME standard dimensioning rule states that all diametral dimensions should be preceded by a phi (ϕ) symbol.

(Reprinted from ASME Y14.5M–1994, Dimensioning and Tolerancing, by permission of The American Society of Mechanical Engineers.)

Graphics Communication Technologies

Computer Aided Design/Drafting (CAD) Systems – are computer software and related computer hardware that supplements or replaces traditional hand tools in creating models and technical drawings.

- AutoCAD
- SolidWorks
- **Creo Parametric**
- Solid Edge
- ALGOR



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