# Engineering Design

## The process, Design reviews, Virtual design enterprise

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speaking as a designer

committed to building better product

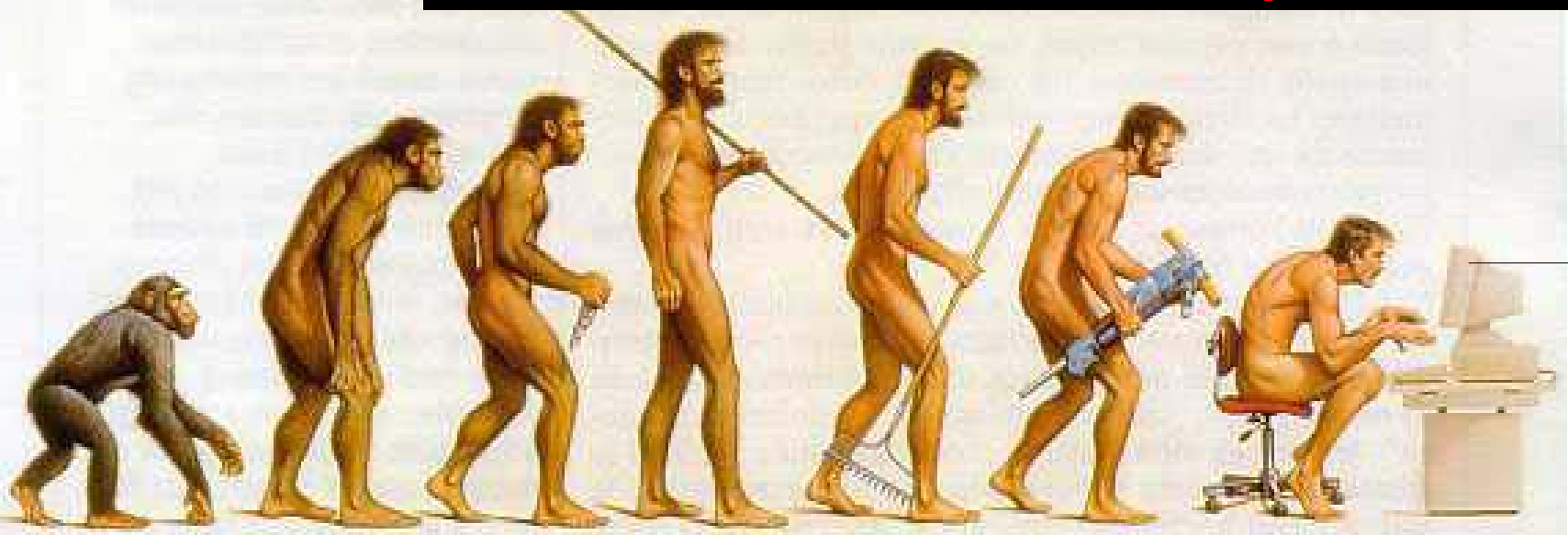
# better = more efficient

"a better learning experience"

"learning-from-working"

"working-to-learn"

**With new methods and tools (more learning)**



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**With existing knowledge basis and management**

# Useful Texts and Sources

- Practical Engineering Drawing, B. Hadley ISBN 0 582 36983 5
- Fundamentals of Graphical Communication, 3/e, G.R.Bertoline, E.N.Wiebe, C.L. Miller, McGrawHill
- Engineering Design and Problem Solving, Eide, Jenison, Mashaw, Northup, McGrawHill
- City Engineering Design web page: http://www.city-design.tk

**”If you want a new story – Read an old book”**

Jack Sauls, Trane Company, USA

# Objectives for Design Project

- Ability in communication
- An extended experience in a creative **engineering design team** environment
- Familiarity with the engineering design **team** approach
- Incorporation of creative processes within design

# Objectives - Continues

**Develop the following team skills:**

- Project management
- Decision making
- Communication
- Collaboration

# Definition of Design

**Design** is process of conceiving or inventing ideas mentally and communicating these ideas to others in a form that is easily understood

**Design** is a systematic process by which solution to the needs of humankind are obtained and communicated

**Design** is essence of engineering

**Design** is a multidisciplinary task influenced by technological and social factors

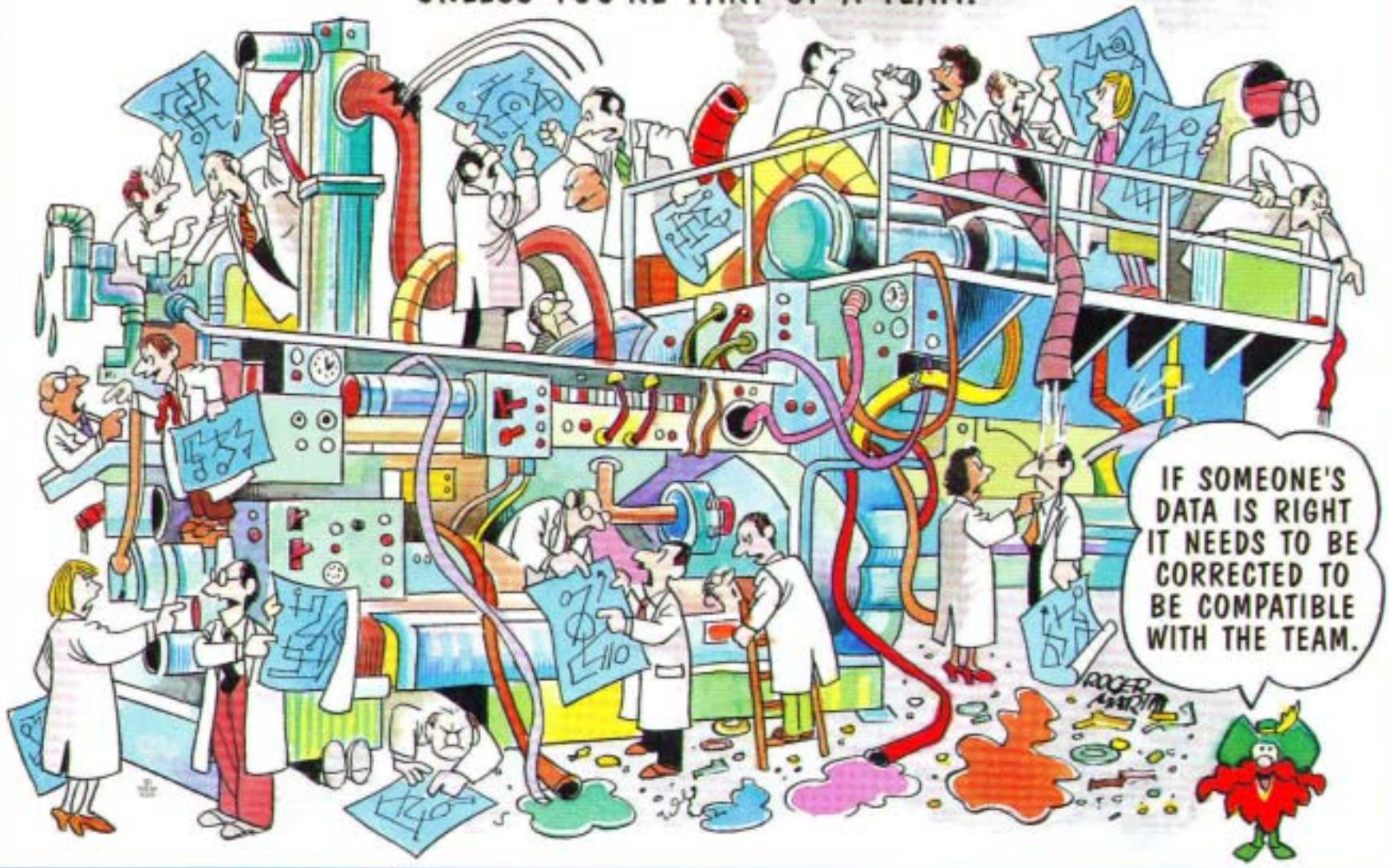
**Design** process is a team work

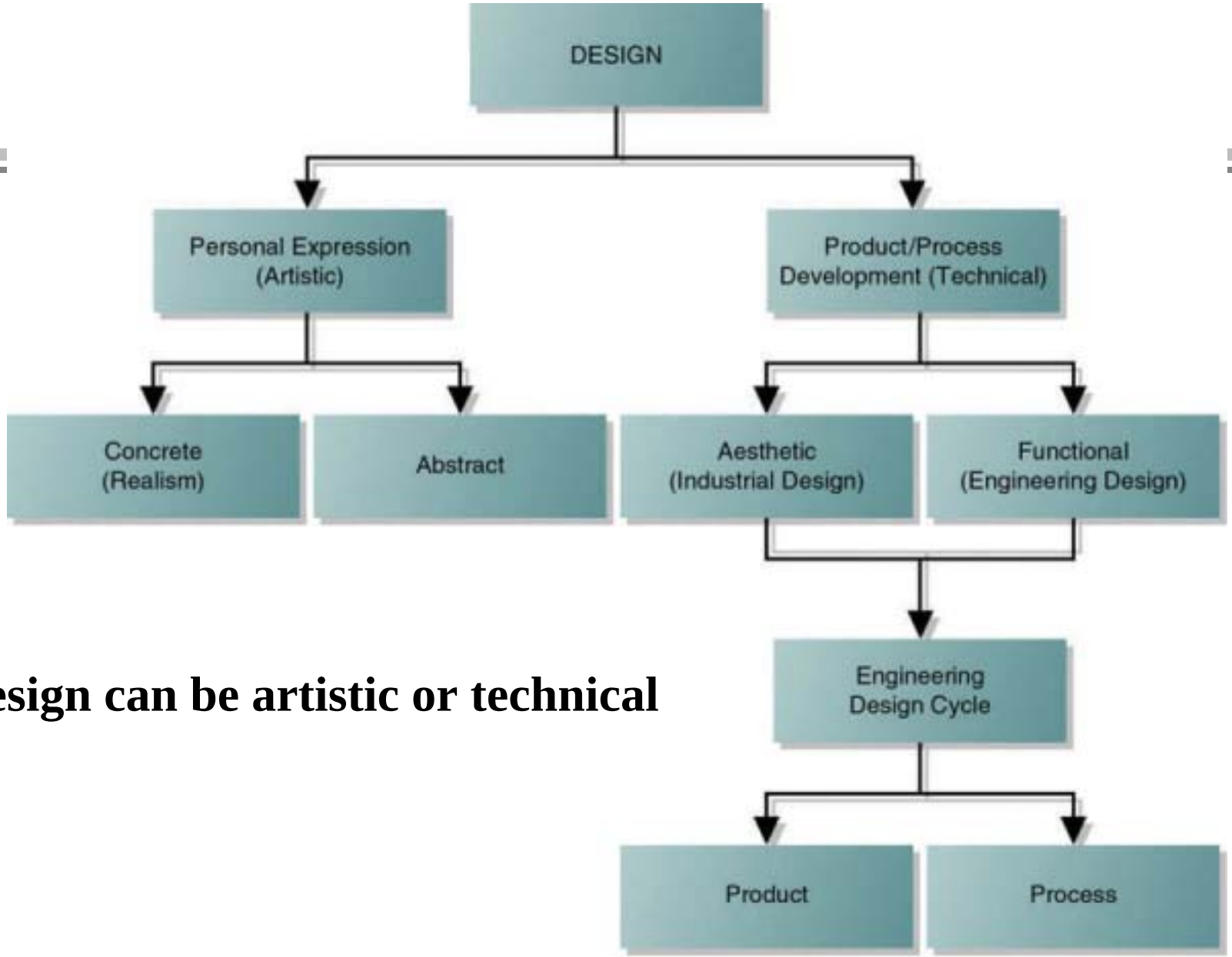
**Design** is an iterative process

**Design** is a continual learning process

# MURPHY'S LAW

NEVER MAKE THE SAME MISTAKE TWICE
UNLESS YOU'RE PART OF A TEAM.






**Design can be artistic or technical**

# Abstract design

Source: © Matthew Kaplan: Photri.

# Aesthetic design

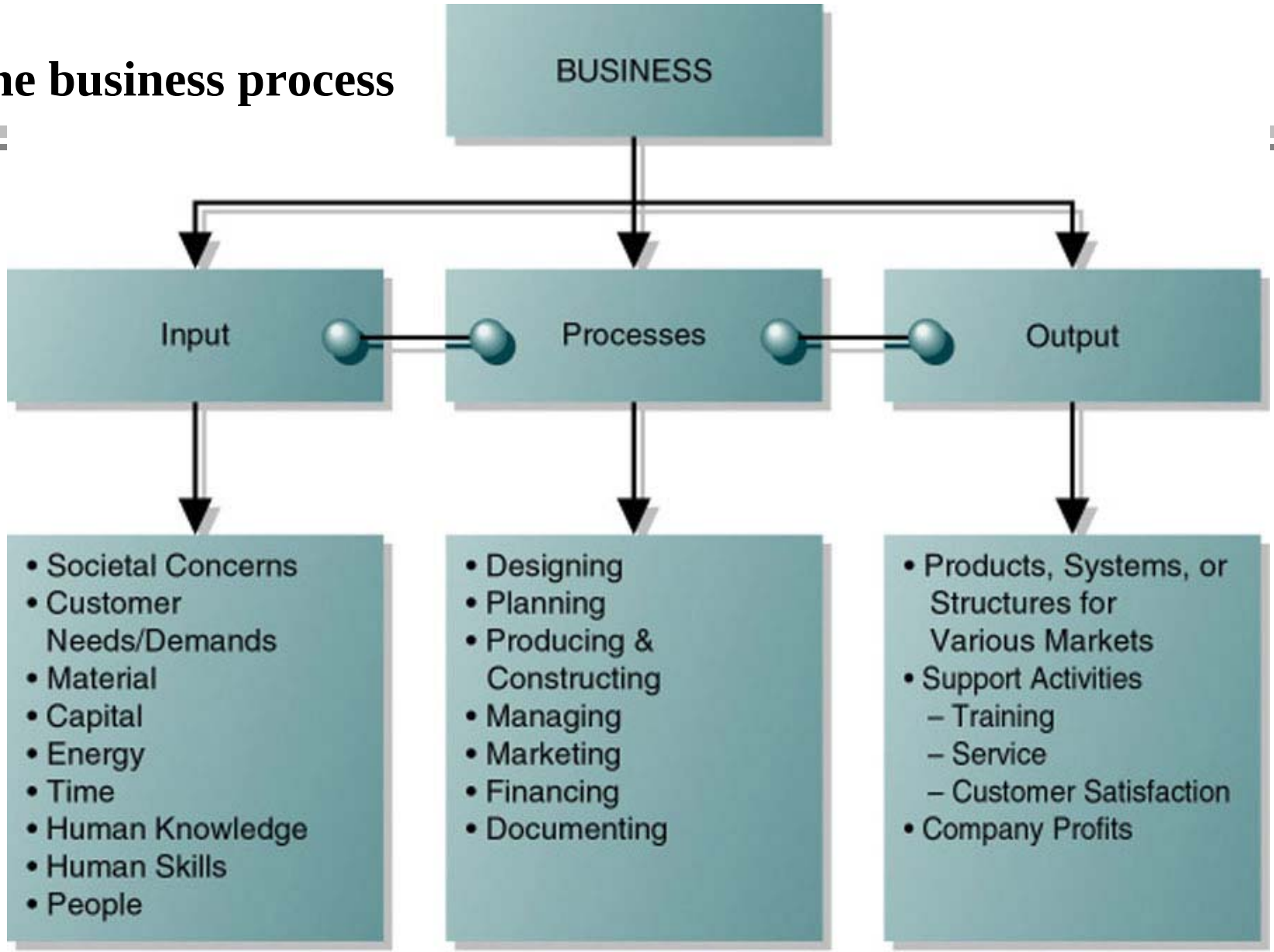
Source: © Michael Rosenfeld: Stone.

# Functional design

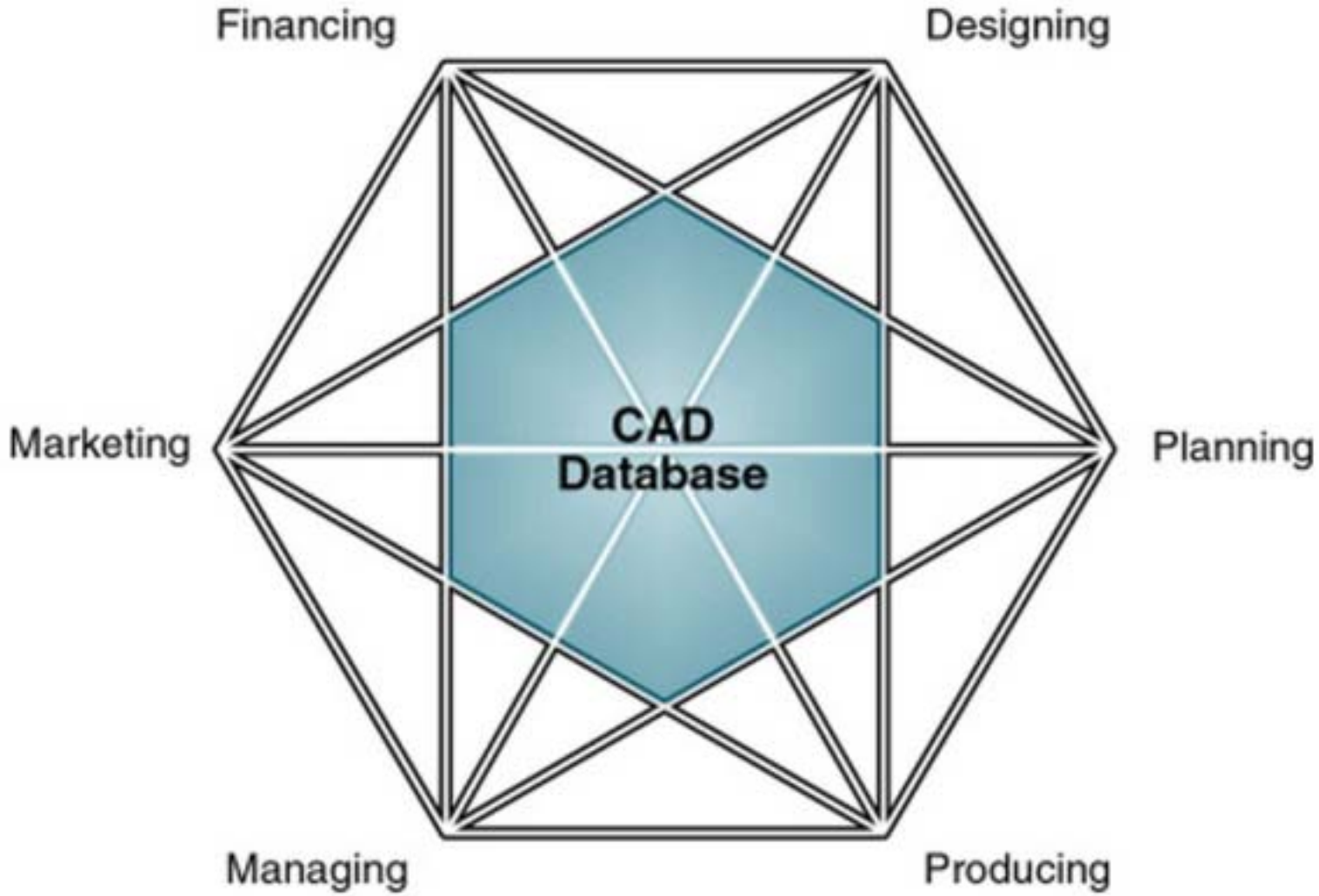
Source: © Michael Rosenfeld: Stone.

# Aesthetic and functional design

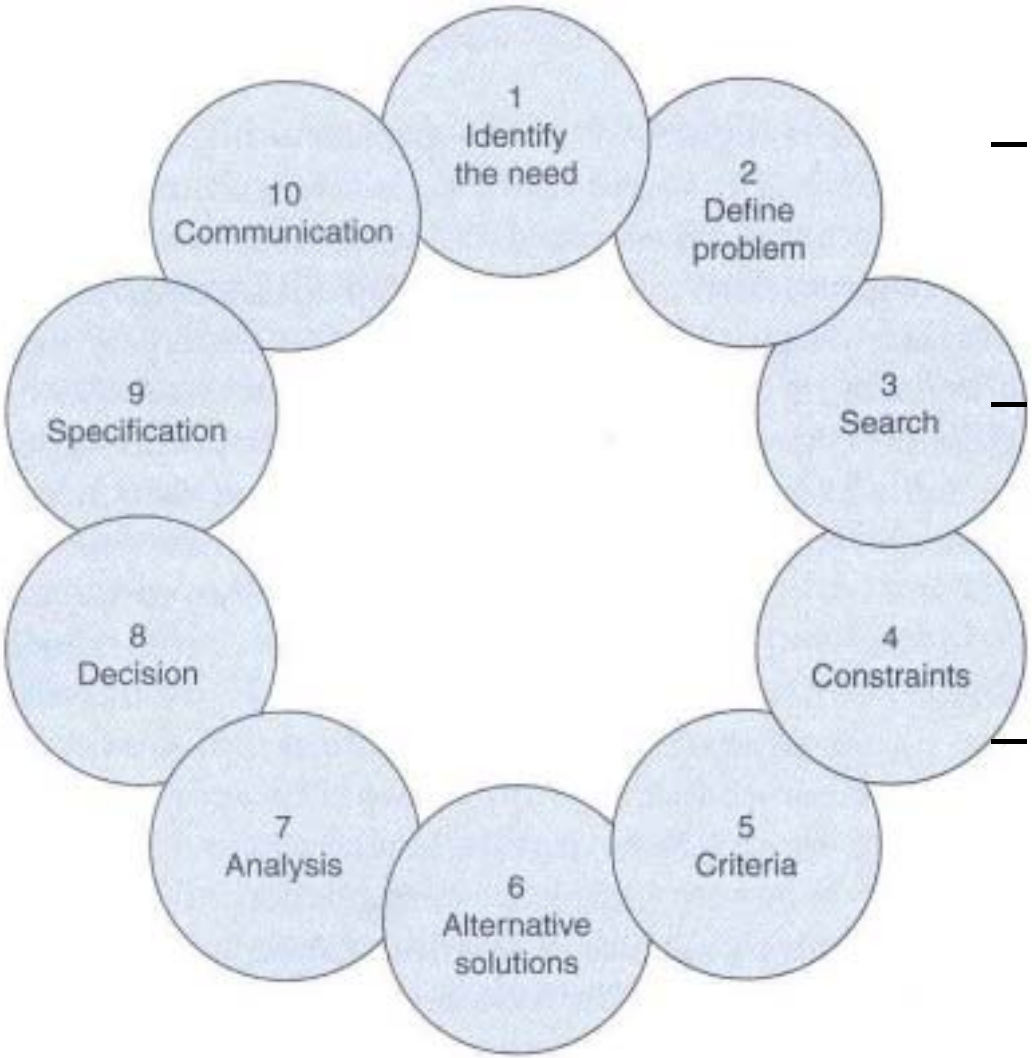
# The business process



# Sharing the CAD database

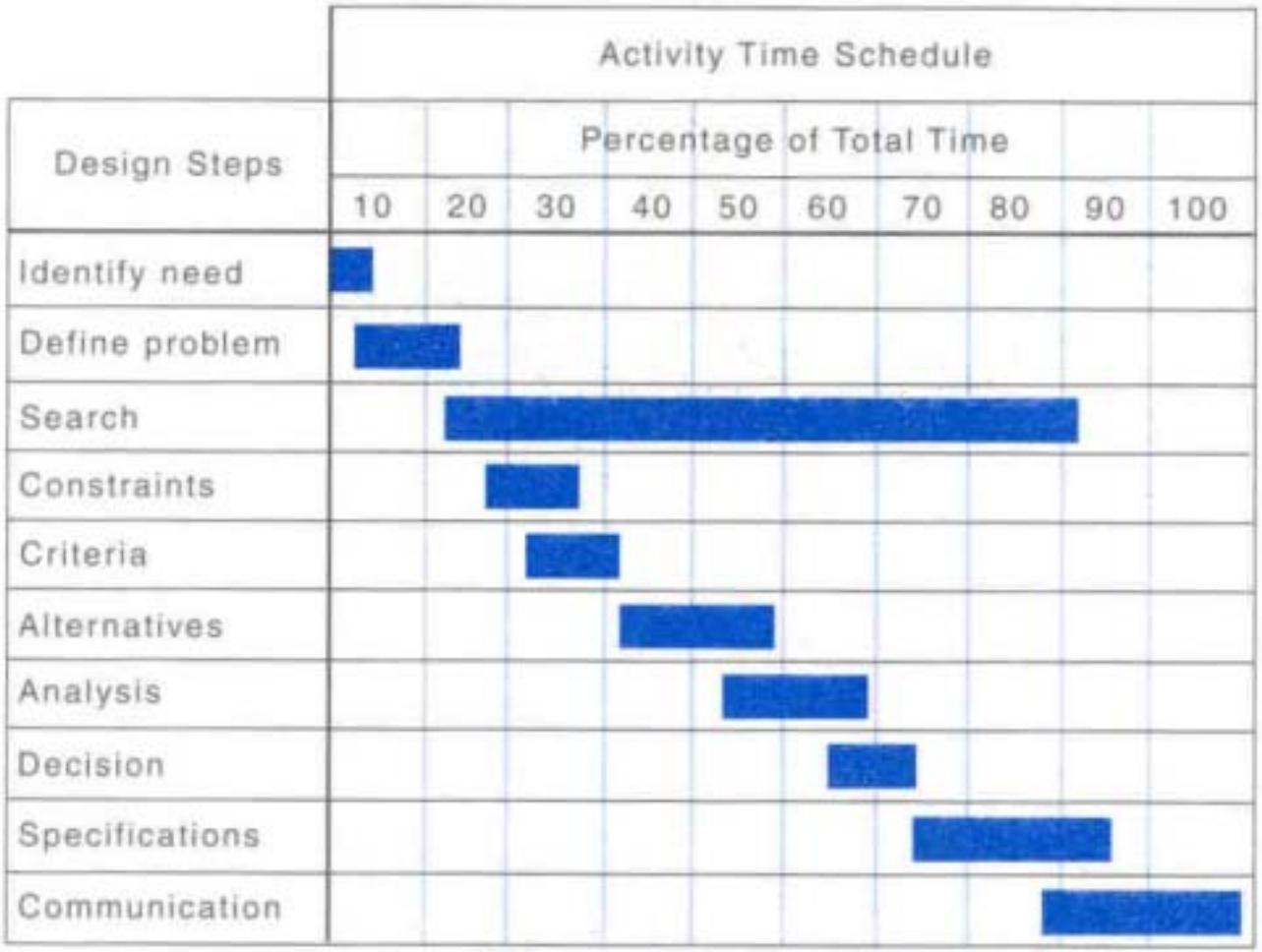


# Engineering Design Process




- **Design** – structured problem solving activity
- **Process** – phenomenon of making changes to achieve a required result
- **Design Process** – cyclic continuous activity

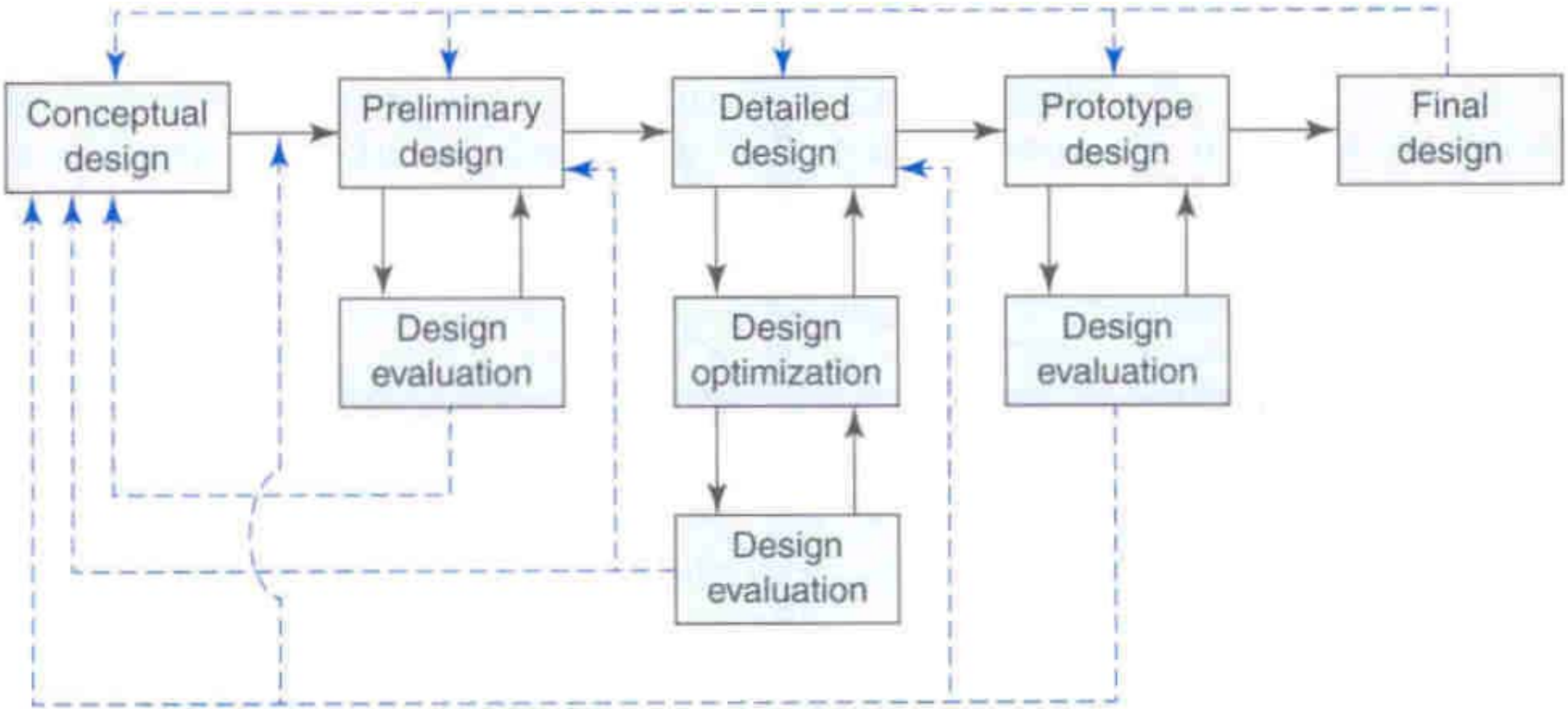
# Design Process Timing



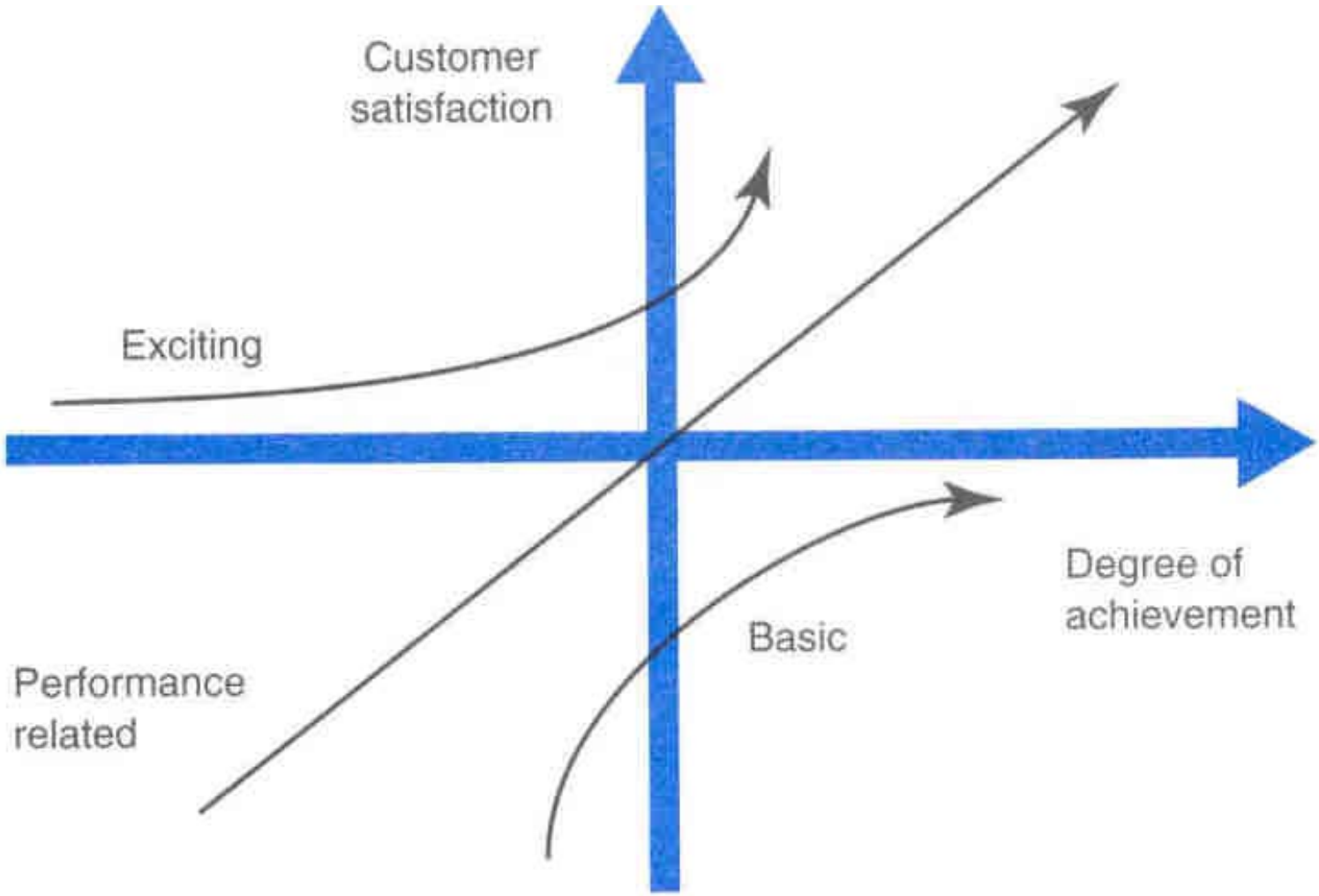

All projects have time constraints

An adequate planning is essential for a success

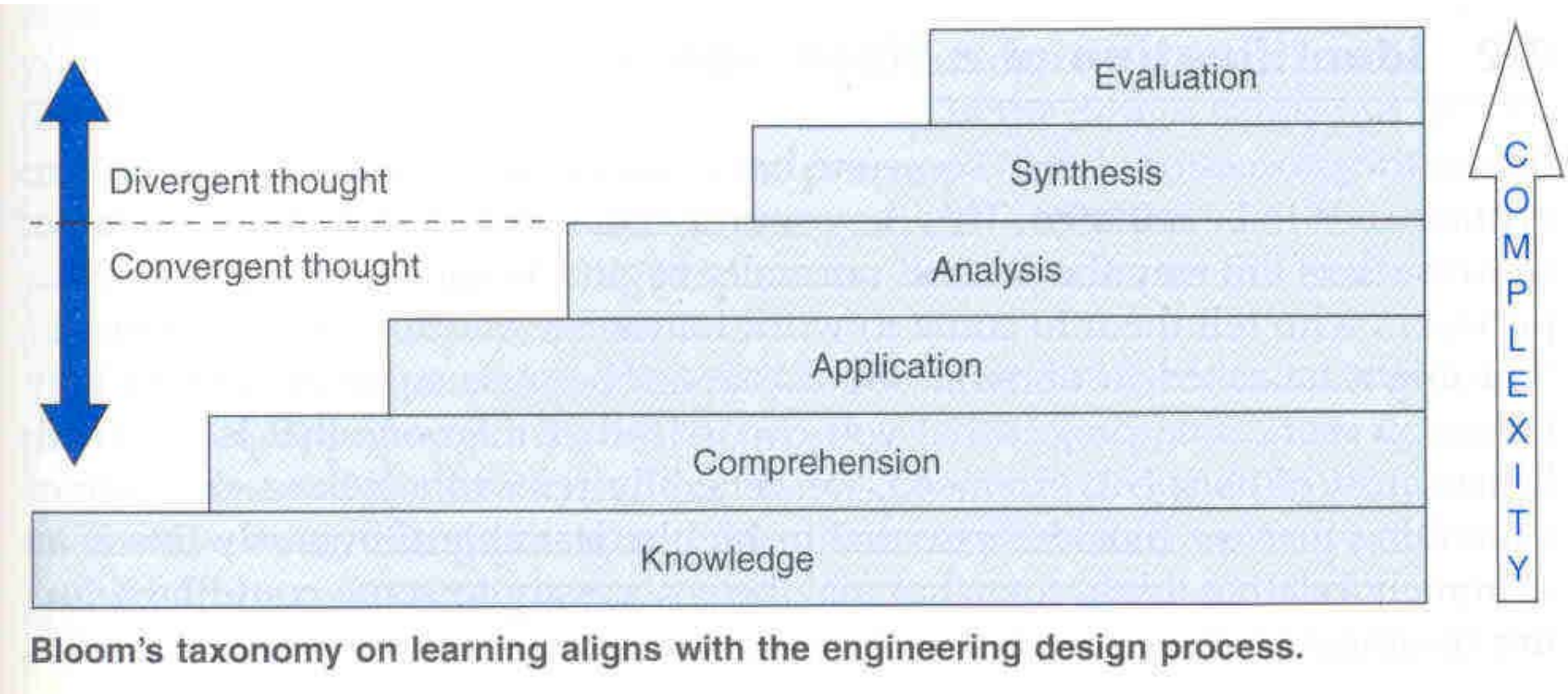
# Categories of engineering design



# Customer (Examiner) Satisfaction



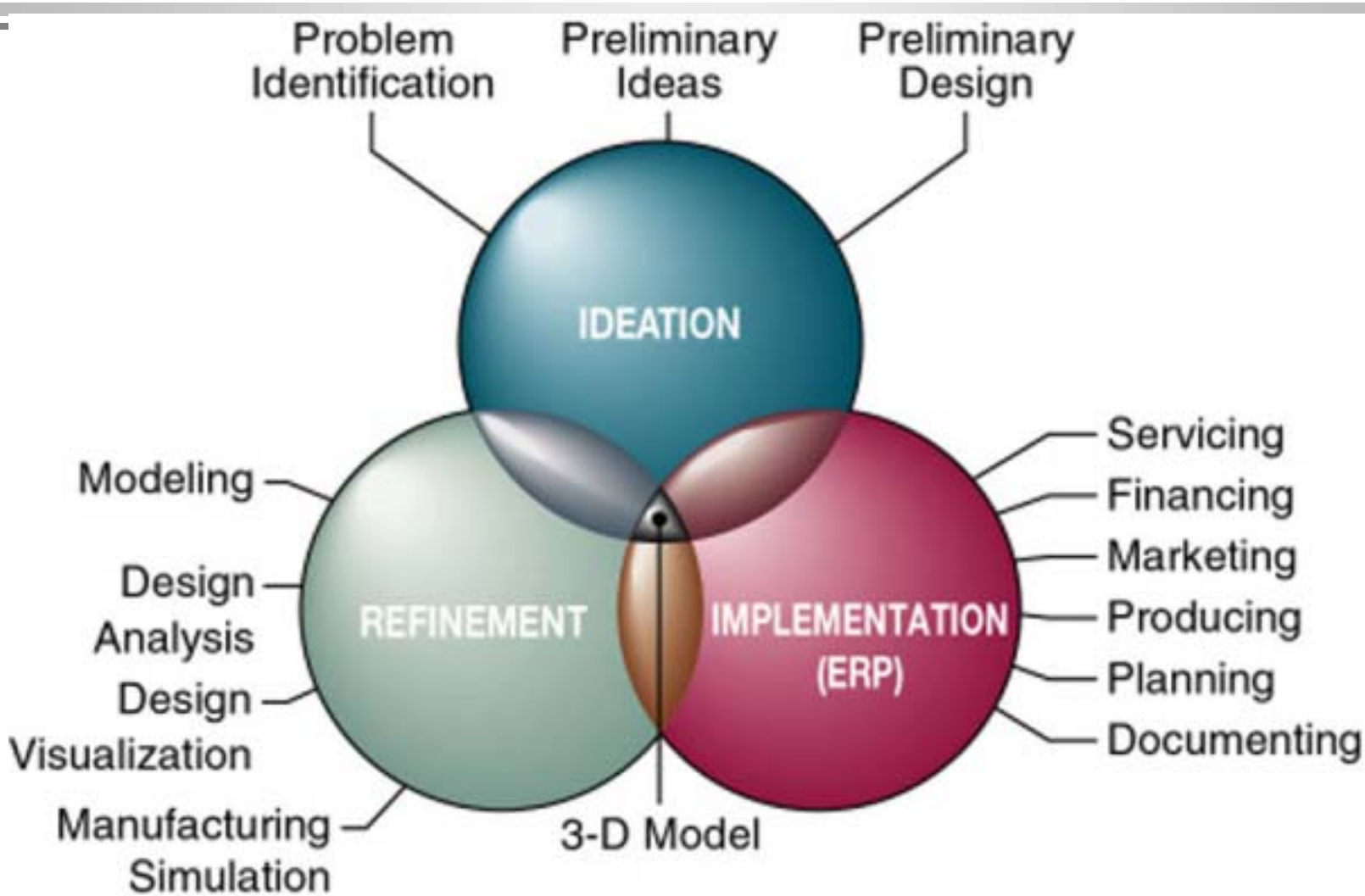
# Bloom's Theory (1950)



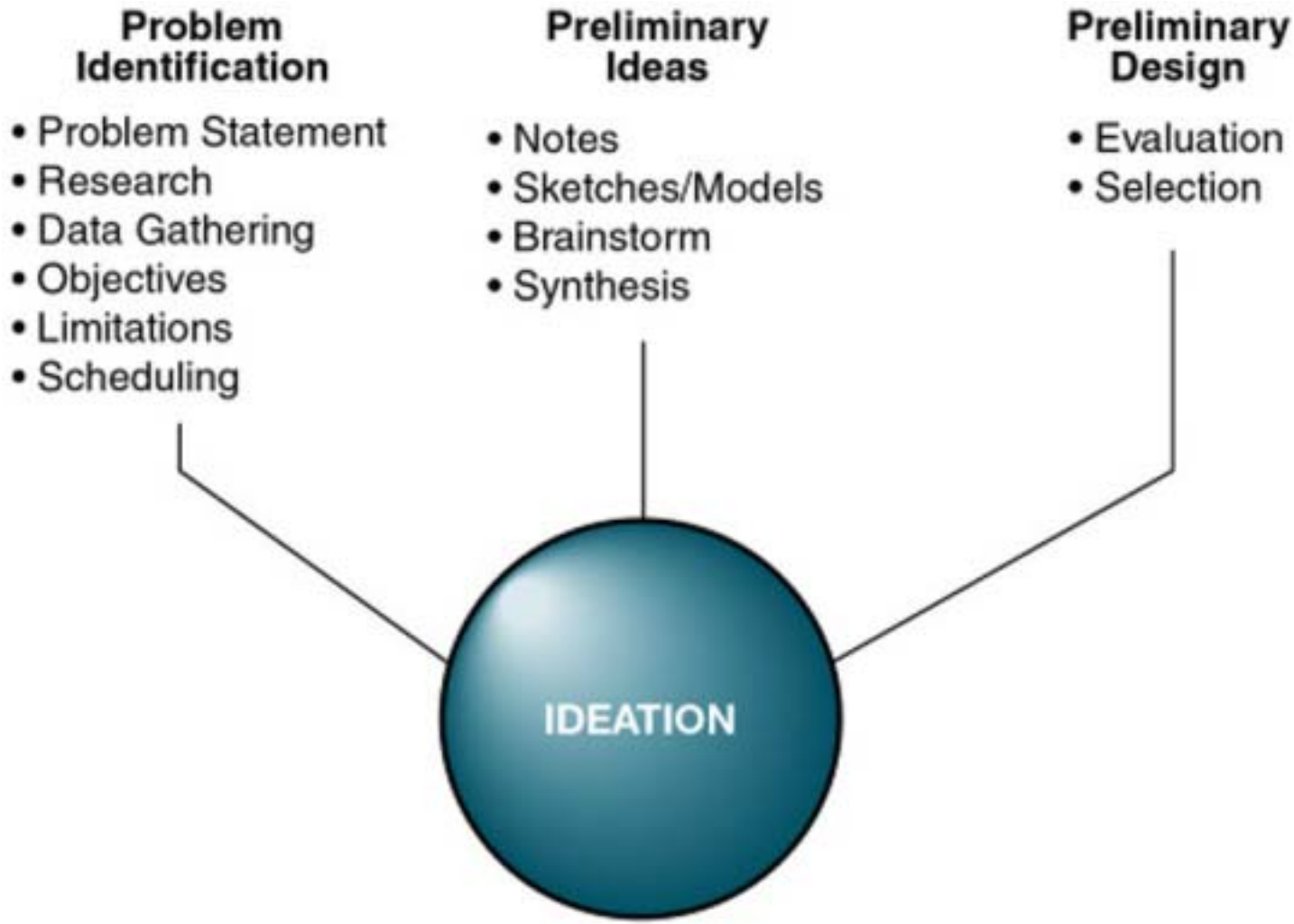

**Bloom's taxonomy on learning aligns with the engineering design process.**

Design is cognitive process – development of cognitive thinking

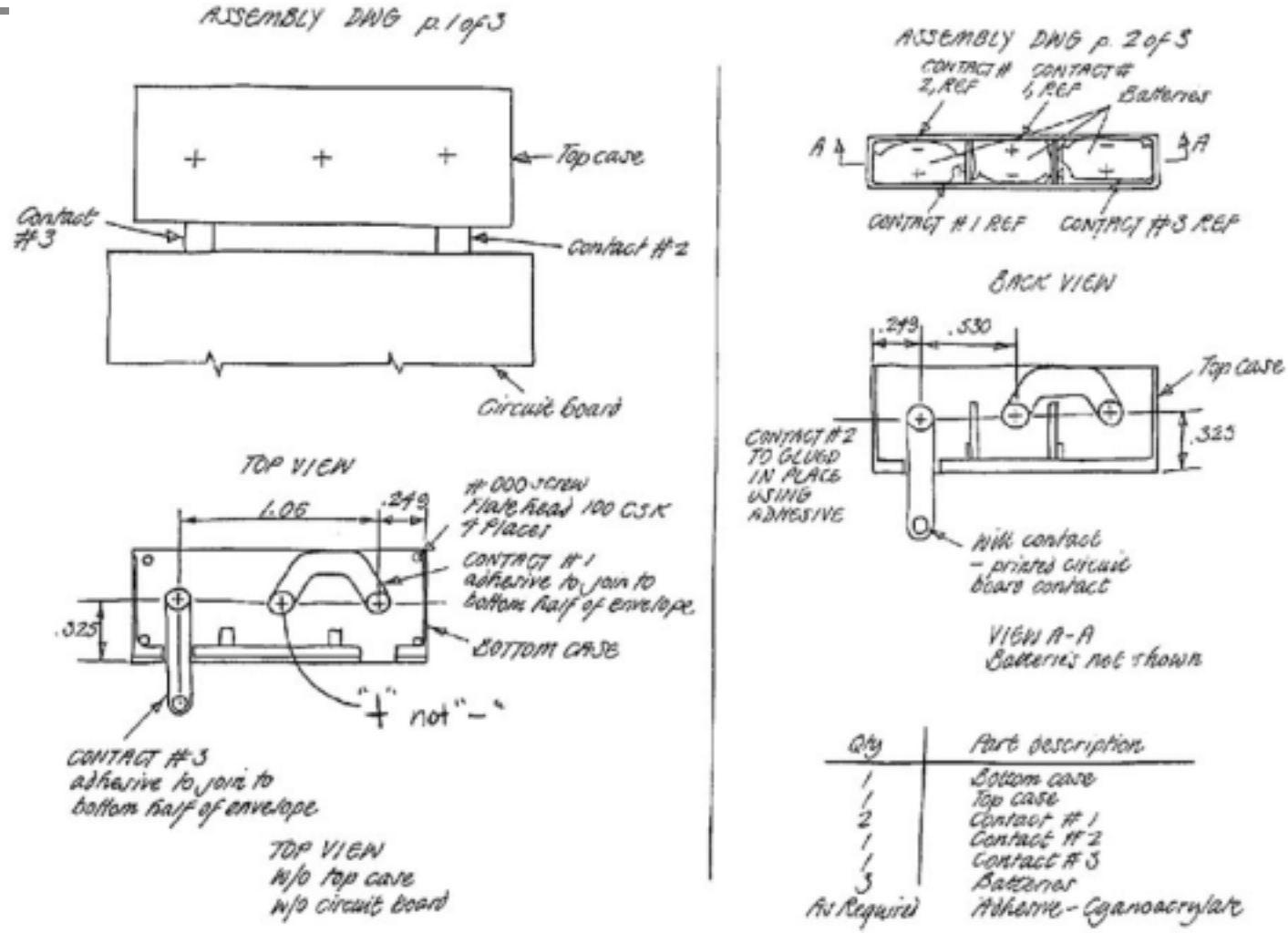
# Concurrent engineering design



# Ideation process

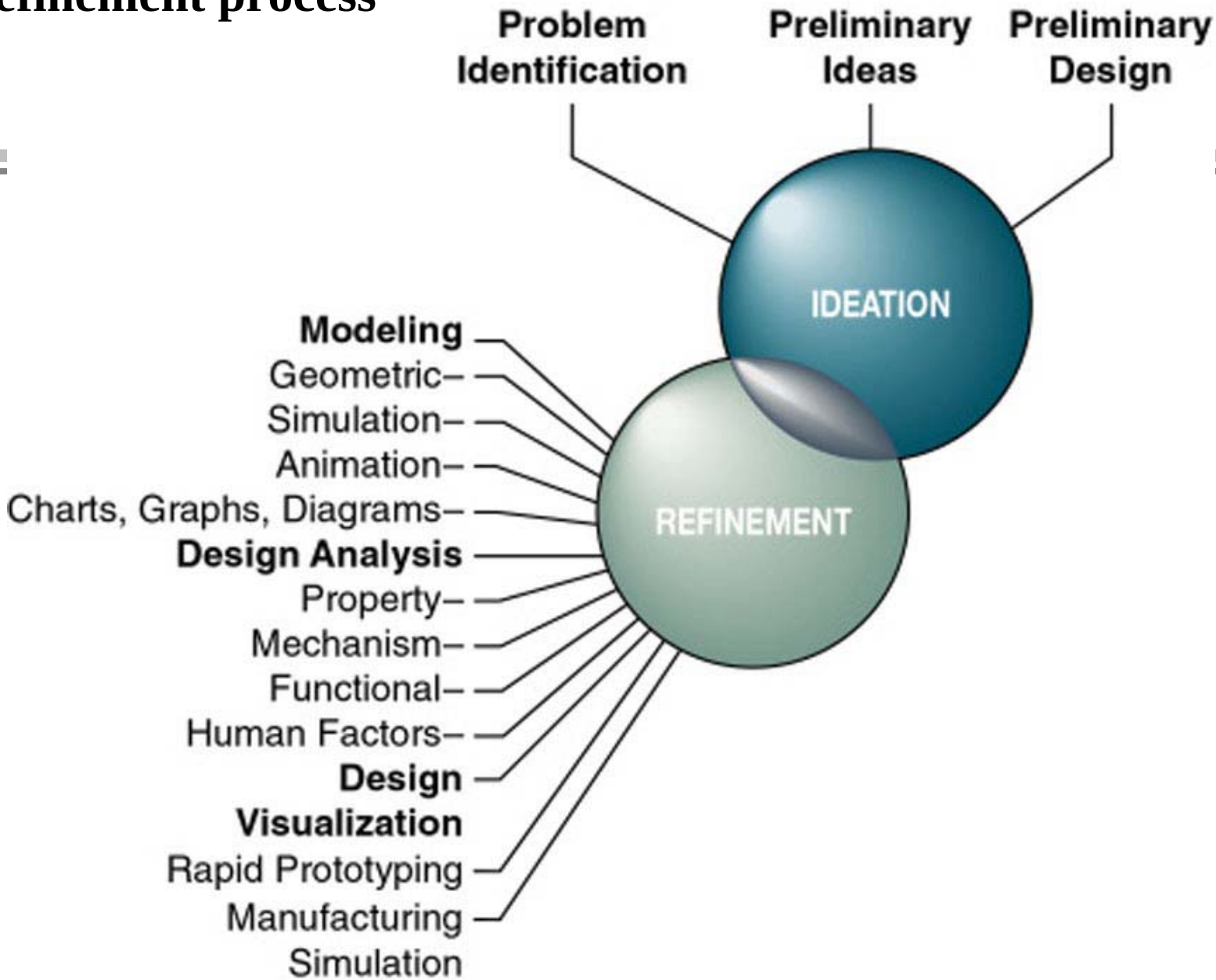


# Pages from a designer's notebook

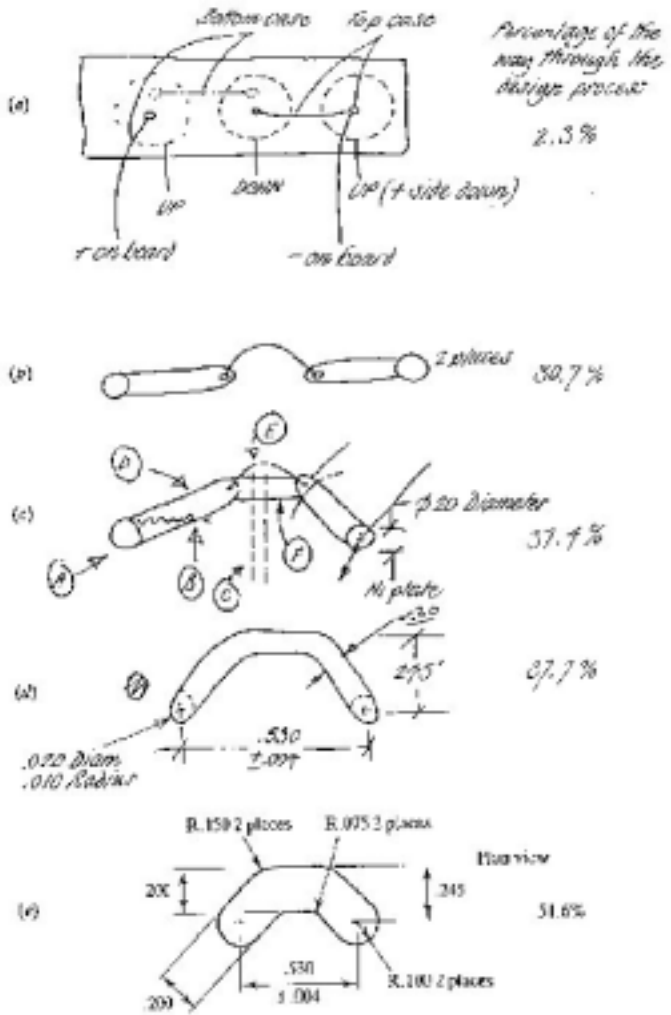



Source: Courtesy of David G. Ullman, *The Mechanical Design Process*, 2d edition, McGraw-Hill.

# Refinement process



# Refinement of a design




Source: Courtesy of David G. Ullman, *The Mechanical Design Process*, 2d edition, McGraw-Hill.

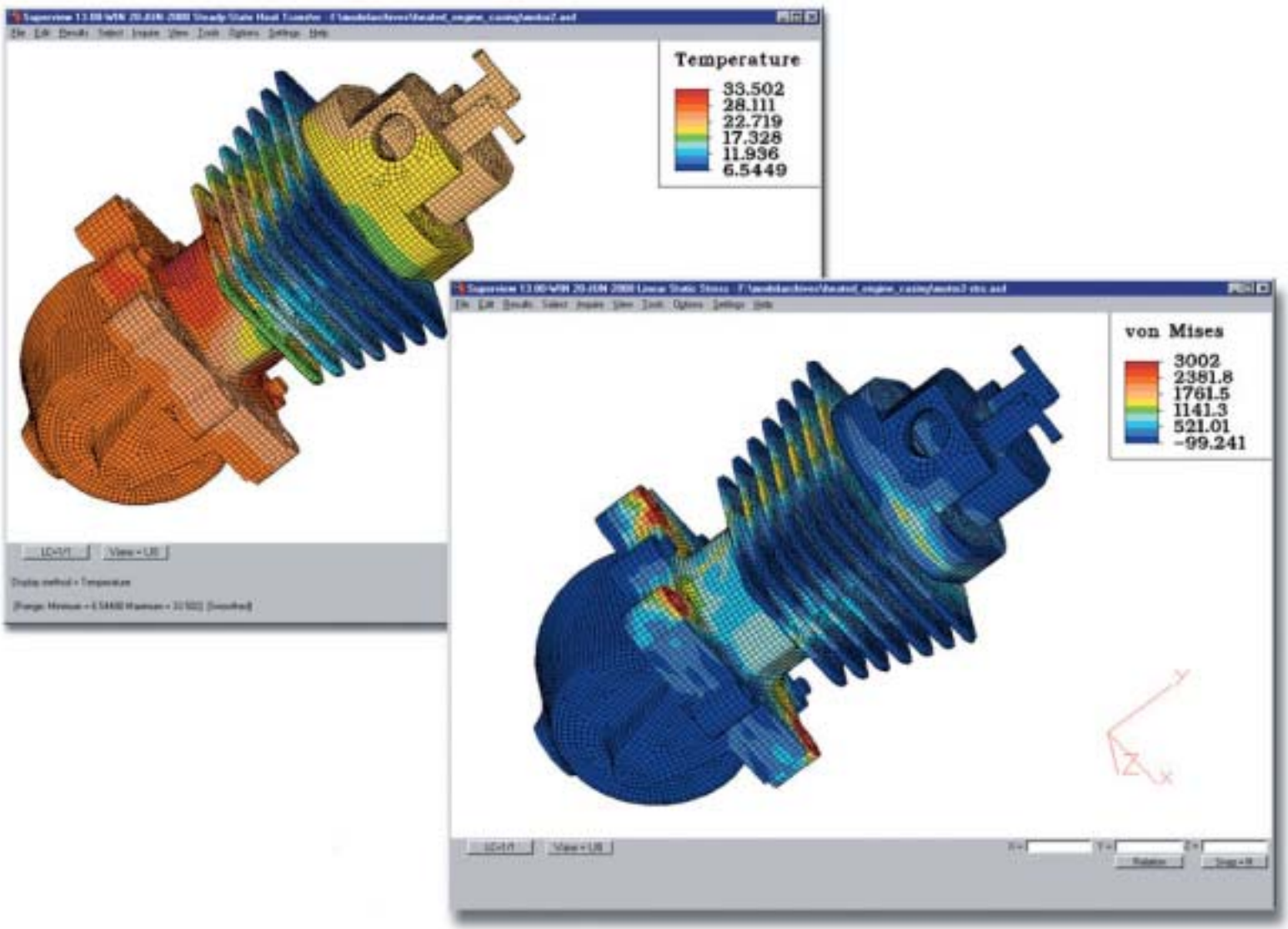
# Rapid prototyping

Source: Courtesy of 3D Systems, Inc.

# Virtual reality technology

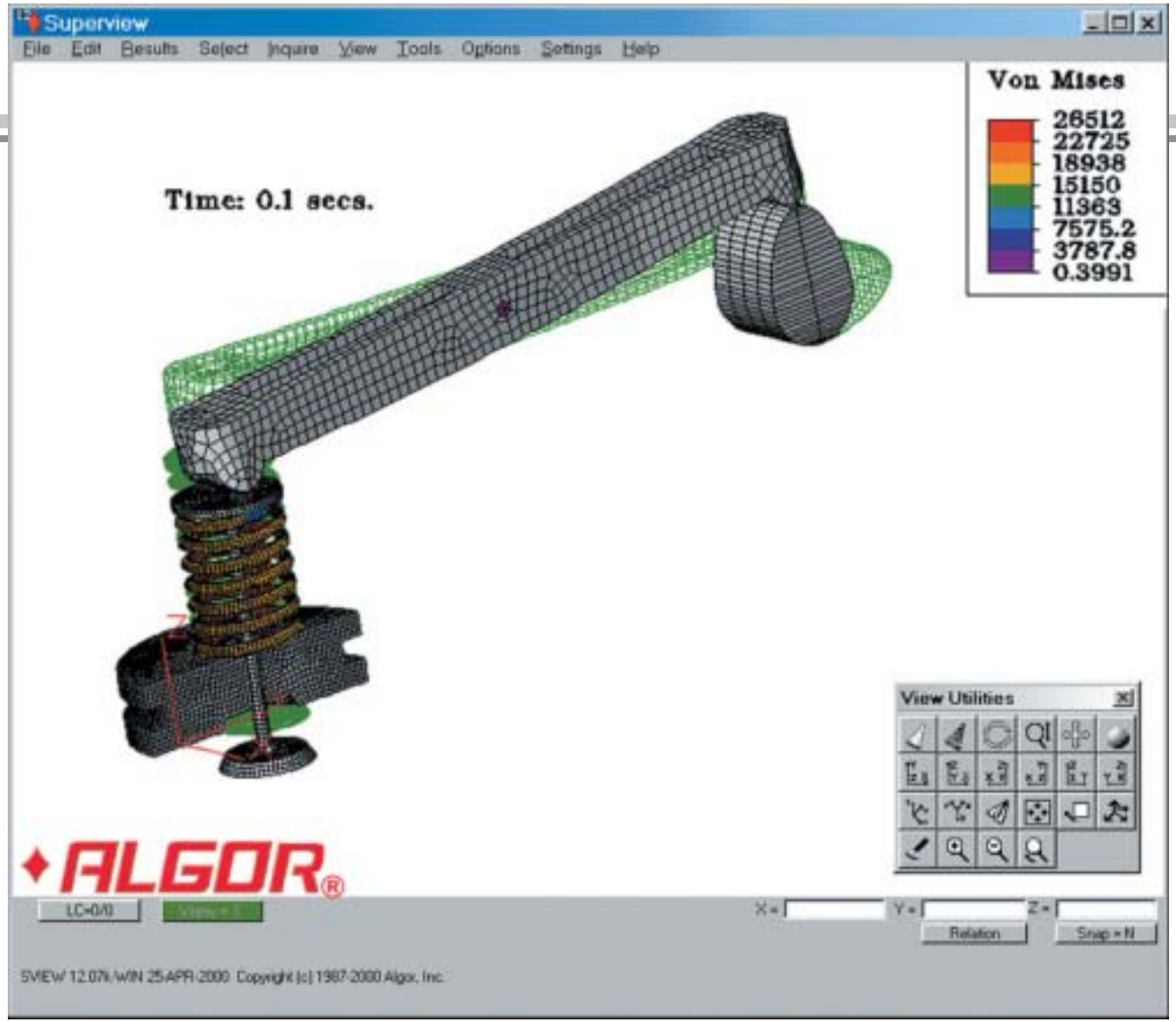
Source: Courtesy of Fakespace Systems, Inc.

# Thermal analysis



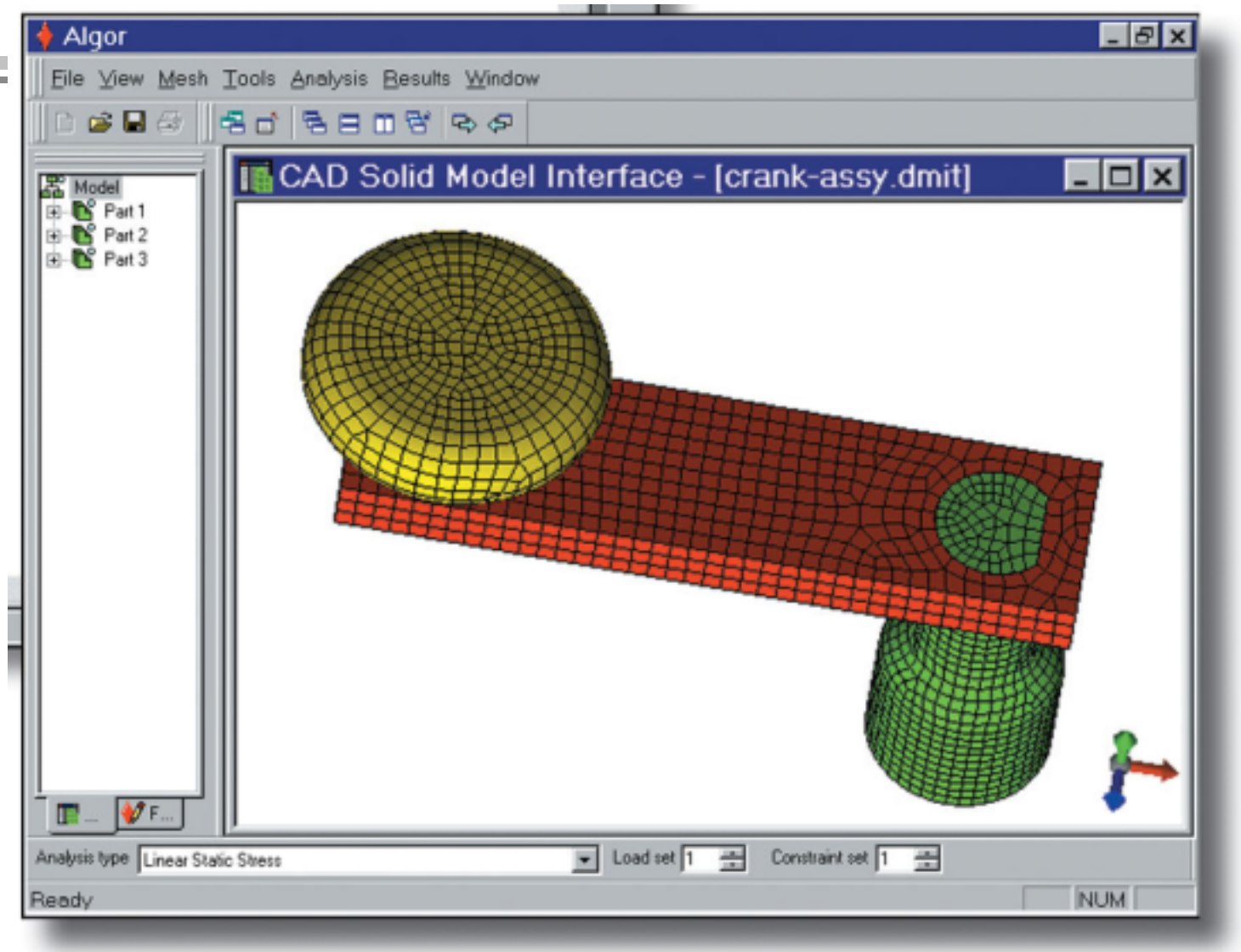

Source: Photo courtesy of Algor, Inc.

# Stress analysis



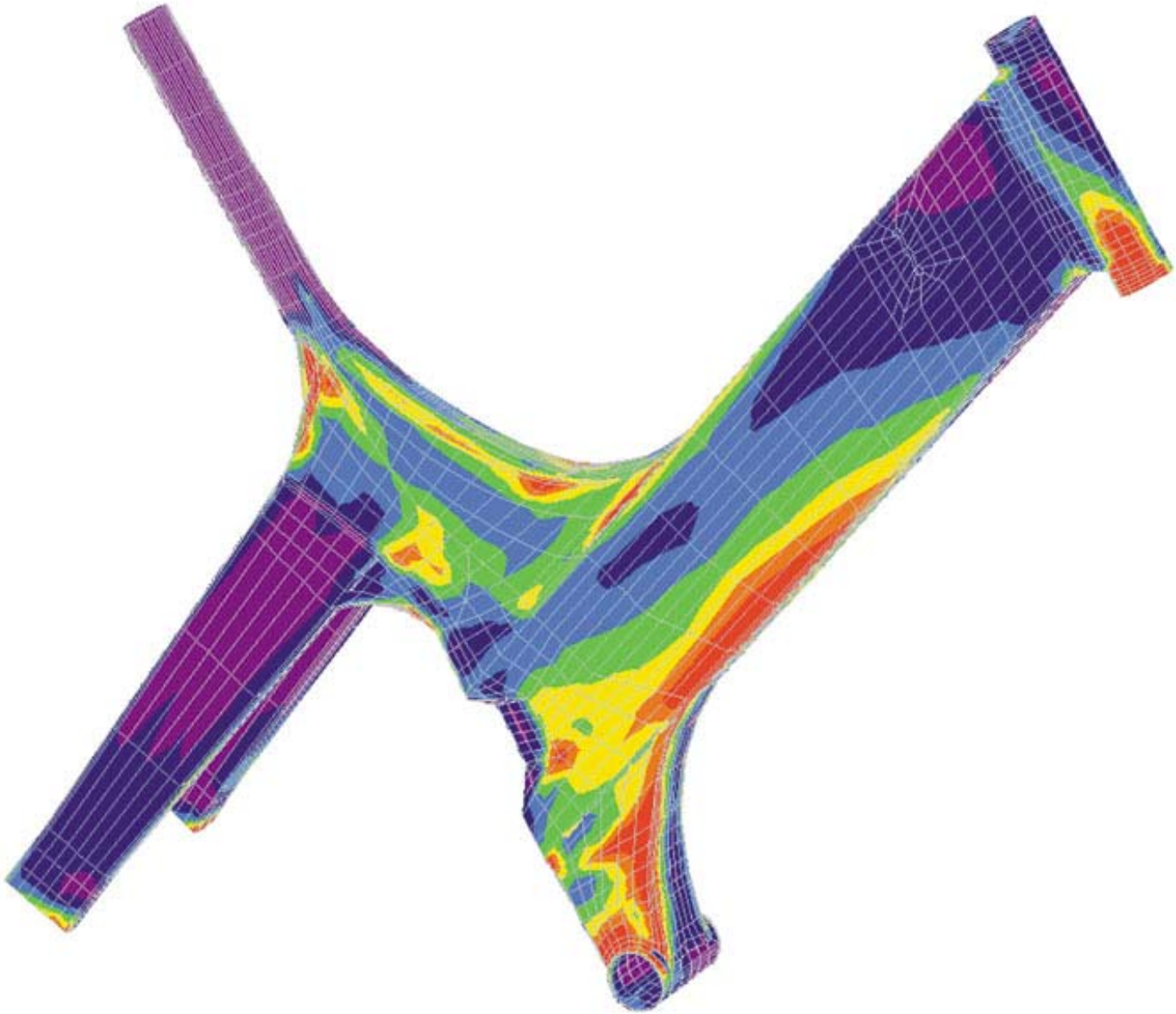

Source: Photo courtesy of Algor, Inc.

# Discretization




Source: Photo courtesy of Algor, Inc.

# Boundary conditions applied

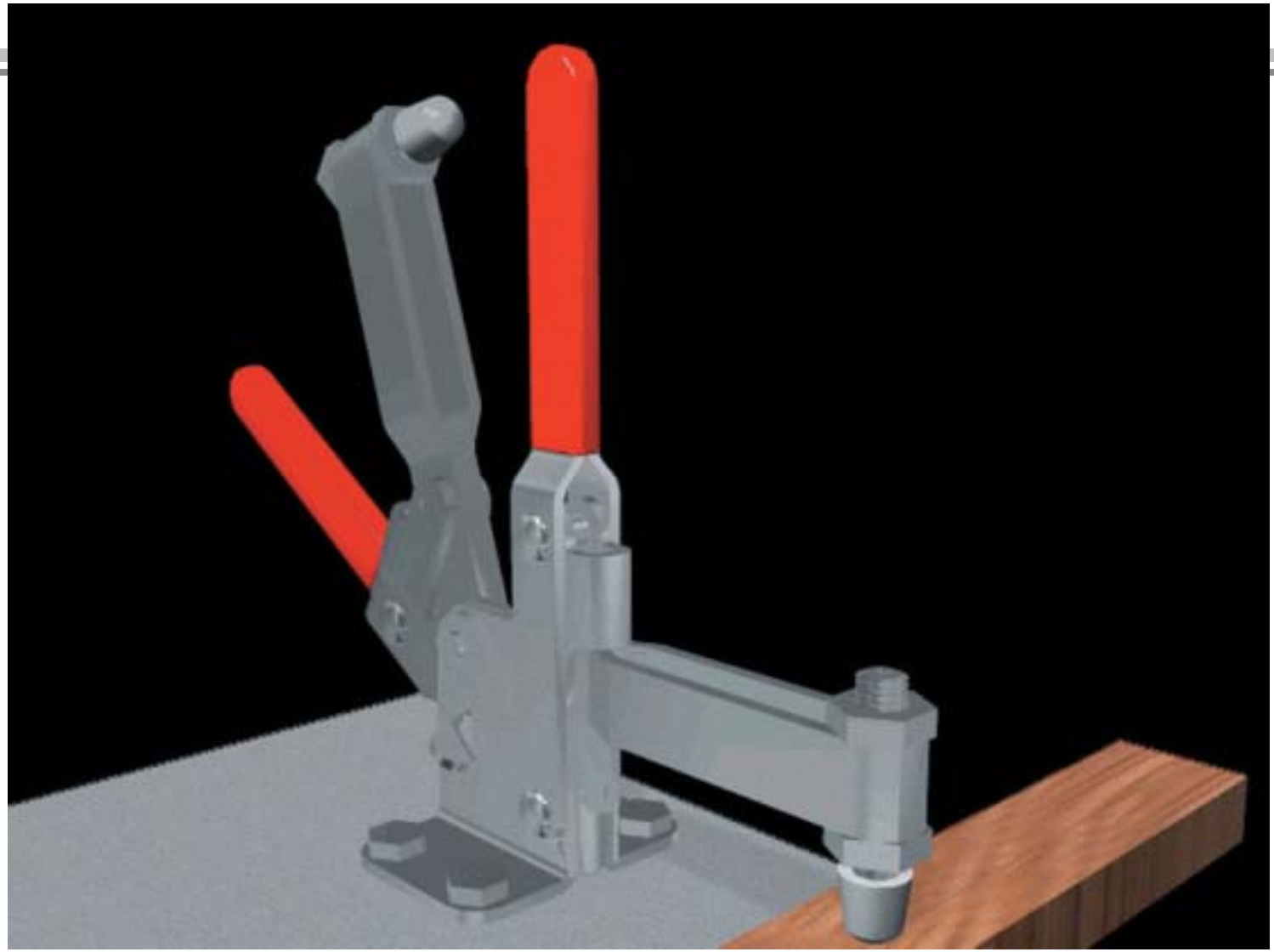


Source: Photo courtesy of Algor, Inc.

# Assembly analysis

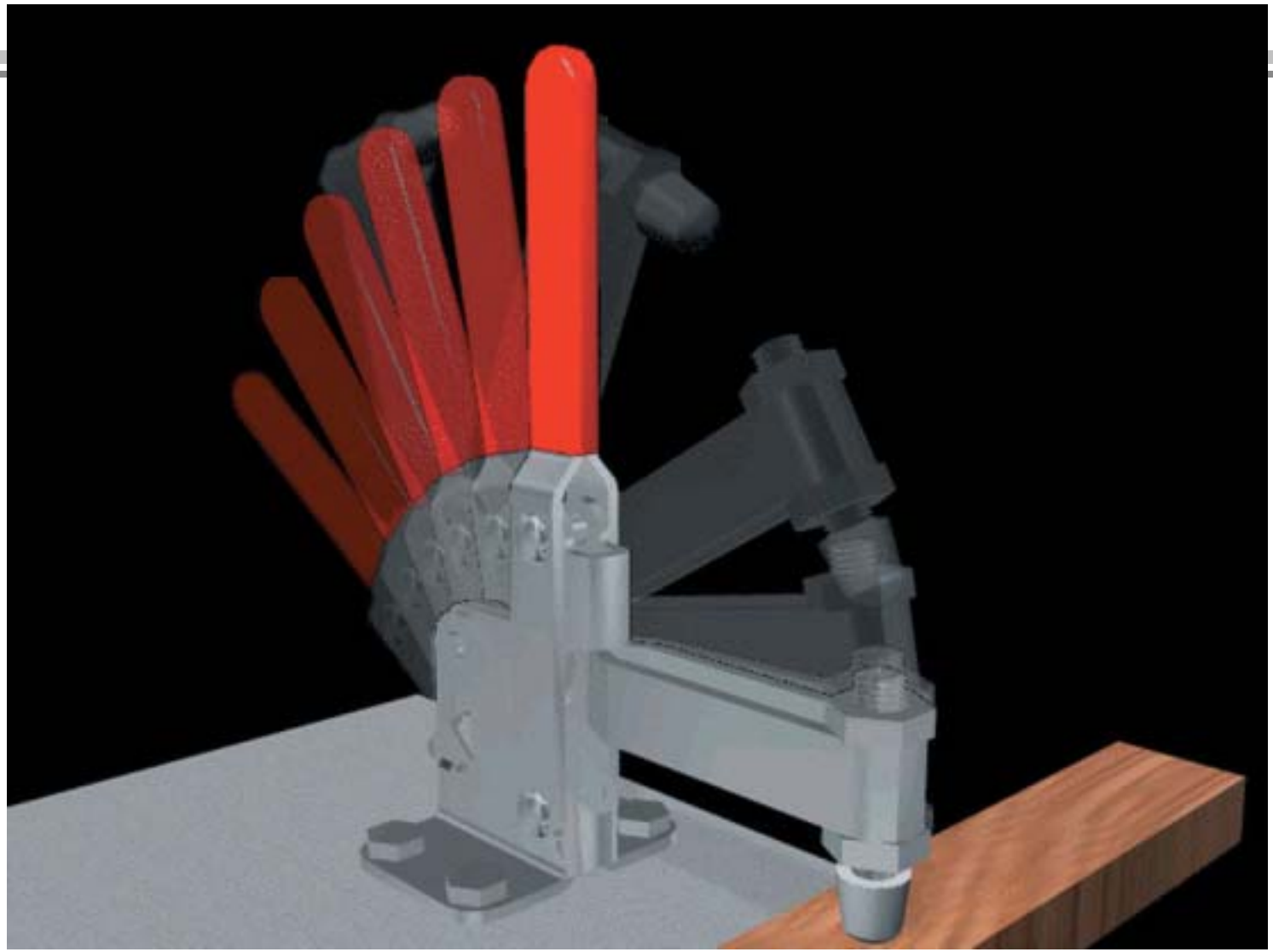
Source: Courtesy of Gary Bertoline.

# Kinematic analysis



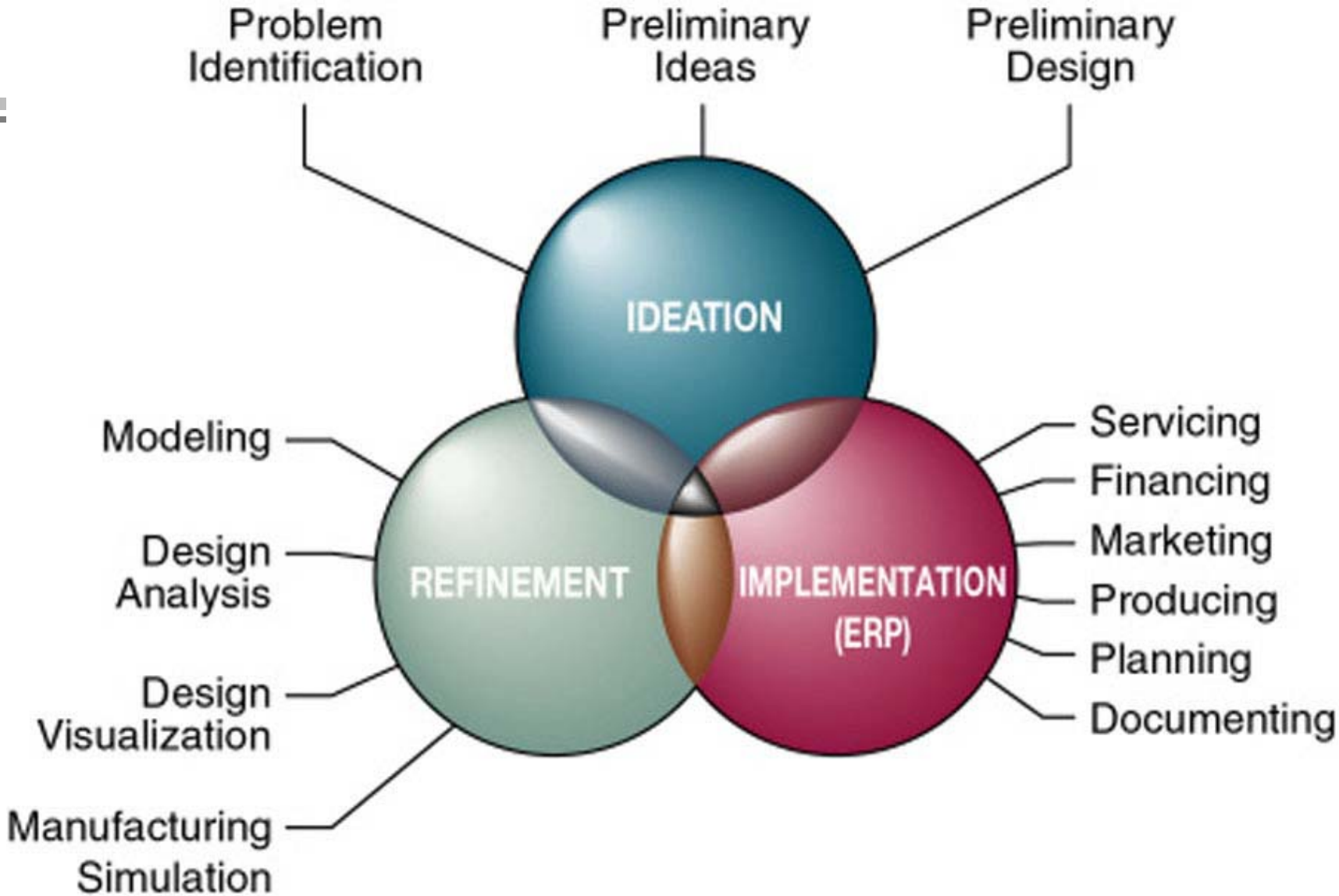
Source: Courtesy of Gary Bertoline.

# Dynamic analysis



Source: Courtesy of Gary Bertoline.

# Implementation process



# Design Review

- Communicating
  - » engineer to engineer
  - » engineer to non-engineer
  - » non-engineer to engineer
  - » more than words

# Overview

- Types of communication
  - » Drawings
    - – Traditional techniques
    - – CAD
  - » Graphics
    - – Technical illustrations, calculations
  - » Written communication
  - » Oral communication
  - » Virtual design studio communication in the virtual reality

# Design Reviews Objectives

- To encourage communication between team members and sub teams
- To review progress, time keeping and project standards
- To set targets for further tasks
- To meet experts when necessary
- To meet people from project management and planning, manufacturing or administration

# Example – Project at Staffordshire University

# Proposed sub project

- Development of virtual reality learning environment for Design teams at City University
  - » Project plan and specification
  - » Equipment: computers, cameras …
  - » Recording of all meetings and other phases of project
  - » Final report, oral presentations, panels …

# Efficiency

# Learning = mc²

Learning = minds in communication²

Efficiency = minds in communication²