Engineering Design *An Introduction*

Chapter 6

Reverse Engineering

Karsnitz • O'Brien • Hutchinson

Engineering Design *An Introduction*

Reverse Engineering Leads to a New Understanding about Products

- Research
  - Important step in the design process
- Reverse engineering
  - Process of analyzing a product's function and features
  - Begins with a product
  - Ends with understanding

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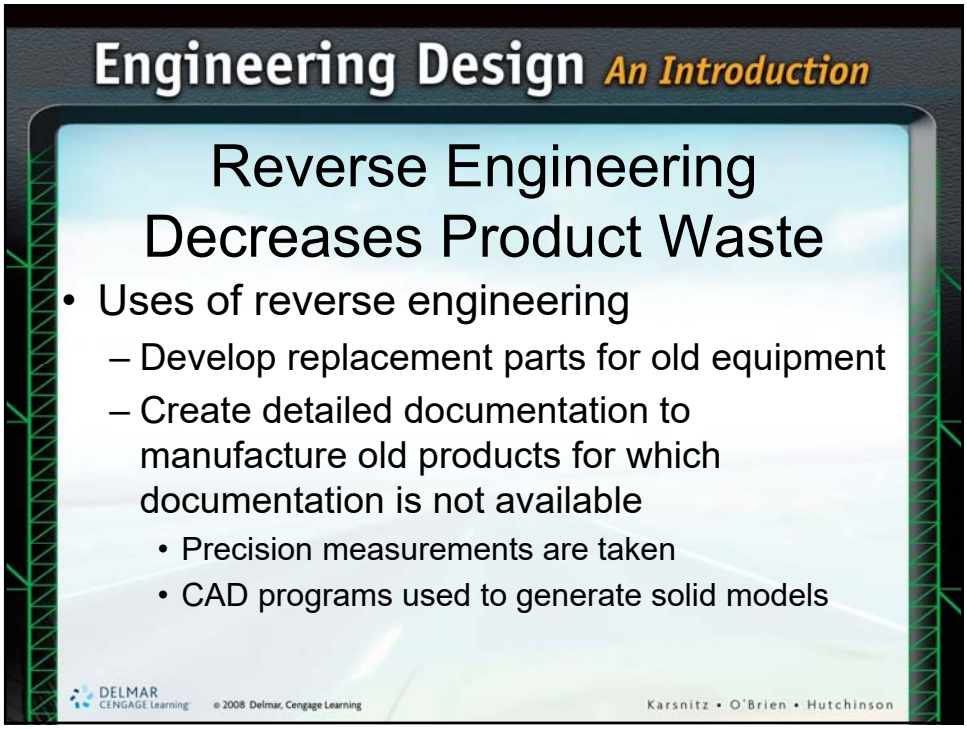
Engineering Design An Introduction
Reverse Engineering Decreases Product Waste
• Uses of reverse engineering
– Develop replacement parts for old equipment
– Create detailed documentation to manufacture old products for which documentation is not available
• Precision measurements are taken
• CAD programs used to generate solid models
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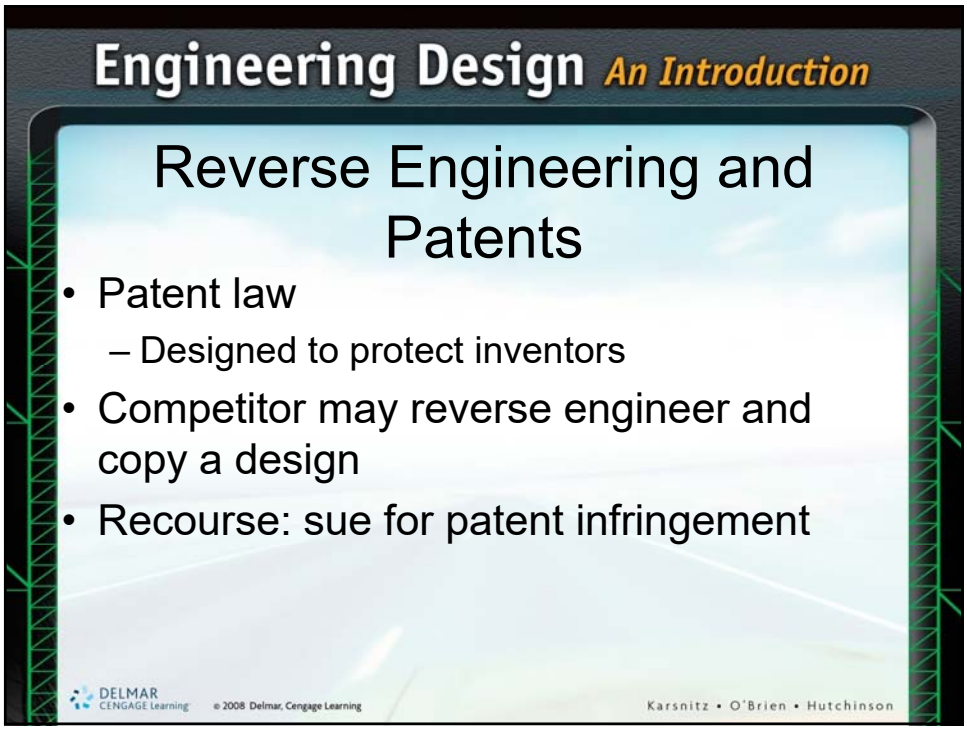
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Reverse Engineering and Patents
• Patent law
– Designed to protect inventors
• Competitor may reverse engineer and copy a design
• Recourse: sue for patent infringement
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Reverse Engineering: The Big Picture

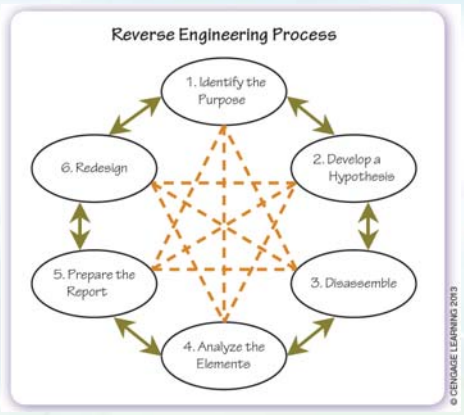

Figure 6-9: Reverse engineering process flowchart.

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Reasons for Reverse Engineering

- Research similar products to discover ideas for more competitive products
- Test a product to determine cause of failure
- Continuous product improvement
- Create documentation for components lacking original documentation

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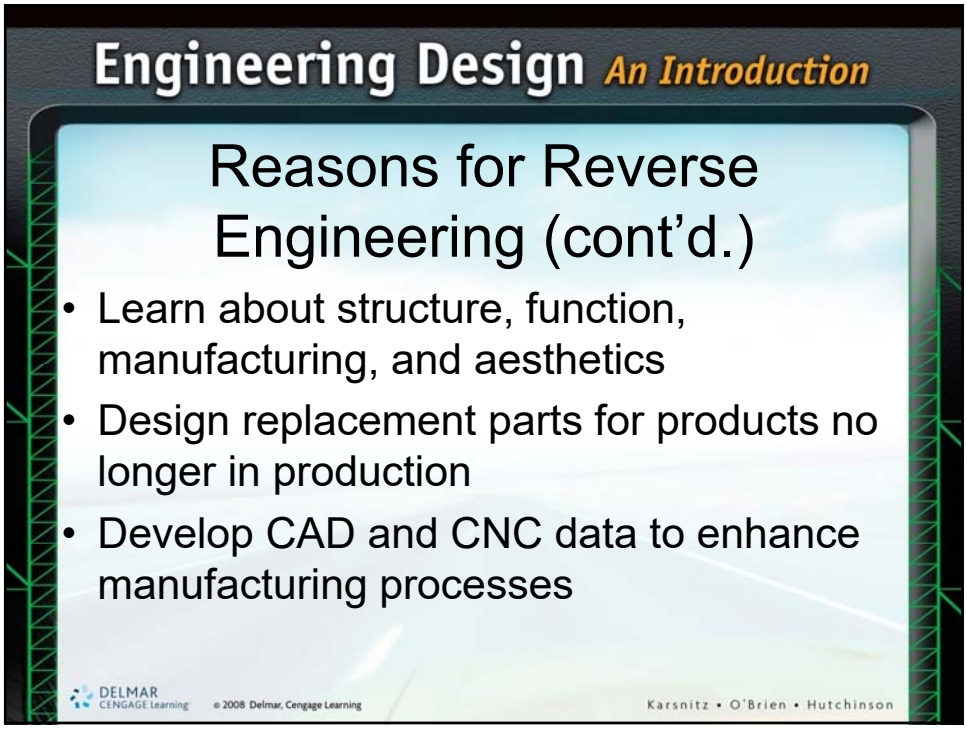
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Reasons for Reverse Engineering (cont'd.)
• Learn about structure, function, manufacturing, and aesthetics
• Design replacement parts for products no longer in production
• Develop CAD and CNC data to enhance manufacturing processes
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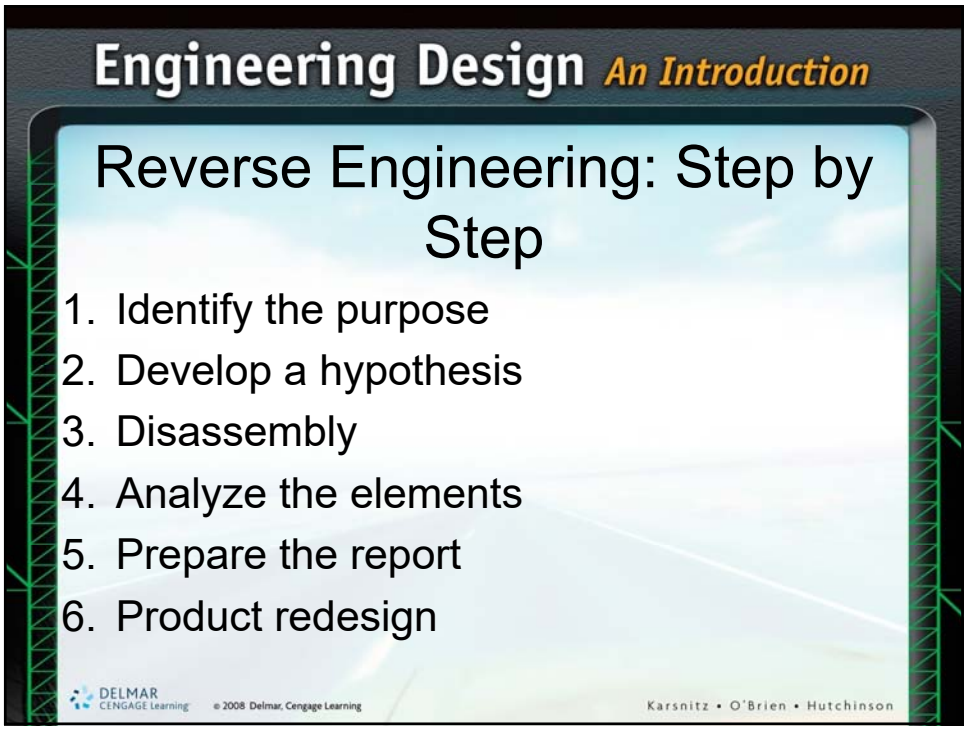
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Reverse Engineering: Step by Step
1. Identify the purpose
2. Develop a hypothesis
3. Disassembly
4. Analyze the elements
5. Prepare the report
6. Product redesign
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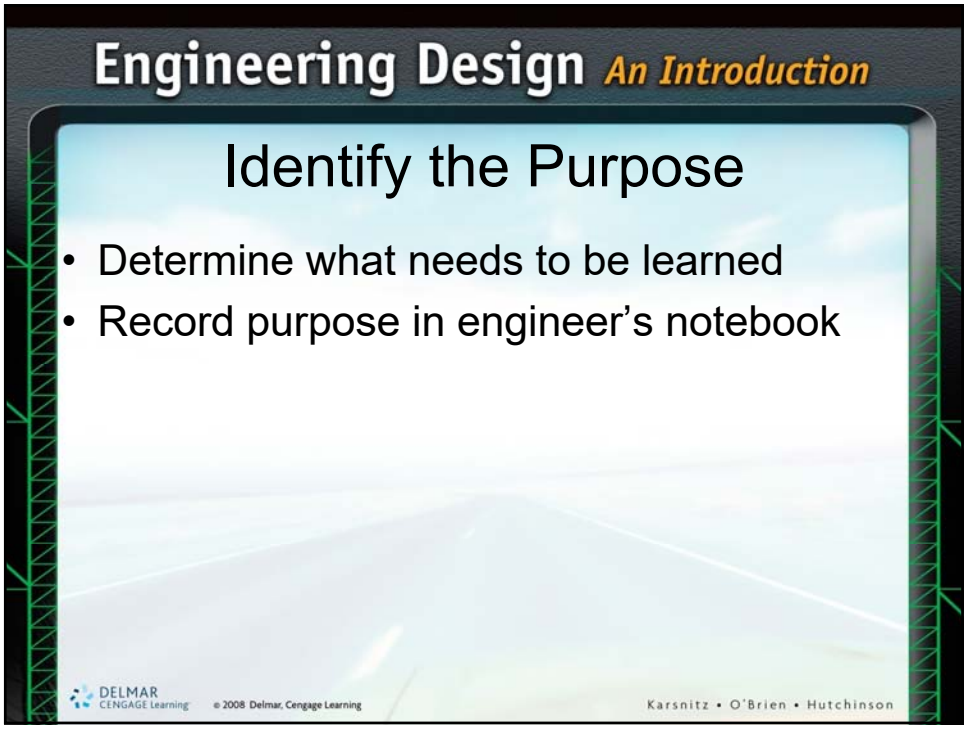
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Identify the Purpose
• Determine what needs to be learned
• Record purpose in engineer's notebook
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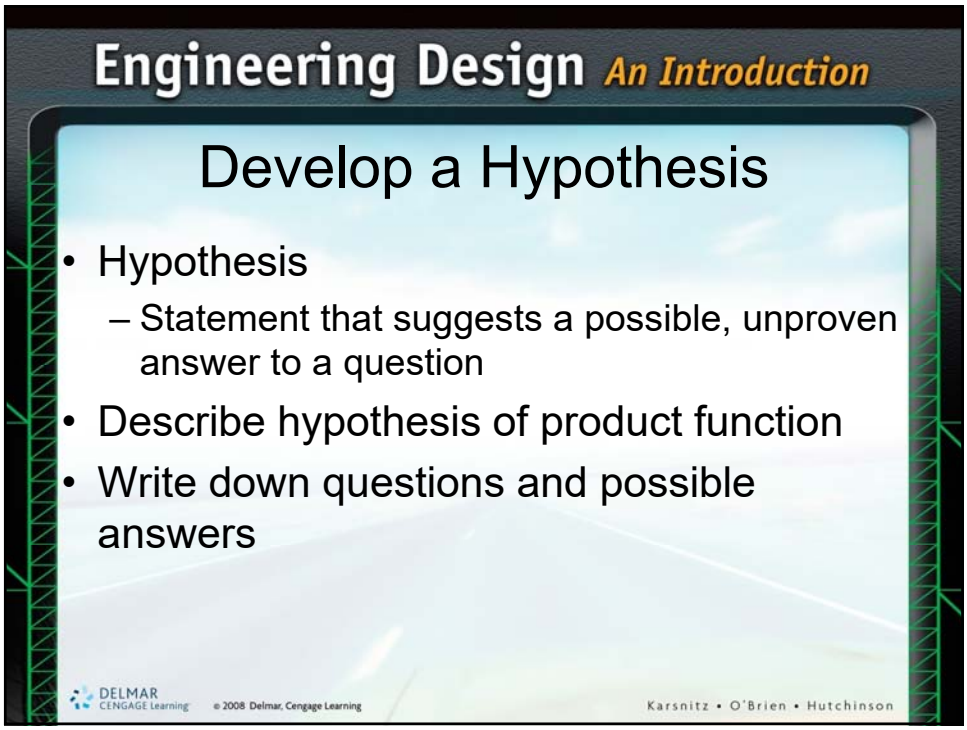
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Develop a Hypothesis
• Hypothesis
– Statement that suggests a possible, unproven answer to a question
• Describe hypothesis of product function
• Write down questions and possible answers
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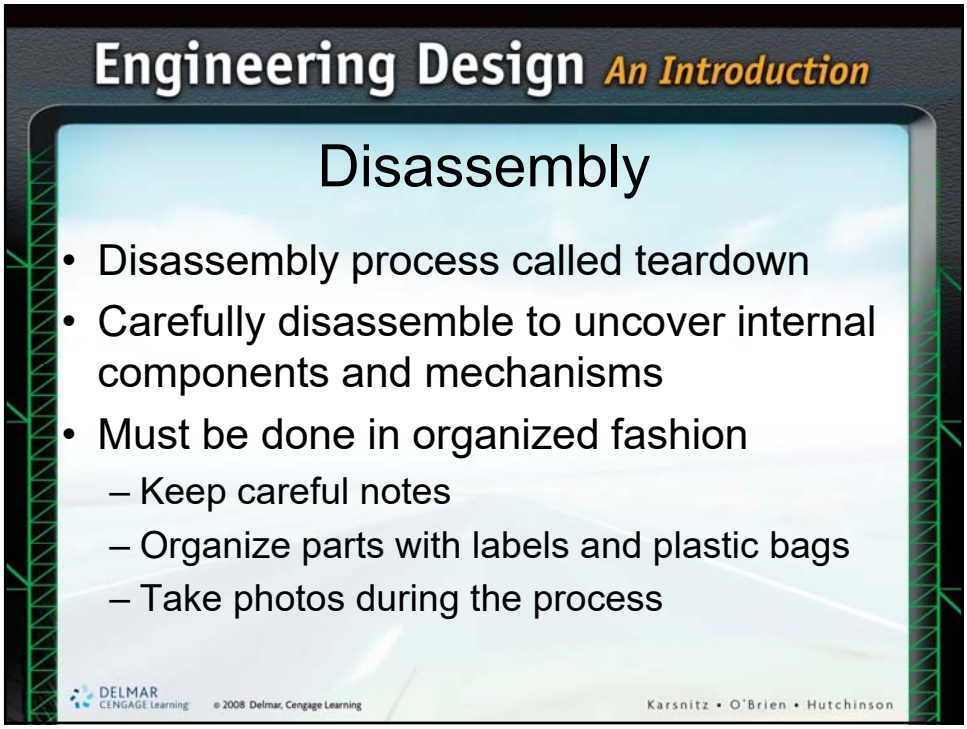
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Disassembly
• Disassembly process called teardown
• Carefully disassemble to uncover internal components and mechanisms
• Must be done in organized fashion
– Keep careful notes
– Organize parts with labels and plastic bags
– Take photos during the process
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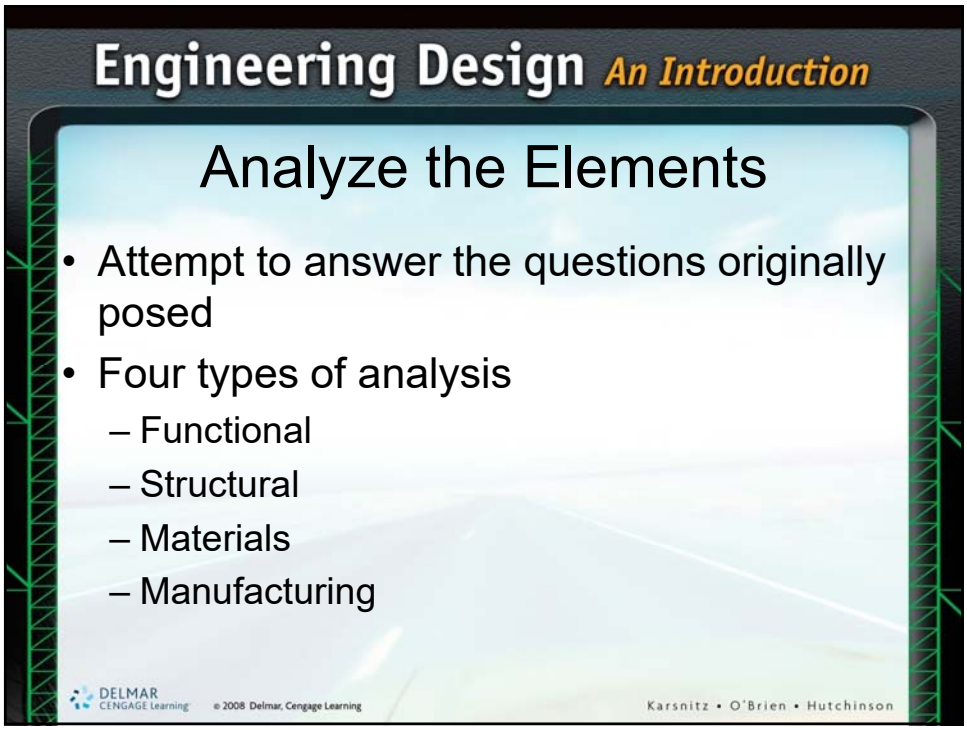
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Analyze the Elements
• Attempt to answer the questions originally posed
• Four types of analysis
– Functional
– Structural
– Materials
– Manufacturing
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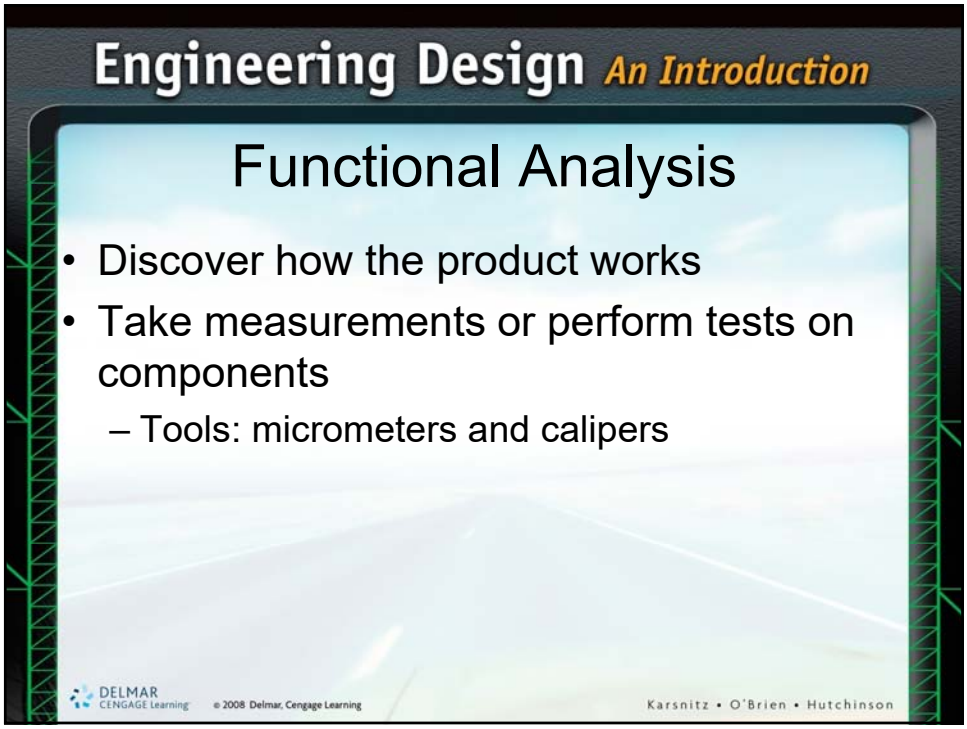
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Functional Analysis
• Discover how the product works
• Take measurements or perform tests on components
– Tools: micrometers and calipers
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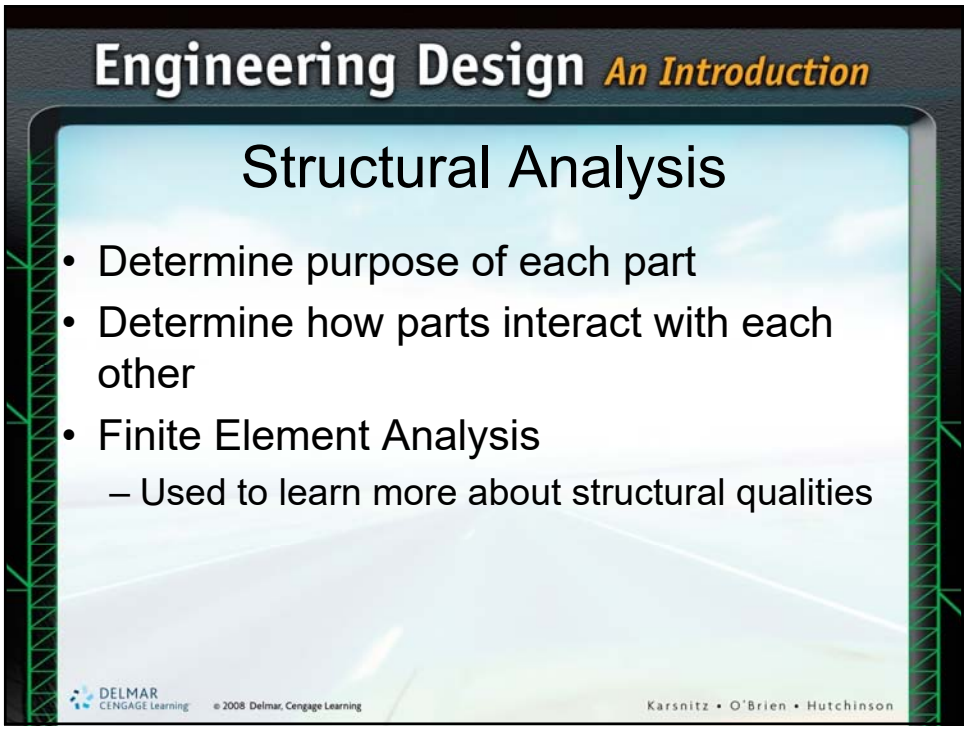
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Structural Analysis
• Determine purpose of each part
• Determine how parts interact with each other
• Finite Element Analysis
– Used to learn more about structural qualities
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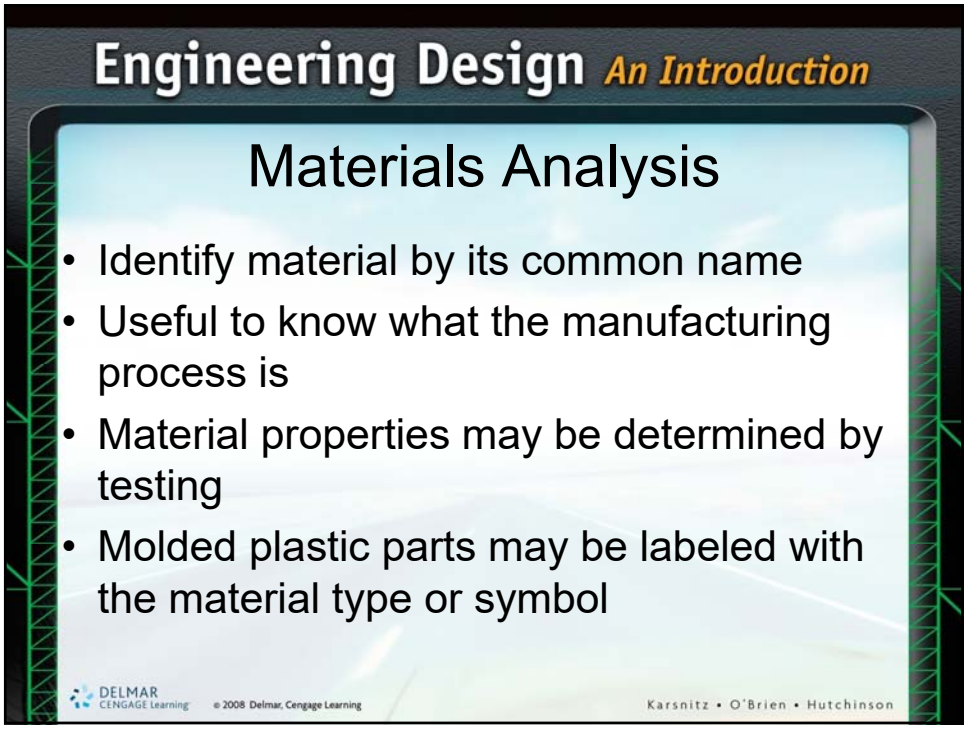
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Materials Analysis
• Identify material by its common name
• Useful to know what the manufacturing process is
• Material properties may be determined by testing
• Molded plastic parts may be labeled with the material type or symbol
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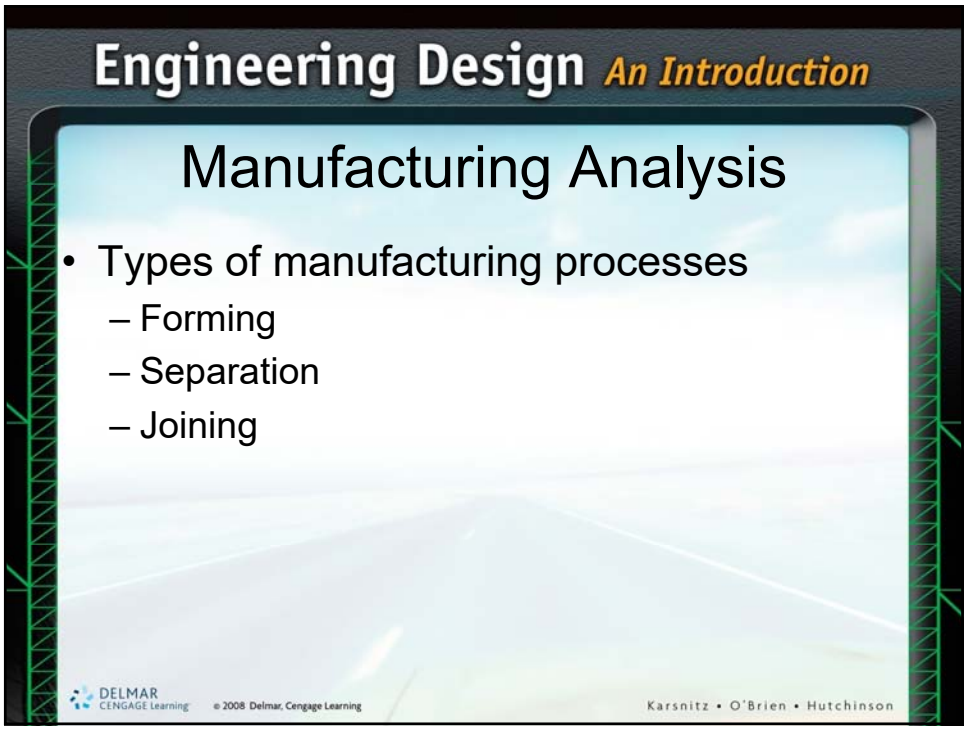
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Manufacturing Analysis
• Types of manufacturing processes
– Forming
– Separation
– Joining
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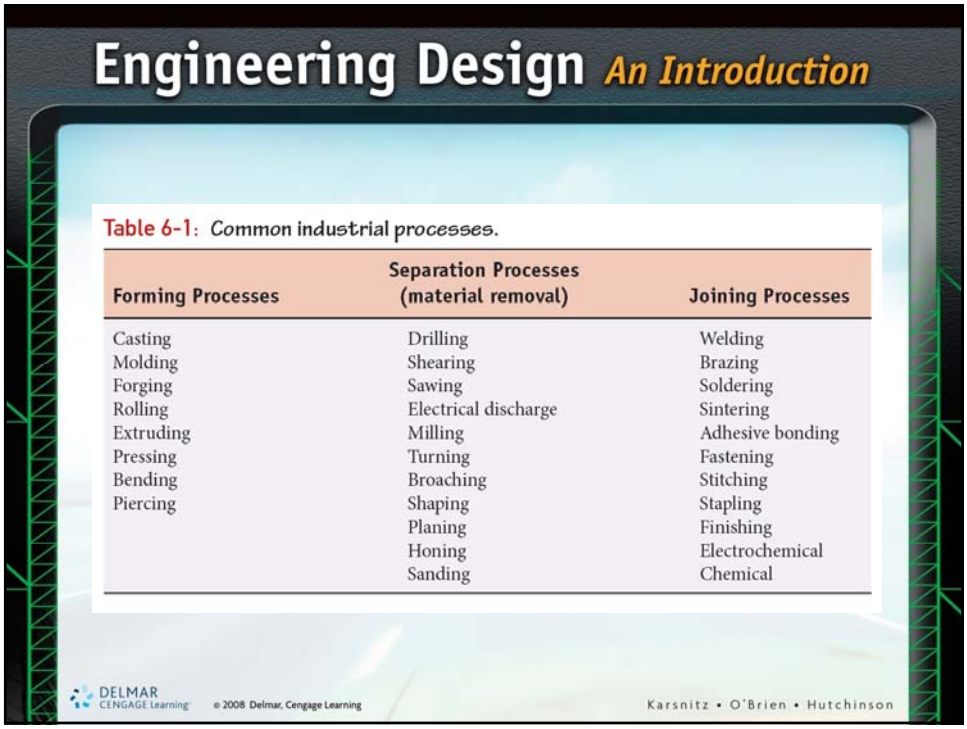
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Table 6-1: Common industrial processes.
Forming Processes
Separation Processes (material removal)
Joining Processes
Casting
Molding
Forging
Rolling
Extruding
Pressing
Bending
Piercing
Drilling
Shearing
Sawing
Electrical discharge
Milling
Turning
Broaching
Shaping
Planing
Honing
Sanding
Welding
Brazing
Soldering
Sintering
Adhesive bonding
Fastening
Stitching
Stapling
Finishing
Electrochemical
Chemical
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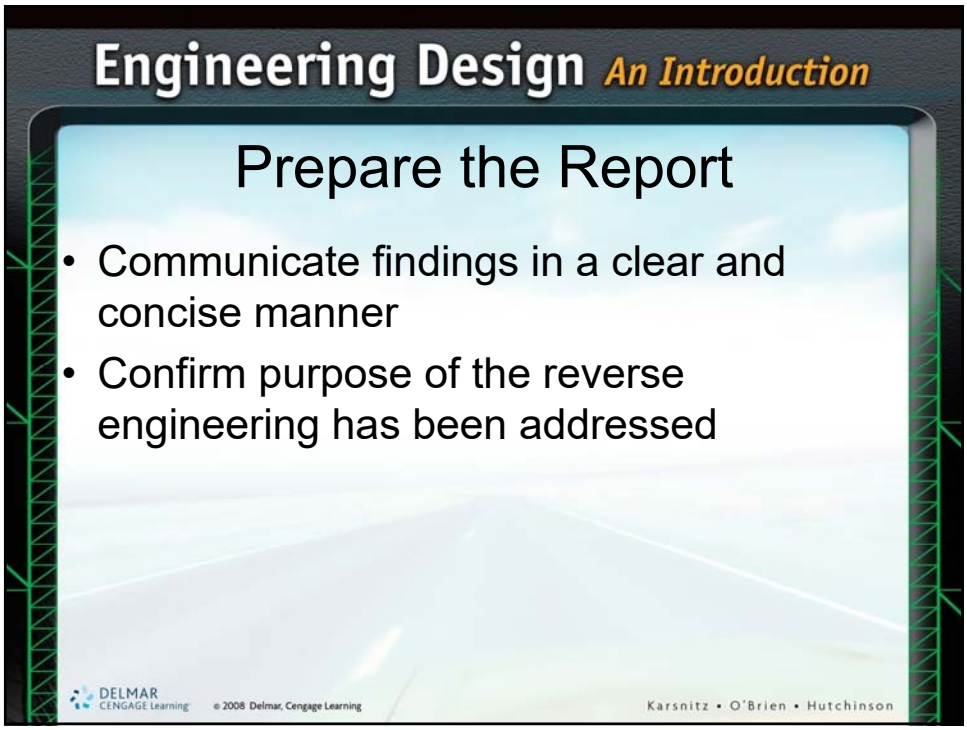
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Prepare the Report
• Communicate findings in a clear and concise manner
• Confirm purpose of the reverse engineering has been addressed
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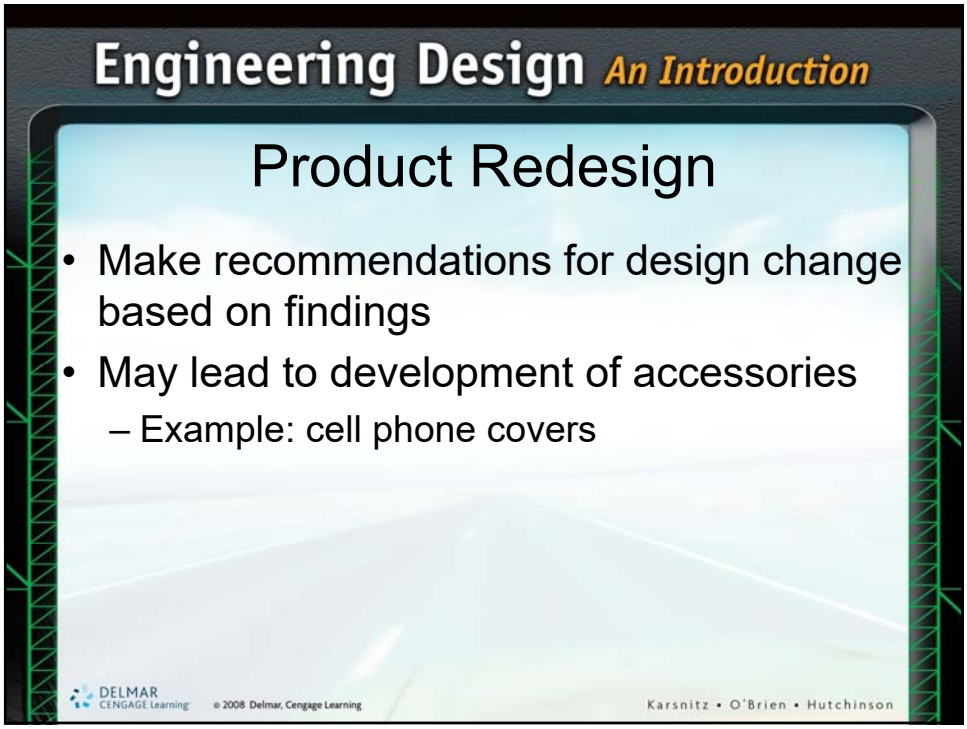
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Product Redesign
• Make recommendations for design change based on findings
• May lead to development of accessories
– Example: cell phone covers
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