



Dear God
thank you
for everything



REVERSE ENGINEERING

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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

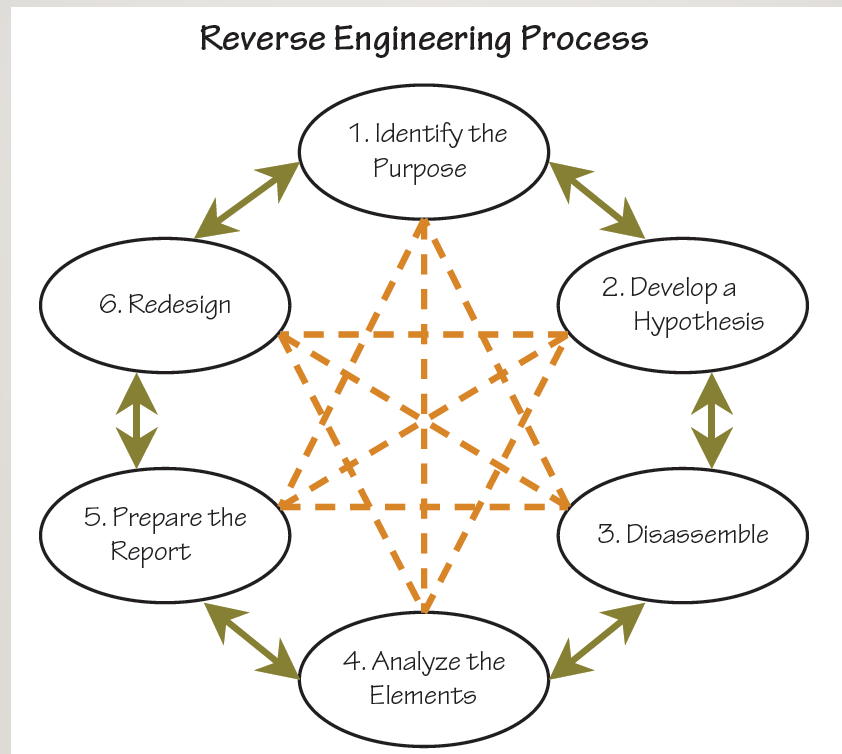
REVERSE ENGINEERING DECREASES **PRODUCT WASTE**

- **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**

REVERSE ENGINEERING AND PATENTS

- **Patent law**
 - Designed to protect inventors
- **Competitor** may reverse engineer and **copy a design**
- **Recourse:** sue for patent infringement

REVERSE ENGINEERING: THE BIG PICTURE



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
- **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

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

I. IDENTIFY THE PURPOSE

- Determine what needs to be learned
- Record purpose in engineer's notebook

2. 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

3. **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**

4. ANALYZE THE ELEMENTS

- Attempt to answer the questions originally posed
- **Four types of analysis**
 - Functional
 - Structural
 - Materials
 - Manufacturing

4.1. FUNCTIONAL ANALYSIS

- Discover how the product works
- Take measurements or perform tests on components
 - Tools: micrometers and calipers

4.2. STRUCTURAL ANALYSIS

- Determine purpose of each part
- Determine how parts interact with each other
- Finite Element Analysis
 - Used to learn more about structural qualities

4.3. 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

4.4. MANUFACTURING ANALYSIS

- Types of manufacturing processes
 - Forming
 - Separation
 - Joining

Table 6-1: Common industrial processes.

Forming Processes	Separation Processes (material removal)	Joining Processes
Casting	Drilling	Welding
Molding	Shearing	Brazing
Forging	Sawing	Soldering
Rolling	Electrical discharge	Sintering
Extruding	Milling	Adhesive bonding
Pressing	Turning	Fastening
Bending	Broaching	Stitching
Piercing	Shaping	Stapling
	Planing	Finishing
	Honing	Electrochemical
	Sanding	Chemical

5. **PREPARE THE REPORT**

- Communicate findings in a clear and concise manner
- Confirm purpose of the reverse engineering has been addressed

6. PRODUCT REDESIGN

- Make recommendations for design change based on findings
- May lead to development of accessories
 - **Example:** cell phone covers

**Be With God
Be King**

