A Design Process

Lecture 6

Design Project
What is Design?

- “. . . to conceive and plan out in the mind, to devise for a specific function or end.” (Webster)
- “. . . making something that has not existed before.” (Petroski)
- “. . . the process of applying various techniques and scientific principles for the purpose of defining a device, a process, or a system in sufficient detail to permit its realization.”
Design Is Also:

- Fun
- Creative
- Challenging
- Interesting
- Undervalued
- And Fun
What Makes a Good Designer?

- Creativity
- Intellectual curiosity
- Unafraid to take chances
- Willing to fail and try again
- Strong knowledge of engineering fundamentals
- Good analysis skills
- Understanding of the design process
- Experience
A Design Process

- Identify a need
- Research the background
- State the goal
- Develop functional (task) specifications
- Ideation and invention
- Modeling and analysis
- Selection of best solution
- Detailed design
- Prototype and test
- Production

Iterate!
Identification of Need

“What the world needs is:”

- A good 5-cent cigar
- Non-fattening food
- An electric car with good range
- A better lawnmower
- A window cleaning robot
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Don’t reinvent the wheel!
- identify similar devices on market
- what are their problems?
- what technologies apply to problem?

Some Sources of Information
- World Wide Web
- Users (interviews - market surveys - focus groups)
- Patents (www.uspto.gov or www.delphion.com)
- Experiments and measurements
- Trade shows and manufacturer’s literature
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Don’t say: “Design a better lawnmower.”
Rather say: “Design a means to shorten grass.”
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Functional (Task) Specifications

☐ Are “Performance Specifications,” not “Design Specifications.”

☐ Performance specs state WHAT is to be accomplished. Design specs state HOW it is to be done.

  ■ Performance spec: “Must be corrosion resistant in a salt spray test per ASTM 4023a.”
  ■ Design spec: Must be made of stainless steel.

☐ Must define the task in a way that:

  ■ Can be accomplished.
  ■ Can be shown (proven) to have been accomplished.
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The Creative Process

- **Idea Generation**
  - Frustration
  - Incubation
  - Eureka!

Blank paper syndrome
Idea Generation

- Don’t just take the first idea that comes to mind
- You want as many concepts as possible
  - Defer judgment on their quality until later
- Techniques to aid in concept generation
  - Draw analogies with other physical contexts
  - List synonyms for the verb in problem statement
  - Brainstorming
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Modeling and Analysis

- Develop models of promising concepts
  - Graphical (sketches, drawings)
  - CAD solid models
  - Mathematical models (simulations)
  - Physical models (proof of principle)

- Analyze the models to determine feasibility
  - Calculation
  - Testing

- When they don’t work, iterate!
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# Decision Matrices

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Project Advice

☐ Use the Design Process – it works!
☐ Take advantage of incubation – start it now!
☐ The better you define the problem, the better will be the result.
☐ Don’t jump to a premature solution.
☐ The more concepts you generate, the better.
☐ “Invention is 1% inspiration and 99% perspiration.” Thomas Edison
Project Discussion