Intro To Design

Systematic Design Process

Design

- A Creative Process
  - Not as well defined as analysis
  - Usually iterative
  - A design evolves
- 5 steps
  1. Problem definition
  2. Research
  3. Generate alternatives
  4. Analyze and select solution
  5. Test and reevaluate
- Documentation

Step 1: Problem Definition

Identify the need/opportunity

- Difficult for truly new concepts

"There is nothing more difficult and dangerous,
or more doubtful of success,
than an attempt to introduce a new order of things."
Niccolo Machiavelli, The Prince (1513)

- Perceived opportunity
  e.g. A quiet vacuum cleaner

The Problem Statement

- Address the real need
  - Research
  - Background knowledge
  - Who is your customer?
- Don't assume a design
  - Concise
  - Flexible
    - Not too specific (details always change)
    - Allow for innovation

Criterion for success

- Measurable Metrics
  - Cost
  - Performance
  - Safety
  - Environmental factors
  - Aesthetics
  - Reliability

Step 2: Research

- Information categories
  - Existing solutions
    - Limitations
    - Advantages
  - Who is in this arena
  - Economic factors (willingness to pay)
  - Other factors (safety, aesthetics, environmental, etc.)
- Information resources
  - Technical journals/Textbooks
  - Library catelog
  - Industrial Indices
  - The Internet
  - Patent offices (US and others)

Step 3: Generate Solutions

- Creativity
  - Curiosity (don't fear the unknown)
  - Openness to new experiences
  - Take risks
  - Multiple vantage points
    - Bottom-up (detail driven)
    - Top Down (See th whole picture)
    - Lateral Thinking
  - Concentration ("Focus Daniel-san)

Organize for Innovation

- Teamwork
  - Variety of backgrounds
  - Differing points-of-view
  - Differing skill sets
- Brainstorming
  - Acceptance of initial ideas – don't critique
  - Praise innovative ideas
  - Stress quantity
  - Combine ideas
  - Record everything … analyze later

Step 4: Analysis and Selection

- Functional analysis
  (does it do what is required?)
- Ergonomics
  (does it fit the user?)
- Safety and reliability
  (don't feed the attorneys)
- Economics (how much does it cost?)
- Engineering analysis
  (will it survive in the real-world?)
- Decision Process (use a decision matrix)

Decision Matrix

TABLE 1 Decision matrix for evaluating alternative can crusher designs

CRITERIA	WEIGHT(%)	DESIGN 1	DESIGN 2	DESIGN 3
Safety	30	2	9	2
R × Weight		60	270	60
Ease of Use	20	8	9	6
R × Weight		160	180	120
Portability	20	5	3	2
R × Weight		100	60	40
Durability	10	8	8	6
R × Weight		80	80	60
Standard Parts	10	7	7	8
R × Weight		70	70	80
Cost	10	6	5	7
R × Weight		60	50	70
Total	100	530	710	430

Step 5: Test and Implement

- Prototype
  - Test new concepts for feasibility (reduce risk)
  - Get feedback from customer
- Concurrent Engineering
  - Do things in parallel
    (take some risks to shorten schedules)
  - Project Planning – use a tool
    (e.g. Microsoft Project)
- Documentation (as you design … not after)
  - Drawings
  - Memoranda
  - Technical Reports
  - Presentations
- Intellectual Property
  (patents, copyrights, secrets … Oh My)

Review

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