Concept Generation

ME 4054W

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References: Text, Chapter 6
Product Concept Generation

- What are all of the possible ways to implement a design?
- Which one is best?
Product Concept Attributes

• A product concept is an idea that addresses the product design specification
• Concept generation is cheap and easy
• Initially, the product concept can be fragmented, complete, abstract, or detailed
• Portions of concepts can be combined to generate new concepts
• Concept selection is hard

Use a process!
Concept Generation (aka Ideation)

• Is a process
• Can be learned
• Is not predictable
• You are trying to find things that are not be apparent
• Is easy if attitudes are positive
Steps for Concept Generation

0. Review the PDS
1. Clarify the problem
2. Search externally
3. Search internally
4. Explore systematically
5. Reflect on the solutions and the process
1. Clarify the Problem

• Understanding
  – Use the PDS to define critical customer needs

• Problem decomposition
  – By function
  – By sequence of user actions
  – By key customer needs

• Focus on critical sub-problems
2. Search Externally

- Interview lead users
- Consult/interview experts
  - Users, vendors, etc.
- Search patents
- Search published literature
  - Trade journals, textbooks, handbooks, magazines
- Benchmark related products
  - “Reverse engineer” direct and indirect competitors

External searches are primarily to learn about existing concepts
3. Search Internally

Brainstorming

• Individual
  – Each team member should generate at least 10 product concepts before the first team brainstorming session

• Group
  – Group brainstorming can be very powerful. Do it!

Internal searches are done to generate new concepts
Guidelines for Brainstorming

1. Suspend judgment – all ideas are accepted without feedback

Resist the urge to judge. Don’t say things like:

• “That’s dumb...”
• “That will never work...”
• “That will cost too much...”
• “That idea will be eliminated quickly...”
• “How many pounds of unobtainium are needed...”
• “That’s a great idea...”
Guidelines for Brainstorming

2. Generate LOTS of ideas
   • Leverage / combine ideas where appropriate

3. Welcome “wild” ideas that may not seem feasible
Guidelines for Brainstorming

4. Use written, graphical and physical media
   • *Document everything*: 3x5 note cards, design notebook, cardboard models – whatever works
   • Use key word descriptors, sketches
   • Date, “inventors”, and 2 witnesses for really good ideas
   • The brainstorming should be compiled and uploaded to your Google website. It will also be in your final report.

The goal is to create scores of ideas
Ideation - Example

What is half of 8?
What is half of 8?

\[ 8 \div 2 = 4 \]

This is one solution, but ...
What is half of 8?
What is half of 8?
Brainstorming Documentation Examples

Motor pulls cart on a string when cart reaches its destination it tips and spills its contents into receiving box.

Motor winds string

"mat" fishing line
cam-profile
short track to get balls over edge

Cart
Track
Box
Pulley

Motor

100 Places
Concept Generation Methods

- Make analogies
- Change the scale
- Wish and wonder
- Use related stimuli
- Use unrelated stimuli
- Set quantitative goals
- Use the gallery method
Brainstorming Process

• Assign a facilitator
• Define the topic
• Agree on a stop time
• Agree on recording method(s)
• Build on ideas of others
• No judging or stopping to evaluate
• Interruptions are OK

Your team should have at least two brainstorming sessions
4. Explore Systematically

• Concept classification tree
• Combination table
• Other methods for exploring ideas:
  – Catalog
  – Sort (affinity grouping)
  – Combine
  – Post on a wall
  – Revisit
Concept Classification Tree

• Benefits:
  – Pruning of less promising branches
  – Identify independent approaches
  – Exposure of inappropriate emphasis
  – Refinement of the problem decomposition for a particular branch

Exhibit 6-7
“Product Design and Development”
By Ulrich and Eppinger
## Concept Classification Table

Exhibit 6-9  
“Product Design and Development”  
By Ulrich and Eppinger

<table>
<thead>
<tr>
<th>Convert Electrical Energy to Translational Energy</th>
<th>Accumulate Energy</th>
<th>Apply Translational Energy to Nail</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rotary motor with transmission</td>
<td>Spring</td>
<td>Single impact</td>
</tr>
<tr>
<td>Linear motor</td>
<td>Moving mass</td>
<td>Multiple impacts</td>
</tr>
<tr>
<td>Solenoid</td>
<td></td>
<td>Push nail</td>
</tr>
<tr>
<td>Rail gun</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
5. Reflect on the Results and Process

• Is the team confident the solution space has been fully explored?
• Are there any alternative function diagrams?
• Are there alternative ways to decompose the problem?
• Have external sources been thoroughly pursued?
Common Problems that limit the Concept Generation Process

- Insufficient external search
- PDS not well defined prior to concept generation
- Existing concepts not leveraged
- Not enough ideas (think 100+)
- Judgment occurs during brainstorming
- Going with the first idea
Go Forth and Brainstorm!

http://www.clamlynch.com/blog/brainstorm.jpg