TIM 80C, Lecture 4 (4/10/14)

Agenda

1) Project Phase I (work for the following week)

2) Concluding remarks on product dissection

3) Function Structures

4) Product Design
   - FAST diagrams
   - Function Structures
   - Morphological Matrices
1) Project Phase I

Need **high-level** criteria to narrow down the 5-7 ideas (prelim proposal) to a 1 that can **used as the basis for the Start-up**

1) **Technical Feasibility**

Can the idea realized into product (working prototype) in a reasonable amount of time (8-9 months) at a reasonable cost ($500K - $2M)

**Example:**

**Scale:** 1 (low) - 5 (high)

Tablet for College Students : 4?
Accident-Proof Car : 2
2) **Commercialization Potential**

Is there a market (customer, $$$) for the product?

**Example**

<table>
<thead>
<tr>
<th>High Technical Feasibility</th>
<th>Low Technical Feasibility</th>
</tr>
</thead>
<tbody>
<tr>
<td>&quot;Bread and Butter&quot;</td>
<td>&quot;Pearls&quot;</td>
</tr>
<tr>
<td>MS Office</td>
<td>iPhone</td>
</tr>
<tr>
<td>&quot;White Elephants&quot;</td>
<td>&quot;Oysters&quot;</td>
</tr>
<tr>
<td>Cure for Cancer</td>
<td></td>
</tr>
</tbody>
</table>

Low How

Commercialization Potential

Place your ideas in the matrix and select a "pearl" or "Bread and Butter" product to work on.
- Combine product ideas
- Make sure your group likes the idea
2) Concluding remarks on Product Dissection

Question: What is product dissection useful for?

Answer:

1) Understanding the relationship between function (WHYs) and the form (Hows) for a product

2) Understand how a product work

3) How a product can fail (in combination with FMEA)

4) How to design new products
3) Function Structure

**Question:** How do we create solution-neutral representation of a product that enables us to create several alternative design concepts (forms) for the new product?

**Answer:** The representation is called the Function Structure for the product.

**Example:** Function structure for a light bulb

```
Create Light

Receive Energy
------------------
Transform Energy into light
```
4) Creating New Products (Product Design)

Question: How do design new products in a way such that we know that we have the best possible form for the desired product functions?

Answer: We have to systematically explore the design space defined by the function structure for the product.

Product Design Process: 9 steps

Step 1: State the overall purpose or objective of the new product

Example: Light bulb

Design an energy-efficient product for creating light in home
Step 2: Dissect existing products on the market are similar to the desired product.

Example: Sylvania light bulb

See lecture 2

Step 3: Create a Function Structure for the new product.

1) Strip out the realizations from the FAST diagrams created in Step 2.

2) Remove any functions that imply a specific form.

3) Add, remove, and/or modify the sub-functions until we get a Function Structure that addresses the objectives in Step 1.

Example:

- Receive Energy
- Transform Energy into Light
- Reduce Energy Consumption
- Create Light
Step 4: For each leaf sub-function in the function structure tree, generate several alternative solution principles for realizing the sub-functions. Apply structured brainstorming!

Step 5: Organize the sub-functions and solution principles into a matrix (table).

<table>
<thead>
<tr>
<th>SF</th>
<th>SP1</th>
<th>SP2</th>
<th>SP3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Receive Energy</td>
<td>120V Mains</td>
<td>Solar</td>
<td>Chemical Reaction</td>
</tr>
<tr>
<td>Transferring Energy</td>
<td>Filament</td>
<td>CFL</td>
<td>LED</td>
</tr>
<tr>
<td>Into Light</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Reduce Energy Consumption</td>
<td>None</td>
<td>Timer</td>
<td>Motion Sensor</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Daylight Sensor</td>
</tr>
</tbody>
</table>

We call this table a morphological matrix for the product (Zwicky ~1970s)
Step 6: Use the Morphological Matrix to generate several alternative design concepts.

Step 7: Write a brief description of how each concept will work.

Example: Concept 2
- Solar panels on the bulb charge a battery pack in the socket that will an LED
- Motion sensor that turn the light off when the room is empty.

- Motion Sensor
- Solar Panel
- Socket
- Battery pack
Step 8: Create a set of criteria and compare the design concepts.

<table>
<thead>
<tr>
<th>Criteria</th>
<th>Concept 1</th>
<th>Concept 2</th>
<th>Concept 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Price</td>
<td>1</td>
<td>2</td>
<td>1</td>
</tr>
<tr>
<td>Performance (Energy Efficiency)</td>
<td>1</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>Compatibility</td>
<td>5</td>
<td>4</td>
<td>1</td>
</tr>
<tr>
<td>Technical Feasibility</td>
<td>5</td>
<td>4</td>
<td>4</td>
</tr>
<tr>
<td>Commercialization</td>
<td>1</td>
<td>3</td>
<td>4</td>
</tr>
</tbody>
</table>

Scale: 1 (Bad) - 5 (Good)

Total: 16

Step 9: Select the design concept based on the selection criteria and develop it into a product.