TIM 80C Lecture #4 (4/9/15)

Agenda

1) Product Spectrum

2) Project Phase I
   (work for following week)

3) Concluding remarks on product dissection

4) Function Structure

5) Product Design
   - FAST diagram
   - Function Structures
   - Morphological Matrices
(1) Product Spectrum

The word product refers to a spectrum.

<table>
<thead>
<tr>
<th>Spectrum</th>
<th>Low-Tech Example</th>
<th>High-Tech Example</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Physical Fitness</td>
<td>Productivity Software</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>($)</th>
<th>product</th>
<th>Running Shoes</th>
<th>Microsoft Word</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>($)</th>
<th>Solutions</th>
<th>Fitness Gym</th>
<th>Microsoft Office</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>($)</th>
<th>Services</th>
<th>Personal Trainer</th>
<th>Microsoft Office 365 (Cloud)</th>
</tr>
</thead>
</table>

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<tr>
<th>($)</th>
<th>Experience</th>
<th>Health Spa</th>
<th>Microsoft Office 365 on Surface Tablet Running Windows 9</th>
</tr>
</thead>
</table>
② Project Phase I

Need high-level criteria to narrow down the 5-7 ideas from the prelim proposal to 1 idea that can be used as the basis for the Start-up

1) Technical Feasible

Can the idea be realized as a product (working prototype) in a reasonable amount of time (3-9 months) at reasonable cost (500k - 2M)

Example:

Scale: 1 (low) - 5 (high)

Tablet for college students: 4-5
Accident-proof car: 2
2) Commercialization Potential

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

Example:

Tablet for College Students: 3
Accident-Proof Car: 5

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

Place your project ideas in the matrix, and select either a "pearl" or "bread and butter" product to work on.
- Combine product ideas
- Make sure your group likes the idea
3) Concluding remarks on Product Dissection

Question: What is product dissection useful for?

Answer:

1) Understanding the relationship between functions (whys) and the form (hows) for a product (how the product works)

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

3) Identifying what is new or different about a product

4) How to design new products
4) Function Structure

Motivation: Before we can design a new product (specify Form), we need to determine what the will do (specify Function).

Function → Form not Form → Function

Problem: We need an abstract (solution-neutral) representation of the product that will allow us to then create a design concept (form) for the new product.

Example: Lightbulb

```
Create Light

| Receive Energy | Transform Energy into Light |
```

This representation is called the Function Structure for the Product.
5) Creating New Products (Product Design)

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

**Approach:** We have to systematically explore the design space defined by the product's function structure.

**Product Design Process:** 9 Step

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

**Example:** Lightbulb

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

Example: Sylvania Lightbulb (see Lecture 3)

Step 3: Create a Function Structure for new product

1. Strip out realizations from the FAST diagram(s) created in Step 2

2. Remove any functions that imply a specific form (realization)

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

Example: Energy-Efficient Lightbulb

- [Create Light]
  - Transform Energy into Light
    - Receive Energy
    - Reduce Energy Consumption
  - State Energy
Step 4: For each leaf sub-functions in 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>
<th>SP4</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Receive Energy</td>
<td>120V Mains</td>
<td>Solar</td>
<td>Chemical Reaction</td>
</tr>
<tr>
<td></td>
<td>Transform Energy into light</td>
<td>Filament</td>
<td>LED</td>
<td>Bioluminescent Algae</td>
</tr>
<tr>
<td></td>
<td>Reduce Energy Consumption</td>
<td>None</td>
<td>Timer</td>
<td>Dimmer</td>
</tr>
</tbody>
</table>

We call this table a Morphological Matrix for the product (1970 Zwicky).
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 power an LED.

- Motion sensor will turn off the LED when the room is empty.

![Diagram of solar panel, socket, and battery pack with a motion sensor label]
Step 8: Create a set of criteria for assessing how a design concept satisfies the design objectives (user needs) and compare the generated concepts.

Criteria: Technical Feasibility, Commercialization, Performance (energy efficiency), aesthetics, price

<table>
<thead>
<tr>
<th>Criteria</th>
<th>Concept 1</th>
<th>Concept 2</th>
<th>Concept 3</th>
</tr>
</thead>
<tbody>
<tr>
<td>Technical Feasibility</td>
<td>5</td>
<td>4</td>
<td>1</td>
</tr>
<tr>
<td>Commercial Potential</td>
<td>1</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>Performance</td>
<td>2</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>Aesthetics</td>
<td>2</td>
<td>2</td>
<td>5</td>
</tr>
<tr>
<td>Price</td>
<td>5</td>
<td>2</td>
<td>1</td>
</tr>
</tbody>
</table>

**15 16 16**

Scale: 1 (Poor) = 5 (Excellent)

(TIM 105: Utility Function for weighting the different criteria)
Step 9: Select the best design concept, based on the selection criteria, and develop it into a product.
TA (Sabine) office hours this week will be on Friday (4/10) 4am - 1pm in E2 686

Instructor office hours today (4/9) from 3-4pm in E2 595