Design Project 1
Coffee Cup for Individuals with Disabilities

There are many causes of hand/finger disabilities throughout the world such as birth defects (e.g., Symbrachydactyly), diabetes, injuries from work equipment (e.g., power saws) or military conflicts (deliberate amputations). In the United States alone, the National Institute of Health (NIH) estimates that 30,673 persons/year are treated with non work-related amputations, with over 90% of these cases resulting in amputations of 1 or more fingers. Globally, there are over 3 million arm amputees in the world, with over 80% living in developing countries.

Upper management has put your team in charge of developing a concept for a new niche market for their disability-friendly coffee cup. Your team is to develop new concepts for a coffee cup that can be utilized by an individual with as little as one finger. You must gather the proper data to determine what this new coffee cup design will be, focusing on global, societal, environmental and economic (GSEE) impacts of your design. Also, you must compare the current product to what is on the market. It will be up to the board of directors to determine if your project will be carried on into production.

Description of the Design Task

Your task is to analyze the current offerings in the market and design a coffee cup that an individual with hand disabilities (i.e., assuming the scenario of having only one finger) can use with ease.

Your design activities will include following steps:

1. Analysis of customer needs
2. Concept Design
   A. External search for concept generation,
      a. Literature search,
      b. Patent searches,
      c. Benchmarking
   B. Revising the design statement,
   C. Internal work for concept generation,
   D. Concept Generation
3. Concept Selection
4. Final Design
   A. Embodiment of the design and feasibility analysis,
      a. Material and Manufacturing Process
   B. Detail Design and prototype.
The design process took much consideration and deliberation. First, we identified the problem. In this case, the problem was that it was difficult for people with one finger to hold a traditional coffee mug. Our job was to create a coffee mug for people with hand disabilities to use easily and efficiently. Next, we identified our customer needs. Our top five customer needs were user friendly, durable, portable, flexible, and one finger use. These would be our first-level attributes in our Customer Needs Hierarchy. We then used the analytical hierarchy process (AHP) to rank these five attributes. The AHP revealed that one fingered use was the most important, followed by user friendly, durable, portable, and finally, flexible. Next, we formulated 18 second-layer attributes. Each would be a subcategory for the five first-layer attributes. For example, under Portable was handheld and lightweight. After we had our 18 second-layer attributes, we ranked them using an AHP. We compared the attribute that fell into the same subcategory. So, handheld and lightweight were ranked in the same AHP because they both fell under portable. After doing this for each subcategory, we knew which attributes were more important than others which was taken into consideration when designing the mug.

Our next step was to create possible designs for the coffee mug. The top priorities for our design were that the cup would be unbreakable, could be held by people with a variety of disabilities on either hand without creating joint strain, and safe to use. We created a concept generation table with possible design. Possibilities included whether the cup would be made from steel or plastic, whether there would be a handle on one side or both, and whether the cup would have a rubber sleeve or not. There were 48 possible concepts that could be derived from the concept generation table.

From the 48 possible concepts, we picked the 16 we thought were best. The next step was generating a concept screening table. 1 of the 16 concepts was the reference and we compared the 15 other possible concepts to it. After doing this we were able to rank the concept in order from what ones we thought were to the ones we didn’t favor as much. Then, the concepts ranked from 1-5 moved on to the next step in the design process. The final step in the process was the concept score table. In this step, we took our 5 top concepts and were able to determine the top one based off of customer needs rankings. Since our group was happy with the final concept, this would be the design for our project. The design process was over and the next step was to form a prototype! This was our final cup design.
This is an example of one of our AHPs

<table>
<thead>
<tr>
<th></th>
<th>Portable</th>
<th>Durable</th>
<th>User friendly</th>
<th>Flexible</th>
<th>One finger use</th>
<th>Total</th>
<th>Weight</th>
</tr>
</thead>
<tbody>
<tr>
<td>Portable</td>
<td>1</td>
<td>5</td>
<td>0.33</td>
<td>0.33</td>
<td>0.1</td>
<td>6.77</td>
<td>0.146</td>
</tr>
<tr>
<td>Durable</td>
<td>0.2</td>
<td>1</td>
<td>0.33</td>
<td>5</td>
<td>0.3</td>
<td>6.86</td>
<td>0.148</td>
</tr>
<tr>
<td>User Friendly</td>
<td>3</td>
<td>3</td>
<td>1</td>
<td>3</td>
<td>1</td>
<td>11</td>
<td>0.237</td>
</tr>
<tr>
<td>Flexible</td>
<td>3</td>
<td>0.2</td>
<td>0.33</td>
<td>1</td>
<td>0.3</td>
<td>4.86</td>
<td>0.105</td>
</tr>
<tr>
<td>One finger use</td>
<td>9</td>
<td>3</td>
<td>1</td>
<td>3</td>
<td>1</td>
<td>17</td>
<td>0.366</td>
</tr>
<tr>
<td>Total</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>46.49</td>
<td></td>
</tr>
</tbody>
</table>

This was our Customer Needs Hierarchy

1. Portable (0.146)
   1. Lightweight (0.0244, 0.167)
   2. Handheld (0.1216, 0.833)
2. Durable (0.148)
   1. Reliable (0.037, 0.25)
   2. Unbreakable (0.111, 0.75)
3. User Friendly (0.237)
   1. Easy to use (0.0422, 0.178)
   2. Easy to clean (0.0047, 0.020)
   3. Efficient (0.0282, 0.119)
   4. Well insulated (0.0258, 0.109)
   5. Safe (0.0412, 0.174)
   6. Simple Design (0.013, 0.055)
   7. Flat base (0.0246, 0.104)
   8. Anti-slip base (0.028, 0.118)
   9. Low maintenance (0.01, 0.42)
   10. Ecofriendly (0.019, 0.080)
4. Flexible (0.105)
   1. Can handle wide range of temp. (0.0175, 0.167)
   2. Accommodate different one finger disabilities (0.087, 0.833)
5. One finger use (0.366)
   1. Ambidextrous (0.2745, 0.75)
   2. No joint strain (0.0915, 0.25)
This is our Classification Tree

<table>
<thead>
<tr>
<th>Unbreakable</th>
<th>Ambidextrous</th>
<th>Handheld</th>
<th>No joint strain</th>
<th>Safe</th>
</tr>
</thead>
<tbody>
<tr>
<td>Plastic</td>
<td>One side</td>
<td>Handles</td>
<td>Lightweight</td>
<td>Smooth edges</td>
</tr>
<tr>
<td>Steel</td>
<td>Both sides</td>
<td>Hole for finger</td>
<td>Small Shape</td>
<td>Rubber sleeve</td>
</tr>
<tr>
<td></td>
<td>Bottom</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>