

Toluwanimi Odemuyiwa

March 24, 2013

Design Process:

In a publication by UNEP and Delft University of Technology on designing for sustainability, the creative and design process was split into these four stages: problem definition, the divergent stage, the clustering stage, and the converging stage. In addition, Tufts University identified key steps in the engineering design process, outlined in the diagram below.



Figure 1 Engineering Design Process

Taken from: <http://engineering.tufts.edu/ggs/designprocess.htm>

Our overall design process followed a combination of the above two models:

Our problem definition was governed by the problem statement of the RFP, namely: **Design an improved bicycle handling system that permits individuals who suffer from arthritis in their wrists and hands to control their bicycles safely and comfortably.**

The Overarching Steps

1. Problem Definition – This stage involves identifying the purpose of the idea generation and solution we are working towards.

- We used the problem statement of the RFP: *Design an improved bicycle handling system that permits individuals who suffer from arthritis in their wrists and hands to control their bicycles safely and comfortably.*
- We expanded this to the more general statement: *Design a system on bicycles that permits individuals who suffer from arthritis in their wrists and hands to brake and steer comfortably.*

2. Generate Possible Solutions

a) Divergent Stage

- Functional Decomposition of the Braking System and Steering
 - Braking:
 - The squeezing of the lever → tension of the Bowden cable → force squeezes a spring and activates brake pads to squeeze the bicycle rim
 - Steering:
 - Cyclist turns a bar relative to an axis → directly attached to front wheel which moves in direction of “bar turn”
- SCAMPER - refer to idea generation sketches
 - *We asked ourselves the following questions(adapted from Figure 2):*
 - Substitute
 - Are there any parts we can replace and/or change?
 - Can we change the shapes of current bike parts?
 - Combine
 - What parts can be combined?
 - Can we recombine the purposes of the different parts?
 - What can be combined to combine the number of uses?
 - Brake pedal combinations
 - Adapt
 - Is there something similar to it, but in a different context?
 - What processes can be adapted?
 - Magnify
 - What can be made larger?
 - What can be exaggerated or overstated?
 - Put to other users
 - Eliminate
 - How can I simplify braking and/or steering?
 - What is unnecessary?
 - What feature of breaking can be understated/omitted?
 - Rearrange or Reverse
 - Are other arrangements possible?

- Can components be interchanged?
- What other body parts can be used to steer/brake?

3. Evaluate Possible Solutions

a) Clustering Stage

- All our designs fell into the following general categories
 - Steering Ideas
 - Braking Ideas
 - Leg-based solutions
 - Hand-based solutions

b) Convergent Stage

- Using the requirements of the RFP and our pushback criteria, we cut out several ideas
- Narrowed it down to gear design(refer to idea sketches), pulley design, and extended lever arm handle
- **Decision Matrix:** - Refer to the poster

4. Make and Test a Model

- Low fidelity prototype
- **High Fidelity prototype**
 - This will involve an actual bike and a solid model

5. Modify and Improve the Design

- This stage will occur after our design critique. We intend on using the feedback we receive to improve our current design.

6. Communicate the Final Design

- This stage will occur at the Showcase when we will communicate our final design solution to the public.

<http://www.d4s-de.org/manual/d4sChapter09.pdf>

