Adaptive Seating for Single Rider Golf Carts

CSU Chico Senior Design Project 2009/2010
Team Members

Dr. Chuen Hsu

Ryan Brandt    Ben House    Matt Coffman    Bryce Tanner
Project Sponsor

BENEFICIAL DESIGNS
RESEARCH/DESIGN/EDUCATION
Designing beyond the norm to meet the needs of all people
Project Justification

- **Current issues:**
  - Lack of appropriate support on current single rider golf carts
  - Expensive
    - Unobtainable by majority of population
Golfers with mid level paralysis need a safe, reliable and comfortable assistive device to support them in an able bodied golfing position.
Design, build and test a safe and reliable system to position an individual, with mid level paralysis, into a semi-standing position.
Customer Requirements

Must Do:

- Keep golfers’ knees from locking (Quantitative)
- Move from seated to semi-standing position (Qualitative)
- Meet Beneficial Designs’ testing requirements (Qualitative)

Omissions: Stable on incline in all orientations (Quantitative), Golf course compliant (Qualitative), Mountable to a single rider golf cart (Qualitative)
Customer Requirements

- **Should Do:**
  - Within budget (Quantitative)
  - Allow for complete golf swing and clearance of cart (Qualitative)
  - Solid positioning for legs and pelvis to limit motion (Qualitative)
  - Comply with RESNA standards (Qualitative)
  - Comply with United States Golf Association Rule 14-3 (Qualitative)
Customer Requirements

- **Should Do (continued):**

  **Omissions:** Adjustable for different users (Qualitative), Weather resistant (Qualitative)

- **Would Be Nice:**
  - Aesthetically pleasing (Qualitative)
  - Allow for one armed swing (Qualitative)
## Specifications and Targets

<table>
<thead>
<tr>
<th>Requirement</th>
<th>Engineering Spec</th>
<th>Target</th>
<th>Method/Device</th>
<th>Condition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Weight</td>
<td>Weight</td>
<td>&lt; 100 lbs</td>
<td>Scale</td>
<td>Fully Assembled</td>
</tr>
<tr>
<td>Within budget</td>
<td>Cost</td>
<td>&lt; $1000</td>
<td>Total Cost of Parts</td>
<td>New purchases only</td>
</tr>
<tr>
<td>Safety Compliance</td>
<td>Standards</td>
<td>RESNA spec.</td>
<td>Beneficial Designs Testing Facility</td>
<td>Beneficial Designs testing procedures</td>
</tr>
<tr>
<td>Not Lock Knees</td>
<td>Angle</td>
<td>&lt; 180°</td>
<td>Protractor</td>
<td>In golfing position</td>
</tr>
</tbody>
</table>

Omissions: Stability, Slope, 5% Grade, Test, Static positioning
Design Solution in Action
Fabrication

- Purchased Parts
  - Hockey pads

- Fabricated Parts
  - Tony Arena- NC programming
  - Rectangular tubing instead of solid stock
Testing

- Overview
  - Operation with and without actuator
  - Chair was tested individually by group members
  - Went to driving range
Testing Results
Discussion of Test Results

- Keep golfers’ knees from locking  Pass
- Move from seated to semi-standing position  Pass
- Meet Beneficial Designs’ testing requirements  Pass
- Within budget  Pass
- Allow for complete golf swing and clearance of cart  Pass
- Solid positioning for legs and pelvis to limit motion  Pass
- Comply with RESNA standards  T.B.D.
- Comply with United States Golf Association Rule 14-3  Pass
- Aesthetically pleasing  It depends
- Allow for one armed swing  Pass
## Final prototype

<table>
<thead>
<tr>
<th>Part No.</th>
<th>Vendor</th>
<th>Description</th>
<th>Part No.</th>
<th>Quantity</th>
<th>Cost</th>
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</thead>
<tbody>
<tr>
<td>1</td>
<td>Bi Rite</td>
<td>1in. x 0.5in. x .065in.</td>
<td></td>
<td>40 ft.</td>
<td>$38.54</td>
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<tr>
<td>2</td>
<td>Bi Rite</td>
<td>1/4in. x 6in. Flat</td>
<td></td>
<td>2 ea.</td>
<td>$10.50</td>
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<tr>
<td>3</td>
<td>Tap Plastics</td>
<td>6 ft. x 3/4in. diameter fiberglass rod</td>
<td></td>
<td>1 ea.</td>
<td>$16.99</td>
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<tr>
<td>4</td>
<td>JO-ANN fabrics</td>
<td>Cappuchino whisper pleather</td>
<td></td>
<td>0.5 yd.</td>
<td>$9.20</td>
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<tr>
<td>5</td>
<td>JO-ANN fabrics</td>
<td>Taupe thread</td>
<td></td>
<td>100 m.</td>
<td>$2.00</td>
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<tr>
<td>6</td>
<td>Valley-wide Fasteners</td>
<td>Brass bushing</td>
<td>CPK81-5308</td>
<td>31 ea.</td>
<td>$18.69</td>
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<tr>
<td>7</td>
<td>Valley-wide Fasteners</td>
<td>3/8 in. brass washers</td>
<td>B-9QS-24</td>
<td>30 ea.</td>
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<tr>
<td>8</td>
<td>Valley-wide Fasteners</td>
<td>3/8-24 x 2 in. bolts</td>
<td>85F-2417</td>
<td>6 ea.</td>
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<td>9</td>
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<td>3/8-24 x 2.5 in. bolts</td>
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<td>10</td>
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<td>3/8-24 nylon lock nuts</td>
<td>95NF-24</td>
<td>16 ea.</td>
<td>$1.13</td>
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<tr>
<td>11</td>
<td>Radio Shack</td>
<td>15A Blade-Type automotive fuses</td>
<td>270-1082</td>
<td>3 ea.</td>
<td>$6.34</td>
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<tr>
<td>12</td>
<td>Radio Shack</td>
<td>15-Amp Inline Blade-type fuse holder</td>
<td>270-1213</td>
<td>1 ea.</td>
<td>$2.80</td>
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<tr>
<td>13</td>
<td>Radio Shack</td>
<td>DPDT 20-Amp Momentary flip switch</td>
<td>275-709</td>
<td>1 ea.</td>
<td>$5.29</td>
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<tr>
<td>14</td>
<td>Power Drives, Inc.</td>
<td>Linear Actuator</td>
<td>DF1210W52-12NNHHN</td>
<td>1 ea.</td>
<td>$293</td>
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<tr>
<td>15</td>
<td>Mcmaster-Carr</td>
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<td>16</td>
<td>Cal-Skate</td>
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<td>Target</td>
<td>Golf balls</td>
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<td>18</td>
<td>Target</td>
<td>Hitting mat</td>
<td>88040887</td>
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**Sub Total**

$515.60
# Budget

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<tr>
<th>Labor</th>
<th>Hours</th>
<th>Hourly Rate</th>
<th>Wage</th>
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<tbody>
<tr>
<td>Redesign</td>
<td>300</td>
<td>$34.97</td>
<td>$10,491.00</td>
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<tr>
<td>Construction</td>
<td>1000</td>
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<tr>
<td>Testing</td>
<td>20</td>
<td>$34.97</td>
<td>$699.40</td>
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| Sub Total      |       |             | $31,690.40|
| Total Cost for Spring Semester |       |             | $32,206.00|
**Additional Content**

- **Design challenges**
  - Biomechanical complications
  - Dynamic trunk support

- **Merits**
  - Stable platform
  - Allows for effective golf swing
  - Provides trunk control
  - Ease of manufacture
Acknowledgements

- Peter Axelson - Beneficial Designs, Inc.
- Dr. Chuen Hsu
- Steve Eckhart
- Brian Rugne - Haggin Oaks Golf Complex
- Liz House
“It was so much better than every other way I have tried... Neither experience really felt like golfing until today.”

- Peter Axelson