### Objective

**HOQ Customer Requirements**
- Four person capacity
- Lightweight
- Ease of assembly
- Ease of disassembly
- Protection from nature
- Fit in backpack/ cartable by single individual

**CTQ Eng. Characteristics**
- Weight
- Folded/stored size
- Deployed size
- Time to set up

**Constraints**
- Flame retardant fabric
- Ventilation
- Cost

### Prototype and Testing

**Prototype Description**
- Full-scale tent leg
- Aluminum plates provide structural support
- Pulley and gear system for deployment, collapse

**Testing and Setup**
- Time to assemble leg: < 1 min.
- Weight of one leg: 1.18 kg
- Estimated total weight (legs, fabric, support plate): ~ 6 kg.

**Improvements**
- Shorten coupler links to eliminate interference
- Include spacers to maintain alignment of gears and pulleys
- Maintain tighter positional tolerances on through holes

### Test Results and Future Work

**Summary of PDP for automated tent**
- Need for convenient tent recognized
- CRs and CTQ eng. characteristics obtained form HOQ
- Concept generation and selection
- Detail design of CB/BR concept
- Prototype FEA modeling, fabrication and testing

**Recommendation for future design and commercialization**
- Integration of compliant tent fabric
- Further weight reduction (e.g. grooved link arms)
- Expansion of product line through creation of 2 – 6 person tent models

**Process reflection**
- Prototype redesign based on results from fabrication and testing of one full-scale tent leg proved a crucial PDP step
- The design team learned that the PDP process allows for systematic and efficient engineering product design

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**Design**

**Operation of Product**
- Lever actuated fold out
- Rotational user input to enable assembly/ disassembly
- Fully reversible operation

**Key Innovations**
- 2-step assembly and packing
- Multiple motions dependent on simple rotation
- Easily compatible with motor for fully automated operation.

**Satisfied Customer Requirements**
- Lightweight structure due to Aluminum and plastic parts
- Simple crank rotation for ease of assembly
- Compact folded design ensures portability

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**Concept Generation**

**Table 1: Final Decision Matrix**

<table>
<thead>
<tr>
<th>Concepts</th>
<th>JP</th>
<th>FR</th>
<th>MM</th>
<th>CB/BR</th>
</tr>
</thead>
<tbody>
<tr>
<td>Folded size</td>
<td>0.300</td>
<td>0.100</td>
<td>0.300</td>
<td>0.300</td>
</tr>
<tr>
<td>Time to setup</td>
<td>0.389</td>
<td>0.153</td>
<td>0.069</td>
<td>0.389</td>
</tr>
<tr>
<td>Deployed size</td>
<td>0.079</td>
<td>0.201</td>
<td>0.519</td>
<td>0.201</td>
</tr>
<tr>
<td>Weight</td>
<td>0.125</td>
<td>0.125</td>
<td>0.375</td>
<td>0.375</td>
</tr>
<tr>
<td>Cost</td>
<td>0.300</td>
<td>0.300</td>
<td>0.100</td>
<td>0.300</td>
</tr>
</tbody>
</table>

**Table 2: AHP Results**

<table>
<thead>
<tr>
<th>Concepts</th>
<th>Alternative value</th>
</tr>
</thead>
<tbody>
<tr>
<td>JP</td>
<td>0.223</td>
</tr>
<tr>
<td>FR</td>
<td>0.153</td>
</tr>
<tr>
<td>MM</td>
<td>0.301</td>
</tr>
<tr>
<td>CB/BR</td>
<td>0.321</td>
</tr>
</tbody>
</table>

Concept CB/BR was chosen as the final concept.

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