TIM 105/205, LECTURE #13 (11/7/13)

Agenda:

- Complete process for conceptual design for new products.

- Utility function for assessing, comparing & then selecting a feasible design concept

- Project Phase 1 feedback

- Midterm

- Turn in completed HW #5

- Work on HW #6 before Tuesday's midterm correction between Tuesday & Thursday
Examples

Let's take a look at these chapters in the book:

Chapter on Concept Generation
(Example: Roofing Nailer)

Chapter on Concept Selection
(Example: outpatient syringe)
Utility function for comparing &
assessing several competing design
concepts (alternatives) [Step 7 in conceptual
design process]

Def. of the problem (Objective, Goal)

- Observation

- Assume that we have n selection
criteria \(5 < n < 100\) for comparing
alternative design concepts

- Not all these selection criteria are
equally important

- How do we rationally assign "weights"
to each selection criteria to indicate
the importance of that criteria?

- (Selection criteria are obtained
from the HoQ)
Plan/Process:

Construct a utility function that provides the appropriate weight, \( w_i \), for each selection criteria, \( S_i \) \((i=1,2,\ldots,n)\).

1. Organize the selection criteria as a hierarchy [combination of customer & engineering "needs"]

(See the 1-page "Car door" HOQ for an example:)

\[
\begin{align*}
\text{Car} & \quad \text{Door} \\
\text{HOQ} & \end{align*}
\]

Primary \quad Secondary \quad Tertiary \quad \ldots

2. At each level of the hierarchy, assign relative weights (based on group discussion, etc.) for selection criteria.

3. At each level, compute (calculate) the absolute weight for the selection criteria.
Convention

selection criteria

relative weight (assign)

absolute weight (calculate)
Example

actual product (fingernail clipper)

rel

abs

ease of use

cutting action

release

cleaning/disposal

production cost

material cost

0.6 0.2

0.6 0.12

0.4 0.4

0.4 0.16

0.6 0.24

0.6 0.36

0.6 0.2

0.36

0.36 + 0.12 + 0.12 + 0.16 + 0.24

at any level \( \sum_{i=1}^{n} (\text{absolute weights}) = 1.0 \)

Absolute

for each selection criteria

utf
Step 8: Use the utility function (above) (in the conceptual design process) to select 1-2 feasible concepts for further development (prototyping testing...) (Scale: 1-5 for ranking)

<table>
<thead>
<tr>
<th>Selection Criteria</th>
<th>Absolute Weight</th>
<th>Concept 1 Concept Rating</th>
<th>Concept Utility</th>
<th>Concept 2 Concept Rating</th>
<th>Concept Utility</th>
</tr>
</thead>
<tbody>
<tr>
<td>(cutting) $S_1$</td>
<td>0.36 * 5</td>
<td>1.8</td>
<td>5</td>
<td>1.8</td>
<td></td>
</tr>
<tr>
<td>(release) $S_2$</td>
<td>0.12 * 4</td>
<td>0.48</td>
<td>4</td>
<td>0.48</td>
<td></td>
</tr>
<tr>
<td>(cleaning) $S_3$</td>
<td>0.12 * 4</td>
<td>0.48</td>
<td>2</td>
<td>0.24</td>
<td></td>
</tr>
</tbody>
</table>

$\sum (\text{summation}) = 1.0 \quad \quad (CU)_1 = 4.76 \quad \quad (CU)_2 = 3.32$

**Cumulative Utility**

- Compute the cumulative utility (CU) for each concept
- Rank the design based on the CU
- The higher the CU, the higher the rank