Combining the Resource Consumption Model (RCM) and the Cambridge Engineering Selector (CES) to Analyze Product Design
Product Design and Manufacturing Process Selection

Product Design

Customer

Process Selection

Capacity
Product Life Cycle Cost

$\quad$

100%

80%

60%

Conceptual/preliminary design

Detail design/development

Production and/or construction

Product use/support phaseout/disposal

Committed Cost

Time
Computer-Based Tools

• CAD
• CAE
• CAM
• CAPP

Key to the future: Integration!
• CIM
The Cambridge Engineering Selector

• Materials Selection
• Process Selection
• Originally Chart-based
• Now Computer-based
CES Process Selection Chart
The Resource Consumption Model

- **Cost, Capacity, and Production Time are integrated**
- **Research Model**
RCM Overview

RCM Calculations

Quantity Constraints
Time Constraints
System Constraints

RCM

Resource Parameters
- Cost
  - Resource Cost
  - Salvage Value
  - Repeat Cost
  - Piece Life
  - Quantity Delay

Time
- Time Life
- Time Consumption
- Time Delay

System
- Group ID
- Overlap Percent
- Availability
- Batch or Unit

Alternative 1
- Resource 1
- Resource 2
- Resource 3...
- Resource k

Alternative 2...

Process Design Problem

Alternative j

Cost
- Volume

Time
- Volume

100%
- Volume

Utilization

S

T
RCM Results

Average Part Cost($) vs Production Volume
Proj= Should the tandem or single torch robotic system be purchased? , for Selected Alternatives

Average Part Cost($) vs Production Volume
Proj= P3, Alt= Twin Torch, Selected Resources
An Application of CES and RCM: Shaker Table Design
Methodology – CES
Process Selection

[Diagram showing a chart with various process selection methods and minimum section thicknesses.]
# Manufacturing Process Alternatives for RCM

<table>
<thead>
<tr>
<th>Resource</th>
<th>Machining</th>
<th>Casting</th>
<th>Hot Working</th>
</tr>
</thead>
<tbody>
<tr>
<td>Equipment Cost ($)</td>
<td>200,000</td>
<td>2,000,000</td>
<td>400,000</td>
</tr>
<tr>
<td>Material ($)</td>
<td>30</td>
<td>10</td>
<td>25</td>
</tr>
<tr>
<td>Labor cost ($/hr)</td>
<td>20</td>
<td>100</td>
<td>23</td>
</tr>
<tr>
<td>Fixture cost ($)</td>
<td>20,000</td>
<td>400,000</td>
<td>60,000</td>
</tr>
<tr>
<td>Perishable Tooling Cost ($)</td>
<td>2</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Cycle Time (min)</td>
<td>15</td>
<td>1.5</td>
<td>5</td>
</tr>
</tbody>
</table>
Average Part Cost($) vs Production Volume
Proj= Shaker Table Manufacture, for Selected Alternatives

Average Cost Results
Total Time Results

Total Time (hrs) vs Production Volume
Proj= Shaker Table Manufacture, for Selected Alternatives

- Cast Table
- Machine Table
- Form Table

Production Volume

- 0
- 5000
- 10000
- 15000
- 20000
- 25000
- 30000
- 35000
- 40000
- 45000
- 50000

Total Time (hrs)

- 0
- 5000
- 10000
- 15000
- 20000
- 25000
- 30000
- 35000
- 40000
- 45000
- 50000
Results
Conclusions

• CES and RCM each have unique strengths
• Not a complete solution