Coffee Bean Sorter

Orange Team
Outline

2. Customer
3. Product
4. Distribution
Motivation

- Gourmet size requirement
- Limited processing technology

~17/64”
Customer

As Green as it Gets
Works with a farming cooperative in Guatemala

Maya Pedal
Builds human-powered agricultural tools
Global Market

20-25 million small-scale coffee farmers worldwide
Sorting Methods

Screen Sorting

Drum Sorting
Our Solution
Hopper Design

Challenge:
- Accommodate the average farmer
- Small or large batch loading
Hopper Design

Challenge:

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Bean Paths in Drum

Oversized

Optimal Size

Undersized
Drums

Challenge: Accuracy

- 15 undersized beans per pound
- Dependent on:
  - Feed rate: 230 lb/hour
  - Turning rate: ¼ turn per sec
  - Drum Length: 48 in
  - Drum angle: 1 degree
Collection Bags

Challenge:

- Quick loading and unloading
- Visible throughput
Frame

Challenge:

- Easily manufactured
- No sharp corners
Frame
Benefit Analysis

- 10 times faster
- Annual revenue increase of 10%
- Net Present Value of $800
Cost Analysis

- $205 material costs
- Fabrication costs
  - Estimated 20 hours of labor
  - $36 in labor
- Payoff in 2 months of use
Distribution Scheme

- Building plans
- Field test prototype
- Worldwide dissemination
Questions?
Bean Dynamics and Diameter

Better for sorting

Beans mix rather than bounce

Worse for sorting

Beans bounce and fly

Tumbling helps beans mix between layers

But with too much tumbling, the beans do not contact the drum surface enough to sort
## Results of Testing

<table>
<thead>
<tr>
<th>Design parameter</th>
<th>Improving Accuracy</th>
<th>Improving Rate</th>
</tr>
</thead>
<tbody>
<tr>
<td>Drum diameter</td>
<td>↓</td>
<td>↑</td>
</tr>
<tr>
<td>Drum angle</td>
<td>↓</td>
<td>↑</td>
</tr>
<tr>
<td>Drum length</td>
<td>↑</td>
<td>↓</td>
</tr>
<tr>
<td>Rotation rate</td>
<td>↓</td>
<td>↑</td>
</tr>
<tr>
<td>Hopper feed rate</td>
<td>↓</td>
<td>↑</td>
</tr>
</tbody>
</table>
## Optimization of Drum Dimensions and Rotation Rate

<table>
<thead>
<tr>
<th>Drum angle</th>
<th>Rotation rate rot/sec</th>
<th>Diameter</th>
<th>Length</th>
<th>Total rate lbs/hr</th>
<th>Defect occurrence rate beans/lb</th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td>0.5</td>
<td>big</td>
<td>short</td>
<td>225</td>
<td>327</td>
</tr>
<tr>
<td>2</td>
<td>0.33</td>
<td>big</td>
<td>short</td>
<td>260</td>
<td>130</td>
</tr>
<tr>
<td>2</td>
<td>0.33</td>
<td>big</td>
<td>short</td>
<td>235</td>
<td>96</td>
</tr>
<tr>
<td>2</td>
<td>0.25</td>
<td>big</td>
<td>short</td>
<td>230</td>
<td>66</td>
</tr>
<tr>
<td>2</td>
<td>0.25</td>
<td>small</td>
<td>short</td>
<td>240</td>
<td>47</td>
</tr>
<tr>
<td>2</td>
<td>0.25</td>
<td>small</td>
<td>long</td>
<td>230</td>
<td>20</td>
</tr>
</tbody>
</table>
Sorting Each Bean Type

- Black: Eye
- Pergamino: Size
- Rocks or Twigs: Size
- Cherry: Size
- Genetically Deformed: Eye
# Cost Analysis

<table>
<thead>
<tr>
<th>Material</th>
<th>Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>25 meters Angle Iron</td>
<td>$25</td>
</tr>
<tr>
<td>(2) 4’ x 8’ Sheet Metal</td>
<td>$70</td>
</tr>
<tr>
<td>(1) 4’ x 8’ Screens</td>
<td>$35</td>
</tr>
<tr>
<td>18 tabular feet of 3/4” plywood</td>
<td>$45</td>
</tr>
<tr>
<td>Fasteners</td>
<td>$30</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>$205</strong></td>
</tr>
</tbody>
</table>
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