Mechanical Shredder

Project Proposal

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Overview

• Customer Needs and Requirements Review
• QFD and HOQ assessment
• Decision Matrix Criteria and Concept Designs
• Chosen Design Product and Mechanism Overview
• SolidWorks of Retrofit System
• Bill of materials
Customer Needs Review and Project Goal

- The Customer needs a paper shredder that is completely mechanical, portable, environmentally friendly, and can compete with an electric paper shredder
- The group will be limited to a budget of $100 for our designs and the system has to fit within a $5ft^3$ volume
- Paper shredder must shred 10 sheets per feed, 36 pages/minute, and shred paper, CD’s and Credit Cards
Additional Requirements

- Find an electric paper shredder to purchase and retrofit for project
- Shredder must have option to be wall-mounted, or stand on its own.
- Handle preferably on front face of shredder.
Constraints

- Environmentally friendly with minimum carbon footprint.
- The design cost must be less than $100.00 for fabrication.
- Minimum of 10 sheets per feed.
- Speed: 36 pages/min.
- Paper size: 8.5x11 inches.
- Type of material shredded: Papers, CDs, Credit cards.
- Volume: 5ft³
Testing Environment

• An office that can at least fit a 5ft$^3$ mechanical system, and wall space that system can be attached to

• Data to collect and analyze:
  • Run time
  • Shred Speed
  • Bin capacity
  • Noise level
### Quality Function Deployment (QFD)

#### Engineering Requirements

<table>
<thead>
<tr>
<th>Weight</th>
<th>Volume</th>
<th>Cost</th>
<th>Noise Level</th>
<th>Speed</th>
<th>Pages at a Time</th>
<th>Shred Width</th>
<th>Bin Capacity</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
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<td></td>
<td></td>
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<td></td>
</tr>
</tbody>
</table>

#### Customer Requirements

<table>
<thead>
<tr>
<th>Minimum Carbon Footprint</th>
<th>Reliable</th>
<th>Inexpensive</th>
<th>All Mechanical System</th>
<th>Cost Effective</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>X</td>
<td>X</td>
<td>X</td>
<td></td>
</tr>
</tbody>
</table>

#### Units

<table>
<thead>
<tr>
<th>Units</th>
<th>lbs</th>
<th>ft³</th>
<th>$</th>
<th>db</th>
<th>Pages/Min</th>
<th>x Pages/Iteration</th>
<th>inches</th>
<th>gallons</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>20-25</td>
<td>5</td>
<td>100</td>
<td>65</td>
<td>36</td>
<td>10</td>
<td>0.25</td>
<td>5.25</td>
</tr>
</tbody>
</table>

#### Competitors

<table>
<thead>
<tr>
<th>Competitors</th>
<th>Product 1</th>
<th>Product 2</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>O</td>
<td>O</td>
</tr>
</tbody>
</table>

Source: Meyer
House of Quality (HOQ)

- Weight
- Volume
- Cost
- Noise Level
- Speed
- Pages at a time
- Shred Width
- Bin capacity
Decision Matrix Criteria

Reliability (15%)
Cost Effective (13%)
Materials (Shredded material+10 Pages) (13%)
System Operation (11%)
Volume (9%)
Speed (8%)
Ease of Use (7%)
Stability (6%)
Bin Size (5%)
Shred Width (5%)
Noise Level (4%)
Portable (4%)
Averaged Group Decision Matrix

<table>
<thead>
<tr>
<th>Grade Scale 1-10</th>
<th>Design 1</th>
<th>Design 2</th>
<th>Design 3</th>
<th>Design 4</th>
<th>Design 5</th>
<th>Design 6</th>
<th>Design 7</th>
<th>Design 8</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reliability (15%)</td>
<td>1.2</td>
<td>0.975</td>
<td>1.0875</td>
<td>1.0875</td>
<td>1.0125</td>
<td>1.1625</td>
<td>1.0125</td>
<td>1.0125</td>
</tr>
<tr>
<td>Cost Effective (13%)</td>
<td>0.9425</td>
<td>0.8775</td>
<td>0.8775</td>
<td>0.9425</td>
<td>1.0075</td>
<td>1.04</td>
<td>0.8775</td>
<td>0.91</td>
</tr>
<tr>
<td>Materials (Shredded material+10 Pages) (13%)</td>
<td>1.0075</td>
<td>0.845</td>
<td>0.8775</td>
<td>0.8125</td>
<td>0.845</td>
<td>0.975</td>
<td>1.04</td>
<td>0.715</td>
</tr>
<tr>
<td>System Operation (11%)</td>
<td>0.88</td>
<td>0.825</td>
<td>0.825</td>
<td>0.825</td>
<td>0.825</td>
<td>0.88</td>
<td>0.825</td>
<td>0.6875</td>
</tr>
<tr>
<td>Volume (9%)</td>
<td>0.54</td>
<td>0.7425</td>
<td>0.5625</td>
<td>0.54</td>
<td>0.72</td>
<td>0.6975</td>
<td>0.5175</td>
<td>0.72</td>
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<tr>
<td>Speed (8%)</td>
<td>0.54</td>
<td>0.56</td>
<td>0.52</td>
<td>0.52</td>
<td>0.54</td>
<td>0.56</td>
<td>0.68</td>
<td>0.44</td>
</tr>
<tr>
<td>Ease of Use (7%)</td>
<td>0.6125</td>
<td>0.6125</td>
<td>0.5775</td>
<td>0.5775</td>
<td>0.6125</td>
<td>0.595</td>
<td>0.525</td>
<td>0.4725</td>
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<tr>
<td>Stability (6%)</td>
<td>0.51</td>
<td>0.465</td>
<td>0.465</td>
<td>0.405</td>
<td>0.465</td>
<td>0.45</td>
<td>0.435</td>
<td>0.3</td>
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<tr>
<td>Bin Size (5%)</td>
<td>0.2625</td>
<td>0.375</td>
<td>0.3375</td>
<td>0.325</td>
<td>0.4</td>
<td>0.3875</td>
<td>0.325</td>
<td>0.4</td>
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<tr>
<td>Shred Width (5%)</td>
<td>0.375</td>
<td>0.3625</td>
<td>0.375</td>
<td>0.35</td>
<td>0.3375</td>
<td>0.3625</td>
<td>0.4</td>
<td>0.35</td>
</tr>
<tr>
<td>Noise Level (4%)</td>
<td>0.28</td>
<td>0.29</td>
<td>0.27</td>
<td>0.26</td>
<td>0.29</td>
<td>0.27</td>
<td>0.26</td>
<td>0.24</td>
</tr>
<tr>
<td>Portable (4%)</td>
<td>0.26</td>
<td>0.26</td>
<td>0.24</td>
<td>0.31</td>
<td>0.35</td>
<td>0.34</td>
<td>0.24</td>
<td>0.34</td>
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<tr>
<td>Total:</td>
<td>7.41</td>
<td>7.19</td>
<td>7.015</td>
<td>6.955</td>
<td>7.405</td>
<td>7.72</td>
<td>7.1375</td>
<td>6.5875</td>
</tr>
</tbody>
</table>
Final Concept: Design 1
Final Concept: Design 6
Chosen Product

• AmazonBasics 12-Sheet Cross-Cut Paper, CD, and Credit Card Shredder
• Current Price on Amazon: $54.99
• 8.9 x 12.5 x 15.7 inches System ~1.01 ft$^3$
• 4.8 Gallon Bin
Contained Mechanism
Mechanism Contained Continued
Mechanism CD Shredder
Mechanism Power Source
Gear Assembly
Hand Crank Design
## List of Parts and Prices

<table>
<thead>
<tr>
<th>Parts</th>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>AmazonBasics 12-Sheet Cross-Cut Paper, CD, and Credit Card Shredder</td>
<td>$54.99</td>
</tr>
<tr>
<td>Steel Ball Bearings</td>
<td>~$6.00 each*</td>
</tr>
<tr>
<td>Steel Spur Gear</td>
<td>~$25.00**</td>
</tr>
<tr>
<td>1 Aluminum Crank Handle</td>
<td>~$20.00*</td>
</tr>
<tr>
<td>1 3/8” Diameter Hardened Shaft</td>
<td>$4.45</td>
</tr>
<tr>
<td><strong>Total:</strong></td>
<td><strong>$116.44</strong></td>
</tr>
</tbody>
</table>

*Estimated prices for components from McMaster.com [2]
**Could acquire as custom gear
Conclusion

- The team was given the task to retrofit a mechanical paper shredder from an electric paper shredder and construct a design to do so.
- We propose retrofitting the paper shredder with a hand-crank by installing a custom gear into the unit.
- The paper shredder will still be as effective as an electric paper shredder
References
