**Background/Problem:**
John Deere's current grain testing procedure used in the field during combine testing is time consuming. The method involves weighing a 250 gram sample of grain and remove the fines using a 12/64 inch sieve. After cleaning, a timer is set for 10 minutes to sort out the damaged grain on a flat metal pan. The overall process is limiting to field testing.

**Goals:**
- Cut testing time in half while maintaining accuracy
- Automate the sorting process
- Must remain portable

**Alternative Solutions:**
- **Initial Options Considered**
  - Camera Sorters
  - Seed Dye (Manual Sorting)
  - Seed Dye (Automated Sorting)
  - Infrared light Sorting

- **Final Solution**
  - John Deere seed meter singulates kernels onto conveyor belt where it is sorted manually, separating the damaged and whole grain

**Final Design:**
- Electric motor mounted to steel frame
- Motor Speed is adjustable from 0-10 rpm
- Meter mounts to frame above conveyor belt
- Seed dropped through 3D printed chute
- Adjustable belt speed: 0-80 ft/min
- 3D printed splitter divides damaged and whole kernels

**Cost Analysis**
<table>
<thead>
<tr>
<th>Item</th>
<th>Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>Seed Meter (Donated by John Deere)</td>
<td>$ -</td>
</tr>
<tr>
<td>Frame (Donated by Purdue ABE)</td>
<td>$ -</td>
</tr>
<tr>
<td>3D Printed Parts (Donated by Purdue ABE)</td>
<td>$ -</td>
</tr>
<tr>
<td>Conveyor Belt</td>
<td>$1,300.00</td>
</tr>
<tr>
<td>Vacuum</td>
<td>$20.00</td>
</tr>
<tr>
<td>Miscellaneous Parts</td>
<td>$25.00</td>
</tr>
</tbody>
</table>

**Total** $1,345.00

**Performance Evaluation:**
- 3 tests were performed on 3 different 250g samples with known damage
- The known damage was found by using the seed dye method in a lab setting, making it highly accurate
- Automated grain sorting test results were very consistent, but were only a fraction of the known damage because John Deere’s criteria for damage is less stringent than the lab criteria

- This graph represents an estimated testing time in minutes for various motor speeds for a 250 gram sample
- Determined by fitting a trend line to known testing times and known motor speeds from the various tests performed
- Motor speed is the number one factor that determines testing time

**Impact and Future Possibilities:**
- Singulation resulted in increased accuracy
- Reduced testing time increases the amount of tests performed per work day
- This will lead to additional and improved data, resulting in enhanced John Deere combine performance analysis.
- Possibility of complete automation with this design by adding camera sorting. Elimination of human error with better accuracy

**Unsolved Issues/Improvements:**
- Approximately 40-50 grams of samples were not picked up by the meter plate
- Chute design could be improved to achieve better seed placement on conveyor belt
- Mechanism to orient kernels in the same direction would increase accuracy
- More permanent solution for seed chute flap to slow seeds coming from the meter