

- P11008-

ArcWorks Straw Cutting Device AND Process Improvement



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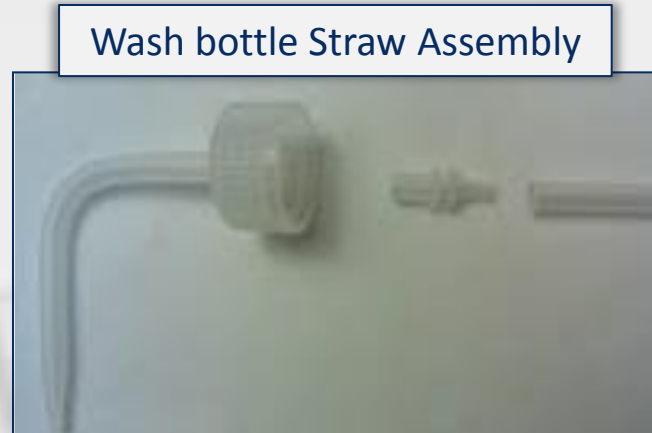
Mission Statement: Design, build, and deliver a functional straw cutting device which ArcWorks would utilize in their wash bottle assembly production process.

Motivation: The current machine used in the production process at ArcWorks is not 100% reliable. With the addition of a more reliable machine, throughput and efficiency can be increased.

Background: ArcWorks is a subsidiary of Arc of Monroe that provides jobs to individuals within the developmentally disabled community. This straw cutting device will be used by high functioning operators and will provide another opportunity for them to perform a specialized task.

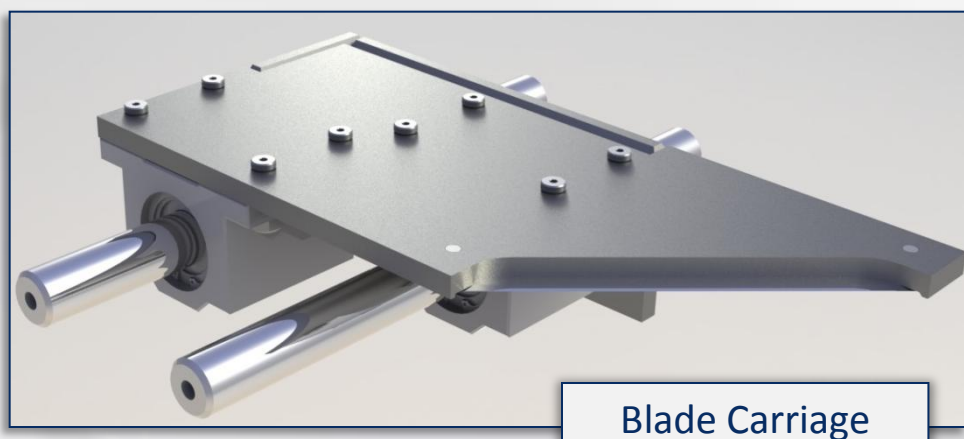
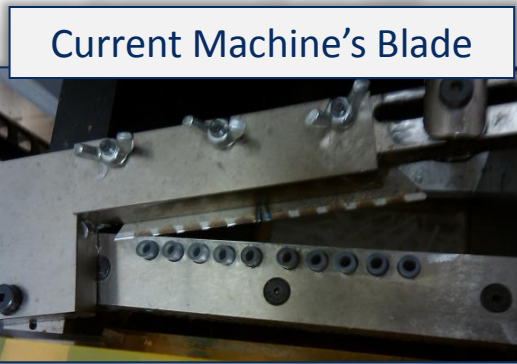
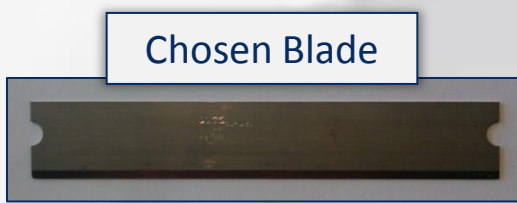
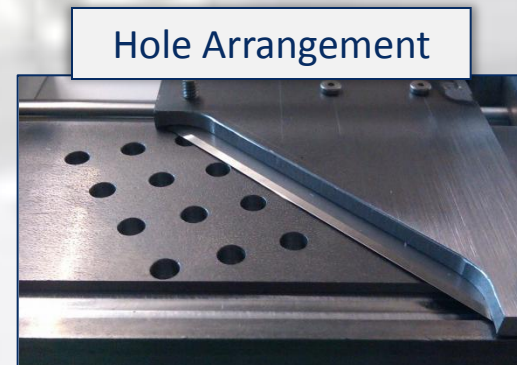
Customer Needs

- Increase Productivity
- Safety of Machine
- Minimize Physical Exertion
- Reduce Downtime
- Complete through cut of straws on first actuation with no deformation
- Straws must lie within desired length tolerance.
- Minimal debris left in work area
- Inexpensive replacement parts
- Utilize cost effective blades.



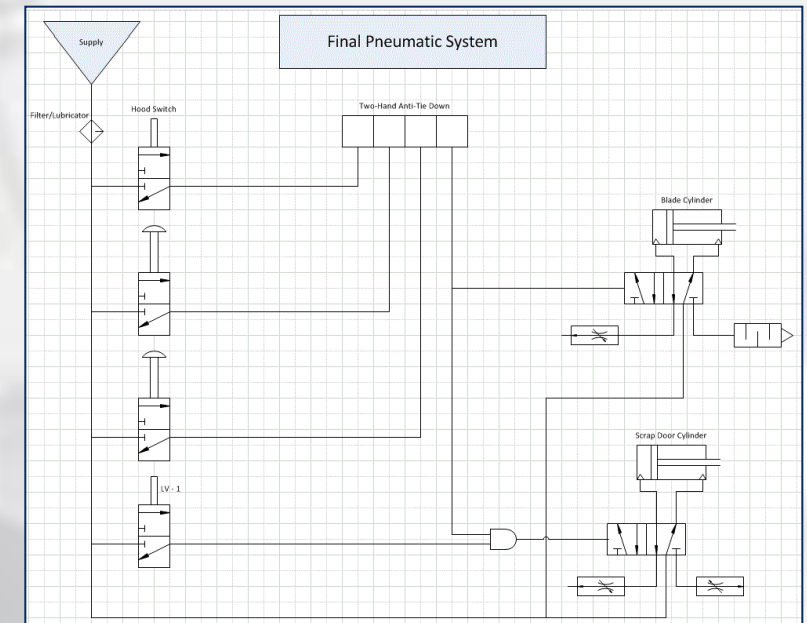
Straw Cutting

- 45° cut angle to optimize blade properties
- 12 straw capacity per cut
- Holes offset to maximize blade utilization and facilitate one cut initiation at a time
- Single robust blade for improved service life
- Quick blade change design
- Full blade travel across holes to ensure all straws are cut



Pneumatic System

- The machine is a simple plug and play design. All that is necessary for operation is standard 100psi compressed air. The pneumatic schematic is pictured to the right.
- A 300 pound-force pneumatic cylinder with a 3 inch stroke was chosen to drive the blade carriage forward
- A 12 pound-force 1 inch stroke cylinder controls the trap door



Safety System

- A Two Hand Anti-Tie Down Switch is used to trigger the pneumatics
- A mechanical switch is integrated which requires the lid to be closed for the system to become operable
- Acrylic shielding to protect from debris



Design

- Extensive model design and feasibility testing was done using SolidWorks CAD software in an attempt to eliminate manufacturing setbacks
- Virtual machine design and construction revealed a great deal of fundamental initial design issues, and furthermore facilitated many otherwise unobtainable design features that can be seen in the final product

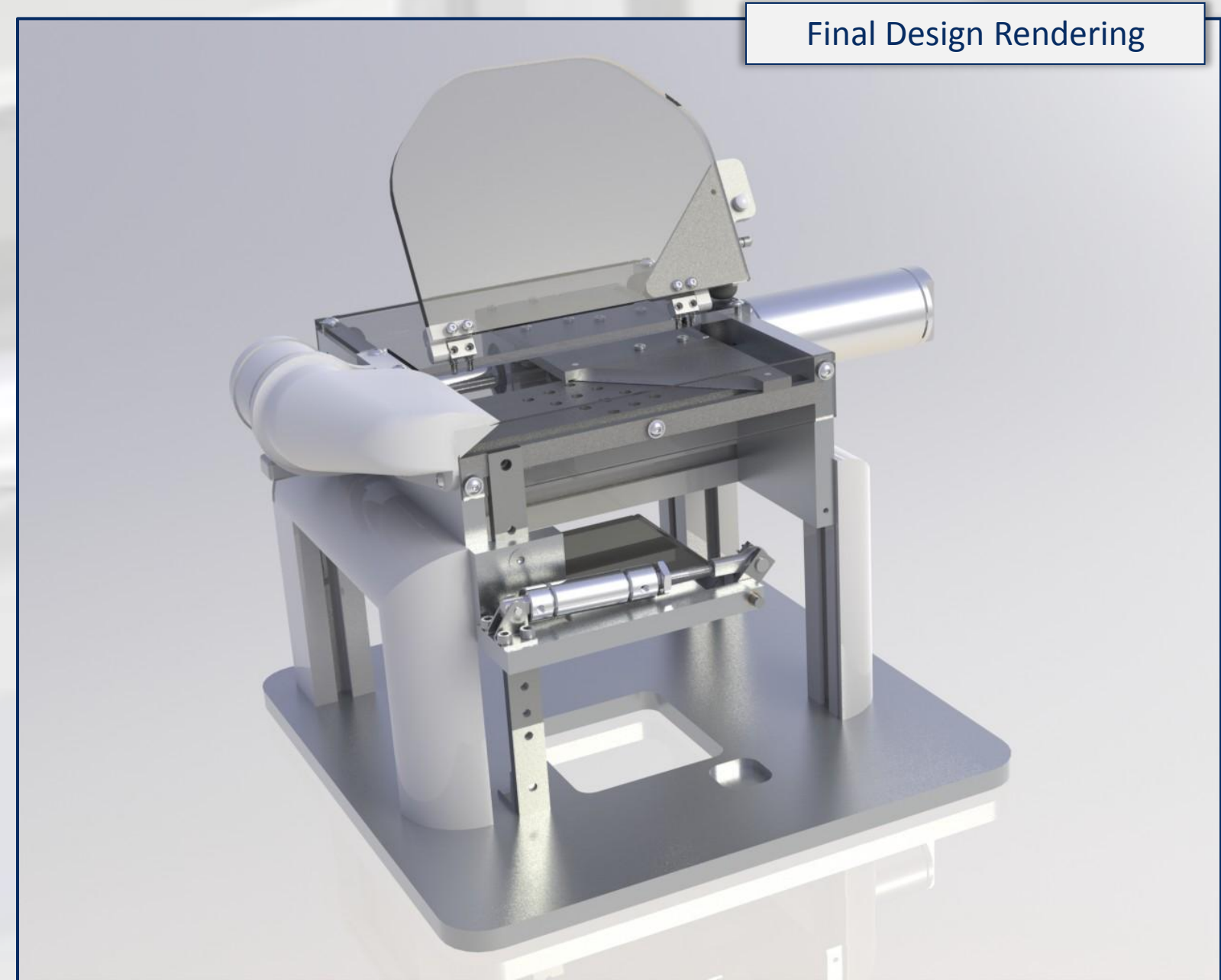
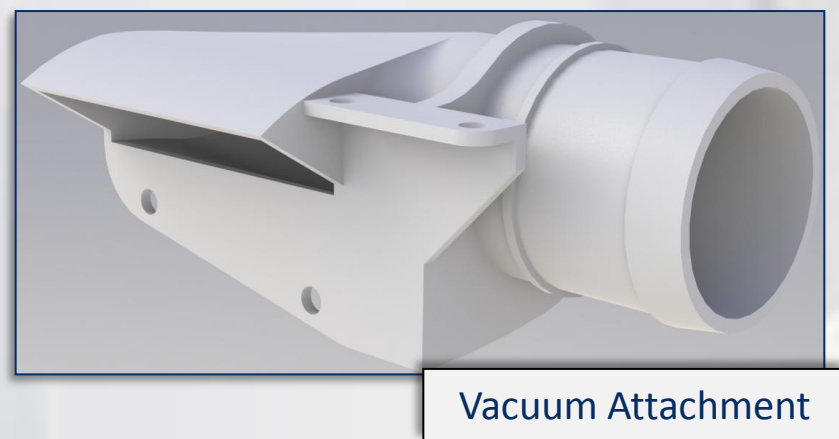
Length Adjustment & Trap Door

- Work in conjunction with each other in same Sub-Assembly.
- Trap door actuated by switch when the blade carriage reaches end of stroke. Once this switch is hit the straws will fall down into a collection bin located under the table.
- System design allows the operator or supervisor to unscrew a bolt, and slide the trap door assembly up or down to one of 9 different straw length settings.



Debris Removal

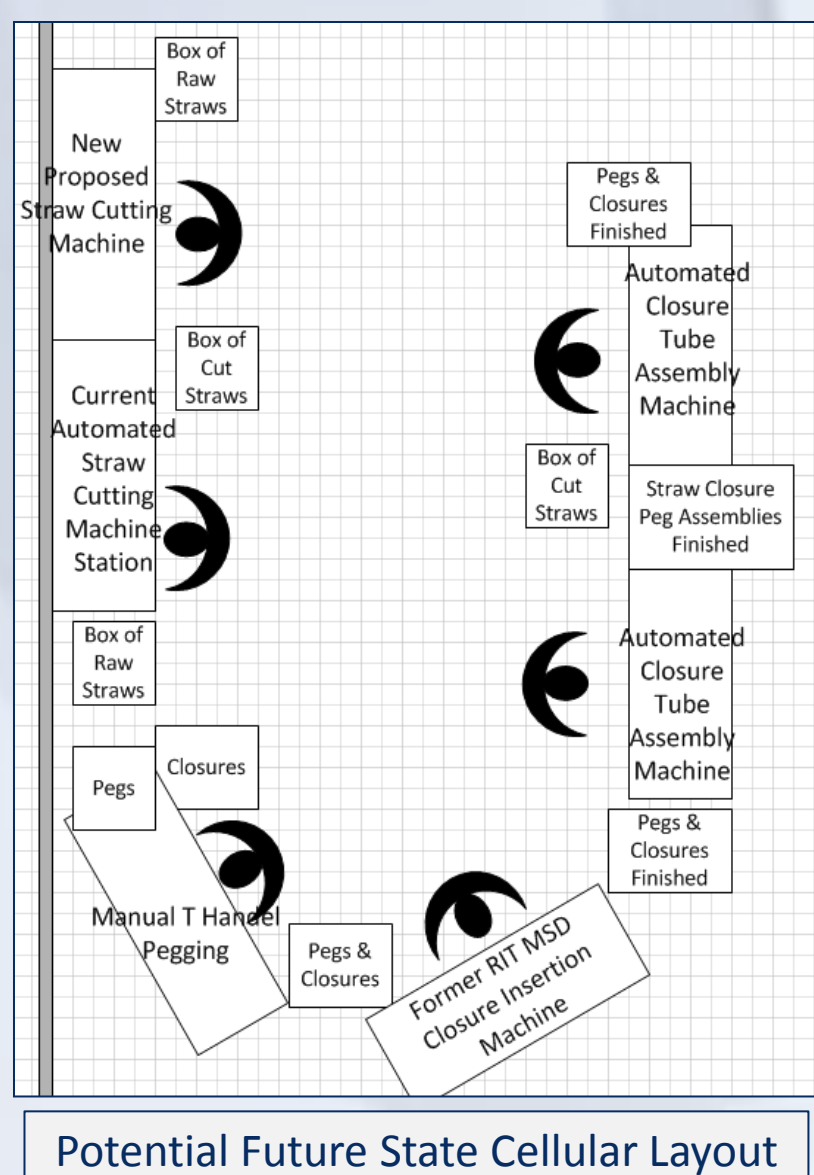
- A 2.5 inch shop vacuum attachment was designed to facilitate removal of scrap material
- Part rapid prototyped in house



*All model design and image renderings done using SolidWorks 2010

Process Improvement

- Efficiency & Throughput
- Inventory Reduction
- Warehouse Management
- Layout
- Process Capability



Testing & Results

- Preliminary tests were completed to test the functionality of the Pneumatic System.
- The Straw Cutting System also went through preliminary testing to test the quality of the cut.
- Once these systems were verified and the mechanical structure was completed the device was tested to determine the actual production rate.
- The table below illustrates the current proposed and actual production rate which can be reached.

Production Rate	Straw Holes	Straws/ Hr	Cuts/Hr	Cuts/min	Sec/Group Cut	Straws/Day	Days to Fill Box	Days to make Safety
Current Device	10	700	70	1.17	51.43	3500	1.43	14.29
New Device Predicted	12	1000	83	1.39	43.20	5000	1.00	10.00
New Device Actual Tested	12	1440	120	2.00	30.00	7200	0.69	6.94
Current + Actual	22	2140	190	3.17	18.95	10700	0.47	4.67

Assumptions
Hours/Day=5
Box= 5,000 Straws
Safety Stock=50,000 straws
Loading/ Unloading is included

Recommendations

- To increase efficiency a loading device could be used to reduce loading time.
- The Trap Door and Length Adjustment Systems should be tested more thoroughly.

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