Automated Capsule Assembly System

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About Controls Corporation of America

World leader in precision gas control manufacturing
- Industries: environmental, medical, aerospace, petrochemical, etc.

Manufactures torches, medical devices, cryogenic systems, welding systems, laser gas systems, and gas systems.

Located in Virginia Beach, VA

Opportunity Statement

Design an **automated** system that allows for the **redistribution of labor** and **increases productivity.**

Current System

Operator stacks parts and places it in a semi automated system.

7 rotations, 6 seconds per rotation	6 stations, 30 seconds per station	Stacking duration	**Assembly Time for 1st capsule**
42 s	**180 s**	**17.4 s**	**239.4 s**

After the first capsule, each capsule will take 36 seconds.

67.88 min

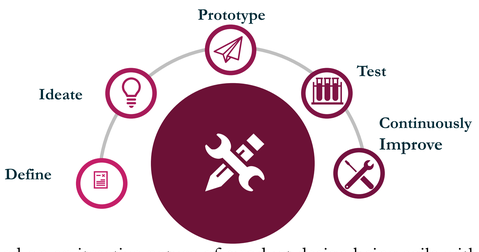
Operator Time for 400 Capsules

Goals

Aimed to achieve the following with our system design.

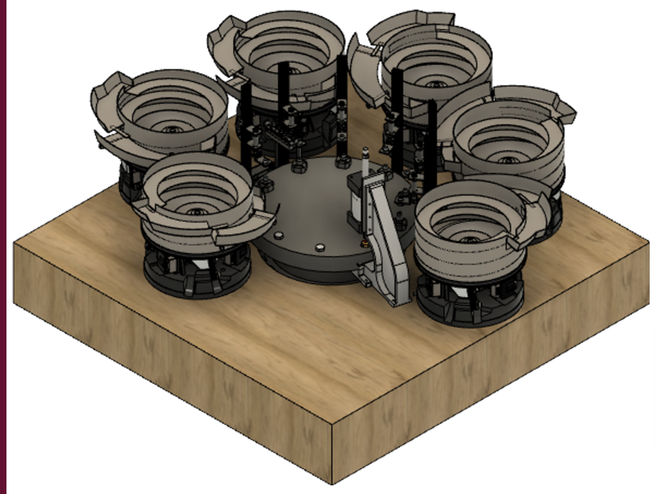
- Automate stacking and assembly process
- Reduce operator's overall interaction time with system
- Maintain the precision and accuracy of stacking and crimping
- Create a system that can be scaled

Design Methodology



Focused on an iterative nature of product design being agile with client

Automated Capsule Assembly System (ACAS)



10 Stations

$150,000 Cost to Build

12.83 min Operator Time for 400 Capsules

COVID-19 Impact

Switched from a cost-efficient and prototypal design to a reliable system design that is less cost constrained.

Specifications of Subsystems

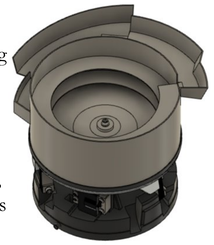
Rotary Table & Controls

As a core sub-system the rotary table is a gear box and stepper motor system.

The table along with all other subsystems are controlled through an Arduino Mega 2560 that manages the functionality of the table.

Vibrator Bowls

The vibratory feeder bowl subsystem is responsible for feeding the components into the funnels.

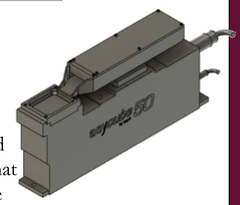


The vibratory bowl takes the components, separates them, orients them properly and feeds them down a tube and into the funnel.

Volume = $2\pi^2 Rr^2$
R = outer radius
r = inner radius

Asycube 50

The Asycube subsystem is responsible for orienting the seat.



The seats are dumped in a 3d printed tray that has divots to hold the seats. The Asycube vibrates the tray and senses the orientation. This process continues until the seats are in the correct orientation.

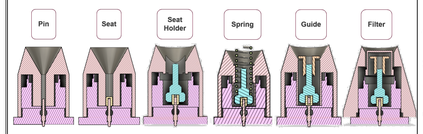
Volume = $2\pi^2 Rr^2$
R = outer radius
r = inner radius

Linear Actuation System

The linear actuation system facilitates the process of stacking the parts of the capsule.

Through a pneumatic actuator, the funnels are lowered to accurately stack the corresponding part, and then raised back to its original position.

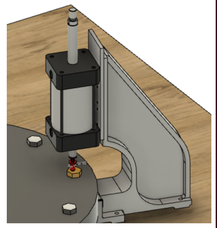
Funnels



Manufactured through 3D printing or lathing, the funnels are a critical sub-system of ACAS. Once lowered onto the dies, components are placed into the funnels to stack into the nozzle. The funnels are capable of maintain the stacked shaped even when lifted from the assembly.

Crimping

The crimping subsystem is responsible for crimping the capsule.



The press is lowered and applies a pressure of 80psi on the capsule. The die at the end crimps the capsule.

Impact

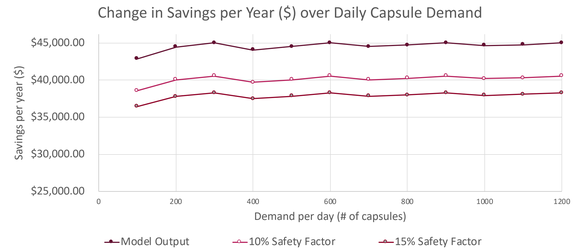
$37,493.50

Annual Savings

81.1% Labor Time Reduction

4.00 Years to ROI

The figures above were calculated using the client's average demand of 400 daily capsules and account for a 15% Safety Factor.



The graph above shows the increasing yearly savings produced by the implementation of ACAS. The system's adaptability allows for this additional benefit with increased demand.

Deliverables

- CAD Drawings and additional files for the final ACAS Design
- Bill of Materials with costs and sourcing of each component of the system
- Mathematical Model Excel File with interactive input parameters to quantify their effects on ROI and overall benefit

Next Steps

- Purchase items listed in Bill of Materials from suggested vendors and manufacture a benchtop prototype
- Test benchtop prototype and compare to the predicted performance measures
- Improve system design iteratively until it meets the specified technical requirements.