



# Capacitor Assembly Automation



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3/30/2017



# Outline

- Introduction and Background Information
- Product Specs
- Problem Statement/Goal Statement
- Current Process
- Improved Process with Updated Operations
- Time Improvements
- Proposed Floor Layout
- Progress Updates, Gantt Chart/Future Work
- Budget Report

# Introduction and Background Information

- Unison Industries
  - Subsidiary of GE
  - Special in electrical components for jet engines, ignition systems and generators
  - 80% of jet engines are installed with ignition systems produced by Unison Industries
- Capacitor Manufacturing Automation
  - Making a manual process automated in order to reduce assembly time
- Options of fully automatic versus semi automatic
  - Fully automatic requires no operator
  - Semi automatic requires some use of the operator

# Product Specs

- 4 individual sections
  - Layer of insulation paper and double sided tape in between
- Insulation material wrapped around whole assembly
- Maximum dimensions: 4.25"H x 2.6"L x 1.38"W

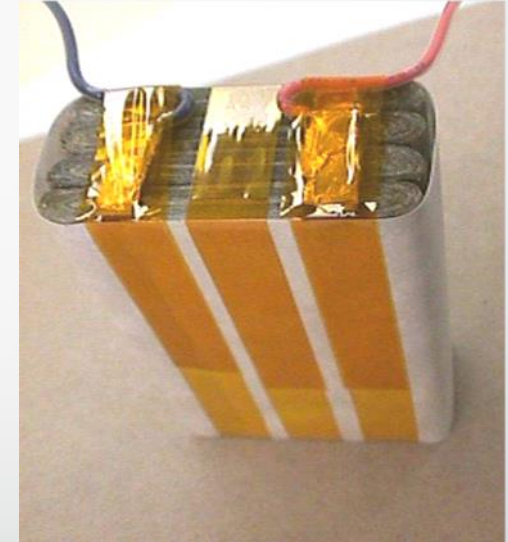


Figure 1



Figure 2

# Problem Statement/ Project Goal

## Problem Statement

- The current process of assembling capacitors takes approximately 27 min
  - The goal is to reduce this time to 15 min
- The assembly process has multiple steps involved
- Each step has been analyzed in order to choose the best ones to improve with either automation or a new manual process

## Project Goal

- Goal Statement: To reduce overall assembly time by adding some automation and updating some of the current manual processes

# Current Manual Assembly Steps

1. Select 4 capacitor sections and attach clipped tabs together and verify capacitance is within range. If not select different capacitors to meet capacitance range
2. Cut a piece of tape and place between each capacitor section. The clipped tabs must line up on one side. (Form capacitor tabs and solder)
3. Attach and solder wire to clipped tabs and wire to unclipped tabs
4. Assemble sleeving wires
5. Assemble tape over both soldered tabs
6. Form safety loop in both wires shown

# Current Manual Assembly Steps Con't

7. Wrap a piece of insulation around sides of pack

8. Secure insulation and wires in place using Tape

9. Final Inspection

A. Using verniers, check the following dimensions:

a. 4.25" max, 1.38" max, 2.60" max

B. Visually inspect the following:

a) Correct and complete assembly

b) Damage to wires or assembly

# Updated Assembly Process

## Tape Rolling

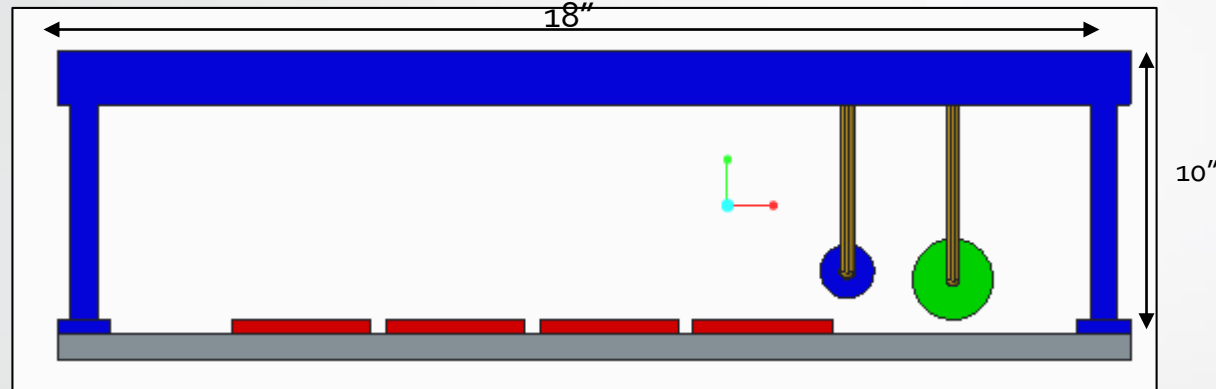


Figure 3

- Powered by motor
- Tape (blue) rolls onto individual capacitors
  - Roller (green) rolls behind the tape to ensure tape sticks
- Saves time by:
  - Reducing number of times the layer on the tape needs to be pulled back
  - Guided slots make the cutting process easier and more efficient



# Tape Rolling Con't

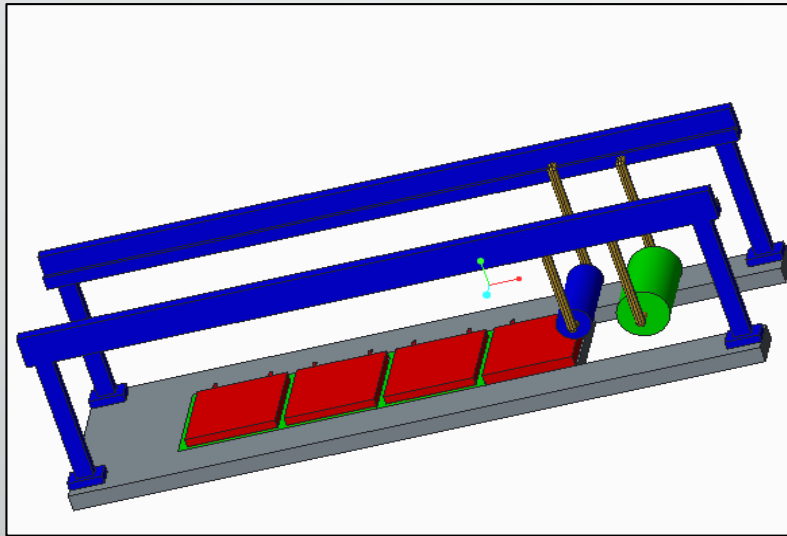


Figure 4

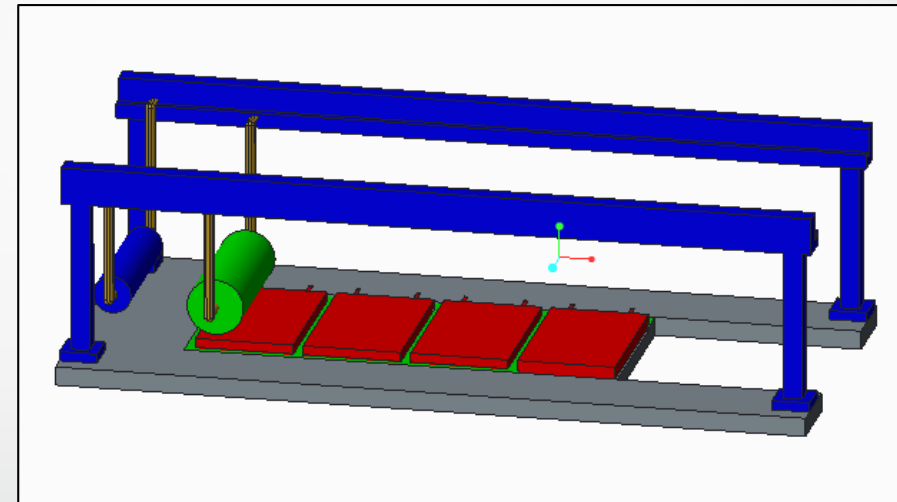


Figure 5

- After tape is placed on capacitors, operator will peel back sealing layer
- After this, the operator will cut the tape in between the sections
  - Scissors will be guided by grooves in the plate

# Tape Rolling to Stacking

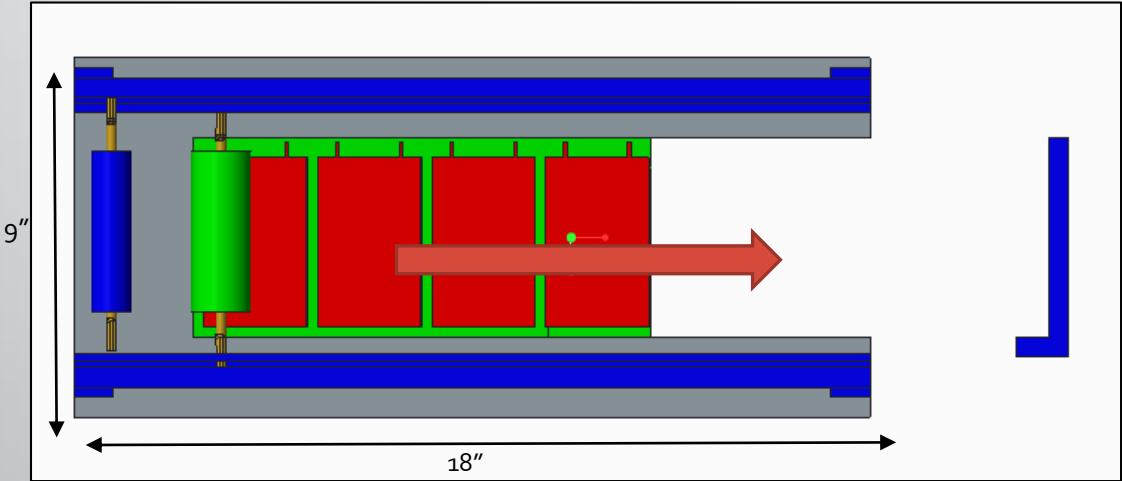


Figure 6

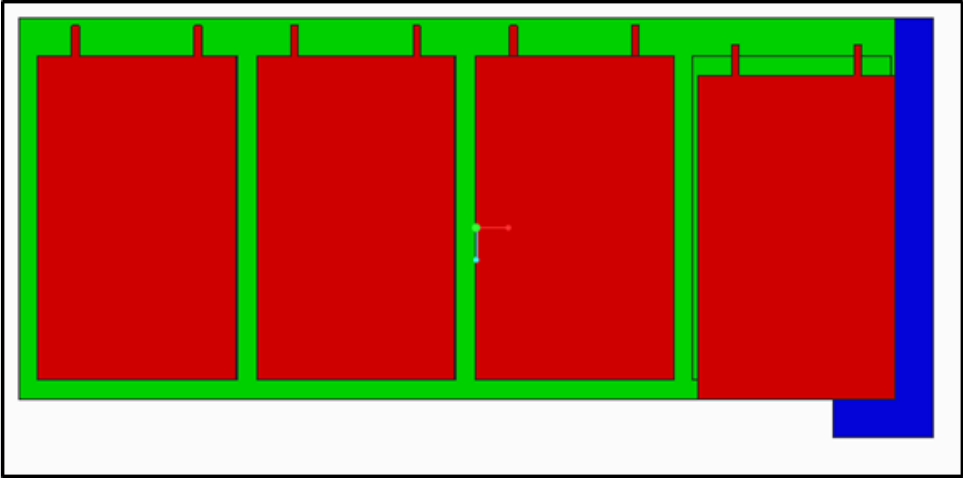


Figure 7

# Stacking

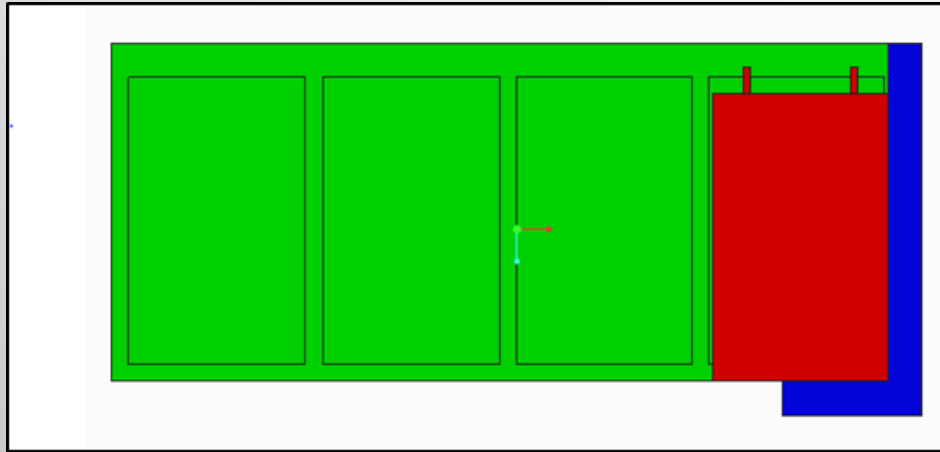


Figure 8

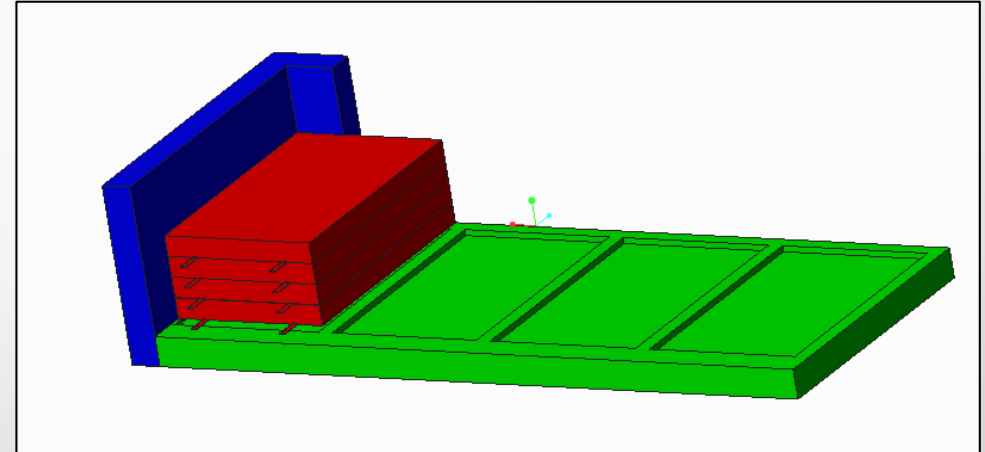


Figure 9

- L-Gauge will guide the stacking of the capacitors
- Saves time by making the capacitors easier to align

## Stacking to Soldering/Attaching Lead Wire

- After stacking, the operator will move the capacitor to the next work station
- At this work station, a second operator will began soldering the tabs, attaching lead wires and forming the safety loops
  - These are intricate processes and will not be updated

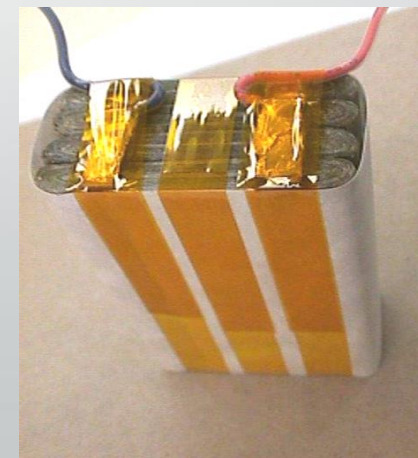


Figure 10

## Soldering/Attaching Lead Wire to Insulation Paper Wrapping

- After soldering, operator will bring the capacitor to the next work station
- The next operator will then load the capacitor into the paper wrapping machine to begin that process

# Paper Wrapping/Tape Wrapping

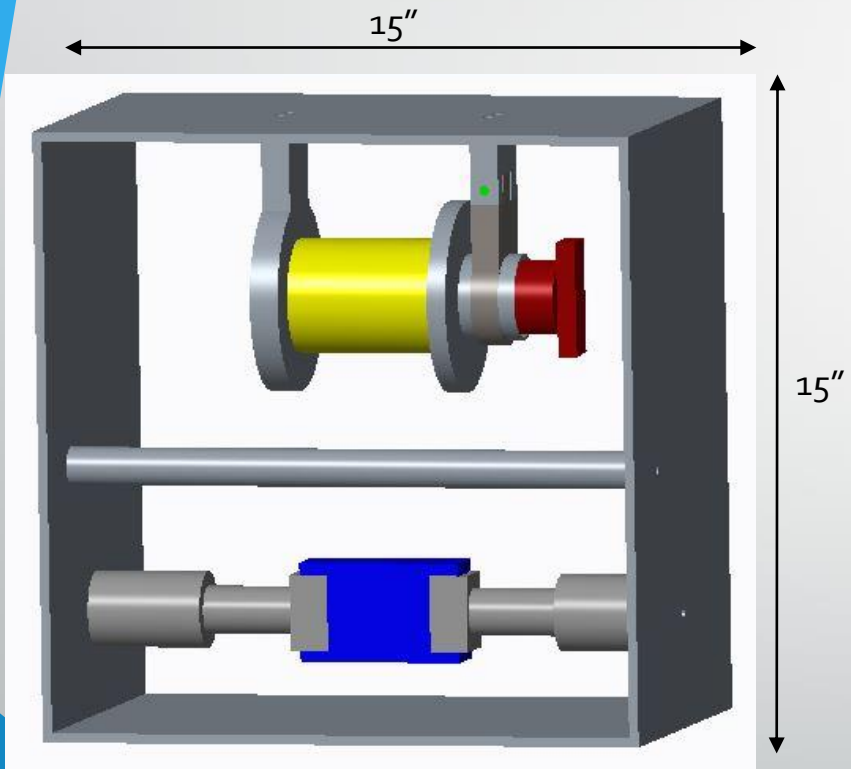


Figure 11

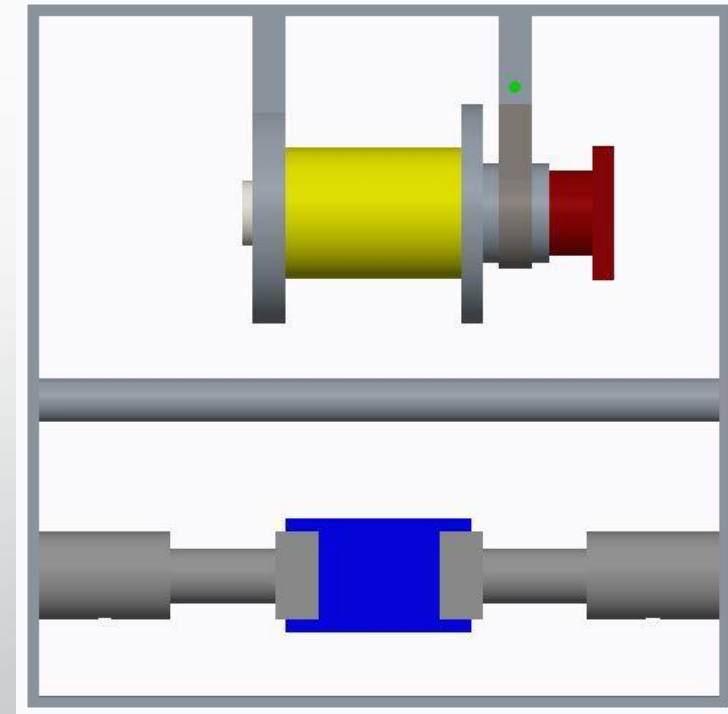


Figure 12

# Paper Roll

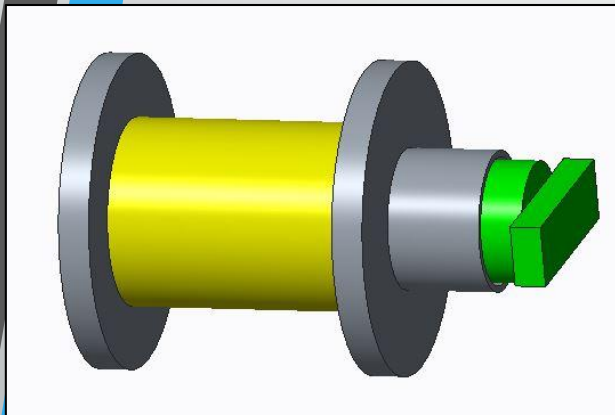


Figure 13

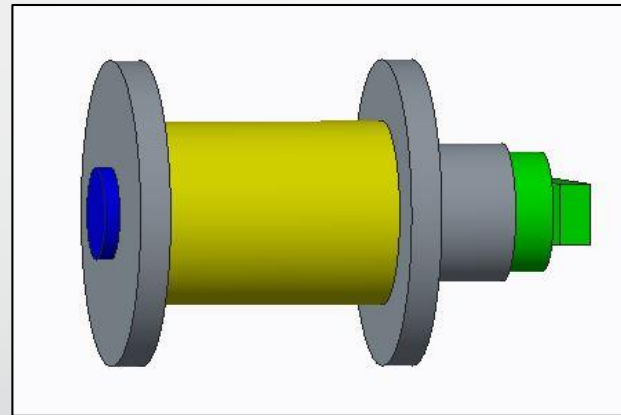


Figure 14

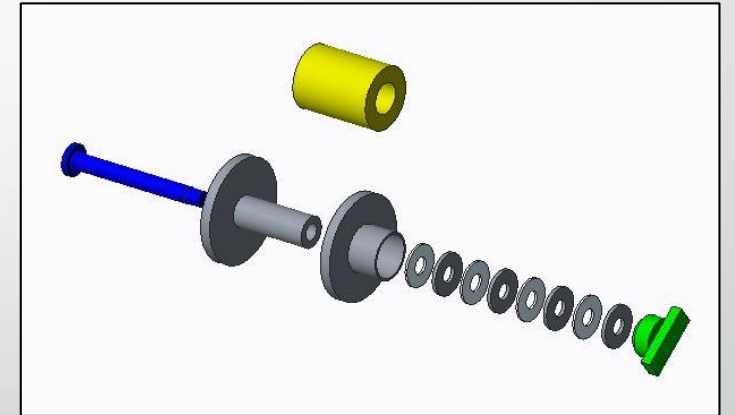


Figure 15

# Paper Wrapping to Dimension Check

- Immediately after wrapping the paper and tape, the operator will unload the capacitor and place it into the gauge block for the final dimensional check
  - Maximum dimensions are 1.38" x 2.60" x 4.25"
- Saves time by checking all dimensions at once

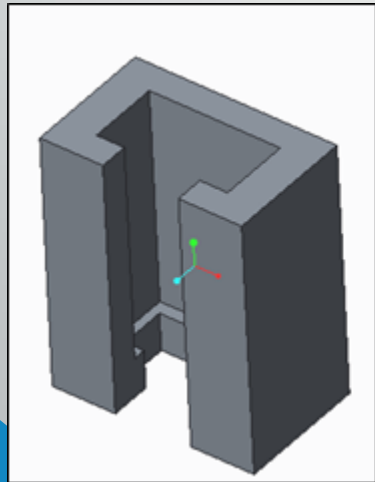


Figure 16

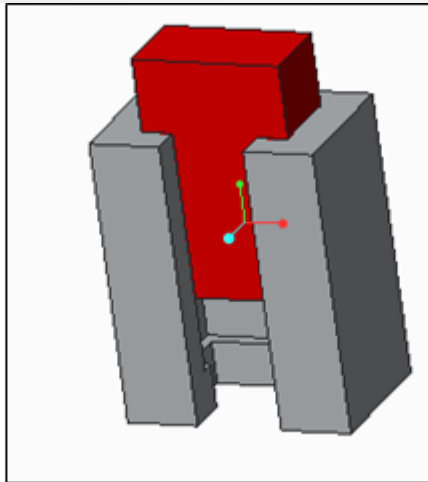


Figure 17

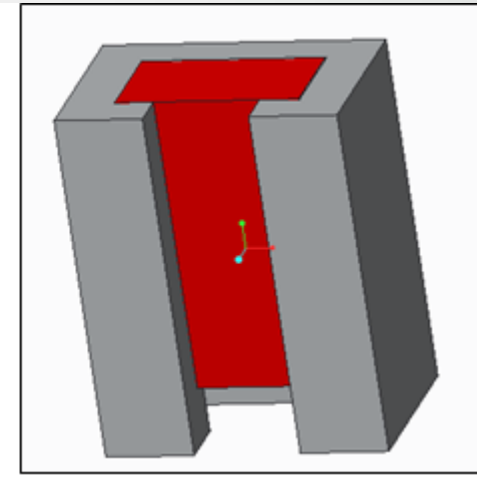


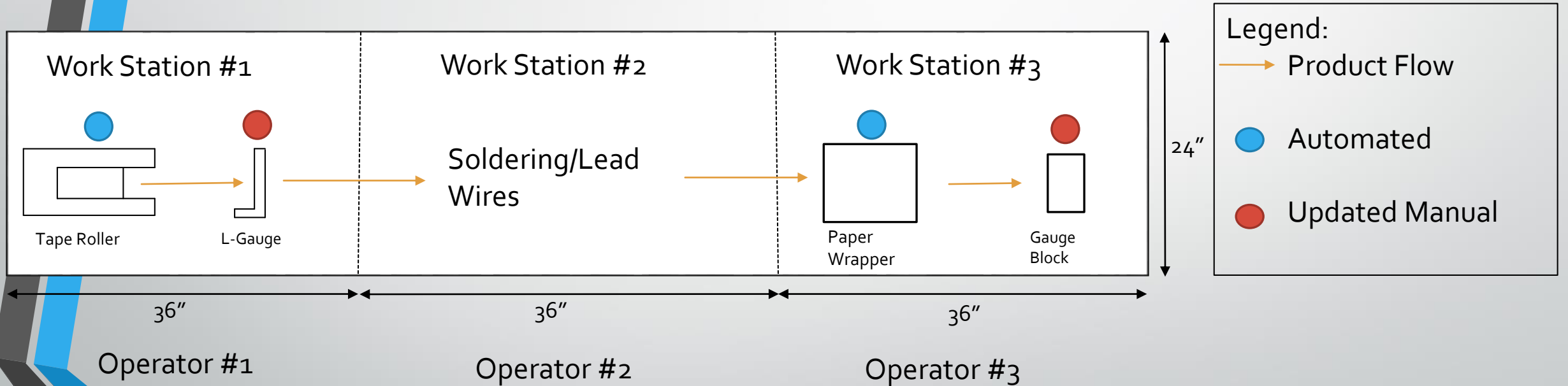
Figure 18



# Estimated Times

Assembly Step	Current Time	Improved Time
Tape Roller	2 min 15 sec	35 sec
Stacking	25 sec	12 sec
Paper Wrapping	2 min 50 sec	1 min 25 sec
Dimension Check	1 min 4 sec	15 sec

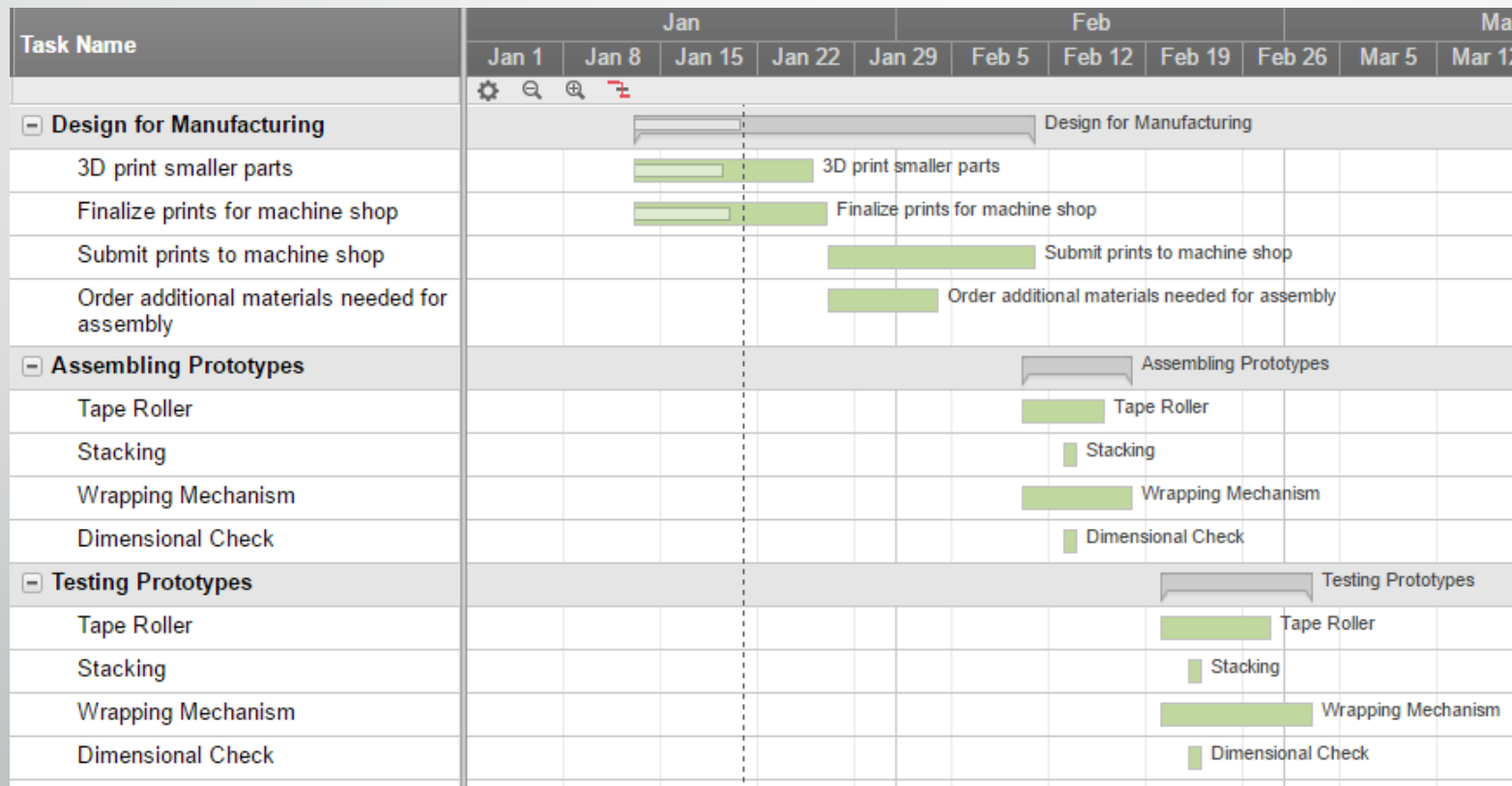
# Proposed Lean Floor Layout



# Progress Updates

- Assembly for the tape roller has begun
- L-Gauge and Block Gauge have been created and are ready for use
- Parts for the paper wrapping device are still in the shop

# Gantt Chart



# Future Work

## Pre-Completion

- Finish assembling prototypes for tape roller and wrapping design
  - Test prototypes
- Make any last minute changes
- Prepare for final presentation

## Post Completion

- Add motors to tape roller and wrapping design
- Possibly automate the stacking design with a robot
- Update the remaining assembly steps

# Current Budget Report

Item	Cost
Guide Rails	\$89
Track Rollers	\$63.84
Posts	\$18.84
Tape	\$37.15
Base Plate	\$144.20
Paper Roll Washers	\$64.81
Aluminum Bars	\$35.67
Aluminum Rods	\$42.31
<b>Total</b>	<b>\$495.82</b>
<b>Remaining</b>	<b>\$1504.18</b>

# Summary

- Designs have been completed
  - Parts are either finished or currently in the shop
- All 4 designs have reduced assembly time during simulation tests
  - Prototype testing has begun for tape roller, L-gauge and the gauge block
- A floor layout has been created to ensure a lean manufacturing process
- The next steps are to finish building and testing the prototypes

# References

- **Kevin Walker, Assembly Steps Handout**





Questions?