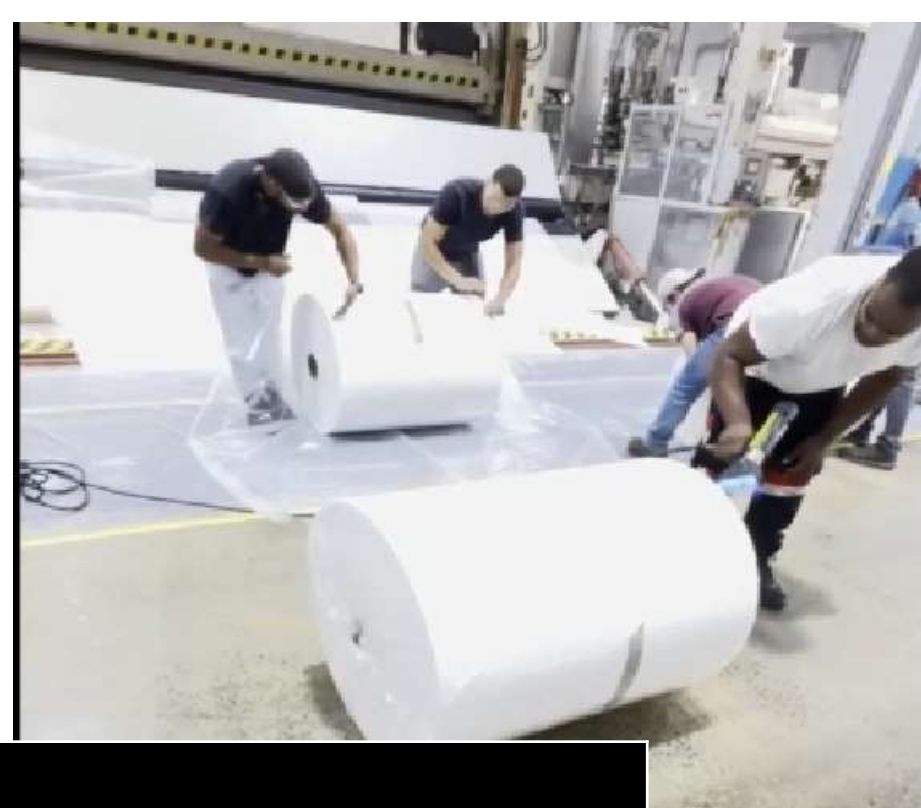


## PROBLEM Statement

Currently Freudenberg wants to address a step in the manufacturing process, this step is wrapping the material once it is produced. This process is a time-consuming manual process. Freudenberg wants to implement a solution that would turn it from a manual to an automated process. This is to reduce the time-cost of the wrapping process and optimize this step with minimal human interaction.



## REQUIREMENTS

#	Description
1	The machine must be able to wrap the maximum diameter roll. (46 inches)
2	The machine must be able to wrap the maximum length of roll (205 inches)
3	The machine is capable of tightly sealing the roll.
4	The machine must be able to punch a hole for the inner roll (core is supported)

## CONCEPTS

- While doing the machine research we found several machine that did not fit the required specification, so the team stayed away from machine with those features.



### Turntable wrapping machine

- Not able to accommodate all roll sizes
- Not beneficial to have centralized

### Farbal: Automatic Wrapping Machine

- Machine includes heating tunnel



## FINAL DESIGN, APPROACH, PLAN

- We began with extensive research on the market
- We coordinated with vendors and Freudenberg to present our findings and proposals
- We narrowed the research down to three machine options
- We analyzed different aspects of the project where cost and time savings were present to assist with our proposal

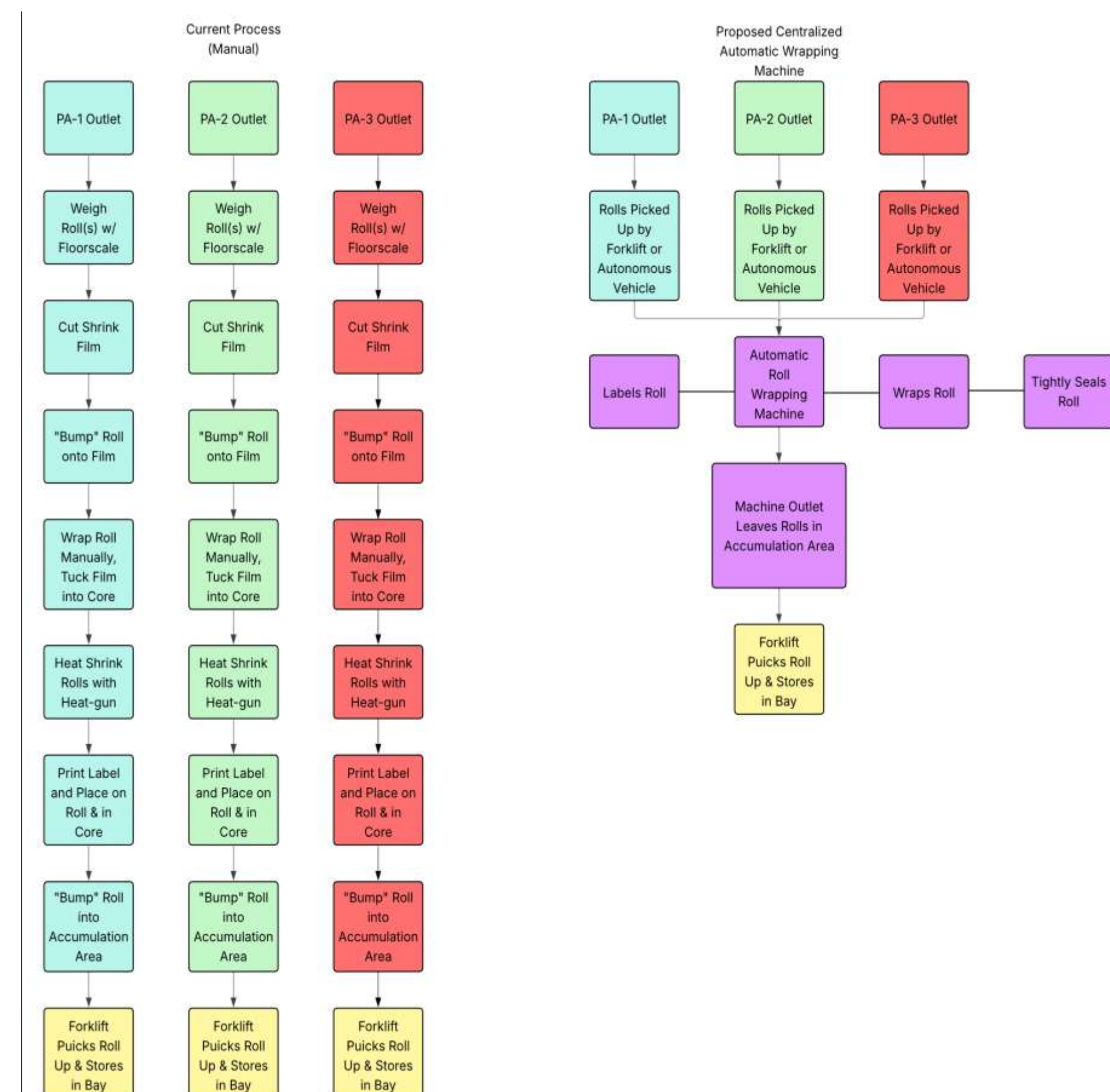


Figure 1. Process Stream

The potential for time savings is visualized in the process stream as our proposed centralized system significantly reduces the actions performed. This led us to the analysis of logistics behind where to put the machine

### Time and Distance Calculation for Machine Location

	A	B	C	D	E	F	G
1							
2		Units		Units	Total Shifts	Total Work Hours for 2 shift	
3	Fork Truck Speed	4.00 MPH		506,880.00 FT-Day	2.00	24.00	
4							
5	Machine	Cycle time per Roll	Units	# slits	Winding Time	Units	
6	PA1	7.50 Minutes		4.00	30.00 Minutes		
7	PA2	7.50 Minutes		4.00	30.00 Minutes		
8	PA3	3.00 Minutes		5.00	15.00 Minutes		
9							
10		Total Trips in 1 Hour and 24 Hours			Total Trips in One Hour	Total Trips Over 24 Hours	
11	Machine	Winding Time	Units	Total Minutes in One Hour	60.00 Minutes	2.00	48.00
12	PA1	30.00 Minutes		60.00 Minutes	2.00	48.00	
13	PA2	30.00 Minutes		60.00 Minutes	2.00	48.00	
14	PA3	15.00 Minutes		60.00 Minutes	4.00	96.00	
15							
16		Distance To and From Wrap Machine and Time Taken					
17	Machine	Distance To and From	Units	number of trips in 24 Hours	Units		
18	PA1	606.40 Feet		29,107.20 Feet			
19	PA2	358.16 Feet		17,191.68 Feet			
20	PA3	219.50 Feet		21,072.00 Feet			
21	Total Distance Covered by Fork truck in one trip then in a 24 Hour Shift	1,184.06 Feet		67,370.88 Feet			
22	Total Time Taken to Cover all Distance			0.13 Days		3.19 Hours	

Figure 2. Distance Calculation and time of travel.

### Proposed Machine Locations A, B, and C and spaghetti Diagram

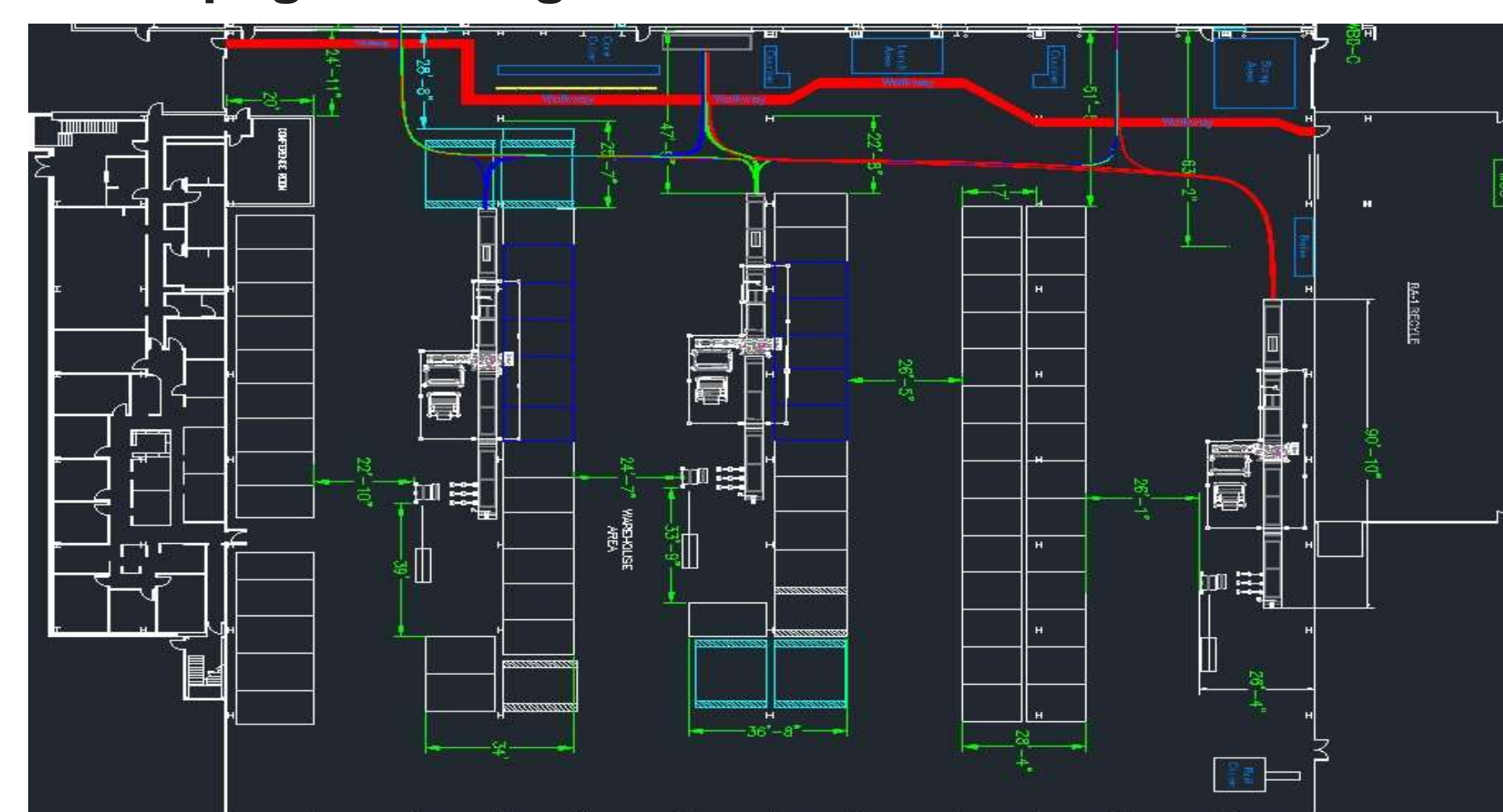
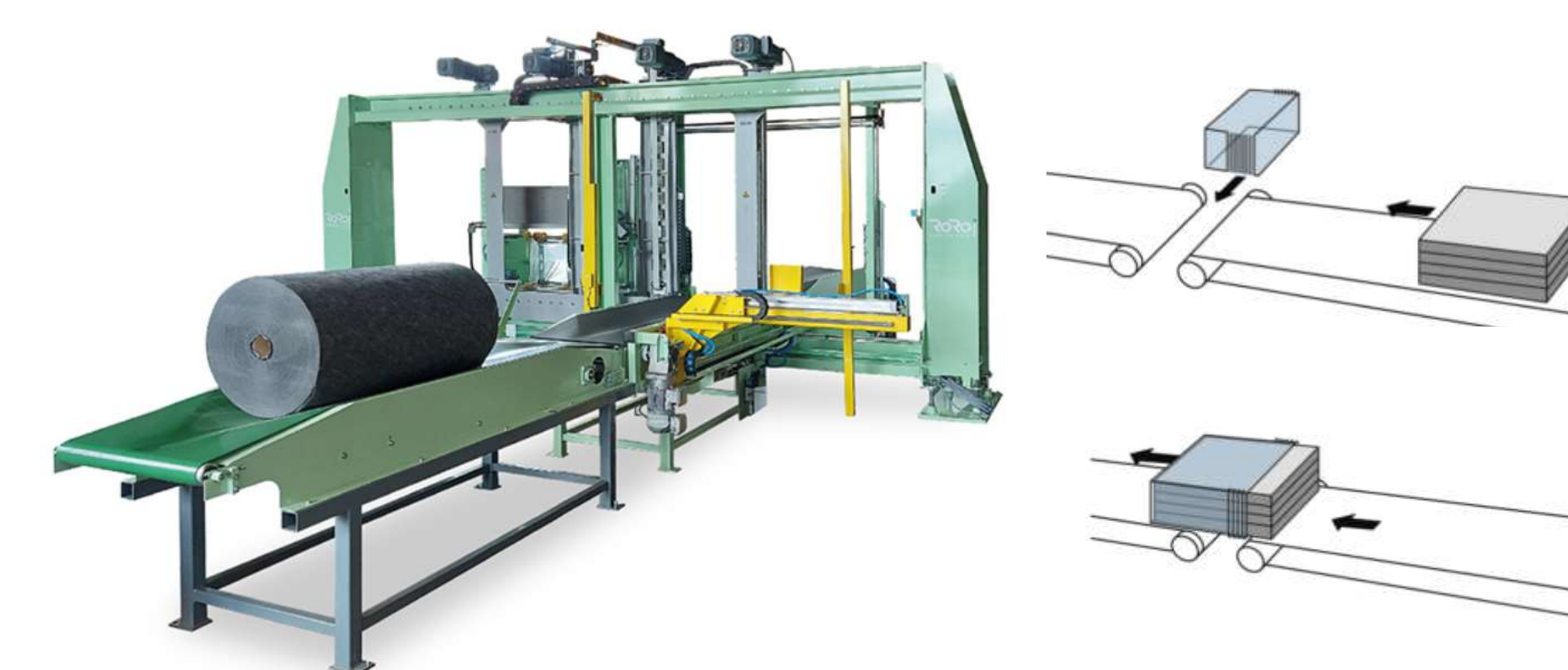


Figure 3. AutoCAD screenshot with each machine location, Spaghetti diagram showing the path followed from each production line to the different location of each machine

## RESULTS

With the communication between the team and sponsor, the team researched and reached out to multiple vendors of Automated packaging companies. Weighing the advantages and disadvantages of each machine to help the team make an educated decision on what machines to propose to the stakeholders. In the end these are the machines selected.

### Tentoma/ Card Monrue: RoRo StretchPack XL S2 R



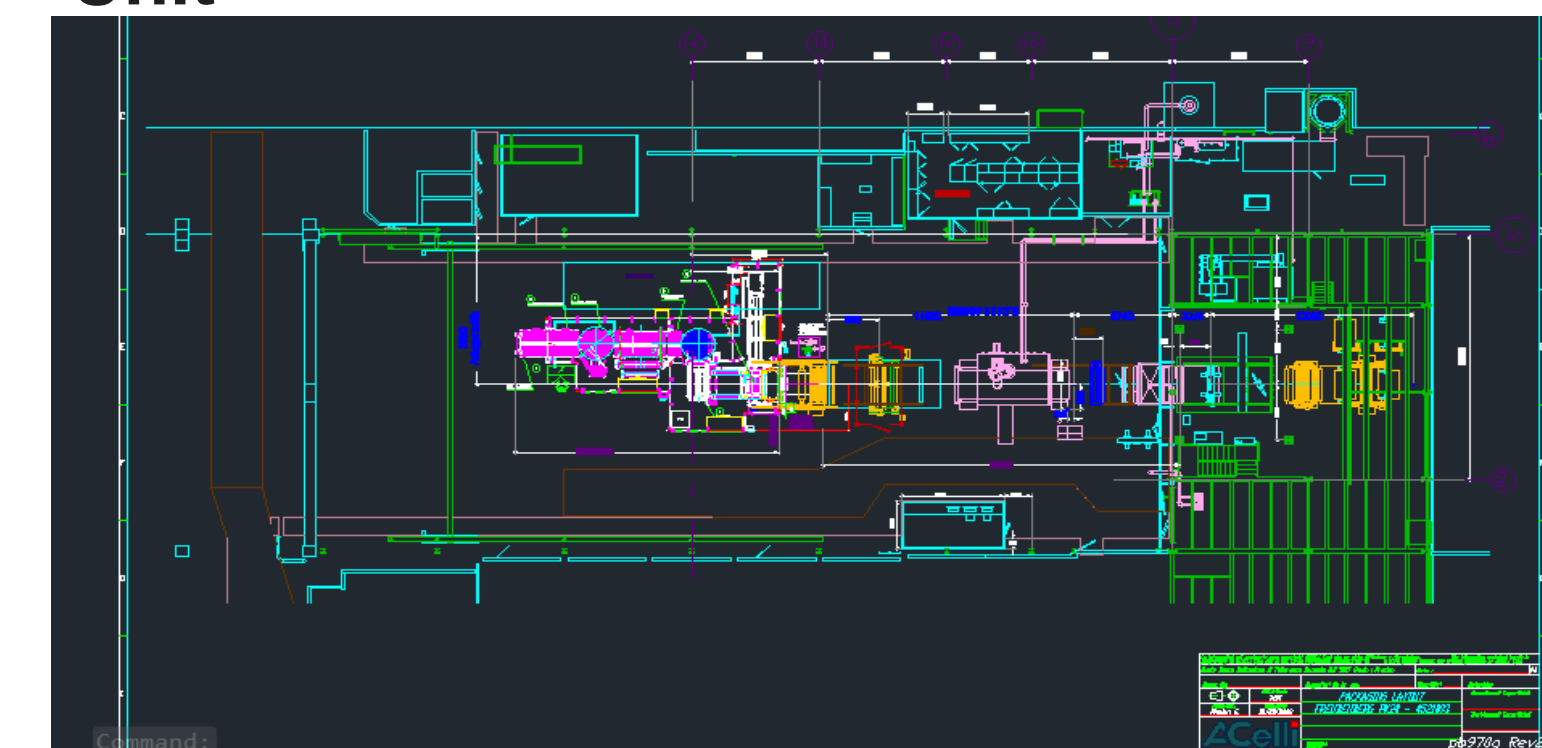
This machine uses a unique stretch film that is collect and barely stretch on mechanical "fingers" and pushes the roll in stretching the film taught. Heat is applied at the ends to seal the roll.

### Farbal: Side Sealing Wrapping Machine



This machine uses a curtain of film and wraps the rolls long way then then seal the backend, then side seals around the roll. Heat is applied at to seal the roll.

### Acelli: Custom Centralized Automatic Roll Wrapping Unit



Acelli is already a partner of Freudenberg, the Durham plant already has many machines from them to aid in production. The team believed it may be possible to make an inquiry about how they would make a wrapping machine. The team has not had a formal meeting with Acelli, but they have sent this drawing.

## SUMMARY AND CONCLUSIONS

The team concluded that of the machines chosen to focus on for continued interest the Card Monroe machine is the front runner, Farbal is the second choice, and Acelli is least likely to move forward. The machines selected for continued evaluation have shown these factors that will benefit the company:

- The first way this helps the company is to reduce safety and health risks, as the manual process has open flames being used and physical moving the rolls has caused knee and hip related injuries in the workers.
- Secondly, the company has used stretch wrapping machines in other locations. But the machines used don't have a clean nice and protective finish, but the current technologies found can make this possible.

## FUTURE WORK

The team is passing the project to the company to make the final selection of the machine and discuss installation in the warehouse.

## TEAM & ACKNOWLEDGEMENTS

- Cameron Baines, ECET
- Nathaniel Ball, Engineering Technology
- Duc Bui, Mechanical Engineering
- Francisco Herrera, ECET
- Jordian Fox, Engineering Technology
- Dyer Benett, SEO/ Operation Manager Freudenberg
- Jaime Kolthoff, Sr. Automation Engineer Freudenberg
- Scott Pierce, Faculty Mentor



## References

Freudenberg Documents: FSS5, Requirement Specification, and RFP  
Technologies: Acelli, Emanpack, Farbal, Orion, Polypack, Sontex, SunTech, and Tentoma