Genie Industries: Improving the Mini Paint Line

Sean Hoon, Will Parnicky, Rafaela Ribeiro, Gino Thompson, and Camden Wheatcroft

PROBLEM BACKGROUND

Genie, a subdivision of the Terex Corporation, is a manufacturing facility located in Redmond, Washington that produces scissor lifts, booms, elevating platforms, and more.

This project focuses on the mini line's paint system, which prepares parts for the final assembly of the GS-1930 scissor lift via a powder-coating process. The GS-1930 has four subassemblies: chassis, extension, platform, and links. These subassemblies are painted either grey or blue depending on the part. The chassis, extension and platform are painted blue in the "blue paint system" and the links are painted grey in the "grey paint system."

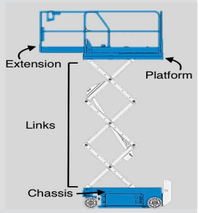

Figure 1. GS-1930 scissor lift

The challenges faced with current system are the following:

- **Flow is non-linear**
- **Capacity at 50 units per shift is lower than the target output**
- **Poor ergonomics due to the strain from pushing carts**

The paint line is planned to be moved in December 2017, which leads to possibilities of improvement and motivates this project.

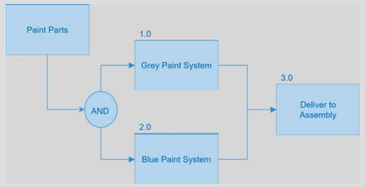

Figure 2. Functional flow diagram of mini line

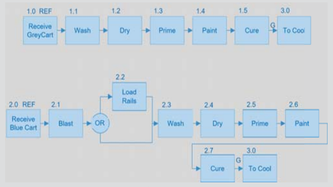

Figure 3. Functional flow diagram of paint line

GOAL

The goal of this project is to design a new mini paint line system that is linear, has a capacity of 60 units per shift, and minimizes the heavy pushing needed to transport the parts through the line. The process we used to achieve this is as follows:

1. Evaluate the takt time
2. Evaluate the cycle times
3. Estimate the machine capacity
4. Identify bottlenecks of process flow
5. Develop layouts
6. Simulate the improved systems for validation
7. Generate a cost benefit analysis

Two alternatives were explored:

⇒ **Alternative 1: Introduce Automation**

- *Towline Conveyor*

  This would reduce transportation time as well as relieve the workers from manipulating the carts around. Consequently, this would allow more time for the workers to instead perform value added operations.

- *Robotic Painting Arms*

  Robotic painting arms have been shown to reduce cycle times while still delivering high quality products. Ultimately, cycle times for each task as well as any variations in quality would be reduced if the parts painted are relatively flat.

⇒ **Alternative 2: Improve Current Operations**

- *Linearize the Line*

  To linearize the line, two door work cells could be incorporated so that carts could be inputted in the front and delivered out the back.

- *Combining Processes*

  The paint and prime station, as well as the wash and dry stations, could be combined into one area so that carts would not have to be moved between them.

DESIGN OF NEW LAYOUT

In order to develop an optimum layout, we created various preliminary designs. Some of the constraints to these designs includes the following:

- Fits inside the area Genie plans to move the mini line to
- Outputs of each subassembly would be at the point of use of the assembly line
- Input points of each subassembly would allow for efficient flow into the system

Using the following criteria we determined which design would best meet the needs of the paint system.

1. Number of cart turns
2. Effectiveness of inputs to assembly
3. Available square footage
4. Viability of implementing a conveyor
5. Travel distance of carts
6. Reception from weld

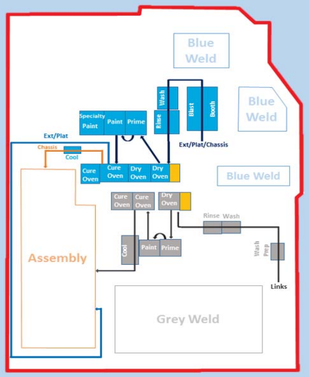

Figure 4. Current state layout

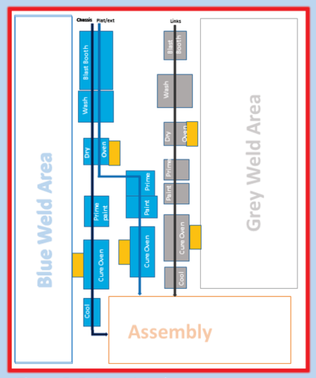

Figure 5. Future state layout

DESIGN VALIDATION

Simulation models were then constructed to verify the design would meet the expected 60 units per shift.

Paint System Capacity Summary

	Carts	Current Simulation Results (avg)	Future Simulation Results (avg)
Capacity per shift:	Upper Links	47 units	64 units
	Lower Links	**49 units**	**62 units**
	Chassis Cart	36 units	60 units
	Platform Cart	48 units	60 units
	Extension Cart	48 units	60 units

Grey Paint System Cycle Times

	Lower Links		Upper Links	
	Current Cycle Time	Future Cycle Time	Current Cycle Time	Future Cycle Time
Prep/Blast	4′	4′	4′20″	4′
Wash	6′30″	4′	6′30″	4′
Dry Off	**13′50″**	**6′**	13′40″	6′
Prime	3′30″	3′	4′	3′
Paint	4′20″	3′	4′	3′
Cure	9′45″	9′	9′45″	9′

Blue Paint System Cycle Times

	Chassis Cart		Platform Cart		Extension Cart	
	Current Cycle Time	Future Cycle Time	Current Cycle Time	Future Cycle Time	Current Cycle Time	Future Cycle Time
Prep	5′	3′	2′30″	2′30″	2′30″	2′30″
Blast	2′20″	2′30″	2′	2′30″	3′	2′30″
Wash	4′	2′30″	4′	2′30″	4′	2′30″
Dry Off	8′20″	8′	7′20″	3′	4′40″	3′
Prime	-	-	2′30″	2′30″	3′	2′30″
Paint	-	-	2′30″	2′30″	2′30″	2′30″
Prime & Paint	8′40″	8′	-	-	-	-
Cure	16′	14′30″	9′30″	8′	9′30″	8′

COST BENEFIT ANALYSIS

Purpose: To evaluate the financial feasibility of implementing an automated paint system and conveyor system into the optimum layout.

Data Source: Data was gathered on relevant cost information by collaborating with one of Genie's engineers.

Results:

One year of implementation costs for each alternative*:

Alternative 1	Alternative 1 with just the conveyor system	Alternative 1 with just the auto paint system	Alternative 2
$2,582,452.50	$2,603,927.50	$2,693,675.00	$2,780,150.00

*includes one year of labor costs

The analysis summarizes the cost of developing our optimum layout alternatives. It also summarizes the benefits that cannot be described with a specific dollar value. You may note that all of the alternatives improve on the current state.

Benefits of each alternative:

Benefit	Metric	Current	Alternative 1	Conveyor	Auto Paint	Alternative 2
Linearity	# of turns	18	**2**	**2**	**2**	**2**
Travel Distance	Linear ft.	636	**531**	**531**	**531**	**531**
Footprint	Sq. Ft.	5751	**5312**	**5312**	**5312**	**5312**
Distance Pushed	Ft.	565	**351**	**351**	531	531

The most cost efficient design is **Alternative 1** which involves a conveyor system and automated paint system. This is mostly due to the decrease in labor costs associated with the use of these automated processes. It is also apparent that using these automated processes results in the most significant increase in benefits.

RECOMMENDATIONS

Based on the data collected from Genie, the simulation models produced in Simio, and the cost benefit analysis, we recommend that the proposed layout is utilized which incorporates a towline conveyor and an automated paint system. This design will:

- Reduce the number of turns made by a cart to 2
- Increase the capacity to 60 units
- Reduces the distance a cart is pushed by 214 ft.

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