Flexible Production Line

Team Members: Gail Kelly, Hannah Winstead, Jose Carrizo, and Kevin Davenport Jr.

Faculty Advisor: Dr. Sarin
Company Contact: Herbert Taute

Company Background

- Founded in Germany in 1926 by Andreas Stihl
- Virginia Beach location produces over 80 products
- Ship internationally allowing for seasonal products that are always in season

Project Background

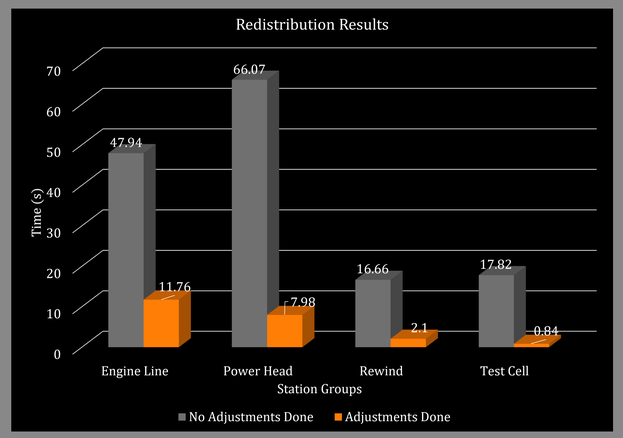
- STIHL has been experiencing more fluctuation with demand
- Forecasting has shifted from estimates monthly to weekly
- This has led to the need for flexible production line

Objectives

- Optimize production line layout to meet output demands
- Allocate tasks to stations and keep worker productivity above 88%
- Minimize changeover time to at most half a day
- Provide Recommendation for new production line

Impact

- Labor cost reduced 18% per shift or ~$273,768 over a three-year period
- Unnecessary units not produced
- Reduction in storage of approximately 40,000 units



Results

Decision Matrix to determine best flexible production line

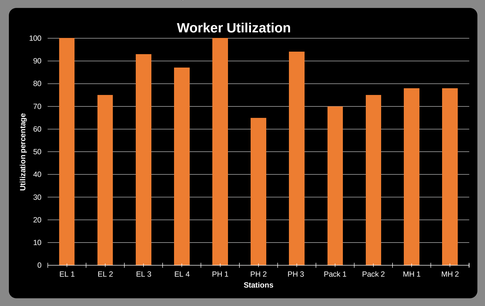
		Setup 1	Setup 2	Setup 3	Setup 4
Criteria (1-5)	Weight (1-5)	Single Worker	U-Line	AGV	Equipment Changes
Low Space	2	2	4	4	4
Low Investment	4	1	3	2	5
Low Walking	2	5	2	5	4
High Range of Effective Rates	3	1	5	4	3
Low Changeover Effort	5	3	4	4	4
Balancing Flexibility	4	5	4	3	3
Final Scores		56	75	70	77

Additional Recommendations:

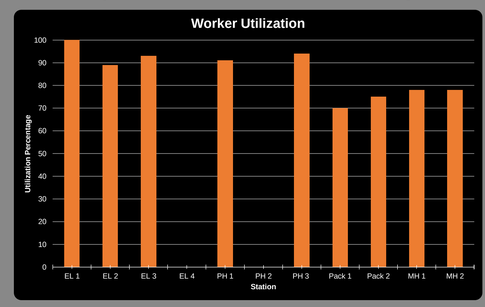
- Mobilize auto stations to increase flexibility in assembly sequence
- Improve flexibility of setup and removal of poka-yoke cameras
- Open to the idea workers standing and walking between stations

Approach

Worker Utilization with new rate and no adjustments made



Worker Utilization with new rate and station adjustments to increase efficiency



Program used to find optimal solution

$$S_{max} = maximum\ \#\ of\ stations$$

$$x_{ki} = \begin{cases} 1, task\ i\ assigned\ to\ station\ k \\ 0, Otherwise \end{cases}$$

$$z_k = \begin{cases} 1, station\ k\ is\ used \\ 0, Otherwise \end{cases}$$

Min. $\sum_{k=1} z_k$ (Minimize number of stations)
s.t. $\sum_{k=1}^{S_{max}} t_i(x_{ki}) \leq T(z_k)$ (Total task does not exceed takt time)
$\sum_{k=1}^{S_{max}} (x_{ki}) = 1$ (Each task assigned to one station)
$\sum_{k=1}^{S_{max}} (x_{ki} - k + 1)(x_{kp_1} - x_{ki}) \geq 0$ (Forward precedence 1)
$\sum_{k=1}^{S_{max}} (x_{ki} - k + 1)(x_{kp_2} - x_{ki}) \geq 0$ (Forward precedence 2)
$\sum_{k=1}^{S_{max}} a_i(x_{ki}) \leq 1$ (Cannot work between auto station)

Research

- Four different approaches to a flexible production line based on desired criteria
- Rebalancing exercise information applied to determine flexible production line layouts