The Original System

- Inconsistent cycle times across machines
  - Lamination room was 17.8 seconds, bag furnace was 15 seconds, other systems were 18 or 17 seconds
- No set value of autoclave batch size
  - Operators ran the autoclave whenever they decided to do so, usually for arbitrary reasons
- Two teams of two workers each per shift
  - Resource utilization was noticeably low; these workers were often idle
System Overview and Objectives

Lamination
- Remove inconsistencies with specifications given by Mike Mund
- Ensure process flow is balanced with the same cycle time for every component

Autoclave
- Determine optimal number of racks of glass (within the constraint of a maximum of 12 racks) to be inserted per cycle.
- Ensure autoclave staging area is not overflowing

Finishing
- Keep resource utilization of human labor close to 100%
- Reduce the number of human workers necessary at this stage (reassigned per assignment problem)
Carlex Simulation Model

AUTOCLAVE SIMULATION MODEL
By: Marshal Turner & Jake Massingill
Simulation of Original System: Finishing Phase

Original: Batch Size 750/ 2 Teams/ Early and Late Shift Workers

\[
\left(\frac{24 - (0.8528 \times 24)}{5}\right) \times 60 = 42.39 \text{ minutes or 42:23}
\]
The Improved System

- More consistent cycle times across machines
  - All systems except bag furnace were set to approximately 18 seconds
- Set and optimized autoclave batch size of 900
  - This is the maximum possible batch size, which means minimum number of cycles per day and maximum savings
- One team of two workers each per shift
  - Resource utilization was nearly at the target of 90%
Simulation of Improved System: Finishing Phase

Improved: Batch Size 900/ 1 Team/ Simplified Worker Model

The gaps where the workers are idle are becoming more narrow
The Optimized System

- Consistent cycle times across machines
  - All systems have a cycle time of 18 seconds
- Set and optimized autoclave batch size of 900
  - This is the maximum possible batch size, which means minimum number of cycles per day and maximum savings
- One team of two workers each per shift
  - Resource utilization was now 93%

These changes can be implemented as early as next week, with no cost to Carlex!
Results and Conclusions

- Four workers were relocated from Finishing, reducing costs for this line by $16,000 per month.
- The Autoclave and Finishing workers now operate and idle at consistent intervals.
- Reduced Autoclave usage reduces energy and maintenance costs.