

Client Introduction

- Global company specializing in products that connect, protect & automate power systems
- SEL facilities assemble highly customizable relays and reclosers supporting power transmission



Problem Statement

- SEL's new Purdue Facility experiences line imbalances and bottlenecks due to product variety
- Unstructured production schedules create idle time between different workstation processes
- Creating & Validating a schedule optimizer will reduce bottlenecks & increase product cycle time

Methods – Empirical Model



Due to limited data availability, heuristics were used to calculate expected process times for unknowns



Used average product build hours and technician expertise to develop mathematical model for process time breakdowns by workstation:

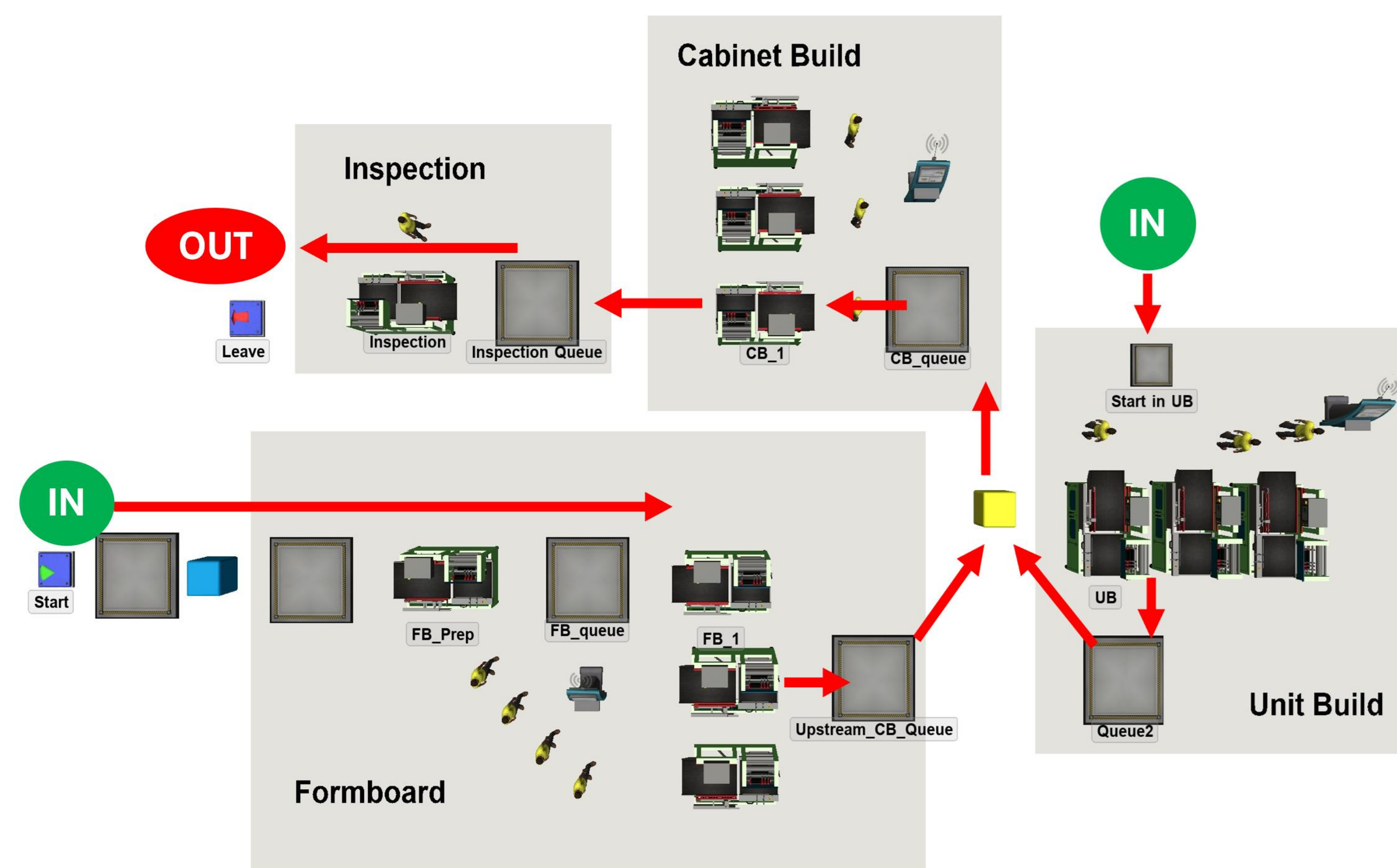
$$XX_{CB_Hrs.} = (XX_{TotalHrs.} - XX_{KnownHrs.}) * CB_{ratio}$$

Solution

- "Optimize" button runs Excel Solver with constraints, which rearranges the input order to minimize idle time
- Updated schedules for both lines are published via CSV file

Day 1:	3/18/2024	Day 2:	3/19/2024	Total Jobs	36			
Reset Order Number		Sort Date Requirements		Optimize				
Table 2: Product Demand	JobID	Latest Start Da	Lastest Start Day Number	MOT Code	Scheduled Day Number	Order	CB Hours	FB Hours
	324400	3/19/2024		CS	1	14	5.84	8.12
	322578	3/15/2024	1	HW	1	15	7.61	12.66
	326249	3/19/2024		L7	1	13	5.27	4.24
	324399	3/19/2024		L7	1	11	5.27	4.24

System Model



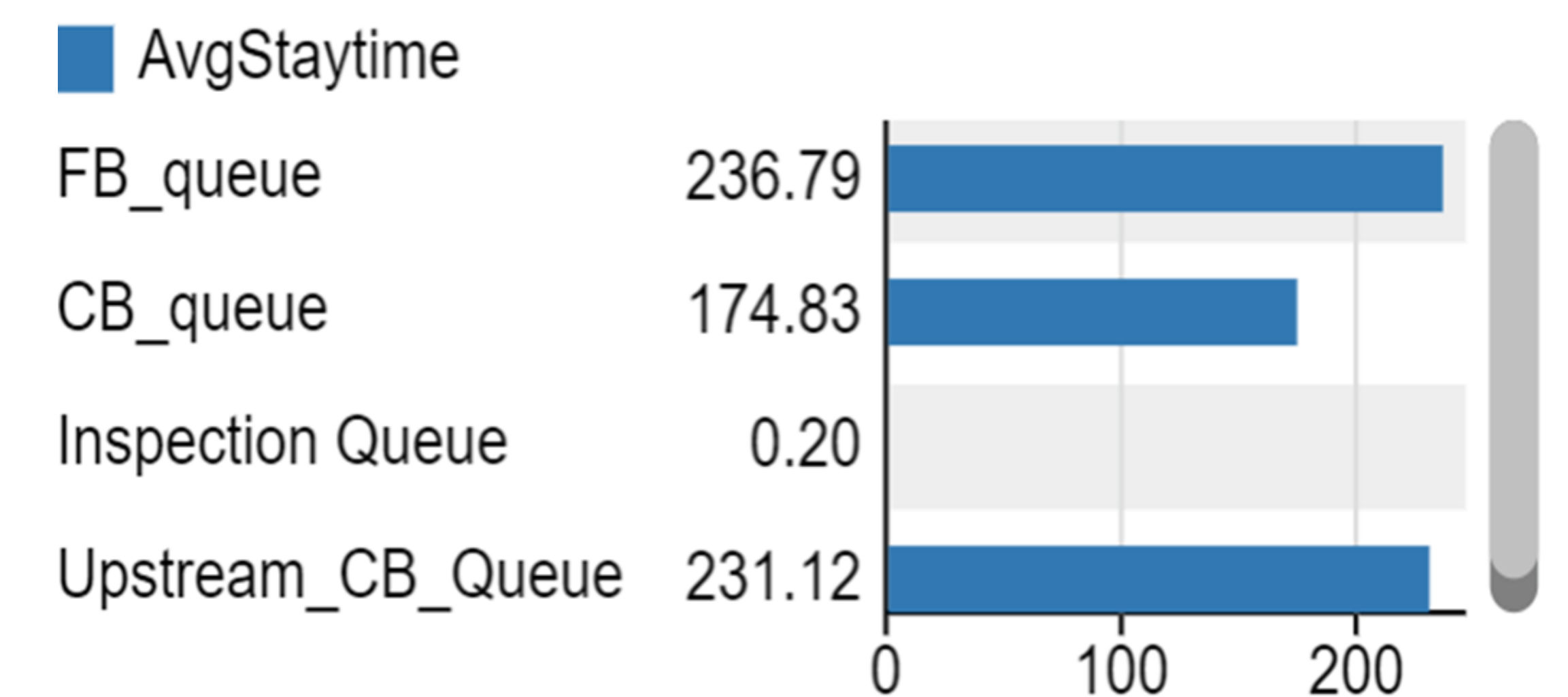
Process line model built in FlexSim.

Accepts process arrival schedules to evaluate scheduling methods. Based on workstation process times associated to product types.

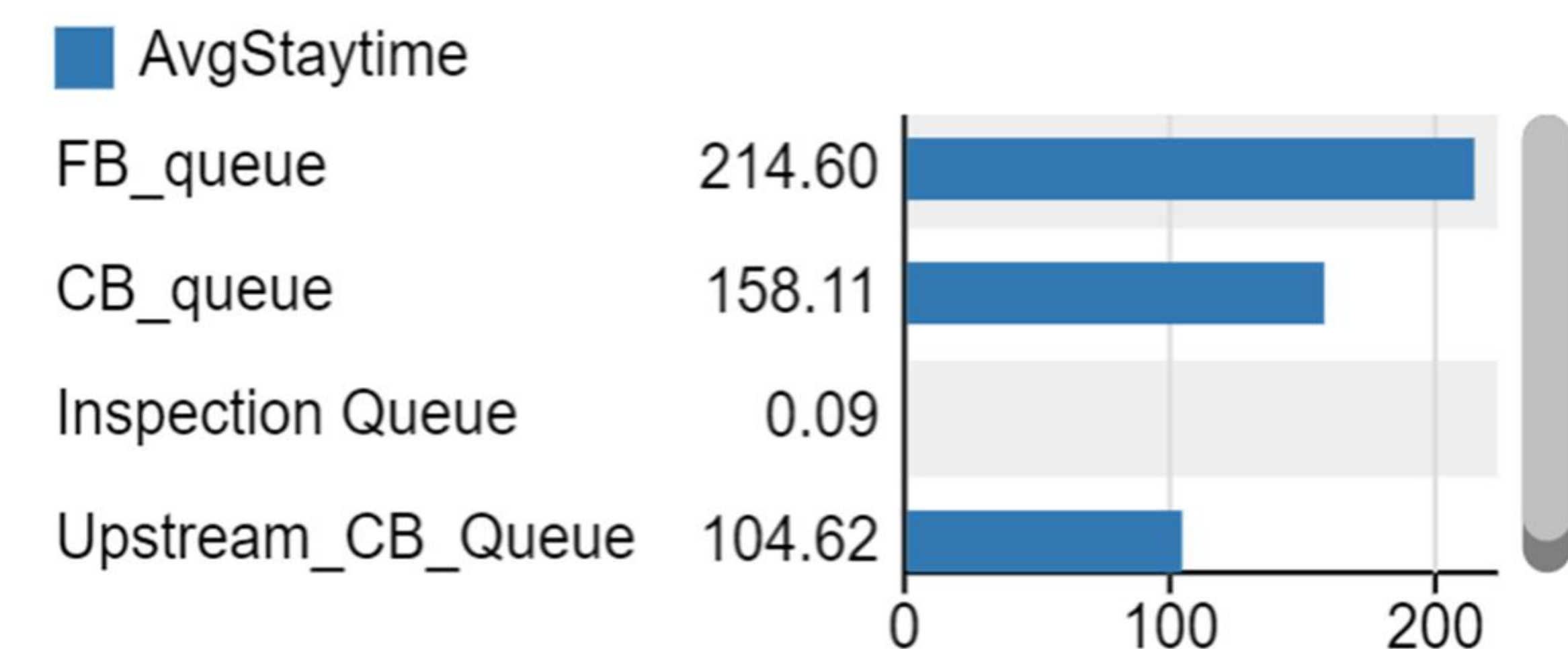


Results

Original



Optimized



The optimized schedule runs the same number of items (in optimal order) up to ~5% faster

156 additional reclosers

built just at Purdue Factory

Avg. **3% increase** in throughput due to elimination of idle time

Methods – Excel Scheduler



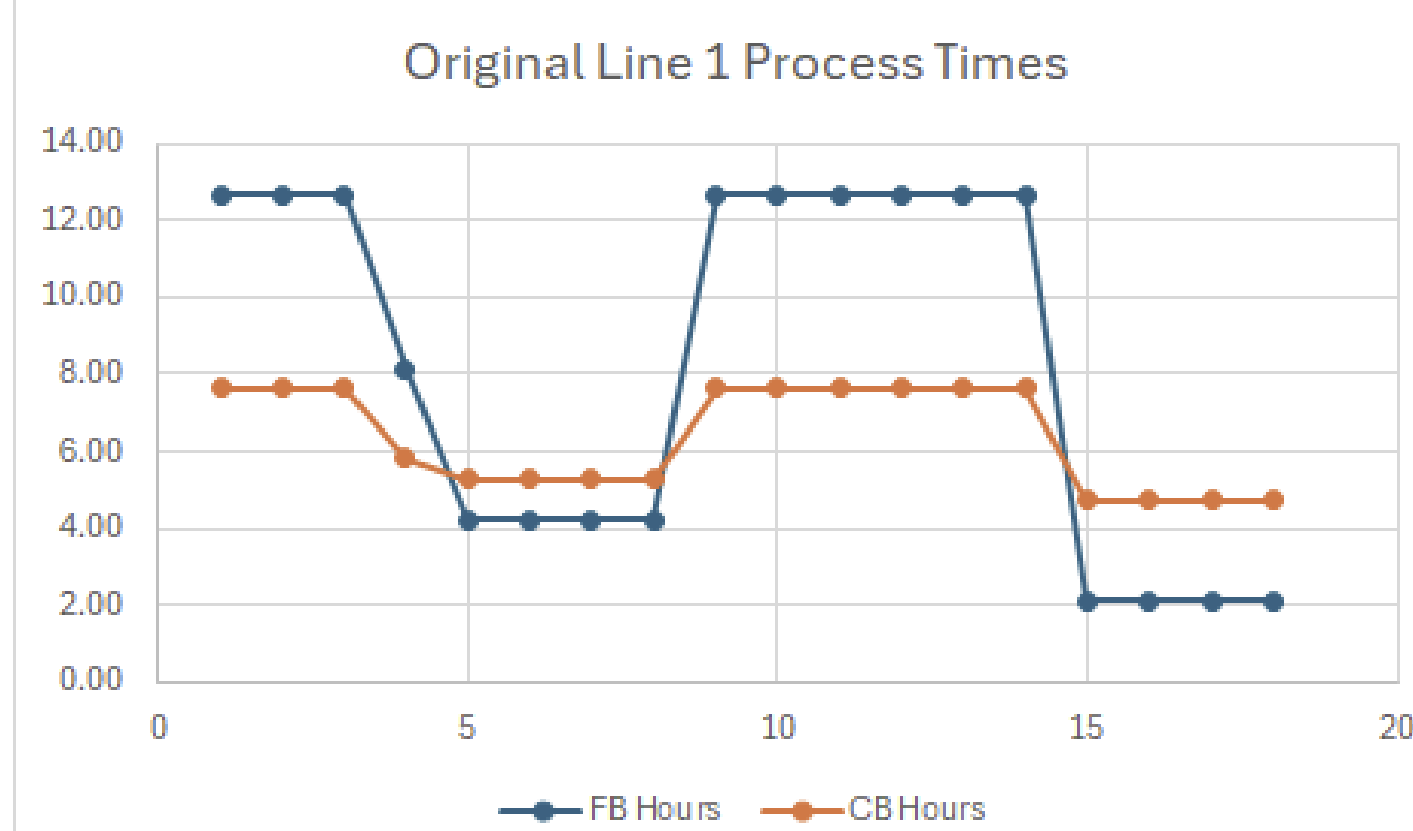
Uses Excel Solver to minimize process time imbalance between high-risk bottleneck stations



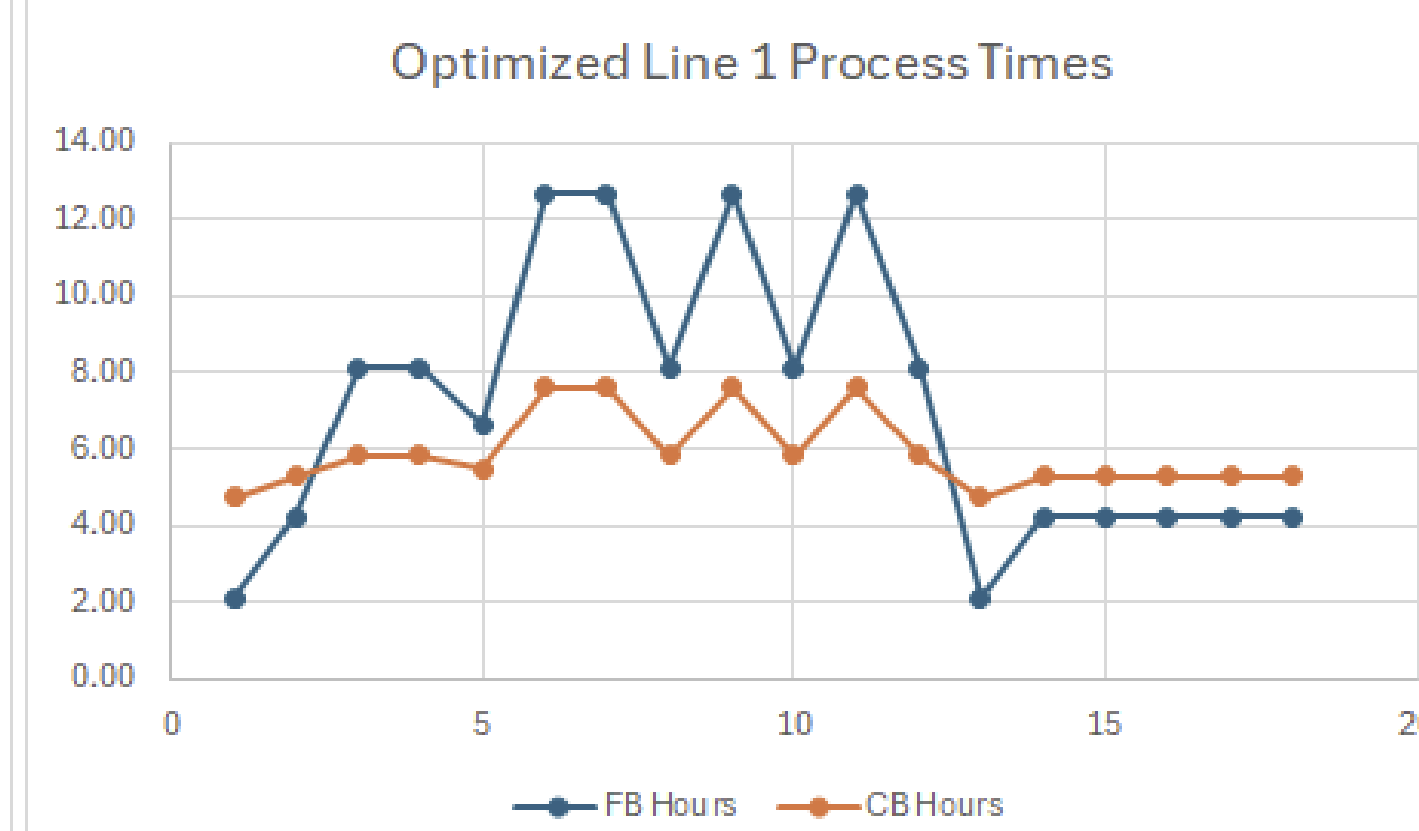
2-day scheduling window used to give scheduler more degrees of freedom in the optimization

Uses existing SEL schedule data and outputs an optimal schedule for the two lines for the facility

Original Line 1 Process Times



Optimized Line 1 Process Times



Distributes complex tasks evenly to reduce bottlenecks
Fewer technician movements and task changes

Discussion

- Process time estimates should be as accurate for best scheduler performance
- Production order tracking systems (scanning in/out) can be used to get actual time to produce an item
- Deliverables are meant to supplement, not replace, current SEL scheduling practices