

PRODUCTION SCHEDULING OPTIMIZATION

A MIP & Agentic AI Decision-Support System

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Theo Skondras

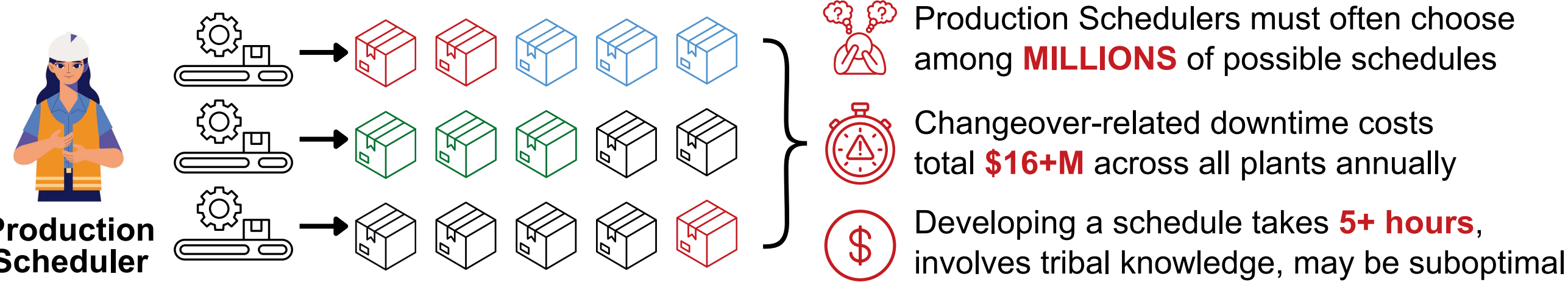


BUSINESS MOTIVATION

Conagra is a food manufacturing and distribution company that operates 40+ plants



At each plant, a **production scheduler reviews** incoming demand and **decides weekly**: which products to run, on which lines, in what quantities, and **in what sequence**



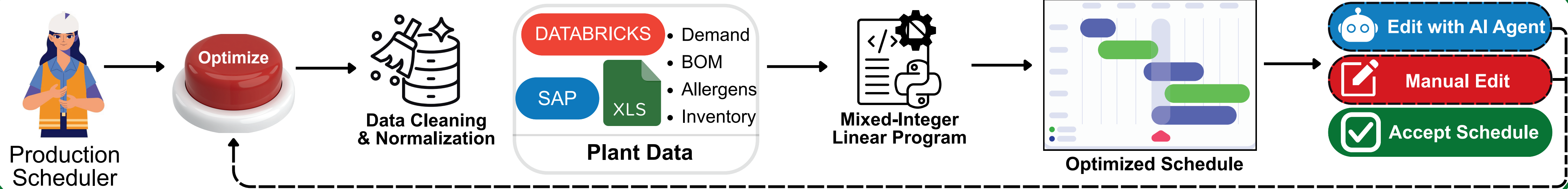
Product changeovers require time, with duration depending on the specific switch

- Equipment changes
- Cleaning & sanitation
- Pre-operational inspection



WORKFLOW

Palantir



OPTIMIZER

$$\min \sum_l \sum_{t \in E} \sum_{i,j} \frac{CO_{i,j,l}}{60} \cdot c_l \cdot y_{i,j,l,t} + \sum_i \pi_i \cdot p_i$$

Minimize Changeover (CO) Cost

Changeover Duration (hrs) ×
Hourly Cost of a Changeover ×
If there is a Changeover (binary)
For all lines (l), days (t), and product transitions (i,j)

Penalize Unmet Demand

Lost Margin per unit of Product i ×
Unmet Units of Product i
For all Products/SKUs (i)

Subject to Constraints:

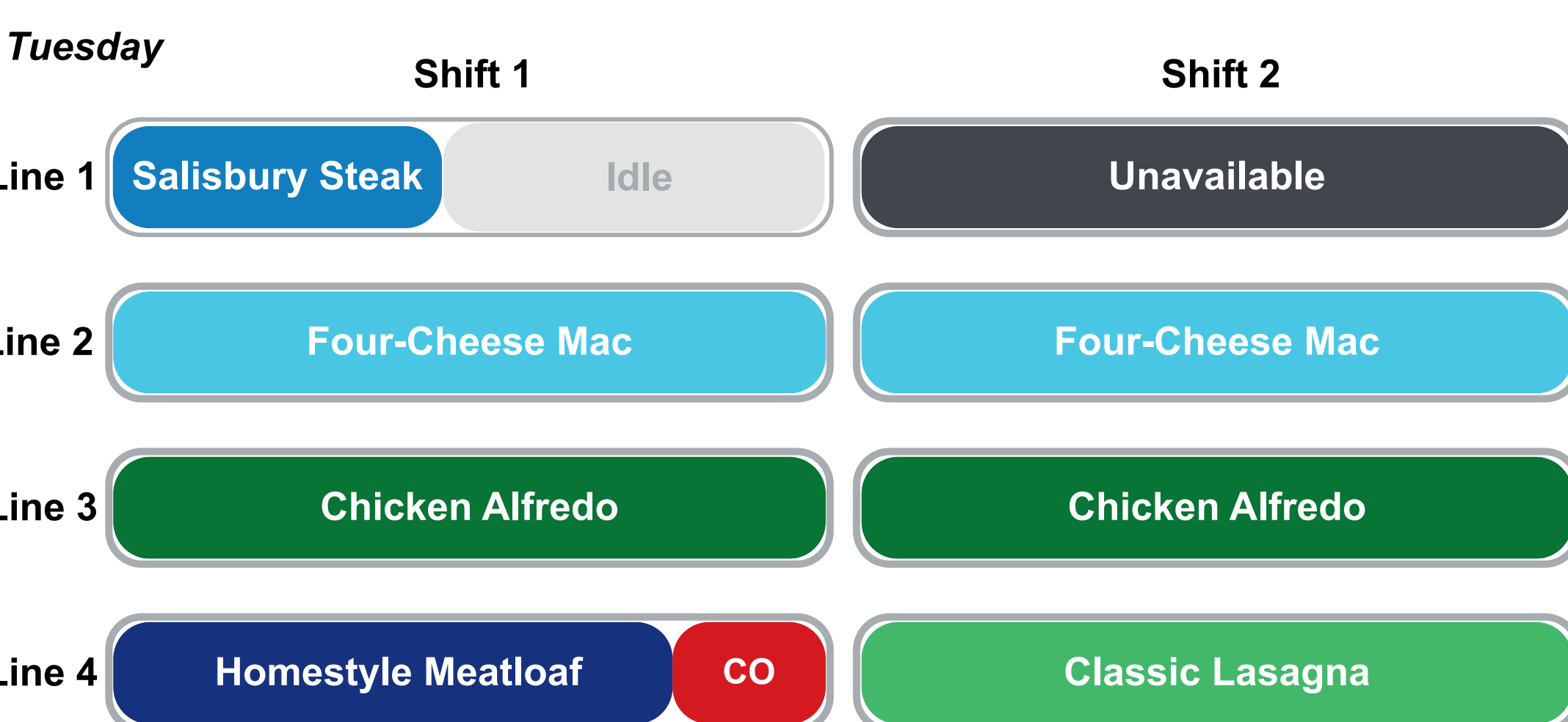
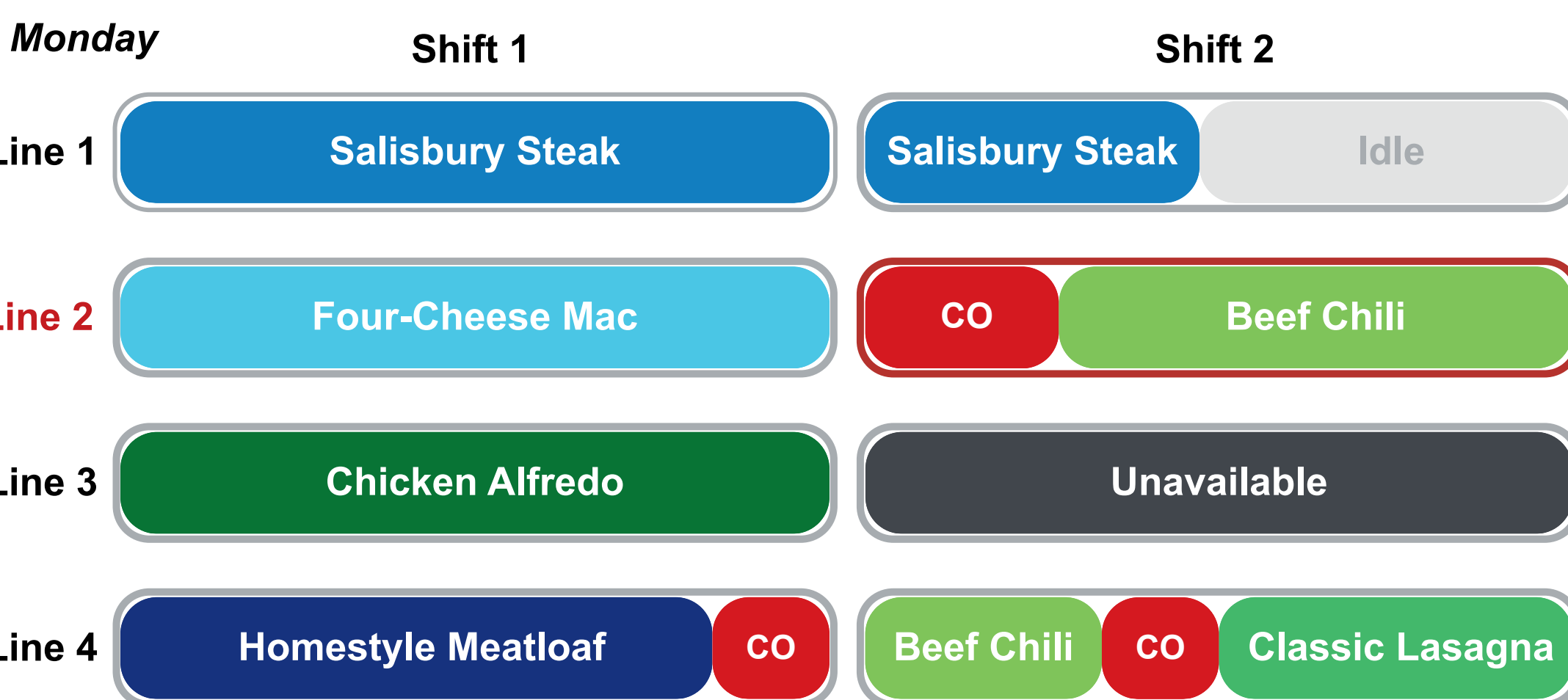
- Labor Availability
- Raw Material Availability
- Shift Time
- Soft Demand Satisfaction
- Slot Assignment, Linearization

· 66 SKUs · 4 Lines
· 5 Days · 2 Shifts

Optimization Software:

HIGHS PYOMO

OUTPUT



Solution Notes

- Lines 1 and 3 can't run together on shift 2; the optimizer chooses optimally which of the two will be operating
- Classic Lasagna can only be produced on shift 2 because specific workers are available only on the second shift. Otherwise, it wouldn't have to be produced on two different days and cause extra changeovers
- Line 1 on day 1 has capacity to produce more Salisbury Steak, but because of delays in raw materials, its production got pushed to day 2, shift 1

Additional Features

- Edit configuration:** line calendars, shift lengths, and labor budgets per day and shift
- Set material constraints:** cap production based on available semi-finished goods
- Drag-and-drop revisions:** move, resize, or swap SKU blocks between shifts
- One-click check:** check any draft against time, labor, demand, and inventory limits
- Freeze and reoptimize:** lock part of the solution and let the model optimize the rest

AI AGENT

Convert Natural-Language into constraints applied to the optimizer code

Scaling:
Add plant-specific constraints to support scale to different plants

Real-time:
Adjusting plant configurations in real time as changes occur

Modify so that lines two and three never run together during the second shift!

Line Conflict Constraint
Lines 2,3 will not run concurrently on Shift 2

Accept Reject

Reoptimize Schedule

Weekly schedule is reoptimized to satisfy the new constraint

SOLUTION IMPACT

160.6 → **75.4** min/week

Average weekly changeover time
backtested on 9 historical schedules



5+ Hours of Manual Labor



Click of a Button

≈ **\$100,000**

Estimated Annual plant savings

≈ **\$8.5M**

Scaled to 30 plants, annually

