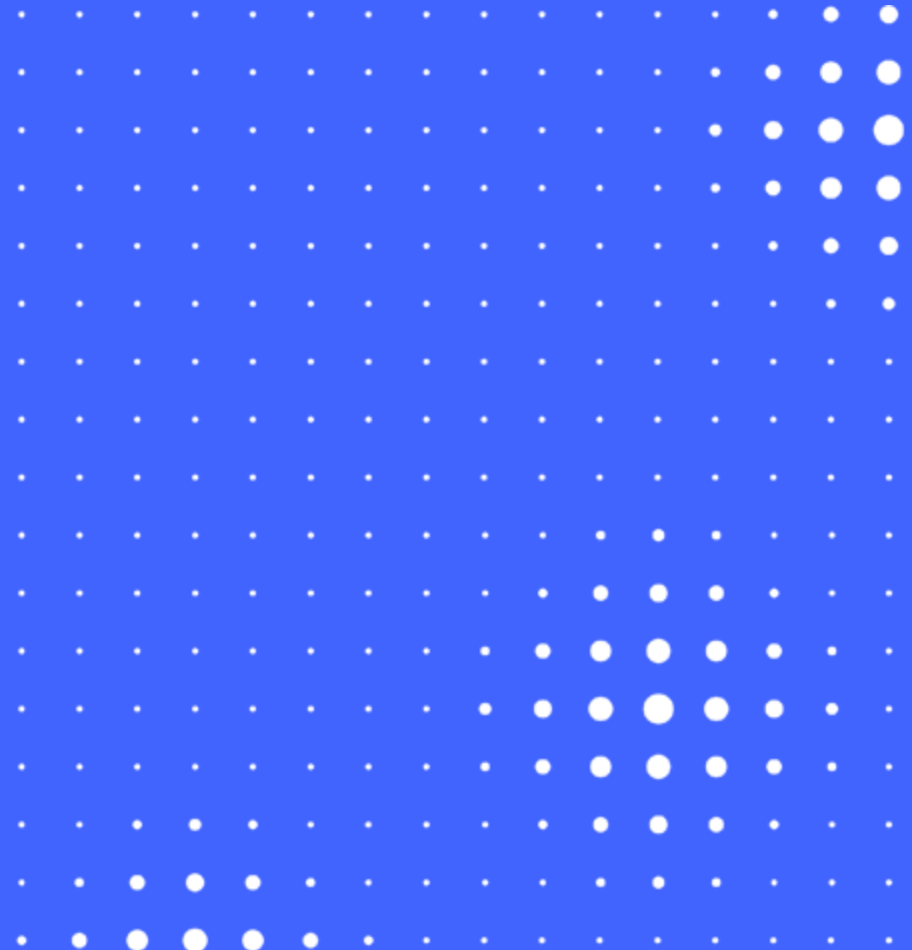


Autonomous production planning with Flex Planner & Spotlight

A Seagate Technology Case Study

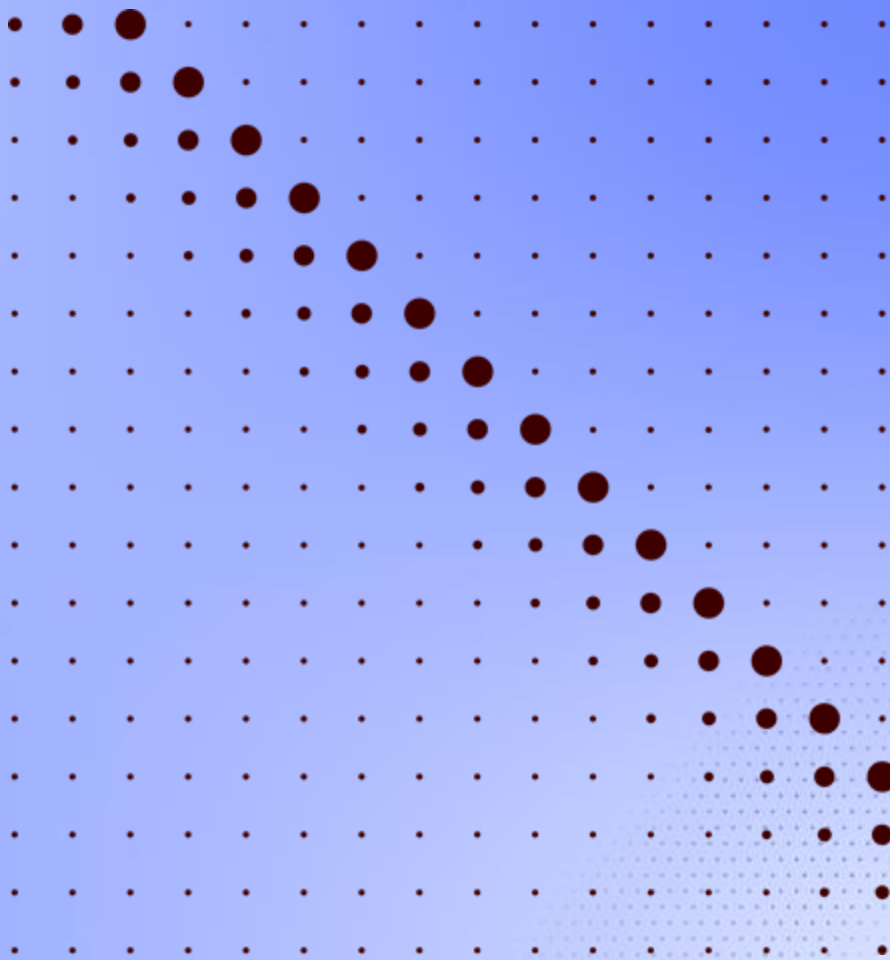
Robert Wallace, Solutions Architect, Seagate Technology
Jamie Potter, CEO & Co-founder, Flexciton



Agenda

- 01 Introduction
- 02 Production Planning Challenge
- 03 Flexciton Technology
- 04 Seagate Deployment
- 05 Results

Introduction



Why Fabs Need to be Autonomous



Decisions must be

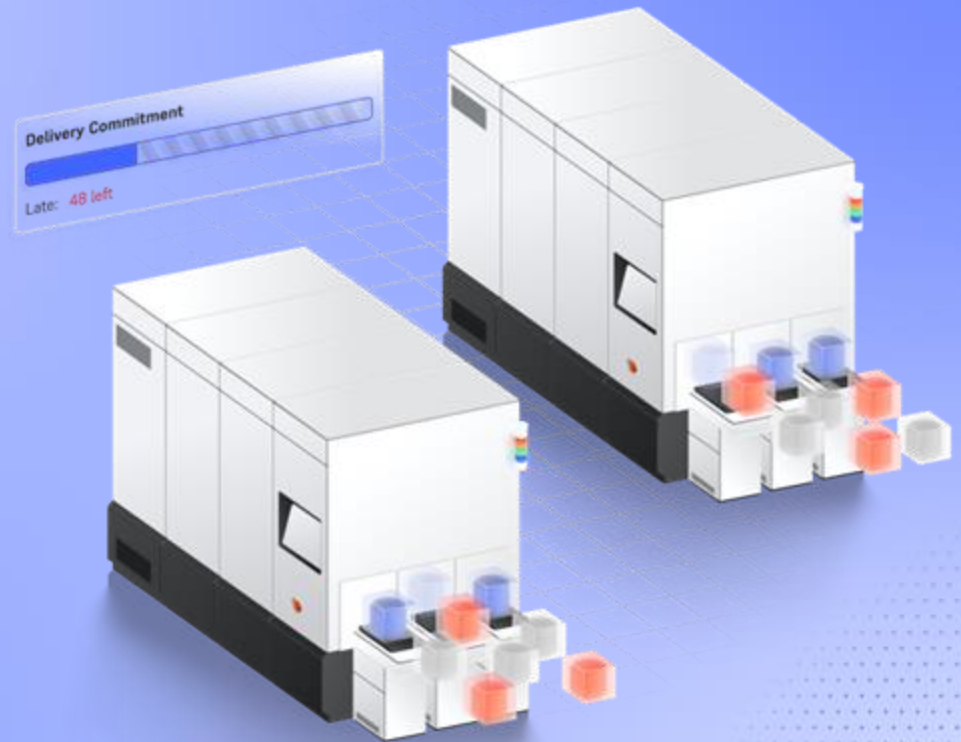
Autonomous

Page 6 Flexciton Turns Autonomous Vision into Reality

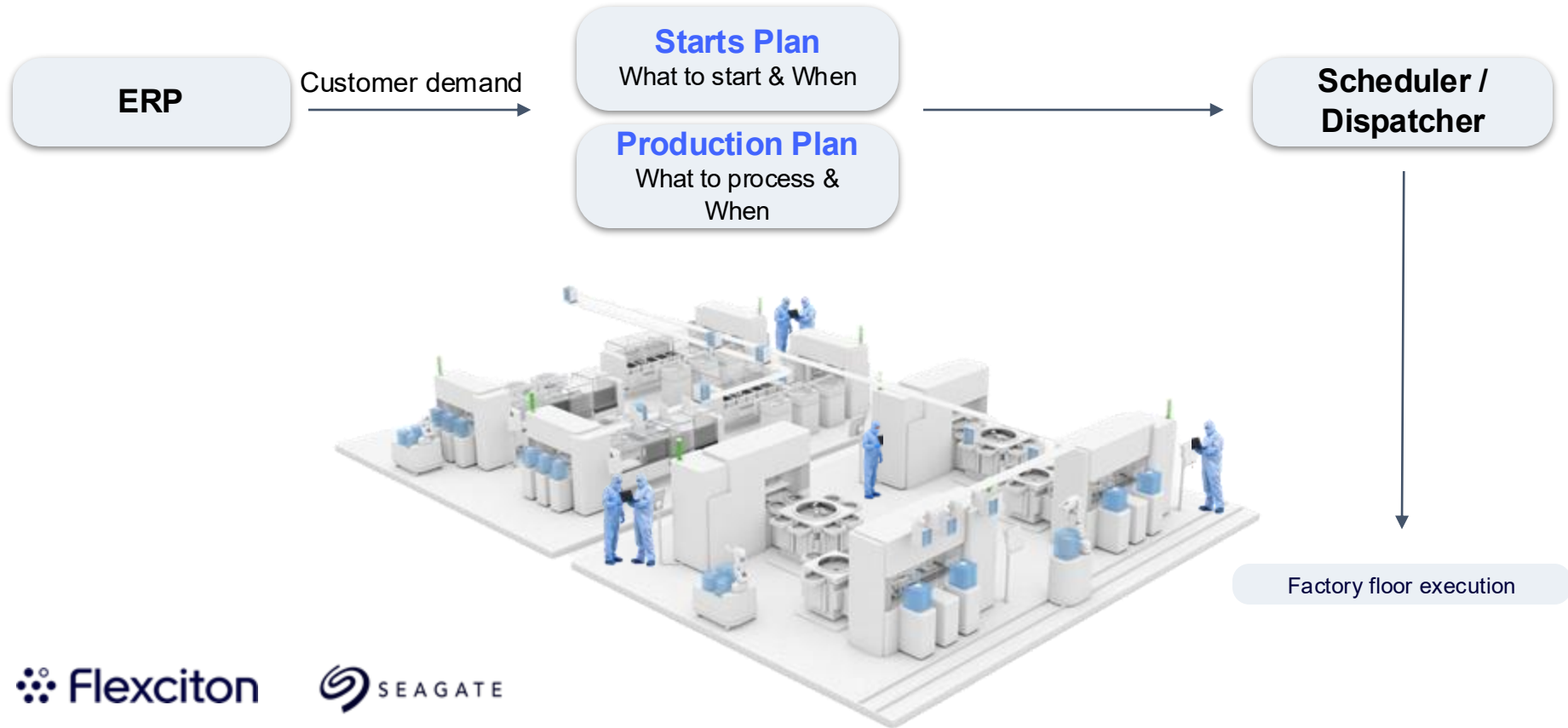
- A leader in **Autonomous Technology** in planning and scheduling for semiconductor manufacturing.
- **Proven technology:** deployments and projects in **front-end and backend fabs** across US, Europe and Asia
- **Efficiency gains:** **6 - 8%** full-fab throughput increase (scheduling), **8 - 10%** cycle time reduction (planning)
- **Expertise:** **30+ experts** dedicated to wafer fab optimization
- **Innovation:** **3 patents** in mathematical optimization technology and 100+ publications in the field

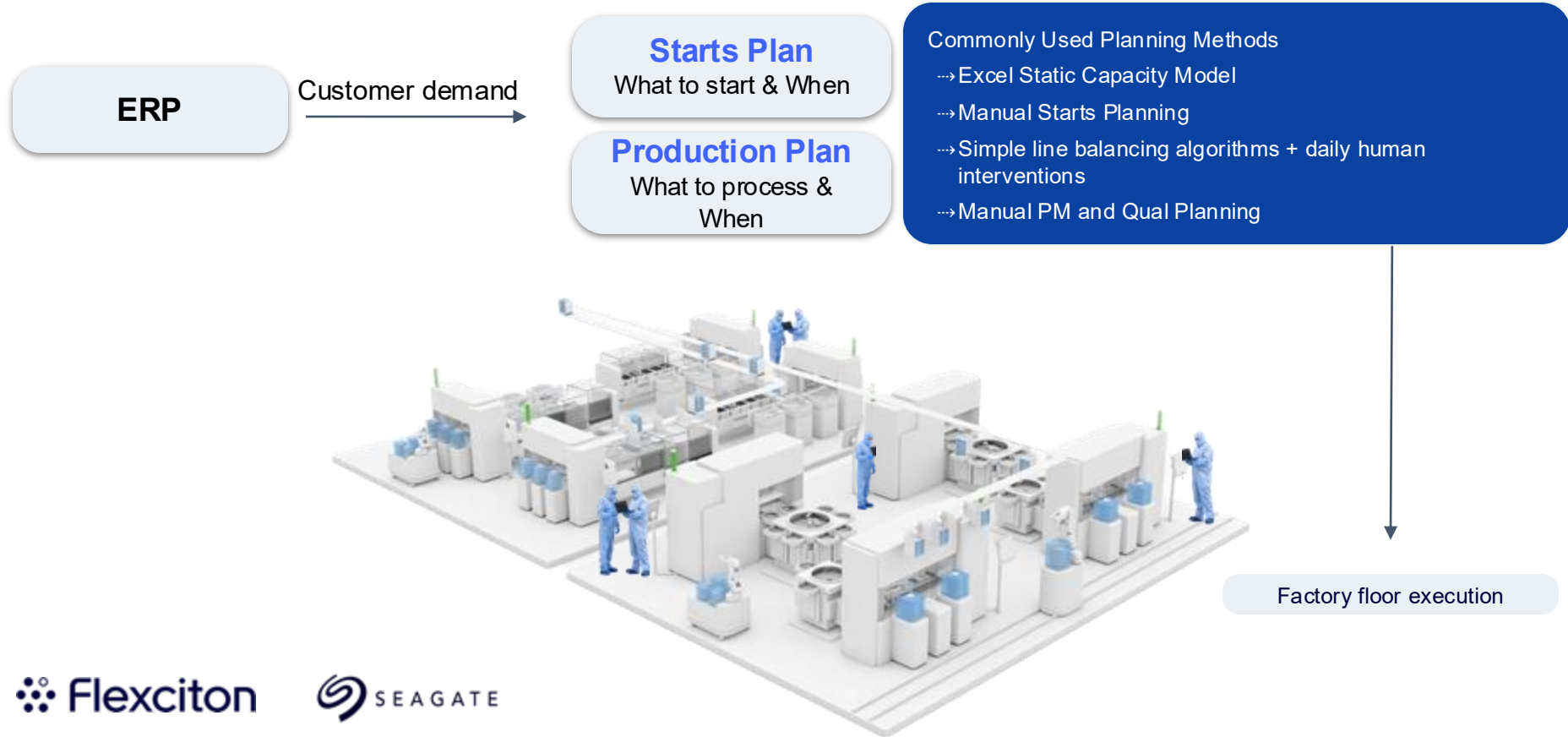


The Production Planning Challenge

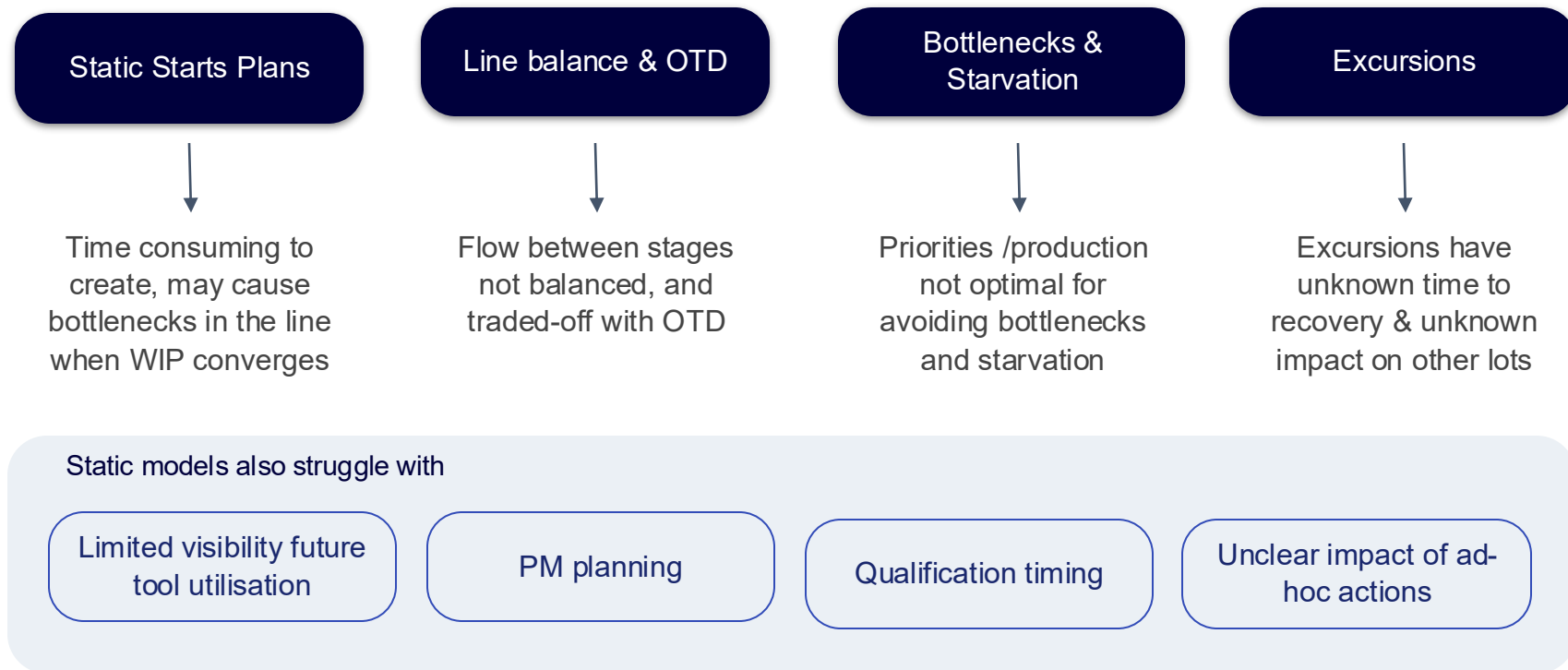


Production Planning Should Align Customers Demand with Production



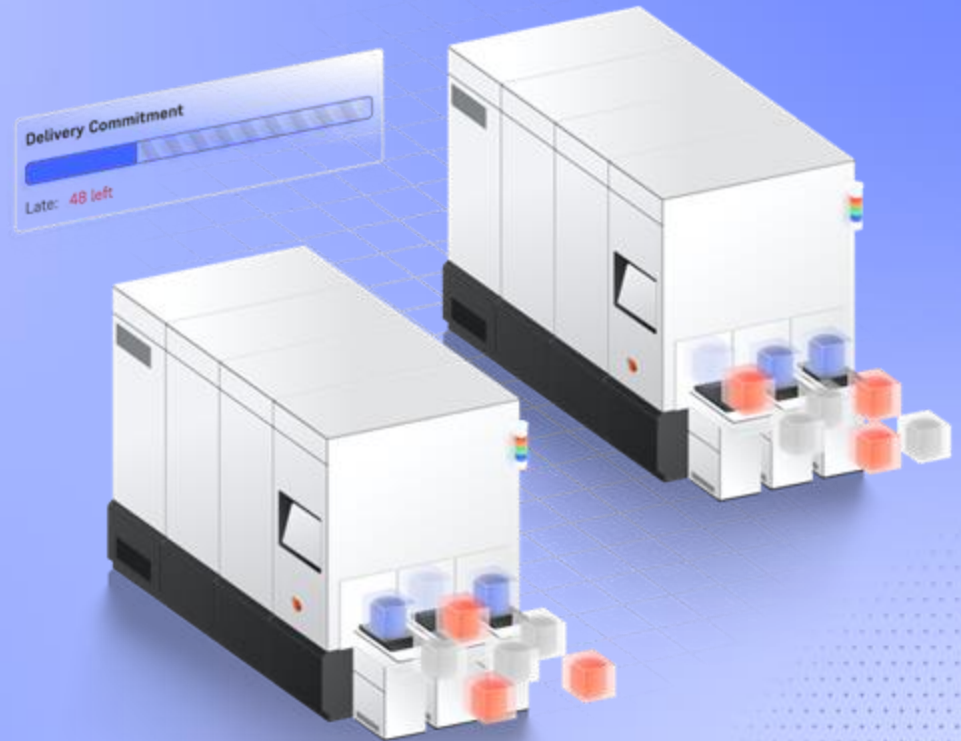


Typical Challenges Caused by Static Capacity Approach



Flex Planner & Spotlight

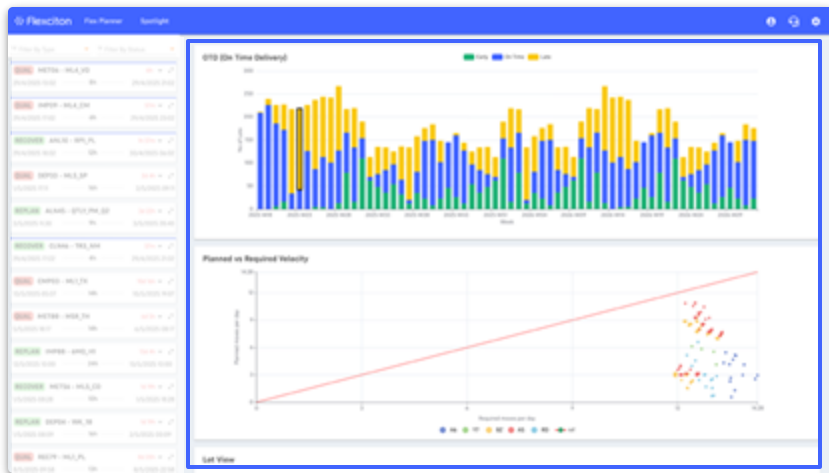
Dynamic Capacity Model & Prescriptive Analytics



A Novel Approach to Production Planning

Flex Planner

Uses **Dynamic Capacity Model** to optimise production plan for next 2-4 weeks



Respects the dynamic constraints of the real fab (unlike static models) and decides how to manage global WIP flow.

Automates wafer starts planning: streamlines a traditionally manual and time consuming process

Prevents shifting bottlenecks: Uses dynamic modelling to anticipate constraints

Removes manual firefighting: Automatically adjusts to changing conditions

Improves recovery predictability: Manages excursion recovery with clear visibility of downstream impact.

A Novel Approach to Production Planning

Spotlight

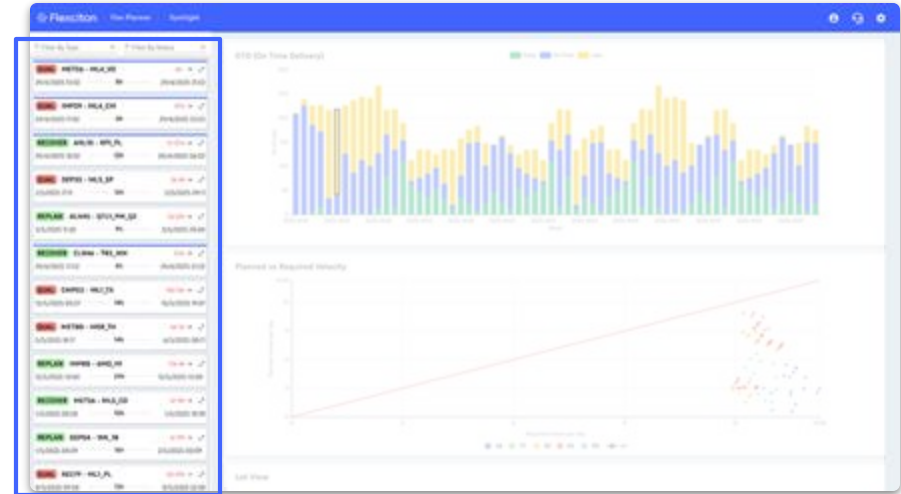
Applies **Prescriptive Analytics** to suggests top proactive actions and quantify them

Proactively identifies constraints: Highlights emerging bottlenecks weeks ahead of impact.

Recommends corrective actions: Automatically prioritises responses to emerging issues.

Quantifies impact: Shows how each action affects delivery, cost, and quality.

Visualises the future state: Displays tool utilisation, WIP flow, and upcoming bottlenecks.



How it works

Flex Planner

Uses **Dynamic Capacity Model** to optimise production plan for next 2-4 weeks

Step	00:00 - 04:00	04:00 - 08:00	08:00 - 12:00	12:00 - 16:00	16:00 - 20:00	20:00 - 00:00	...
Step 1	10	5	2	3	3	0	...
Step 2	8	4	1	0	0	0	...
Step 3	0	15	12	3	0	0	...
Step 4	0	0	10	10	6	4	...

Starts Plan

Product	Starts
A	10

Production Plan



Tool Schedule

Spotlight

Applies **Prescriptive Analytics** to suggest top proactive actions and quantify them

Step	00:00 - 04:00	04:00 - 08:00	08:00 - 12:00	12:00 - 16:00	16:00 - 20:00	20:00 - 00:00	...
Step 1	7	4	6	4	2	0	...
Step 2	4	6	5	3	1	0	...
Step 3	0	8	8	6	4	4	...
Step 4	0	0	5	8	10	10	...

Consider replanning PMs

Tool CVC_07 & CVC_08 low utilisation

Consider enabling oper

7032e 7032 on ATI_39

How it works: planning every step of every lot using real capacities



How it works: shipment control - What may be late?

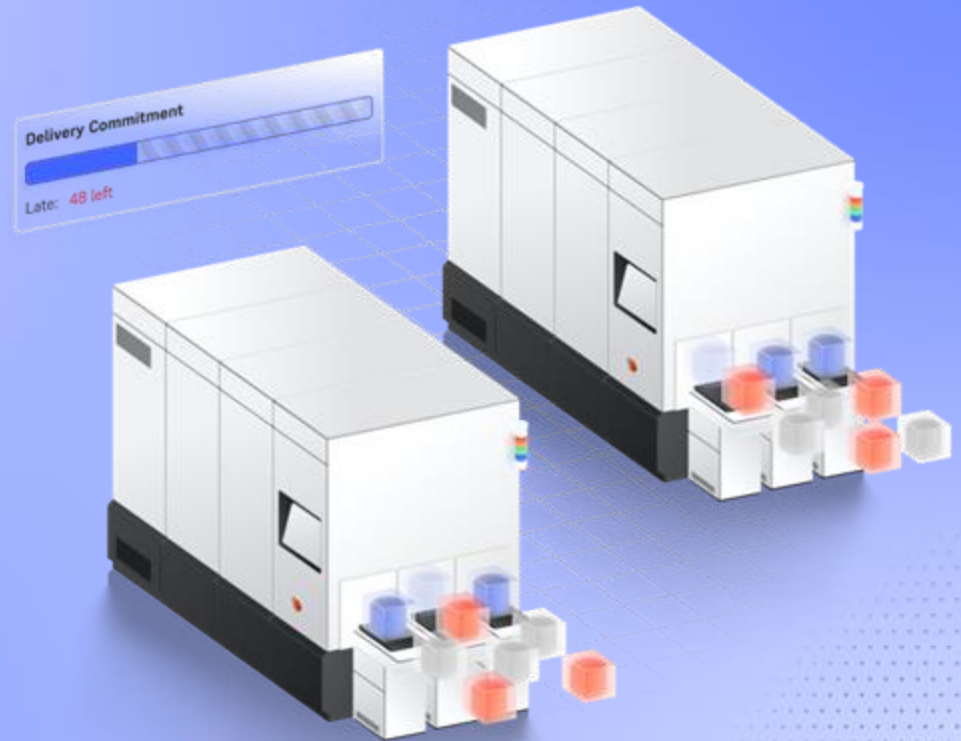


How it works: shipment control - What may be late?



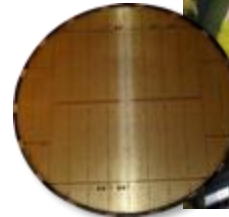


Seagate Deployment

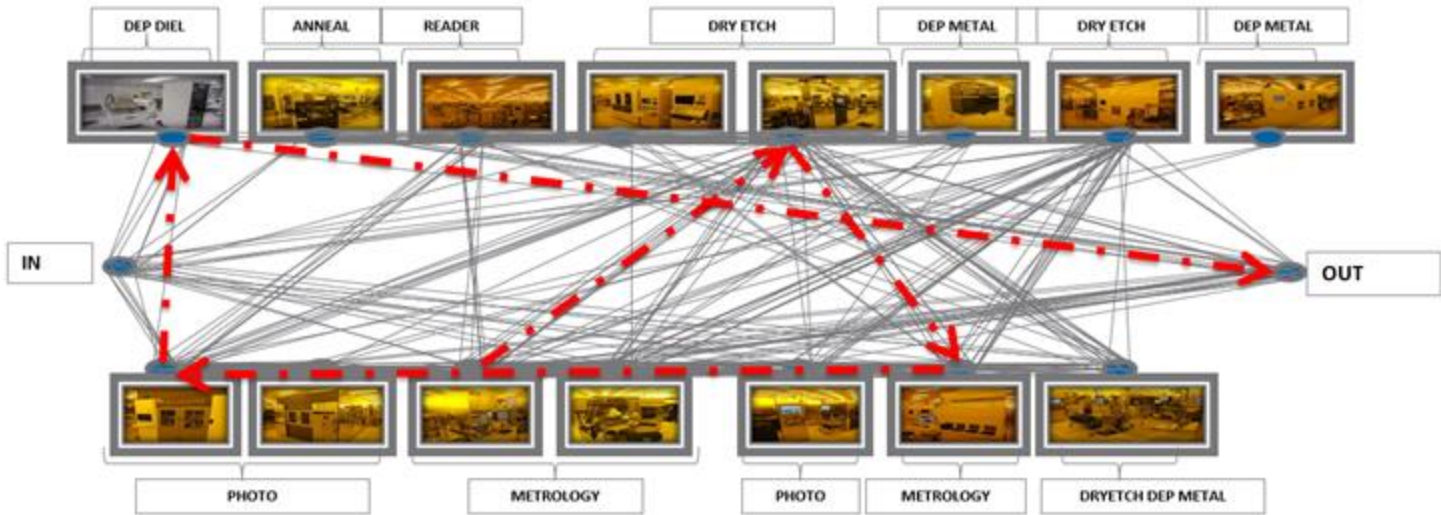


Seagate Technology

- A leader in mass-capacity data storage
- Innovation driven by belief that data holds infinite potential
- Seagate Springtown wafer fab
 - Established in 1993, one of two Seagate fabs
 - Sits at the heart of the \$25B worldwide data storage industry
 - The largest of only 5 facilities of its type in the world
 - Supplies around 25% of global demand for read-write heads for hard drives

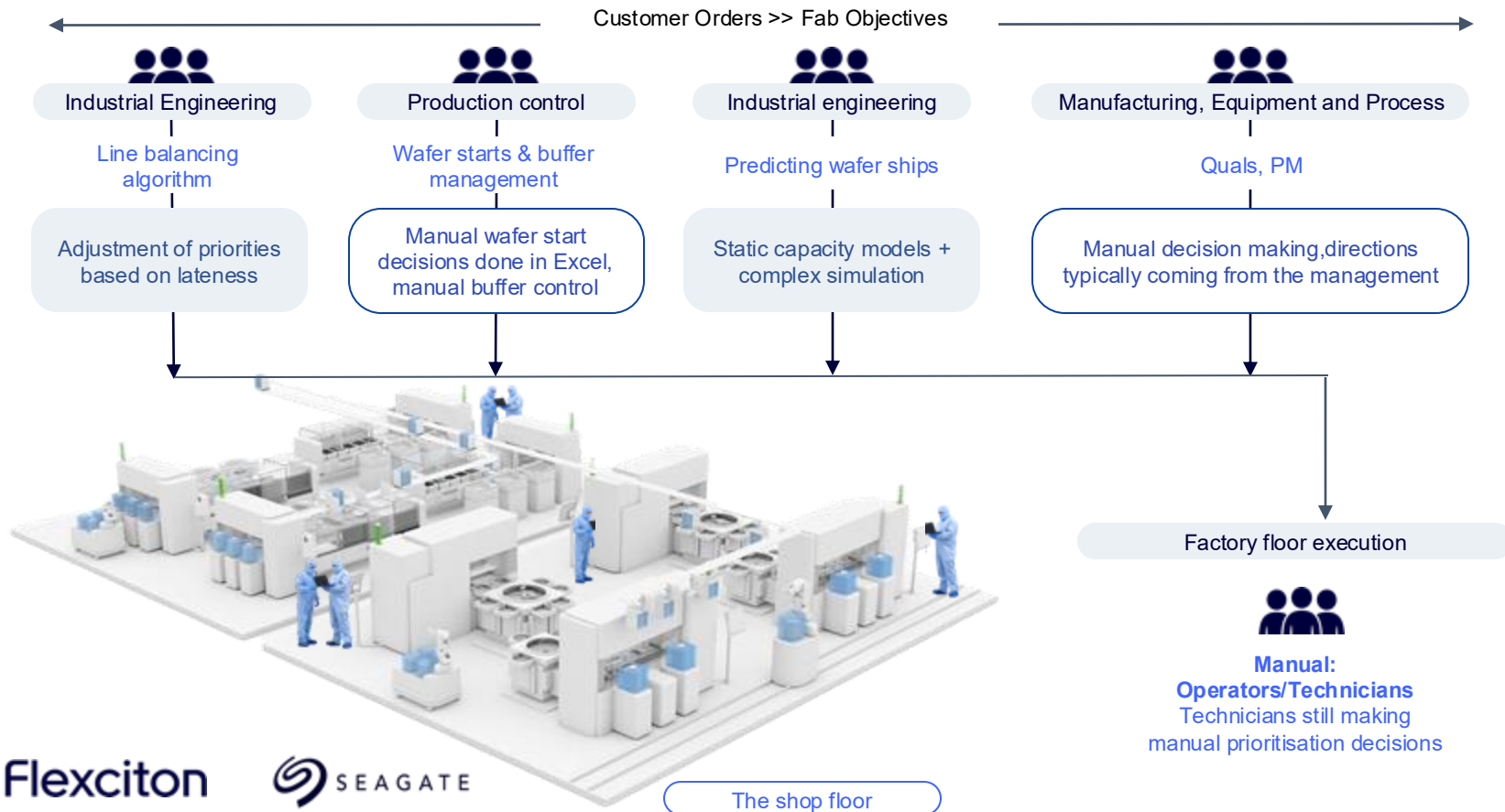


Seagate Wafer Fab – Level of Complexity



- 100k complex nano-devices on single wafer
- Highly re-entrant process
- Multiple internal fab-to-fab transits

Production Planning **before** Flex Planner deployment



Production Planning Opportunities

Improve velocity

Improve velocity whilst maintaining or increasing WIP levels

Avoid starvation

Reduce idle-no-WIP time at important toolsets

Balance the line

Prioritize WIP throughout the line equally, and avoid WIP bubbles

Flatten priorities

Control WIP flow with more granularity; no “quota problem”

Protect racks

Avoid overfeeding racks (searching time impacts toolset efficiency)

Gain foresight

Provide decision-makers with a forward-looking view of fab production

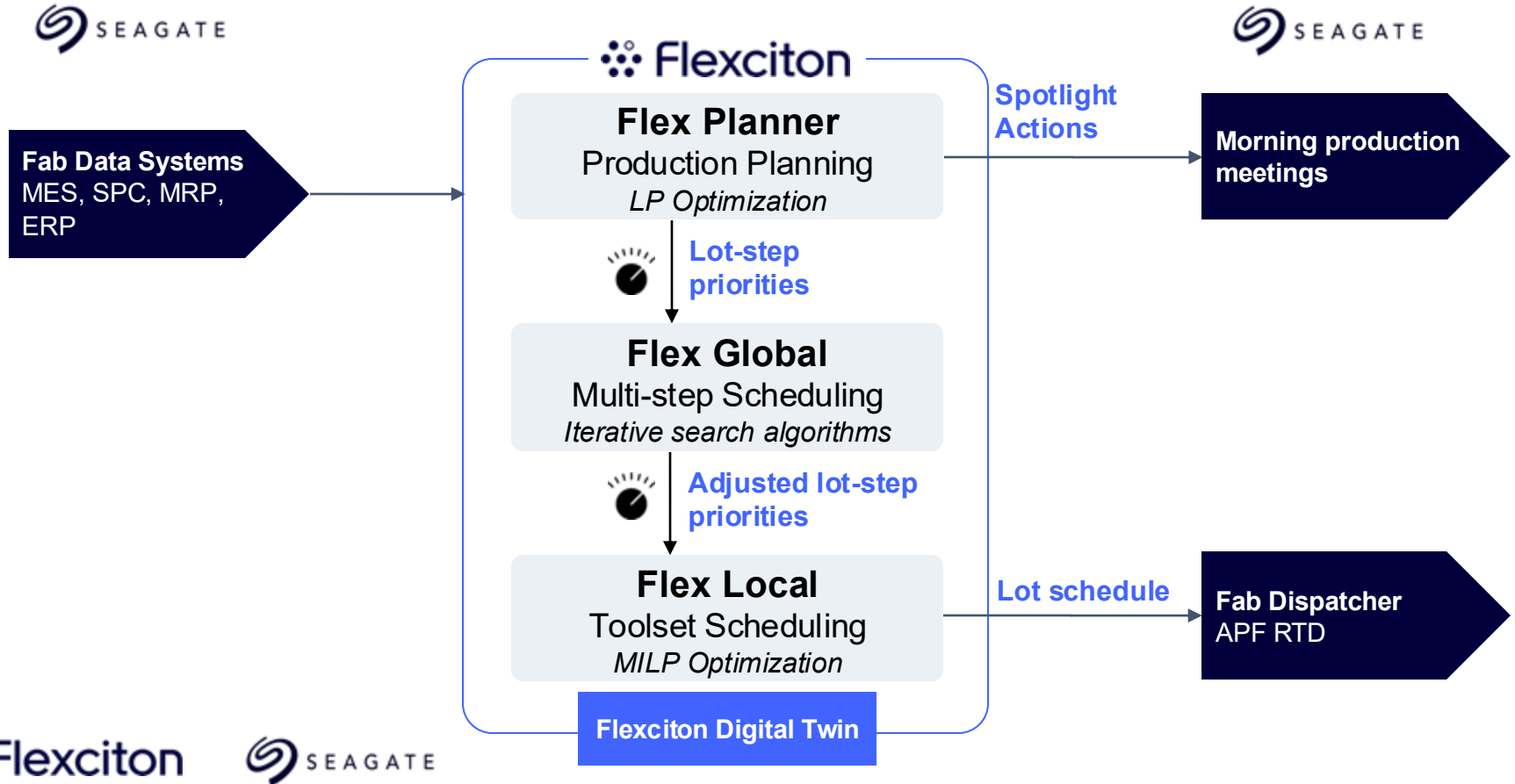
Take proactive action

Identify and quantify actions should be taken to improve production

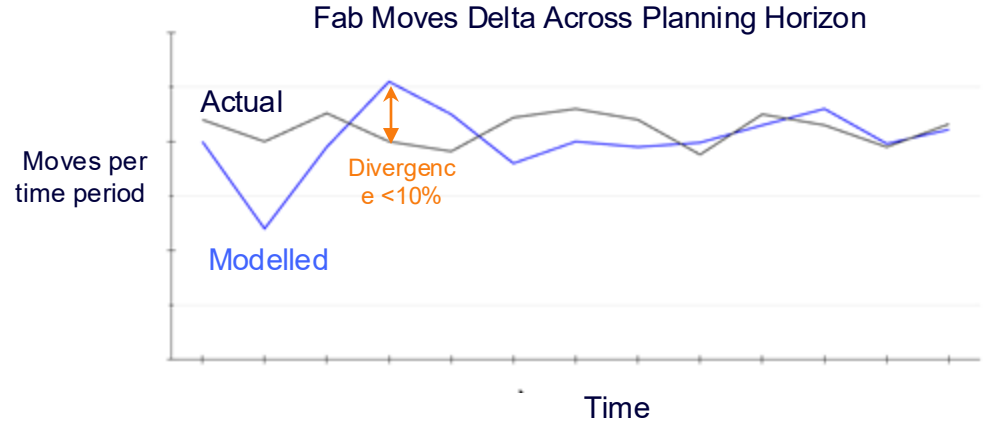
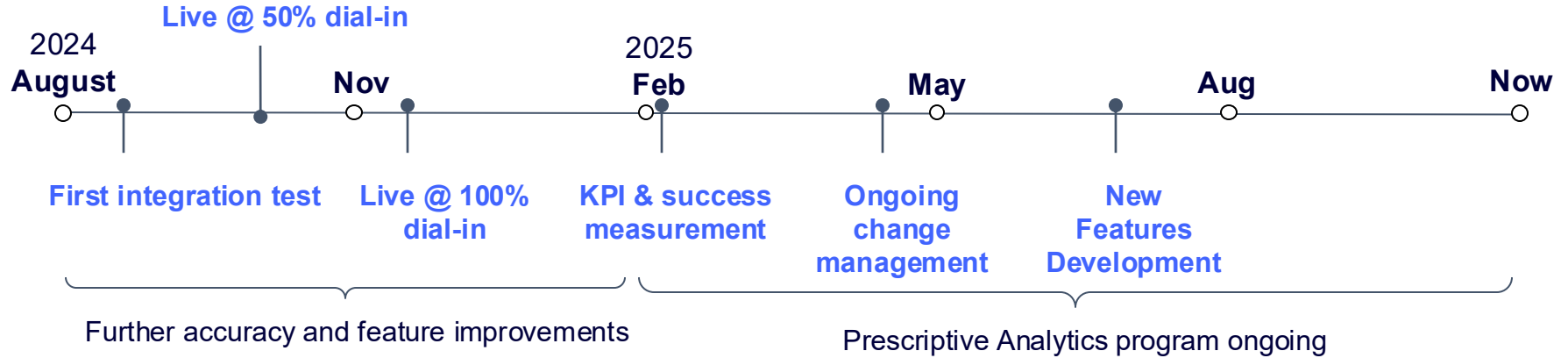
Align teams

Align the actions of all fab teams towards a common objective

AS IS Integration to Local Scheduling & Fab



Flex Planner Deployment



Spotlight Deployment

Workshops

Series of workshops with key members of Industrial Engineering, Manufacturing, Equipment Engineering, Process Engineering

Rapid Iteration

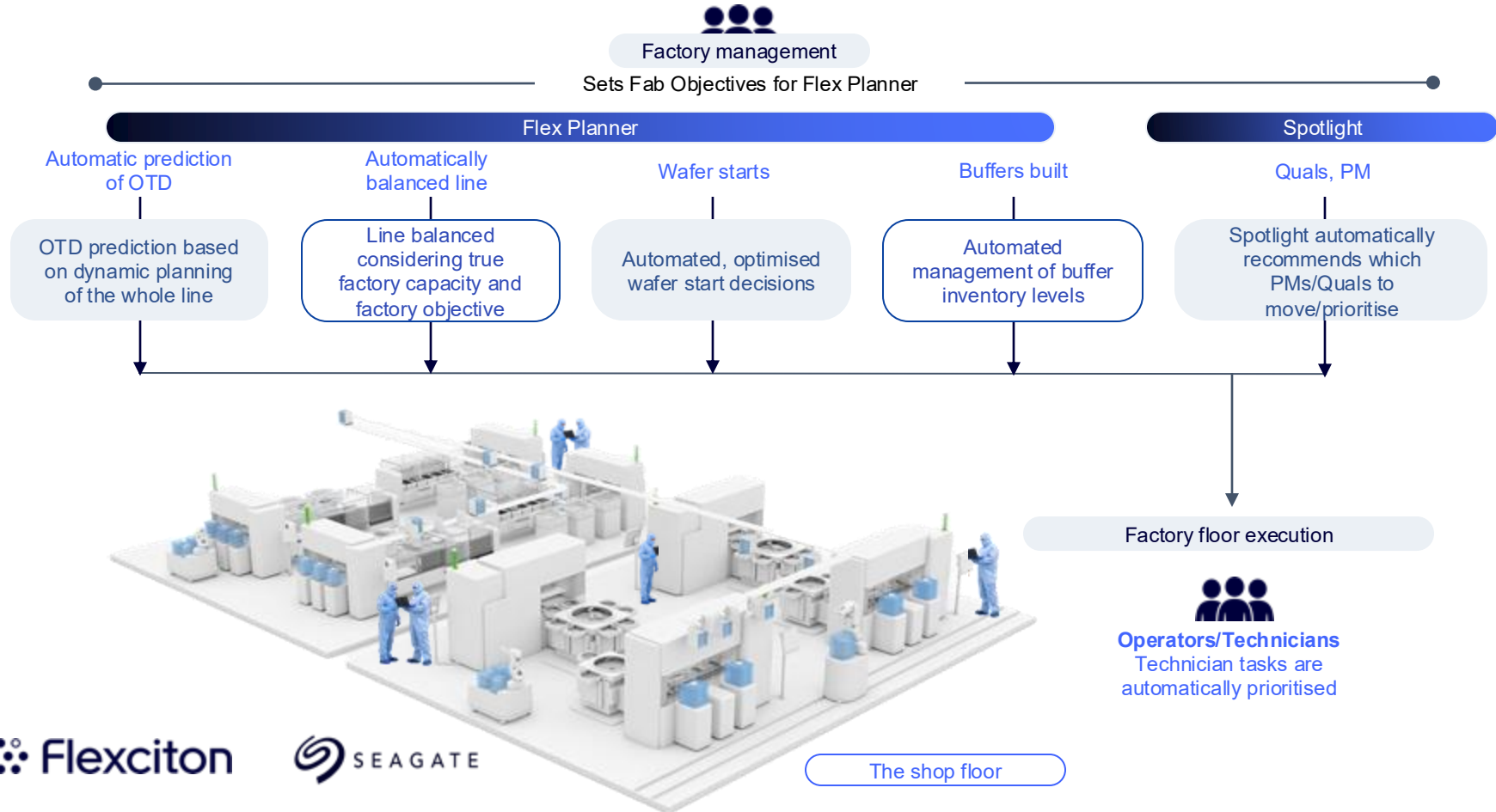
Product design & functional requirements rapidly iterated with Seagate internal deployment team

Algorithm Validation

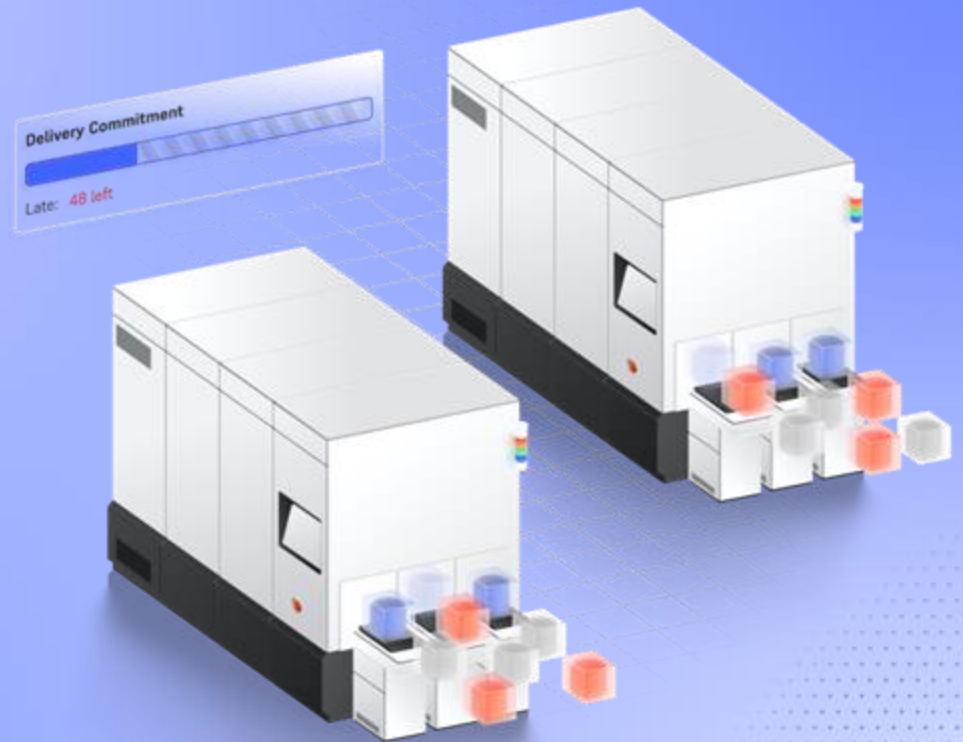
Algorithm technical design validated against Seagate's existing internal tools and manual analysis



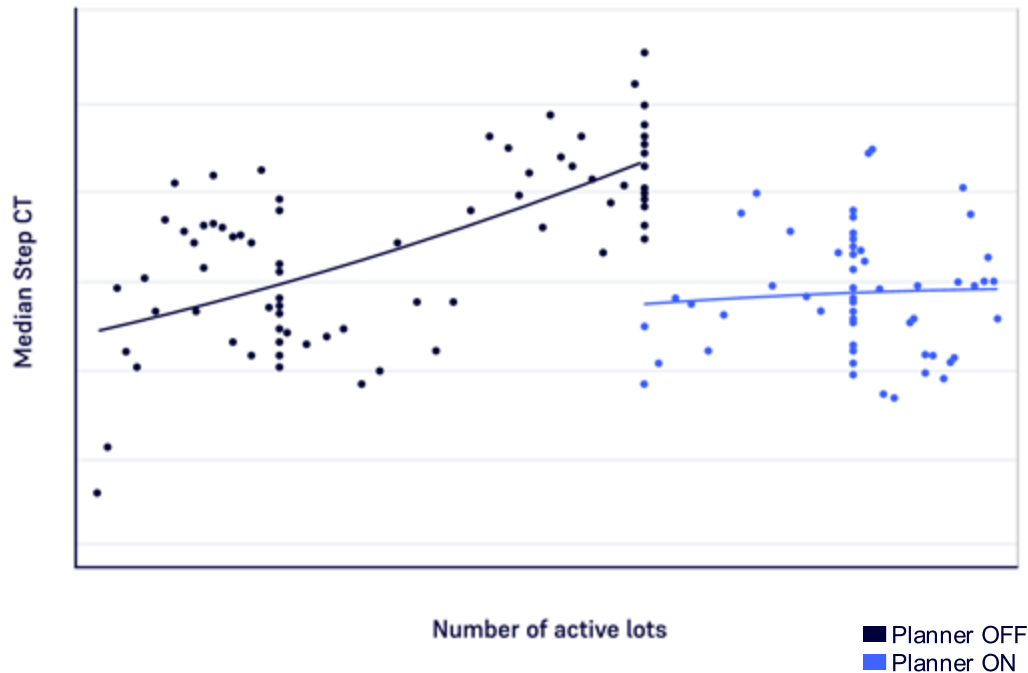
Production Planning **after** Flex Planner deployment



Results



Cycle Time vs WIP Level

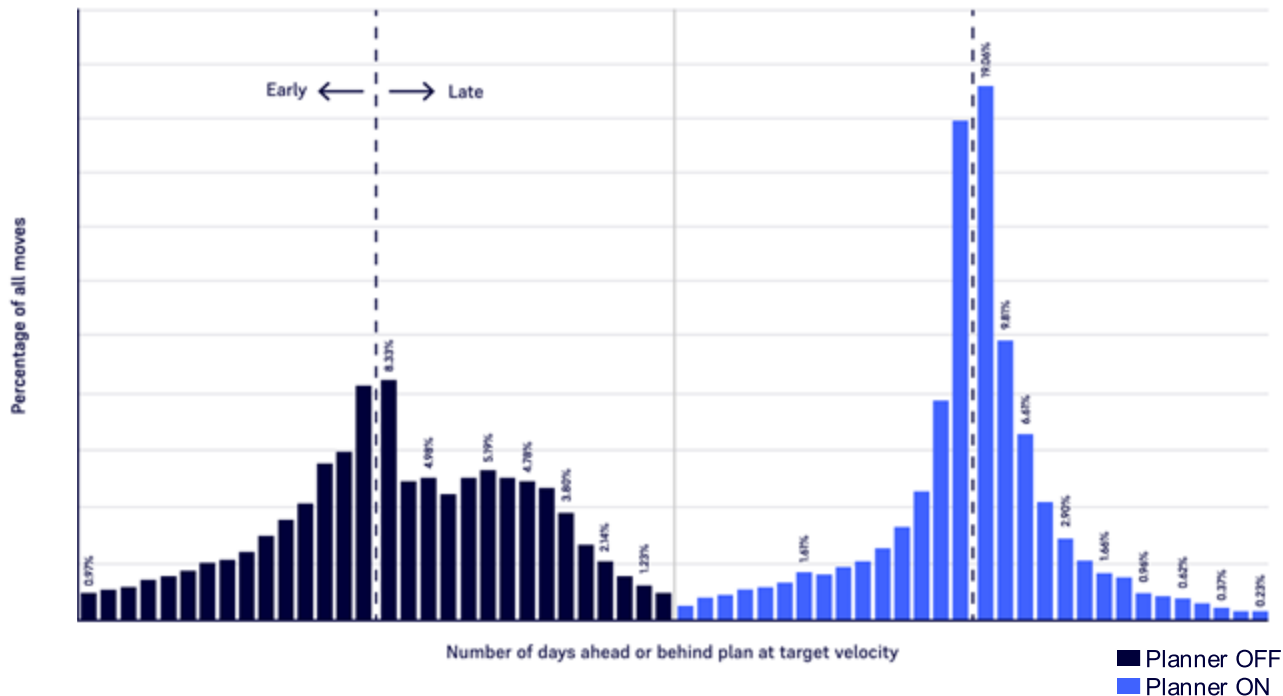


Overall fab WIP level over this 5 month period increased ~16%.

As expected, Planner dropped CT onto a lower trendline.

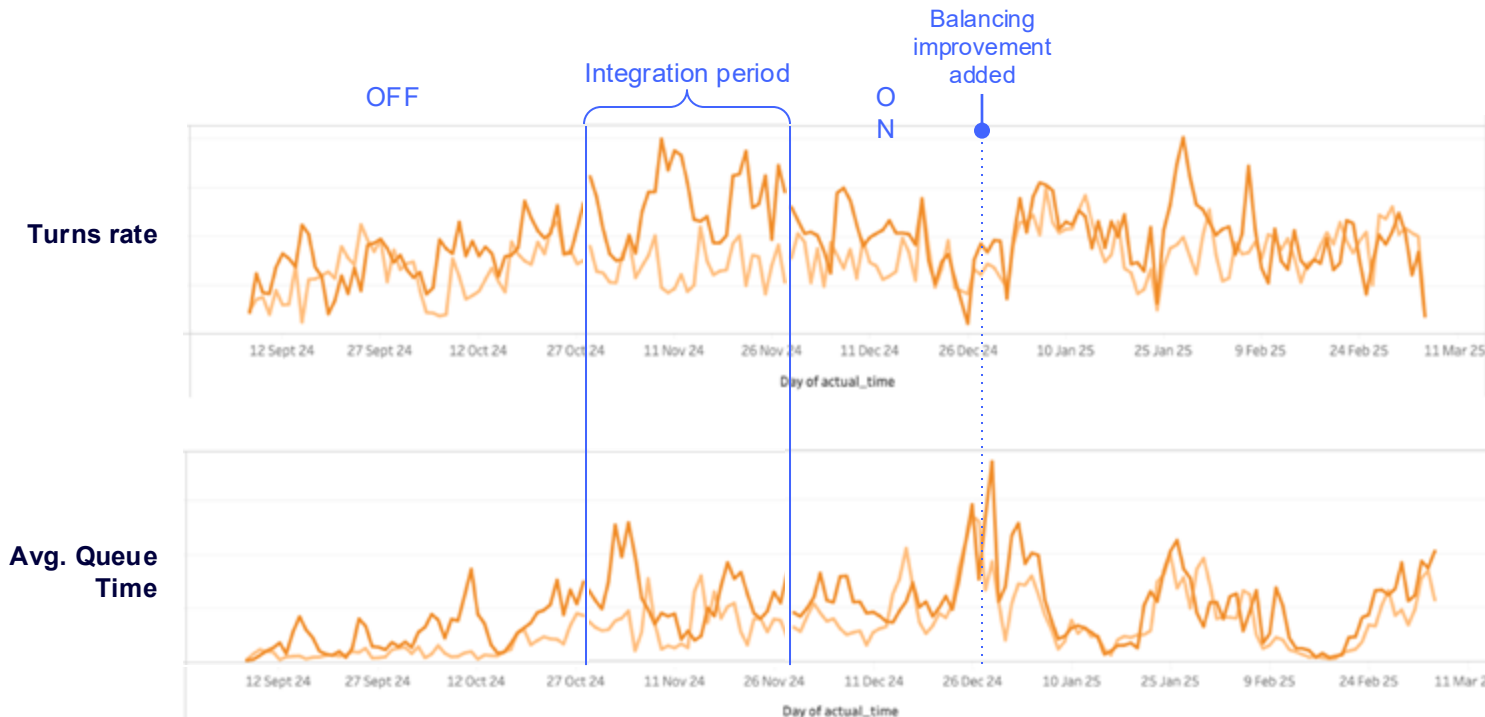
Can be thought of as dropping onto a new operating curve.

Days early/late relative to plan @ target velocity

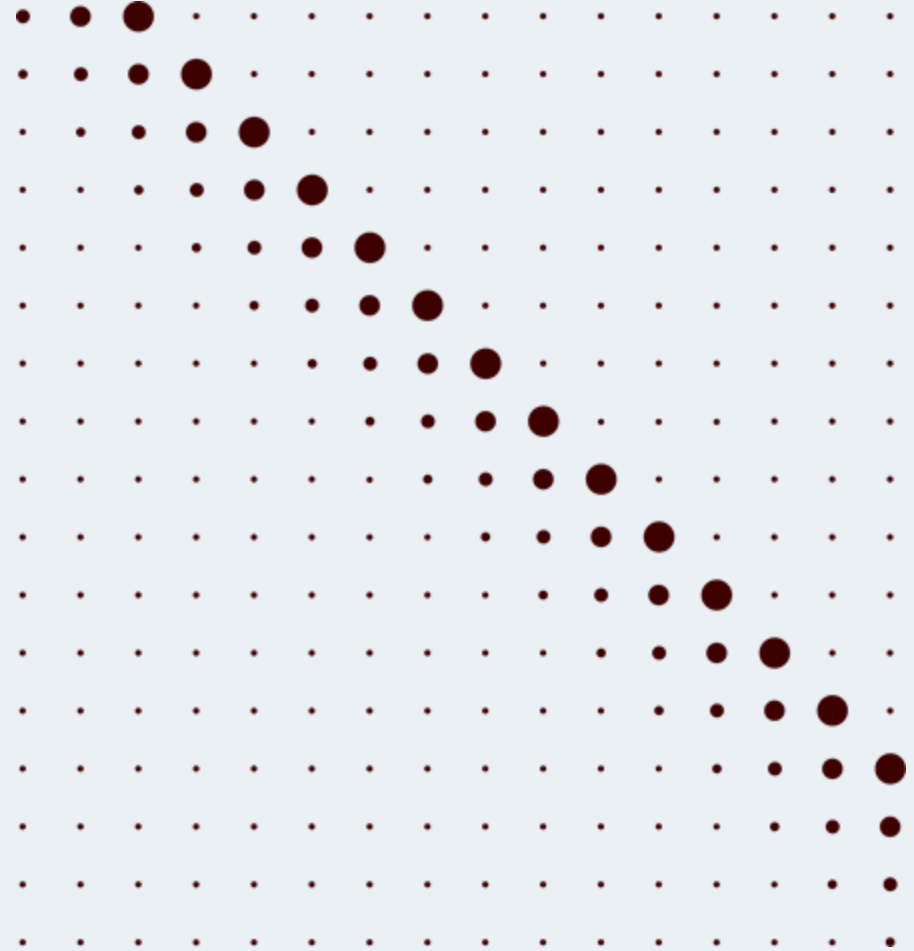


Balance of stages processed at a key toolset

There is no Flex Planner linearity objective - if demand is linear, then moves balance will be too



Summary



Summary

- Flex Planner has been **successfully deployed at Seagate Springtown** since October 2024. All planning decisions have been made by Flex Planner since the end of November 2024.
- Improvements to cycle time (at least **8%**), conformance to planned velocity (stdev reduced **57%**), and lateness (**-70%** over 7d behind plan) have been observed
- Deployment will contribute to meeting Seagate's high fab demand, with median lot velocity in the first two zones improving **15.2%** despite **10.3%** higher fab WIP level
- Further improvements expected from deploying **wafer starts planning, production targets interface**, and continuing **prescriptive analytics deployment**.

Thank you

flexciton.com

www.linkedin.com/company/flexciton

