Step into the Future:
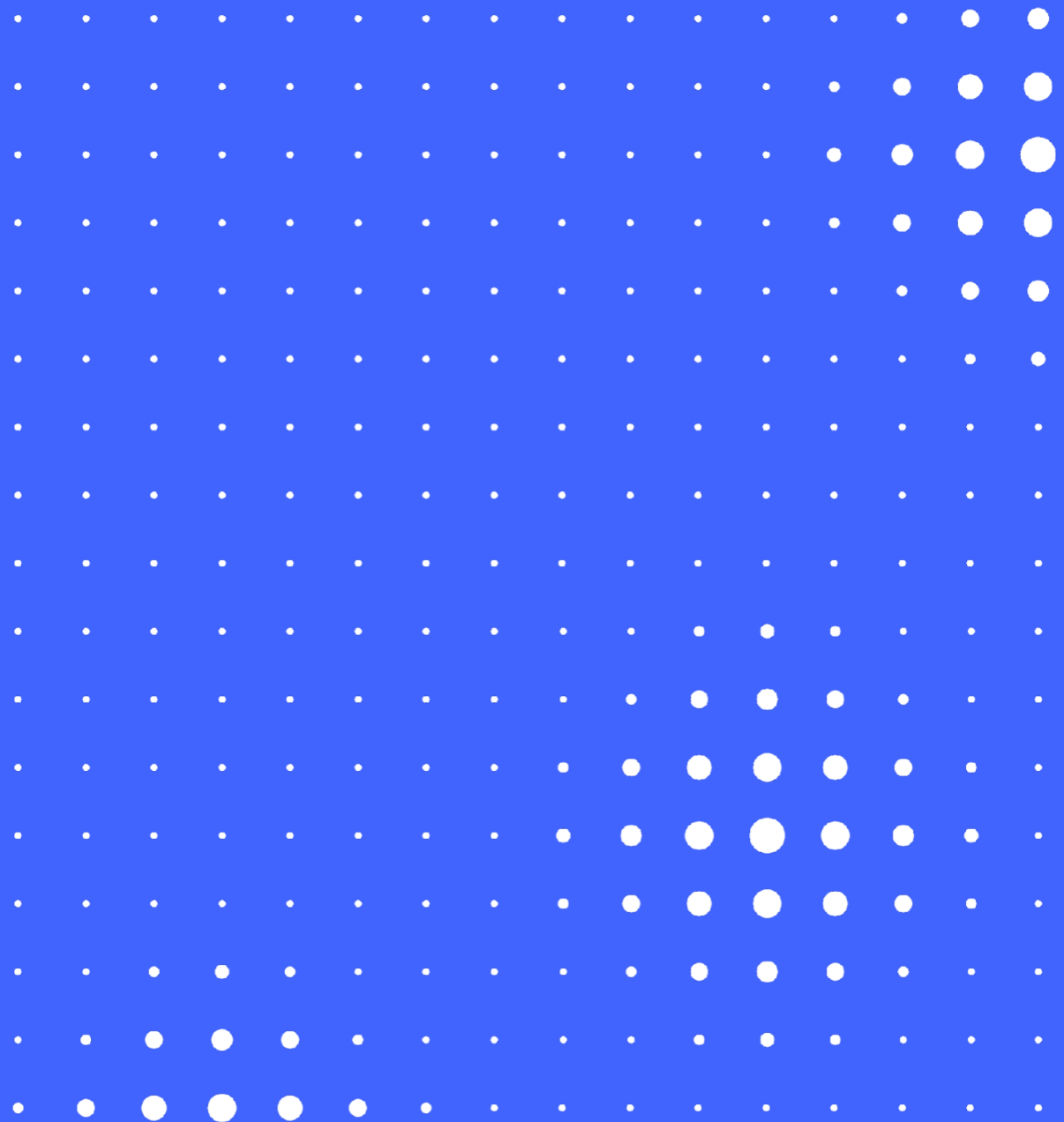Unparalleled Efficiency Gains with the Next Generation Optimisation-based Platform

Fab Management Forum, SEMICON Europa 2022
November 16th, 2022

Flexciton

Industry megatrends

Growing demand, and fabs can't expand fast

Industry cycles & supply chain disruption

Shortage of skilled labour

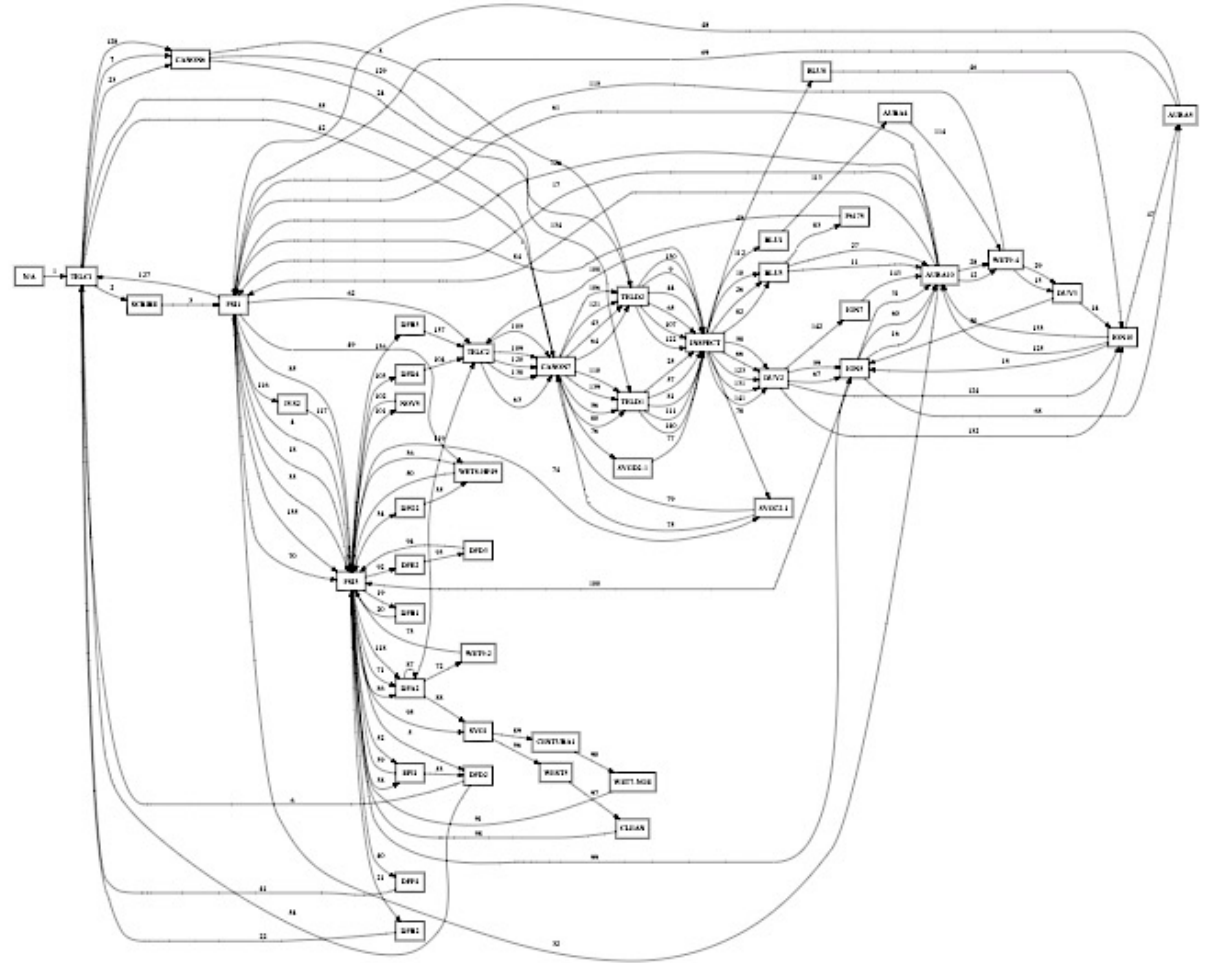**Complexity of semiconductor manufacturing**

Next-gen product complexity

The climate challenge place pressure on manufacturing efficiency and sustainability
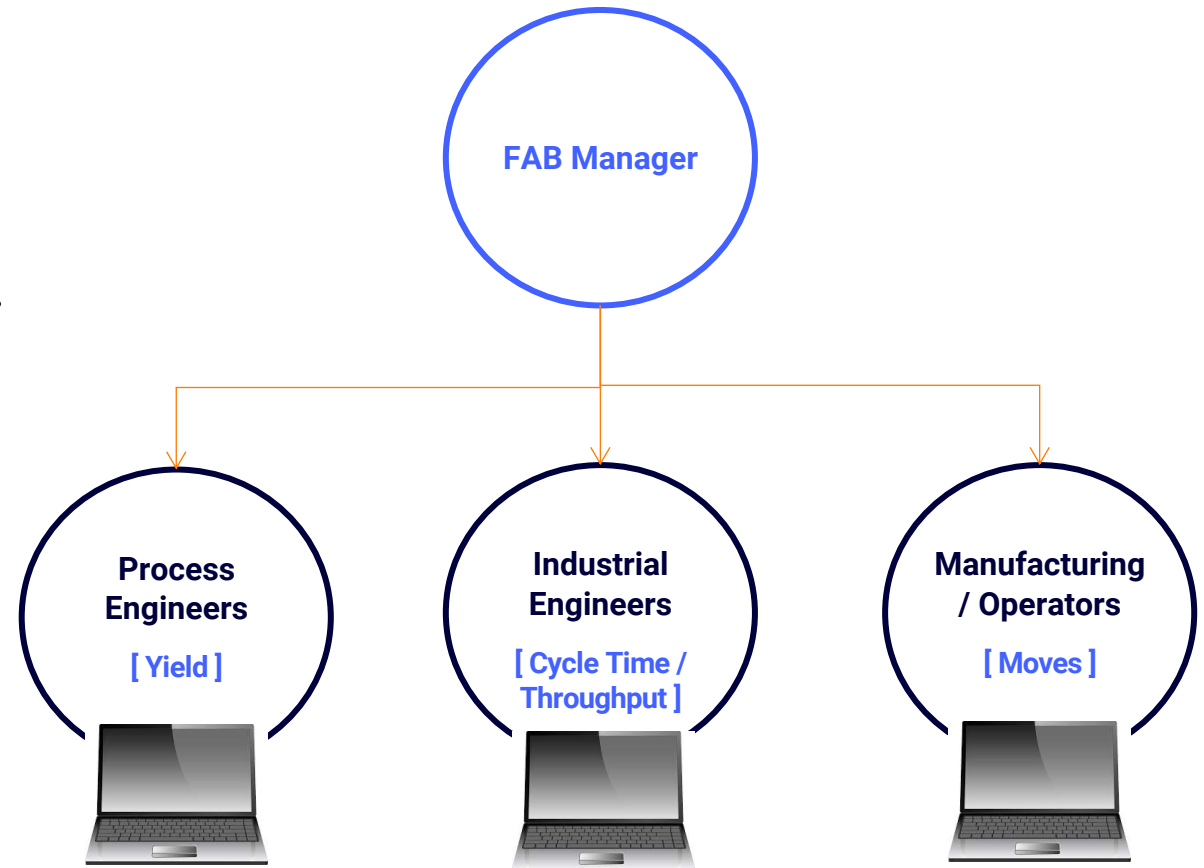
Flexciton

"
It's not rocket science - it's much more complicated

Flexciton

How fabs deal with complexity

- The overarching objectives are broken down into KPIs for each area.

- Each area tries to maximise their KPIs.

- Engineers use different kinds of complex specialised software to run and monitor these KPIs in each area.

FAB Manager

Process Engineers

[Yield]

Industrial Engineers

[Cycle Time / Throughput]

Manufacturing / Operators

[Moves]

Flexciton

The state of software in the industry

- Highly complex software where a human has many different controls and levers to operate it.

- Requires highly skilled users to operate / maintain.

- Impossible to operate in the most efficient way.

Flexciton

Example: production scheduling

Fab Goal e.g. minimize high priority cycle time + maximize capacity

Metrology	Photo	Furnace
Thin Film	Epitaxy	Clean

Scheduling means deciding which lots to run on each tool

Flexciton

Example: production scheduling

Fab Goal e.g. minimize high priority cycle time + maximize capacity

Metrology

Recipe A should always run on Tool 1

Photo

If the reticle is already on the tool, run the Lot there

Furnace

Always wait for a full batch

Thin Film

Process highest priority Lot first

Epitaxy

Run at least 10 Lots until recipe changeover

Clean

Clean just before a furnace run

Scheduling means deciding which lots to run on each tool

This is usually done by deciding on "rules" of how to run certain areas.

These rules *should* be trying to achieve the fab's goal.

Flexciton

Example: production scheduling

Fab Goal e.g. minimize high priority cycle time + maximize capacity

Metrology

Recipe A should always run on Tool 1

Photo

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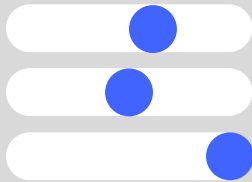
Clean

Clean just before a furnace run
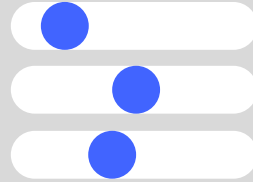
Software is either:

1. Self-programmed rules

Example: production scheduling

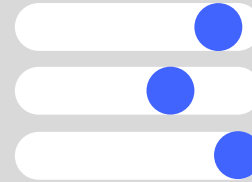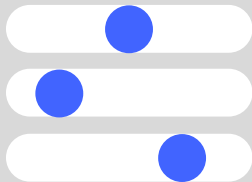Fab Goal e.g. minimize high priority cycle time + maximize capacity

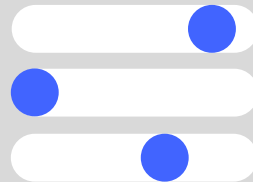**Metrology**
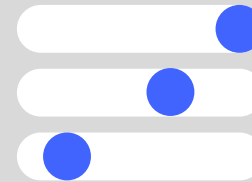
Photo

Furnace

Thin Film

Epitaxy

Clean

Software is either:

1. Self-programmed rules

OR

2. Out-of-the-box rules which need to be configured

Flexciton

Example: production scheduling

Fab Goal e.g. minimize high priority cycle time + maximize capacity

Metrology

Photo

Furnace

Thin Film

Epitaxy

Clean
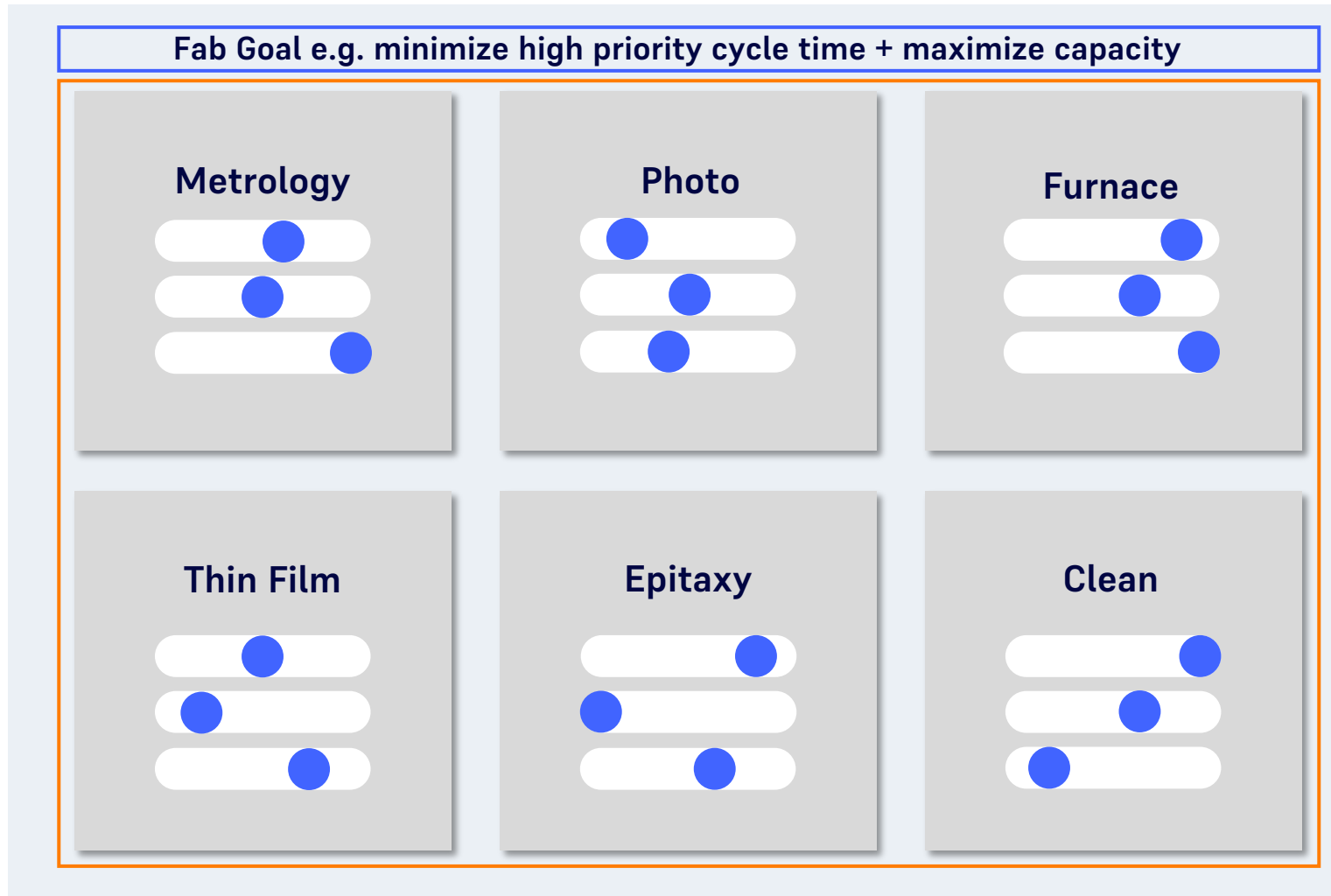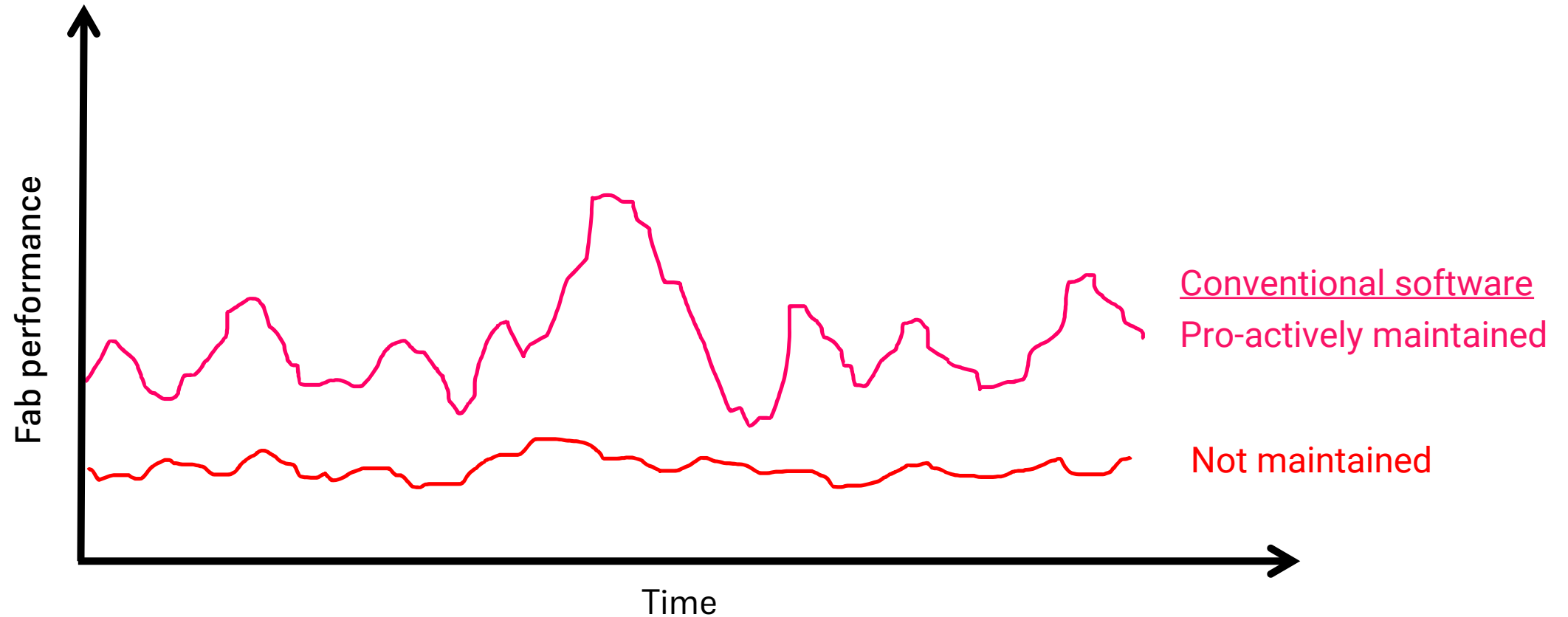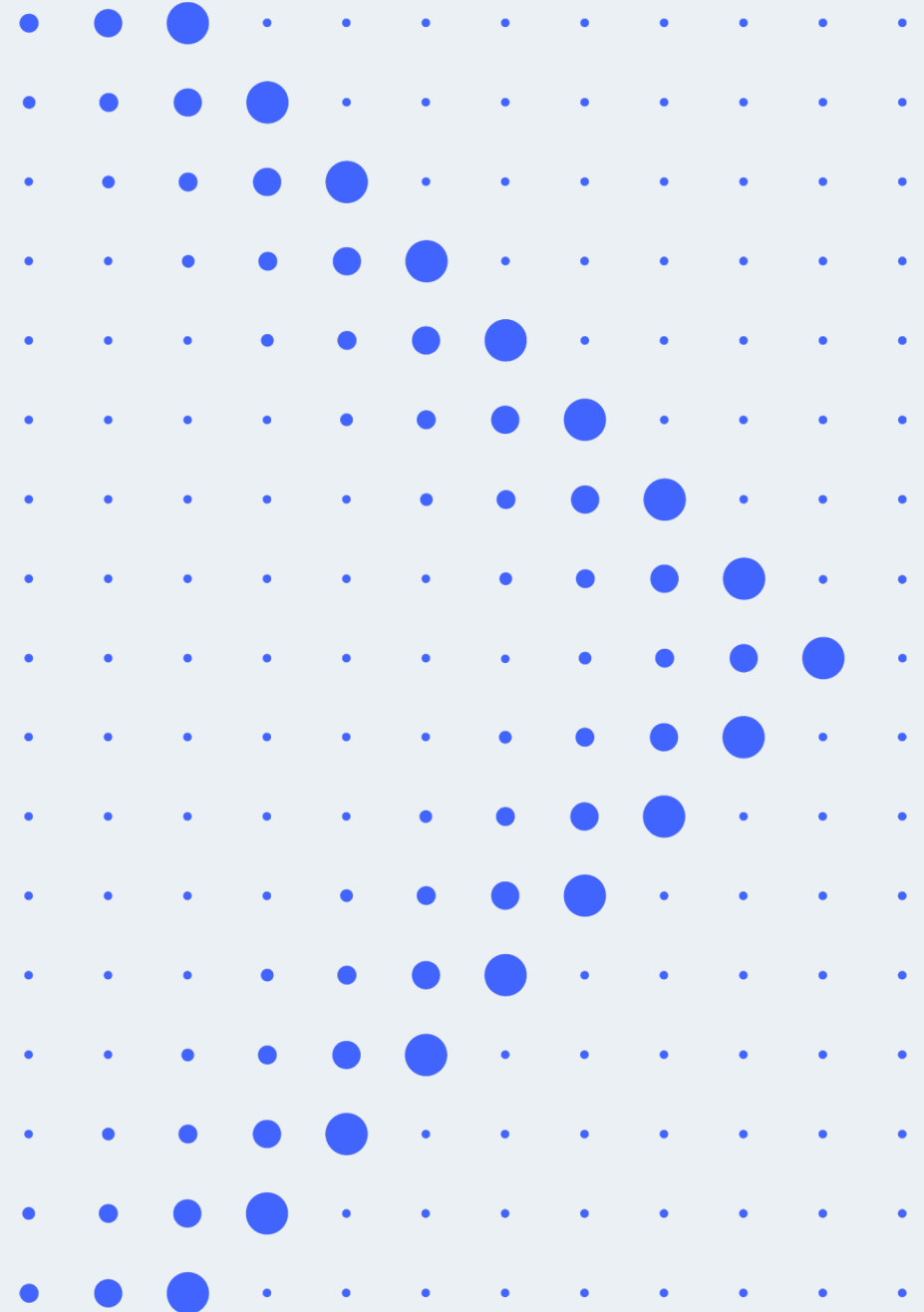
Configuring all of these rules to achieve the fabs goal is almost impossible and requires constant attention.

Flexciton

Production scheduling: Fab performance

Conventional software
Pro-actively maintained

Not maintained

Time

Fab performance

We built Flexciton to help fabs conquer complexity and accelerate progress

Flexciton

Flexciton is an advanced optimisation platform built to simplify and streamline chipmaking

5 years

Experience working with semiconductor manufacturing

40 engineers

Dedicated to optimising wafer fabrication

500+ publications

Regular speakers at industry tech conferences
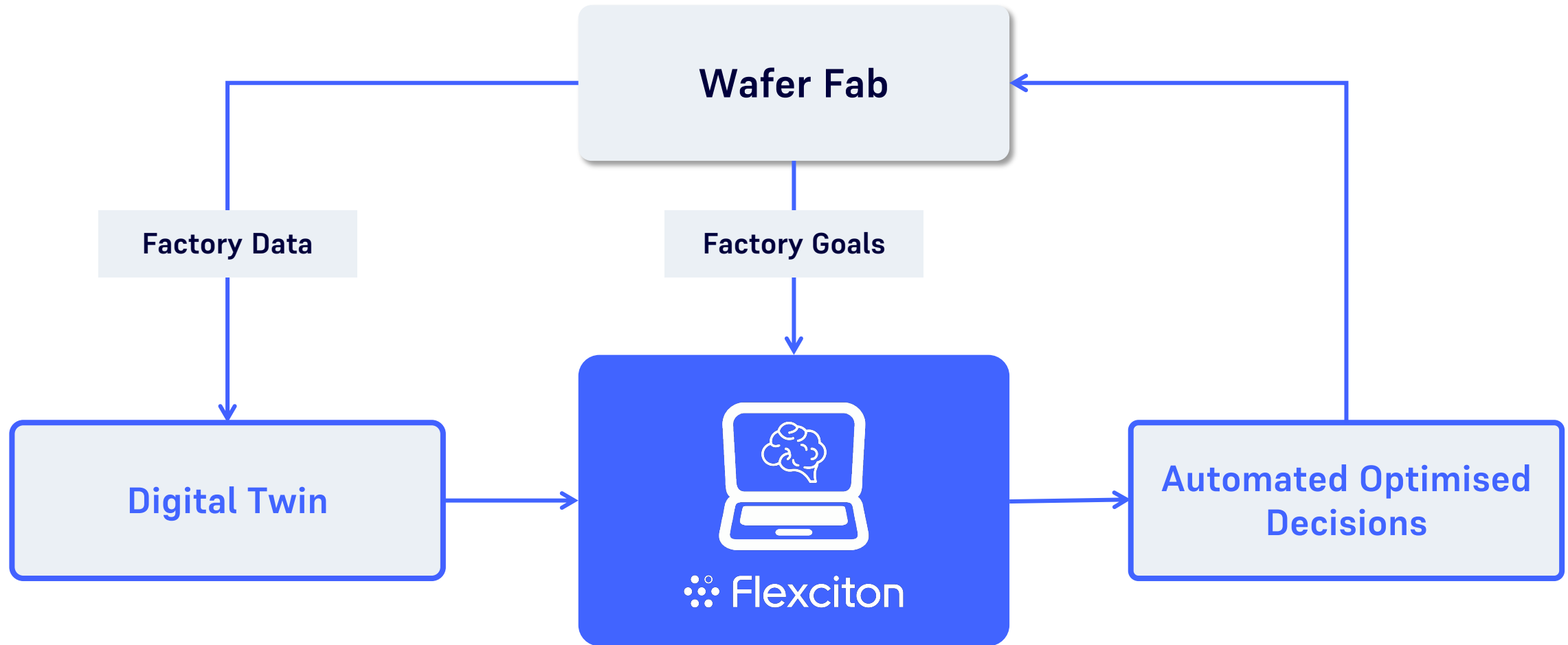Winter Simulation Conference, ASMC, INFORMS

HQ

Based in London, working with chipmakers globally

2020

Semicon West Best of West Award
The finalist

Flexciton

The Flexciton Optimisation Platform
Our core application: scheduling optimiser

Wafer Fab

Factory Data

Factory Goals

Digital Twin

Flexciton

Automated Optimised Decisions

Flexciton

Describe what you want and get it automatically

Describe Fab Goal →

Metrology

Photo

Furnace

Wet Bench

Epitaxy

Clean
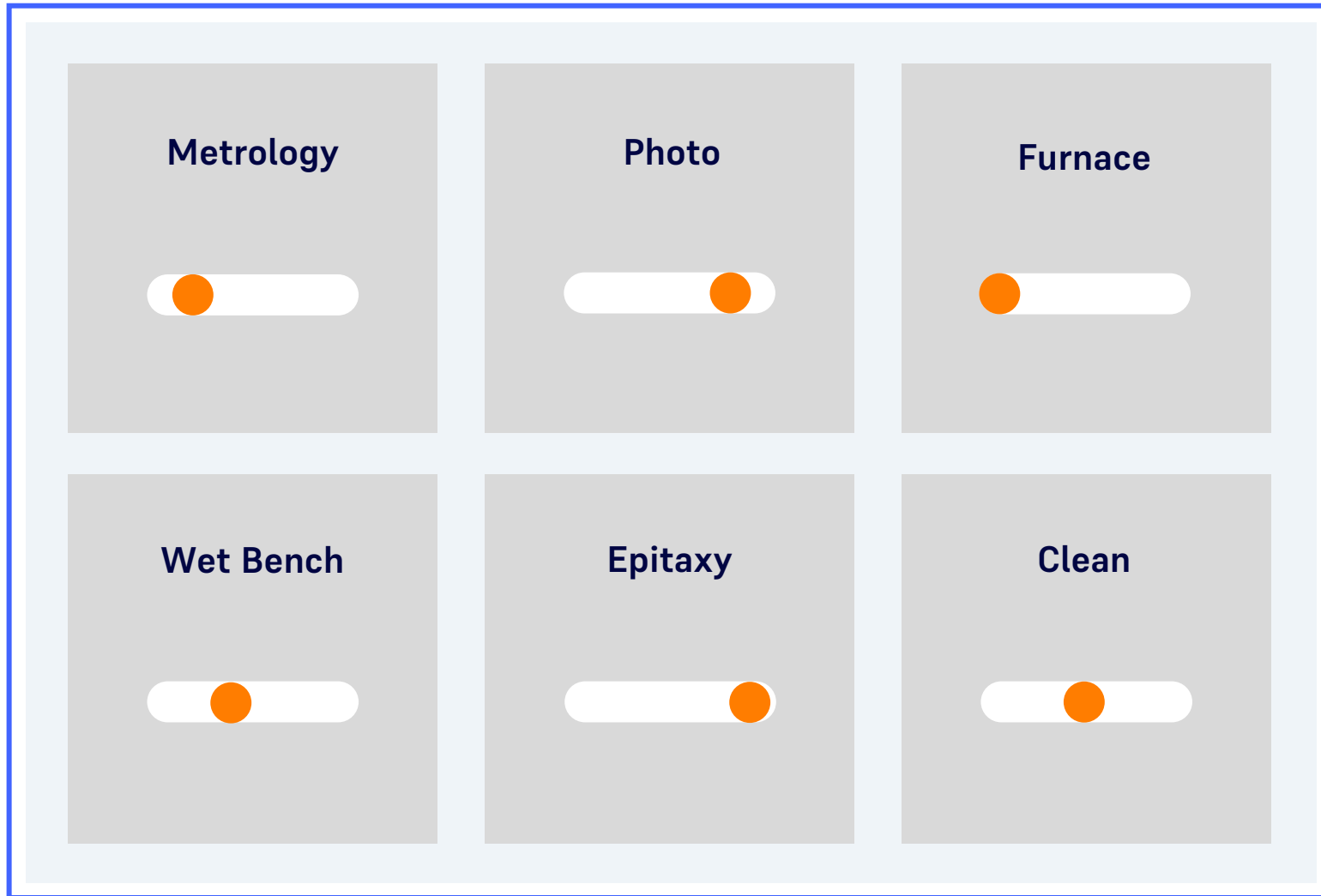
← **Automatically Optimised**

Flexciton

How does Flexciton work

Our core application: scheduling optimiser

- Designed to solve any scheduling problem, including:

    - whole line balancing

    - multistep constraints (timelinks)

    - photo tools (reticles)

    - batch tools

- Modern interface allowing effortless configuration and consistent performance

- Cloud-native, globally hosted

⁝⁝ Flexciton

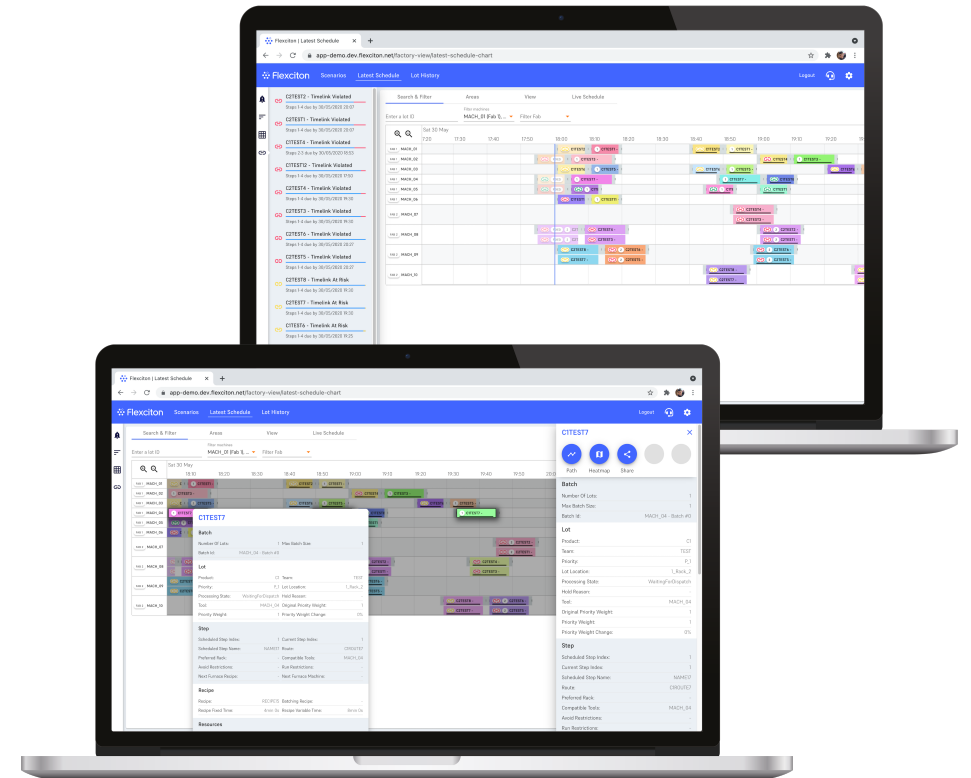# How does Flexciton work

Our core application: scheduling optimiser

Manufacturing
Execution System

Factory data

Flexciton optimiser
Setting fab objectives

Flexciton optimiser
Generating schedules

Local toolset
optimisation

Fab-wide
optimisation

Release Decisions

one loop every 4 min

Real-Time Dispatcher

Dispatching

Flexciton

How does Flexciton work

Our core application: scheduling optimiser

Manufacturing
Execution System

Factory data

Flexciton optimiser
Setting fab objectives

one loop every 4 min

Flexciton optimiser
Generating schedules

Schedules 3h ahead,
optimizes toolset KPIs

Local toolset optimisation

Fab-wide optimisation

Release Decisions

Schedules 24h ahead,
predicts & reduces
bottlenecks, handles
multi-step constraints

Real-Time Dispatcher

Dispatching

Flexciton
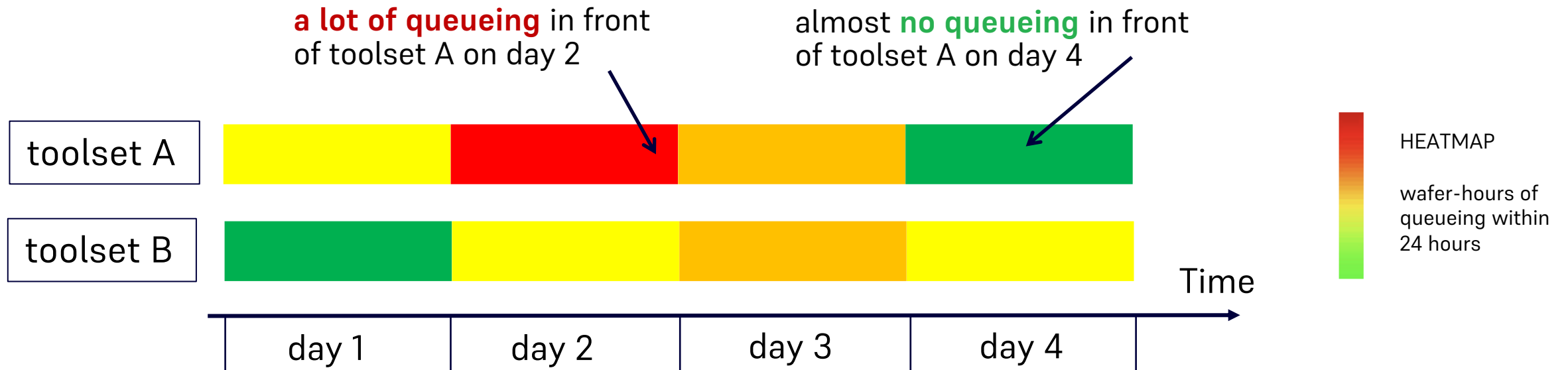
How does Flexciton work

An overview of a fab status quo

Our system analyses historical transactional data to find out how bottlenecked is each toolset over time

a lot of queueing in front of toolset A on day 2

almost **no queueing** in front of toolset A on day 4

toolset A

toolset B

Time

day 1 | day 2 | day 3 | day 4

HEATMAP

wafer-hours of queueing within 24 hours

Flexciton

How does Flexciton work

An overview of a fab status quo

We map the current status quo of a fab and look at WIP patterns across the whole fab.

Toolsets

Flexciton

How does Flexciton work

An overview of a fab status quo

We map the current status quo of a fab and look at WIP patterns across the whole fab.

Bottleneck
Toolsets

Flexciton

How does Flexciton work

An overview of a fab status quo

We map the current status quo of a fab and look at WIP patterns across the whole fab.

Bottleneck Toolsets

Bottlenecks move over time

How does Flexciton work

An overview of a fab status quo

We map the current status quo of a fab and look at WIP patterns across the whole fab.

Our Fab-Wide Optimisation helps to balance the load across all toolsets, reduce the bottleneck peaks and send the right WIP at the right time

Bottleneck Toolsets
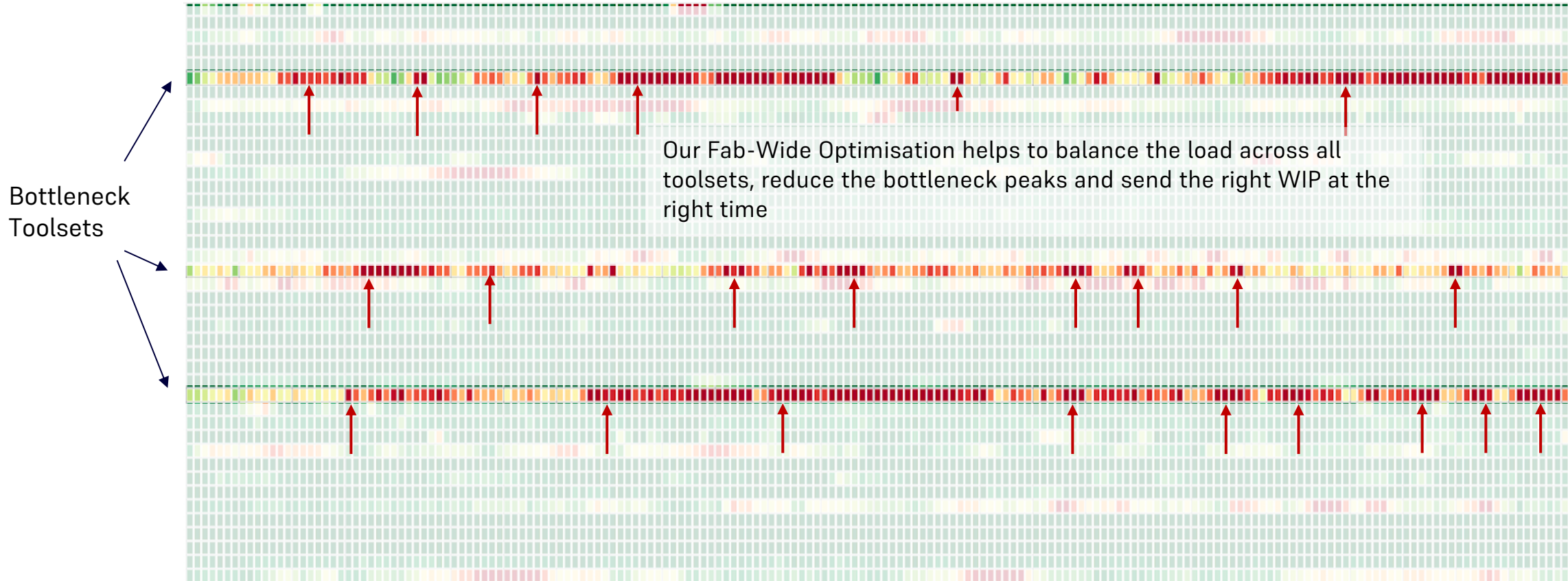
Flexciton

How does Flexciton work

Focus on your goals, not parameters

Set your goals & go

Optimise your fab production

Improve KPIs & deliver goals

- No rule-setting required
- Minimizes human decision making
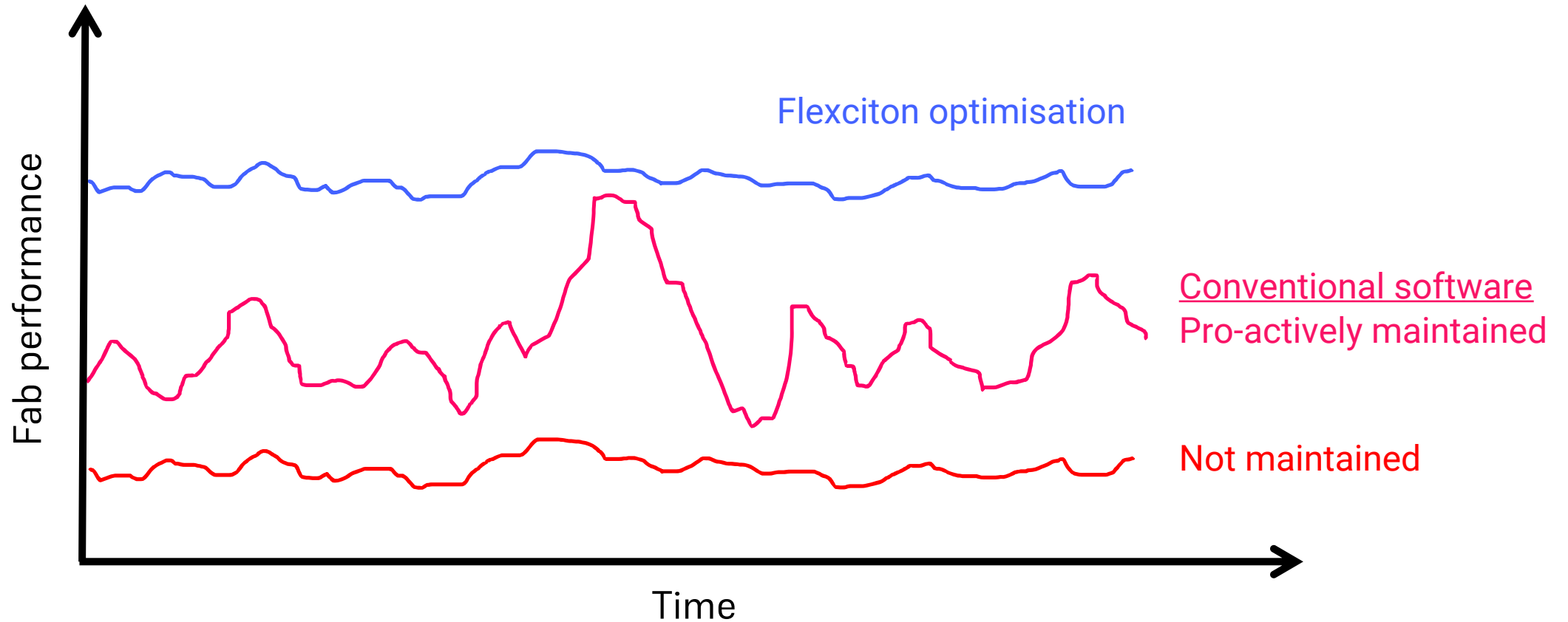- Can be integrated with any existing software or workflow
- Modern and intuitive UI

- The system is designed to work with any constraints found in a fab
- Automatically optimises to meet your fab's KPIs
- Schedule all levels: Lots, Reticles, Pods, Maintenance

- Delivers consistent results at the most complex tools and constraints
- Reduce average cycle time, timelink violations and reticle moves
- Improve on-time delivery
- Increase batch size (tool utilization)
- Increase operators' efficiency
- guarantees 10x ROI

Flexciton

Resulting fab performance

Flexciton optimisation

Conventional software
Pro-actively maintained

Not maintained

Fab performance

Time

Flexciton

What makes Flexciton solution unique

The only goal-centric and self-adapting scheduling solution

- The fab sets the goals, the solution finds the optimal way to reach those goals
- Delivers exceptional results even for the most challenging constraints
- Easily scales to fab-wide multi-toolset decision making
- Performs consistently in every situation
- Automatically adjusts to the ever-changing fab environment

The only solution that does not require setting and maintaining the rules

- Does not require setting or maintaining IF-THEN rules
- No skilled users required
- No tribal knowledge loss risk
- Quick onboarding of new operators

The only cloud-native solution

- To solve a problem of such complexity, we use the latest and most powerful and secure cloud solution
- Enables the delivery of optimised schedules within minutes
- Easy to scale to multiple fabs
- We can update the software automatically without disrupting the fab's operation

Flexciton

Case Studies

Flexciton
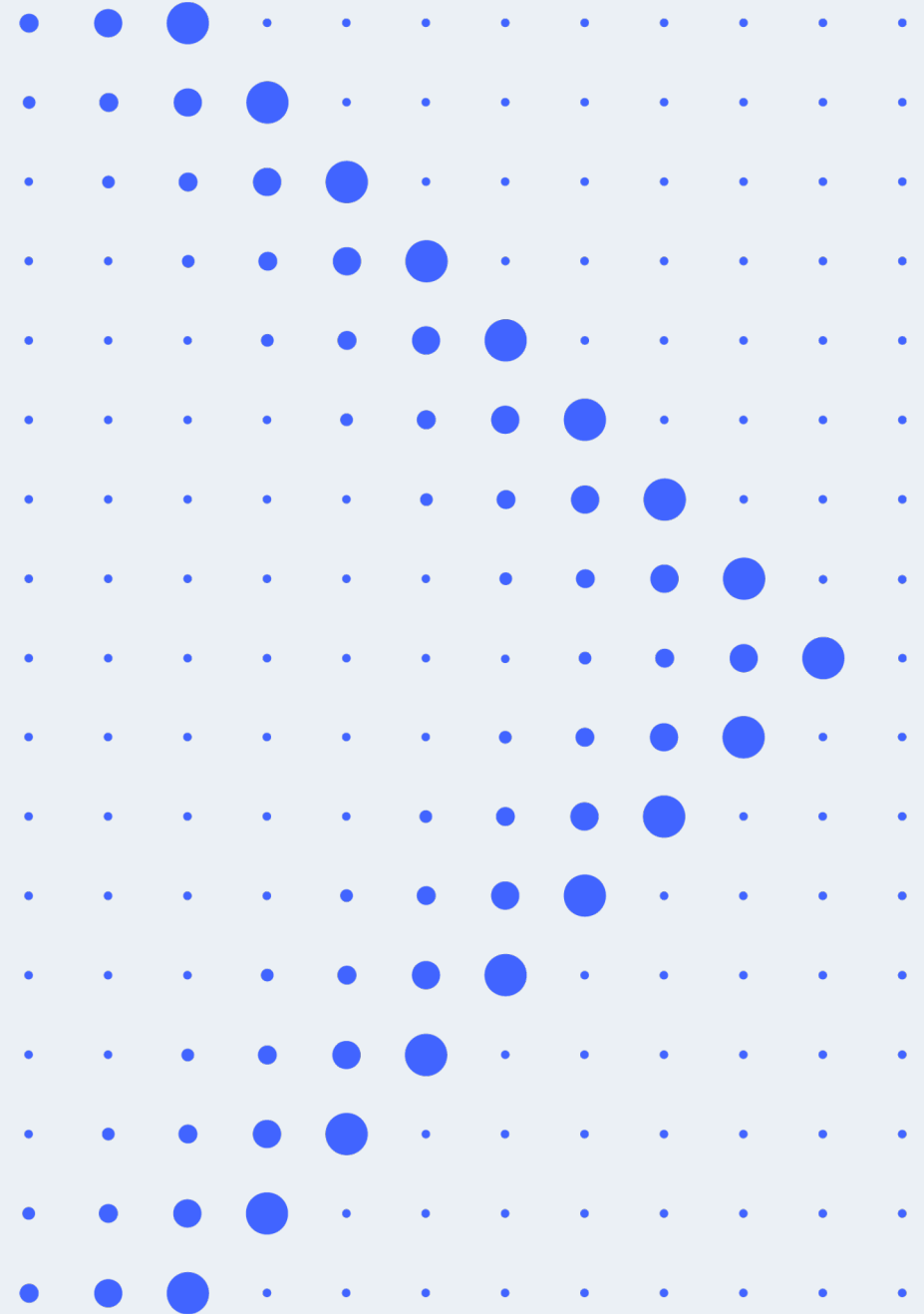
# Case study #1: Gains at Photolithography Area

SEAGATE

Introduction

- Long and highly re-entrant process with 1,600 steps.

- The photolithography area sets the cadence of the Seagate facility and with the added complexity of reticle movement, it's critical to have an optimised schedule.

- The results are from one toolset (live production environment), with an internal reticle library, where reticles can be moved individually between tools and cabinets.

Flexciton

Case study #1: Gains at Photolithography Area

Results

5.3% reduction in reticle moves with **9.4%** increase in lot moves

Reticle Moves

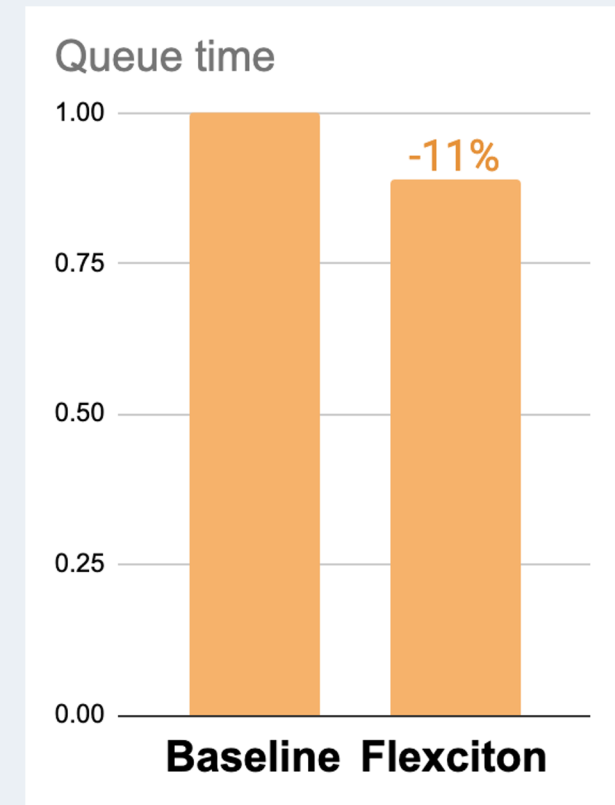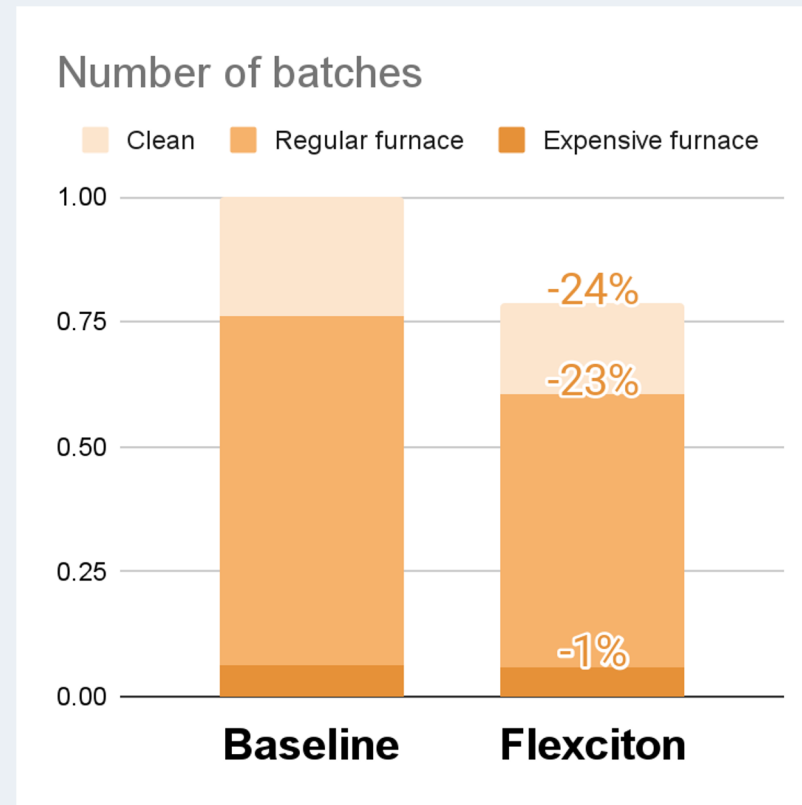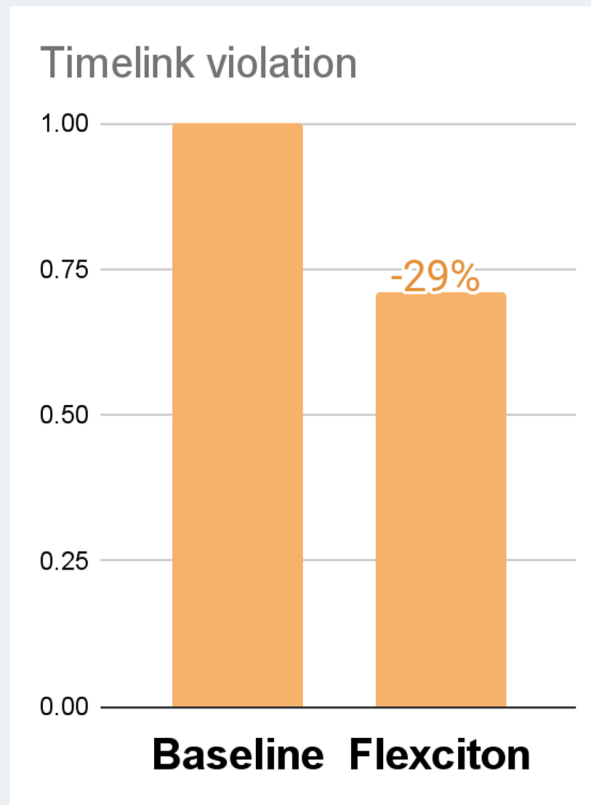Lot Moves
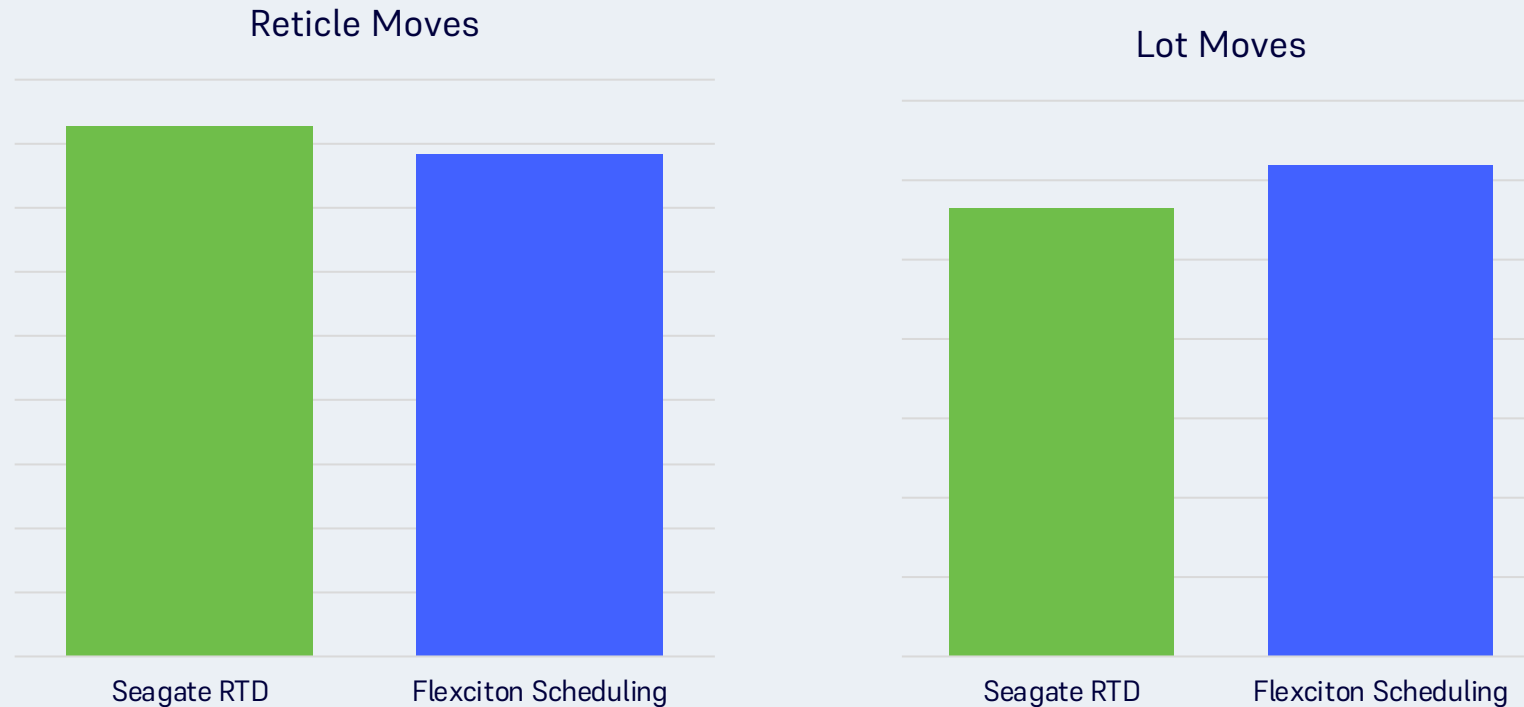
Case study #2: Gains at Clean & Furnace

Introduction

- Renesas challenged us to solve their scheduling problem with multi-step batch tools with timelinks constraints.

- We applied our advanced optimisation technology in a simulation environment encompassing the scheduler, a digital twin of the factory state, a schedule executor and a real-time-dispatch simulator.

Case study #2: Gains at Clean & Furnace

RENESAS
BIG IDEAS FOR EVERY SPACE

Results

29% reduction in timelink violations, **22%** reduction in number of batches and **11%** reduction in queue time

Timelink violation

Baseline — Flexciton: -29%

Number of batches

Legend: Clean | Regular furnace | Expensive furnace

Baseline — Flexciton: -24%, -23%, -1%

Queue time

Baseline — Flexciton: -11%

Flexciton

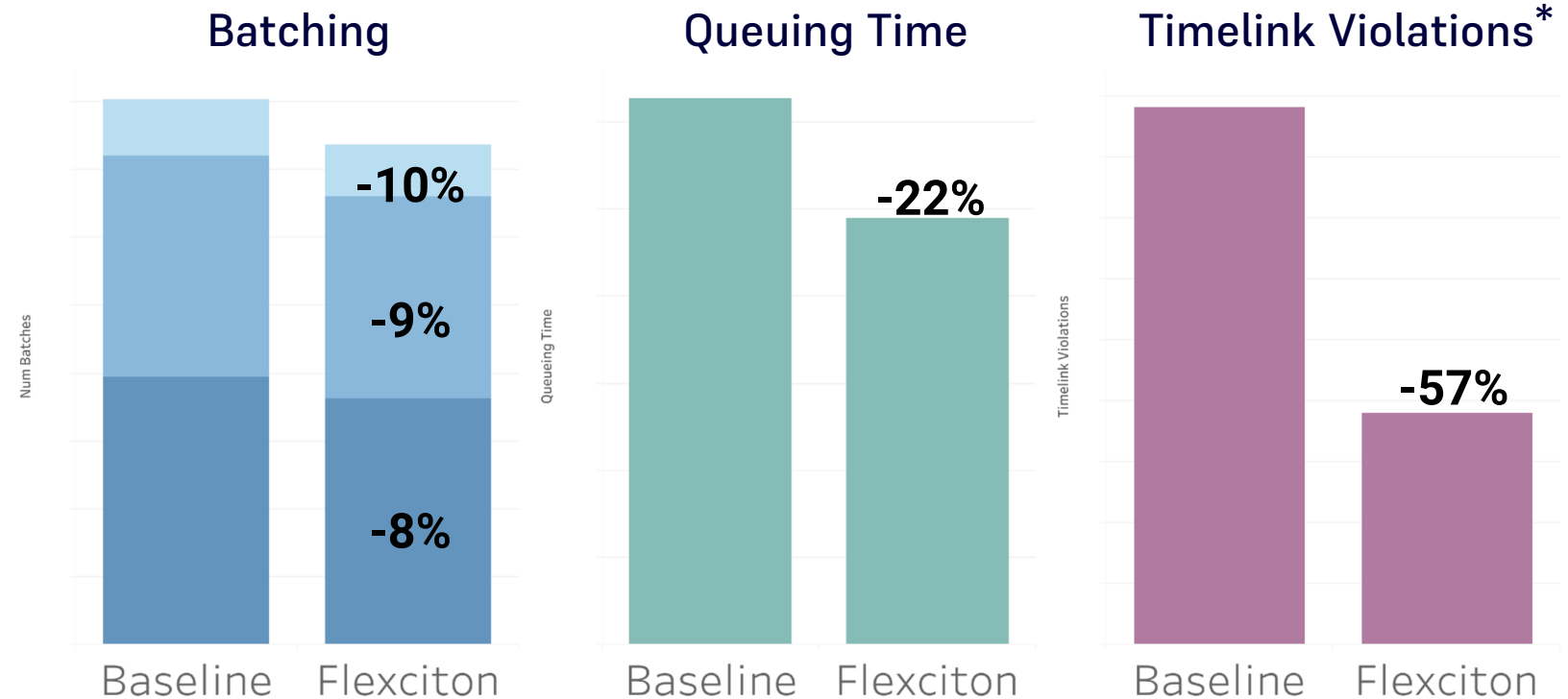# Case study #3: Improvements at Clean & Furnace – fab in EU

Introduction

- A fab in Europe supplying automotive manufacturers.

- The fab has been struggling to achieve expected efficiencies at clean and furnace due to complex timelink constraints.

- We took a similar approach to Renesas, where we built a simulation environment to apply our optimisation technology.

- The results from the offline simulation (next slide) led to live deployment of Flexciton optimiser in this fab.

Flexciton

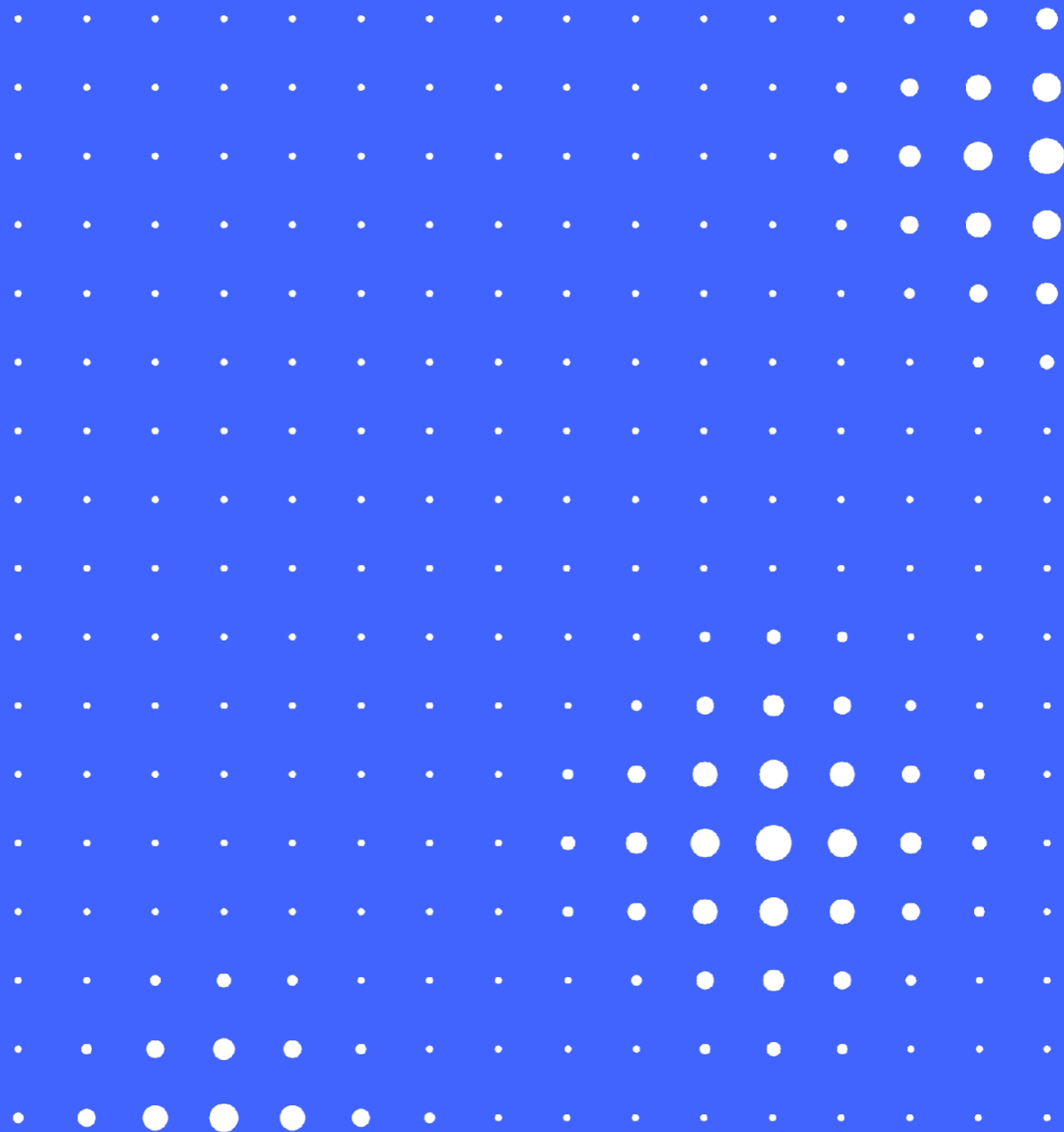# Case study #3: Improvements at Clean & Furnace – fab in EU

Results

Tool Type
- Expensive Furnace
- Regular Furnace
- Clean

Batching

- -10%
- -9%
- -8%

Baseline   Flexciton

Queuing Time

- -22%

Baseline   Flexciton

Timelink Violations*

- -57%

Baseline   Flexciton

* Non-critical violations that cause rework

Flexciton

Thank you

flexciton.com

Flexciton

Contact details

contact@flexciton.com

Flexciton Head Office

Linen Court, Floor 7
10 East Road
London
N1 6AD

Flexciton