

Maximizing Equipment Productivity: Harnessing the Power of AI^XTM

Brad Eaton

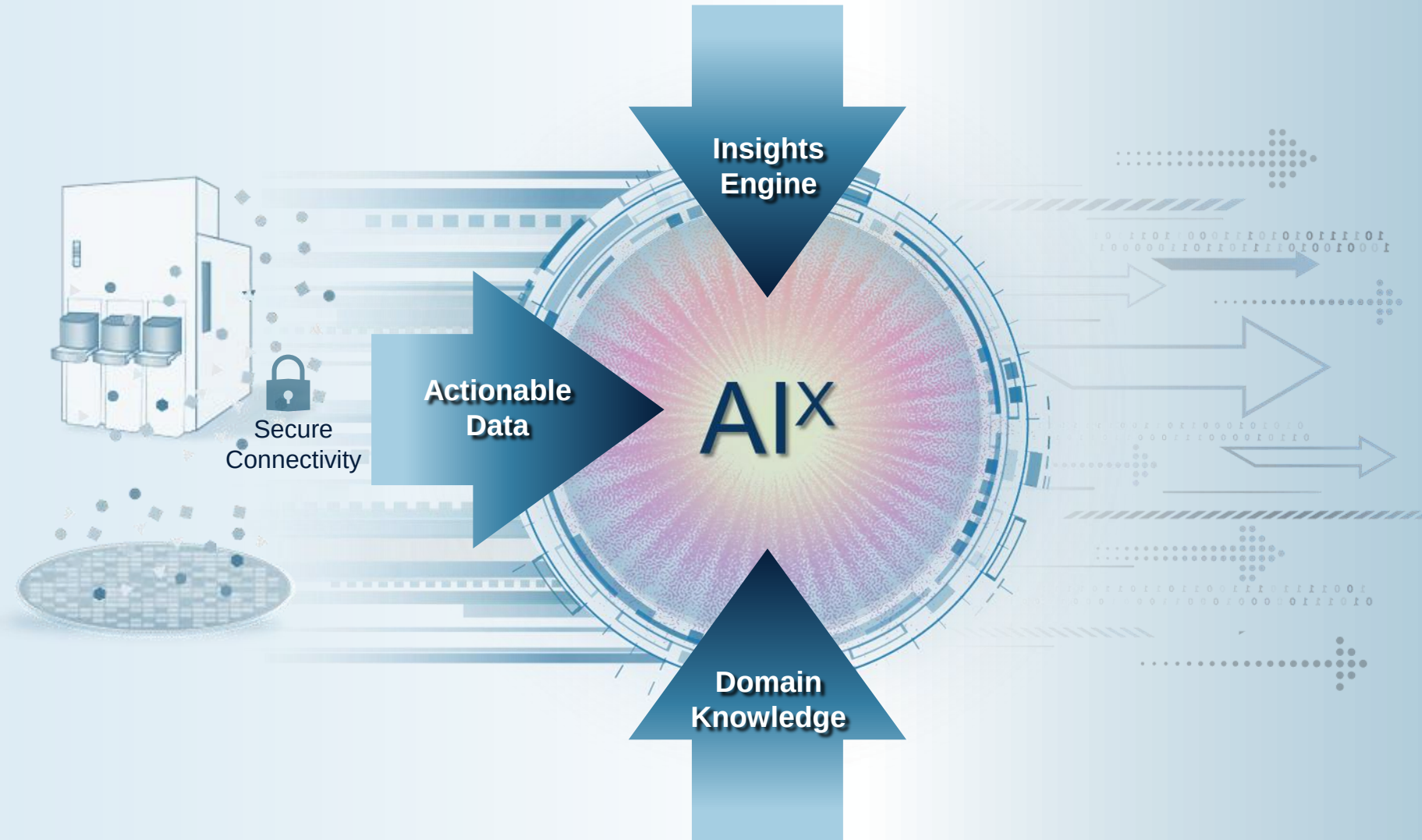
Applied Global Services, Applied Materials

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Applied Materials External Use



AI^XTM – Actionable Insight Accelerator



ACCELERATE Results



R&D

Time to eval
Process window optimization



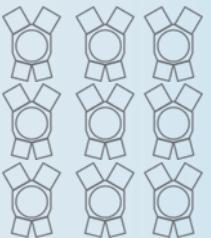
Ramp

Ramp time
Yield optimization

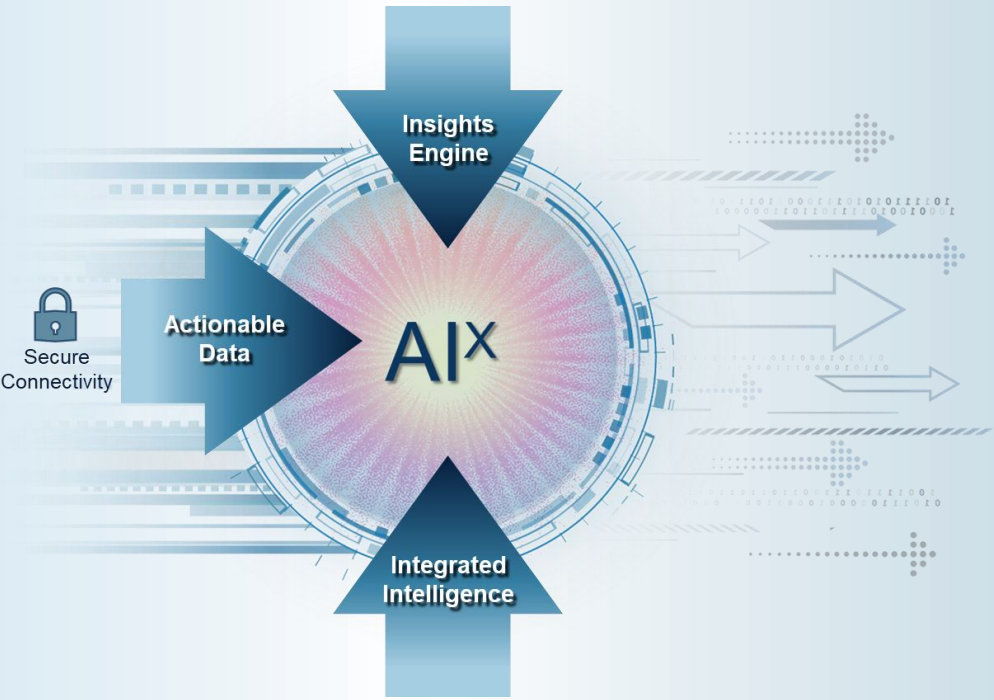


HVM

Output
CoO
Yield



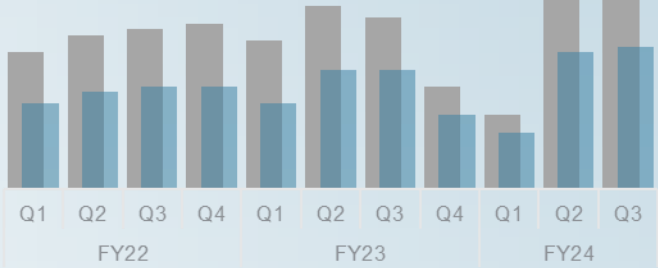
AI^x | Connected Tools Perform Better



LESS ESCALATIONS

Escalations per Tool

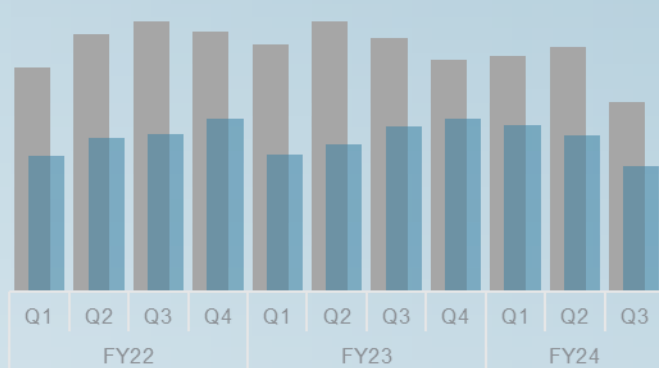
■ Non AI^x ■ AI^x



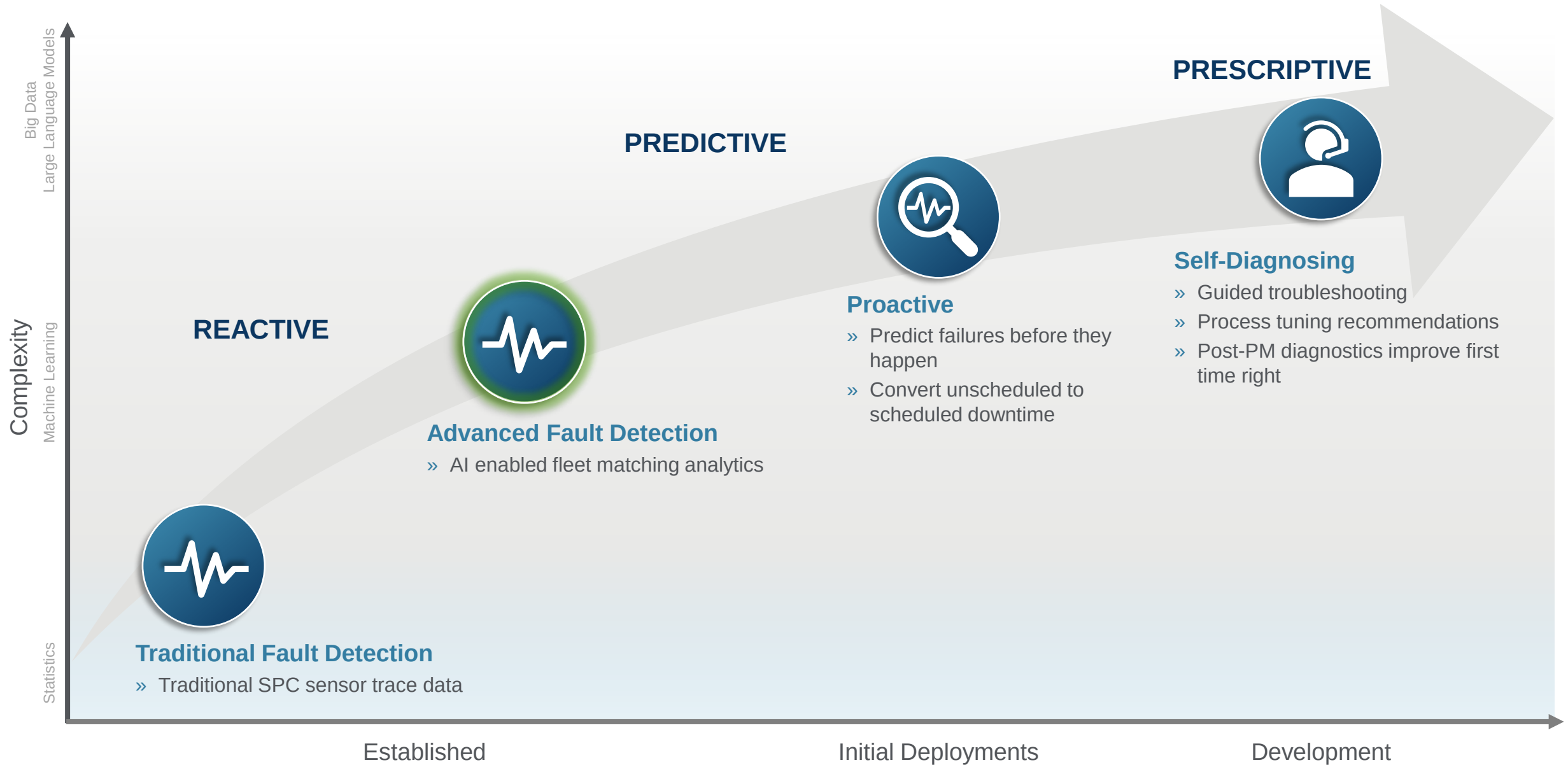
LOWER DURATION

Escalations Duration per Tool

■ Non AI^x ■ AI^x

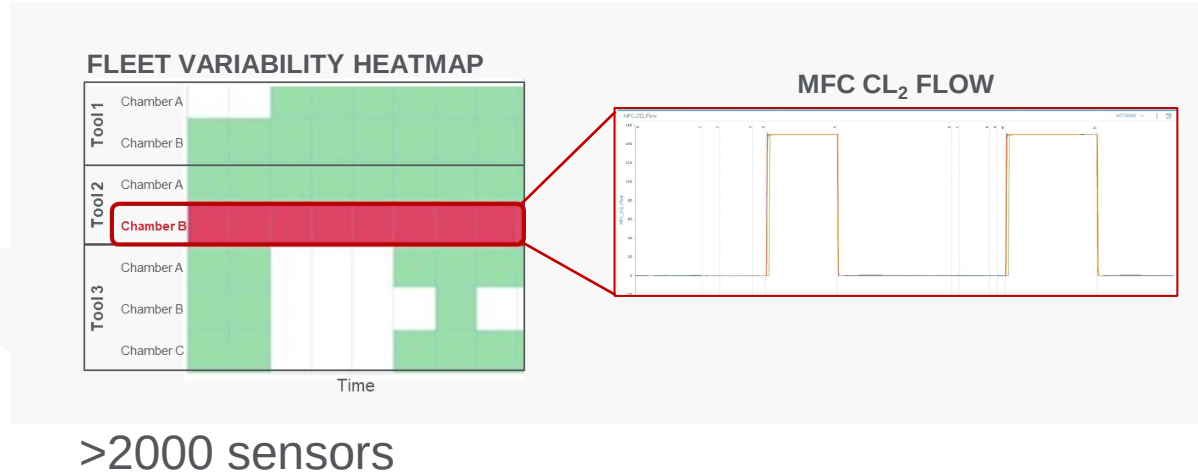


AI^X | Analytics Evolution



AI^X | Advanced Fault Detection + Prediction

Minutes later:
Identify root cause



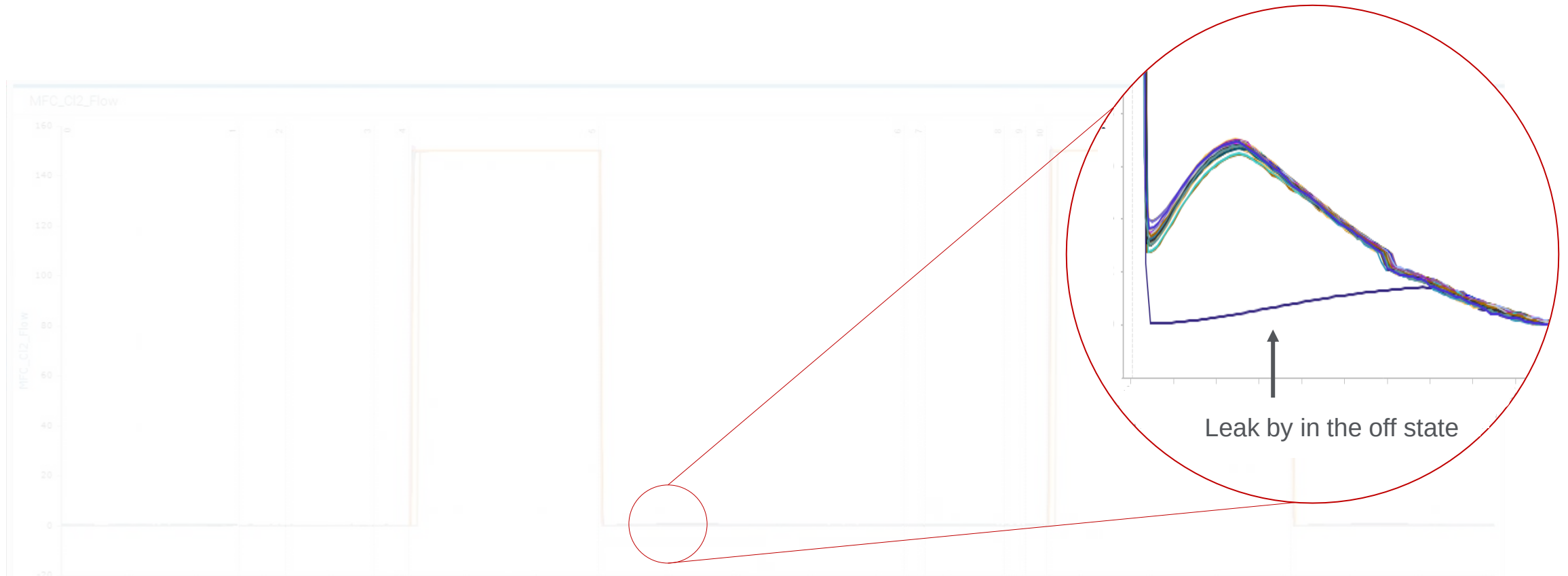
- Using AI to look at **thousands of sensors simultaneously** across the fleet
- Dashboard: drill down to trace data and find root cause

AI^x | Detects Patterns in Data that are Invisible to Humans

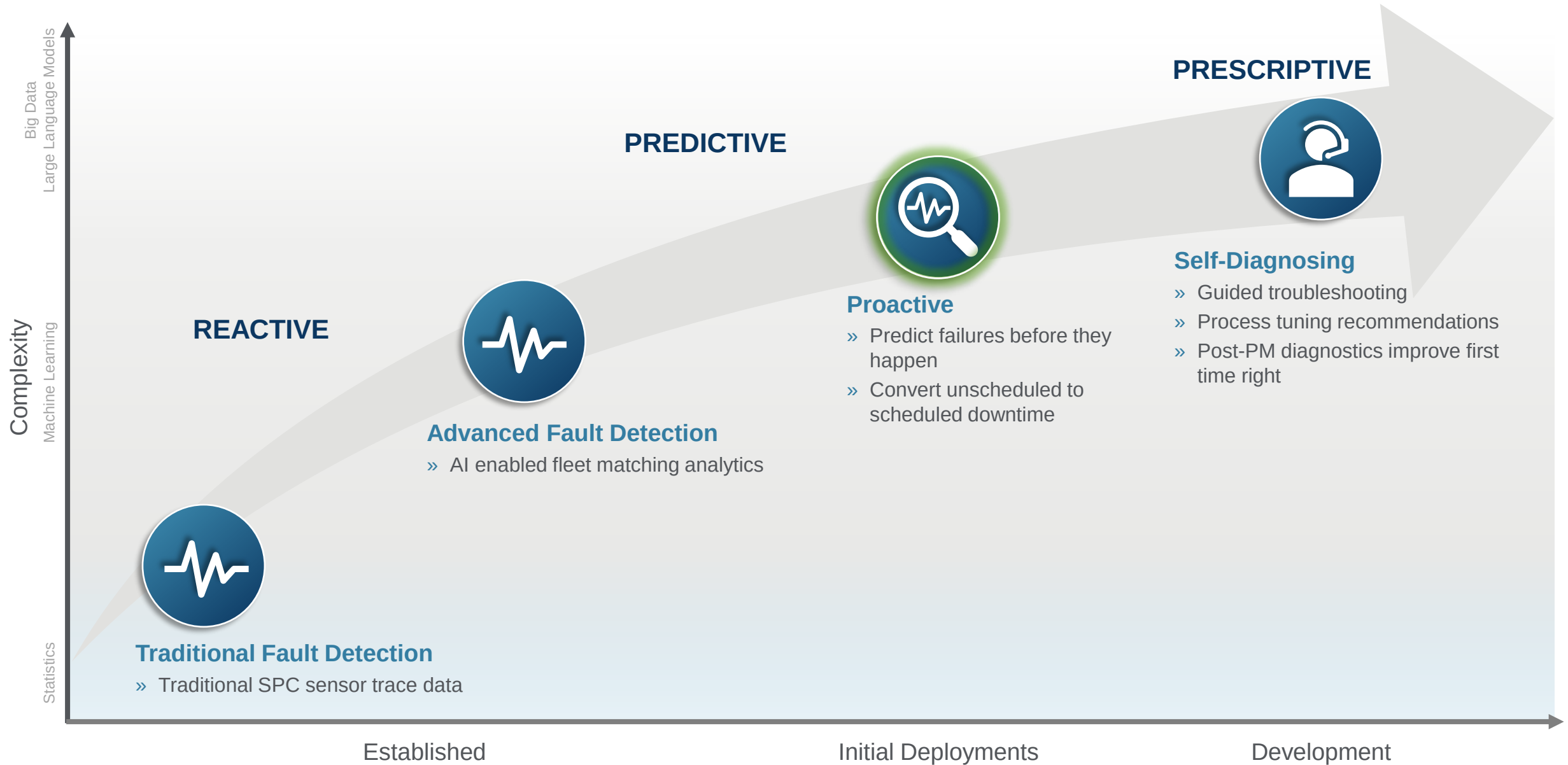
MFC Cl2 Flow



AI^x | Detects Patterns in Data that are Invisible to Humans

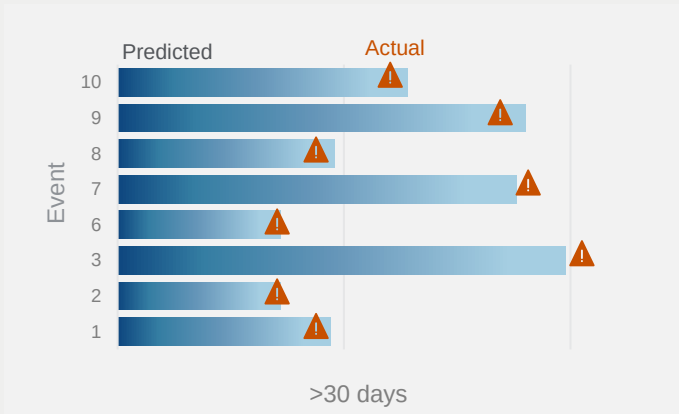


AI^X | Analytics Evolution



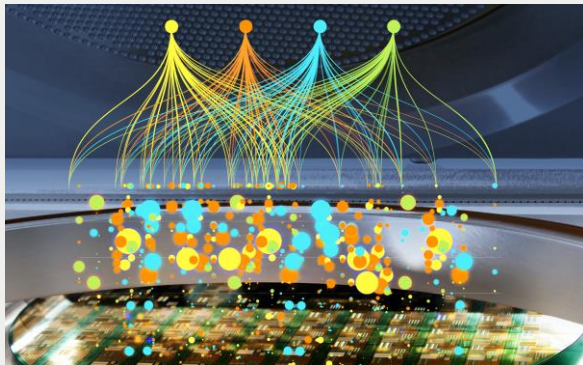
AI^X | Predictive Capabilities

COMPONENT FAILURE PREDICTION (PdM)



Predicting remaining useful life of components (PdM)

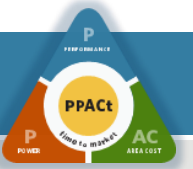
WAFER EXCURSION PREDICTION



Detecting excursion or early issue to prevent wafer scrap on tool level

Cost of finding, stopping and correcting a problem grows **Exponentially** for every stage it exits



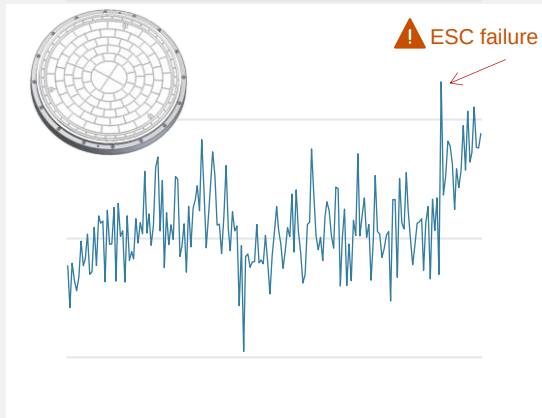


AI^x

- » ML ranked sensor correlation
- » Component design knowledge
- » Physics-based model

Chamber Health Index

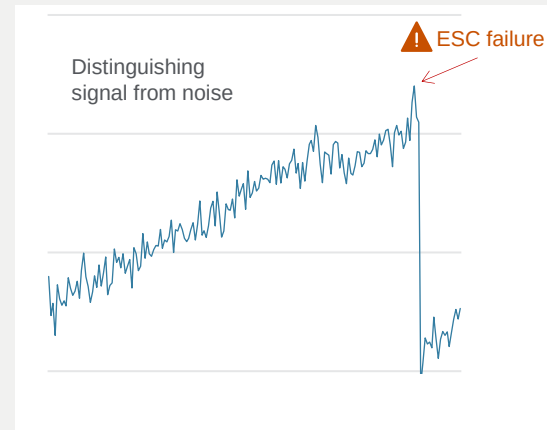
>1,000 Models per chamber



No clear trend before failure

Domain Knowledge Guided Model

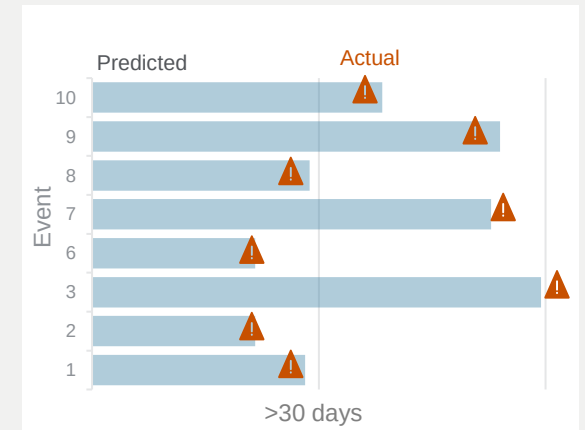
AI + SME guided multi variate model



Clear signal predicted

Predictive Model

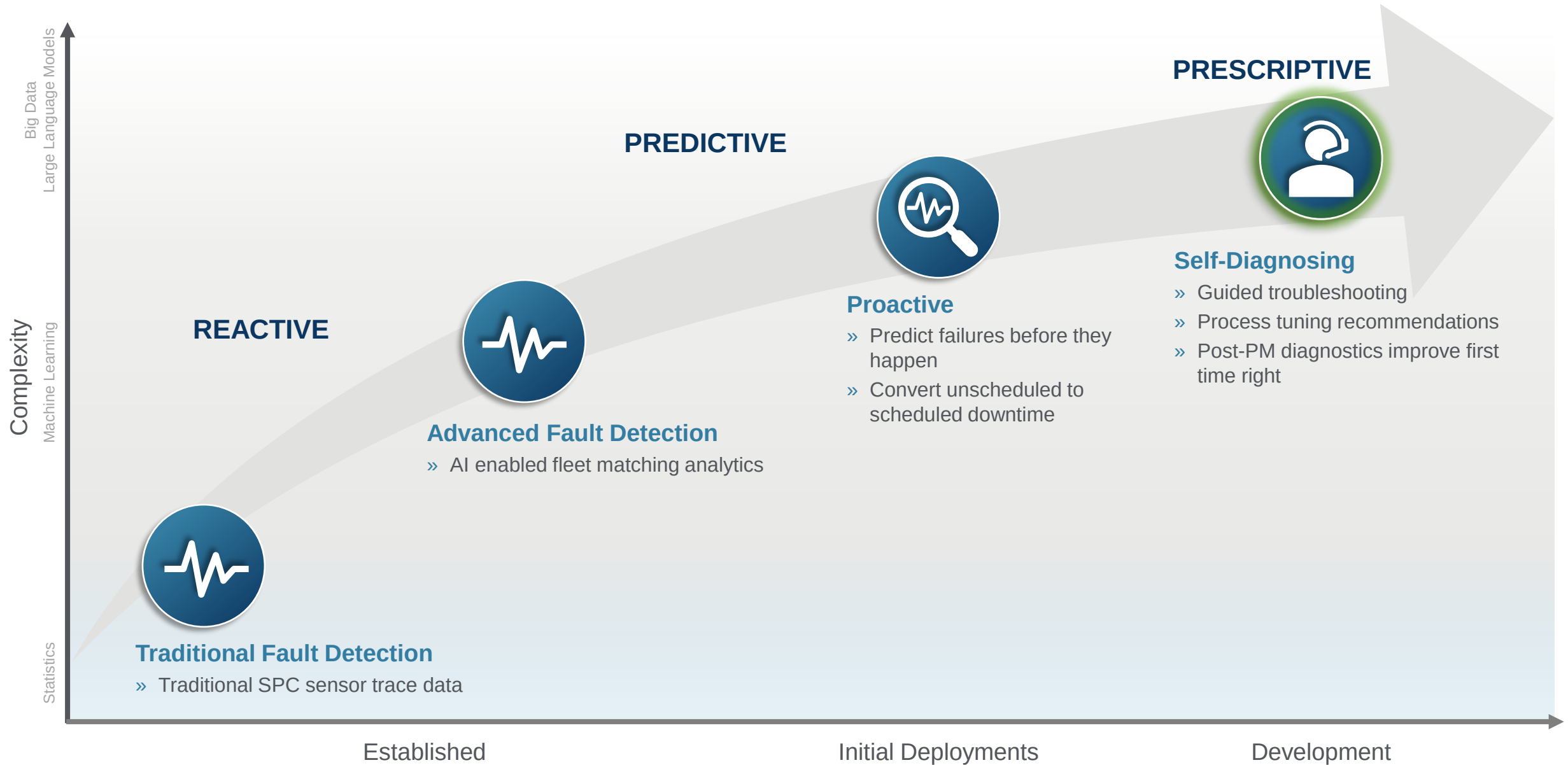
Prediction accuracy



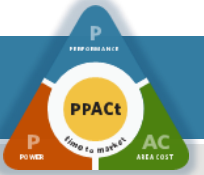
Predict ESC failure
>30 days ahead with >90% accuracy

Maximizing Productivity: Unscheduled → Scheduled

AI^X | Analytics Evolution



AI^X | Prescriptive Analytics - Self Diagnosing RF System



AI^X

- » ML sensor-ranking correlates to 4 common match failure modes
- » Self diagnosing
- » Automatic classification

PROBLEM

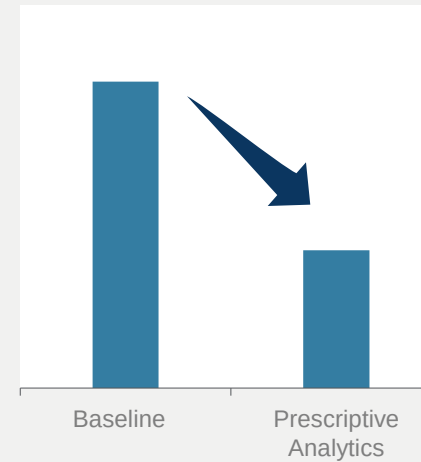
- Mis-replacement of RF components resulted in unscheduled down
 - » High number of replacements
 - » High rate of parts mis-replaced (50%)

SOLUTION

- Machine learning based RF classification model
- Pinpoint failure in RF match or RF generator
- First time right corrective maintenance

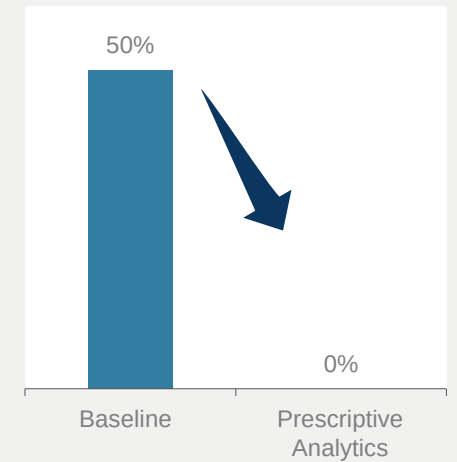
RF Match Mis-replacement Reduction

Total Number of mis-placement



55% reduction

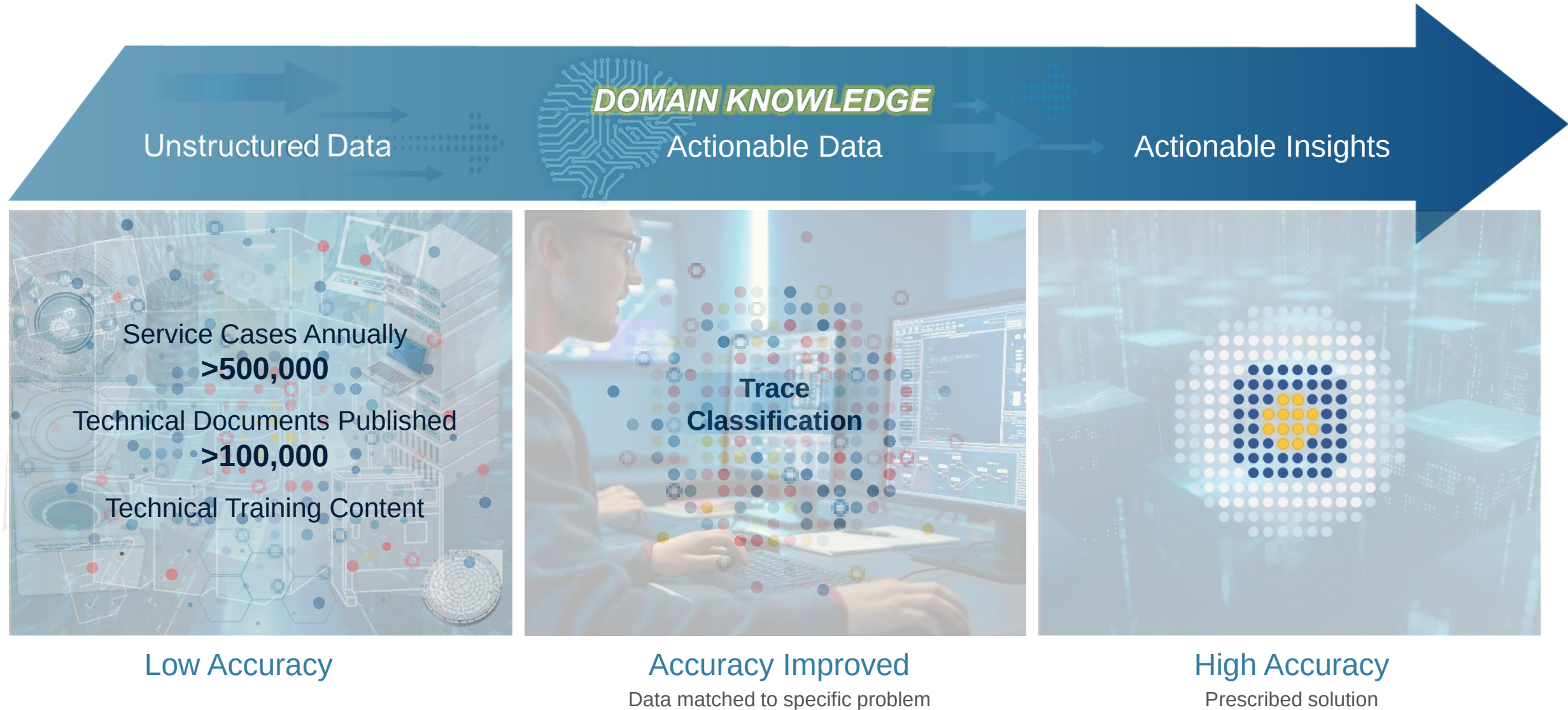
Mis-replacement rate %



Zero Mis-replacement rate

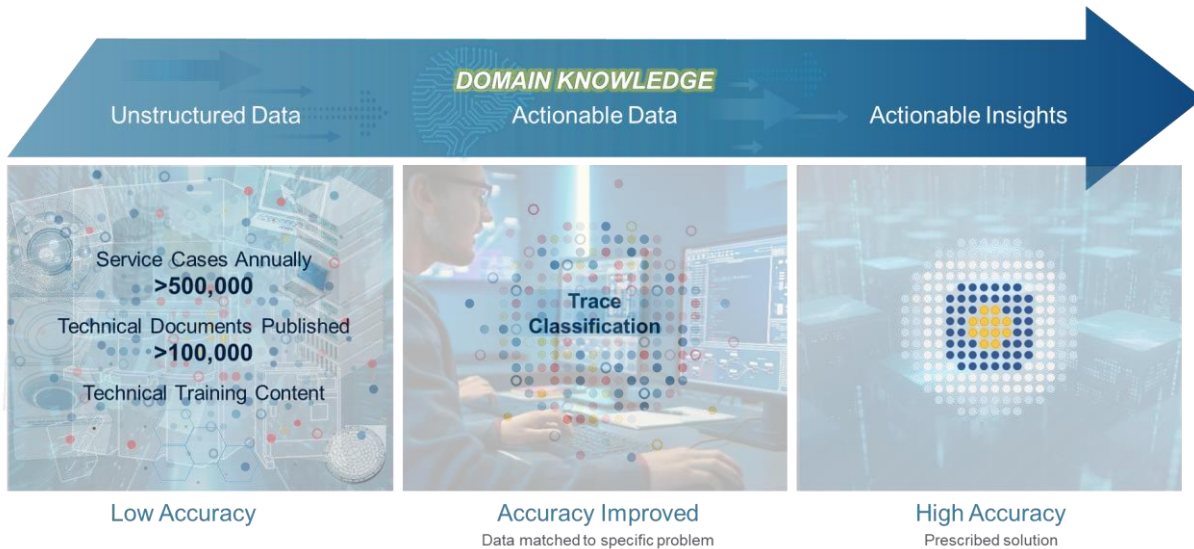
Reducing Mean Time to Repair

AI^X | Using LLM to Assist in Prescriptive Solutions

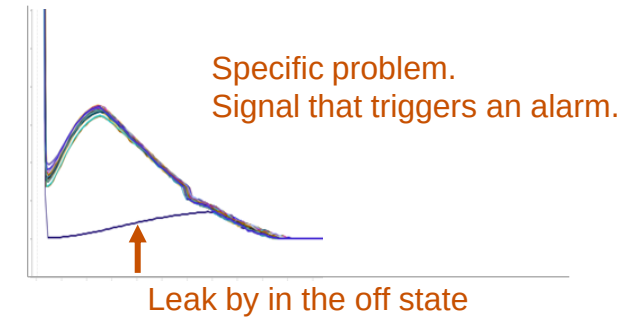


AI^X | Using LLM to Assist in Prescriptive Solutions

Using LLM to Assist in Prescriptive Solutions



Backside helium fault in system chamber

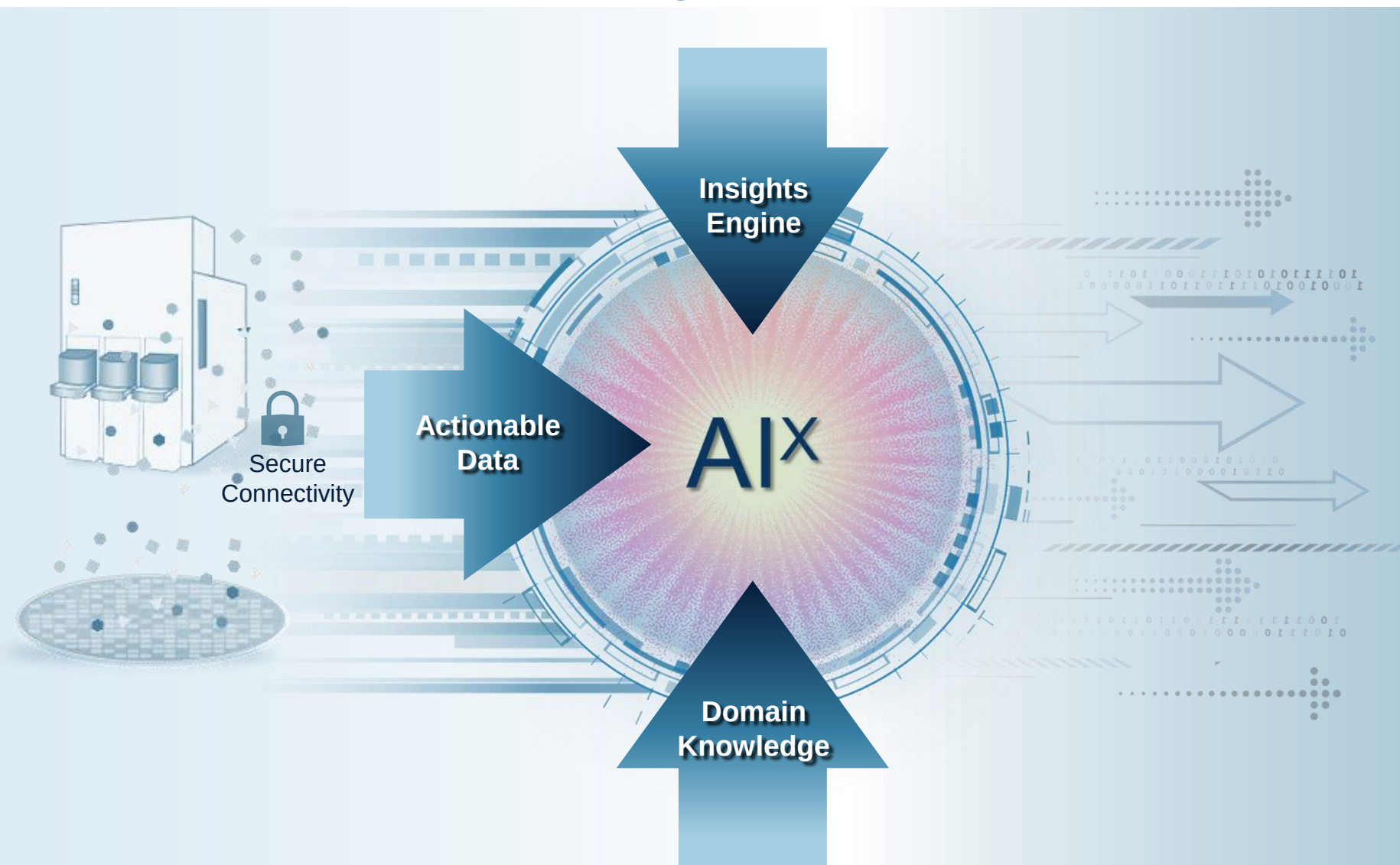


Natural language recommendation

Recommended solutions

1. Run MFC calibration routine.
 - Add MFC pressure
 - Go to "Monitor" screen and click on the stick where this MFC is present
 - Select MFC leak-by flow path and click open full and wait 10s
2. Visually inspect MFC for any inconsistencies.
3. Replace MFC.

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Yield optimization



HVM
Output
CoO
Yield

