



# COGNITIVE ENTERPRISE REINVENTING YOUR FABS WITH AI

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# Cognitive Enterprise

## Reinventing your fabs with AI

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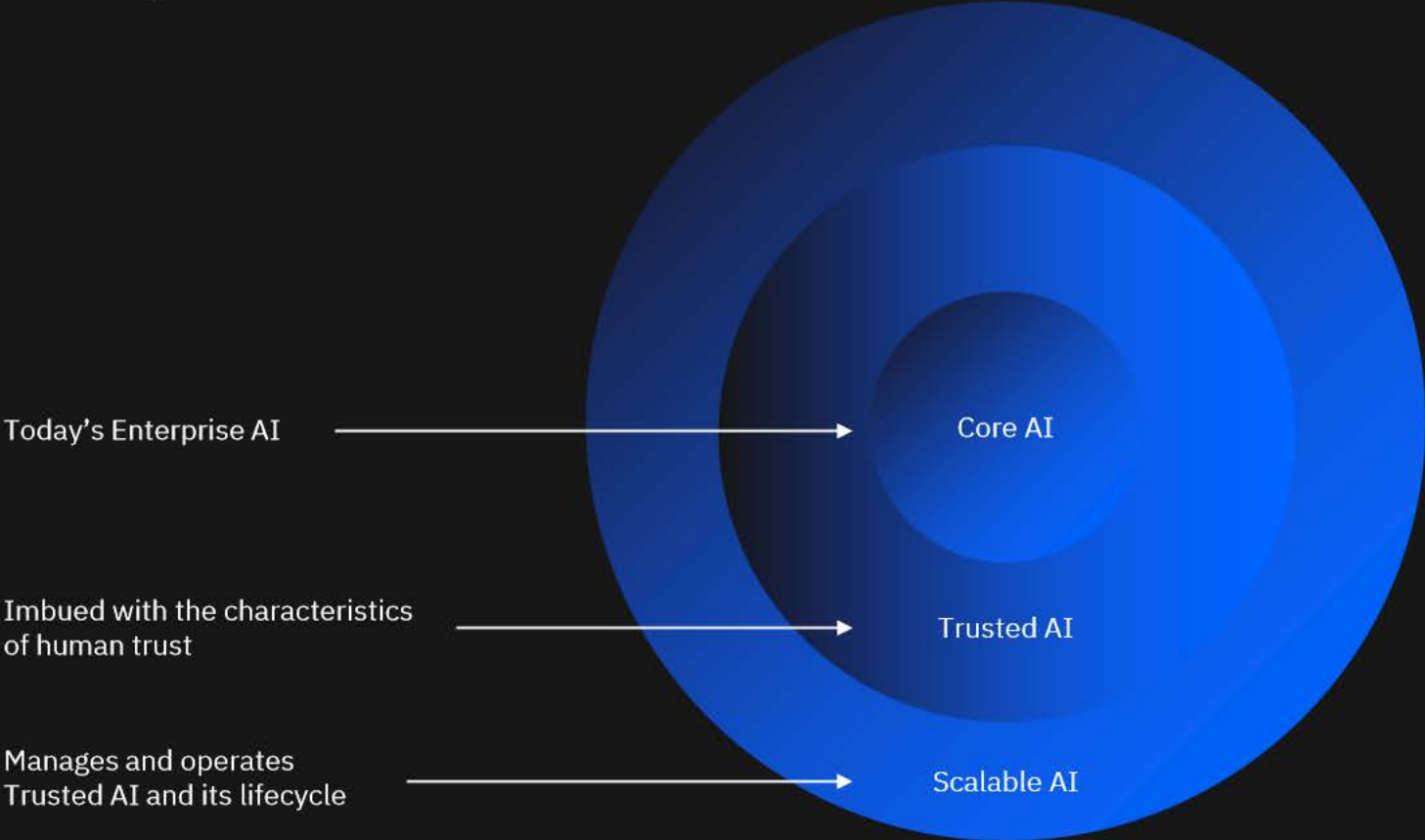
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# AI for enterprise



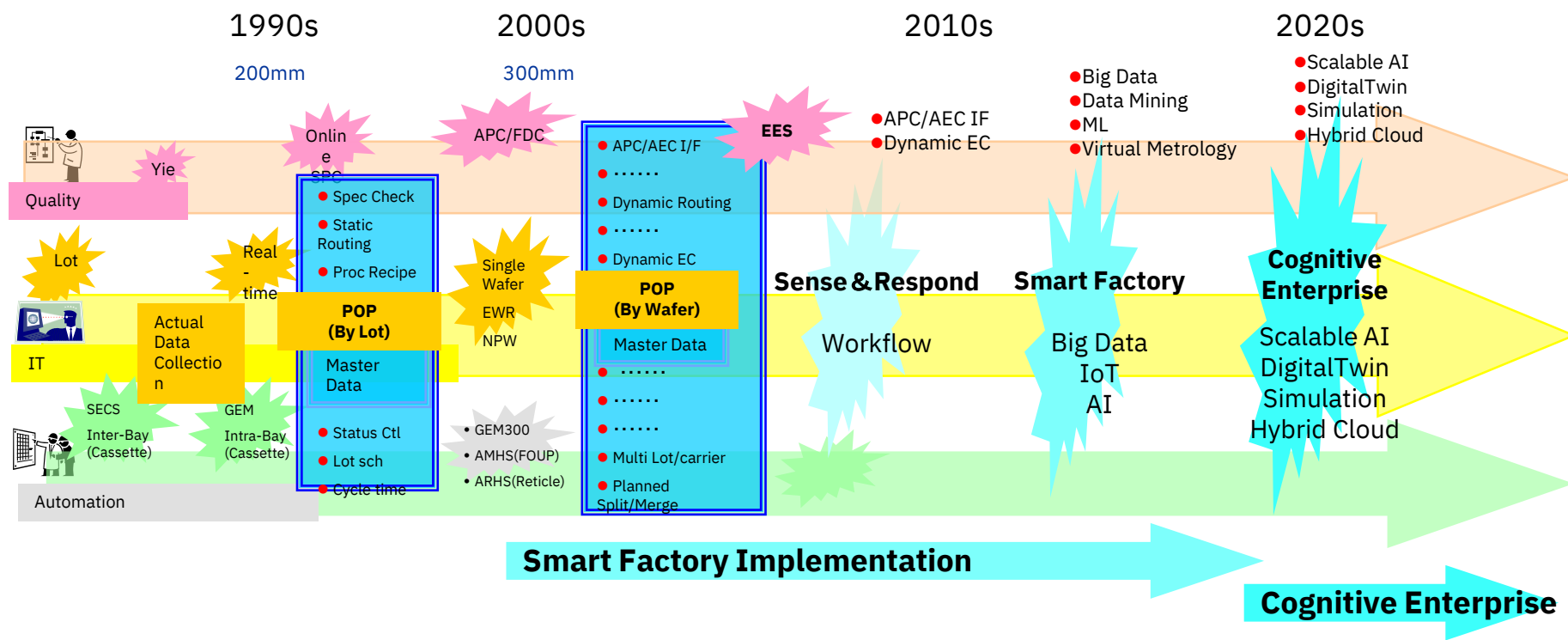
# CURRENT STATUS AT 300MM WAFER FABS ?

# 01

## AGENDA

- 01 Current status at 300mm wafer fabs ?
- 02 IBM Cognitive Enterprise
- 03 Cognitive Enterprise for 300mm wafer fabs
- 04 Facility Management with AI

# Smart Factory implementation has started at 300mm wafer fabs since 2000s, Sense & Respond workflow scenarios increased the level of automation, Leverage of AI and big data has been started, but it's still limited.



**Leverage of AI and big data is now shifting to “Trusted & Scalable AI” with comprehensive result from automation of AI and big data analytics execution.**

## **Internal Semiconductor Solution Development 2005 - 19**

### **Yield Enhancement and Product Quality Control** (Process, Integration, and Product Engineering users)

1. Manufacturing History Data Mining (Chamber signals)
2. Large Scale Data Monitoring (Reduce SPC false alarms)
3. Trace Based Tool Stability & Matching
4. Trace Based Wafer Diagnosis
5. Trace Based Predictions (Virtual Metrology, Maintenance)
6. Wafer Performance Predictor
7. Real Time FDC Enhancements
8. Memory Array Failure Pattern Analysis
9. Performance Based Chamber Matching
10. **Comprehensive trace data monitoring**
11. Lithographic source anomaly detection
12. Etch chamber state assessment
13. Deposition virtual metrology

Comprehensive Trace Analysis  
Complementing FDC



### **Production Planning and Scheduling** (Manufacturing Operations users)

1. Range Break Optimization
2. AMHS Load Estimation
3. WIP Simulation
4. Maintenance Scheduling
5. Capacitated Range Management
6. Optimized Sector Scheduling
7. Operations Simulation / Optimization



# IBM COGNITIVE ENTERPRISE

# 02

## AGENDA

- 01 Current status at 300mm wafer fabs ?
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# IBM Cognitive Enterprise

White paper download

<https://www.ibm.com/thought-leadership/institute-business-value/report/cognitive-enterprise>



# COGNITIVE ENTERPRISE FOR 300MM WAFER FABS

# 03

## AGENDA

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# Digital Reinvention™ at 300mm wafer fabs in Chapter2

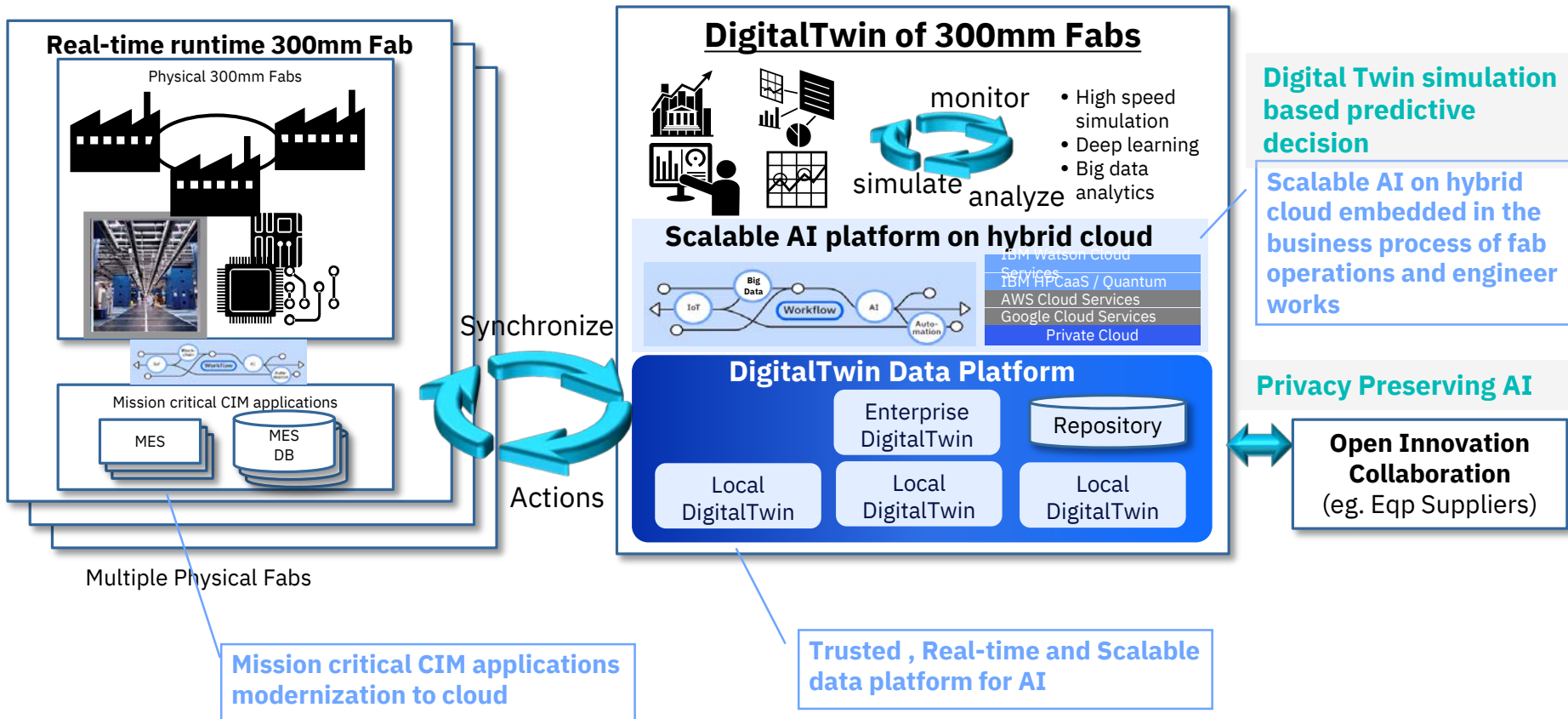
## At 300mm wafer fabs in Chapter2

**Scalable AI on hybrid cloud embedded in the business process of fab operations and engineer works**

**DigitalTwin of fabs is Trusted , Real-Time and Scalable data platform for AI**

**Mission critical CIM applications modernization to cloud applications on Hybrid cloud**

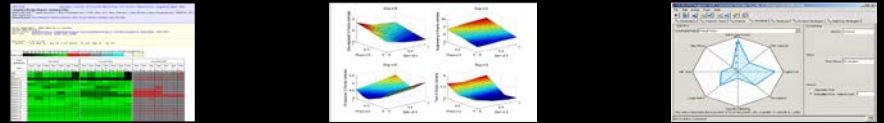
# DigitalTwin of 300mm Fabs is the Cognitive Enterprise platform for 300mm wafer fabs



# SROM: AI for Microelectronic Manufacturing via Hybrid Cloud

## Microelectronic Analytics Expertise

- 1. Detection of abnormal events & product quality
- 2. Diagnoses of aberrant events & product
- 3. Prediction of yield, quality, & throughput  
Operations optimization



## SROM Differentiation

- 1. Complex Industrial Manufacturing Semantics
- 2. Advanced AI & Machine Learning (GMM, LSTM, Cohort Analyses, ...)
- 3. Scalable Big Data Solution Platform



**SROM Powered AI Solutions for  
Microelectronic Manufacturing  
and Development via Hybrid  
Cloud**

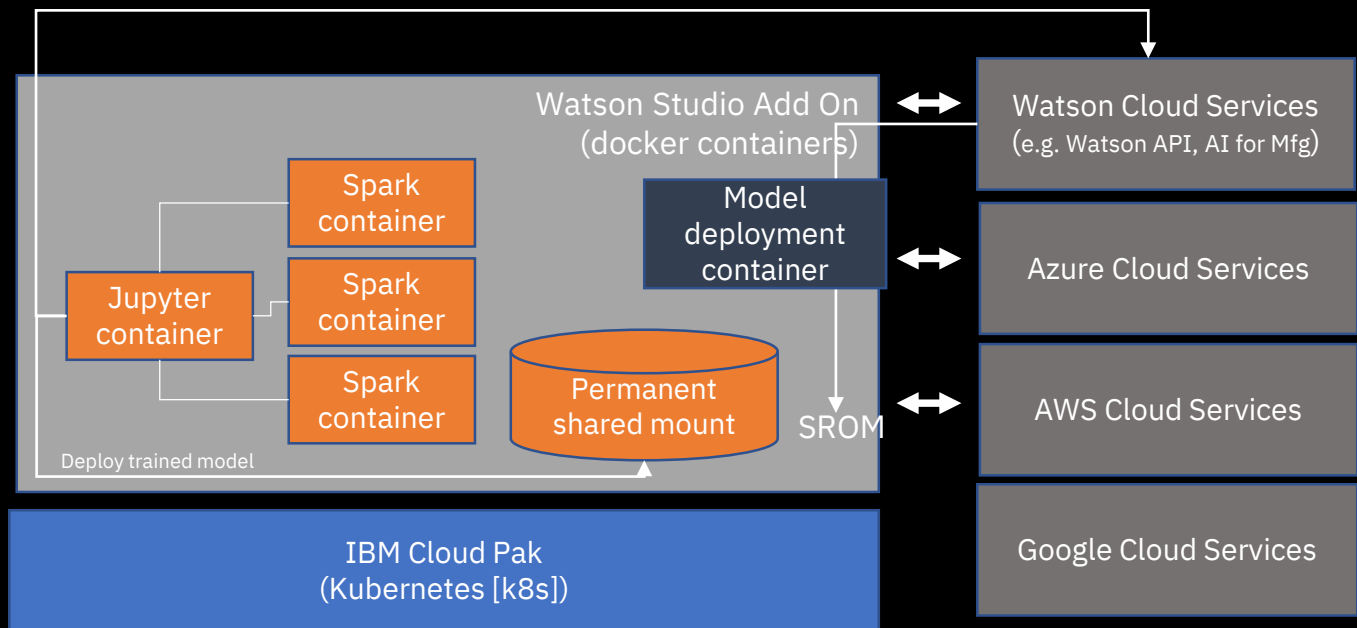
SROM: Smarter Resources and Operations Management

# Multi-Cloud Hybrid Cloud Deployment – AI Applications

## SROM (AI for Mfg)

- Anomaly detection
- Failure pattern analysis
- Root cause analysis
- Survival analysis
- Cohort analysis
- Process optimization

## Deployment Mode



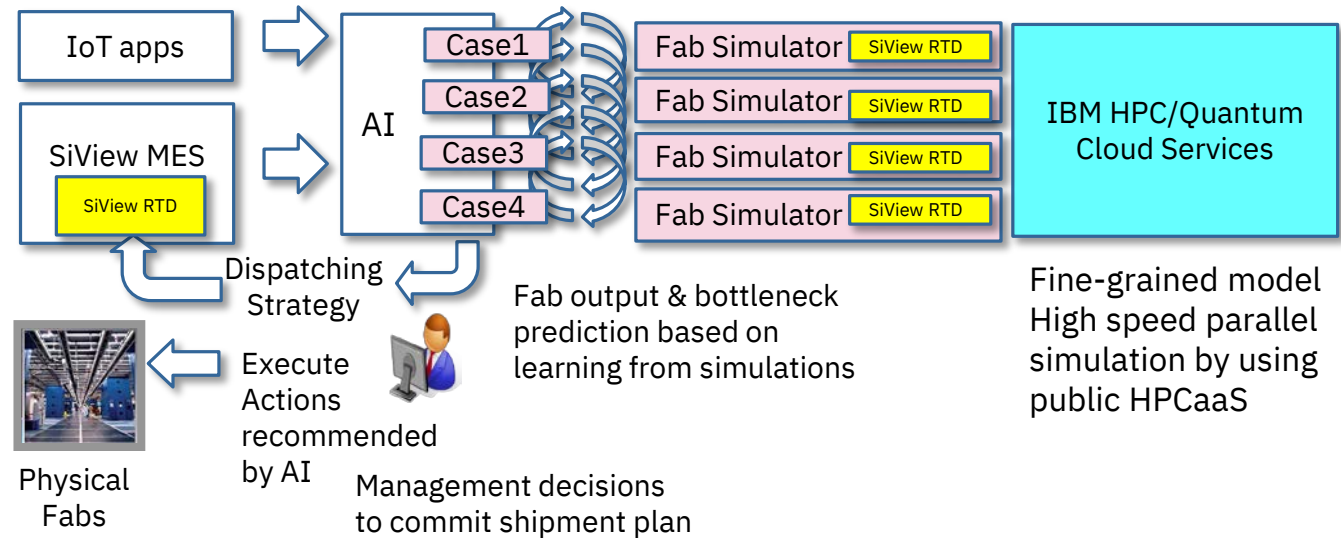
# DigitalTwin simulation based predictive decision support by AI on IBM cloud services (HPC/Quantum) will increase fabs operation efficiency

## Common challenge at 300mm Semiconductor manufacturers

- Complexity of dispatching WIP Lots across multiple Fabs becomes higher and higher.
- Advanced technology node increases uncertainty
- Difficult to predict near future fab output whether fabs can meet the business target (ex. monthly shipment target, on-time delivery ratio)

## DigitalTwin simulation based predictive decision support

AI generates and executes multiple simulation cases and evaluates the results, then recommend actions.



# Autonomic operations

Adaptive operational processes and workflows will continuously learn and be autonomic



# FACILITY MANAGEMENT WITH AI

# 04

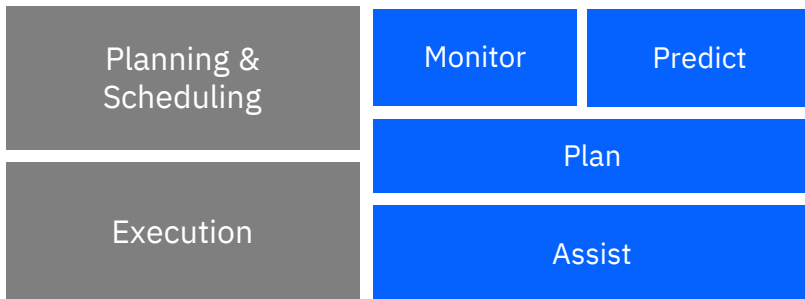
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# 300mm Fabs Facility Management System is enhanced with Analytics and AI

APM enhances EAM foundation with Analytics and AI



APM  
(Asset Performance Management)

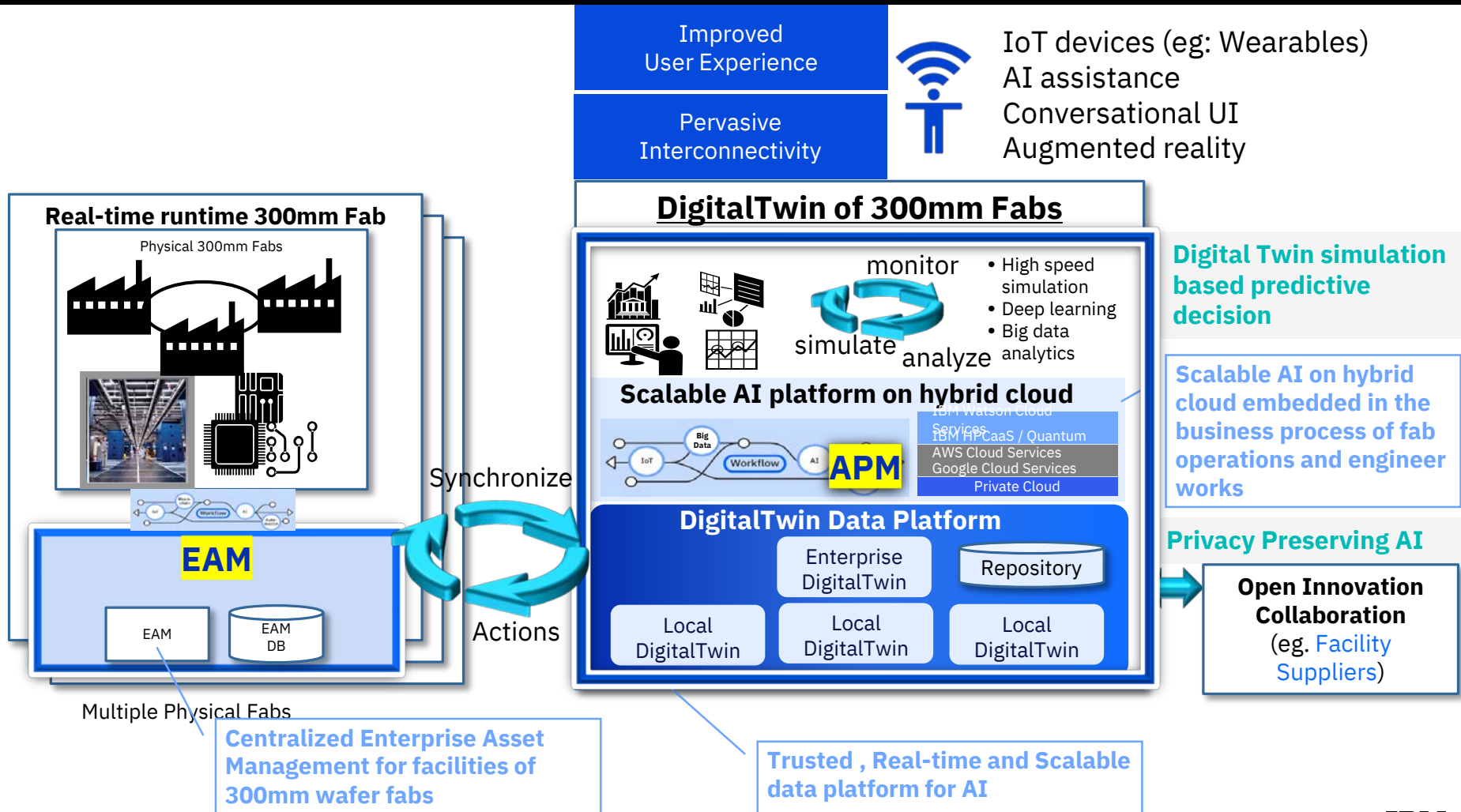
**Decision  
Optimization**



EAM  
(Enterprise Asset Management)

**Maintenance  
Execution**

# DigitalTwin platform for Facility Management at 300mm fabs



# What does the Future of Work look like for Technician ?



Use voice to check and execute work orders



Digital assistant to ask questions



Capture pictures of findings using phone



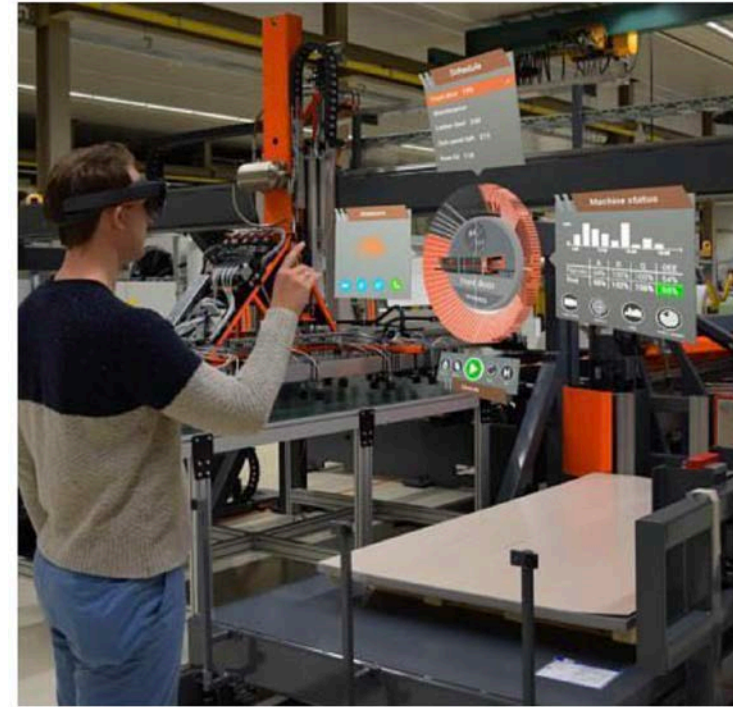
AI guidance to ask questions regarding issues



Connect with remote expert



Continual training of AI knowledge base



*Execute work orders more efficiently and complete tasks right the first time - safely*

# Technician of the Future

*....is here today*



### Maximo WorkCenters

*Reimagined core user experiences for different personas*



### Anywhere Mobile

*Connected and disconnected native mobile support*



### Equipment Maintenance Assistant

*AI-powered digital assistant for the field technician*



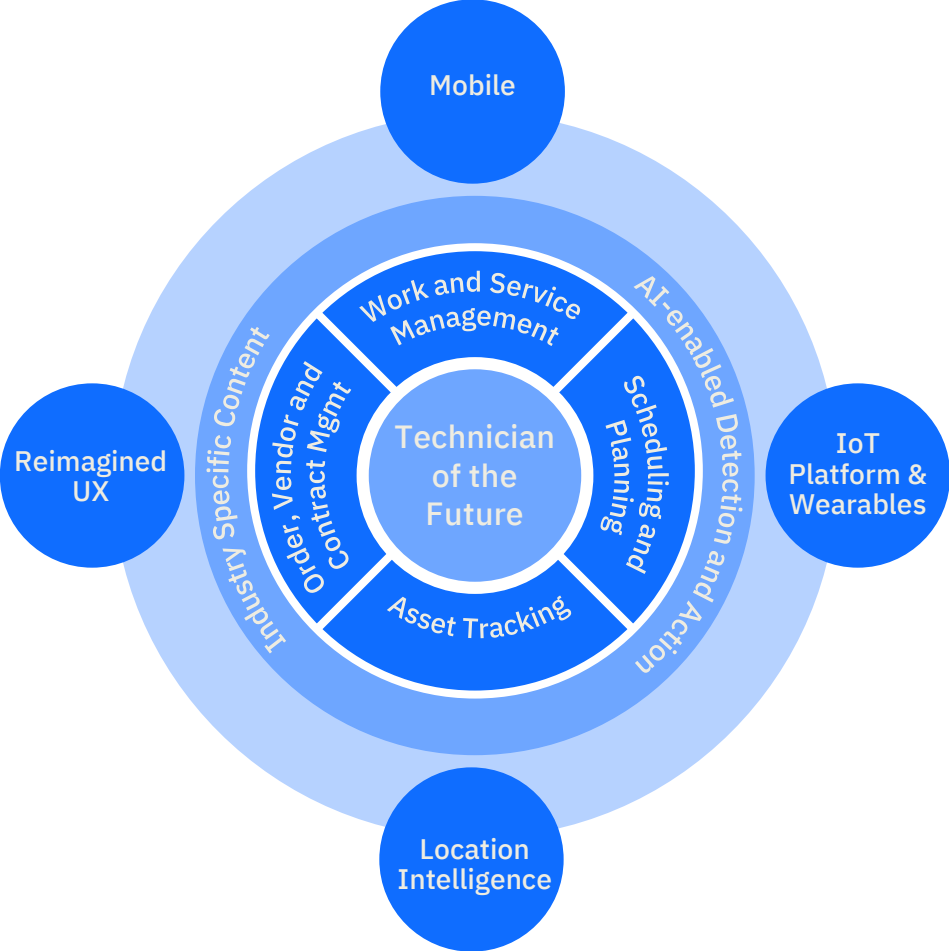
### Maximo Augmented Collaboration

*AR-enabled interaction between an expert and field tech*



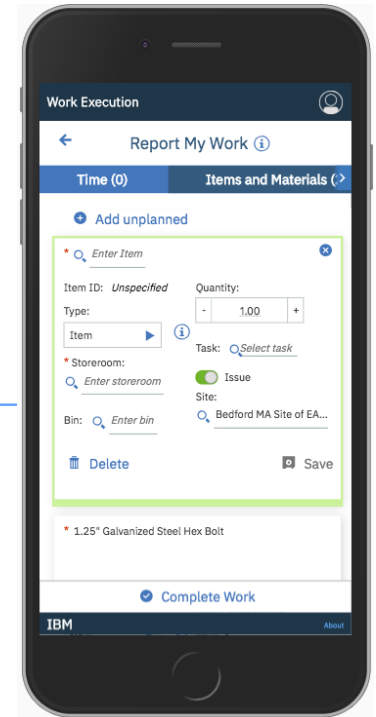
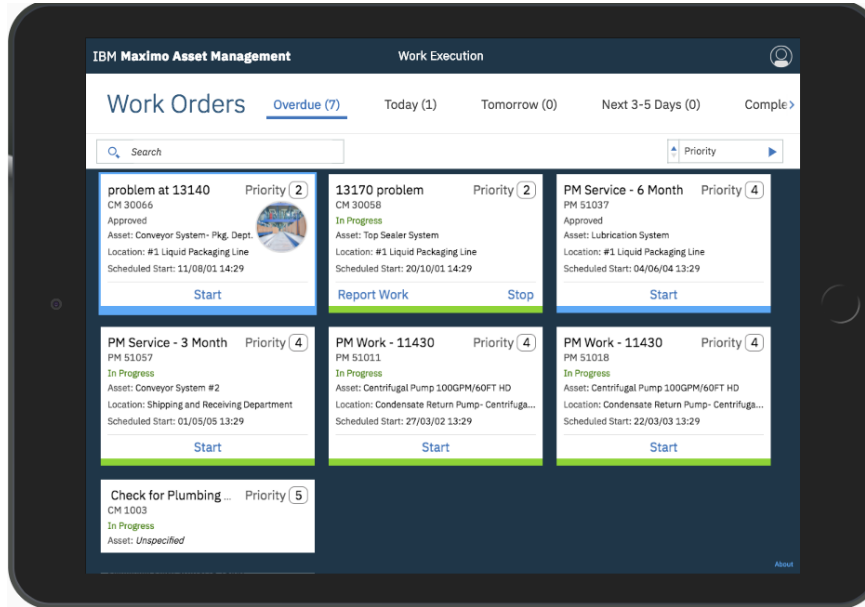
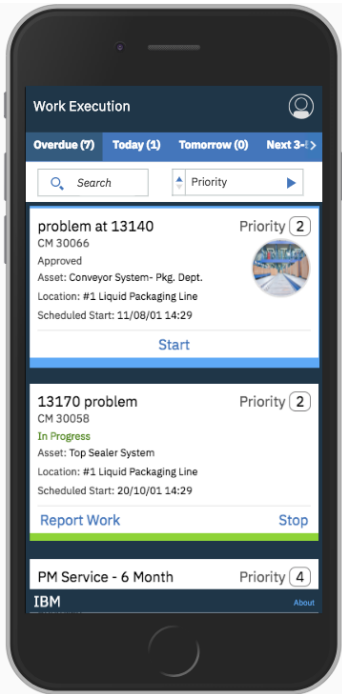
### Worker Insights

*Ensure your employees are safe wherever they are*



# Work Execution Work Center

Focus on the work you need to know about now, no matter what device you have in your hands



Quickly report on items and materials used

# Equipment Maintenance Assistant

An AI assistant for your field service teams



Ask questions in natural language

Equipment Maintenance Assistant Studio

Step by step to build up your knowledge base.

How to install P-series pump

14 topics are related to "How to install P-series pump"

P-Series Manuals

Startup Procedure

Hints

HMIC Overheating

Status: 1

Priority: High

Risk: High

Related work items related to "HMIC Overheating"

Quickly retrieve passages and documents from structured and unstructured sources



Standardize your repair processes



Reduce mean time to repair and improve first time fix, reducing repair costs



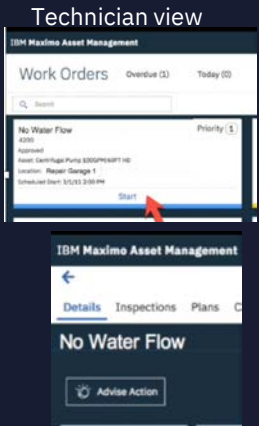
Customer Satisfaction

Generate measurable business value

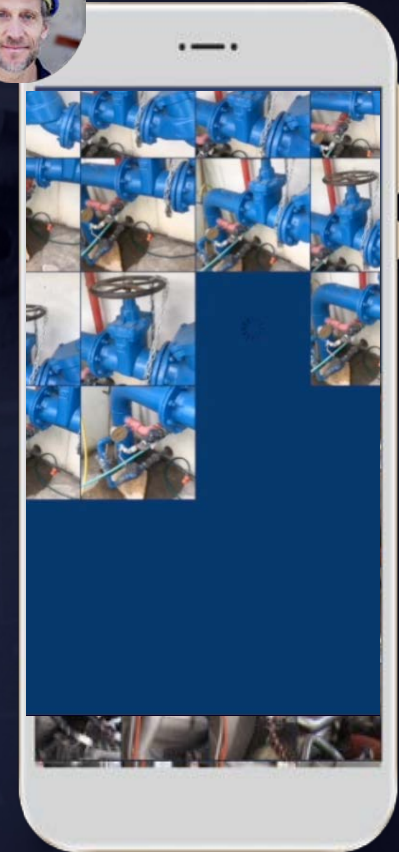
# Maximo Augmented Collaboration

*Bringing expertise in real-time to the jobsite*

Technician view



Expert view



How our technology differs from off-the shelf solutions

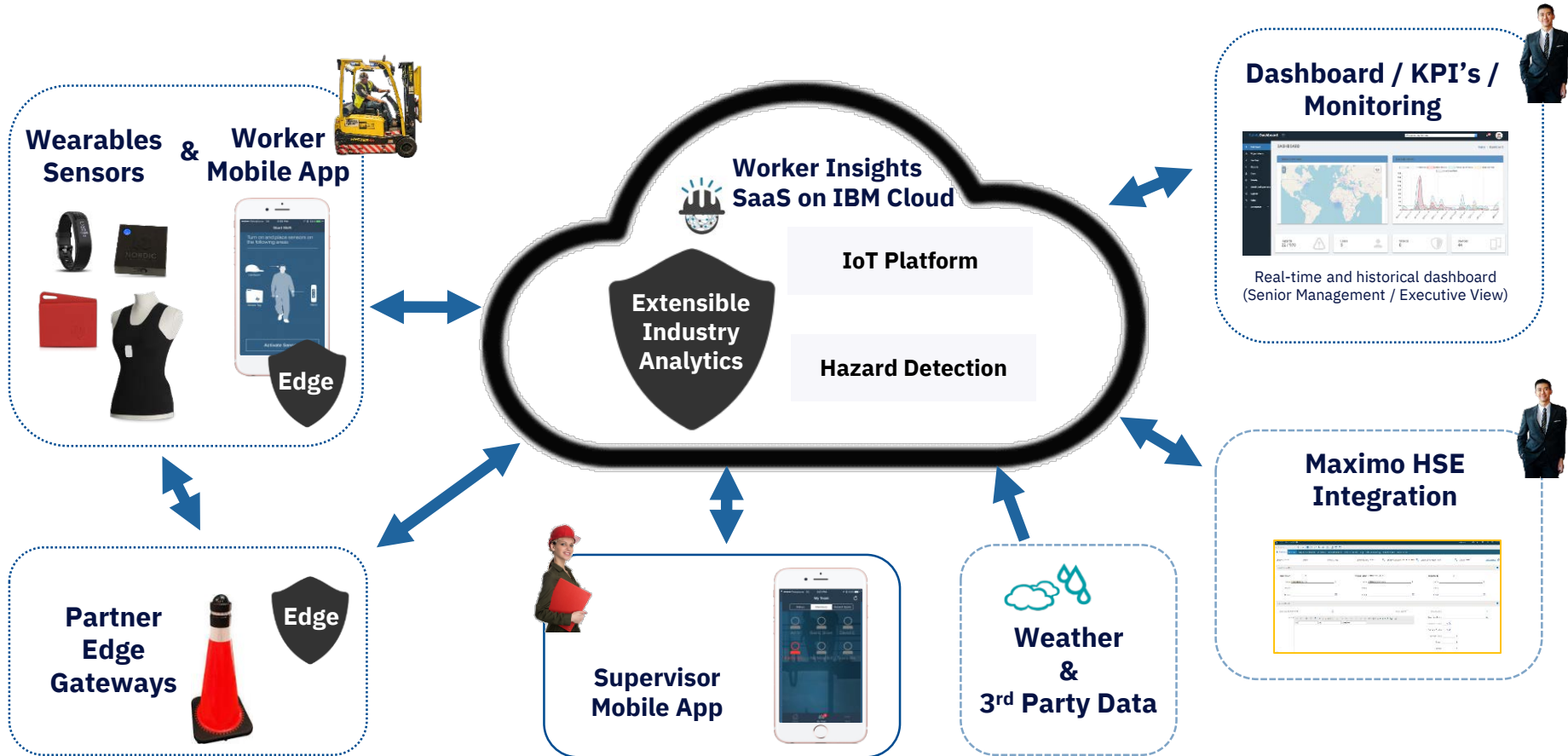
Launched from a Maximo Work order

Technician and expert views

Session details saved in the Maximo Work order for self guidance

Builds AR content for complex environments with peer guidance

# Maximo Worker Insights Overview

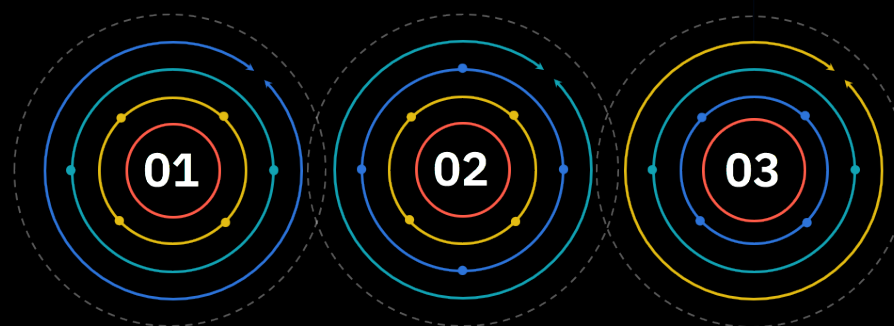




# IBM Garage

## IBM Engagement Model

The practices, architectures and toolchains cover the entire product lifecycle from inception through capturing and responding to customer feedback and market changes.



- Enterprise Design Thinking
- Agile
- DevOps
- Transformation Framework
- Culture, Learning, Discovery

### Think

- Envision Future State
- Establish & Prioritize Idea Backlog
- Build Prototype
- Prove Prototype
- Build POC
- Prove POC

- Design Thinking Workshop
- End User Testing

- Define Value Drivers
- Prove Prototype
- Prove POC
- Competitive Analysis
- Operating Model Assessment

- Build Prototype
- Build POC
- Use Cases
- Playbacks

### Transform

- Architect MVP
- Build MVP & Iterate
- Playbacks
- Use Cases
- Story Backlog

- Prove Hypothesis
- Redesigned Business Model
- Business Canvas Model
- Target Operating Model

- Design MVP
- Prove Hypothesis
- End User Testing
- Incorporate Feedback

- Build MVP & Iterate
- MVP Runbook

### Thrive

- Continuous Deployment
- MVP1
- MVP2
- Production Architecture
- Playbacks
- Story log updated

- Deploy Architecture
- Security & Compliance

- End User Testing
- Design Optimization
- Idea Log updated

- Value Forecast & Plan
- Value to Capability Map
- Enterprise Change Adoption Plan
- Digital Labor & Change Management Plan

## SUMMARY

- Semiconductor 300mm wafer fabs has implemented **Smart Factory since 2000s** and the level of automation has become higher and higher by continuous addition of event driven automation scenario on **workflow engine**. **Leverage of AI and big data analytics** has been started at most of 300mm wafer fabs, but it's still limited to get big benefit.
- **“Trusted & Scalable AI”** is key direction of AI for massive usage of AI.
- **300mm wafer fabs** are also ready to move to **Digital Reinvention Chapter-2 Cognitive Enterprise transformation**.
- **DigitalTwin platform** is key business platform and it consists of **DigitalTwin data platform** and **Scalable AI platform on hybrid cloud** on top of **modernized mission critical applications on hybrid cloud**.
- **Facility management** at 300mm wafer fabs is also ready to move to Chapter-2 Cognitive Enterprise on DigitalTwin platform with **improved user experience** to support technicians by **pervasive interconnectivity with AI / expert assistance**.

## QUESTIONS AND FURTHER DISCUSSION ?

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