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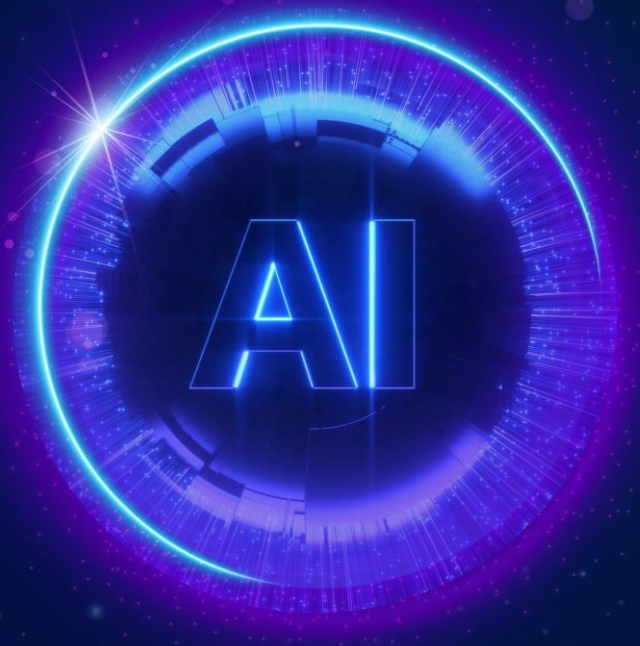
# Artificial Intelligence

## Executive Conference

*explore the power of AI to transform semiconductor design & manufacturing*




**Presentation**

**AI, the next evolution of PDF Solutions portfolio**

**John Kibarian**

CEO, PDF Solutions

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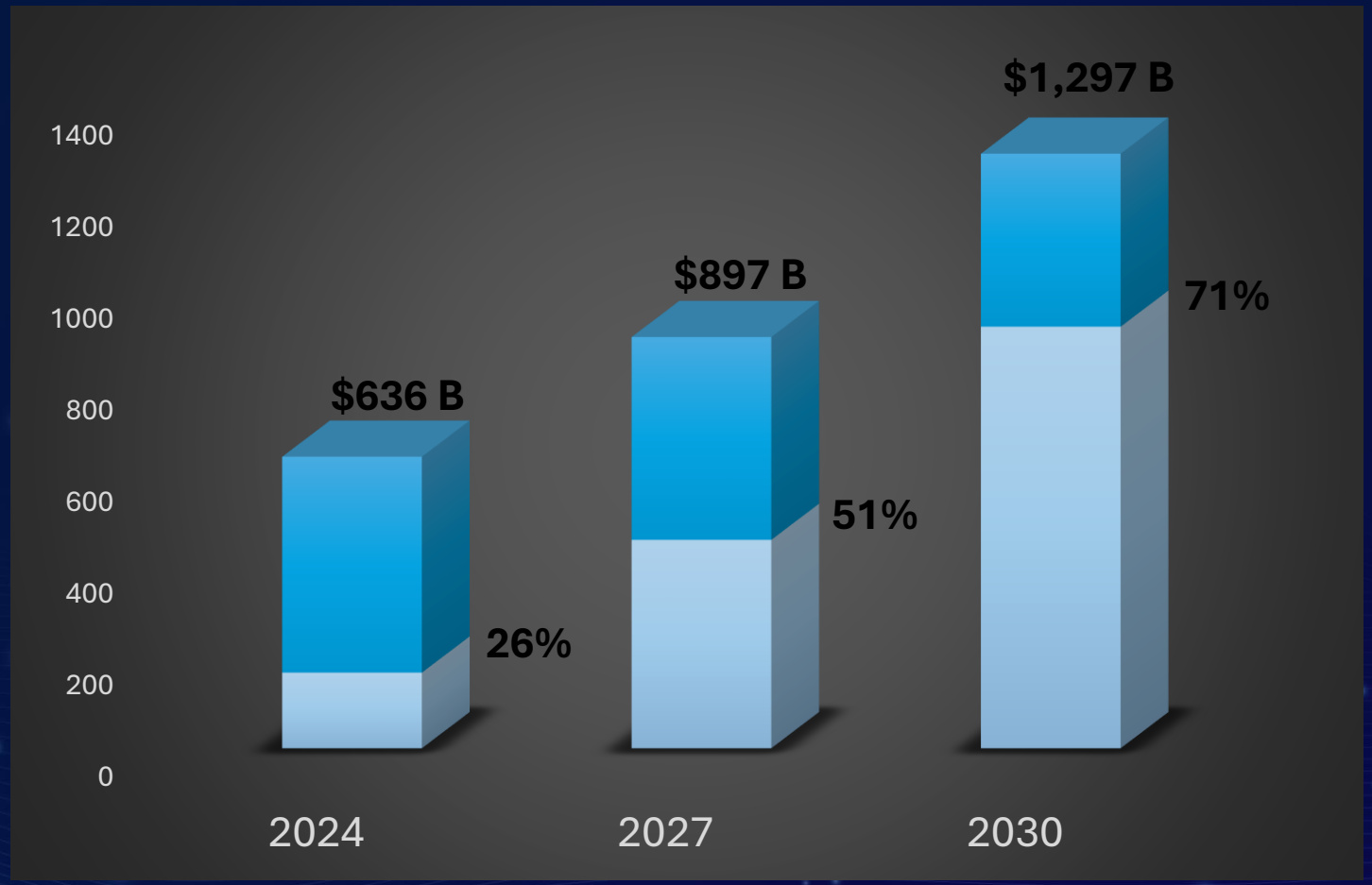
# AI is driving semiconductor revenue growth.

## AI related devices will represent 71% of total semiconductor revenue in 2030




*Source: BIS 2024*

How do we use Analytics and AI to help the industry efficiently deliver on this opportunity?

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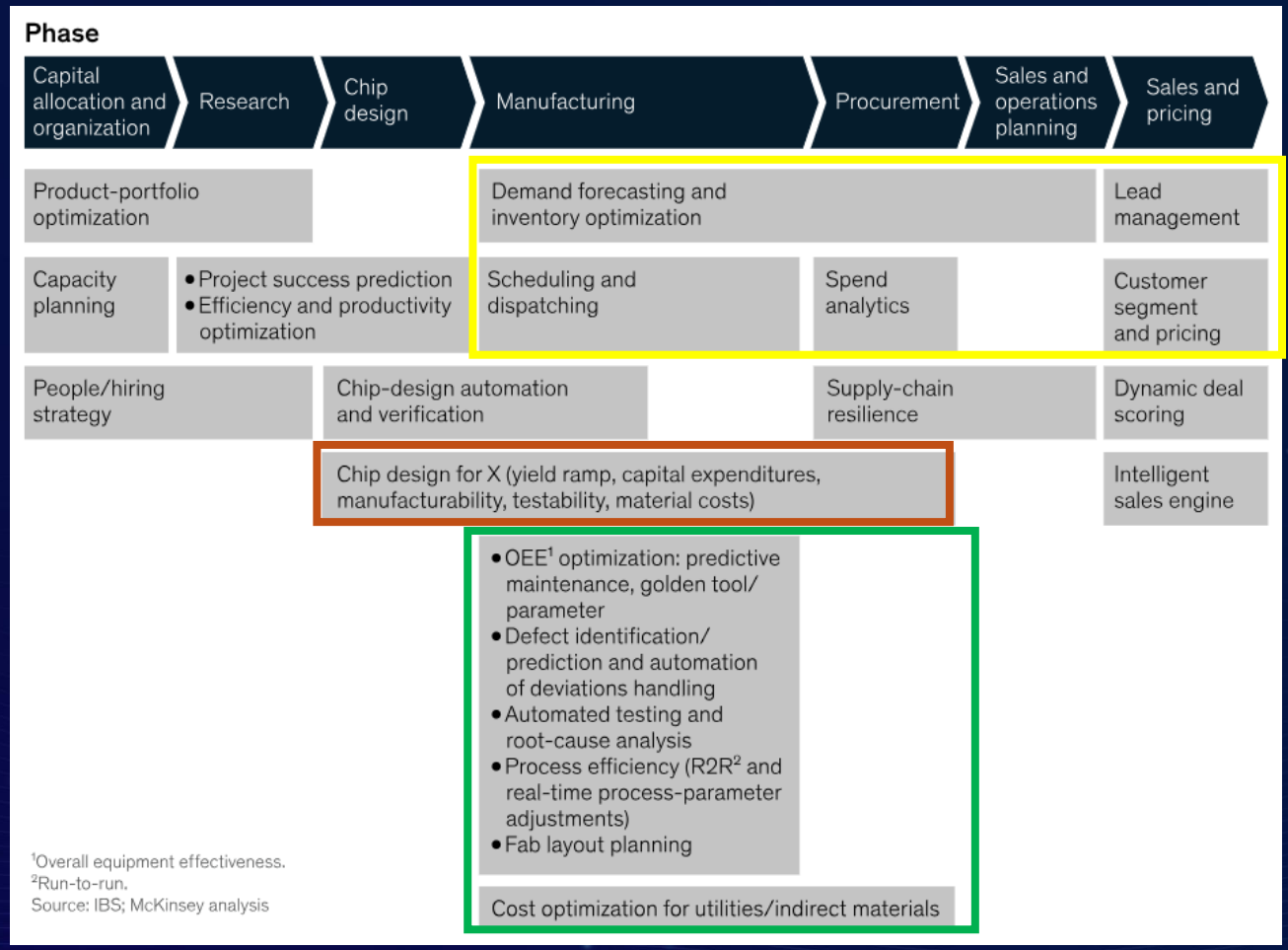
# AI/ML use cases in the semiconductor industry

AI/ML currently contributes between $5 billion and $8 billion of annual earnings at semiconductor companies

This figure could potentially rise to between $85 billion to $95 billion per year in the long term, equivalent to about 20% of the industry's current annual revenue

- Manufacturing Efficiency
- Chip / Process Design
- Supply Chain Integration




*Source: McKinsey 2021*

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# How can we scale AI /ML and move beyond the daily support of the knowledge worker?

*"One problem is **messy data**, scattered in different formats across departments and systems. "Single source of truth" - the company had 37. A **failure to organize data** before using it to train increases the risk of hallucinations and mistakes"*

*"It's very easy to build impressive POCs. A lot of people have got stuck in that trap. **The challenge emerges when you try to translate to production**. There is a huge gap between early POCs and production"*

*"Transforming into a digital firm requires changing operating architectures and align around a platform approach"*

*"A large Japanese semiconductor company with tens of thousands of employees has 30 employees with the know how to use AI/ML. **For AI to have an impact, it must be pervasive**"*

**DATA**

**SCALING**

**AUTOMATION**

**SKILLS**

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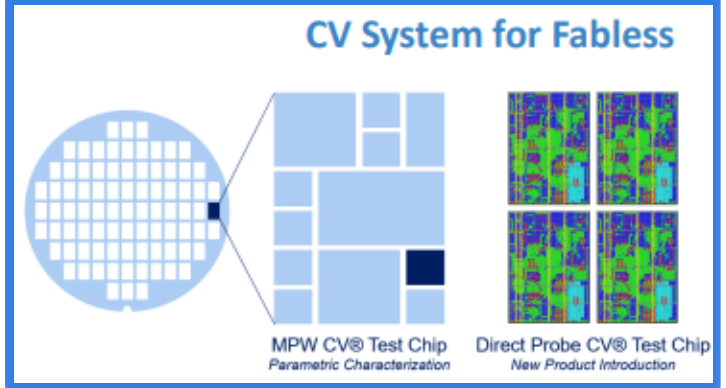
*Source: Theeiet.org 2024 & SemiEngineering 2024, Keystone 2019*

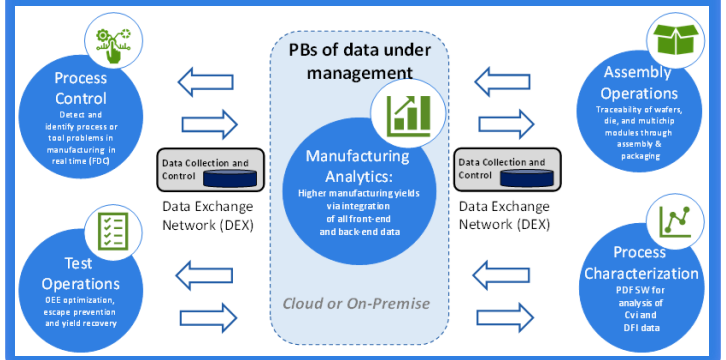
# The Transformation of PDF Solutions

## PDF Solutions has consistently anticipated the evolution of the industry and developed new scalable analytics capability

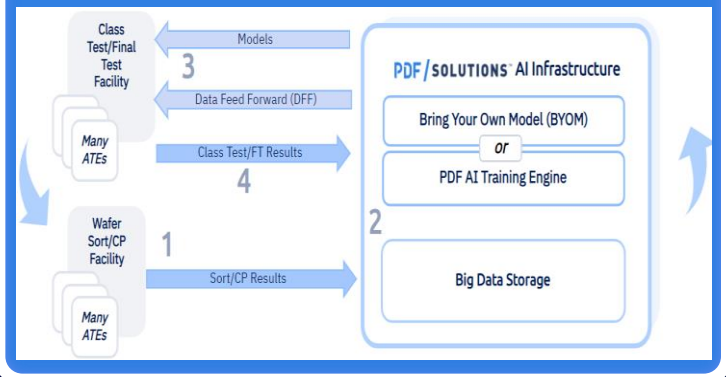
### Yield Ramp Characterization Vehicle




### High Volume Manufacturing Analytics




### AI-driven 3DIC test solutions



# Our approach to scaling AI /ML in our solutions

## AI solutions for large-scale semiconductor deployments need to be built with 3 main design principles

01 Data Infrastructure & Semantic

02 AI Enabled Decision Making

03 Enterprise Scale Solutions

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# Tangible applications of AI in semiconductor industry

## Today we are presenting a series of AI enabled solutions all built on the overall PDF Solutions platform

| | Manufacturing Data Lakehouse | Guided Analytics | AI-Enabled Digital Twins for Equipment | AI for Test & ModelOps | GenAI for enterprise applications |
|---|---|---|---|---|---|
| Data Infrastructure & Semantic | ☑ | ☑ | ☑ | ☑ | |
| AI Enabled Decision Making | | ☑ | ☑ | ☑ | ☑ |
| Enterprise Scale Solutions | ☑ | | ☑ | ☑ | ☑ |

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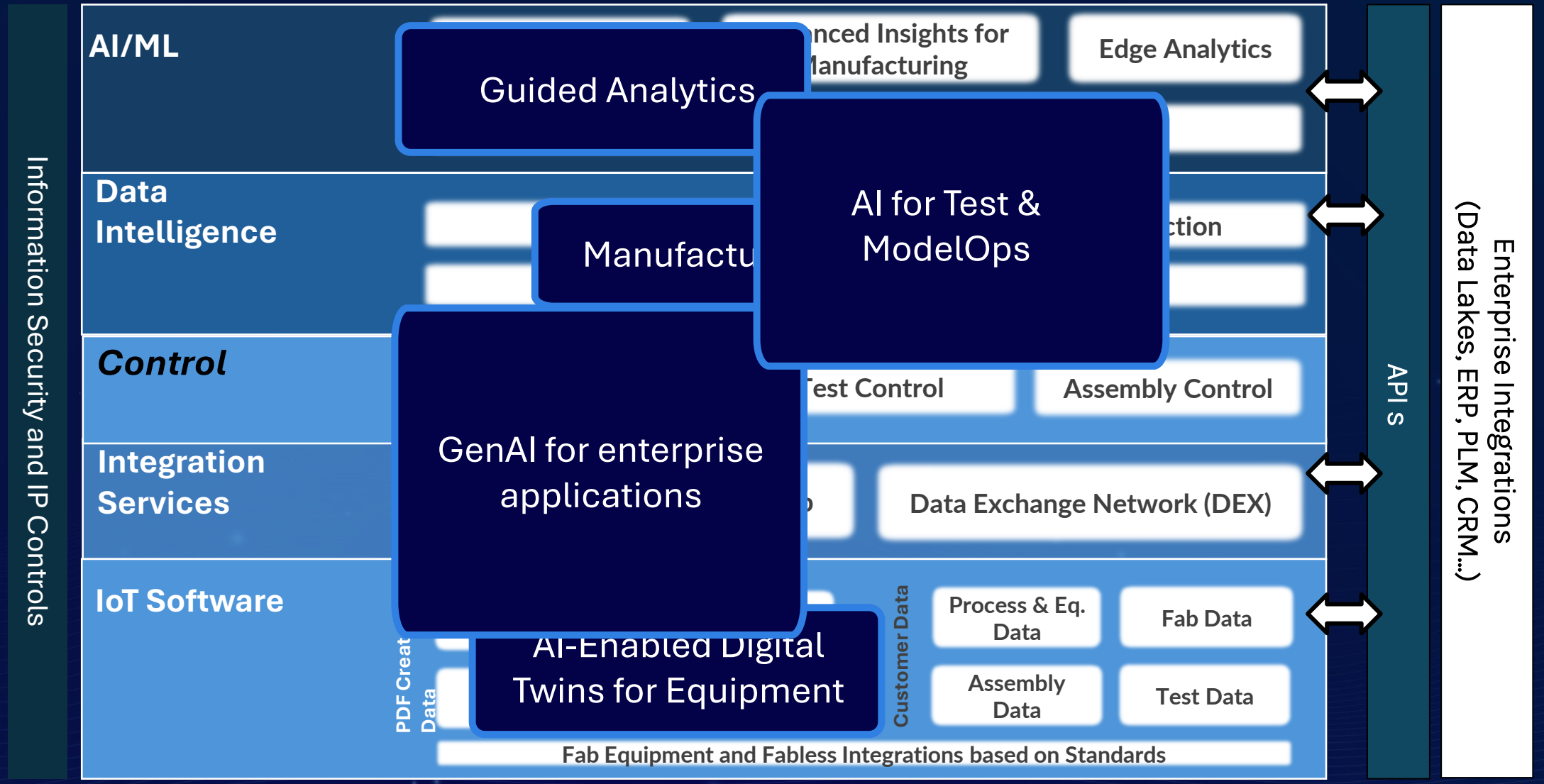
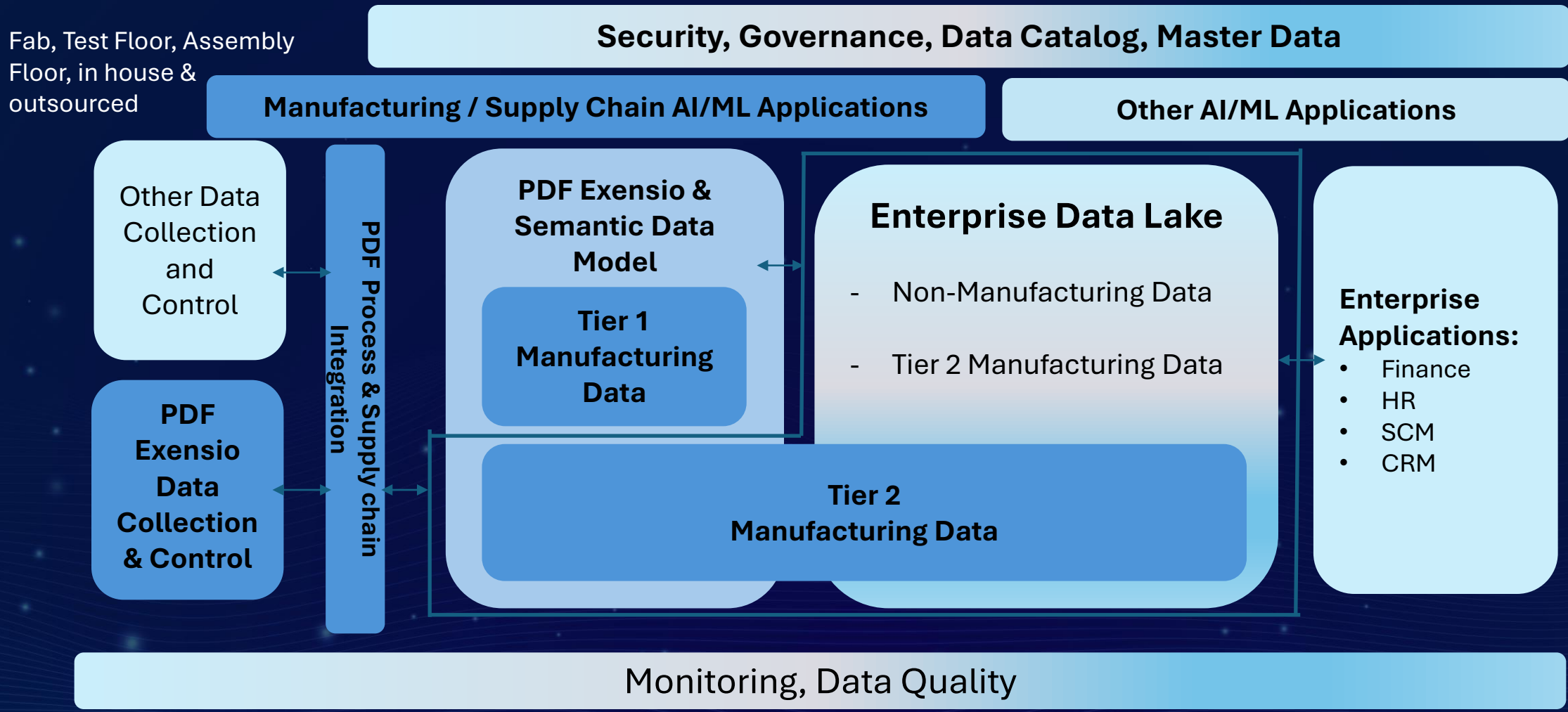
# AI enabled solutions are built on the PDF Solutions platform



Manufacturing Data Lakehouse

# Manufacturing Data Lakehouse

## PDF Solutions Exensio is the foundation to align manufacturing data across the enterprise



Guided Analytics

## Extremely large and complex data sets

### 80% of the time of the data analysts is spent in data wrangling and querying activities

exensio®

### 2 PB of Data

Exensio Cloud Hosted Data:

4 times as much as the entire Spotify music library or the equivalent of a 1000 years of non-stop HD movie streaming…

RENESAS

### Automatically summarizes data and run diagnostics

For 2000 products: Wafer sort (includes die bins, Parametric test), final test (die bins, Parametric test), PCM data, info on test equipment used, site and retest information

EDTM 2024


### Up to 1M columns & 5M rows

Large Exensio Manufacturing Analytics deployment

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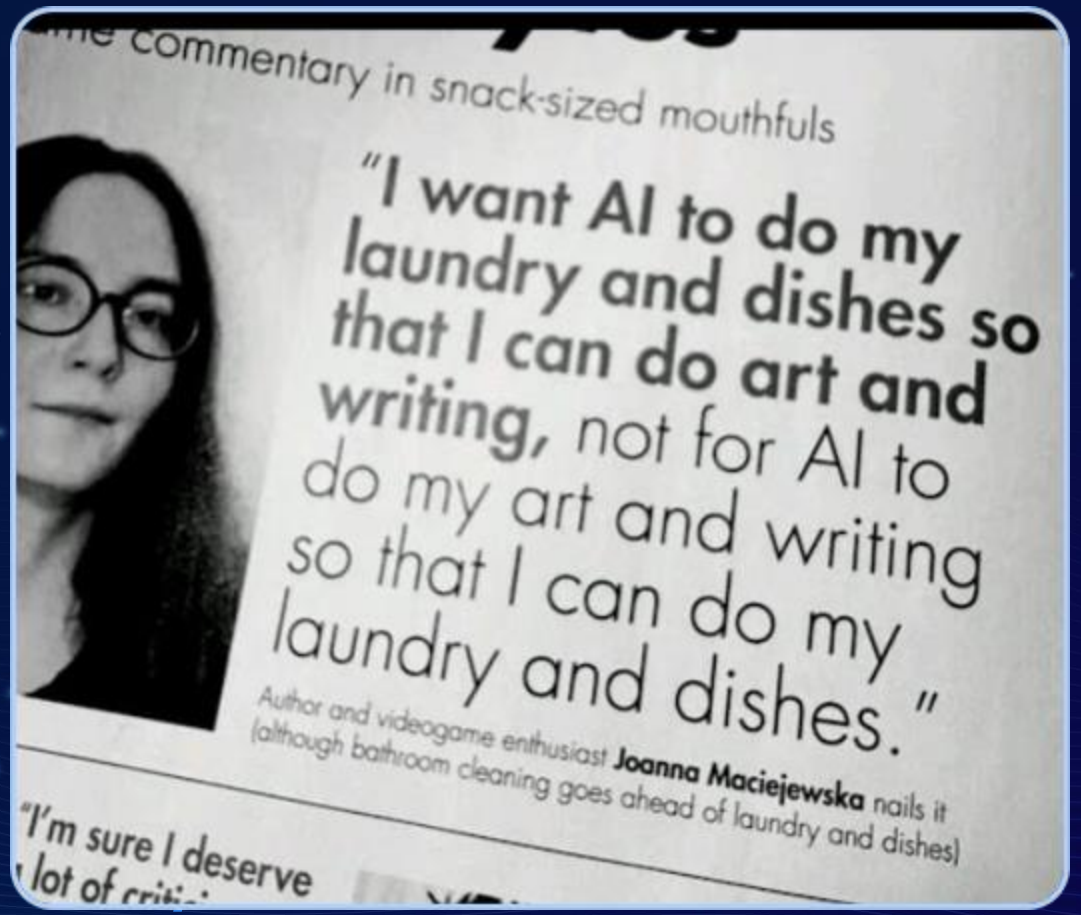
## Transforming user experience

With AI there is an opportunity to dramatically transform the experience of the users and create new modes of decision making when dealing with extremely large and complex data sets

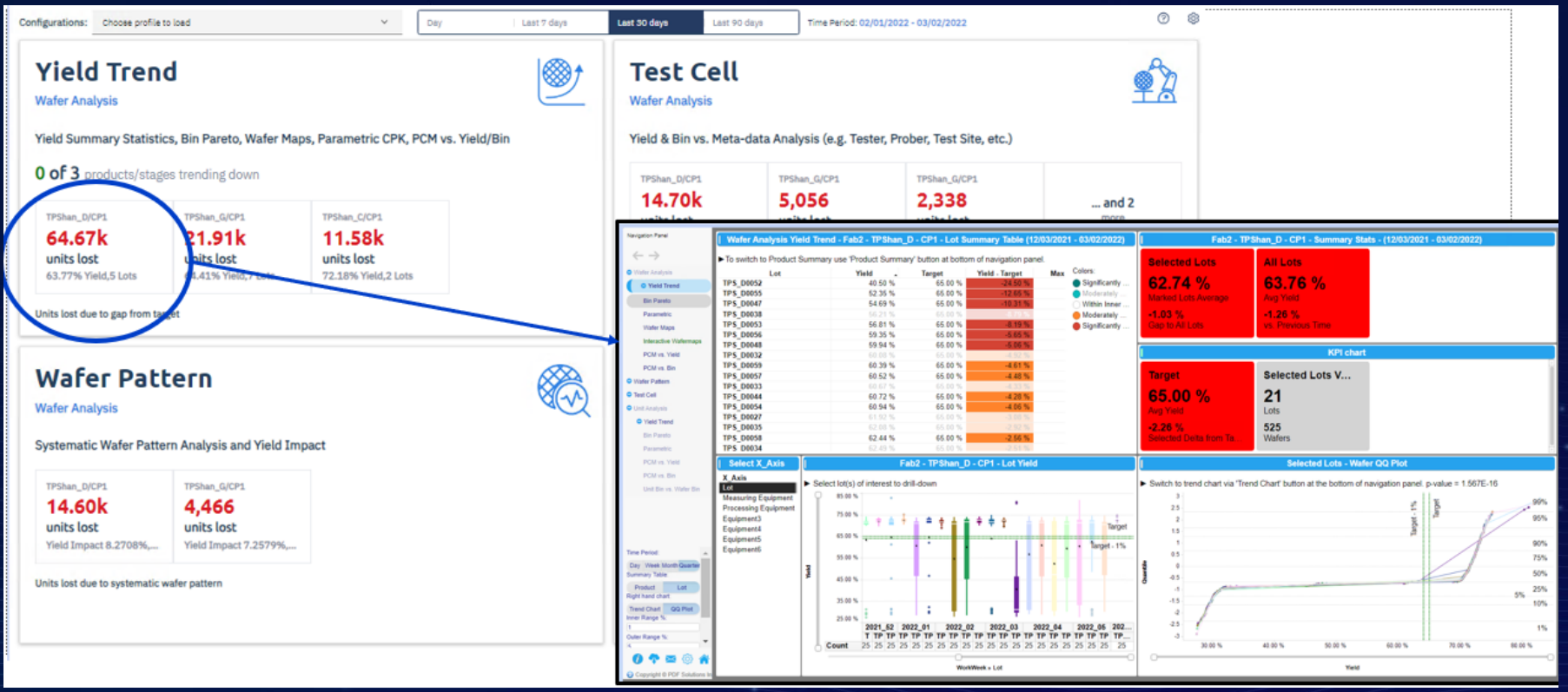



- data
- \+
- infrastructure
- \+
- model

## Guided Analytics

# Mine all the data continuously, identify issues, guide users to resolutions

1. Automated advanced ML identifies failure signals and associated root causes
2. Ultra-fast performance
3. Analyze all your data types daily, Continuously mine 100% of your data




Greatly simplifies and reduces engineering effort

- Signals
  - Low Yield, Mid Yield
  - Excursions
  - Bin_Pattern (e.g. Bin15_edge)
- Root causes
  - PCM/WAT (WS)
  - Test Cell Tools (WS/FT)

Executive dashboard highlights relevant results across all products

Easy to understand dashboard with very few clicks required

AI-Enabled Digital Twins for Equipment

## Why Digital Twin?

01 **Development**

- Virtual prototyping
- Collaborative design

02 **Manufacturing**

- Equipment characterization
- Chamber matching
- Reduce fleet variability

03 **Servicing**

- Predictive failure analysis
- Enhance services opportunities

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# AI-Enabled Digital Twins for Equipment

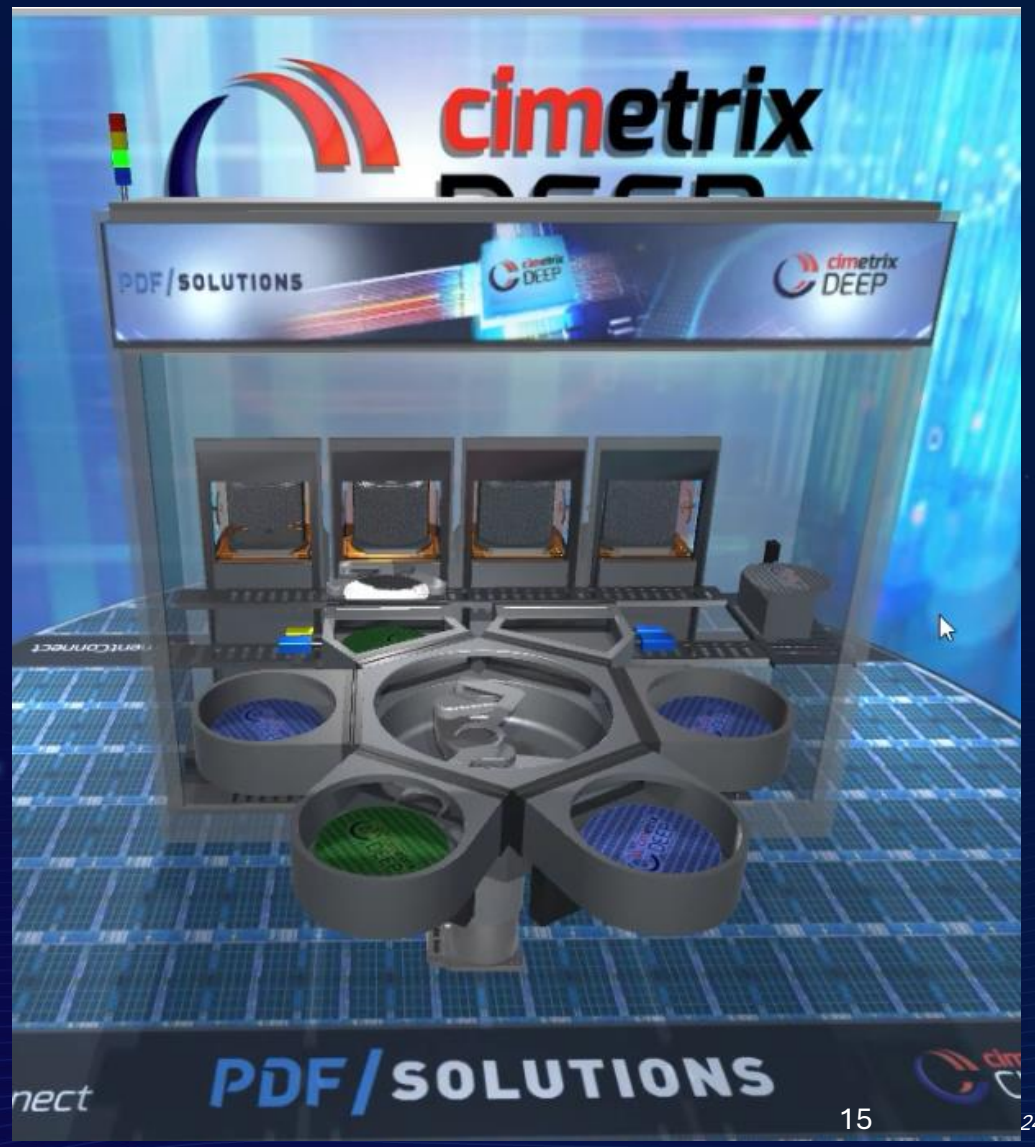
AI-Enabled Digital Twins for Equipment

1. Provides a Higher Level of Equipment Reliability and Deeper Visibility into Equipment Performance

   - Ability to Check Overall Equipment Health
     - Overall Equipment Health & Characterization
     - Monitor Critical Equipment Sub-Component's Health
     - Create Golden Fingerprints for Each Sub-Component

   - Predict Failures Before They Happen
     - AI/ML Monitors and Identifies When Component Health Starts to Deteriorate Over Time
     - Prevents Costly Unscheduled Tool Downtime

2. Enables a new flow of recurring revenue from services contracts

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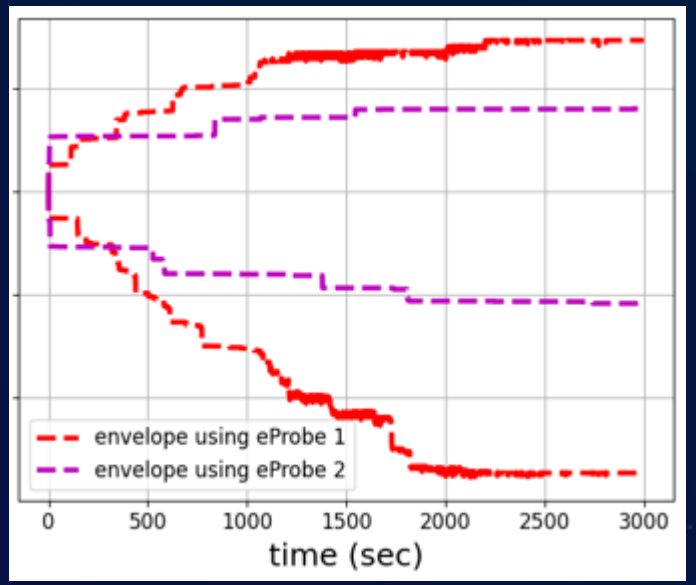
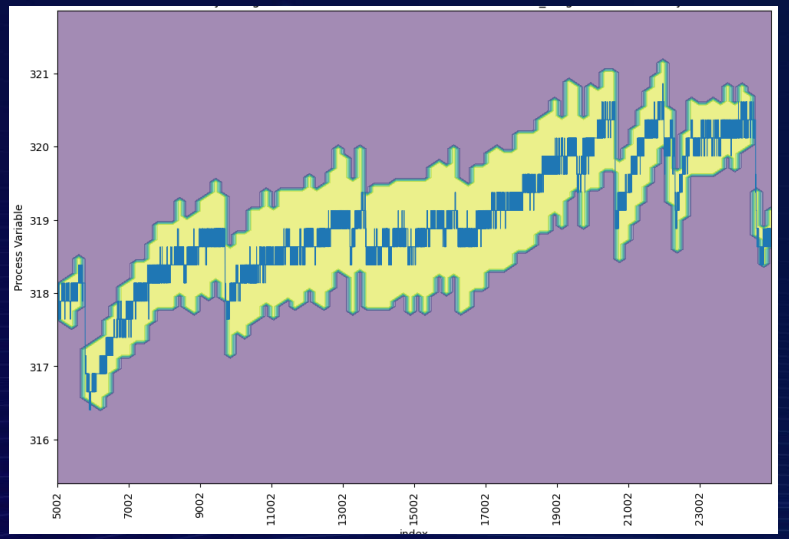
AI-Enabled Digital Twins for PDF Solutions eProbe

AI-Enabled Digital Twins for Equipment

## PDF Solutions is scaling the deployment of its eProbe solution with an AI driven support services capability


*Predict tip quality as measured by the variability of Emission current as a function of Heating current using "envelope modeling"*



# Testing hybrid devices across a globally distributed supply chain calls for an integrated approach

AI for Test & ModelOps

Shipping

Shipping

Shipping

Planning / Costing

Planning / Costing

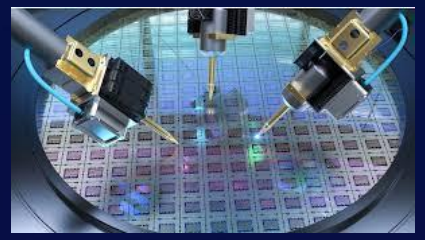
Planning / Costing

Planning / Costing

Planning / Costing

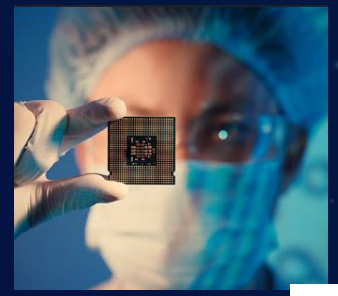
Design

Foundry



Wafer Sort

Packaging



Final Test

4 to 6 Dies
2 to 4 HBM
10-20 Test Insertions

Shipping

Planning / Costing

KGD

Adaptive Test
Data Feed Forward
Die matching

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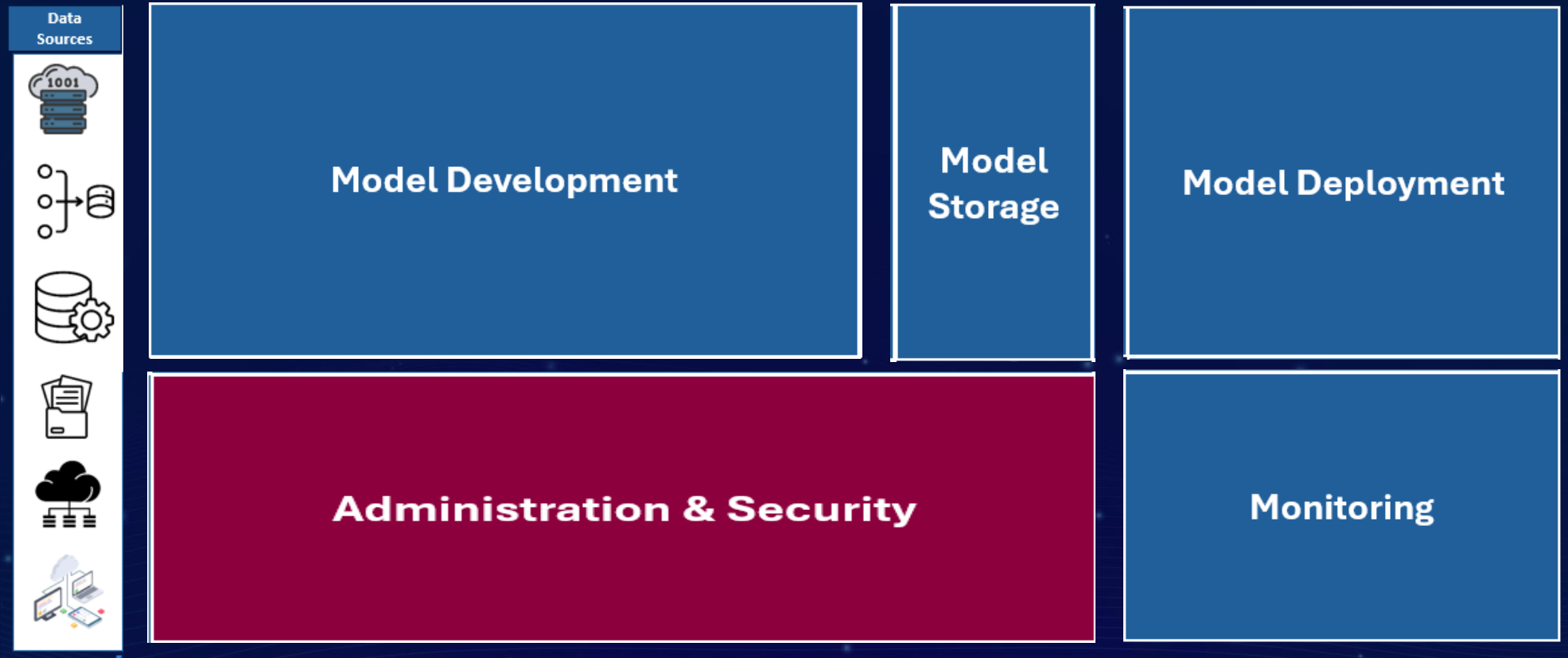
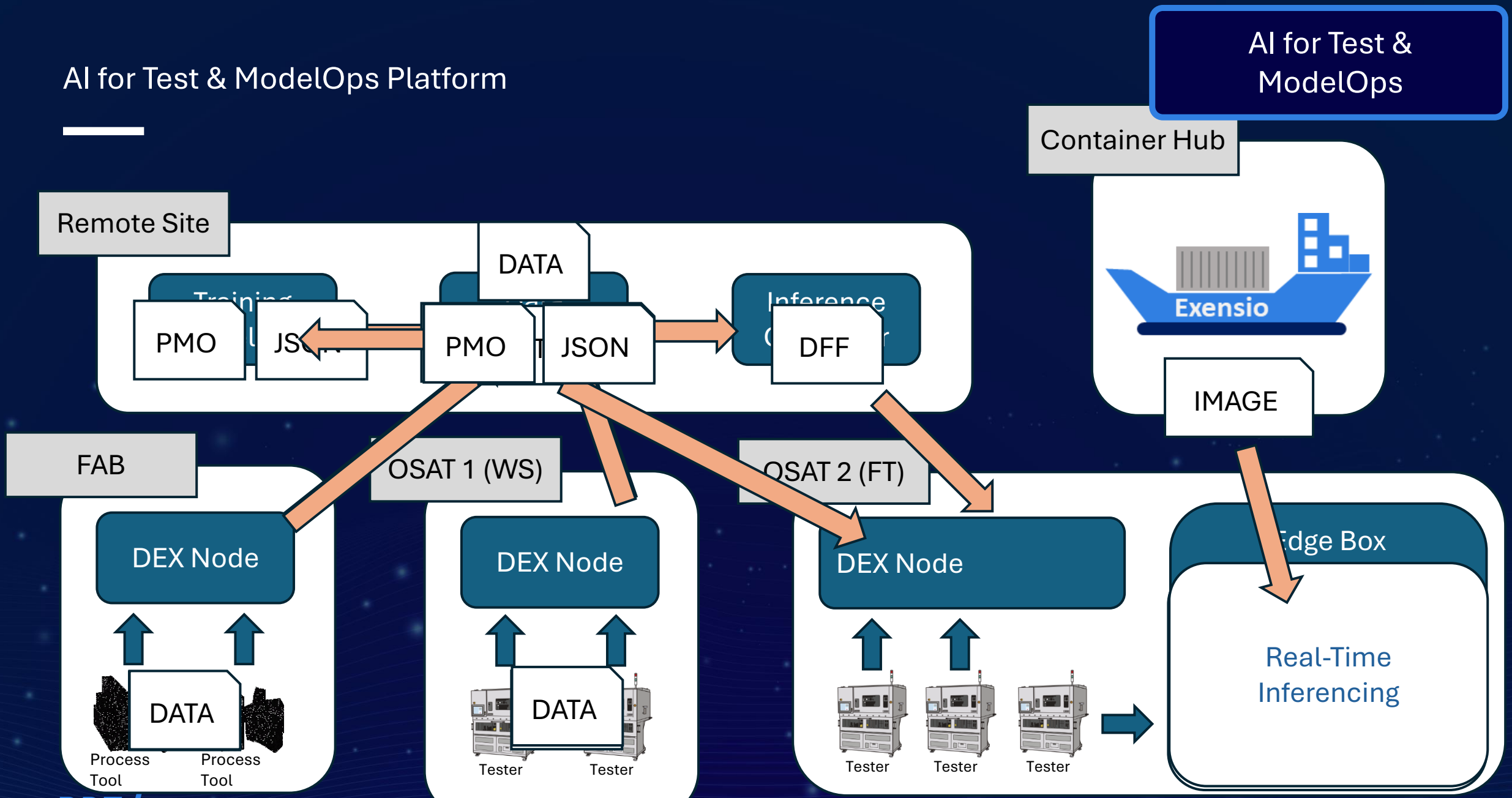
# Create, Manage and Control models across their lifecycles

AI for Test & ModelOps

It is not only about the "best model" it is about the platform to support the deployment of various models where they will drive action.



# AI for Test & ModelOps Platform



# Transforming PDF Solutions with GenAI

GenAI for enterprise applications

## PDF Solutions strategy to adopt GenAI

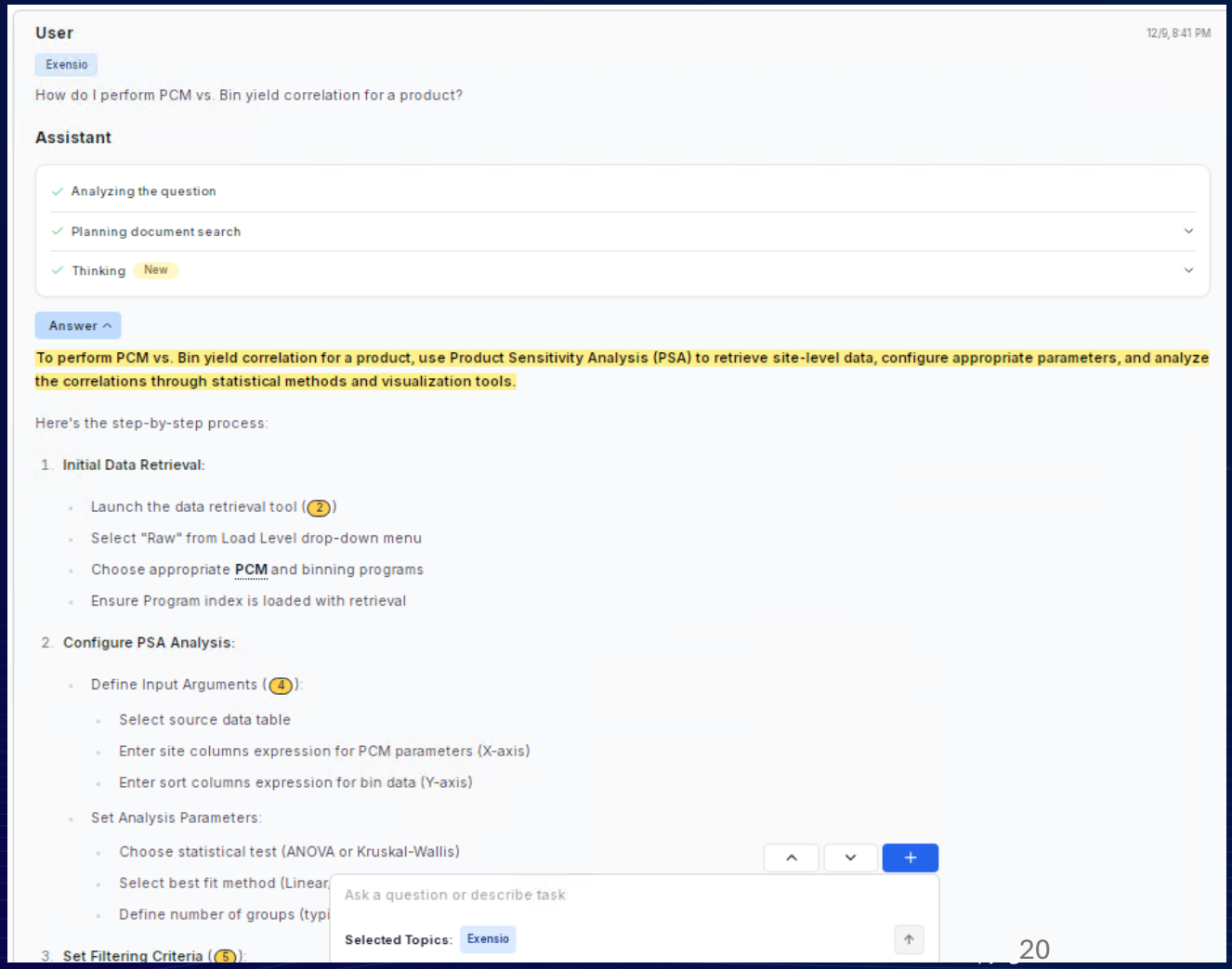
1. **Data security and privacy**

   Virtual Private Cloud (VPC) or on-prem.
   No external API's.

2. **Platform with existing LLM models & systems**

3. **Improving Exensio usability and user experience**

4. **Better predictive models with less data**

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# SAP and PDF AI Solutions Summary

GenAI for enterprise applications

## Gen AI use cases that are most valuable based on customer feedback

1. Solving Supply Chain Hurdles with GenAI
2. AI Yield Analytics Order Fulfillment Forecasting
3. GenAI Consumption Based Dynamic Product Costing
4. Quality Shield & Traceability with GenAI
5. GenAI Green Factory & Sustainability

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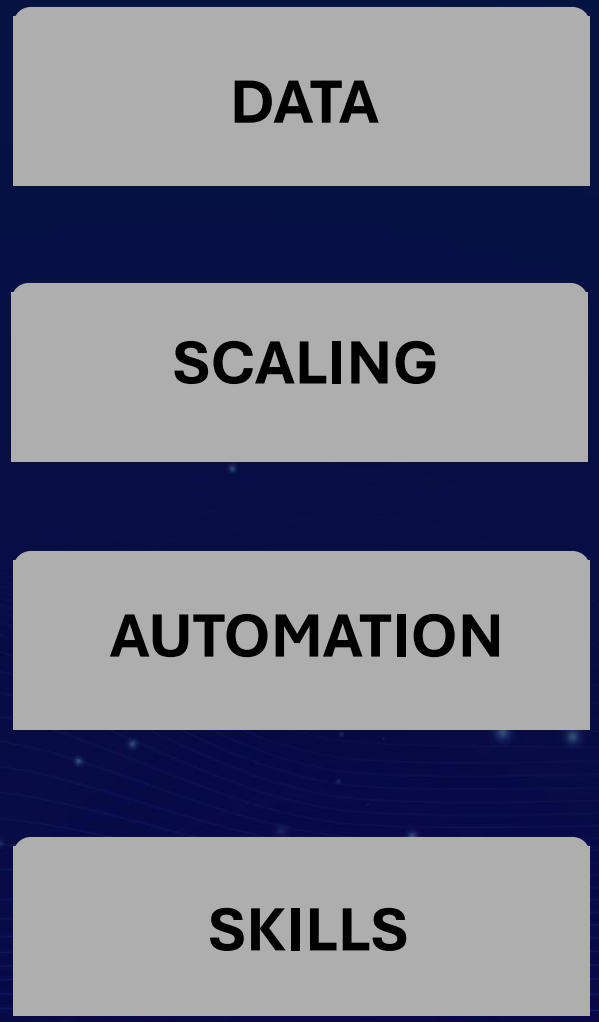
Sapience Manufacturing Hub

SAP

# Scaling AI /ML in Semiconductor Manufacturing

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*Source: Theeiet.org 2024 & SemiEngineering 2024, Keystone 2019*


# Thank You

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