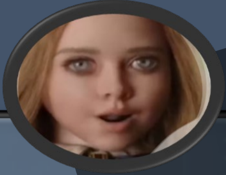


Based on who you talk to, AI is either going to save the world, or destroy it.
**What about Manufacturing?**

# The Role of AI in Manufacturing

## - Use Cases from the SEMI industry -

**Didier Chavet**

**Sep 2023**

Micron® | Intelligence Accelerated™

# The Role of AI in Manufacturing
## - Use Cases from the SEMI industry -

AI has emerged as a transformative force that can revolutionize manufacturing processes.

### Session Objectives

- ✓ Understanding the paradigms of Industry 3.0, 4.0 & 5.0
- ✓ Apprehending how AI can revolutionize manufacturing
- ✓ Realizing how an integrated and modern MES platform can facilitate the emergence of AI in manufacturing


Our 13 manufacturing sites around the globe annually produce millions of wafers, and from their operations, daily generate 13TB of data and 3.3 millions of images running through AI models.

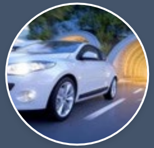
Micron® | Intelligence Accelerated™

# Micron is both enabling and leading the adoption of the 5th Industrial Revolution applications.

Micron's leading portfolio of memory and storage devices at the core of 5G & AI revolution

AI

**Cloud**
DRAM, 3D NAND, TLC/QLC SSDs, NVDIMMs, 3D XPoint



**Automotive**
DRAM, LPDRAM, GDDR6, e.MMC/UFS, NOR, SLC/MLC NAND, TLC SSDs

**Mobile**
LPDRAM, e.MMC/UFS, 3D NAND

**Networking**
DRAM, LPDRAM, GDDR5, GDDR6, eUSB/e.MMC/UFS, NOR, TLC/QLC SSDs, HBM

**IoT**
DRAM, LPDRAM, e.MMC/UFS, 3D NAND, NOR, SLC/MLC NAND, SSDs, MicroSD cards

Data

Intelligence

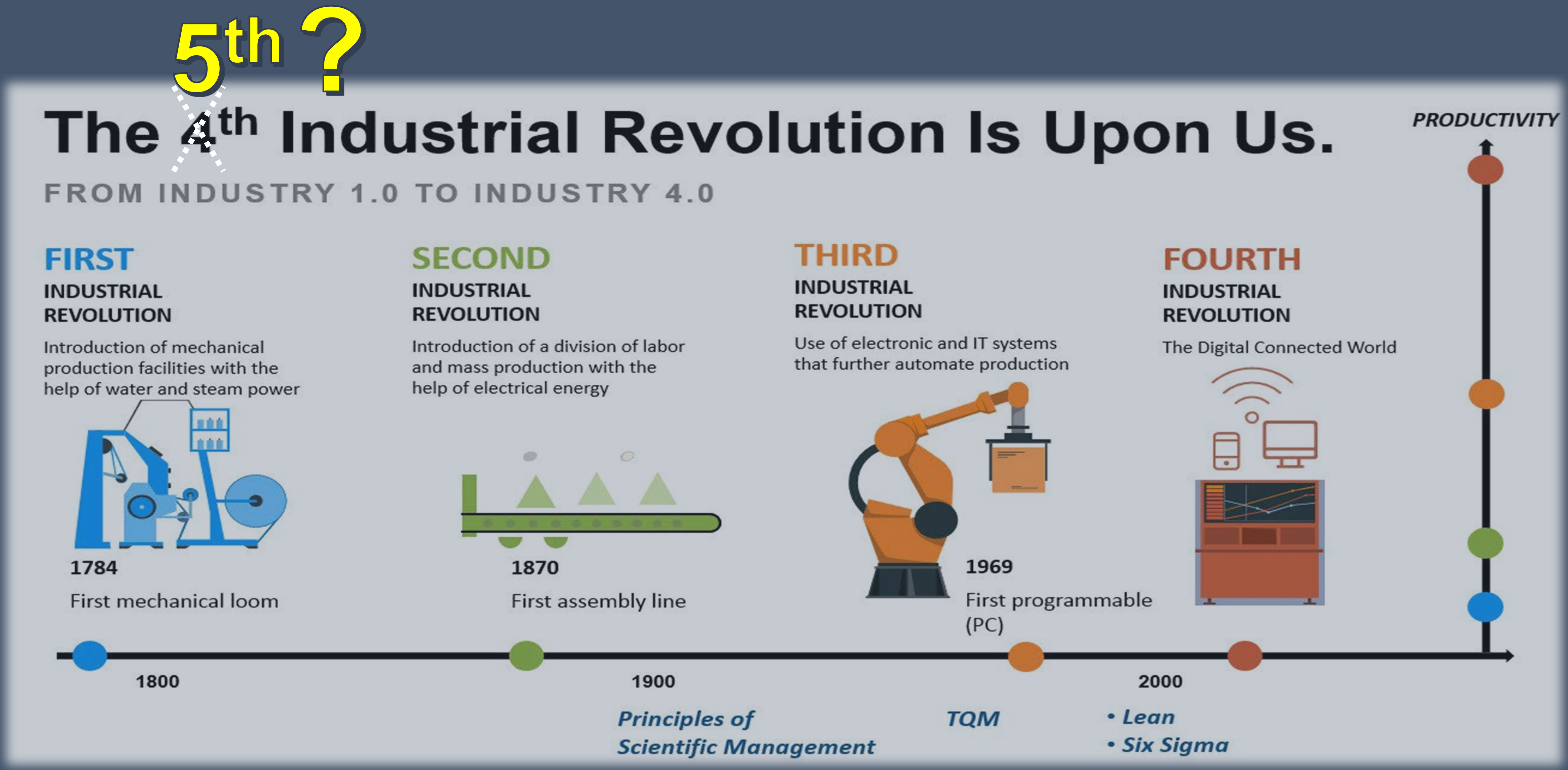
5G

Micron recognized by WEF as leader in adopting AI technologies in manufacturing Lighthouses

WEF = World Economic Forum

**Singapore NAND Center of Excellence**

**Taiwan DRAM Center of Excellence**



5th ?
The ~~4th~~ Industrial Revolution Is Upon Us.
FROM INDUSTRY 1.0 TO INDUSTRY 4.0
PRODUCTIVITY
FIRST
INDUSTRIAL REVOLUTION
Introduction of mechanical production facilities with the help of water and steam power
1784
First mechanical loom
SECOND
INDUSTRIAL REVOLUTION
Introduction of a division of labor and mass production with the help of electrical energy
1870
First assembly line
THIRD
INDUSTRIAL REVOLUTION
Use of electronic and IT systems that further automate production
1969
First programmable (PC)
FOURTH
INDUSTRIAL REVOLUTION
The Digital Connected World
1800
1900
2000
Principles of Scientific Management
TQM
• Lean
• Six Sigma

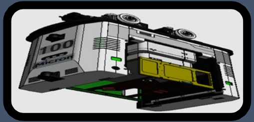
# The Role of AI in Manufacturing

## - Use Cases from the SEMI industry -

### Automation Roadmap

**3.0**

**Physical Automation**



- ✓ Activity Manager
- ✓ MCS

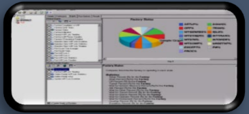
**Process Control**

- ✓ Scheduling
- ✓ Dispatching

**System Automation**

- ✓ Host Automation
- ✓ RMS
- ✓ SPC

**Tracking & Monitoring**



**MES**

**3.0**


Zoom Slide

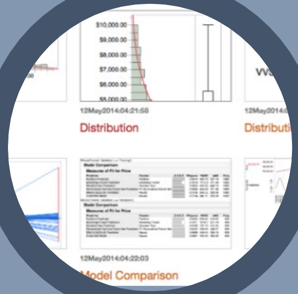
MES = Manufacturing Execution System
RMS = Recipe Management System
SPC = Statistical Process Controls
APC = Advanced Process Controls
MCS = Material Control System

# A Typical Automated Manufacturing Step

## Pre-Process

## In-Process


## Post-Process




**Micron Singapore:**
- 50% Decrease in New Product Ramp Up Time
- 4% Increase in Tool Availability
- Improve Labor Productivity

**Micron Taiwan:**
- 18% Increase in Labor Productivity Improvement
- 40% Decrease in Product Downgrade Reduction
- 20% Decrease in Time Reduction in New Product Ramp
- 15% Decrease in Energy Power Saving

Automated Stage & Delivery

Automated Validations

Automated Execution

Automated Process Controls

Automated Reports

Automated Dispatch & Pickup

# The Role of AI in Manufacturing

## - Use Cases from the SEMI industry -

**Automation Roadmap**

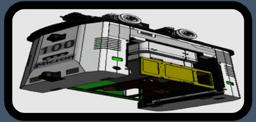
**3.0**

**Digital Roadmap**

**4.0**

When working in concert, automation and analytics create an **effective orchestration** of physical and digital devices.

**Physical Automation**



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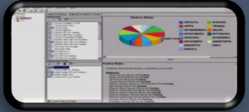
**Tracking & Monitoring**



**MES**

**Preventive Analytics**

- ✓ Machine Health
- ✓ Root Cause Analysis
- ✓ Commonality Analysis

**Integration**

- ✓ Fast Data Platform
- ✓ Big Data Platform
- ✓ Edge Computing

**Industrial IoT**


Mobile, RFID, Sensor Devices & IOT Platform

**3.0**


Zoom Slide

**4.0**

Zoom Slide

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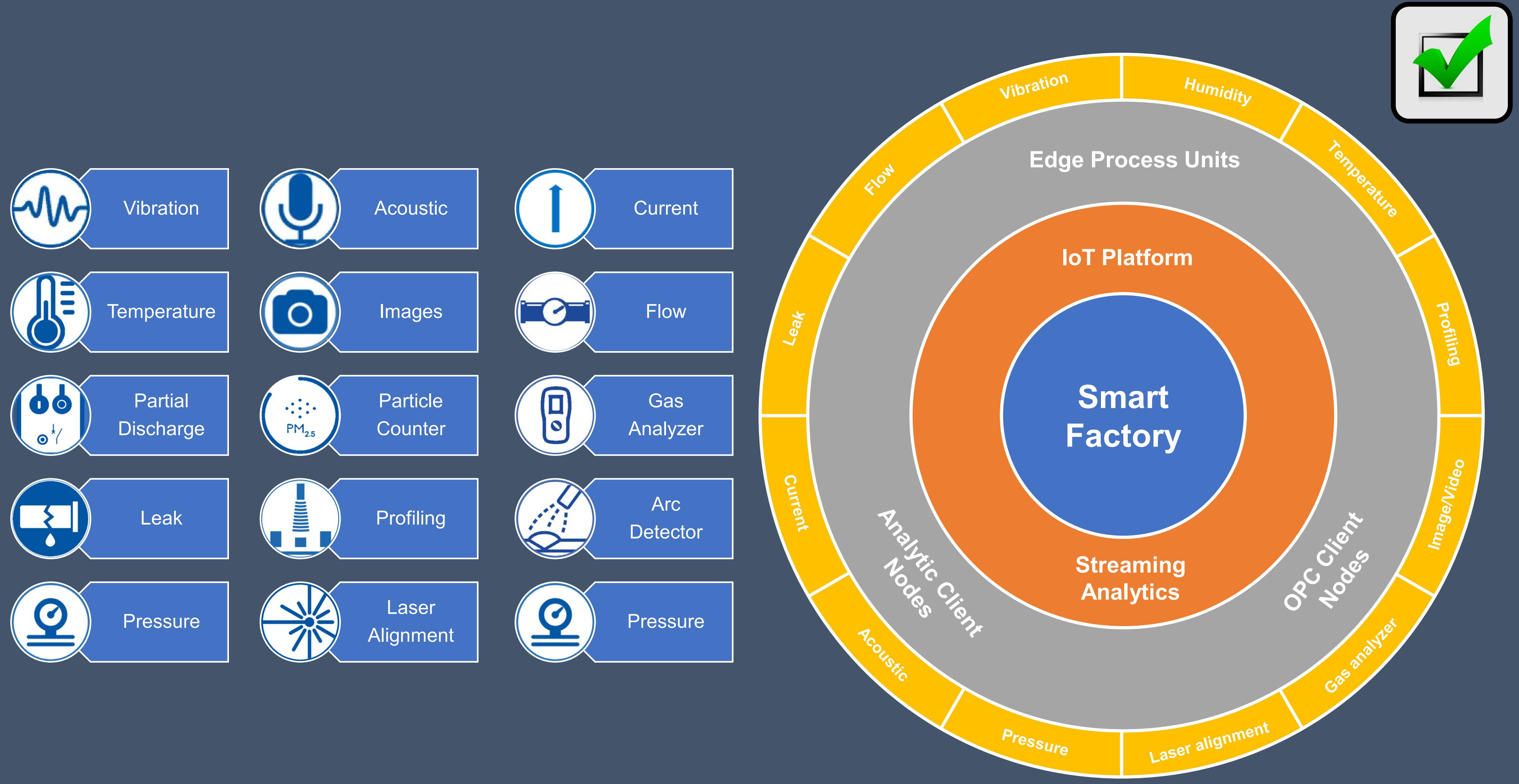

Vibration
Acoustic
Current
Temperature
Images
Flow
Partial Discharge
Particle Counter
PM2.5
Gas Analyzer
Leak
Profiling
Arc Detector
Pressure
Laser Alignment
Pressure
Vibration
Humidity
Temperature
Profiling
Image/Video
Gas analyzer
Laser alignment
Pressure
Acoustic
Current
Leak
Flow
Edge Process Units
IoT Platform
Smart Factory
Streaming Analytics
Analytic Client Nodes
OPC Client Nodes

# The Role of AI in Manufacturing

## - Use Cases from the SEMI industry -

### Automation Roadmap

**3.0**

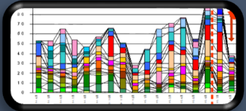
### Digital Roadmap

**4.0**

### Artificial Intelligence

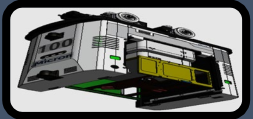
**5.0**

**Optimization**



Predictive Manufacturing

**Physical Automation**



- ✓ Activity Manager
- ✓ MCS

**Process Control**

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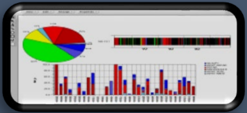
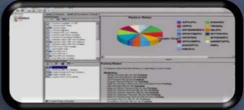
- ✓ Dispatching
- ✓ APC

**System Automation**



- ✓ Host Automation
- ✓ RMS
- ✓ SPC

**Tracking & Monitoring**



**MES**

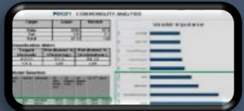
**Prescriptive Analytics**

Automated Machine Adaptation

**Predictive Analytics**

- ✓ Simulation
- ✓ Yield Prediction
- ✓ Decision Making

**Preventive Analytics**



- ✓ Machine Health
- ✓ Root Cause Analysis
- ✓ Commonality Analysis

**Integration**

- ✓ Fast Data Platform
- ✓ Big Data Platform
- ✓ Edge Computing

**Industrial IoT**


Mobile, RFID, Sensor Devices & IOT Platform

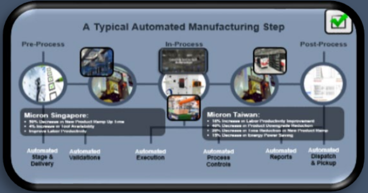
Zoom Slide

Zoom Slide

### AI.1 Intelligent Analytics

Services capable of performing tasks that would typically require human intelligence, and designed to process and **analyse vast amounts of data**, **recognize patterns**, and **make predictions or take actions** based on the acquired knowledge

**3.0**

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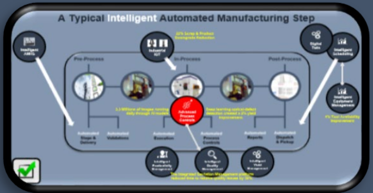
**4.0**

Zoom Slide

**AI.1**

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**Bring a Smart Factory's intelligence to the next level.**

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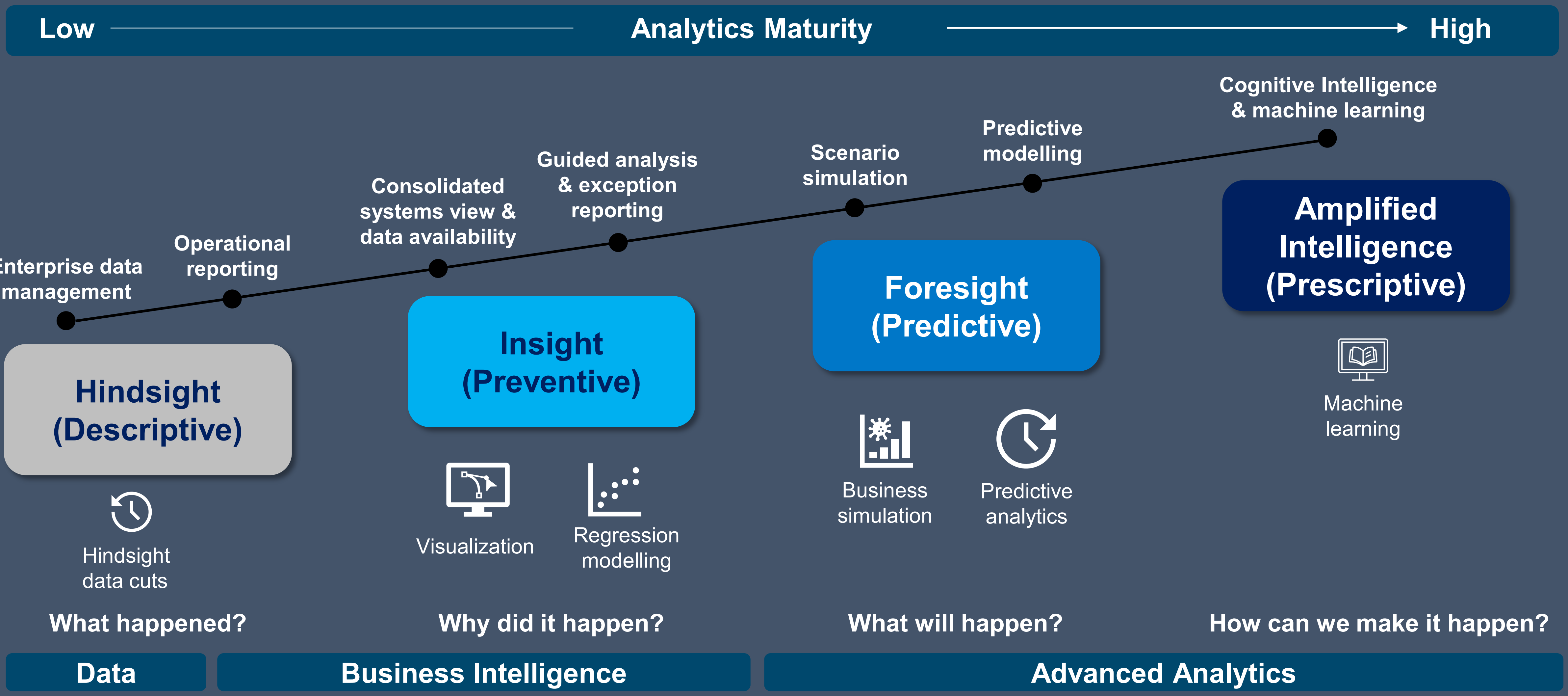
# AI.1 :: Intelligent Analytics :: Maturity Model



# AI.1 :: Intelligent Analytics :: MFG Use Cases

1. **Process Optimization**: Manufacturing processes often involve complex variables, such as machine settings, material compositions, and environmental conditions. Analytical data models can analyze historical process data and identify patterns, relationships, and optimization opportunities. It can then prescribe the optimal process parameters to enhance productivity, minimize waste, and improve quality.

2. **Supply Chain Optimization**: Analytical data models can optimize supply chain operations by considering various factors such as demand forecasts, inventory levels, transportation costs, and production capacity. By simulating different scenarios and analyzing the potential outcomes, the AI system can recommend optimal strategies for procurement, production scheduling, inventory management, and distribution.

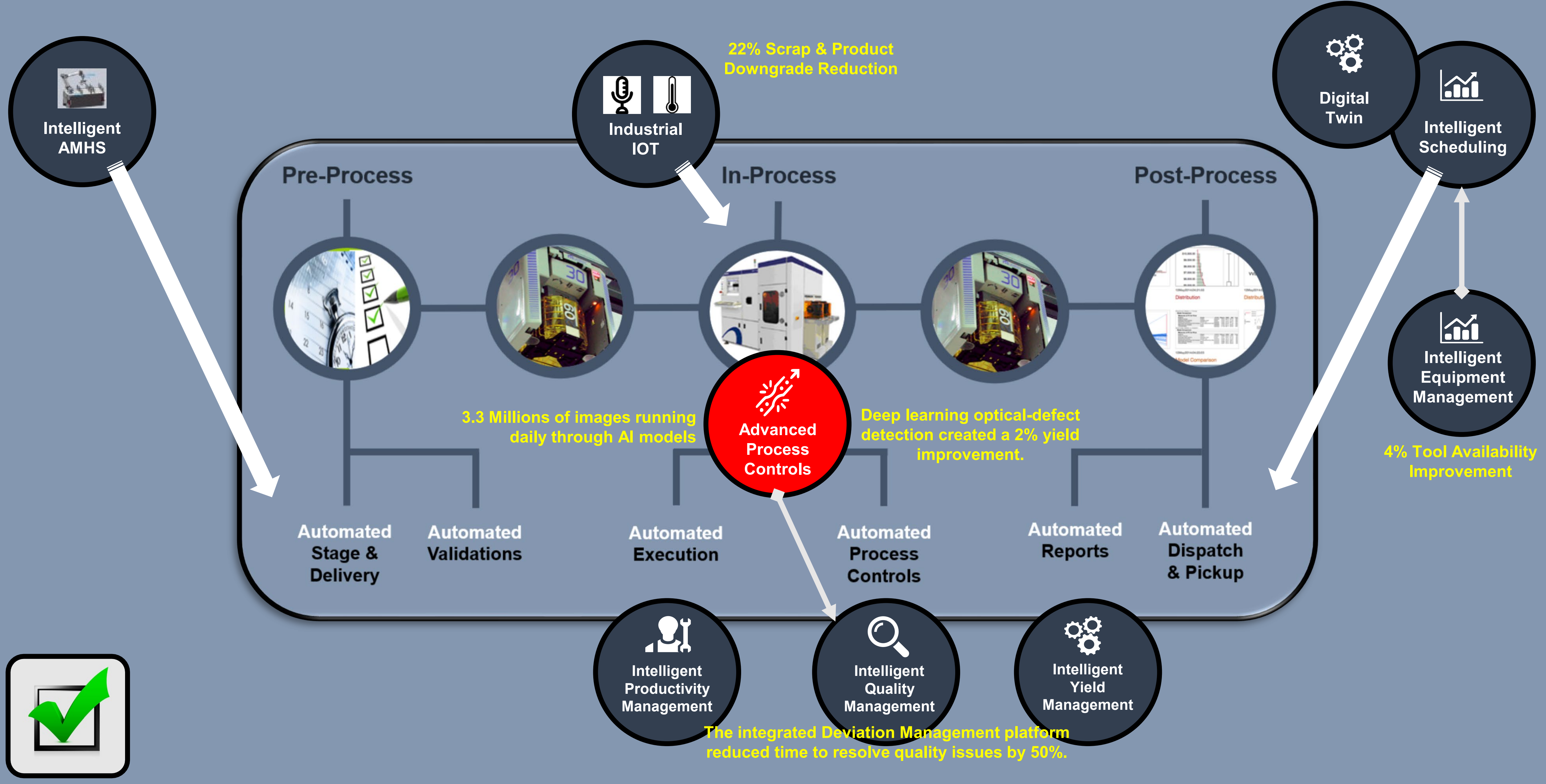
3. **Quality Control and Defect Detection**: Analytical data models can help in quality control by analyzing vast amounts of sensor data, images, or video footage from production lines. By learning from historical data, the AI model can detect patterns associated with defects, identify potential root causes, and prescribe corrective actions. This can improve product quality, reduce waste, and minimize the need for manual inspections.

4. **Energy Efficiency Optimization**: Manufacturing facilities consume significant amounts of energy, and optimizing energy usage can result in cost savings and environmental benefits. Analytical data models can analyze real-time sensor data, energy consumption patterns, and production requirements to recommend energy optimization strategies. These recommendations can include optimal machine configurations, production scheduling, or even the integration of renewable energy sources.

5. **Maintenance and Predictive Analytics**: Analytical data models can aid in predicting equipment failures and optimizing maintenance schedules. By analyzing sensor data and historical maintenance records, the AI system can identify patterns and indicators of potential equipment malfunctions. It can then prescribe maintenance actions, such as scheduling maintenance activities during low-production periods, ordering spare parts in advance, or conducting specific preventive maintenance tasks to avoid downtime.

6. **Resource Allocation**: Analytical data models can analyze resource data, resource consumption, and resource availability to support resource allocation decisions in manufacturing settings. It can recommend optimal resource assignment strategies, scheduling techniques, and resource allocation plans to reduce waiting times, decrease cycle times, and enhance operational efficiency.

# A Typical Intelligent Automated Manufacturing Step



# AI.1 :: Intelligent Analytics :: SEMI Use Case #1

## Predictive Maintenance :: The Evolution of Maintenance Strategies

### Digital Roadmap

**4.0**

Intelligent Analytics

AI.1

**Prescriptive Analytics**

Automated Machine Adaptation

**Predictive Analytics**

- ✓ Simulation
- ✓ Yield Prediction
- ✓ Decision Making

**Preventive Analytics**

- ✓ Machine Health
- ✓ Root Cause Analysis
- ✓ Commonality Analysis

**Integration**

- ✓ Fast Data Platform
- ✓ Big Data Platform
- ✓ Edge Computing

**Industrial IoT**

Mobile, RFID, Sensor Devices & IOT Platform

---

**PRESCRIPTIVE**

Let the machines help you decide how to avoid predicted failures!

**PREDICTIVE**

Predict exactly when it will break and maintain it accordingly!

**PREVENTIVE**

Maintain it at regular intervals, so it doesn't break!

**REACTIVE**

Fix it when it breaks!

---

### Benefits

- Manufacturing Tool Availability Improvement
- Cost of Non-Quality Improvement
- Labor Productivity Improvement

# AI.1 :: Intelligent Analytics :: SEMI Use Case #2

## Advanced Process Controls (APC) :: Evolution of the Triple A Paradigm

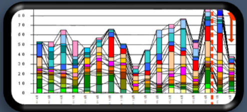
### Automation Roadmap

**3.0**

Intelligent Analytics

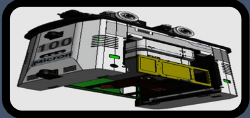
AI.1

Optimization



Predictive Manufacturing

Physical Automation



- ✓ Activity Manager
- ✓ MCS

Process Control

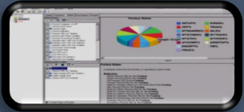
- ✓ Scheduling
- ✓ Dispatching
- ✓ APC

Advanced Process Controls

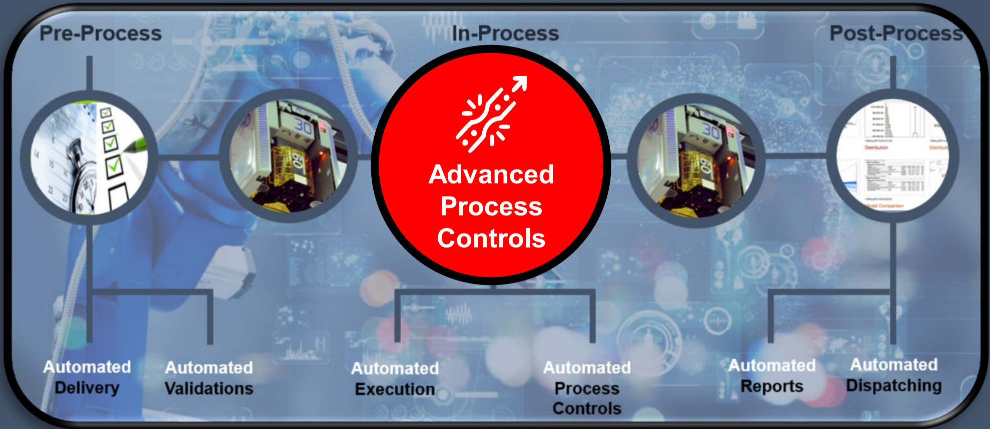
System Automation

- ✓ Host Automation
- ✓ RMS
- ✓ SPC

Tracking & Monitoring

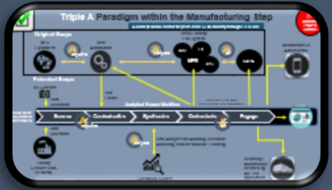


**MES**




### Benefits

- Yield Improvement
- Cost of Non-Quality Improvement
- Labor Productivity Improvement



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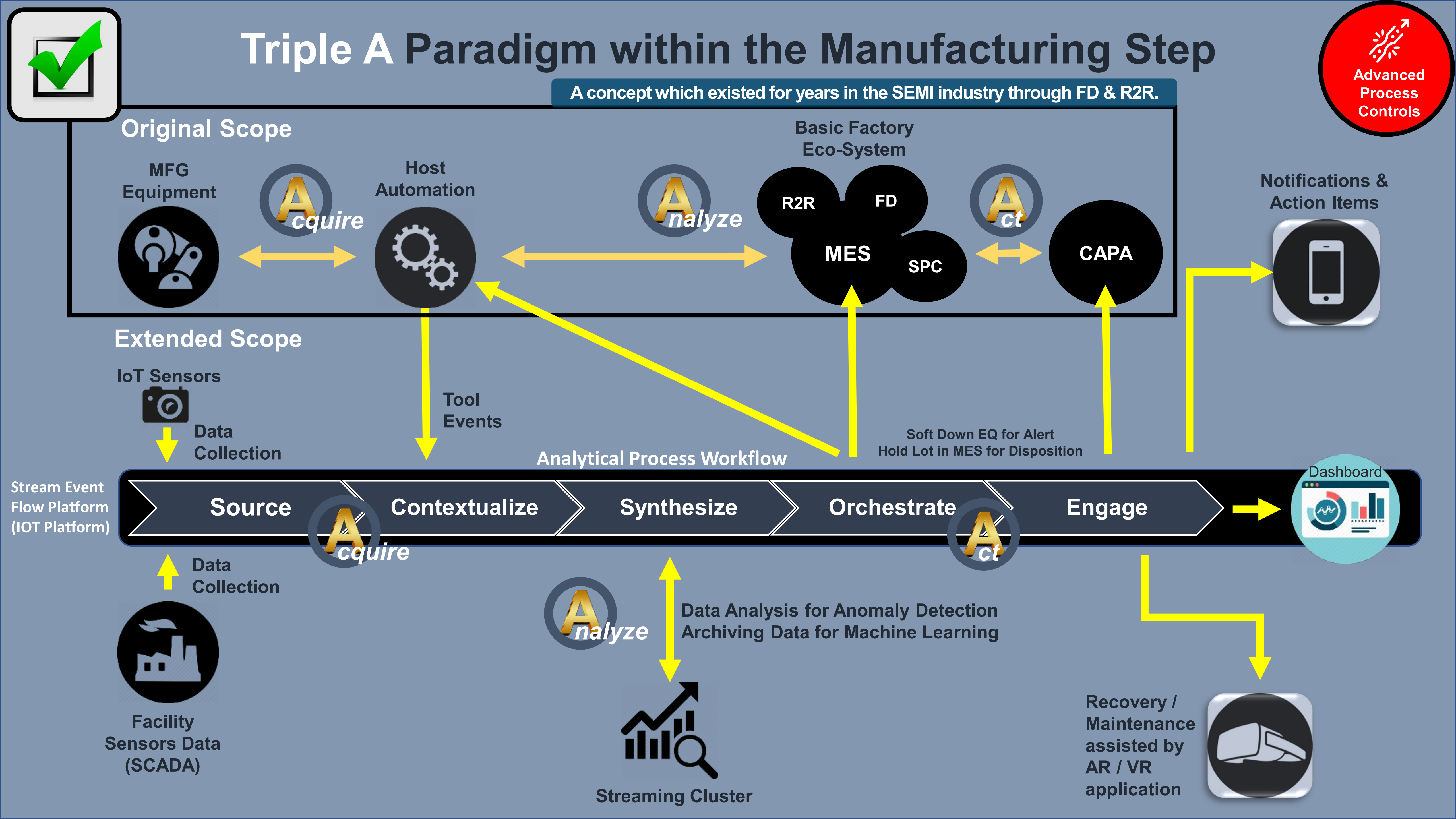
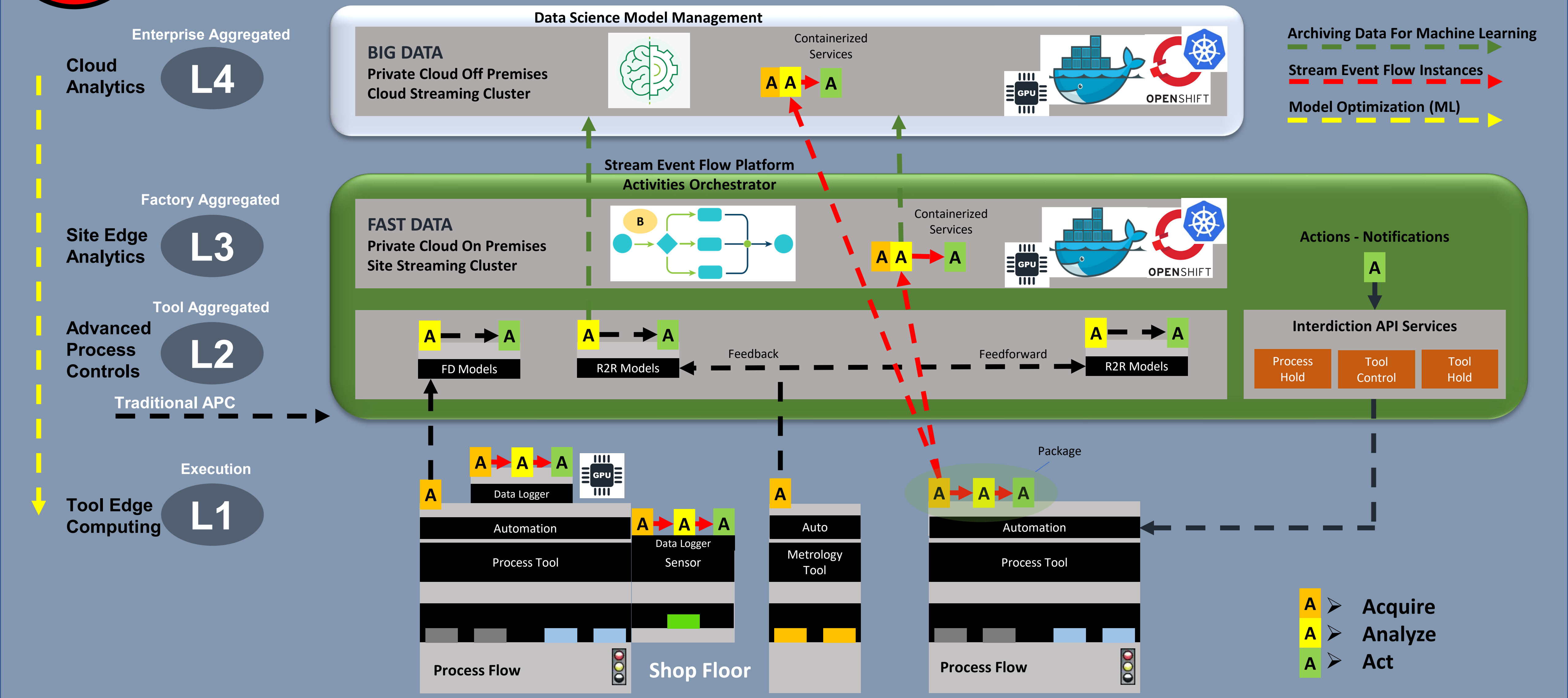


Triple A Paradigm within the Manufacturing Step
A concept which existed for years in the SEMI industry through FD & R2R.
Advanced Process Controls
Original Scope
MFG Equipment
Acquire
Host Automation
Analyze
Basic Factory Eco-System
R2R
FD
MES
SPC
Act
CAPA
Notifications & Action Items
Extended Scope
IoT Sensors
Data Collection
Tool Events
Analytical Process Workflow
Soft Down EQ for Alert
Hold Lot in MES for Disposition
Stream Event Flow Platform (IOT Platform)
Source
Contextualize
Synthesize
Orchestrate
Engage
Dashboard
Acquire
Act
Data Collection
Analyze
Data Analysis for Anomaly Detection
Archiving Data for Machine Learning
Facility Sensors Data (SCADA)
Streaming Cluster
Recovery / Maintenance assisted by AR / VR application

Advanced Process Controls

# Triple A Paradigm extended across 4 analytical layers



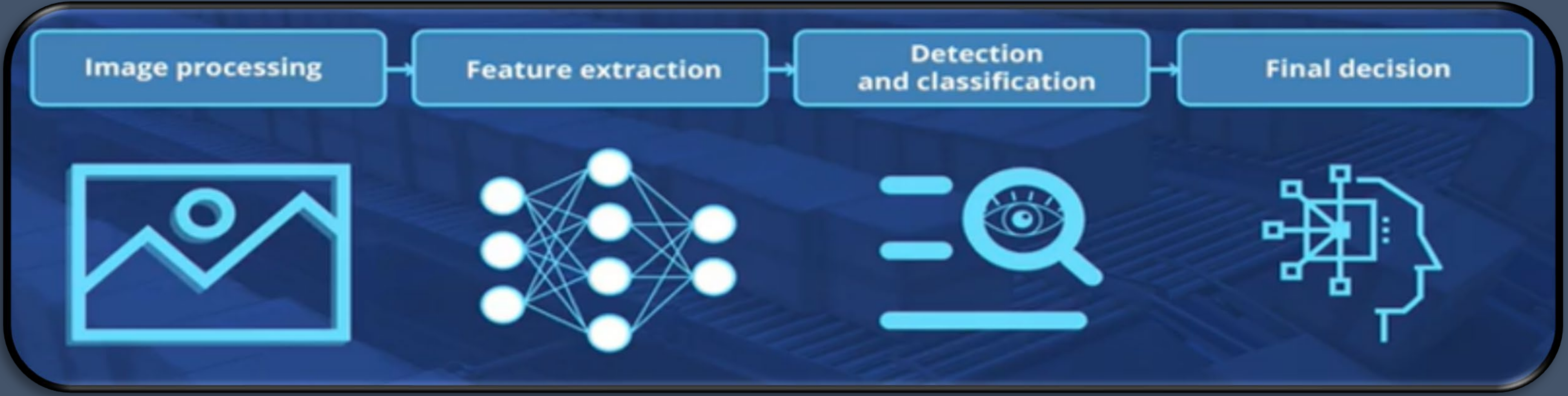
Advanced Process Controls

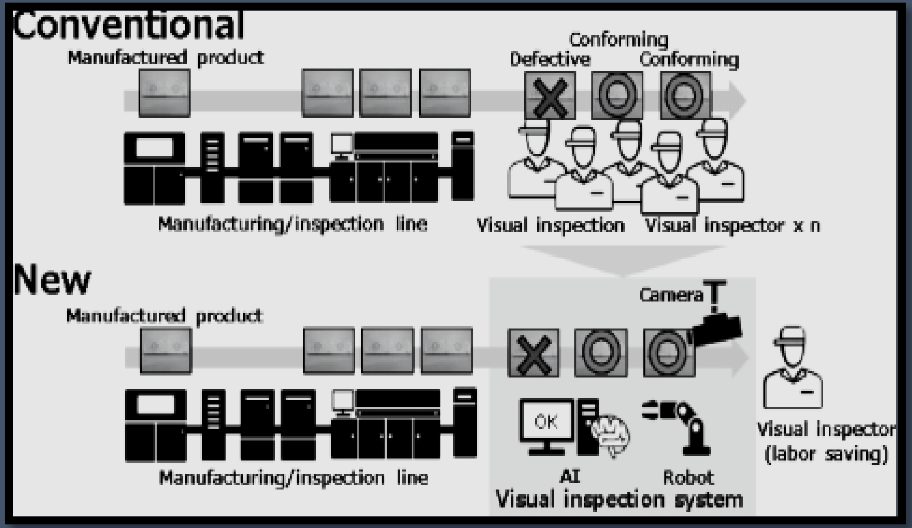
# Triple A Paradigm extended across 4 analytical layers

| | Definition | Data | Generic Tasks | Examples |
|---|---|---|---|---|
| Enterprise Aggregated<br>Cloud Analytics **L4** | Designed to (1) receive structured or unstructured data from all enterprise & factory data sources and (2) execute Advanced Analytics models capable to analyze excursions, genealogies & complex yield analysis | Aggregated Data at the enterprise level (tool, sensor, manufacturing process step, operator, material & product) characterized by a low sampling rate and a long retention period | ➢ Commonality Analysis<br>➢ Predictive Models (process optimization on-the-fly)<br>➢ Prescriptive Models (machine auto-correction)<br>➢ Model optimization pushed to L3 | ➢ Excursion Analysis<br>➢ Product Genealogy<br>➢ Overall Yield Analysis |
| Factory Aggregated<br>Site Edge Analytics **L3** | Designed to (1) receive structured or unstructured data from all factory data sources (APC, SPC, MES, RTD, …) and (2) execute on premise Advanced Analytics models capable to predict tool & product attribute behaviors leveraged by floor systems enabling manufacturing intelligence | Aggregated Data at the factory level (tool, sensor, manufacturing process step, operator, material & product) characterized by a low sampling rate and a long retention period | ➢ Data capture, transformation, aggregation & transmission to L4<br>➢ Commonality Analysis<br>➢ Predictive Models (process optimization on-the-fly)<br>➢ Prescriptive Models (machine auto-correction)<br>➢ Model optimization pushed to L2 | ➢ Test Time Reduction<br>➢ Test Operation Skip |
| Tool Aggregated<br>Advanced Process Controls **L2** | Designed to reduce Raw Data to an aggregated level sufficient to execute Fault Detection, Run-2-Run & Statistical Process Control models monitoring one (usually) or multiple (more rarely) manufacturing steps and their related tools | Aggregated Data at the tool, sensor & manufacturing process step levels characterized by a medium sampling rate and a medium retention period | ➢ Data capture, transformation, aggregation & transmission to L3<br>➢ Fault Detection Models<br>➢ Run-To-Run Models<br>➢ SPC Models<br>➢ Model optimization pushed to L1 | ➢ Fault Detection<br>➢ Run-To-Run<br>➢ SPC<br>➢ Ongoing Reliability Test<br>➢ Overall Equipment Effectiveness |
| Execution Layer<br>Tool Edge Computing **L1** | Designed to (1) meet the latency & reliability demands of a high frequency time series data transmission from a tool or a sensor, (2) collect & (3) analyze its Raw Data in which an automated analytical computation (executing simplistic Fault Detection models) is performed at an appliance located close to the tool (instead of storing the data into a centralized data store & then computing) | Raw Data for one specific tool or sensor characterized by a high sampling rate and a short retention period<br>Parametric data sampling rate can vary from 1kHz (1 thousand measurements per second or lower) to 1MHz (1 million measurements per second). | ➢ Data capture, transformation, aggregation & transmission to L2 and/or L3<br>➢ Homegrown Edge Computing Models (Spark, H2O, PMML, R) on single thread or aggregated / correlated threads across multiple sensor / machine parametric data messages<br>➢ Simplistic SPC Edge Computing Models | ➢ Machine Auto Shutdown<br>➢ Predictive Maintenance |
| Analytical Process Workflow<br>Stream Event Flow Platform **B** | Designed to build & deploy stream event flows enabling data acquisition, data analysis & actionable insights across all analytical layers | | | |

# AI.1 :: Intelligent Analytics :: SEMI Use Case #3

**Image Analytics** :: Automated Defect Classification (AOI)
**Video Analytics** :: Automated Anomaly Detection

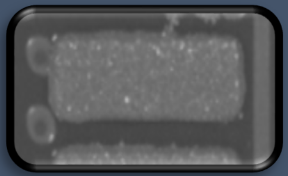


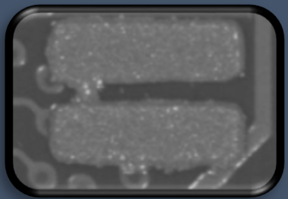

## Benefits

- Yield Improvement
- Cost of Non-Quality Improvement
- Labor Productivity Improvement

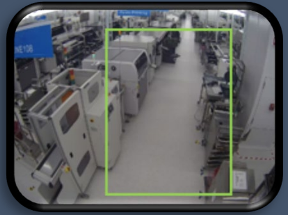
Pass



Defect



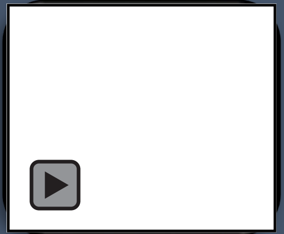
Operator Working Time Compliance



Unattended Material

Work Attendance

Material Counter



Splice Compliance

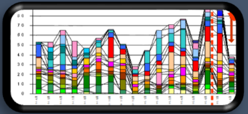
AOI = Automated Optical Inspection

# The Role of AI in Manufacturing

## - Use Cases from the SEMI industry -

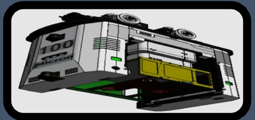
| Automation Roadmap | Digital Roadmap | Artificial Intelligence |
|---|---|---|
| 3.0 | 4.0 | 5.0 |

**Optimization**



Predictive Manufacturing

**Physical Automation**



- ✓ Activity Manager
- ✓ MCS

**Process Control**

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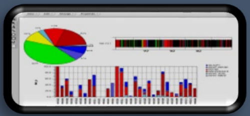
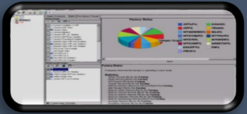
- ✓ Dispatching
- ✓ APC

**System Automation**



- ✓ Host Automation
- ✓ RMS
- ✓ SPC

**Tracking & Monitoring**



MES

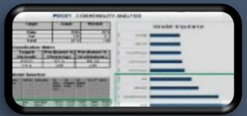
**Prescriptive Analytics**

Automated Machine Adaptation

**Predictive Analytics**

- ✓ Simulation
- ✓ Yield Prediction
- ✓ Decision Making

**Preventive Analytics**



- ✓ Machine Health
- ✓ Root Cause Analysis
- ✓ Commonality Analysis

**Integration**

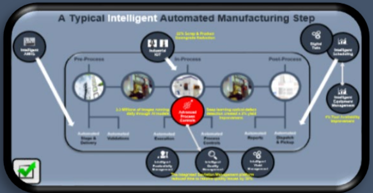
- ✓ Fast Data Platform
- ✓ Big Data Platform
- ✓ Edge Computing

**Industrial IoT**

Mobile, RFID, Sensor Devices & IOT Platform

**Intelligent Analytics**

AI.1

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**Intelligent Robots**

AI.2

### AI.2 Intelligent Robots

Robots capable of **comprehending** and **responding** to their **environment through sensory perception** and **cognitive processing**, analyzing data, making informed decisions, and **collaborating with humans** to achieve shared goals, and enhance productivity and innovation

MES = Manufacturing Execution System
RMS = Recipe Management System
SPC = Statistical Process Controls
APC = Advanced Process Controls
MCS = Material Control System

# AI.2 :: Intelligent Robots :: SEMI Use Case #1

## Intelligent Robot Transformation :: An Automated Material Handling Perspective

**Material Delivery**

Automated Material Handling System

Automated Guided Vehicle (AGV)

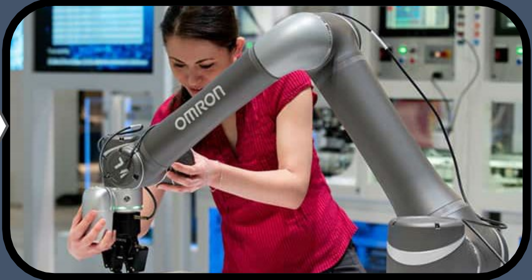

Automated Mobile Robot (AMR)


AMR Integration with COBOT

**Task Execution**

Industrial Robot

Collaborative Robot (COBOT)




### Benefits

- Yield Improvement
- Cost of Non-Quality Improvement
- Labor Productivity Improvement

AI Introduction
Enabling Human – Robot Collaboration

# AI.2 :: Intelligent Robots :: SEMI Use Case #2

## Virtual Reality / Augmented Reality Technology

### AR :: Remote Expert Conferencing

### AR :: SOP

### AR :: Overlay In Construction

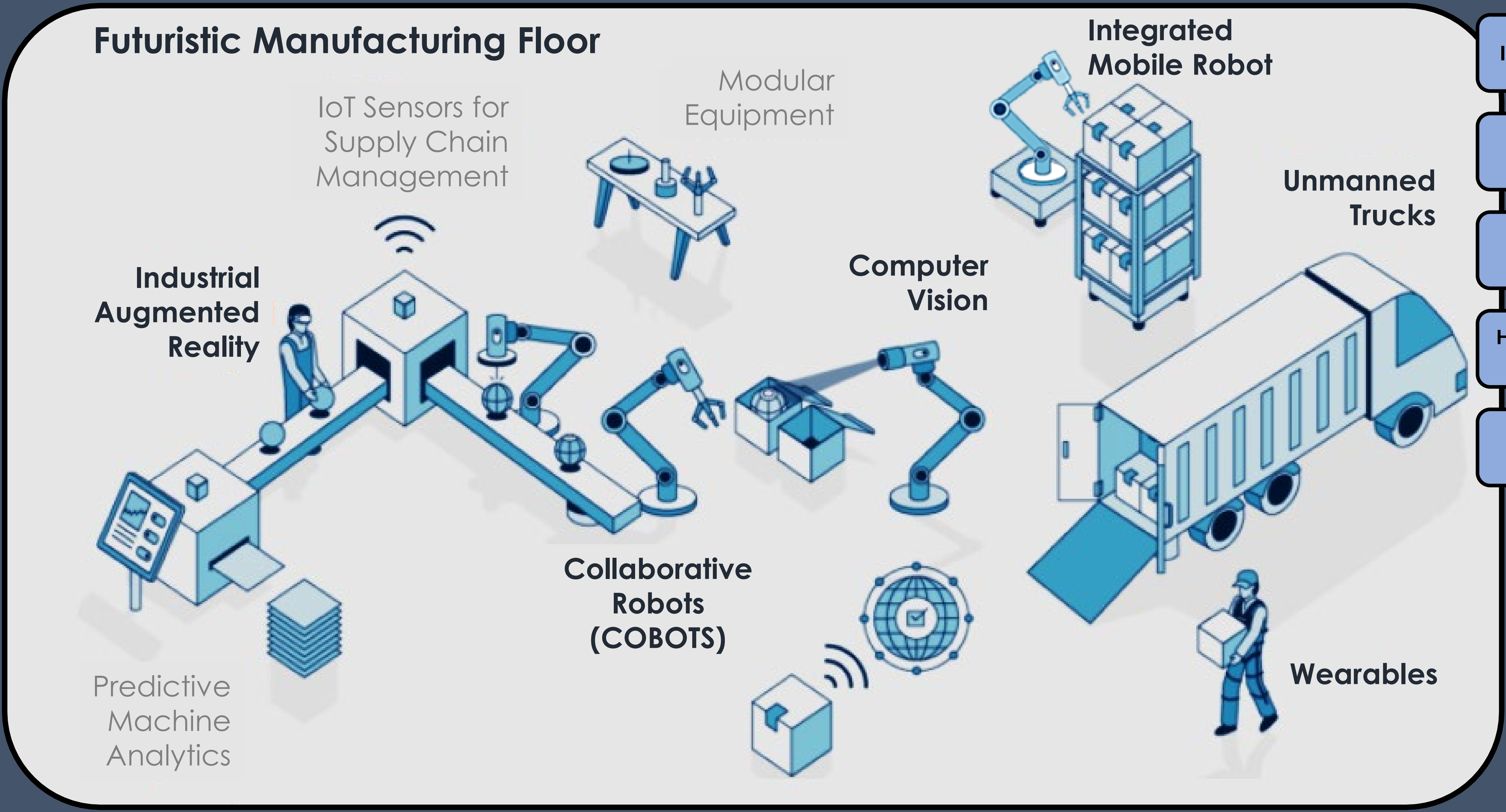

### VR :: Training

**Benefits**

- Yield Improvement
- Cost of Non-Quality Improvement
- Labor Productivity Improvement

SOP = Standard Operating Procedure

# AI.2 :: Intelligent Robots :: SEMI Assembly Use Case #3

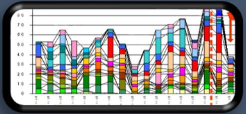



- Intelligent Analytics
- Computer Vision
- Sensors
- High Speed Network (5G / Wi-Fi 6/7)
- Edge Compute

# The Role of AI in Manufacturing

## - Use Cases from the SEMI industry -

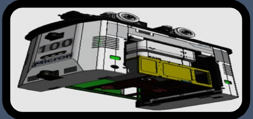
| Automation Roadmap | Digital Roadmap | Artificial Intelligence |
|---|---|---|
| 3.0 | 4.0 | 5.0 |

### Optimization


Predictive Manufacturing

### Prescriptive Analytics


Automated Machine Adaptation

### Physical Automation


- ✓ Activity Manager
- ✓ MCS

### Predictive Analytics

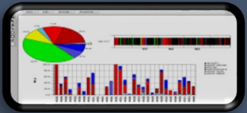

- ✓ Simulation
- ✓ Yield Prediction
- ✓ Decision Making

### Process Control


- ✓ Scheduling
- ✓ Dispatching
- ✓ APC

### Preventive Analytics

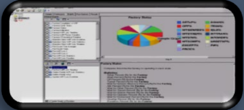

- ✓ Machine Health
- ✓ Root Cause Analysis
- ✓ Commonality Analysis

### System Automation


- ✓ Host Automation
- ✓ RMS
- ✓ SPC

### Integration

- ✓ Fast Data Platform
- ✓ Big Data Platform
- ✓ Edge Computing

### Tracking & Monitoring


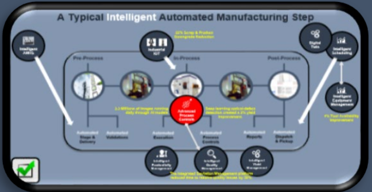
MES

### Industrial IoT


Mobile, RFID, Sensor Devices & IOT Platform

### Intelligent Analytics

AI.1

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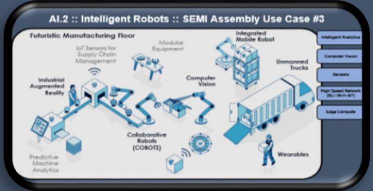
### Intelligent Robots

AI.2

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### Intelligent Collaboration

AI.3

**AI.3 Intelligent Collaboration (Generative AI)**
Services capable of **generating content** based on user inputs and preferences with the purpose to provide users with **new ideas** and **easier access to information**, enabling **faster iteration** and **complementing traditional AI.1** to enhance its capabilities

MES = Manufacturing Execution System
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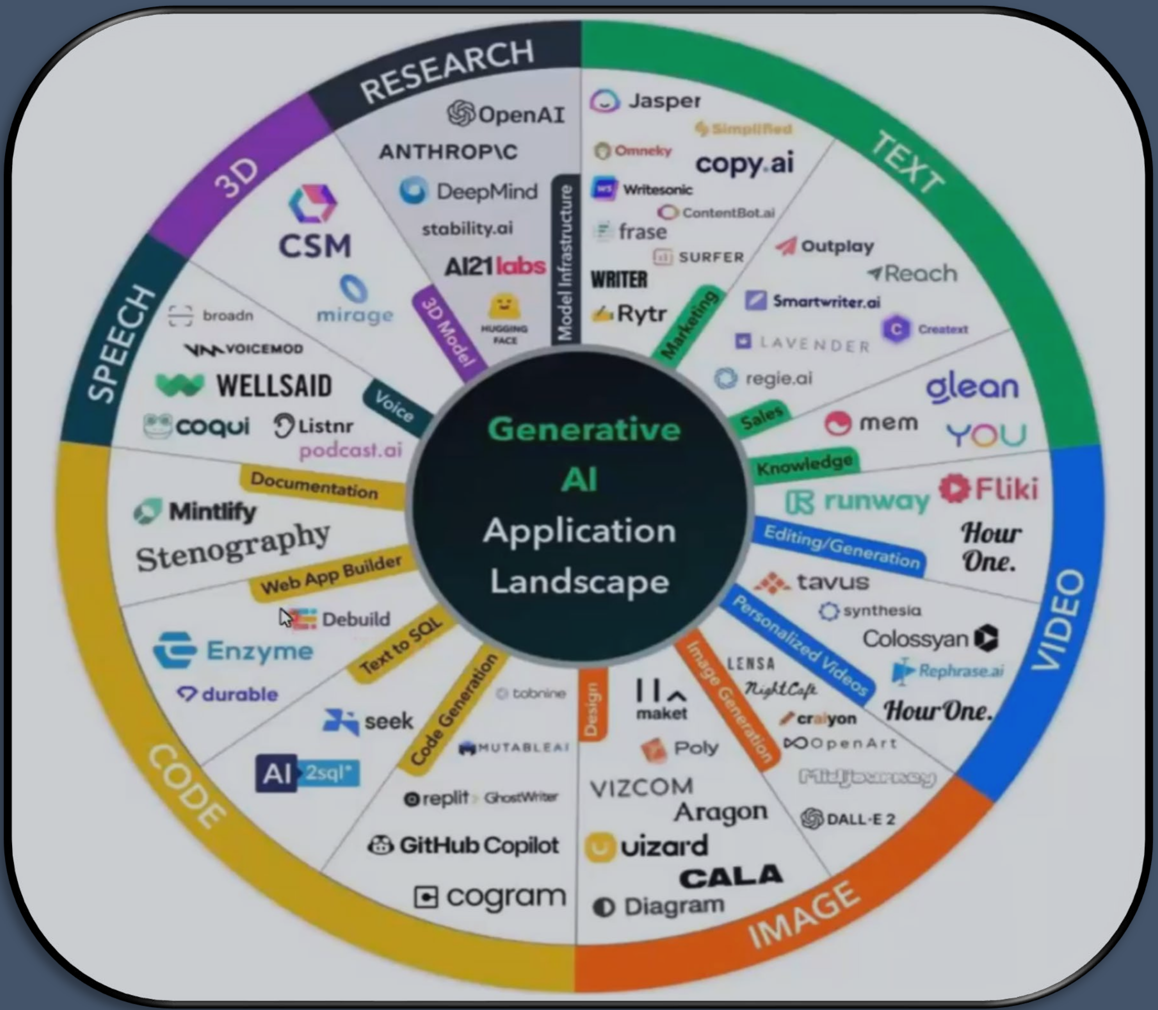
# AI.3 :: Generative AI :: Capabilities

## Content generation

- Generate training materials
- Generate email responses
- Generate all sorts of content

## Summarization

- Summarize documents
- Extract key information
- Categorize information

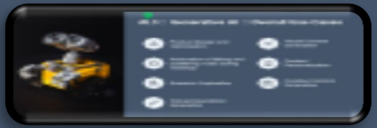



## Semantic search

- Search over knowledge bases
- Execute knowledge mining
- Enable intelligent agents

## Code generation

- Generate code from text
- Explain code in natural language
- Generate test code



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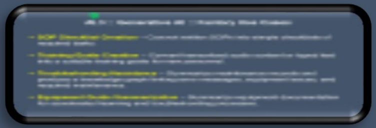

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# AI.3 :: Generative AI :: Overall Use Cases

- Product Design and Optimization
- Automation of taking and publishing notes during meetings
- Scenario Exploration
- Textual Description Generation
- Visual Content Generation
- Content Personalization
- Creative Content Generation

# AI.3 :: Generative AI :: Factory Use Cases

- **SOP Checklist Creation** – Convert written SOPs into simple checklists of required tasks.
- **Training Guide Creation** – Convert transcribed audio content or typed text into a suitable training guide for new personnel.
- **Troubleshooting Assistance** – Summarize maintenance records and produce a knowledge graph linking error messages, equipment issues, and required maintenance.
- **Equipment Guide Summarization** – Summarize equipment documentation for accelerated learning and troubleshooting processes.

# AI.3 :: Generative AI :: IT Use Cases

## Prescriptive Monitoring

Generative AI can analyze and find patterns to identify risk. Predictive AI focus on monitoring, while generative AI can suggest and implement fixes.

## Scenario-Based Troubleshooting

Generative AI can be trained on past IT events, knowledge base and scenarios. This can be used during risk assessment to "simulate" scenarios.

## Explanation of Code

This allows for support team to understand business logic embedded in the code simplifying troubleshooting.

## Code Generation

AI-assisted software development which can include task ranging from simple code completion, to creating entire routines bases on user request.

## Bug Finding and Remediation

Analyze human/AI generated code for bugs and propose fix.

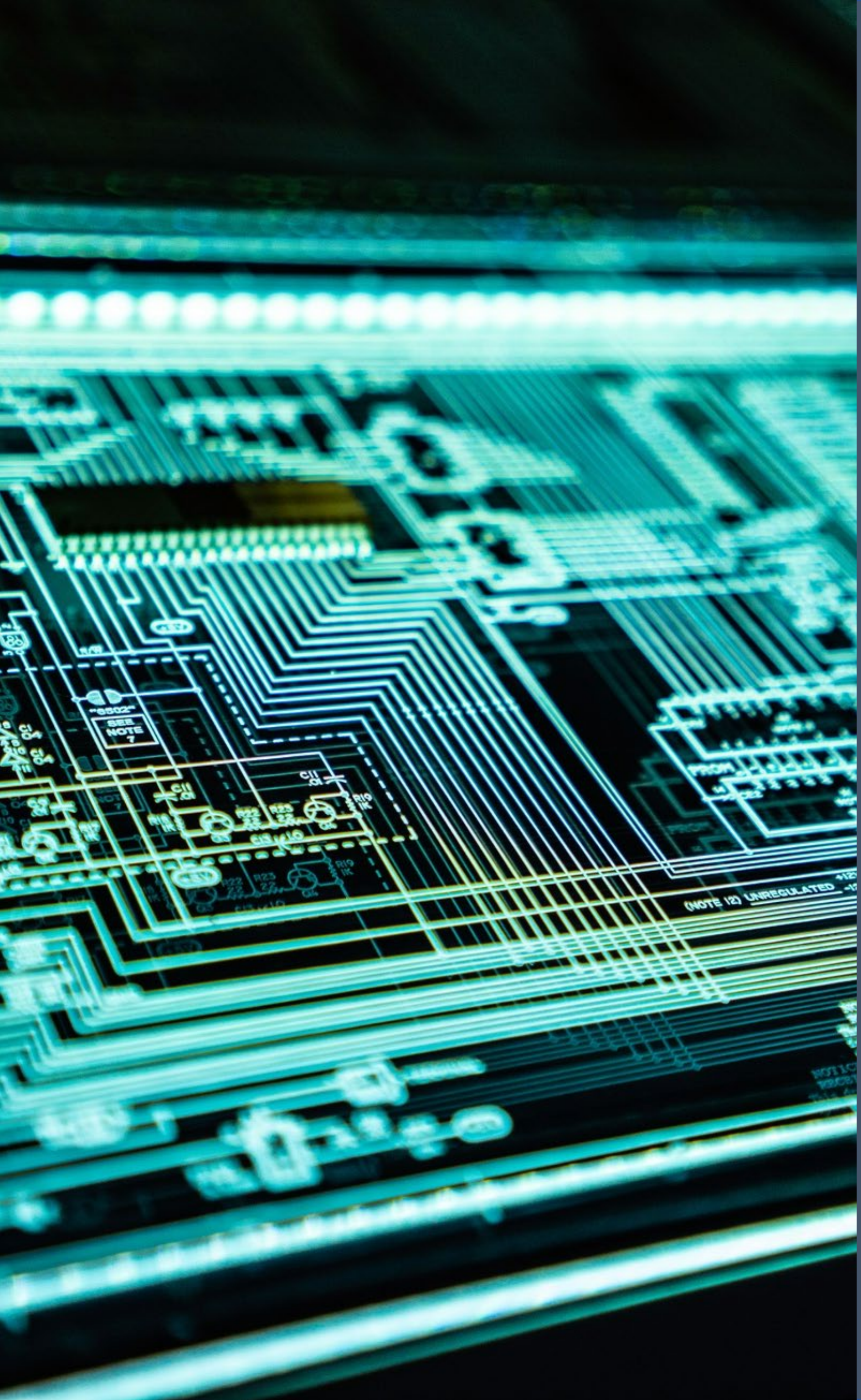
## Test Case Generation

Generate test cases for testing. When integrated with Test suite, it can execute test, report result and identify defects.

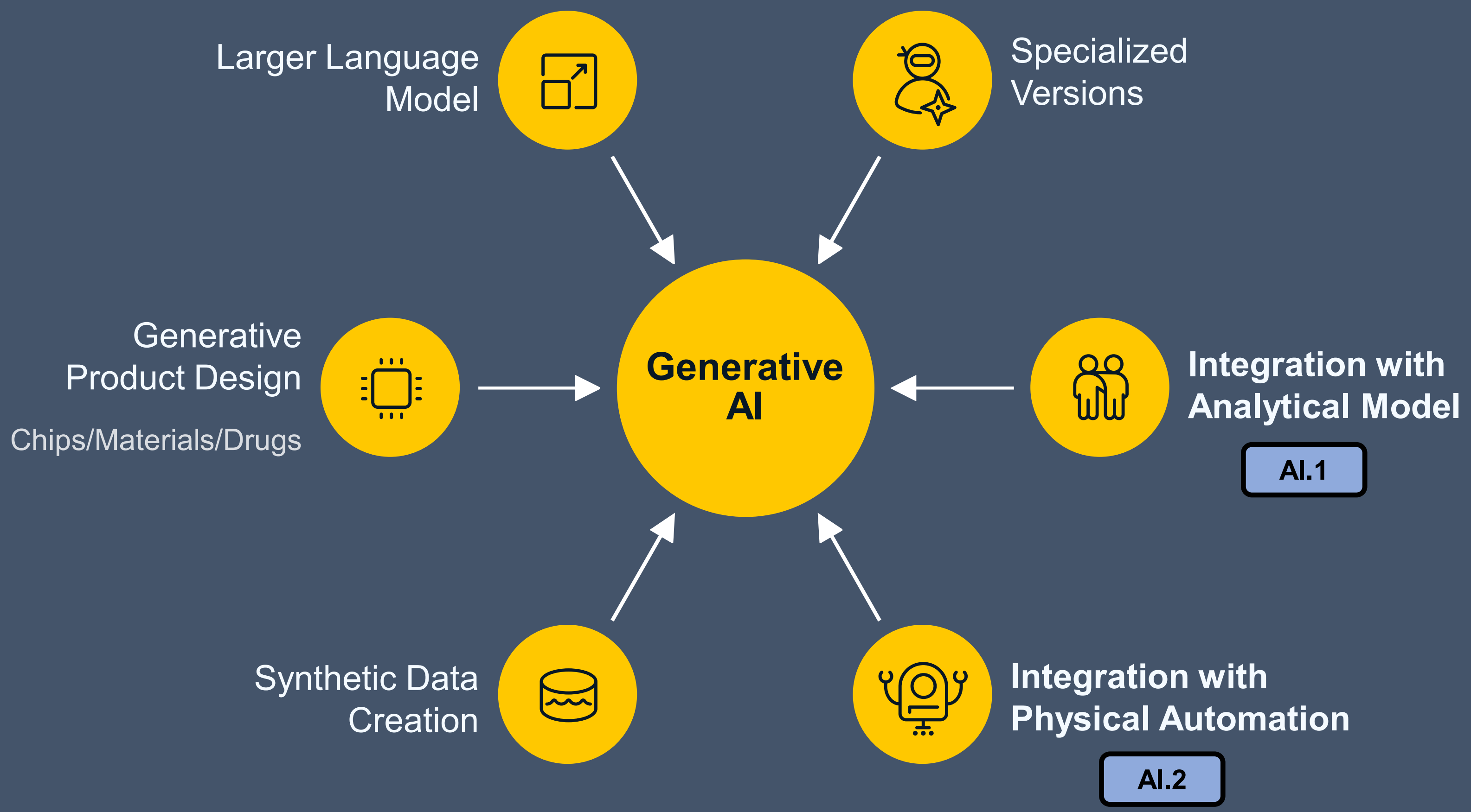
# AI.3 :: Generative AI :: Limitations & Concerns

- Indifferent to truth
- Does not understand math
- Needs fine-tuning to work with internal knowledge-bases
- Computationally expansive to train and fine-tune

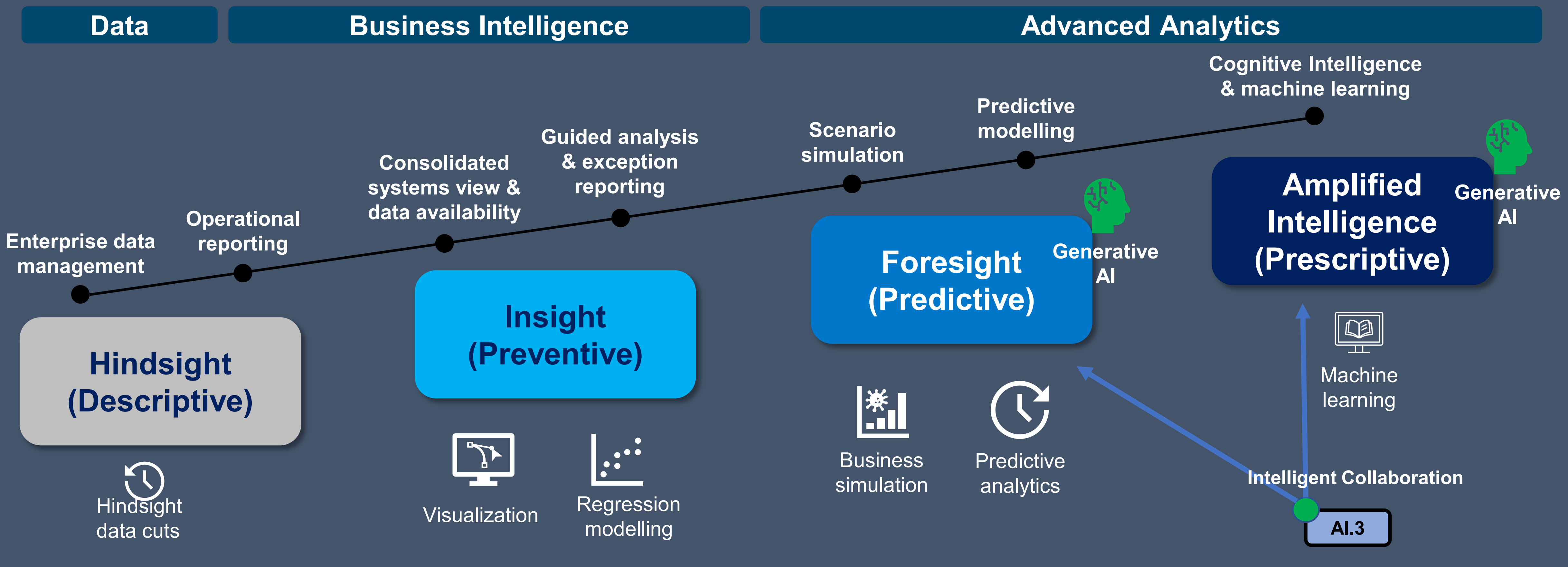
| | | |
|---|---|---|
| **Data Loss** | ▪ Company content utilized with these services, may lead to **data-loss scenarios** where parties could access or retrieve the content outside of approved and intended use. | ▪ Services must be enterprise-managed services.<br>▪ Classifications of content need approval per solution.<br>▪ Data-loss prevention controls must be established. |
| **Output Quality** | ▪ These tools may produce **inaccurate**, **inconsistent**, or **irrelevant** content due to intrinsic limitations and/or limited training.<br>▪ These tools can hallucinate and make **wrong statements** and **recommendations** (for instance, describe how to cook cow eggs). | ▪ Zero Trust and human-in-the-loop concepts are required forcing the validation of content and disabling the  copy paste function. |
| **Legal Considerations** | ▪ Legal risks can vary greatly depending on the application. Concerns may include, but are not limited to, **third-party rights infringement**, **ownership concerns** for generated content, **loss of confidentiality**, **violation of privacy laws**, **potential negative impact on IP protections**. | ▪ Engagement must be application-specific.<br>▪ Services must be enterprise-managed services.<br>▪ Privacy, HR, Legal and patent policies and use cases must be reviewed. |
| **Ethical Considerations** | ▪ These tools may generate content that is **harmful**, **offensive**, **misleading**, or **biased** if they are not aligned with ethical principles or social norms.<br>▪ These tools may also raise **moral dilemmas** about the authenticity and accountability of AI-generated content. | ▪ A company-wide awareness, education, and training campaign must be undertaken. |
| **End-User Trust** | ▪ Users will have **difficulty distinguishing between human-generated and AI-generated content**, which may affect their perception of the generated content. | ▪ A company-wide awareness, education, and training campaign must be undertaken. |

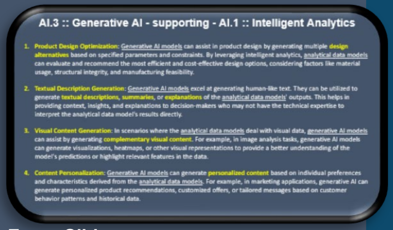


# AI.3 :: Moving Forward with Generative AI



# AI.3 :: Generative AI - supporting - AI.1 :: Intelligent Analytics



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By leveraging generative AI, the **value** of analytical data models can be **enhanced** by providing **additional content**, **context**, **explanations**, **visualizations**, and **personalized outputs**.

This combination of analytical models and generative AI-generated content can lead to **more comprehensive** and **actionable insights** for decision-making and problem-solving.

# AI.3 :: Generative AI - supporting - AI.1 :: Intelligent Analytics

1. **Product Design Optimization**: Generative AI models can assist in product design by generating multiple **design alternatives** based on specified parameters and constraints. By leveraging intelligent analytics, analytical data models can evaluate and recommend the most efficient and cost-effective design options, considering factors like material usage, structural integrity, and manufacturing feasibility.

2. **Textual Description Generation**: Generative AI models excel at generating human-like text. They can be utilized to generate **textual descriptions**, **summaries**, or **explanations** of the analytical data models' outputs. This helps in providing context, insights, and explanations to decision-makers who may not have the technical expertise to interpret the analytical data model's results directly.

3. **Visual Content Generation**: In scenarios where the analytical data models deal with visual data, generative AI models can assist by generating **complementary visual content**. For example, in image analysis tasks, generative AI models can generate visualizations, heatmaps, or other visual representations to provide a better understanding of the model's predictions or highlight relevant features in the data.

4. **Content Personalization**: Generative AI models can generate **personalized content** based on individual preferences and characteristics derived from the analytical data models. For example, in marketing applications, generative AI can generate personalized product recommendations, customized offers, or tailored messages based on customer behavior patterns and historical data.

# AI.3 :: Generative AI - supporting - AI.2 :: Intelligent Robots

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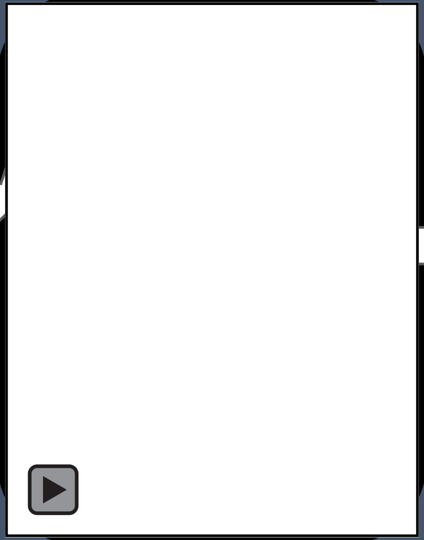


Intelligent Robot (Future)

**Task Execution**

Industrial Robot

Collaborative Robot (COBOT)


### Benefits

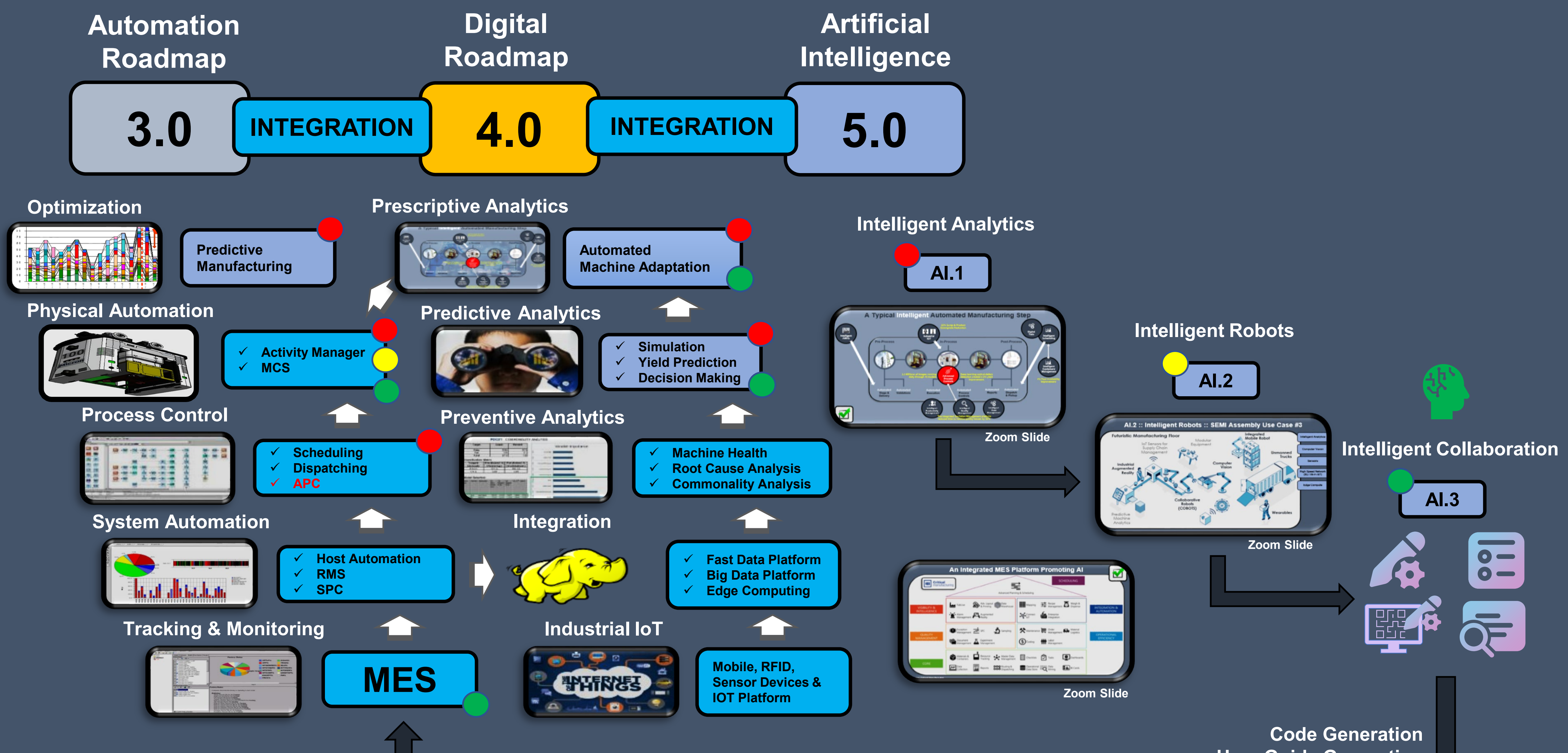
- Yield Improvement
- Cost of Non-Quality Improvement
- Labor Productivity Improvement

Intelligent Collaboration

AI.3

**AI Introduction**
**Enabling Human – Robot Collaboration**

# An Integrated MES Platform Promoting AI

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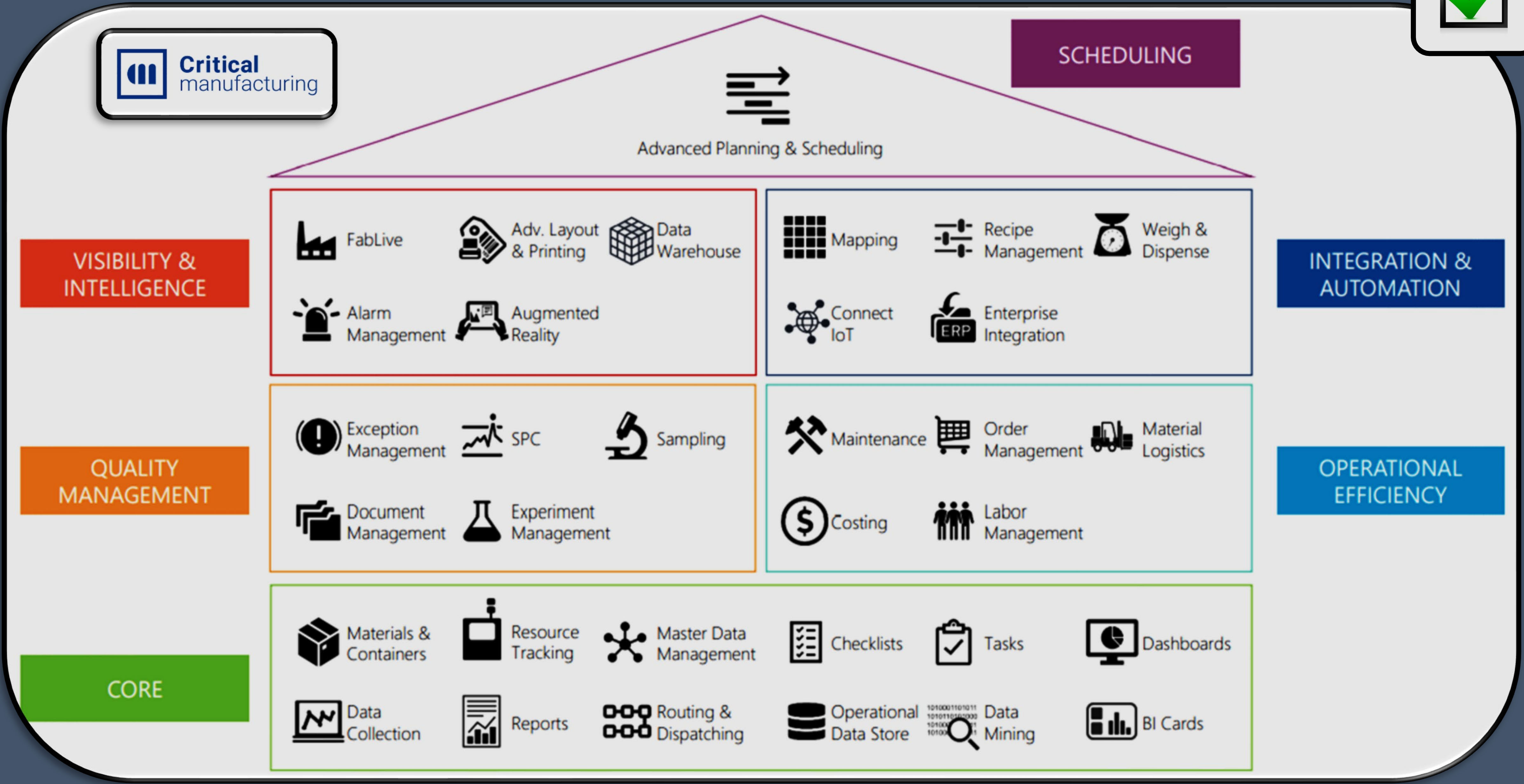
# An Integrated MES Platform Promoting AI




Source: Critical Manufacturing

Micron® | Intelligence Accelerated™

On the factory floor, pauses can be disastrous. Henceforth, "Fast Data" is of the essence.

State-of-the-art flash-based storage platforms support lightning-quick data analytics.

AI allows robots to work collaboratively with humans as well as to function independently – for AI to work, however, it needs "Fast Data".

**The future of AI depends on data that moves at the speed of thought.**

Industry 5.0 needs computers that can take in, sort, and analyze vast quantities of data in nanoseconds.

We applied deep neural nets to wafer images training an AI system of classification differentiating flakes, corrosion or scratches. An AI system keeps running, does not get tired, and does the analysis job in a fraction of second.

Our GDDR6X graphics memory is capable of feeding data to GPUs at extreme speeds.


*Transforming how the world uses information to enrich life FOR ALL*

# The Role of AI in Manufacturing

## - Use Cases from the SEMI industry -

THANK YOU!

Didier Chavet

Sep 2023

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