IISE ANNUAL CONFERENCE & EXPO 2026

SEMS Society for Engineering and Management Systems

Hosted by Society for Engineering and Management Systems (SEMS)

Special Session:
From Innovation to Impact—Scaling Smart Manufacturing Through Academia–Industry Collaboration

Haresh Malkani
CTO, CESMII

Jim Davis
UCLA CIO/CTO (Emeritus)

iise.org/annual

#IISEANNUAL2026

Sunday (May 17)
3:00–4:20 PM (CT)

Speakers



Haresh Malkani
Chief Technology Officer
Collaborative Ecosystems for Smart Manufacturing Innovation Institute (CESMII)



Jim Davis
UCLA CIO/CTO (Emeritus)
Collaborative Ecosystems for Smart Manufacturing Innovation Institute (CESMII)

Speakers



Haresh Malkani
Chief Technology Officer
Collaborative Ecosystems for Smart Manufacturing Innovation Institute (CESMII)

Bio:

- CTO, CESMII – The Smart Manufacturing Institute
- Leads CESMII's technology strategy and roadmap, advancing smart manufacturing through sensors, controls, modeling, and analytics.
- Former Director of Digital Manufacturing & Automation at Arconic/Alcoa.
- 35+ years of industrial RD&E experience
- Ph.D., M.S. (Northwestern University); B.S. (Maharaja Sayajirao University, India)

Speakers



Jim Davis
UCLA CIO/CTO (Emeritus)
Collaborative Ecosystems for Smart Manufacturing Innovation Institute (CESMII)

Bio:

- Vice Provost, CIO/CTO (ret.), Professor Emeritus, UCLA
  Executive Oversight, CESMII & CA Smart Manufacturing Initiative
- Co-founded Smart Manufacturing (2006); national leader in digitalization and AI in manufacturing.
- Former CIO at UCLA & The Ohio State University; 30+ years in IT, research, and innovation leadership.
- Background in AI, modeling, and control systems; Fellow of AIChE.

From Innovation to Impact: Scaling Smart Manufacturing **Through Academia-Industry Collaboration**

Jim Davis
Smart Manufacturing co-founder, UCLA/CESMII

Haresh Malkani
CTO, CESMII

IISE Annual Conference & Expo

Arlington, TX
2026 May 17

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Themes

- Smart Manufacturing
- Industry Impact of Smart Manufacturing
- Scaling Industry Adoption
- Q&A

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What is Smart Manufacturing

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Smart (Preventive, Predictive, Proactive, Energy Productive, Zero Incidents) **Manufacturing** at scale in 2007



Right **Information**

At the



Right **Time**

In the



Right **Form**

At the



Right **Place**

With the



Right **Technology**



For the



Right **People**



(or machines)

To enable



Smart **Decisions**

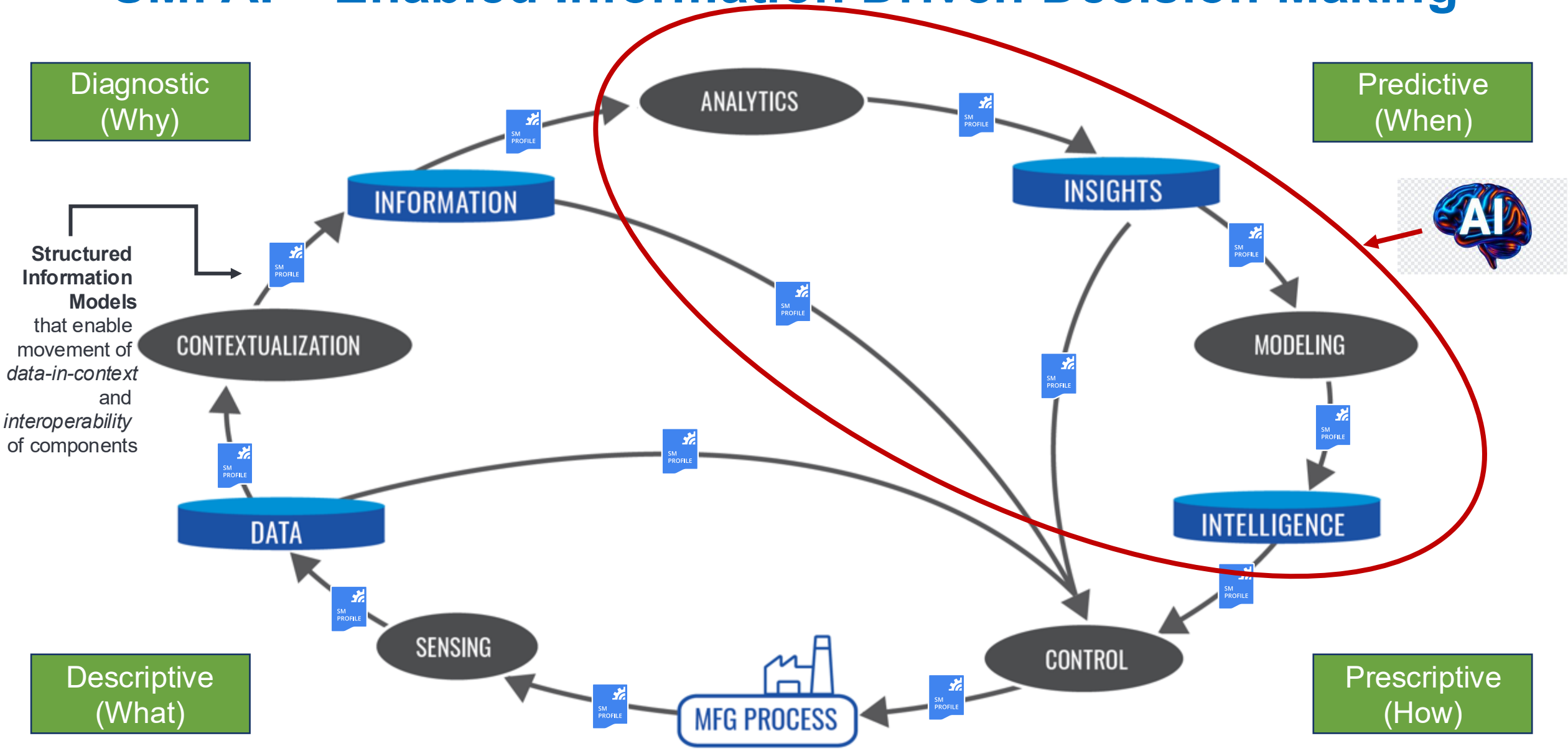


Intelligent Systems

Physics-informed, Exhibits intelligence, Augmented intelligence, Exceeds human capacity/speed, Learns/unlearns, Facilitates insights

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SM: AI – Enabled Information Driven Decision Making

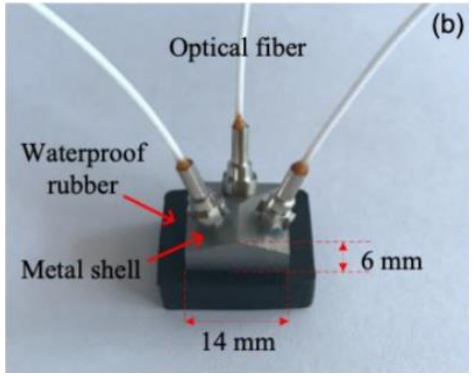


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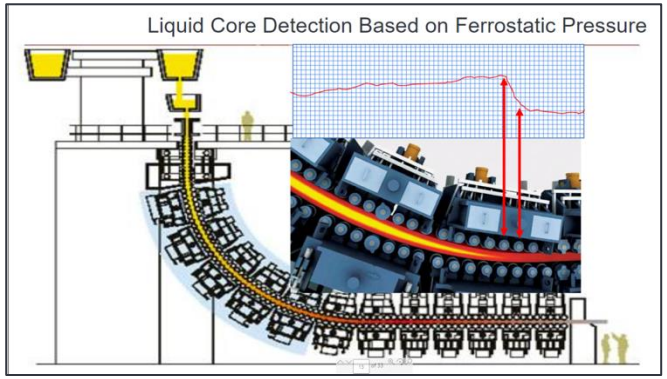
Smart Manufacturing in Steel Continuous Casting

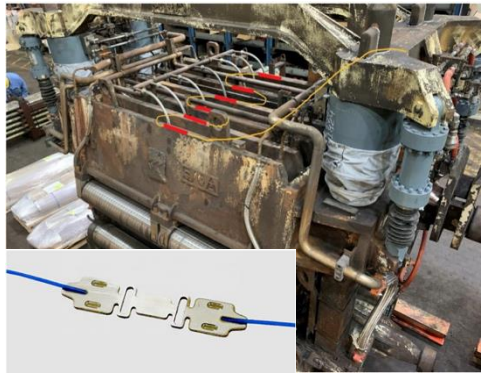
ArcelorMittal, RPI, Purdue, Missouri Science & Technology University

3D Sliding and Debonding Sensor

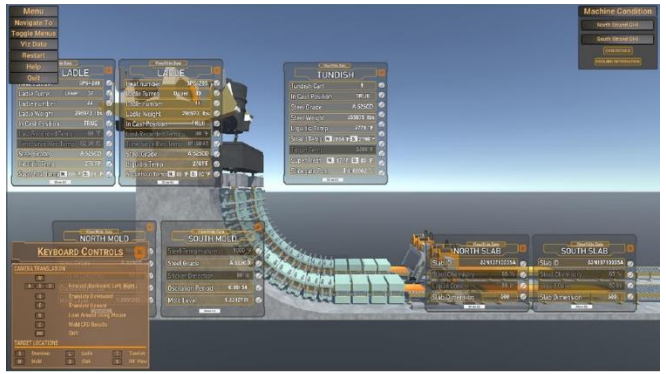


Liquid Core and Plugging Detection





Optical Strain Sensing



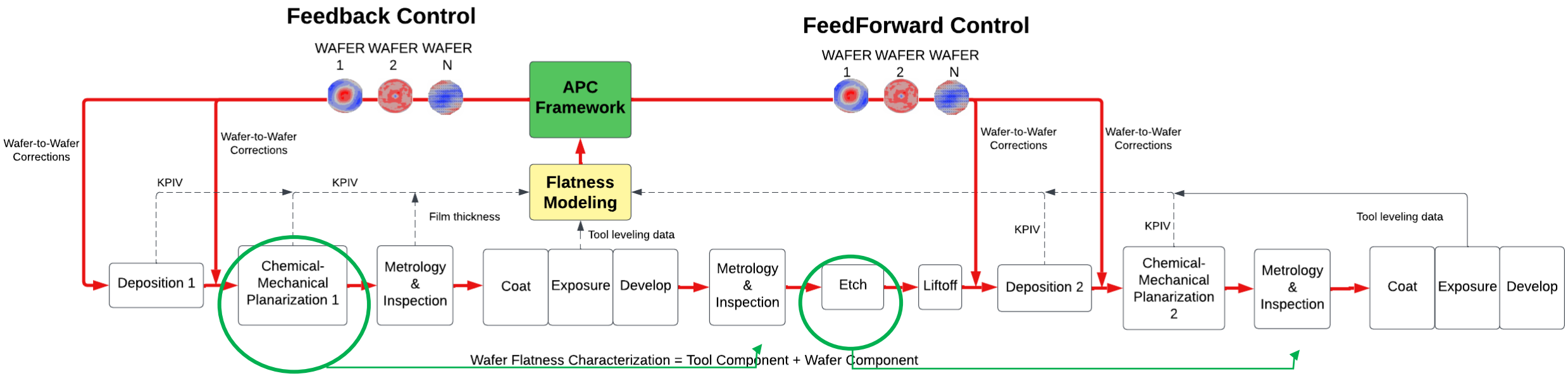
Continuous Caster Digital Twin

- Data acquisition infrastructure implemented and configured for caster health monitoring
- Advanced strain measurement and 3D displacement sensors to detect liquid core in continuous steel caster developed and tested
- Digital twin for simulating caster operation developed and demonstrated for maintenance applications
- Machine learning based model developed to predict caster plugging.

Significance and Impact: Realtime sensing and predictive modeling will improve caster performance and downstream product quality. Potential impact of $90M in energy savings for steel industry from improved quality, and $2M/strand from predictive maintenance.

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Wafer Manufacturing Virtual Metrology



Semiconductor Manufacturer-Defined
Smart Manufacturing Priority Application Areas

- Predictive Maintenance
- Advanced Process Control
- Fault Detection and Control
- Root Cause Analysis
- Virtual Metrology
- Automated Inspection
- Energy Management
- Materials Management

Industry Impact of Smart Manufacturing

Operational

Productivity, Precision, Performance
Machine, Factory, Intercompany, Supply chain Ecosystem

Digital

Un-siloed Scaled Data Sources
Accessible, Scaled, Qualified Operational AI-Ready Data
Multi-machine, Multi-product, Multi-machine models

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CESMII
THE SMART MANUFACTURING INSTITUTE

Industry Adoption
Economic Improvement & Direct Energy/GHG Reduction Reachability (10% Adoption – 10 Year)

Industry (U.S. entities)	Industry Defined SM Solutions/Technologies	Economic Improvement (Direct Energy/CHG Reach
Paper (3089)	Moisture defoamer productivity; Evaporation and drying energy; Data driven asset productivity & Line interoperability; Soft sensing, Digital Twin and ML for control	**15-25%** (240 TBTU) /(20 MMTCO2e)
Cement (11730)	Kiln energy optimization while maintaining quality; Data driven asset productivity & Cross site optimization; Digital Twin & ML for control	**15-30%** (70 TBTU)/(10 MMTCO2e)
Steel (2588)	Casting downtime prevention; Hot rolling microstructure quality; Line operation productivity; Sensing, Digital Twin & ML for analysis	**20-25%** (190 TBTU)/(14 MMTCO2e)
Metals (3979)	Forging specification assurance; Heat treatment energy; Line operation integration; Change over performance; Data driven asset productivity, tooling maintenance; Digital Twin & ML integrated optimization	**20-30%** (40 TBTU)/(4 MMTCO2e)
Food & Bev, Pharma (75950)	Heating and drying energy; Demand response; Dynamic recipes; Line and supply chain integration; Data driven asset energy productivity; Plant wide interoperability; ML for integrated diagnostics	**15-20%** (130 TBTU)/(10 MMTCO2e)
Oil & Gas, Chemical (44425)	Air separation, heating, compression, and cooling productivity; Line interoperability & integrated situation management; ML, Digital Twin & fault modeling for performance & diagnostics	**5-10%** (290 TBTU)/(30 MMTCO2e)
Auto, Aero, Semiconductor (8725)	3D Printing QA; Machining, deposition, precision, metrology, line and supply chain integration for QA; Asset performance, health & energy; Product QA; Cross-company data aggregation; ML and physics informed models for monitoring, analysis, and precision prediction	**10-20%** (140 TBTU)/(10 MMTCO2e)
Supply Chain	Food & Beverage, Pharma, Consumer Health Products, Auto, Aero – SC productivity, Demand response, QA, SC data from raw materials to end products for SC variation and disruption resilience	**10-15% additional impact**

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Operational Scaling (60 Projects)

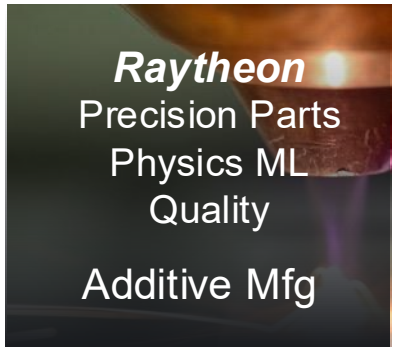
Asset Improvement/QC | Distributed Operations | Line Operation/ Factory Improvement









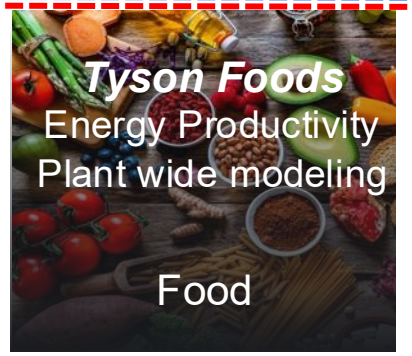




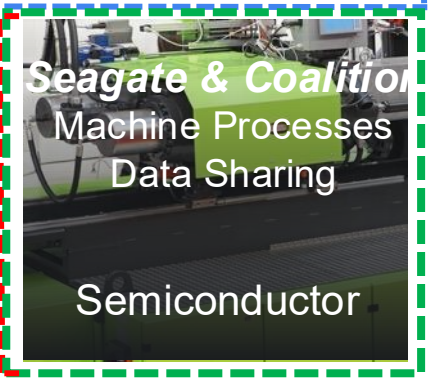


















Small, Medium & Large Enterprises

Data Supply Chain

Supply Chain Interoperability

Supply Chain Resilience

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Demonstrated Impact

~60 Collaborative R&D Projects

55+ Participating Member Organizations

15 Industry Verticals

10-35% in Energy Reduction Demonstrated

10-40% in Productivity Improvement Demonstrated

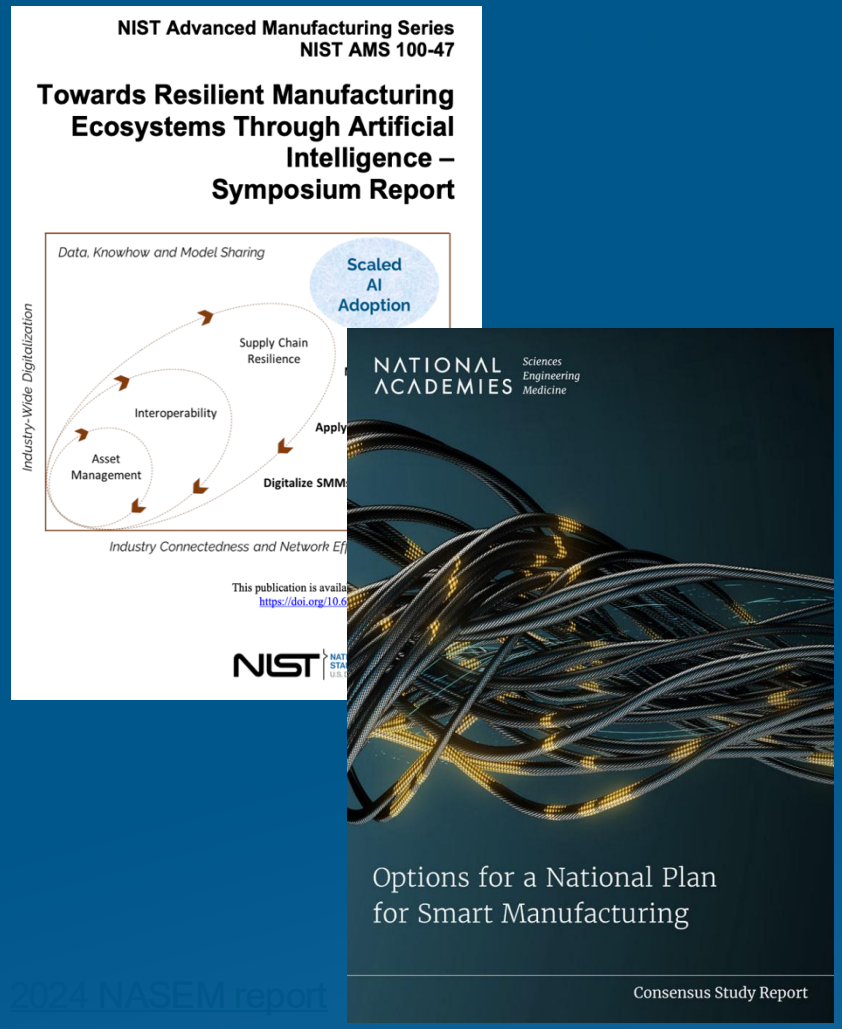
25-50% in Reduced SM Implementation Costs Demonstrated

28 Projects Using AI (ML, Predictive Modeling)

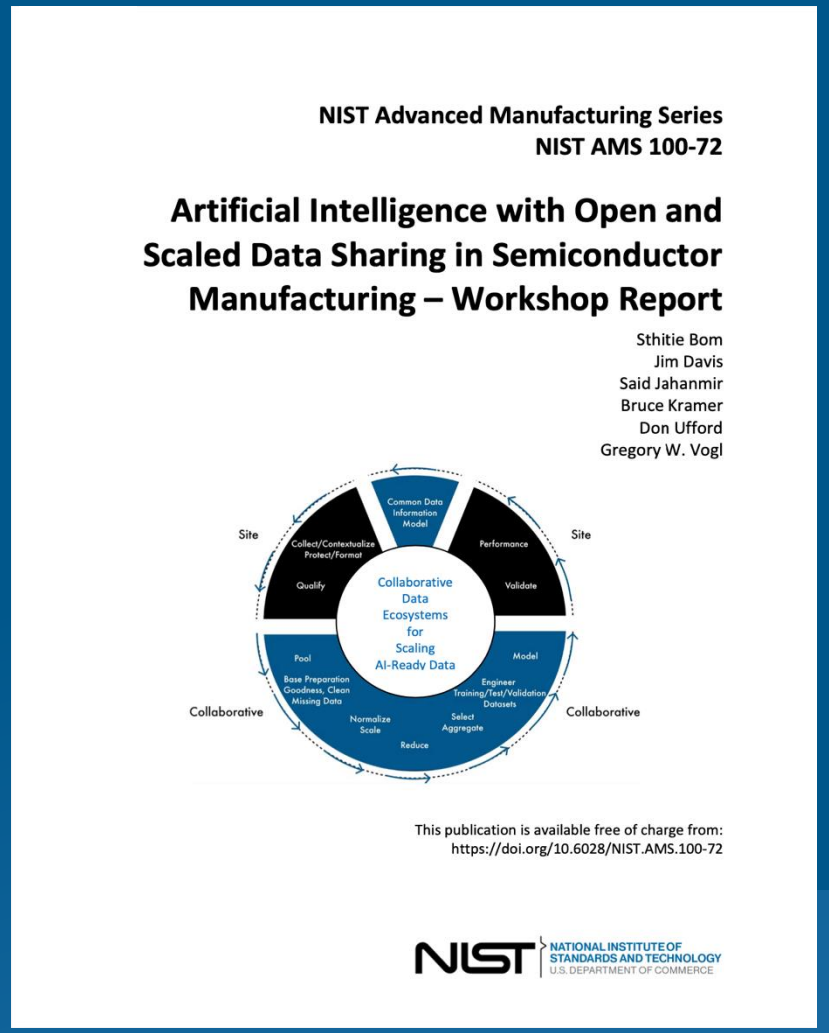
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Ecosystem Data-First AI Strategy for Smart Manufacturing



2024 NASEM report



The future business practice of harvesting and processing real-time manufacturing data at scale for ML solutions that are robust, accessible, and affordable for manufacturers

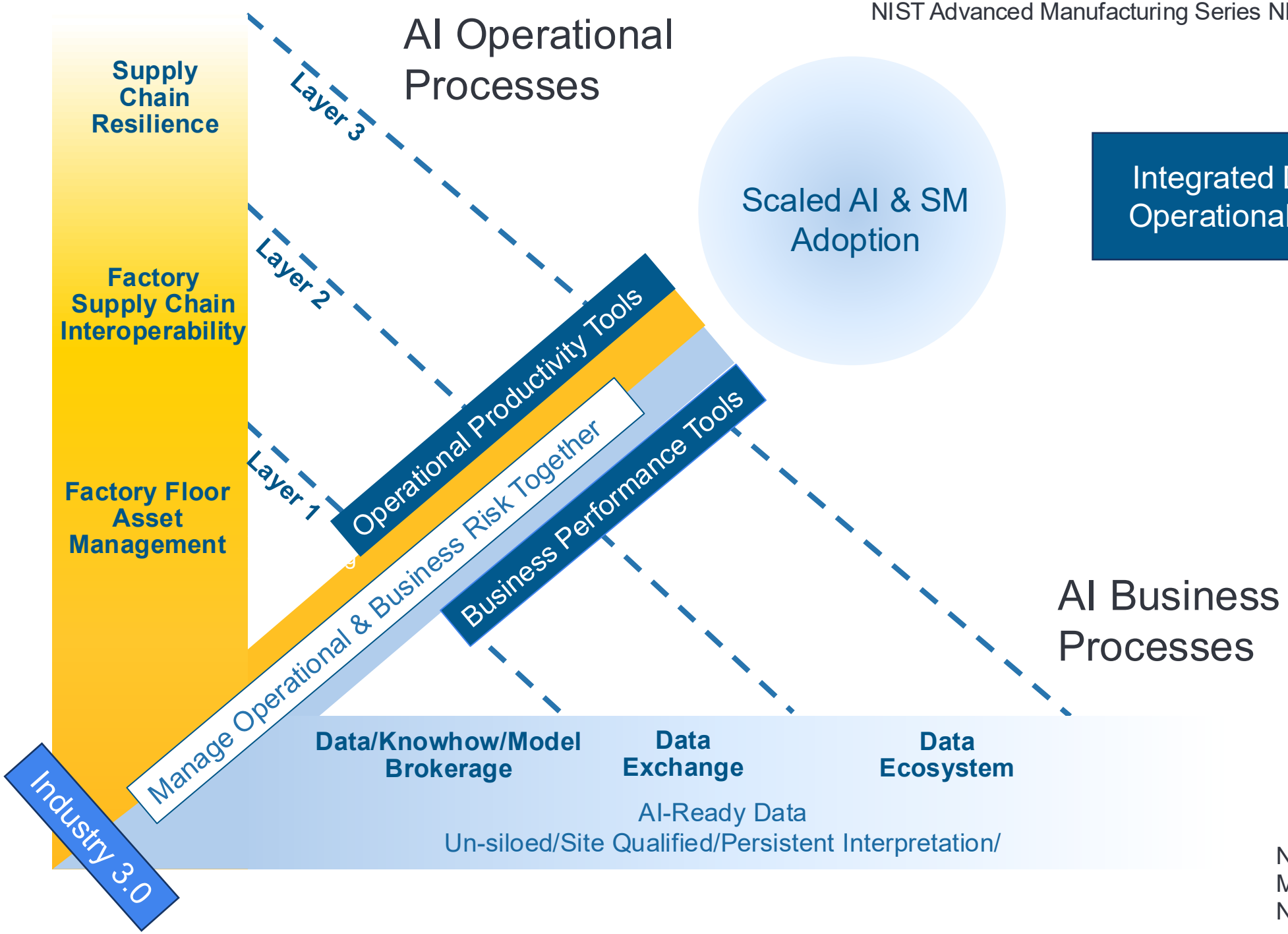
Industry experience with:

- **Qualified and trusted data at greater scales and lower cost**
- **Improved quality, usefulness and value of data**
- **Data for greater operational scales**

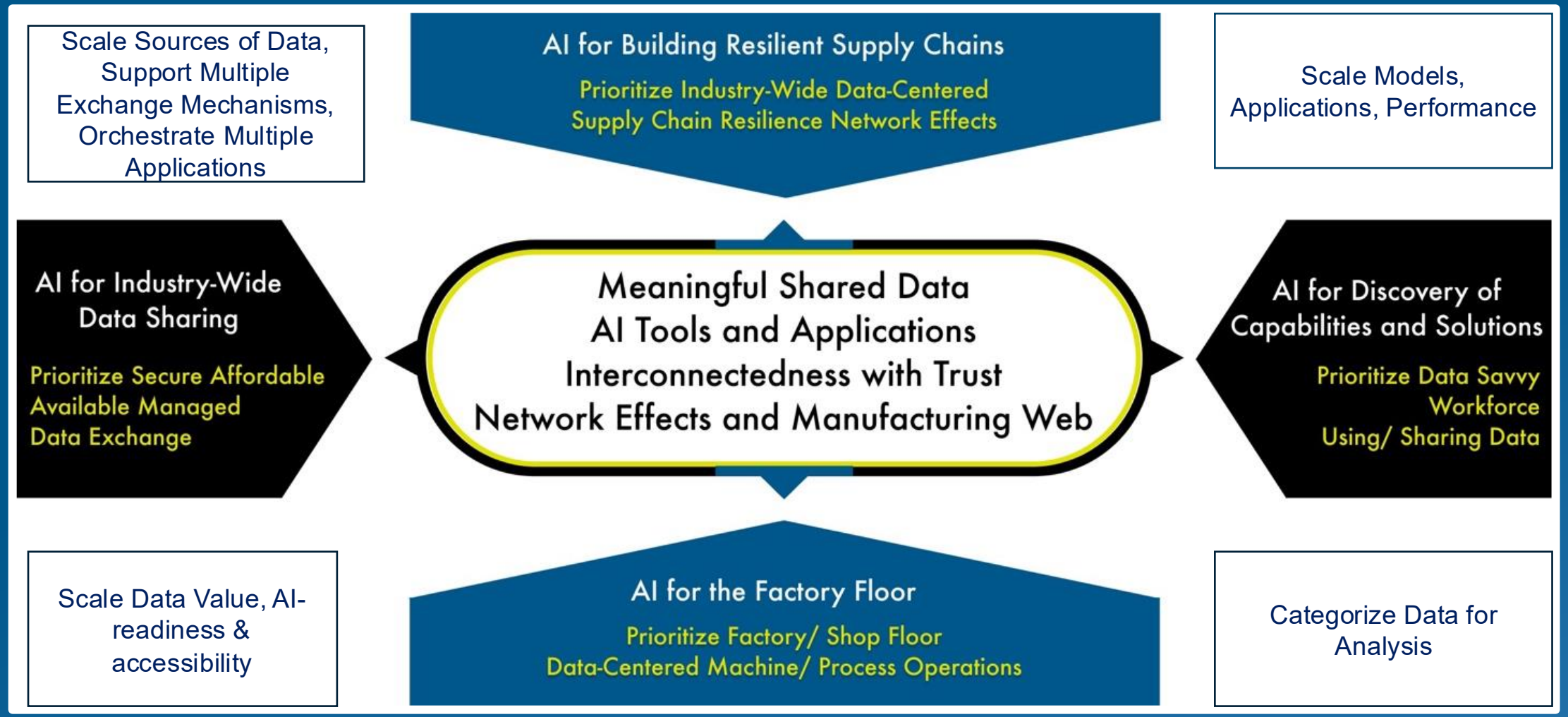
2025 NSF/NIST report

Three reports on meaningfully shared and scaled data; AI tools and applications; interconnectedness with trust; and scaled decision-making, automation, and autonomy

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AI Operational Processes
Supply Chain Resilience
Factory Supply Chain Interoperability
Factory Floor Asset Management
Layer 3
Layer 2
Layer 1
Scaled AI & SM Adoption
Integrated Digital & Operational Scaling
Operational Productivity Tools
Business Performance Tools
Manage Operational & Business Risk Together
AI Business Processes
Data/Knowhow/Model Brokerage
Data Exchange
Data Ecosystem
AI-Ready Data
Un-siloed/Site Qualified/Persistent Interpretation/
Industry 3.0

Integrated Digital and Physical Networks at Scale



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Scaling and Deploying

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Scale to the Level of U.S. Industry

(Push) Technology → Workforce → Mindset → Market

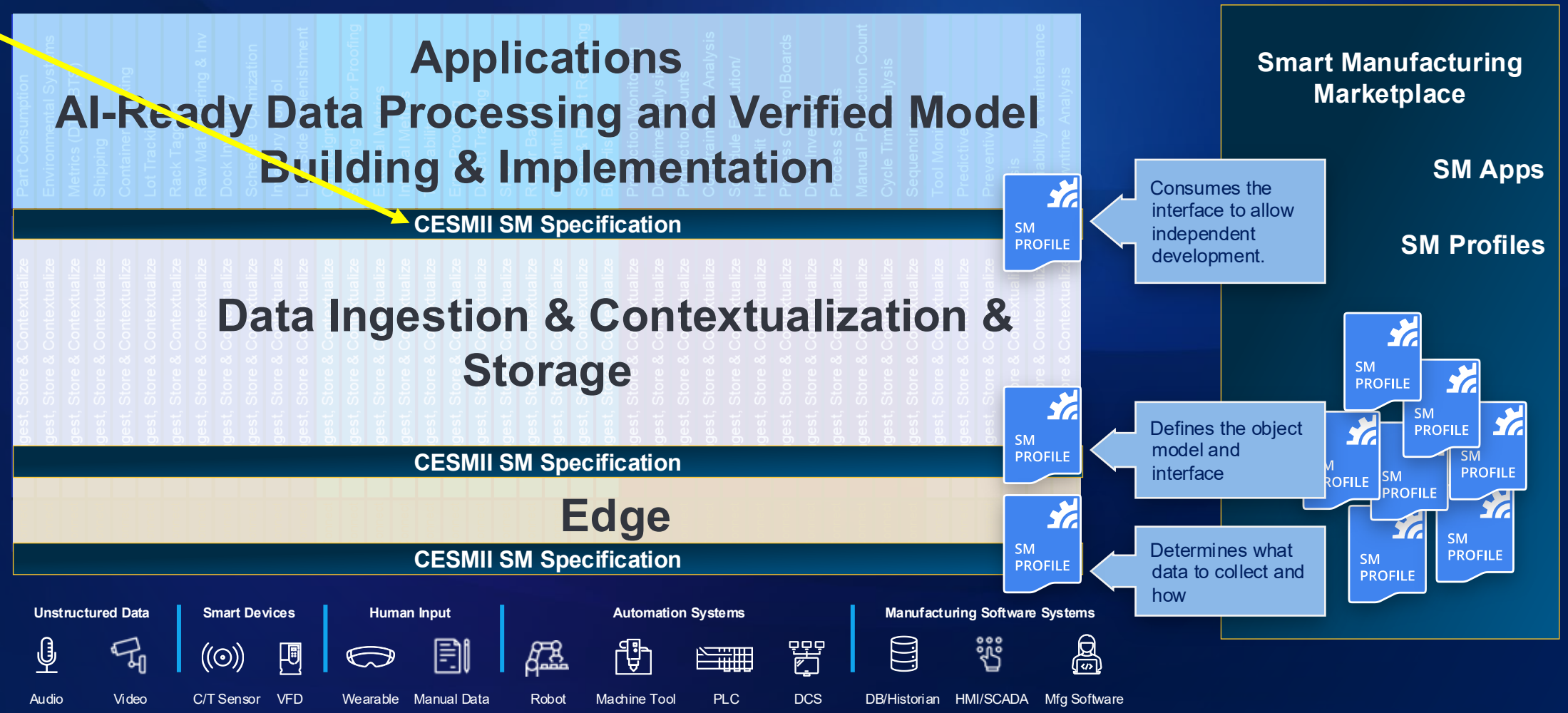
Headwinds to: Integration-Scaling-Network Effects

(Pull) Mindset ← Market ← Workforce ← Technology

i3X: Industrial Information Interface eXchange

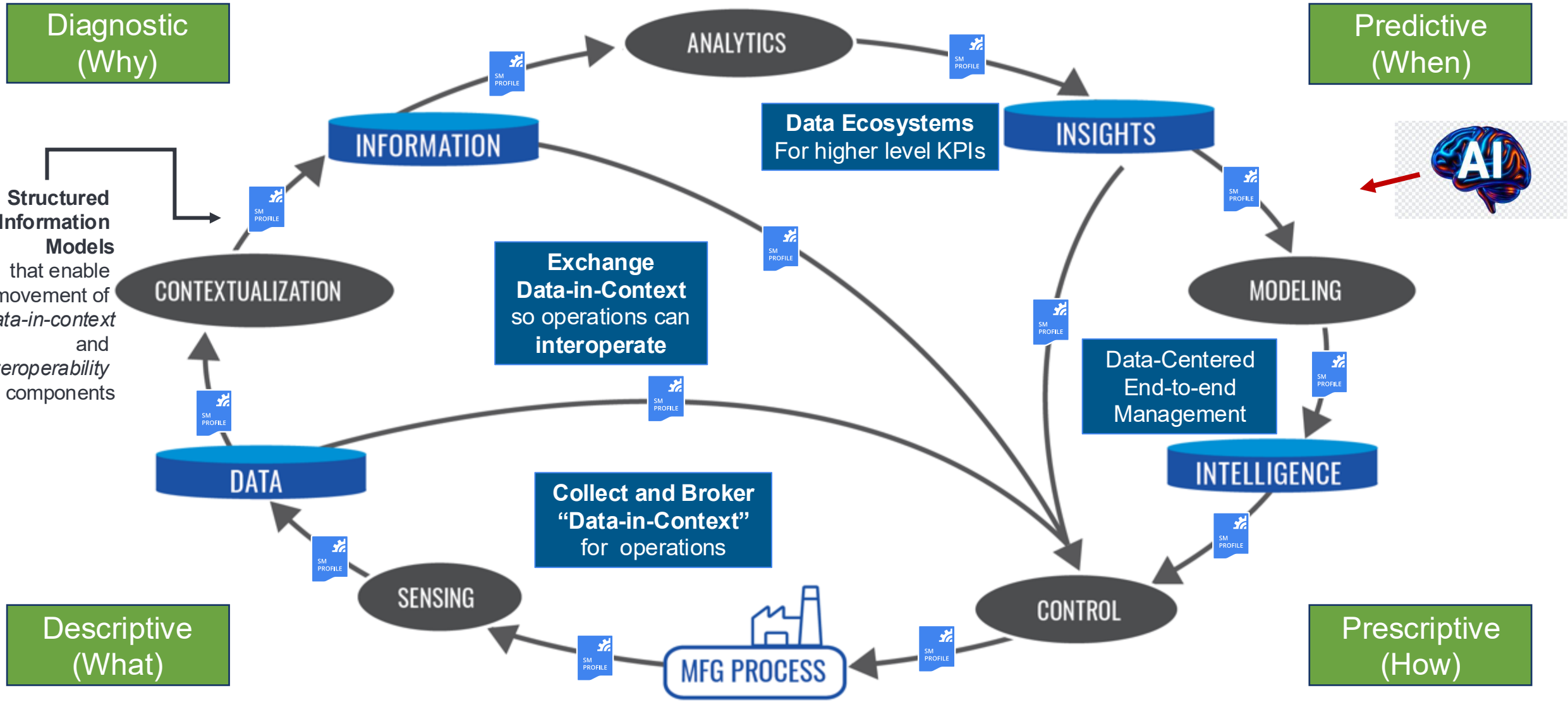
Un-silo, Persistent Contextualization Use/Reuse, Accessibility at Scale

Data Interoperability Demands an Information Model-Driven Architecture



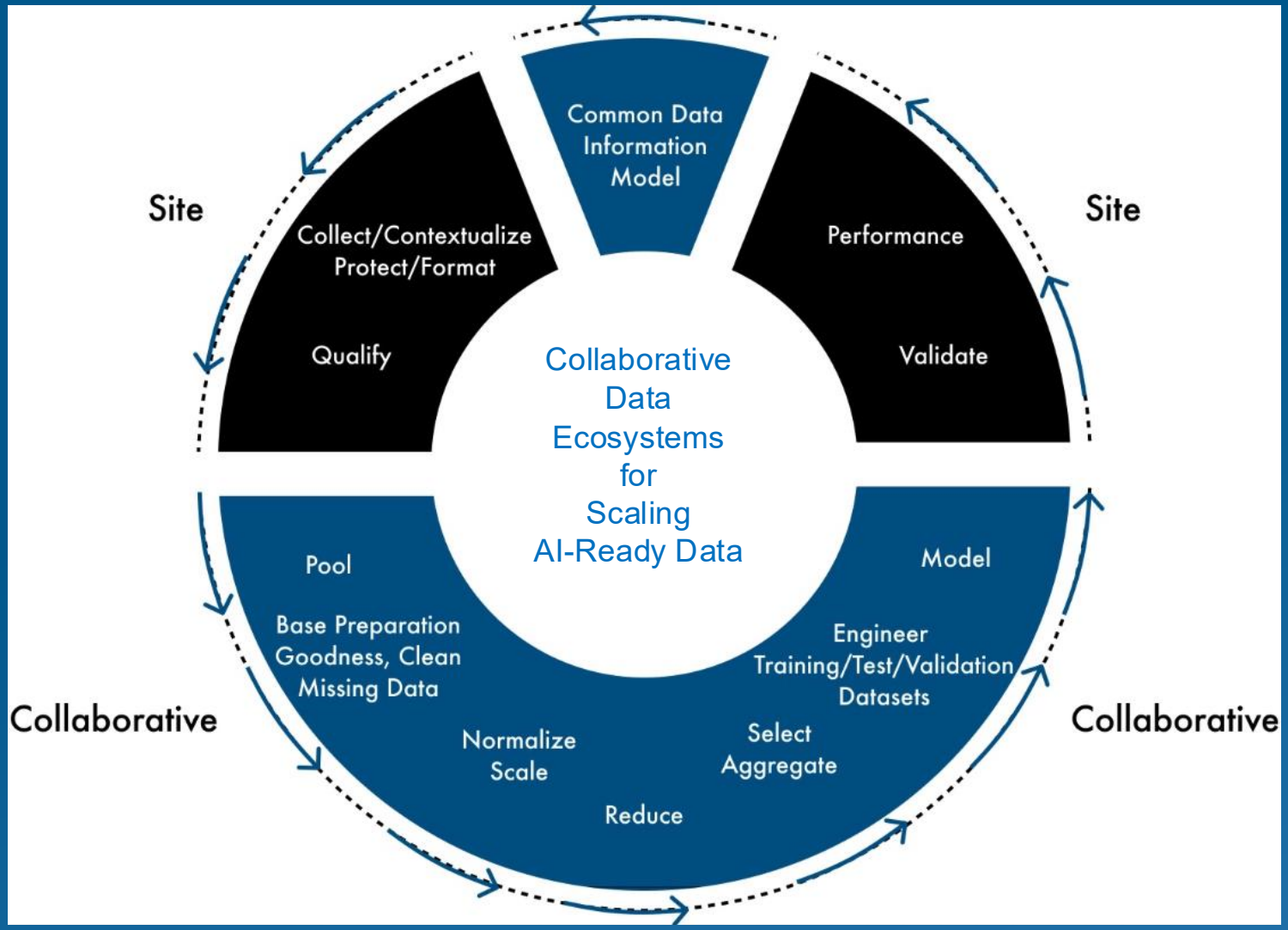
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Persistent Contextualization and Access at Scale



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Consistent and Collaborative Data Refinement and Model Building



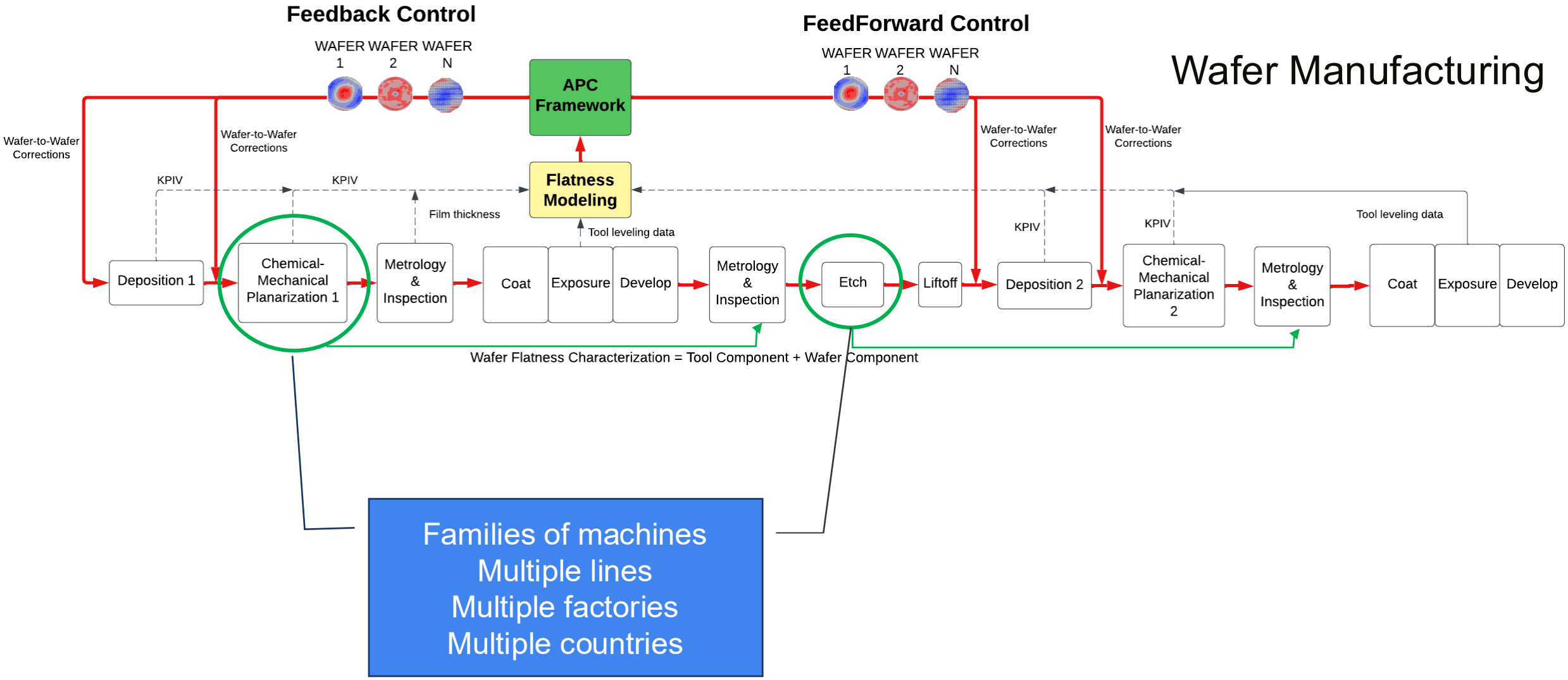
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Let’s Consider an Example

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Let's Start with a Tangible Use Case

Mindset Oriented toward Ecosystem



Seagate Tool Data

Categorical Features

Numeric Sensor Data

Base Processing Averaged Over Batch

Tool xx – PM y	Masked Substrate Family	Masked Process	Thickness Pass/Fail

RF Power	Gas Channel 1 flow	Gas Channel w flow	Hi Vac Pressure	Probe Voltage	Reflected RF Power	Rough Pressure	Start Pressure
Meas Type Oxide Target	Beam Current	Beam Voltage	Suppressor current	Suppressor Voltage	Body Current	Body Voltage	Discharge Current
Discharge Voltage	Filament Current	Filament Voltage	Pbn Gas Flow Rate	Cryo Pump 1st Stage Temp	Cryo Pump 2nd Stage Temp	Foreline Pressure	Shield Timer
Actual Tilt Angle	Clamp Claw Timer	Clamp Status	Gas Pressure	Program Tilt Angle	Rotation Speed	Shutter Position	Stage Gas Flow Rate
Batch Complete	Batch Duration	Missing Data	Data Variability Run	Machine Condition			

Etch Tool x – Process Module Y

Multiple Materials
Multiple Products

- Variables processed by batch
- Usable batch run must contain categorical features
- Usable batch run must not have missing data
- Each numeric variable averaged over duration
- One dataset per batch run

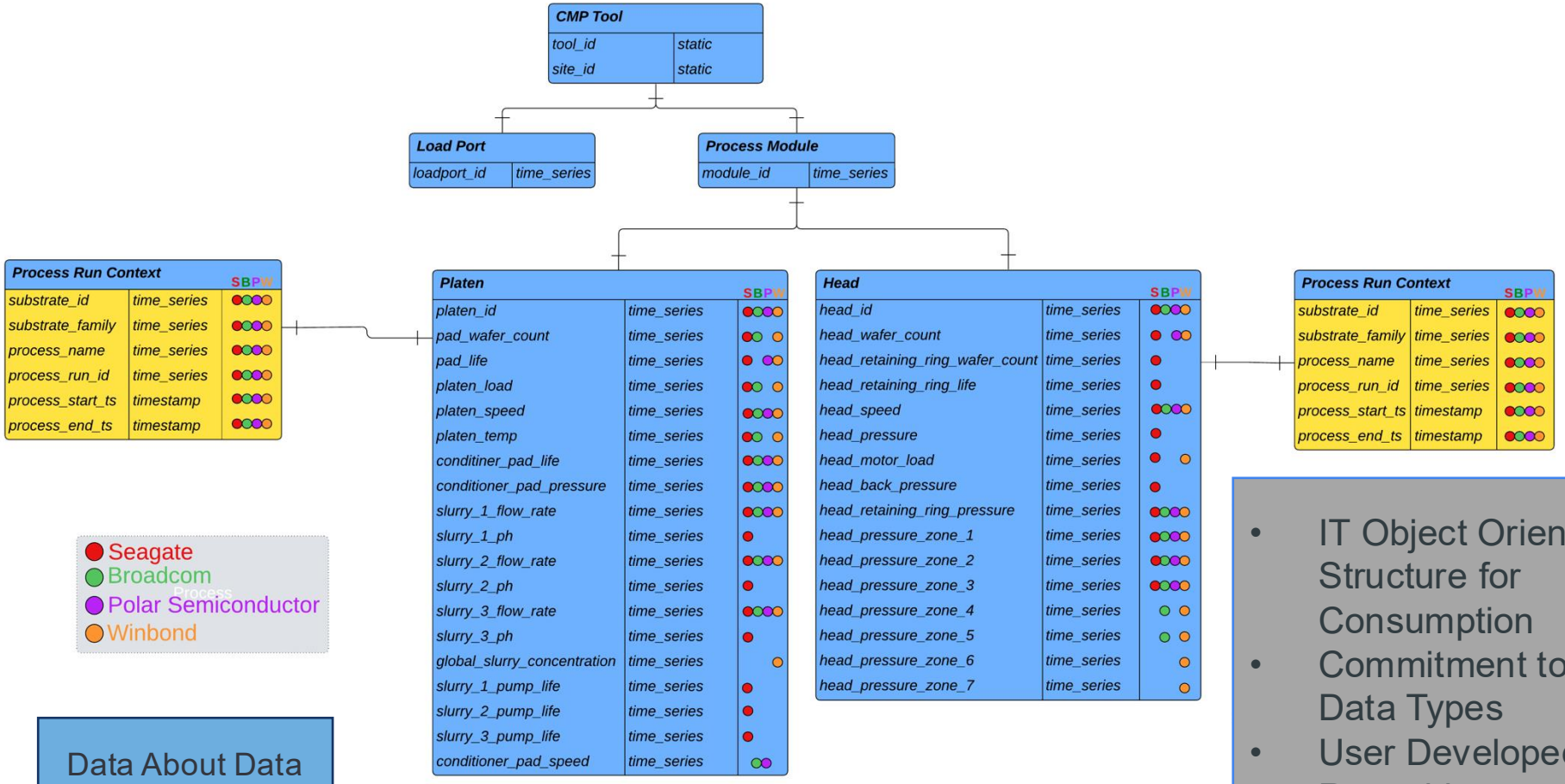
Data About Data

Tool 04-PM1	39717	Fail 2.22%
Tool 07-PM1	23387	Fail 1.41%
Tool 02-PM2	36335	Fail 2.41%
Tool 05-PM2	771	Fail 13.49%
Tool 07-PM2	2722	Fail 2.65%

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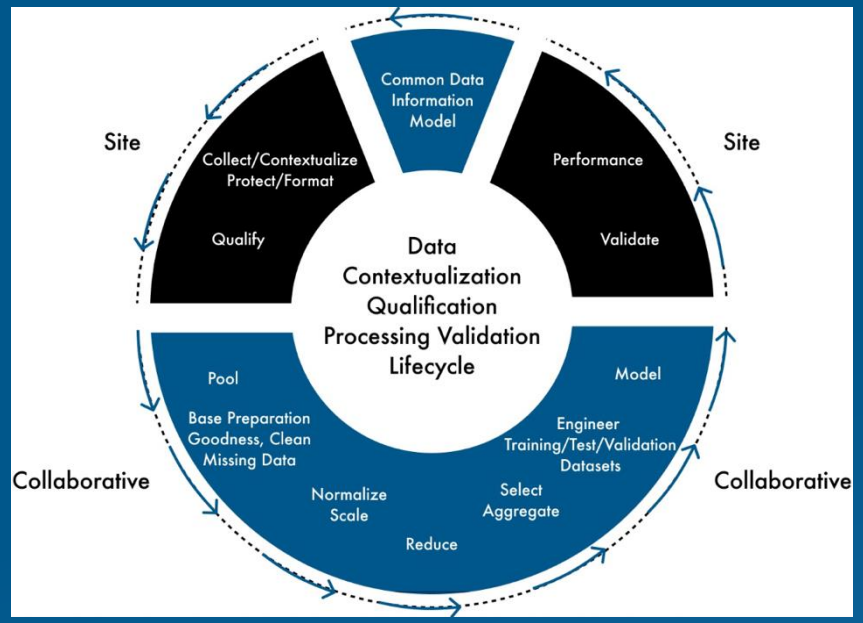
Cross-Company Data Information Model (SM Profile)

Semiconductor Chemical Mechanical Planarization Tool Profile



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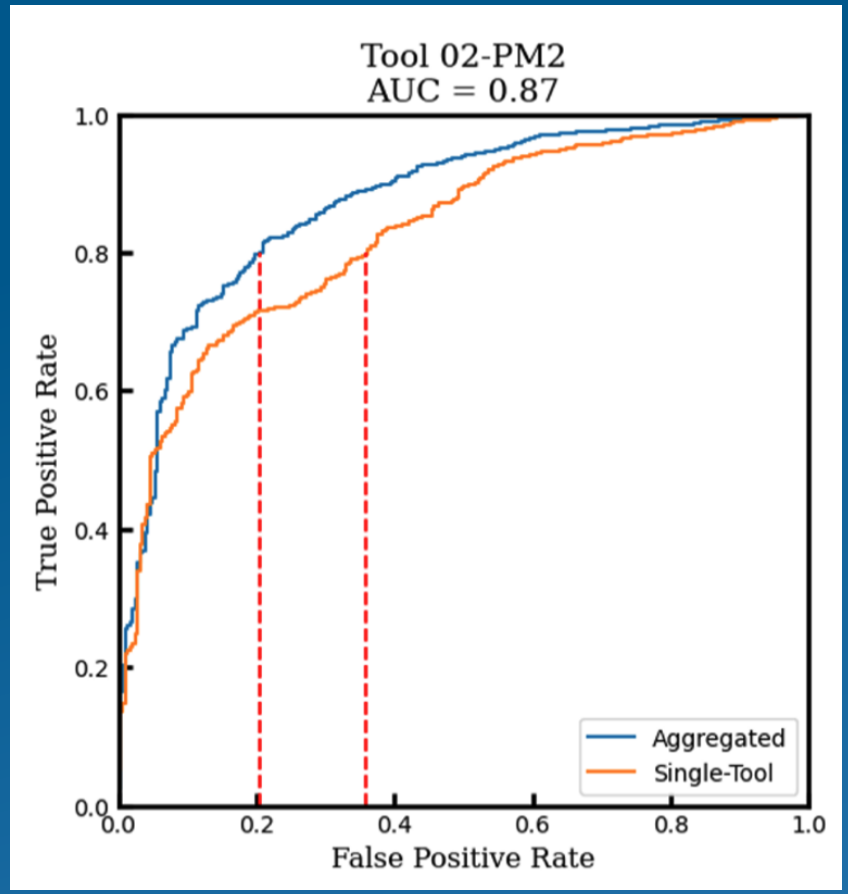
Monetizing Digital Scaling
Avoiding DIY Data Engineering Reduced Cost of Data & Aggregating Data Increased Value of Data



Consistently
Protected, Qualified,
Processed
Data

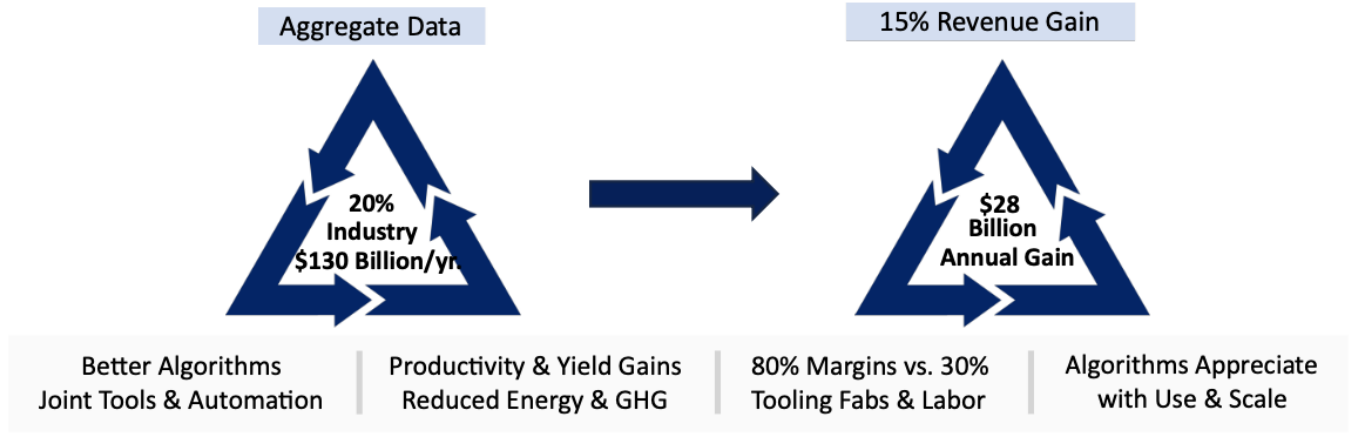
Collaborative Modeling &
Validation
For

Improved Performance &
Cross Machine, Material,
Product, Analysis



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Multiple Applications, Multiple Products, Multiple Materials, Multiple Machines, Multiple Companies



$28 Billion in Capital Avoidance, Labor Efficiency and Yield Improvement

Semiconductor Manufacturer-Defined Smart Manufacturing Priority Application Areas

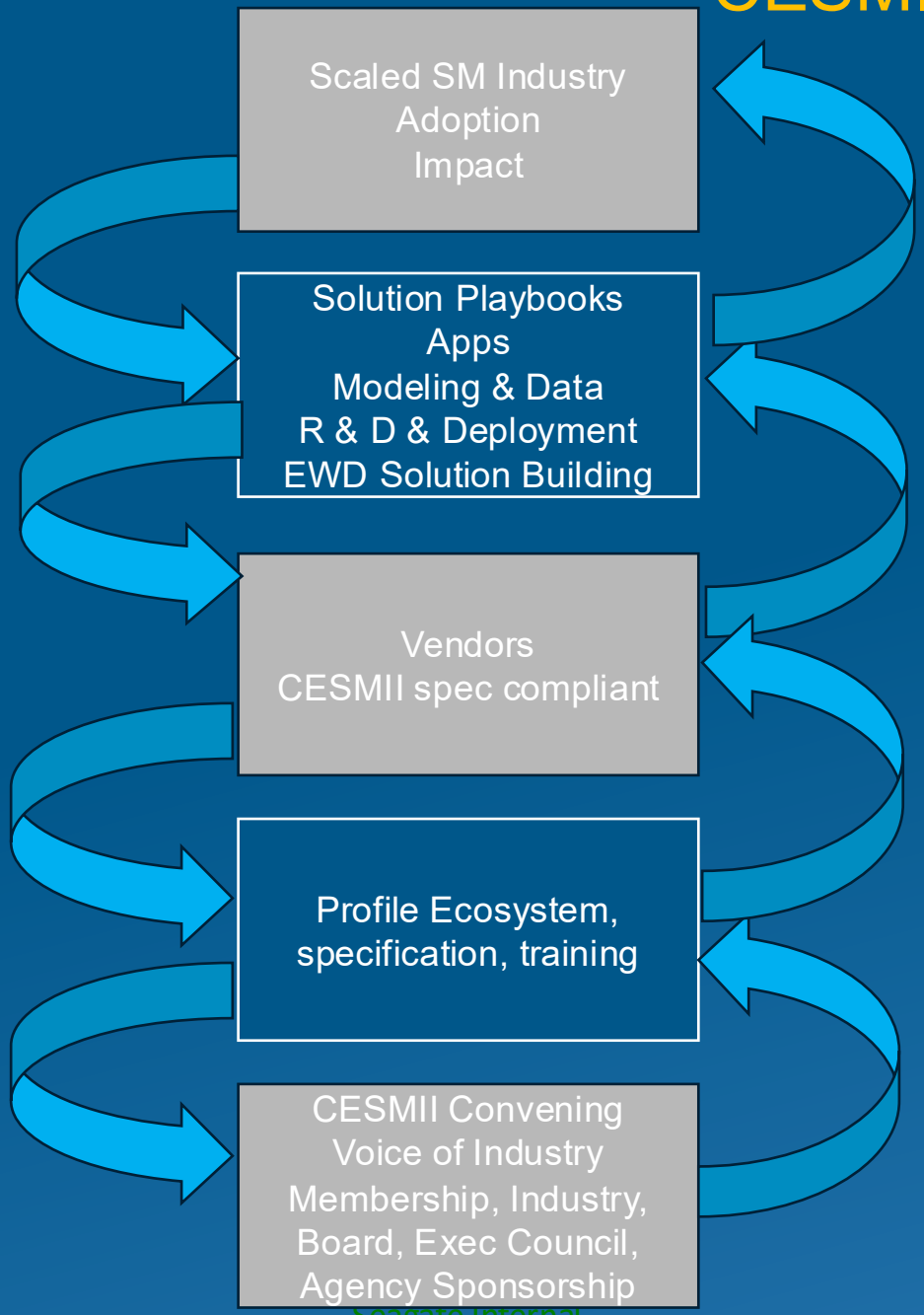
- Predictive Maintenance
- Advanced Process Control
- Fault Detection and Control
- Root Cause Analysis
- Virtual Metrology
- Automated Inspection
- Energy Management
- Materials Management

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Scaling Industry Adoption

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CESMII's Tech Transfer Model



Pull) Mindset ← Market
← Workforce ← Technology

(Push) Technology →
Workforce → Mindset → Market

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mission. strategy. role.

Driving the **next wave** of manufacturing productivity, energy productivity and competitiveness through **smart manufacturing innovation**.

2017

Founded by the **D.O.E**, A Program in **UCLA**

$200M+

Private/public partnership

Improve energy productivity

through **sensing, control, modeling, analytics & platform** technologies

How.

Fund the **Innovation and R&D** necessary to dramatically **reduce the cost & complexity** of using real time operations data to drive revenue & cost improvements.

*CESMII represents the **voice of manufacturing;** engaging the smart manufacturing ecosystem through a membership model*

210+ Members

- **Manufacturers** — Small, Medium & Large
- **System Integrators & Consultants**
- **Machine Builders**
- **Technology Providers**
- **Academia & Labs**

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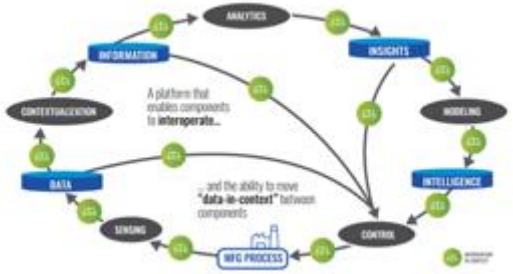
The CESMII Story

1

Develop SM technologies to solve manufacturing problems

SM Building Block Technologies

Multiple Industry Verticals



10-25% economic impact
on operations and energy

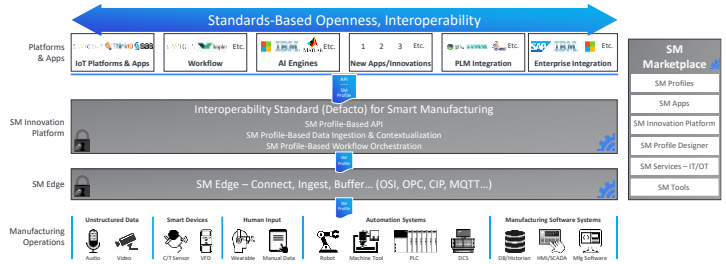
- **Productivity**
- **Quality, Yield, Waste**
- **Energy consumption**

2

Accelerate SM Adoption in SMMs and Supply Chain

SM Innovation Platform, Profiles, Marketplace

Small & Discrete Manufacturing



25-50% reduction in SM
implementation costs

- **Performance & Productivity**
- **Implementation Cost/Complexity**
- **SMM & Supply Chain Adoption**

3

Upskill the Workforce Through Education, Training

SM Education and Training

Talent Pipeline & Incumbent Workforce



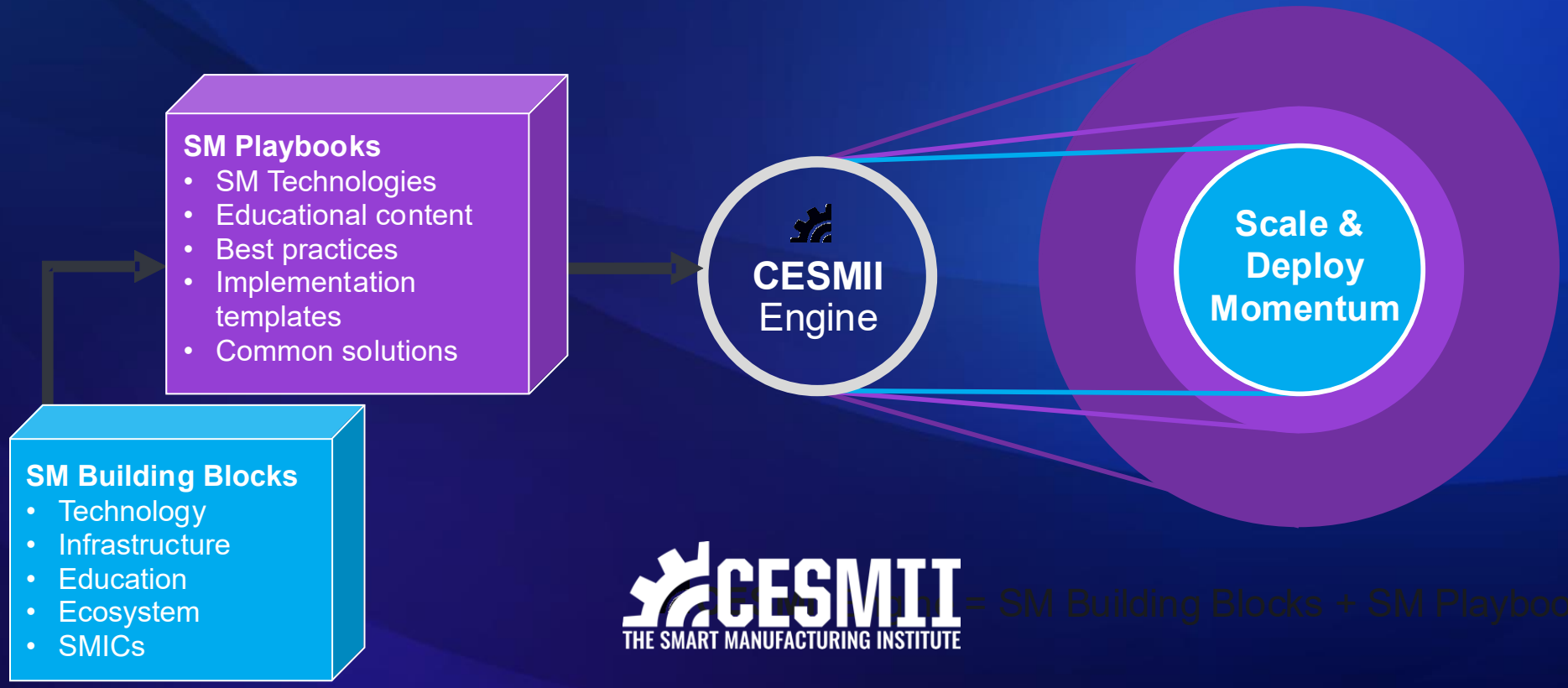
6+ new curriculums, >2000/yr
students and professionals trained

- **Education & Training**
- **Upskilling**
- **SM adoption**

Smart Manufacturing Innovation Centers (Dissemination of Technology and Training)

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Renewed Focus on Scaling and Deployment



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Challenges and Opportunities

- Cost effective, vendor agnostic, standards based, **interoperable infrastructure technologies** are essential to scale SM & AI for Manufacturing
- **Education and training** of the workforce is critical to understand, implement and sustain SM/AI solutions – not to do everything but to under their role
- Industry **Scale and Integration will drive Business and Technology tools and SM/AI Adoption** across small, medium and large manufacturers
- **Ecosystems of Digital and Operational Capability drive the full value of data; Technology and Education partners** provide the expertise to collaboratively drive SM/AI adoption for individual and industry business

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CESMII's Industry Value Driven Tech Transfer Adoption

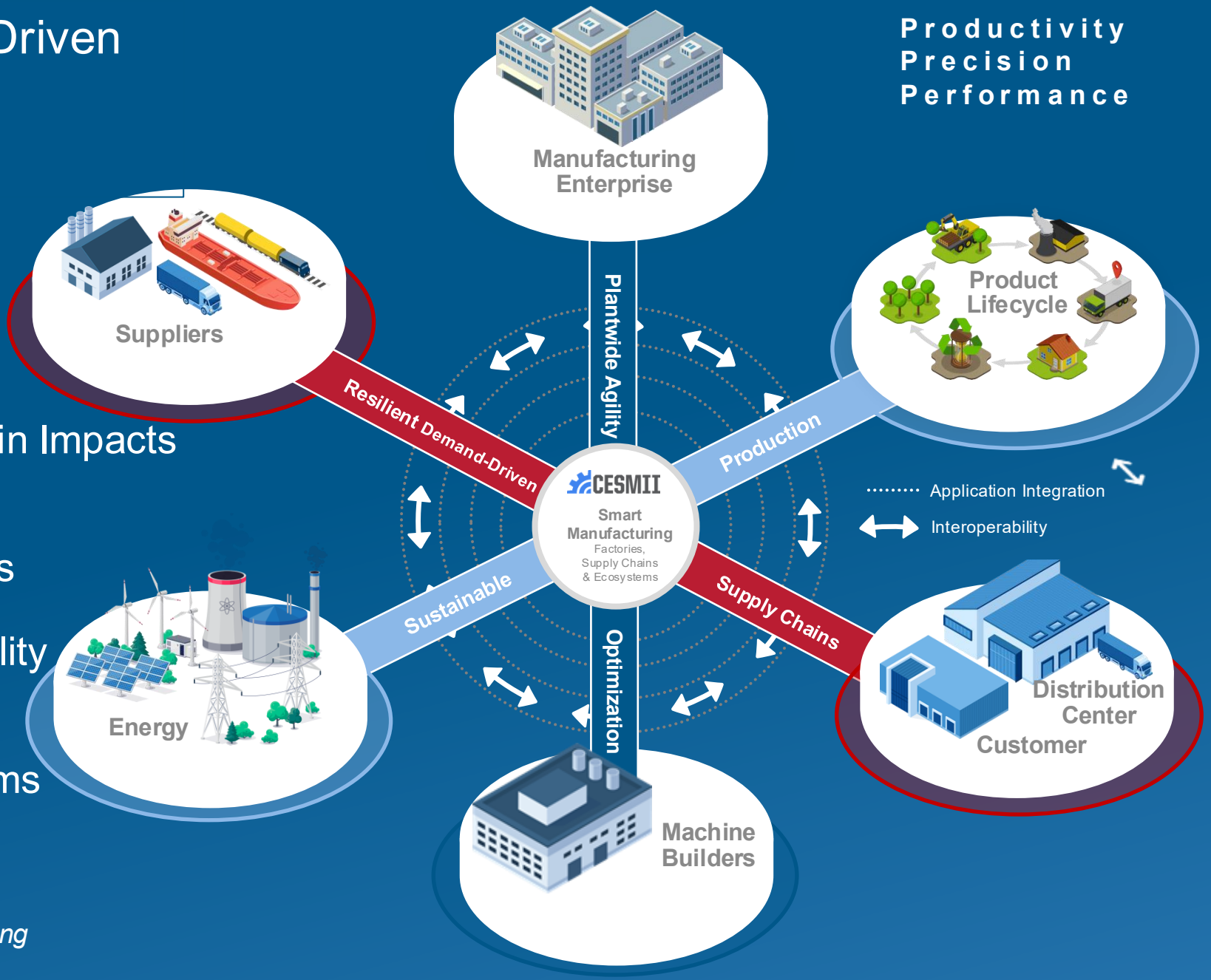
comments by Jim Davis UCLA/CESMII

Scaled Change in Mindset
Scaled Factory and Supply Chain Impacts
Scaled Training Impacts

Scaled Adoption of SM Solutions
Scaled ASCPM* Integration
Scaled Operational Interoperability
Scaled Data Interoperability

Multiply Collaborative Ecosystems
New revenues streams
Achieve Network Effects

**Advance Sensor Controls Platform and Modeling*



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Thank you!

UCLA Advanced Research Computing

CESMII
THE SMART MANUFACTURING INSTITUTE

A Program in UCLA

BUILDSM
Building Smart Manufacturing for Califomia
UCLA Advanced Research Computing
BUILD SM CENTER

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