AMMTO Peer Review

Accelerating the
Democratization of Smart Manufacturing

CESMII
THE SMART MANUFACTURING INSTITUTE

2023 May 17

CESMII THE SMART MANUFACTURING INSTITUTE mission. strategy. role.

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

U.S. DEPARTMENT OF ENERGY

2017
Founded by the D.O.E

$140M+
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** and **generate cash.**

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

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

CESMII's Integrated Roadmap Pillars

SM ECOSYSTEM INTEGRATION

- Unite ecosystem in innovative collaboration
- Develop ambassadors for SM value and principles
- Leverage a national network of innovation centers

SM ENABLING TECHNOLOGIES

- Collaborative R&D
- Develop key technologies
- Robust and configurable
- Integration into SM system

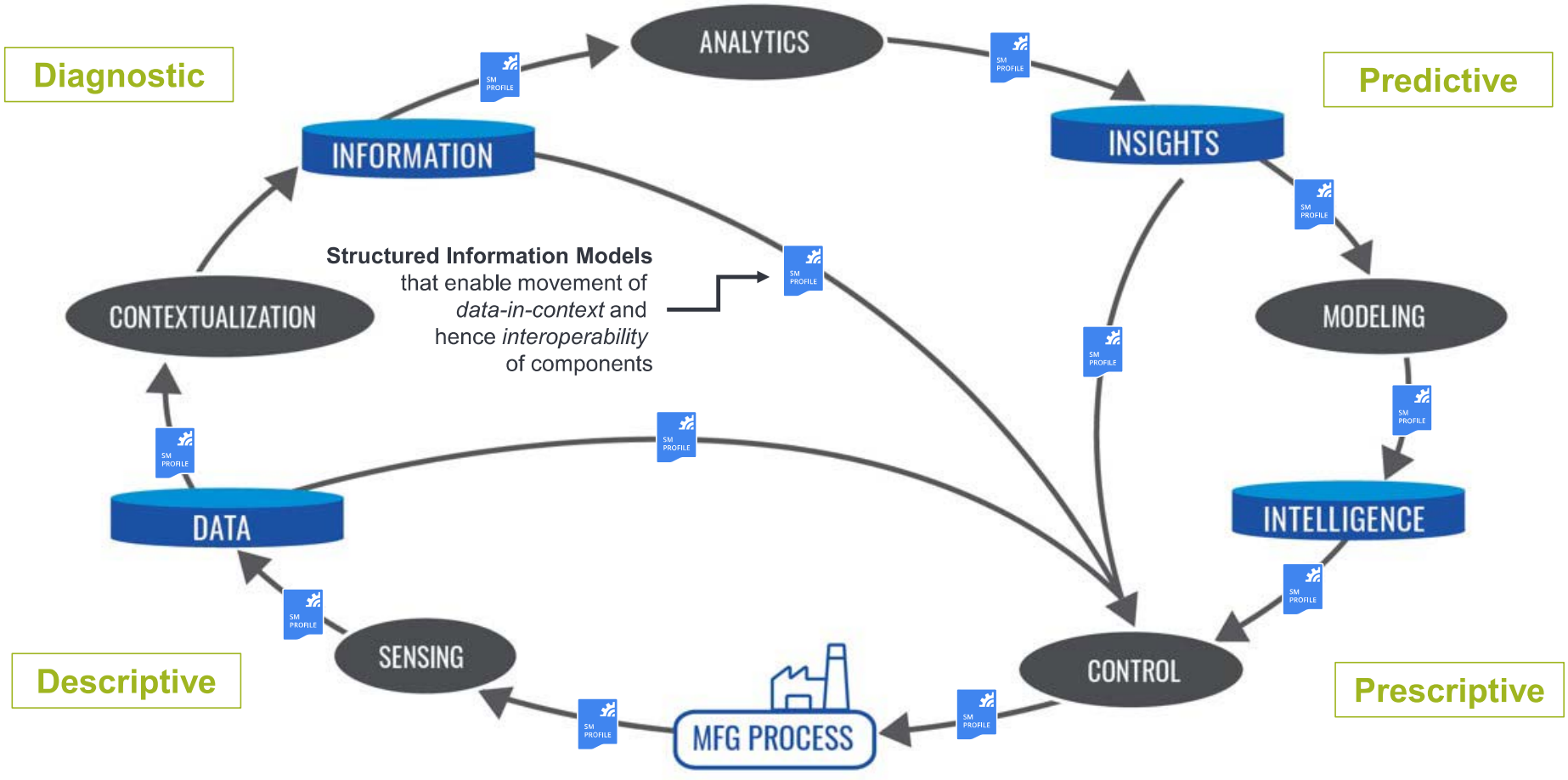
SM EDUCATION

- SM principles and practices
- Build and sustain SM skills
- SM platform and tech training
- Educator resources

SM INNOVATION PLATFORM

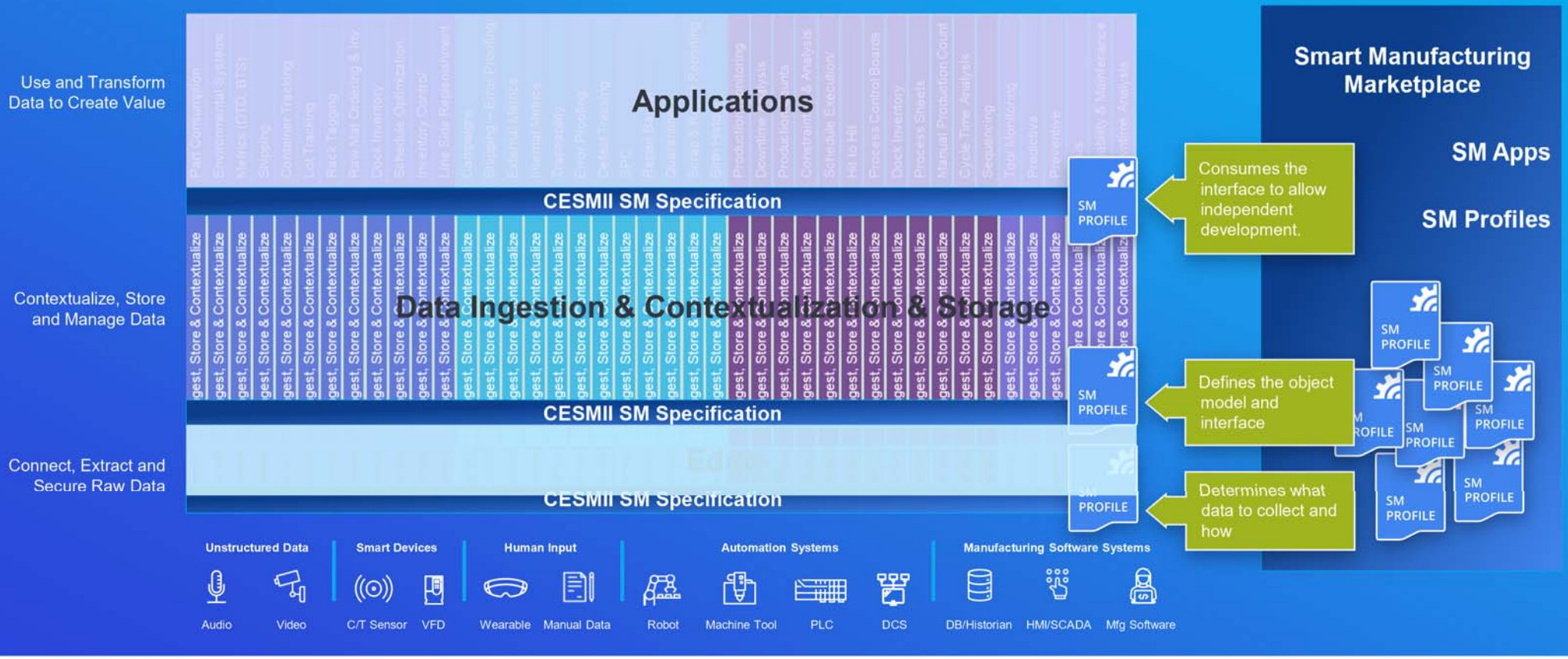
- Platform and Marketplace
- Enable reuse of technologies
- Secure, flexible, scalable
- Cost effective deployment

SM Technology Building Blocks and Information Flow



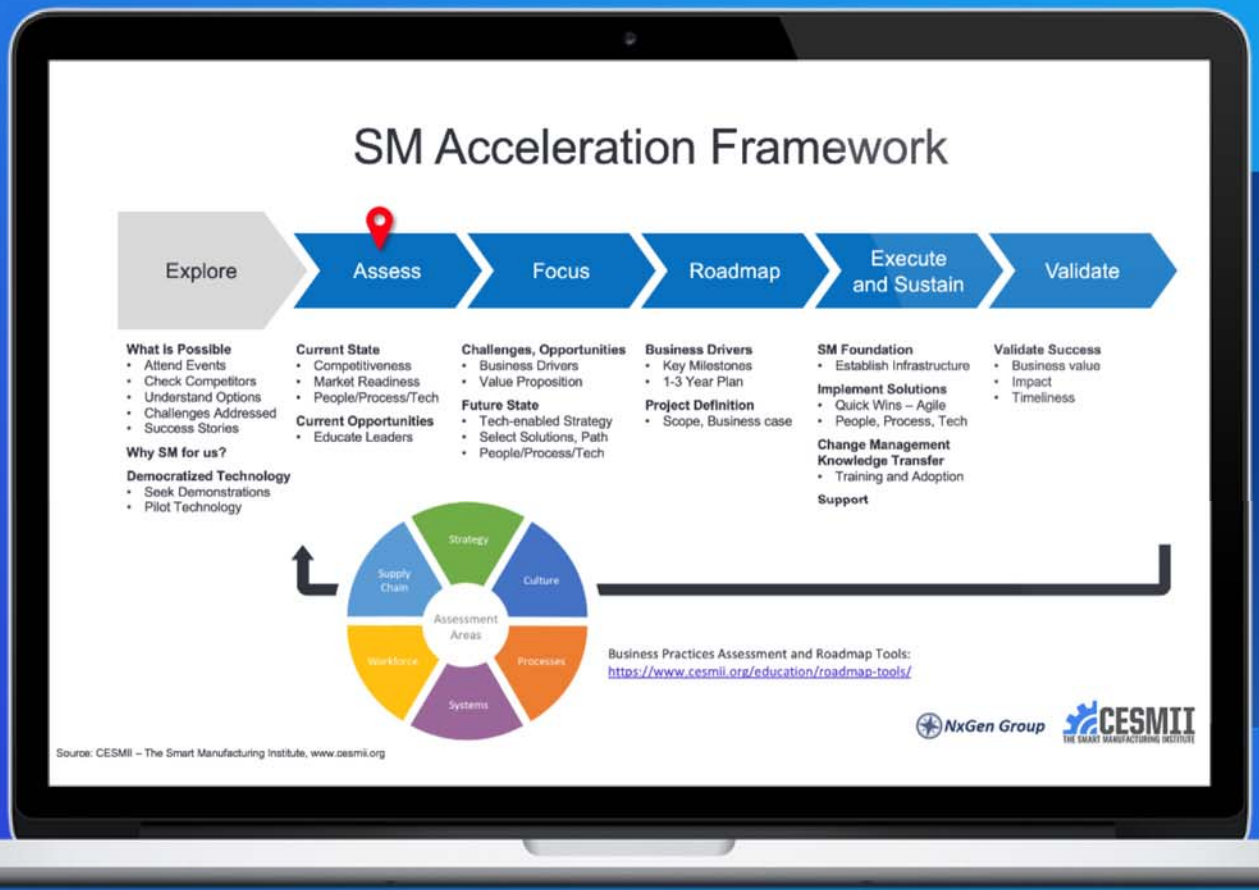
A Sustainable and Future-Proof Strategy for SM

Interoperability Demands an Information Model-Driven Architecture



Smart Manufacturing Roadmap Tools

The CESMII Acceleration Framework helps you establish
a strategic and tactical roadmap specific to your business.



This is your no-cost starting point.

Complete this assessment to gain better insight into your operations identify areas for improvement.

START HERE

SM Learning System - Hardware Kit

SM Edge

- Windows
- Linux
- Comms Drivers

PLC

- Allen Bradley
- Phoenix Contact
- Siemens

Applications

- Heater Element
- Motor with Vibration
- Weighing System (Weight, Part Count, etc.)
- Current Measurement (Infer Asset Util, Quality, etc.)
- Historian (Plant Operations Data Store)
- HMI/SCADA Apps (Plant Ops Use Cases)

Sensor to SM Edge to Cloud

- Load Cell, Current Transformers, Temperature, Vibration, Humidity, Proximity, Potentiometer, Push Buttons, Selector Switches, Etc.

PLC to SM Edge to Cloud

- Load Cell, Current Transformers, Temperature, Vibration, Humidity, Proximity, Potentiometer, Push Buttons, Selector Switches, Etc.


An ecosystem of ~180 Collaborating Members

Excellence in Execution Strategy & Aligning with Our Metrics

1. 15% improvement in energy efficiency in first-of-a-kind demonstrations at manufacturing plants or of major processes within 5 years
2. 50% reduction in cost and time to deploy SM in existing processes within 5 years
3. Significant industry adoption of SM technology within 5 years
4. Sustainable portfolio of business, technology, research and development, and workforce development activities that directly replaces initial Federal funding within 6 years
5. 50% improvement in energy productivity within 10 years
6. SM Workforce Capacity in the US will be Increased – 2X by 2020 & 5X by 2030

Focus on Industry Relevance and the Translatability/Re-Use of Project Outcomes for Many Other Manufacturers ● Primary Impact ○ Secondary Impact

Create & Scale SM Capabilities

SM Enabling Technologies (ASCPM*)

ENABLING R&D PROJECTS

1 2 3 4 5 6

SM technology gaps: sensors, AI/ML, controls, modeling, 5G…

Advancing SM Technologies

PLATFORM & CAPABILITY PROJECTS

1 2 3 4 5 6

Develop core technologies: Innovation Platform, Profile Designer, Marketplace and tools

Advance SM Practices & Knowledge

EDUCATION & WORKFORCE DEVELOPMENT

1 2 3 4 5 6

Develop SM education content: train, equip & certify SM practitioners, citizen technologists…

Implement SM Capabilities

Implement & Validate SM Capabilities

SM INNOVATION PROJECTS

1 2 3 4 5 6

Implementation of SM innovations leveraging the SMIP, Profiles and Apps…

Pilot SM Technologies, Tools and Practices

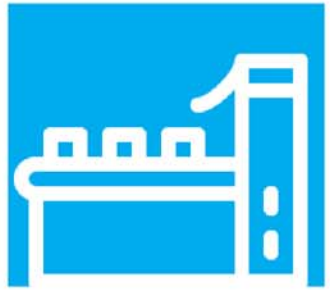
APPLICATION PROJECTS

1 2 3 4 5 6

Free, pre-production use of CESMII capabilities for Proof-of-Concept development

*ASCPM = Advanced Sensors, Controls, Platform & Modelling for Manufacturing

Industries We Impact



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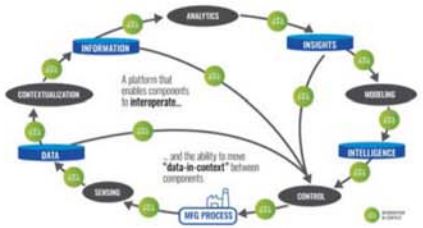
The CESMII Story

1

Develop SM technologies to solve manufacturing problems

SM Building Block Technologies

Energy Intensive Industries



10-25% reduction in energy
for steel and cement industries

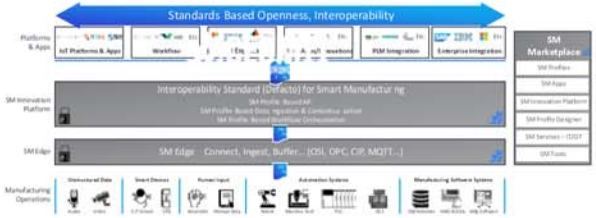
- Energy Productivity
- Quality, Yield, Waste
- Decarbonization

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

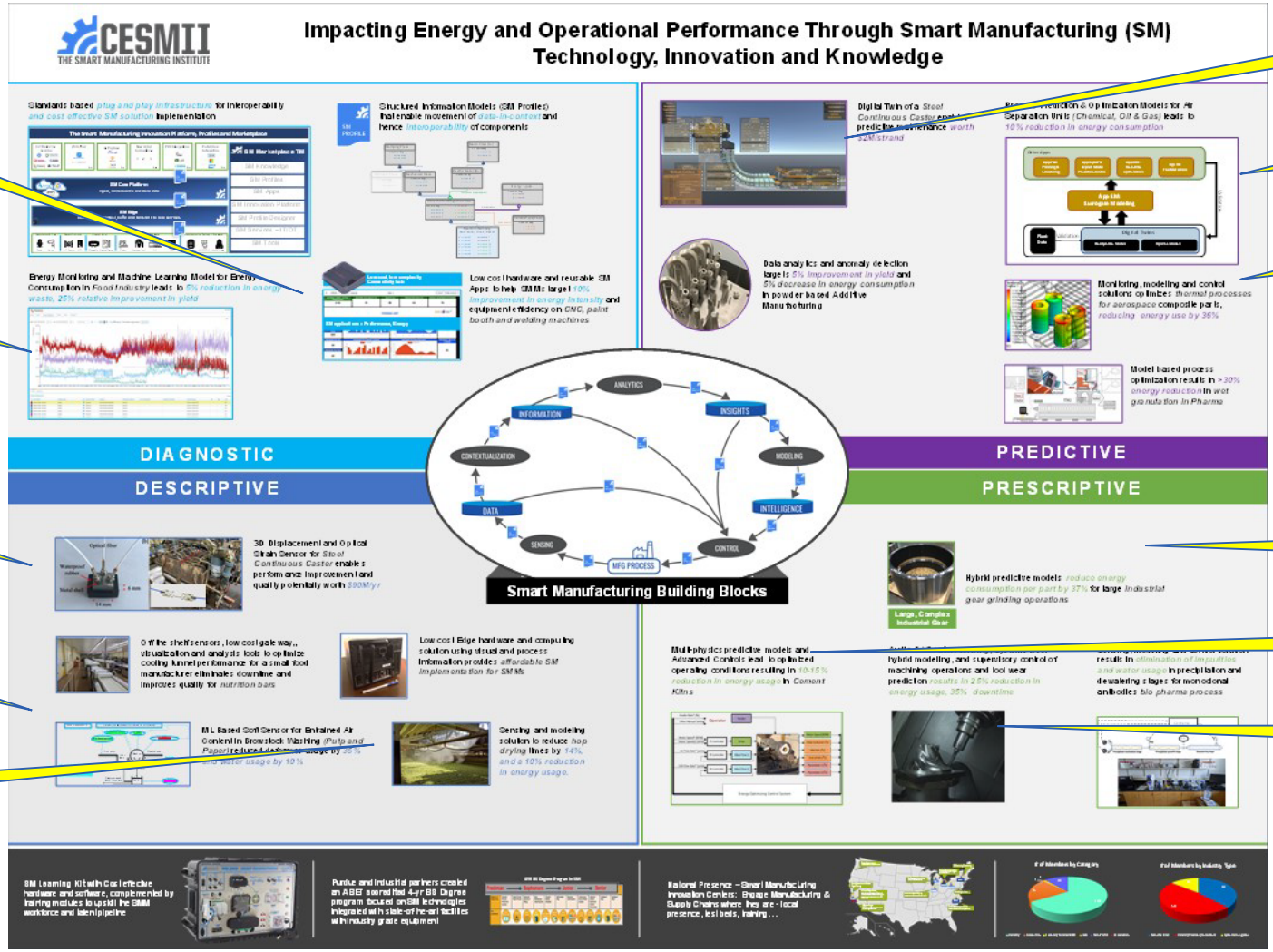
SM Education and Training

Talent Pipeline & Incumbent Workforce

6 new curriculums, >6000
students and professionals trained

- Education & Training
- Upskilling
- SM adoption

Smart Manufacturing Innovation Centers (Dissemination of Technology and Training)



SMMs

Food

Steel

Paper

Drying

Steel

Chemicals

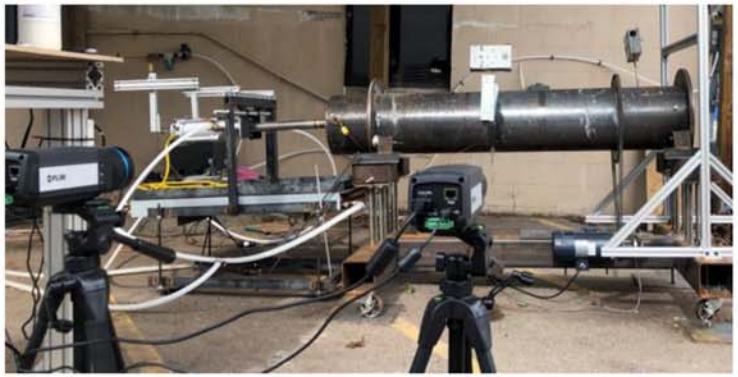
Thermal

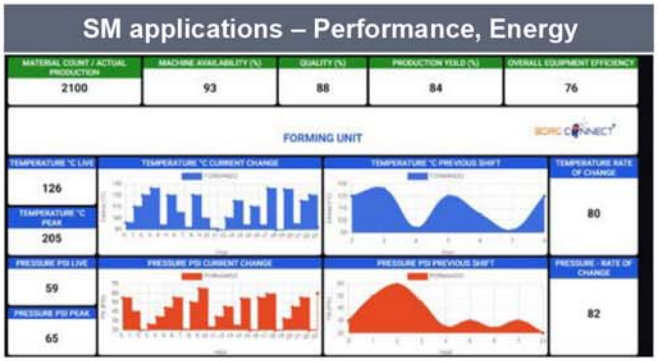
Grinding

Cement

Aerospace

Project Examples



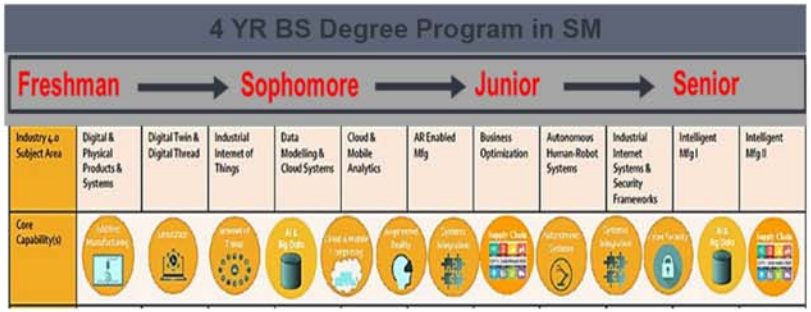


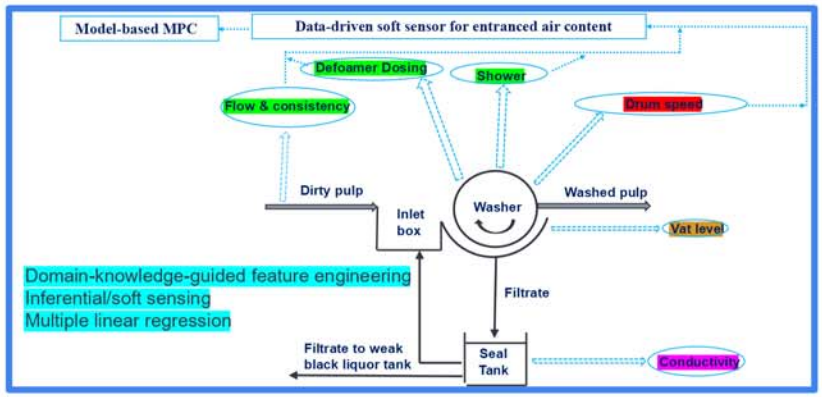
Low-cost, low-complexity Connectivity hub

Multi-physics predictive models and Advanced Controls lead to optimized operating conditions resulting in ***10-15% reduction in energy usage*** in ***Cement Kilns***

Low cost hardware and reusable SM Apps to help SMMs target ***10% improvement in energy intensity*** and equipment efficiency on ***CNC, paint booth and welding machines***

Project Examples





Purdue and industrial partners created an **ABET accredited 4-yr BS Degree program** focused on SM technologies integrated with state-of-the-art facilities with industry grade equipment

ML Based Soft Sensor for Entrained Air Content in Browstock Washing ***(Pulp and Paper)*** reduced defoamer usage by ***35% and water usage by 10%***

National Reach through SM Innovation Centers

Enable SM access for small, medium, and large businesses, connecting manufacturing assets to our SM Innovation platform, national policy development, industry awareness, and workforce development.

UCLA · Rensselaer · NC STATE UNIVERSITY · feyen zylstra Industrial Tech Solutions · Case Western Reserve University · digital foundry AT NEW KENSINGTON · PURDUE UNIVERSITY

SMART MANUFACTURING EXECUTIVE Council

A National 'Think Tank' of Smart Manufacturing Leaders, Advocating for the Transformation of the Ecosystem

Our Charter: The Smart Manufacturing Executive Council has been formed to engage business and technology executives, thought leaders and visionaries advocating for the transformation of the U.S. manufacturing ecosystem.

Our Objective: To develop practical guidance and policy recommendations that will help this ecosystem across this digital divide.

- Leverage admired Manufacturing Businesses, **demonstrating their leadership on this journey**, and showing others the way
- Inspire this ecosystem to evolve their strategies and business models to truly **support the democratization of manufacturing technologies** and ensure that SMMs can engage in Smart Manufacturing as well
- Provide guidance for each of the **8** stakeholder groups in our manufacturing ecosystem, helping them understand their role in this evolution, and **invest in the knowledge and skills** required for this transformation
- **Inform US policy makers** on the transformative actions and policies that will **accelerate US adoption** of Smart Manufacturing

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