

Clean Energy Smart Manufacturing Innovation Institute (CESMII)



Accelerating your Smart Manufacturing Transformation

DE-EE0007613

Smart Manufacturing Leadership Coalition

July 2017 – July 2018

Dr. Sudarsan Rachuri

U.S. DOE Advanced Manufacturing Office Program Review Meeting

Washington, D.C.

July 17-19, 2018

OUTLINE

- CESMII Overview
- Mission/Vision
- RMC Model
- Roadmap
- Defining SM and Platform
- RFP, Projects
- Progress so far
- Long term plan

CESMII Overview

TIMELINE

- CESMII awarded – Dec. 2016
- Project End date - Dec. 2021
- Start up period (BP1) completed 2/28/2018
- Currently in BP2
- Project 30% complete

BUDGET

	2017 BP1	2018 BP2	Total (2019 – 2021)
DOE Funded	\$5.4M	\$18M	\$46.6M
CESMII Cost Share	\$6.2M	\$18M	\$145.8M
Total	\$11.6M	\$36M	\$240M

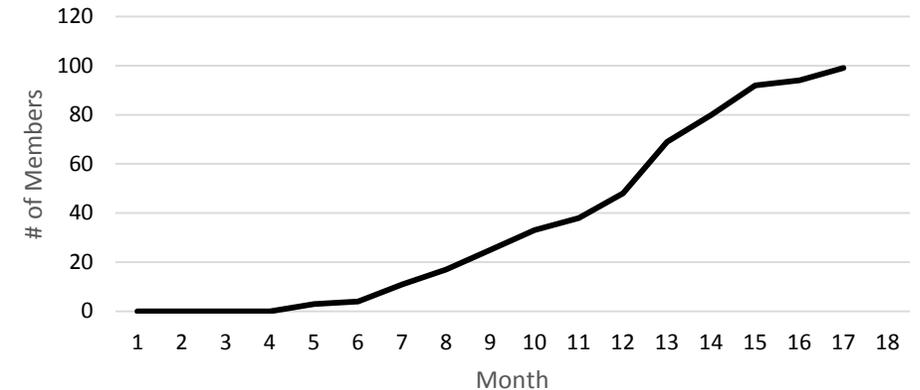
MANAGEMENT

- SMLC owns Co-operative Agreement
- CESMII (LLC) executes and operates the agreement
- CESMII Governance Board Manages

MEMBERSHIP

- 99 Institutional members
 - 52% Industrial
 - 41% Academics
 - 7% Other
- Governance, Business Development, Workforce Development, Technology Development, Projects
- Strong Pipeline

MEMBERSHIP GROWTH



CESMII's Mission is to Accelerate Smart Manufacturing Adoption

Vision: Smart Manufacturing is manufacturing in 2030

MISSION

Radically accelerate advanced sensor, controls, modeling, simulation, and platform development and adoption in U.S. manufacturing through integrated, industry-led Smart Manufacturing technical, business, and educational methodologies.

OBJECTIVES

To enhance U.S. manufacturing productivity, global competitiveness, and reinvestment, significantly:

- ↑ energy productivity
- ↑ environmental sustainability
- ↑ economic performance
- ↑ workforce capacity

GOALS

Demonstrate at least a **15% improvement in energy efficiency** in first-of-a-kind demonstrations at manufacturing plants or major processes **within five years** of Institute operation, supporting a goal of at least **50% improvement in energy productivity in 10 years**.

Develop tools and technologies to **reduce the cost of deploying Smart Manufacturing in existing processes by 50%** relative to the existing state of the art within five years.

Demonstrate **significant industry adoption of Smart Manufacturing technology** in each of the following topic areas within five years: advanced sensors; control systems and data analytics; high-fidelity modeling; and toolkits.

Establish a portfolio for technology RD&D and workforce development that directly replaces the initial Federal funding (i.e., \$14 million per year), starting in the sixth year of operation.

Broad Deployment – “ALL Manufacturing”

United States Manufacturing Facts



**Number
Manufacturing
Establishments**

**% Less Than
500
Employees**

**% Less Than
100
Employees**

**% Less Than
20
Employees**

292,825

99%

92%

69%



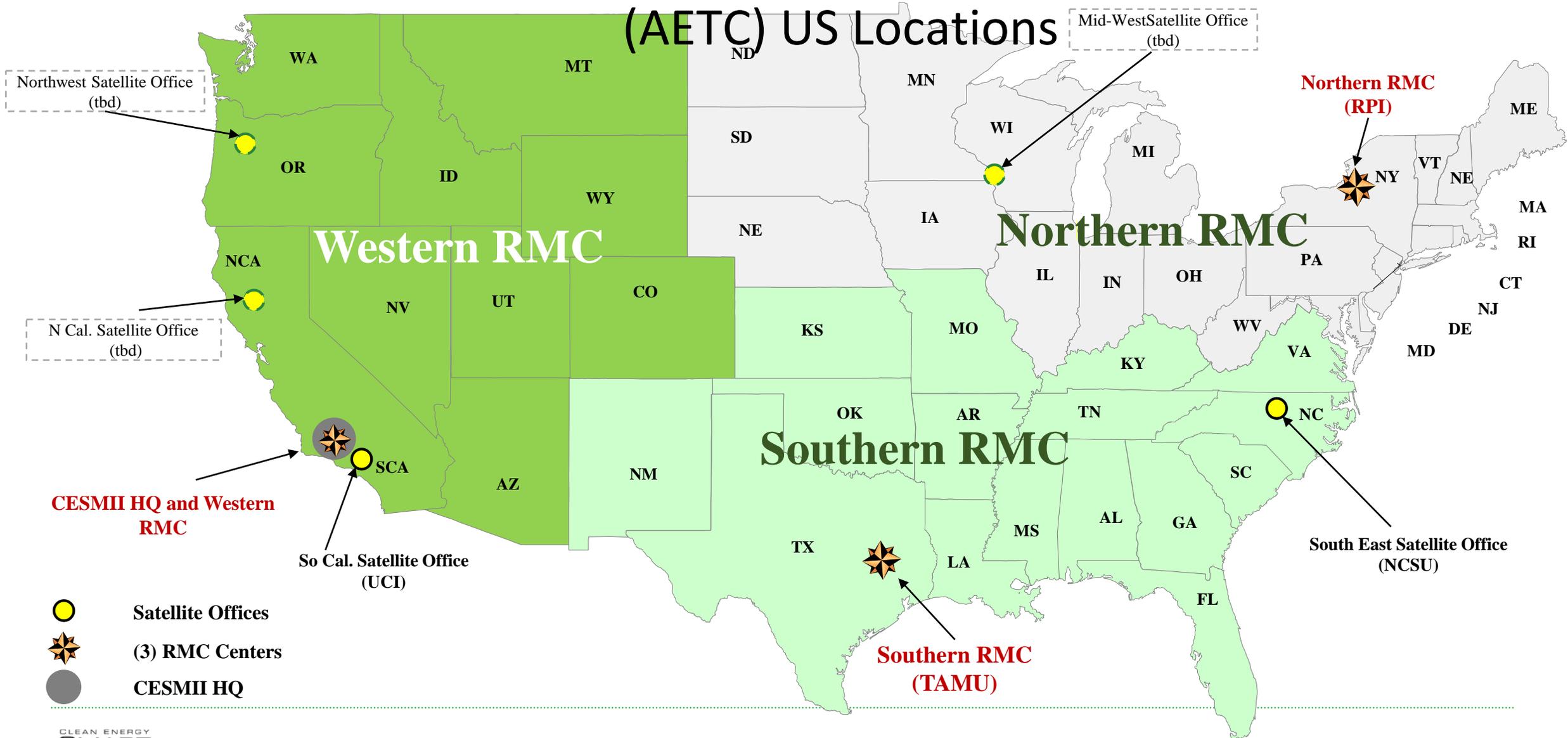
38,532

99%

94%

74%

Air Education Training Command (AETC) US Locations



- Satellite Offices
- ★ (3) RMC Centers
- CESMII HQ

CESMII has an Integrated Strategy & Roadmap to Realize its Mission

CESMII Integrated Strategy **Optimize Manufacturing and Increase Energy Productivity**

Business Practices



Enabling Technologies



- Facilitate SM adoption
- Develop value proposition
- Mitigate risks and barriers
- Provide strategies & tools

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

- Build & sustain SM skills
- Customized training
- Resources & programs
- Technology & practices



Workforce Development



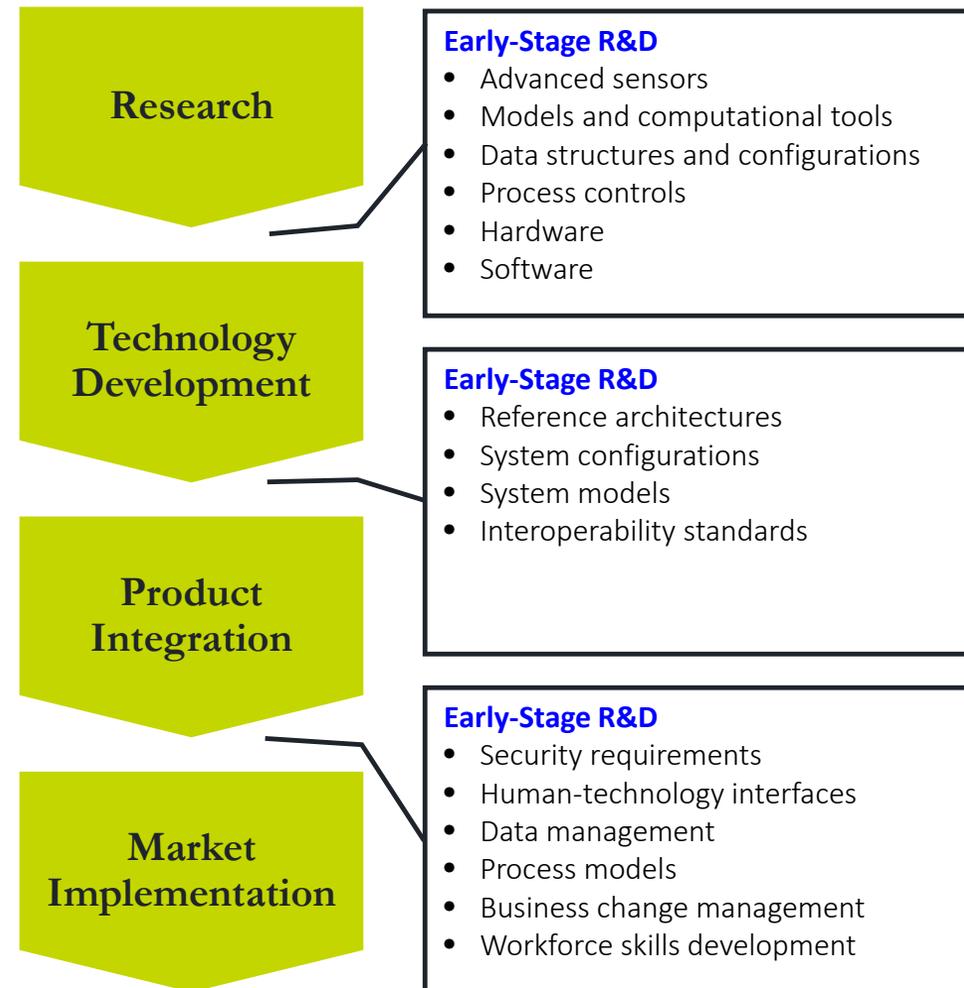
SM Platform Infrastructure

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

Defining RT&D Portfolio

To facilitate implementation of new manufacturing solutions and integration of operational technologies and information technologies (OT/IT), CESMII will **accelerate early-stage R&D** in ways no company or industry can do alone.

The CESMII R&D Portfolio will simultaneously **address knowledge gaps and advance innovation in SM technology, processes, and workforce.**



How Smart Manufacturing help in breaking the status quo?

SM will enable
 Innovative Culture
 Invention driven
 Sustainable
 Proactive

Market Stagnation
 Technology obsolescence
 Disruptive technologies



$$Y = K^a L^b R^c$$

Output (Revenues)
 Capital Labor Research
 Research Quotient (RQ)

Emphasis on maintaining market leadership

$$Y = K^a L^b$$

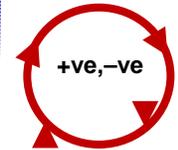
Output (Revenues)
 Capital Labor

Less investments in manufacturing technologies

Manufacturing Technology

New technologies (s/w and h/w)
 Product platform and offerings
 Process improvements

Innovation in process, resources and equipment
 H/w and s/w innovation (AI, ML, IIoT, CPS)
 Human-System Interface, Cognitive Computing



Sales, Marketing, P/L

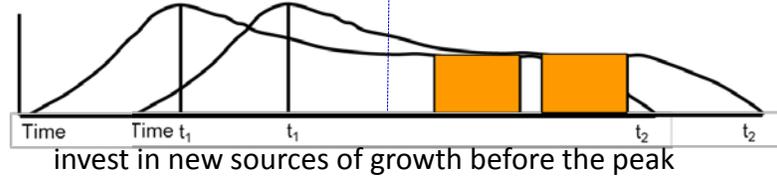
Business strategy loop – both +ve, -ve

Market share, M&A, Product offerings



flourish slowly but fail rapidly
 Or
 Grow fast but fail faster

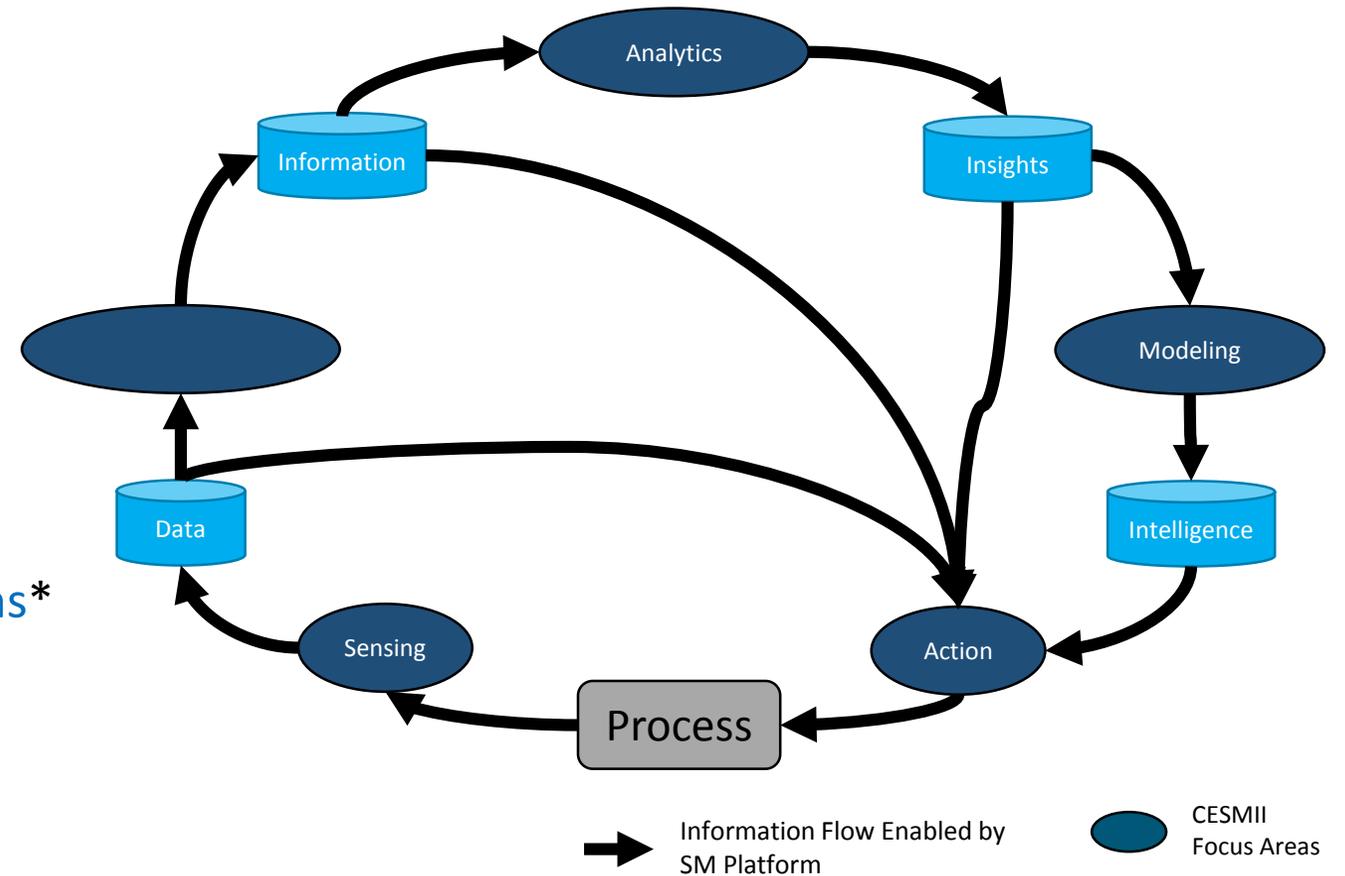
But, industry feels that it is risky investment at this stage - thus creating "systemic risk" that may be triggered by Market Stagnation
 Technology obsolescence
 Disruptive technologies



Smart Manufacturing – As Defined by CESMII

Smart Manufacturing (SM)

...enables the availability of:
...the right information
...the right technology
...at the right time
...in the right form
...to the right people
...powering smart decision-making
...within factories and across entire value chains*



* Small-Medium-Large Enterprises

A more detailed look at Smart Manufacturing

Smart Manufacturing provides **effective** and **secure human-system platform** for **better decision making** and **improving the overall productivity and efficiency** of manufacturing **across the networked enterprise**.

Effective – simple to implement, adapt, and deploy through open interoperable standards.

Required elements: IoT/IIoT standards, protocols, and best practices, Industrial Control System and automation standards.

Secure – Security as a fundamental basis for cyber physical system

Required elements: cyber security framework, blockchains.

Human-system– human in the loop for better augmentation of human-system cognition

Required elements: process automation, industrial control system, robotic system, cognitive computing, AI, Semantic Modeling VR/AR.

Platform – similar to computing platform and mobile computing platform an operating system for cyber physical system.

Required elements: IIoT OS (including edge and cloud computing and associated micro-services).

Better decision making – based both on first principle and data-driven (converting data into actionable insights) models.

Required elements: Decision and information theory, AI, Machine and Statistical learning, AI, cognitive computing, high-fidelity modeling, model composition, advanced sensor network, edge and cloud analytics, model predictive control.

Improve overall productivity and efficiency – faster, better, cheaper, safer, and cleaner.

Required elements: KPIs for Operational Technology (OT) - throughput, quality, cost, capital investment in implementing Smart Manufacturing, resource (energy, material, water) productivity.

Across networked enterprise – interconnectedness from devices to the entire enterprise.

Required elements: Supply network visibility and traceability.

There are Three Fundamental Types of Platforms



Transactional Platforms: Facilitate transactions between individuals and organizations. Examples include Uber, Airbnb, eBay and Amazon Marketplace



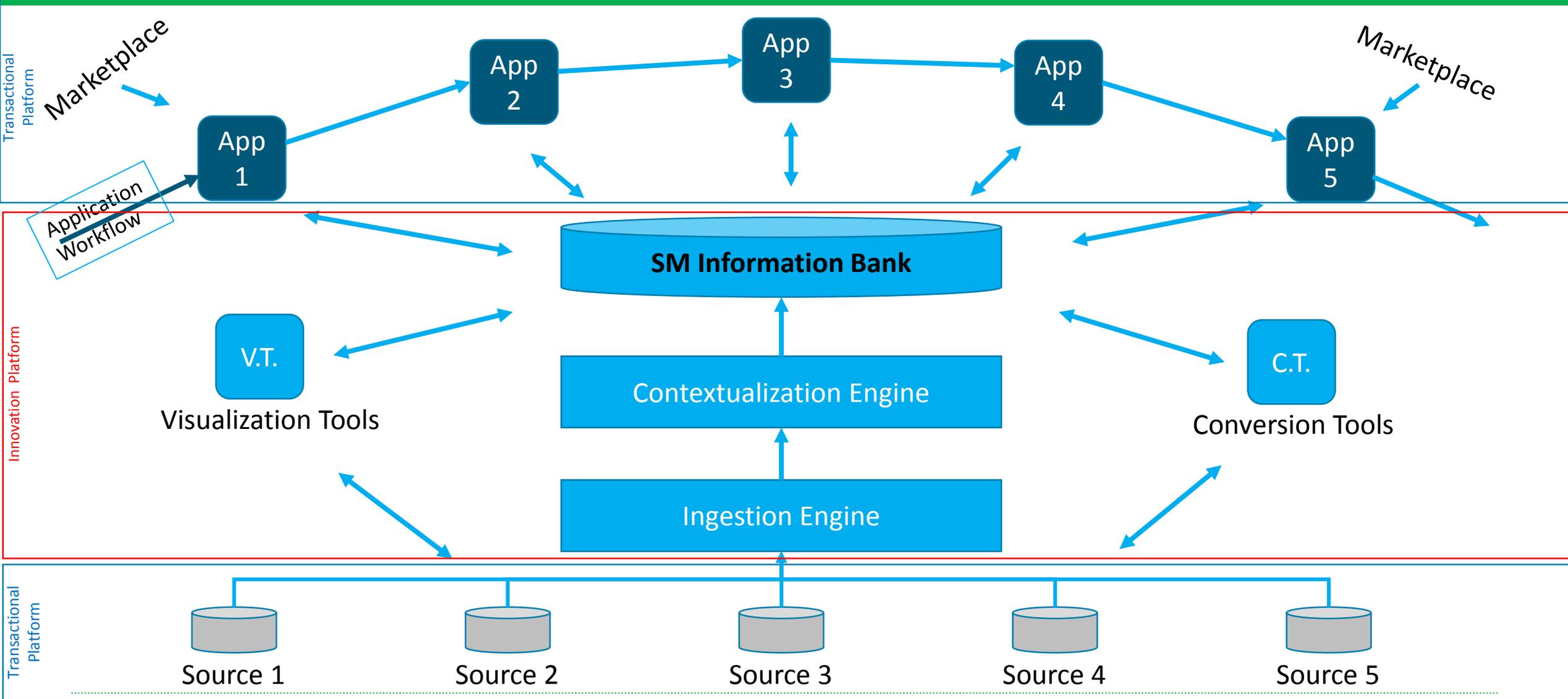
Innovation Platforms: Consist of a foundation of technological building blocks on top of which many innovators can contribute through complementary products and services through application programming interfaces (API). Examples include Windows, MacOS, iOS and Android OS

The SM Platform

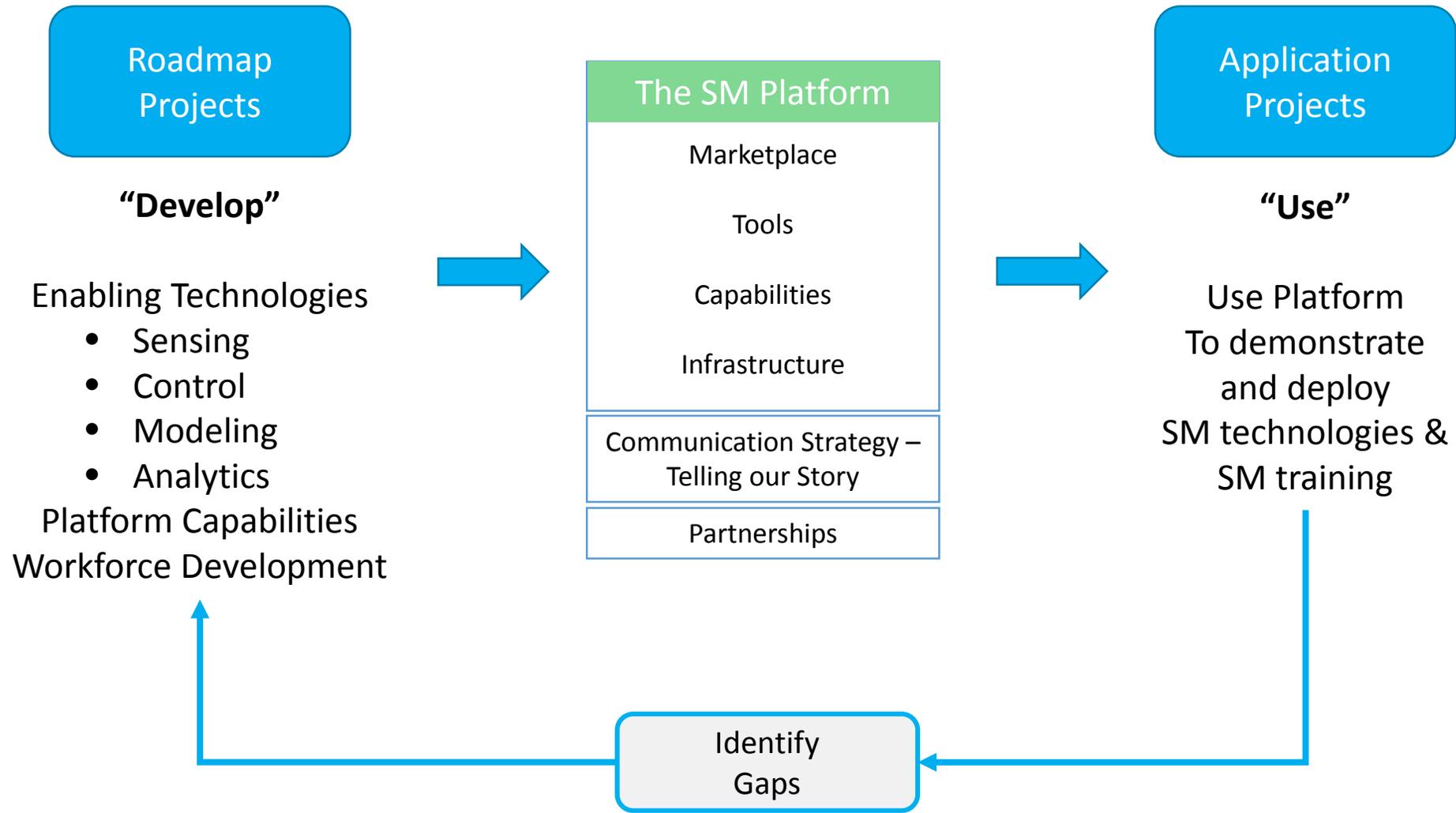


Integrated Platforms: Technology, product or service that has elements of both transaction as well as innovation platforms. Example includes Apple's App Store for use by customers, and a developer ecosystem that supports content creation

The SM Platform – High Level View of Core Functionalities



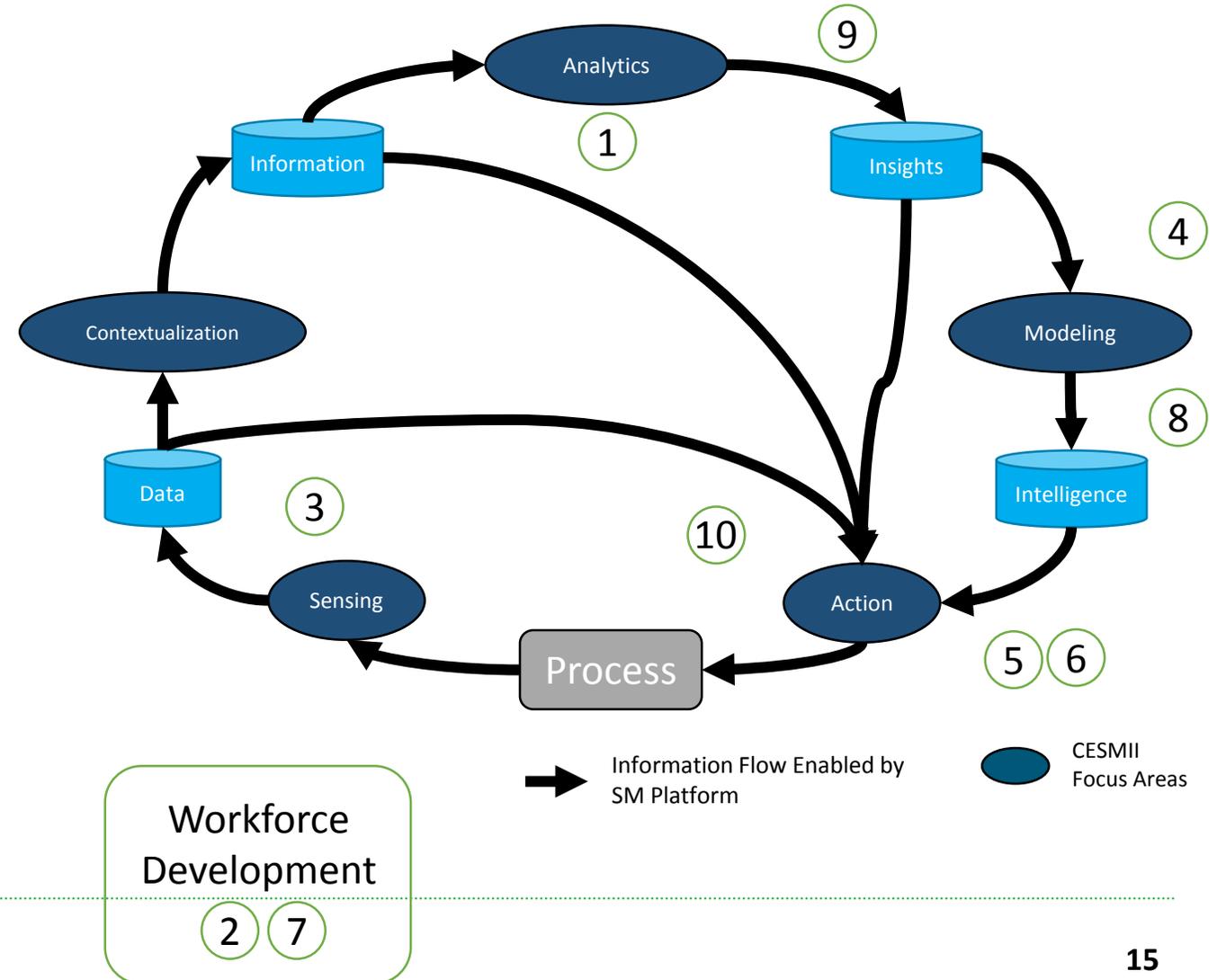
Technical Approach to Accelerate Smart Manufacturing Adoption



Projects Support our Focus Areas

Selected Projects

- 1 Data Analytics-Machine Learning and Data Centric Analytics for discrete manufacturing
- 2 Smart Manufacturing Workforce Development Community College and University Curriculum Program
- 3 Mobile ,Connected Plant Floor Smart Worker
- 4 Inferential Modeling/Contextualization for Energy Optimization
- 5 SM for Chemical Processing – Energy Efficiency – Air Separation
- 6 Energy Management for Subtractive/Additive Manufacturing
- 7 SM Training Simulator/Toolkit for Educational Learning
- 8 Zero Defect Steel Slab Manufacturing thru SM technologies
- 9 Energy Efficiency for Cement Manufacturing
- 10 Energy efficient metal material processing through SM technologies (sensors, controls, modeling)



Results and Accomplishments



BUSINESS PRACTICES

- Value Proposition Defined
- Membership Increased (99)
- Readiness Maturity Assessment
- 12,000 Mfg contacted
- Embedded MEP
- (20) Affinity Groups Chartered
- Annual Membership Mtg
- Business Committee



WORKFORCE DEVELOPMENT

- WFD Workshop (>90 people)
- Knowledge Mgmt Portal created
- (20) SM documents
- Initial Course Catalog defined
- SM 101 – 1st Class
- SM workshops
 - >340 attendees
- WFD Committee



ENABLING TECHNOLOGY

- Project Call
- Technology Gaps defined
- SM Technical Workshops
- SM Common Language Glossary
- Market Place Creation
- Technology Committee



SM PLATFORM

- Demonstration at TAMU
- SM Platform Vision and Approach
- Arconics Application project
- 12 Application projects defined
- Cloud Provisioning and Security
- Selected foundational technologies for SM Platform



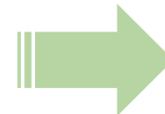
Project Call – 41 submissions – 10 selections - \$16M Total Cost

Organization, Staffing and Facility - Restructure

CESMII Roadmap Developed - >130 participants

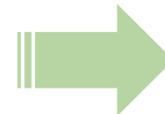
Transition to Sustainability

CESMII sustainability strategy is to Gain **Broad Adoption** of Smart Technology and Practices

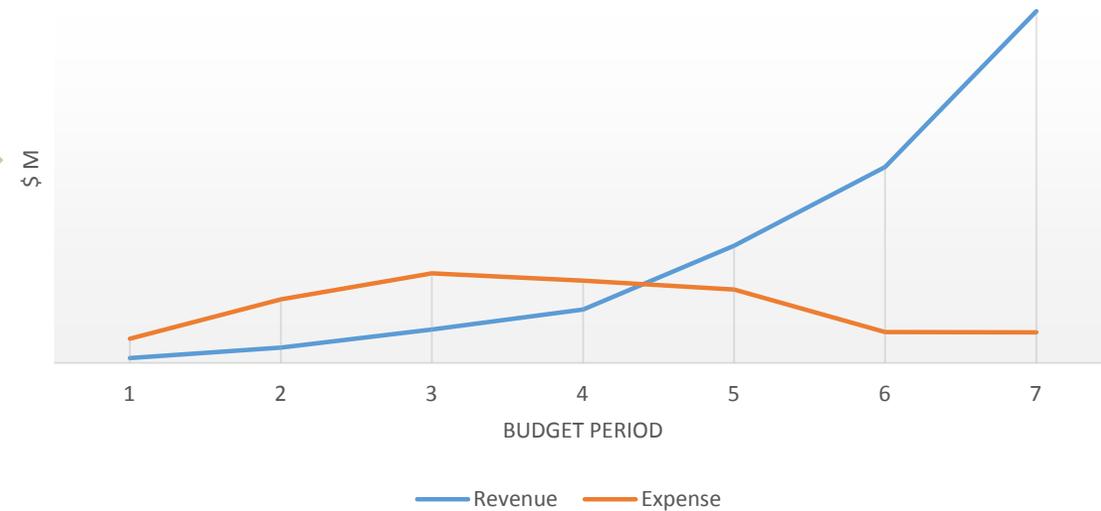


Sustainability Pillars	Revenue Generation Areas		
Membership	Membership Dues	Member funded Projects	Sponsors
SM Technology	SM Platform	SM Marketplace	SM ToolKits
SM Knowledge	Training	Consulting	Certification

- SM Technology drives revenue Growth
- Membership and SM Knowledge Revenue provides operational stability



PROJECTED REVENUE VS EXPENSE





https://twitter.com/CESMII_SM



<https://www.linkedin.com/company/clean-energy-smart-manufacturing-innovation-institute/>

Thank You

Email: info@cesmii.org

Website: www.cesmii.org

Accelerating your Smart Manufacturing Transformation