California Regional Manufacturing Center (CA RMC)

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CTO

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Accelerating
Your Smart Manufacturing Transformation

Overview

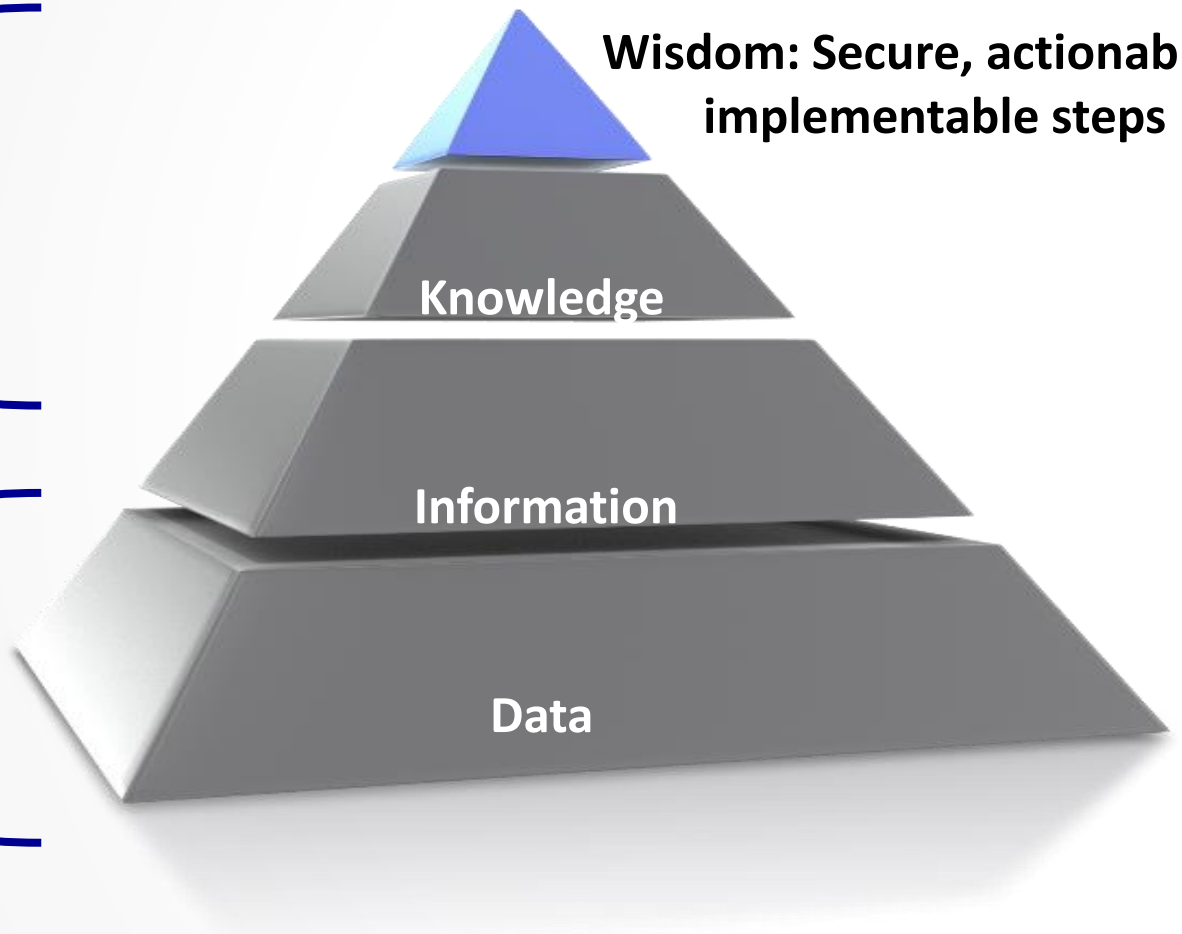
- What is Smart Manufacturing?
- How is CESMII addressing Smart Manufacturing

IoT vs Big Data vs SMART Manufacturing

What's the difference?

Big Data

IoT



Smart

Accomplished through

- ***Open Architecture*** **– Multi-Vendor Compatible**
- ***Open Access*** **– low cost & easy to use**
- ***Open Market Place*** **– composable software libraries & data**
- **Open Market Place - Innovation**
- ***Trusted Data Broker***

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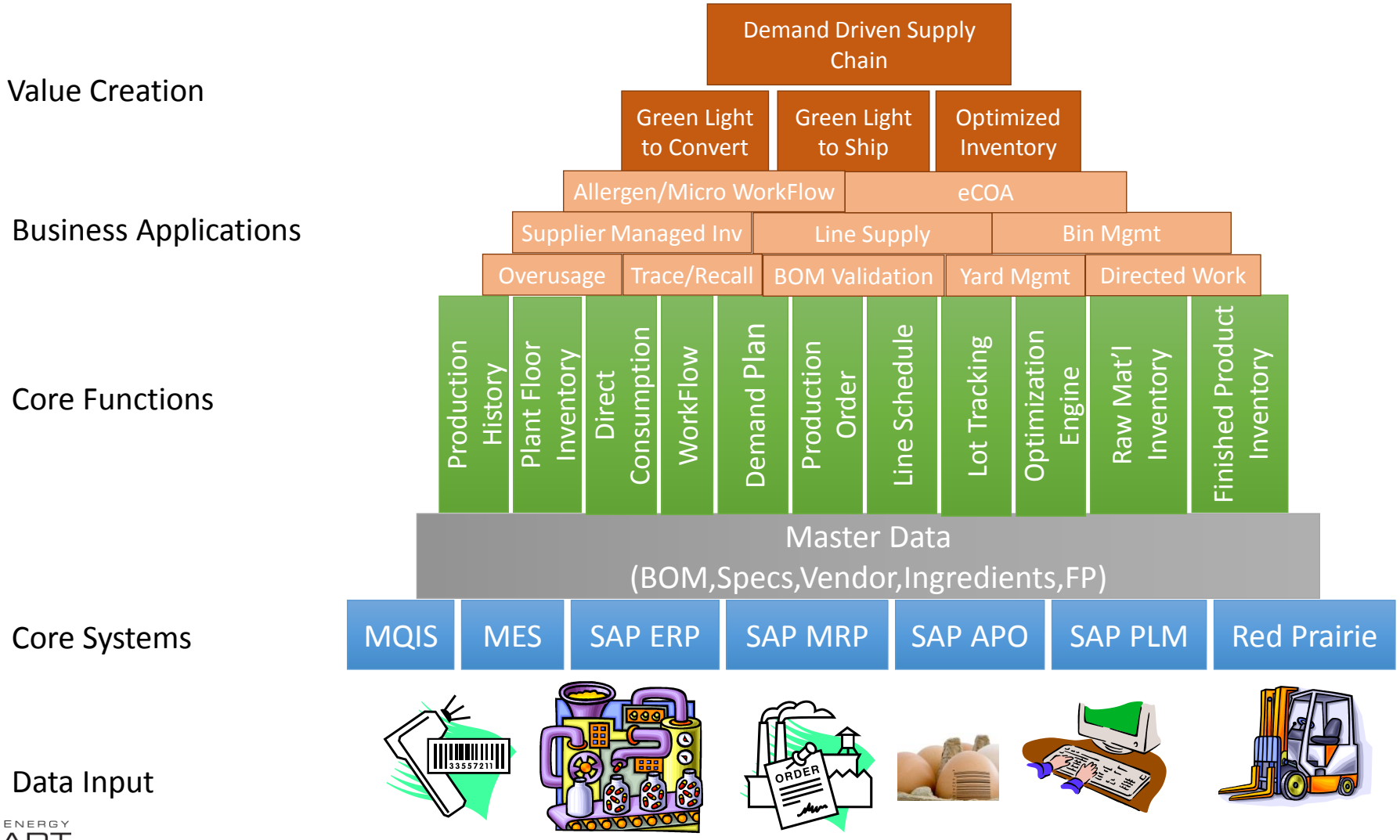
Every Company has an ECO System of " STUFF"



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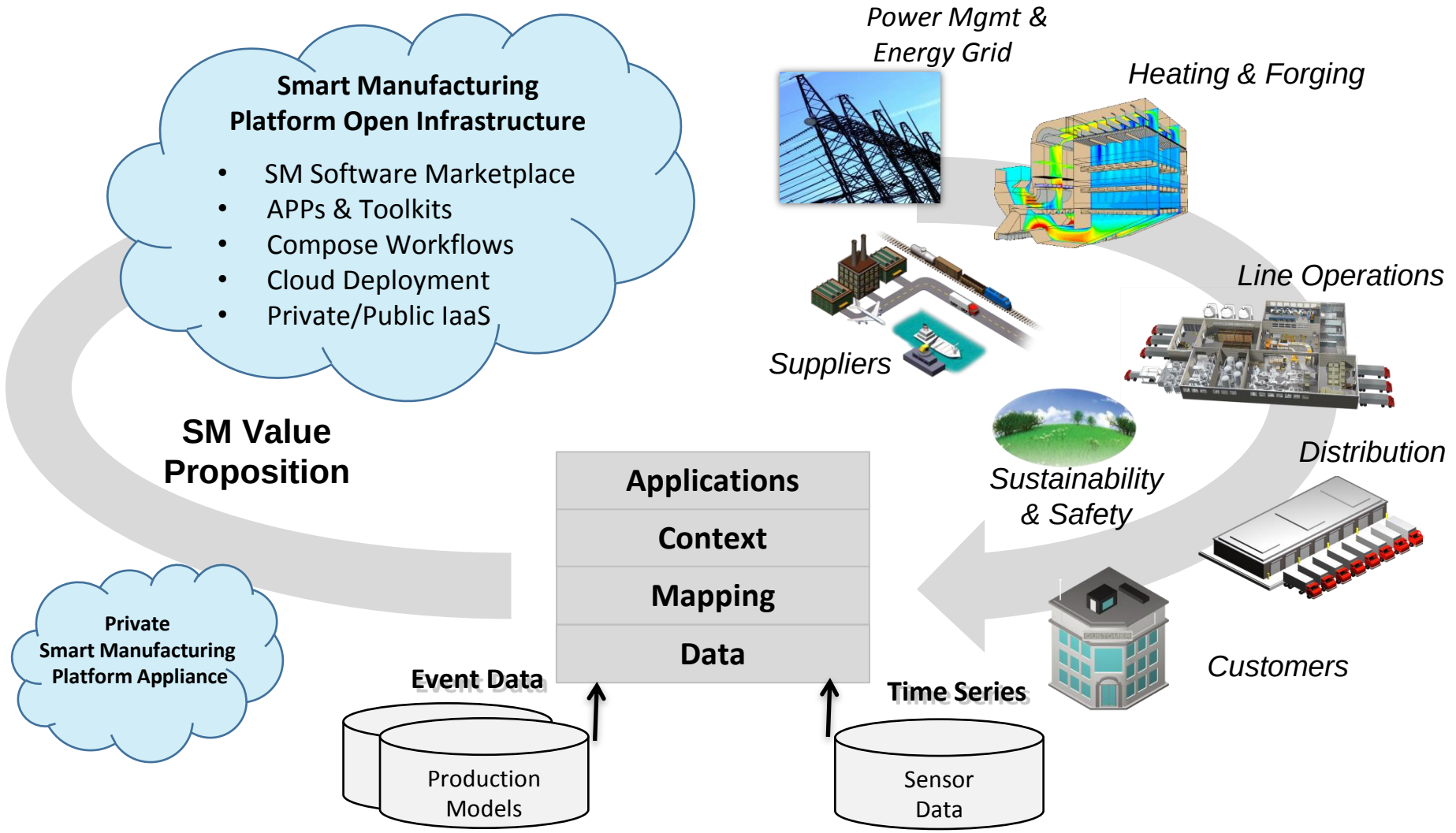
Industry Needs a Platform

CESMII has an Open Implementation Platform



Traditional Manufacturing Automation Environment and Software Tools

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Smart Manufacturing Layers

Industry Testbeds

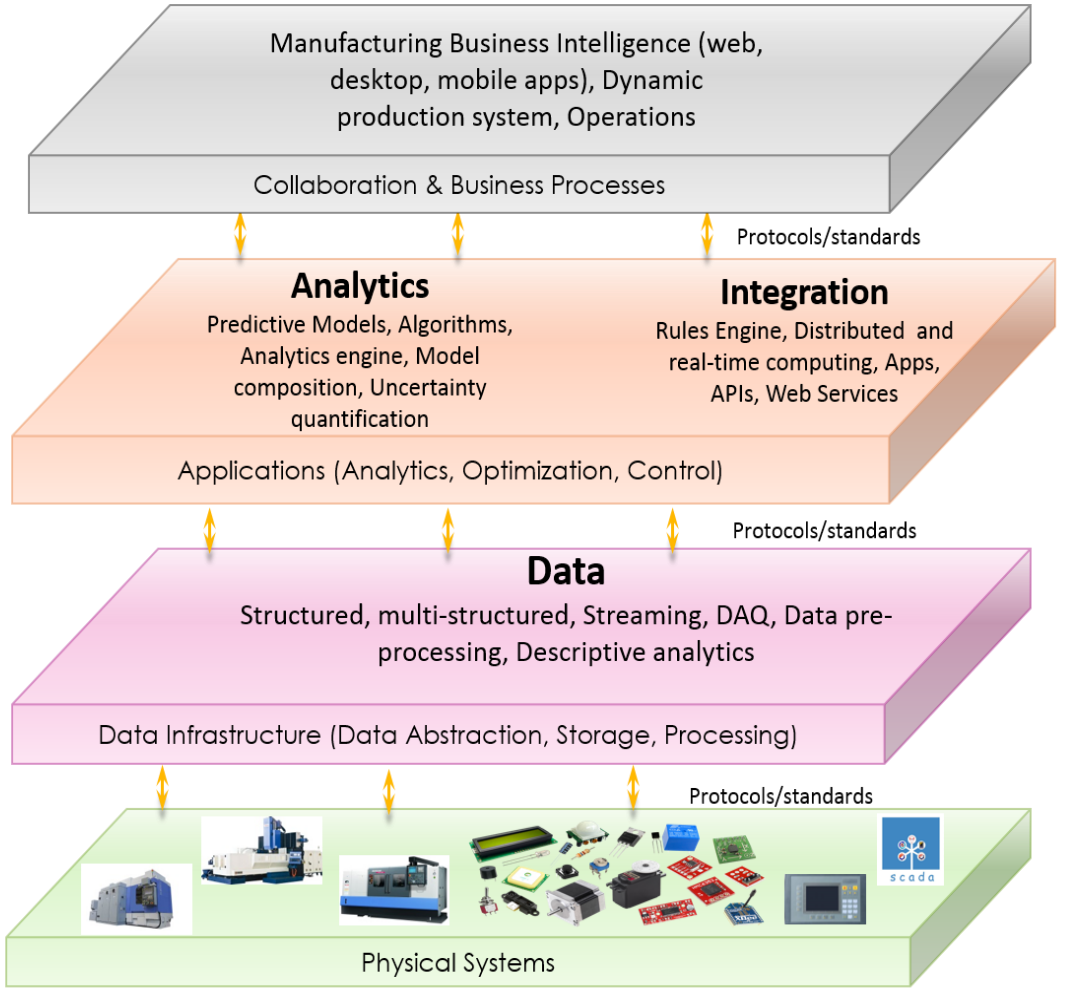
First-of-Kind Application Toolkits for SM Deployment

Advanced High Fidelity Modeling

Open Standards Software and Communication Platforms

Real-Time Data Analytics and Control Systems

Advanced Sensors



SCADA Supervisory Control and Data Acquisition

PLC Programmable Logic Controller

HMI Human Machine Interface

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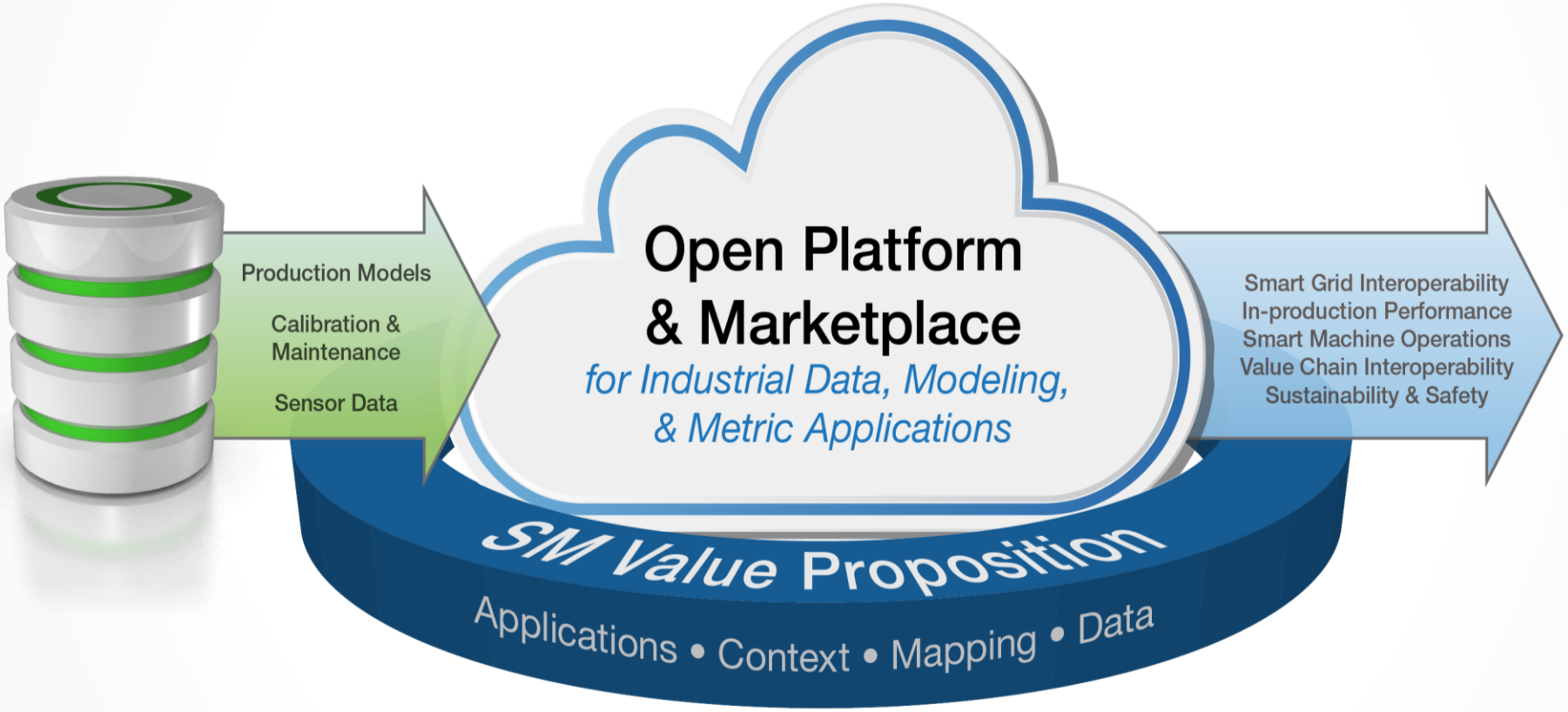
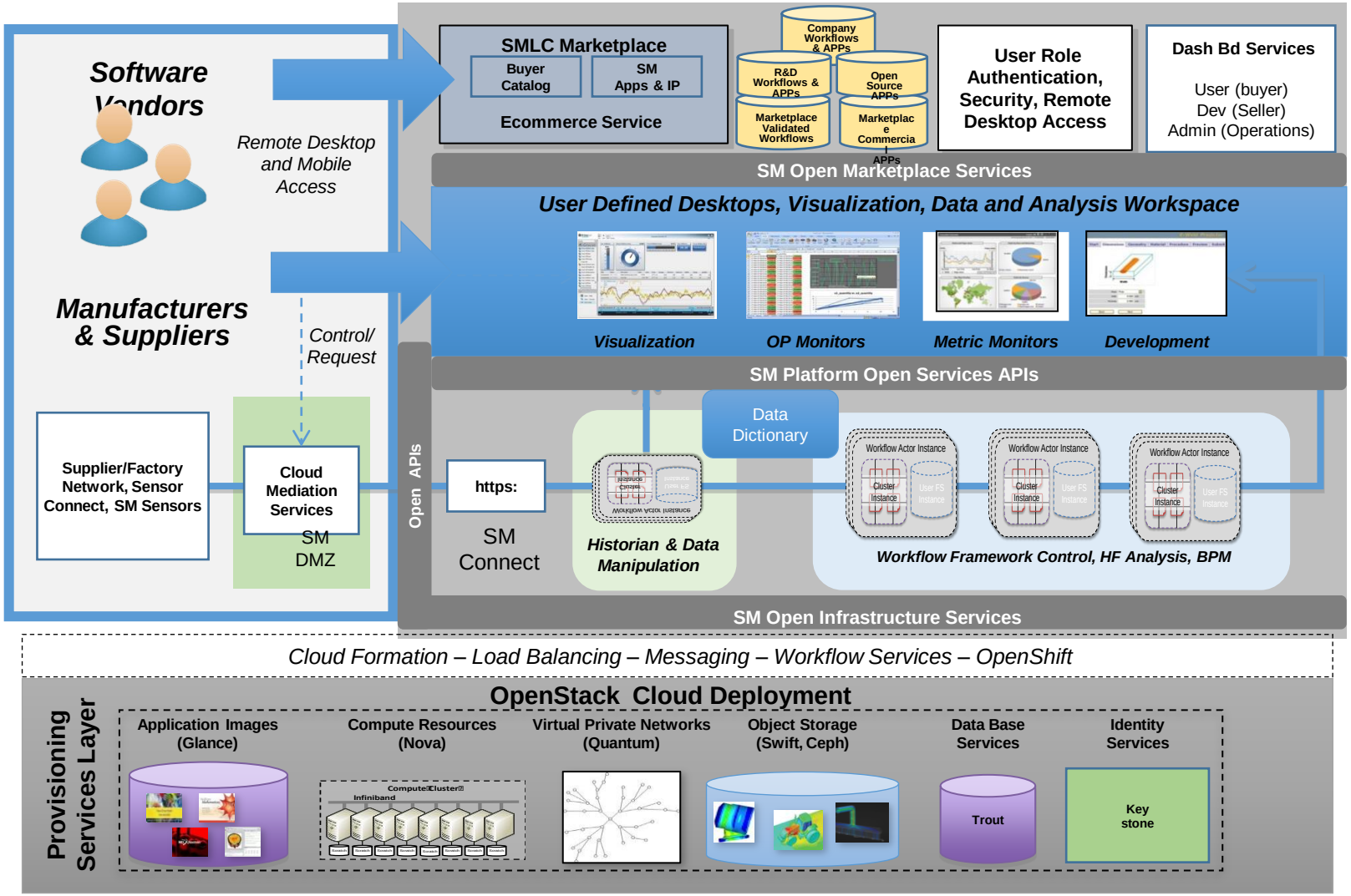
The Smart Manufacturing™ Platform



SMLC CESMII Platform Architecture



HW Providers: Public Cloud Vendors, Regional Community Clouds, Private Company, Gov Labs

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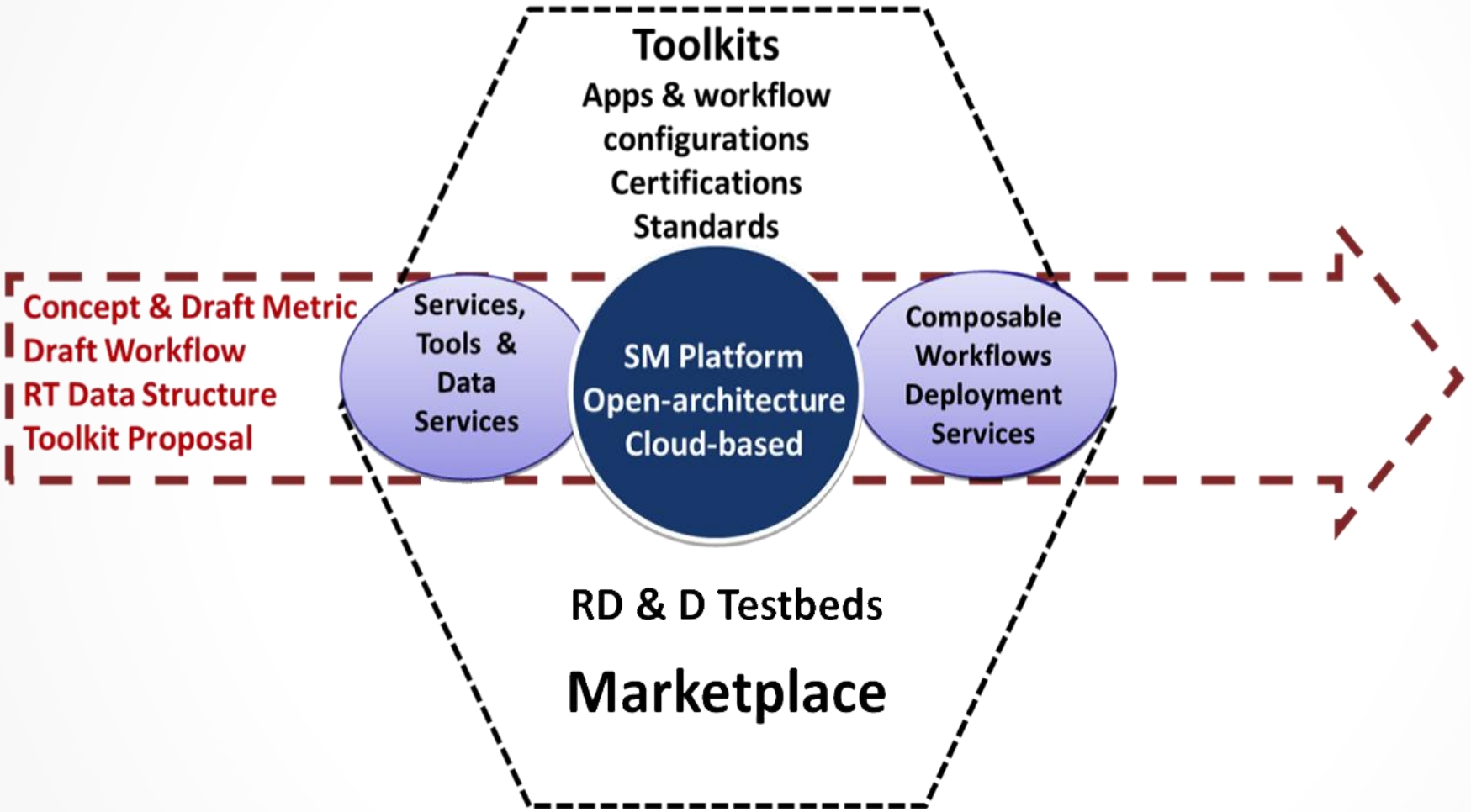
Smart Manufacturing Test Beds

- Research, Development, and Demonstration (RD&D)
- Industry First of a Kind
- Industry Replication

Industry Hosted Test Bed Structure



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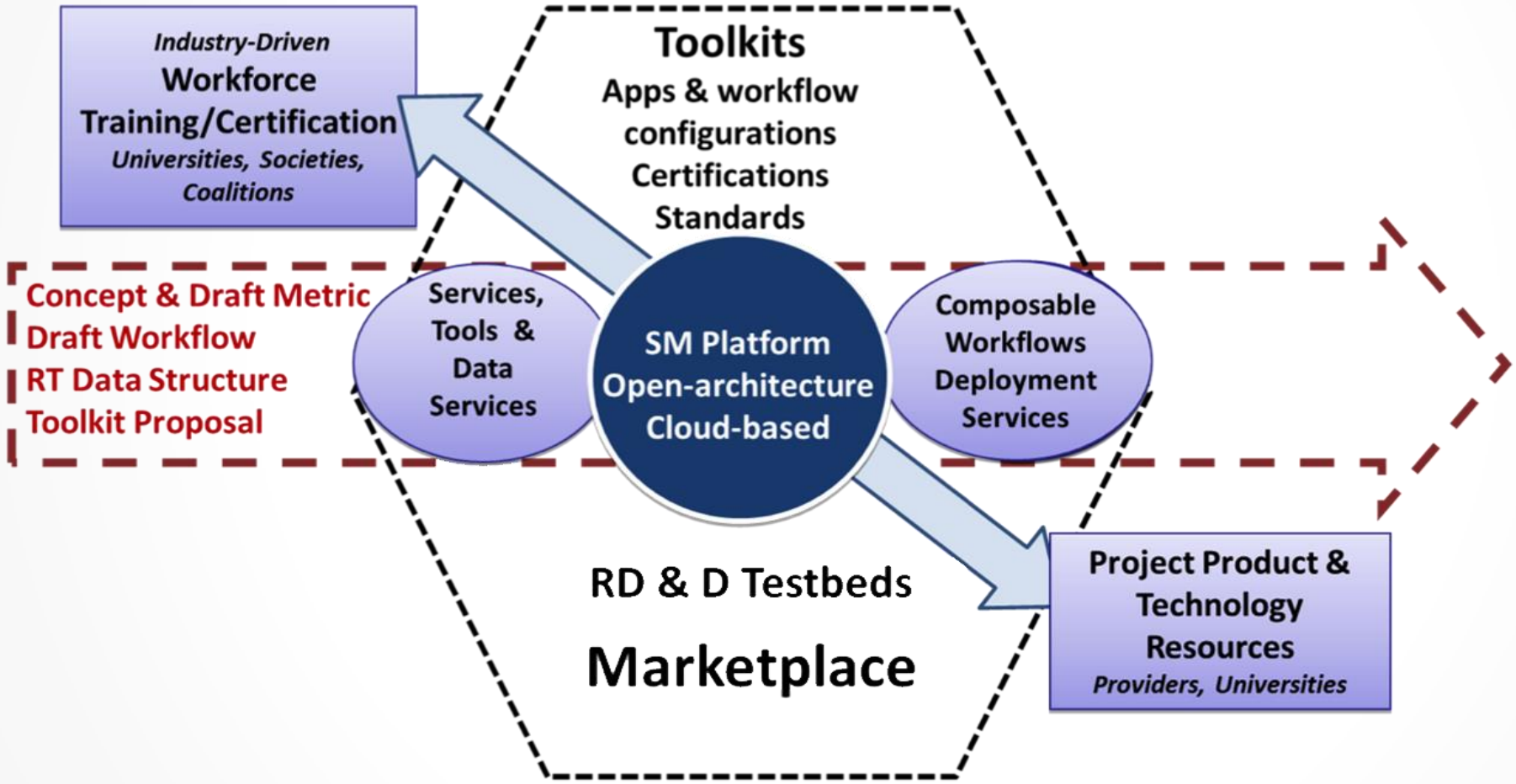

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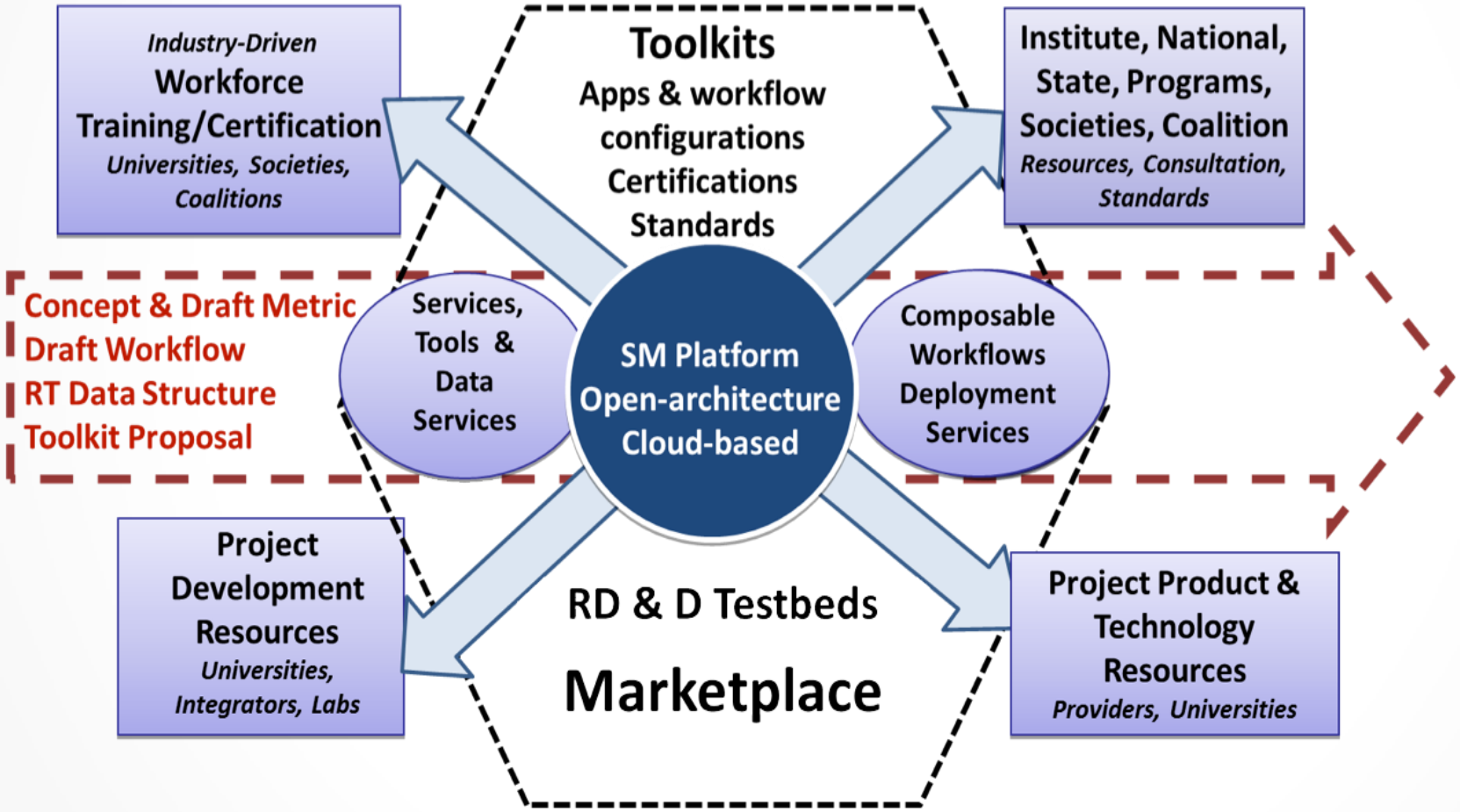

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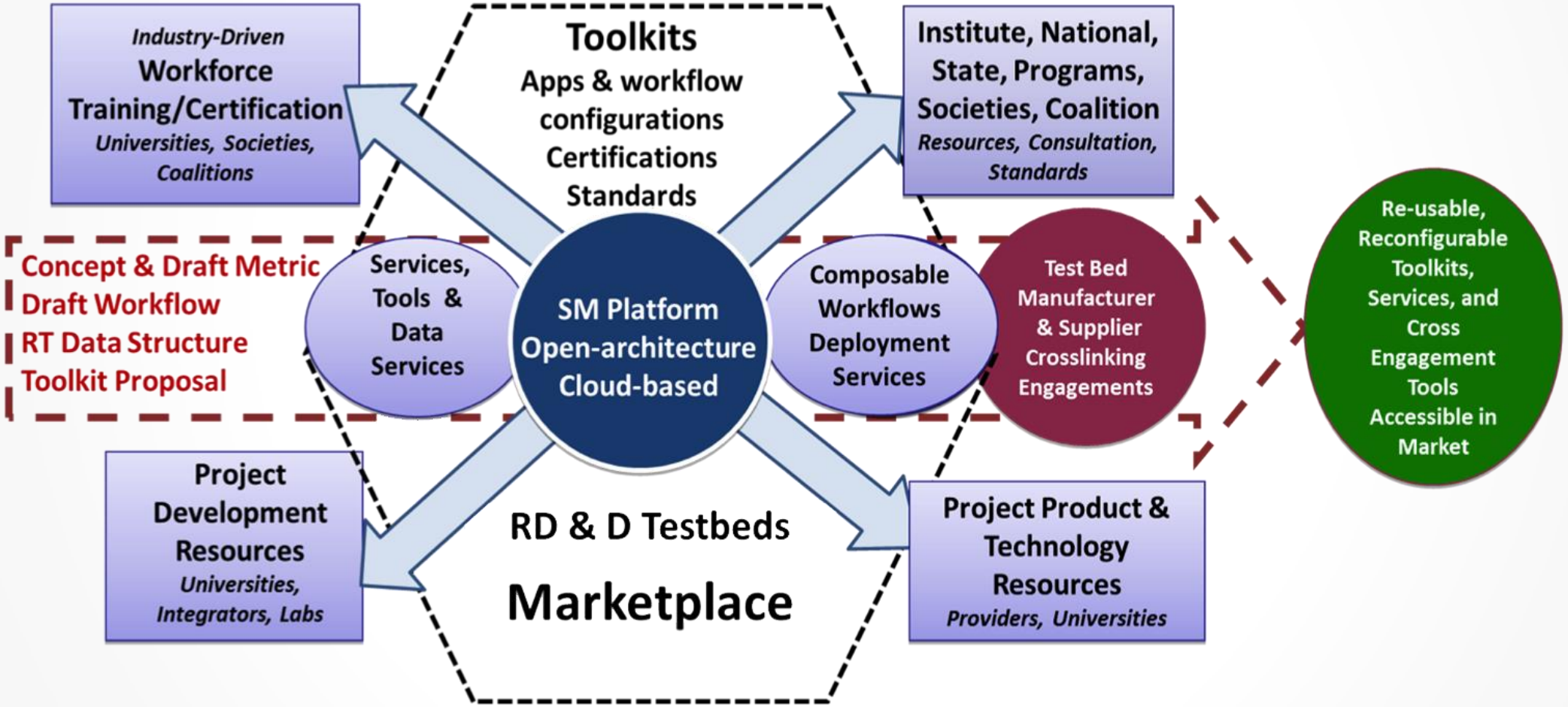

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Today's Industry Challenges

Infrastructure no one company could provide

Challenges Individual Company

- **Compartmentalized ROI's are constrained or prohibitive**
  - Incremental investment difficult
  - Need 80% reduction in cost of implementing modeling and simulation
  - Need 10x reduction in the cost of sensors and sensor infrastructure
  - Need to radically shorten the deployment time horizon
- **Business Risk**
  - New business model
  - Collaboration vs. transaction
  - Uncertainty about technology, security & IP
- **Organizational Risk**
  - IT capability lacking or IT not talking to operations
  - Workforce skills
  - Collaboration

Challenges Beyond Individual Company

- **ROI comprehensive opportunity**
  - Multiple systems
  - Integrated global performance metrics
  - Require aggregating data
  - Depends on other companies - supply chains
- **Investment/Return "Chicken & egg" Issues**
  - Environment for broad software innovation
  - Increased revenue in adjacent industries
  - Increase revenue in new products and services
  - Increase in SME's addressing total market
  - More highly skilled sustainable jobs created
- **IT Infrastructure and support needs to be scaled**
  - Need to retrofit $60 B IT investment in existing Installed base of serviceable manufacturing facilities
  - Need to halve the non-value 70% IT infrastructure costs

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A Connected Manufacturing Ecosystem
SME's, supply chains & value chains

- **Demand Dynamic Inventories**
  - Exact demand (delivery quantities and dates) met with minimal excess inventory in the supply chain
  - Reduce batches to one piece flows, with consumption transactions provided to suppliers immediately
  - Gear supply chain activities to both real-time and forecast requirements
- **Win-Win Optimization**
  - Receipt, execution, or order adjustments dynamically based information from their suppliers
  - Control the need for premium freight and expediting, and cut just-in-case inventory out of the entire system
  - Manage complexity through intelligence and flow of Information
  - Faster changeovers and more agility in delivering orders in varying order sizes
- **New Value Chain Opportunities**
  - Electronic chain-of-custody from suppliers for all shipments before receiving those orders
  - Product transparency
  - Track and traceability
  - Values chain sustainability
- **Minimize Disruption**
  - Ease strain across the supply chain by reducing disruptive incidents caused by order changes
  - Automatically escalate severity and response priorities
  - Corrective action workflows without process upsets
- **Better products & Collaborative Innovation**
  - Give customers more freedom to customize products and manufacturers more ability to deliver them
  - Innovation in product

A National Network

Portfolio of investments that creates an ecosystem of value.

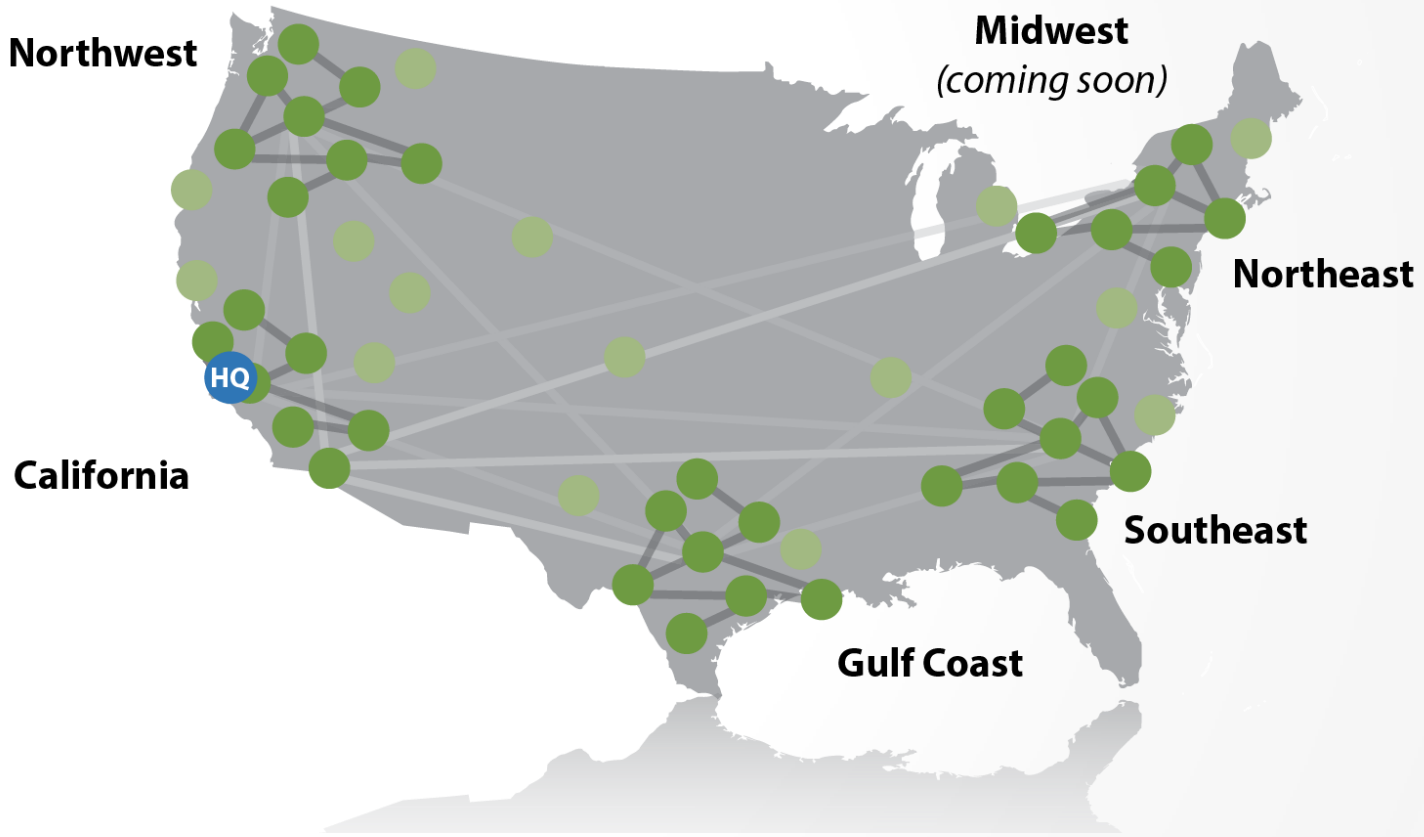
Our Institute will:

- Provide Breakthrough Capability to Drive Energy Reduction by $195 B
- Be Industry Led and Driven
- Service all Manufacturing Segments
- Develop the Workforce and Job Creation
- Be Open to All Size of enterprises
- Achieve Financial Independence in 5 Years or less
- Drive market transformation
- Achieve a growing supply chain
- Rapid technology development and dissemination

Power of a National Network

Interlinked Regional Manufacturing Centers

- Local and National representation of industry needs and priorities
- Deep business & academic relationships locally
- Key market and domain expertise
- Connect you to CESMII resources NATIONALLY
- Certified Local Training resources for your teams
- Participate in Testbeds & Research programs



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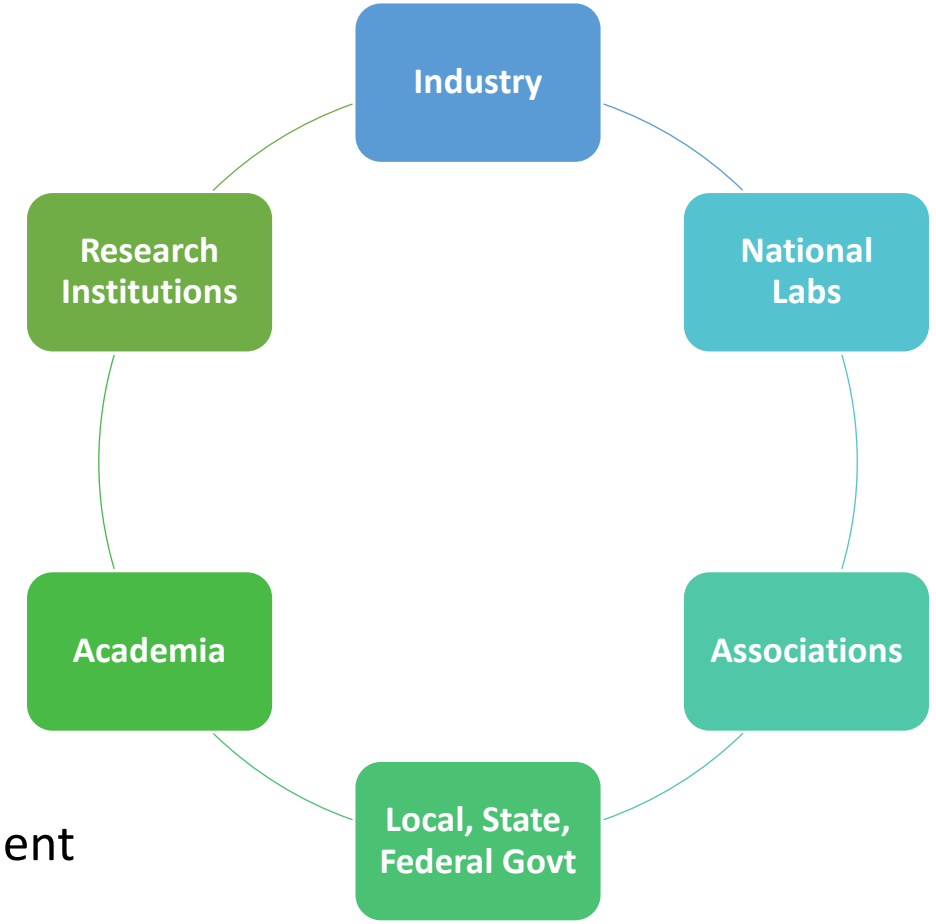
CESMII's Partners

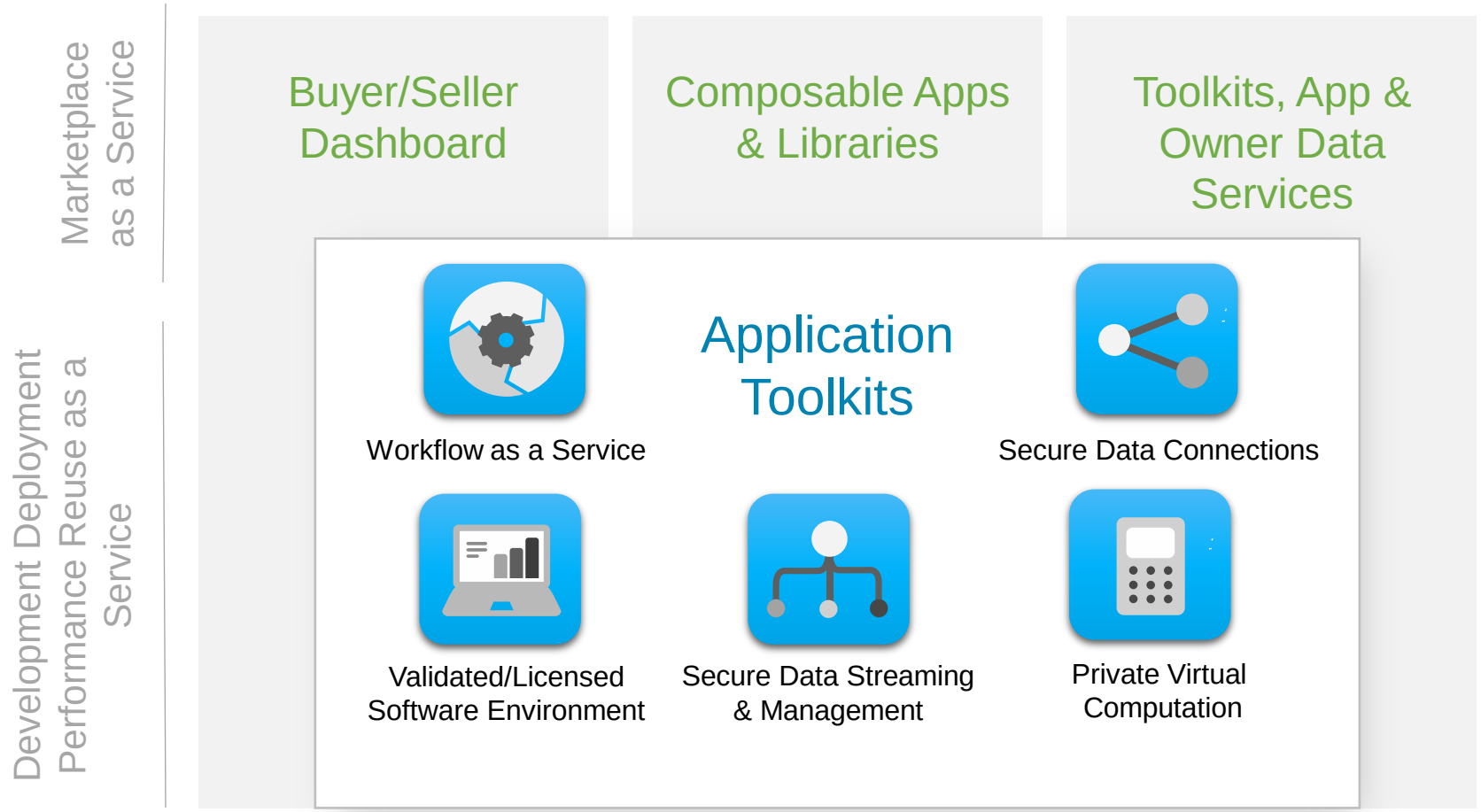
Integrated Eco-System for SUCCESS

- Manufacturer User Community – Asset owners
- Provider Network:
  - Sensors, Controls, Platforms, Modeling
  - Organizational & Workforce Development
- Academic Partners, Associations, Labs
  - RD&D, training, curriculum development, certification, tech transfer
- US Department of Energy, local, state, federal government



A Common Platform

SM Open Platform Infrastructure Bringing Together a Collaboration



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Cohesive Business Model

Portfolio of investments that creates an ecosystem of test beds.

- leverage unique capabilities, facilities, and networks
- proximity -> easy access to SMEs and energy intensive industries
- building a national resource
- rapid development and dissemination of SM tech
- achieve critical mass
- drive market transformation
- achieve a growing supply chain

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Focused Efforts

Key Markets

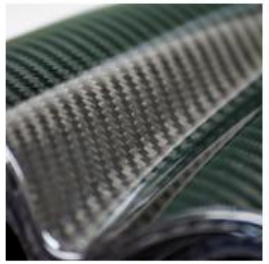
Energy Intensive Markets

- Petroleum Refining
- Chemicals, Plastics, Rubber
- Wood Pulp and Paper
- Primary Metals
- Food Processing
- Glass and Cement


Automotive


Aerospace


Chemicals


Composites


Food & Beverage


Industrial Gas

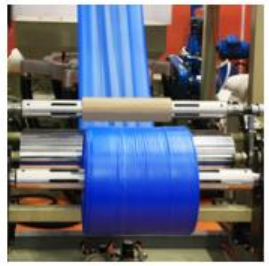

Glass


Micro-electronics


Metals & Fabrication


Paper & Pulp


Refining, Petrochemicals


Plastics

Energy Dependent Markets

- Solar PV, Carbon Fiber Composites, Light Emitting Diodes, Electro-Chromic Coatings & Corrosion resistant alloys, Advanced textiles for fashion, Exotic materials for space, Nano materials for healthcare, Membranes, Computers & Electronics, EV Batteries, Multi-material joining, Other Industries that have a 25% or greater cost of energy as part of the total cost of manufacturing

Testbeds are Industry Driven

Test Beds enable the ability to test new technologies in environments directly reflective of their real-world counterparts. Institute-managed but industry-led, this approach ensures:

Broad Buy-in

Diverse Testing Conditions

Market Responsiveness

Validation of New Models & Capabilities

Business Acceleration though Industrial & RD&D Testbeds

- First Ever, Broad Scale Real World Demonstration Programs with US Manufacturing Companies
- Merging IT with OT problem solving: Test fast, Fail/Succeed Fast, Iterate
- Addressing industry pull with new approaches to integrated advanced technology solutions
- Enabled by new sensor, control and SM Platform and Market Place

	Year 1	Year 2	Year 3	Year 4	Year 5
Decrease First of Kind System	25%	30%	35%	40%	50%
Accelerated outcomes	2 years to 1 year	+5% faster	+10% faster	+15% faster	+20% faster
Decrease Replication cost/risk		60% first replication	65% multiple replications		

Workforce & Training

Addressing the skills gap for future and incumbent workers

- ADOPTION of Smart Manufacturing requires knowledge across the enterprise
  - Operators on the floor, Engineers, Plant Managers, and C-Suite
  - Training & Certification of staff
- DEPLOYMENT of Workforce Training, Curriculum & Certification Nationally:
  - Start with a common vocabulary
  - Understanding the systems approach
  - Tailored to the type of organization (Large or SMEs)
  - Meet regional needs
  - Engage with Industry & Academia to validate
- EASY ACCESS: Built on our RMC Networks and other professional organizations

Diverse Membership for Success

Engaged Value Chain Participants: Users/Owners & Providers

Edge Devices
Enterprise Applications
Plant Applications

Cloud

Smart Manufacturing Platform Open Infrastructure

Cloud Technology
High Performance Computing

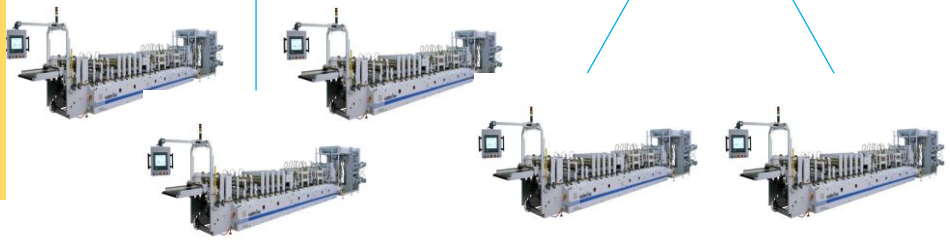
SM Software Marketplace
Re-usable:
- Objects
- APPs
- Toolkits

Asset Owners
Asset Users
Supply Chain
Value Chain

Legacy Systems
Smart Systems
HMI
Mfg Lines
Mfg Cells

Actuators
Meters

Controllers
Sensors



<u>Users / Owner of Technology</u>:
- Open Architecture
- New Business Models
- New Solutions
- Better data to the floor…..

<u>Providers of Technology</u>
- New Opportunities
- Market Diversity
- Expanded Solution Set
- Potential IP & Acquisitions

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Conclusion

- The Smart Manufacturing paradigm encompasses process modeling, data analytics, control, optimization, and manufacturing
- Successful demonstration of SM on test beds will aid in dissemination and evangelizing
- Saving energy is an important metric that improves profitability while addressing sustainability
- Development of a vendor-agnostic SM platform and app marketplace will accelerate software integration and adoption of SM in a wide range of industries

Questions