Industrial Scale Demonstration of Smart Manufacturing (SM) Achieving Transformational Energy Productivity Gains

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AIChE, General Dynamics, Emerson, NCMS, Nimbis Services, NIST, Praxair, Schneider Electric, SMLC, UCLA & University of Texas

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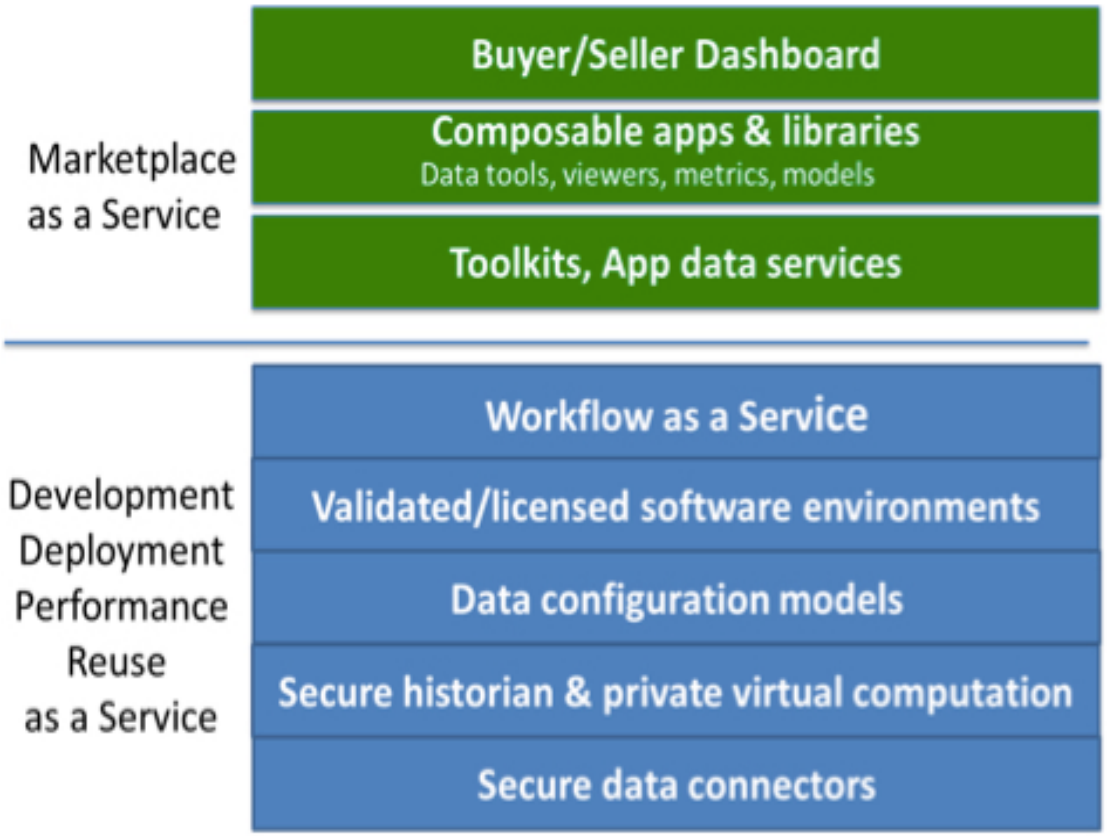
Project Objectives – SM Platform

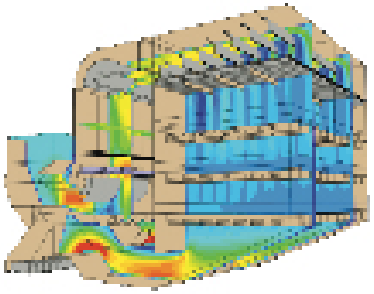
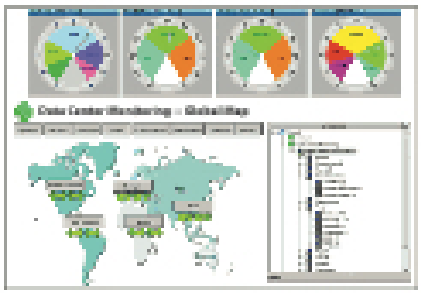
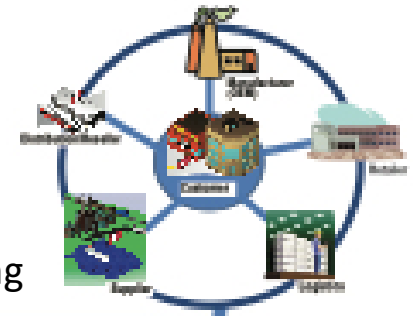


Develop and demonstrate an open architecture Smart Manufacturing (SM) Platform and Market Place:

- Extensive application of real-time, sensor-driven enterprise data analytics, modeling, optimization and metrics
- Accelerated development, deployment and reuse of smart data-driven, multi-vendor system applications while halving the cost
- Build and demonstrate applicability, interoperability and operational security for two diverse commercial test beds - Praxair and General Dynamics.

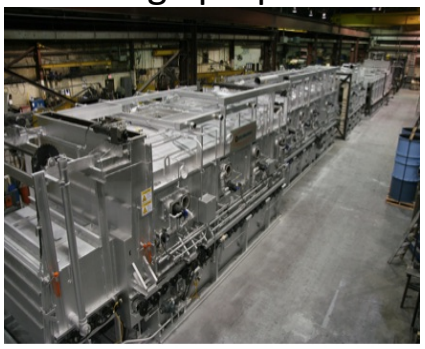
- Develop plans to commercialize, sustain, and grow SM technology through SM Open Platform deployment services and application libraries (apps), alignment with provider involvement, and trusted brokering of data and applications in an industry-defined Marketplace aligned with small, medium and large manufacturer requirements

Project Objectives – Untapped Energy Gains

	SMR Furnaces	*Operations*	*Supply Chain*
Continuous		Hardened RT sensor system	Reuse sensor system
Integrated Distributed Operations		HPC RT modeling 	Reuse modeling 

Increase production

Praxair

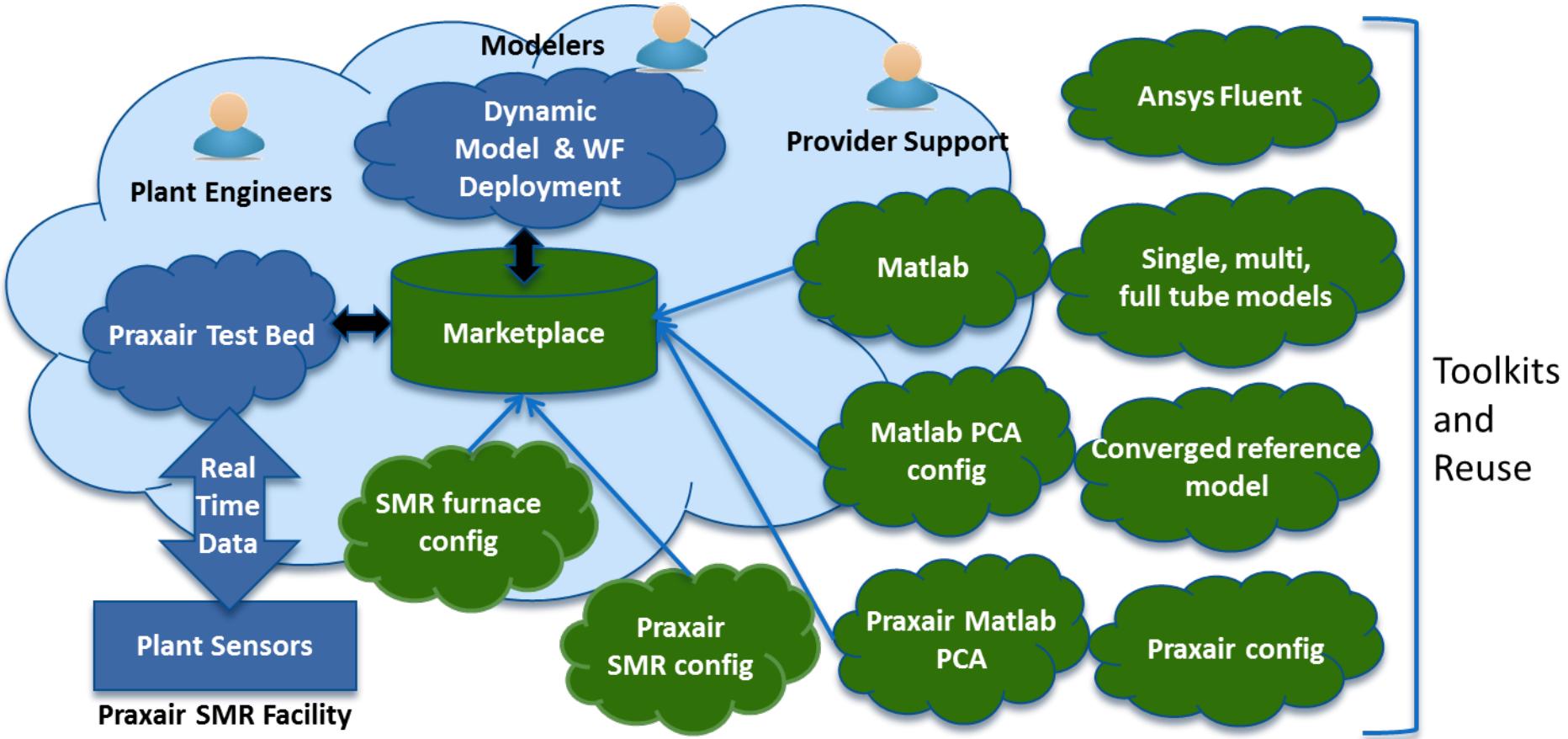
	Forging	*Heat Treatment*	*Machining*
	Manage tolerances	Manage properties	Manage quality
Discrete			
Integrated Line Operation			

Higher precision properties & lower downtime

General Dynamics

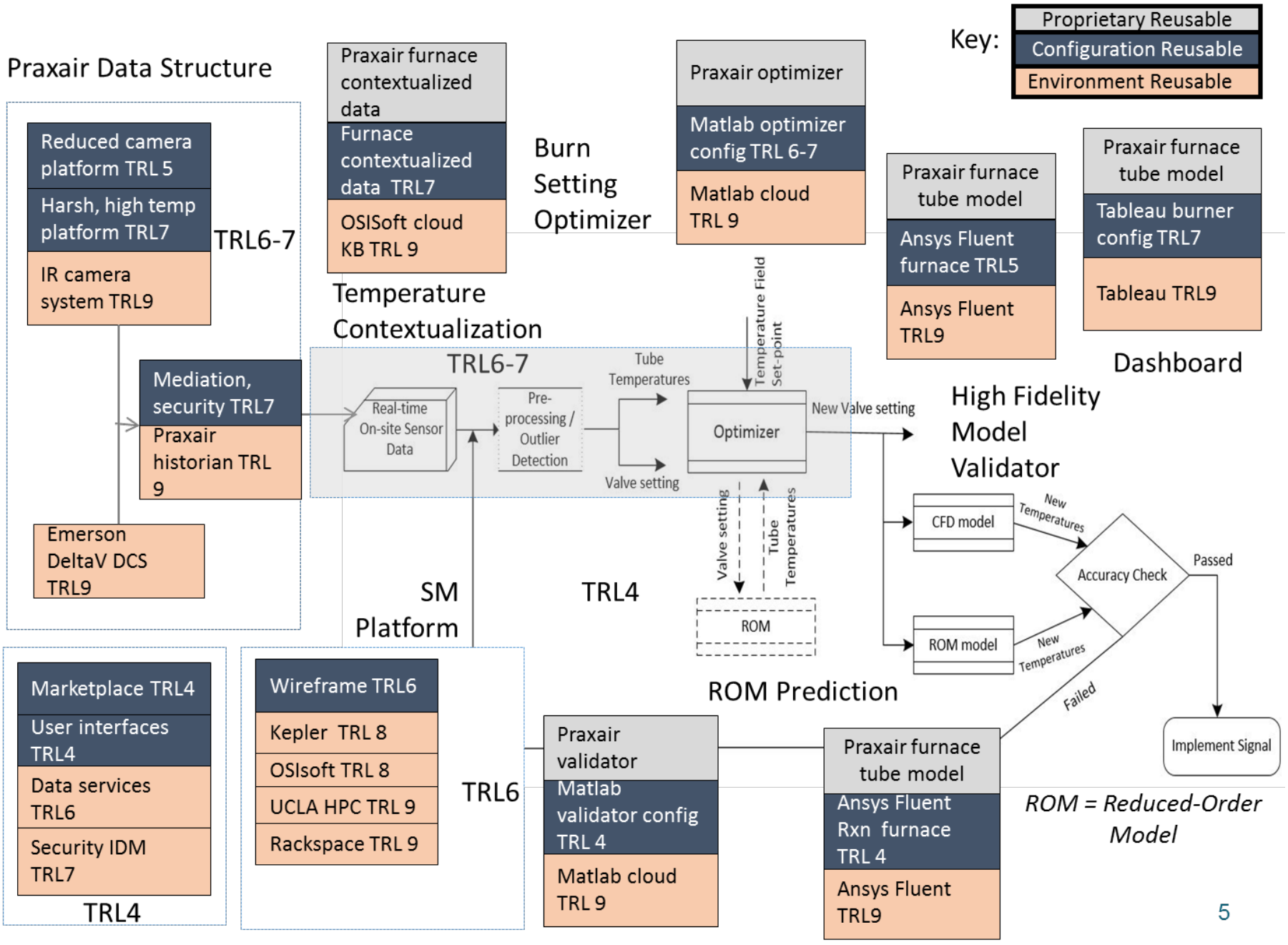
Demonstrate significant untapped Energy Gains for two diverse test bed operations using Advanced Sensor, Control, Platform and Modeling and deployment facilitated by the SM Platform

Technical Innovation – SM Platform

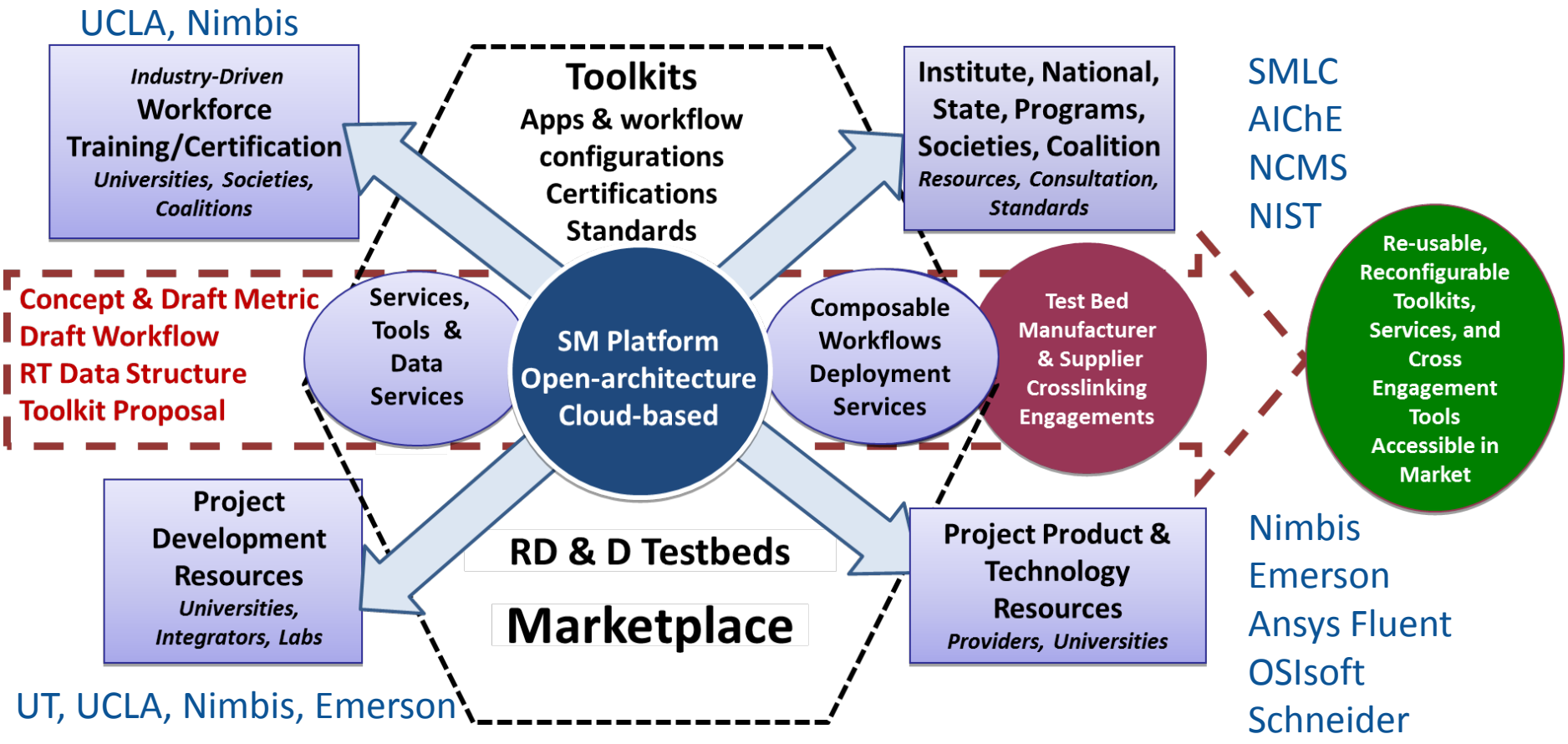


- More efficient/accelerated approach to engineering real-time applications
- Data to many applications strategy
- One data structure to solve many problems
- Highly layered marketplace of product configurations that interoperate
- Marketplace composability and configurability on any cloud platform

Energy Gains with Innovation in Technology Integration & Reusability



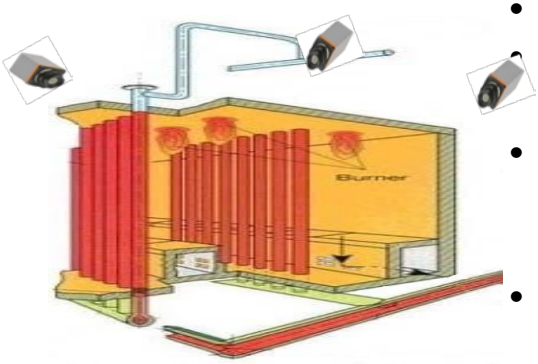
Technical Approach - Test Bed Collaboration Model



Productivity gains from radically accelerated application and lowered costs:
(1) Adopting new ruggedized hardware and software sensing systems
(2) Minimizing hardware, development, implementation, maintenance
(3) Increasing degrees of freedom, flexibility
(3) Progressive, gains in trust, managed risk, human involvement, business outcomes

Technical Approach – Measurement/Deployment Progression

First Steam Methane Reformer Furnace Port Arthur, TX



- 88% efficient
- Distributed sensing
- Distributed actuation (96 burners)
- High fidelity model & reduced order models

10 -15% reduction wasted energy

Simple Model

Reduce Cameras

Halve capital cost

10-15% reduction wasted energy

HPC Model

Burner Controls

Dynamic energy mgmt

Metrics

On track 25% reduced waste energy

Extend to 20 U.S. SMRs 75-80% efficient

General Dynamics Scranton PA

Integrated line management of part precision, materials/metallurgical properties, dynamic part movement, defect reduction, energy management

30% reduction wasted energy

Part Tolerances

Predictive Maintenance

Part quality

Reduce idle time

Part Properties 3D Radiation

Improved gas flow control Recuperation

Part quality

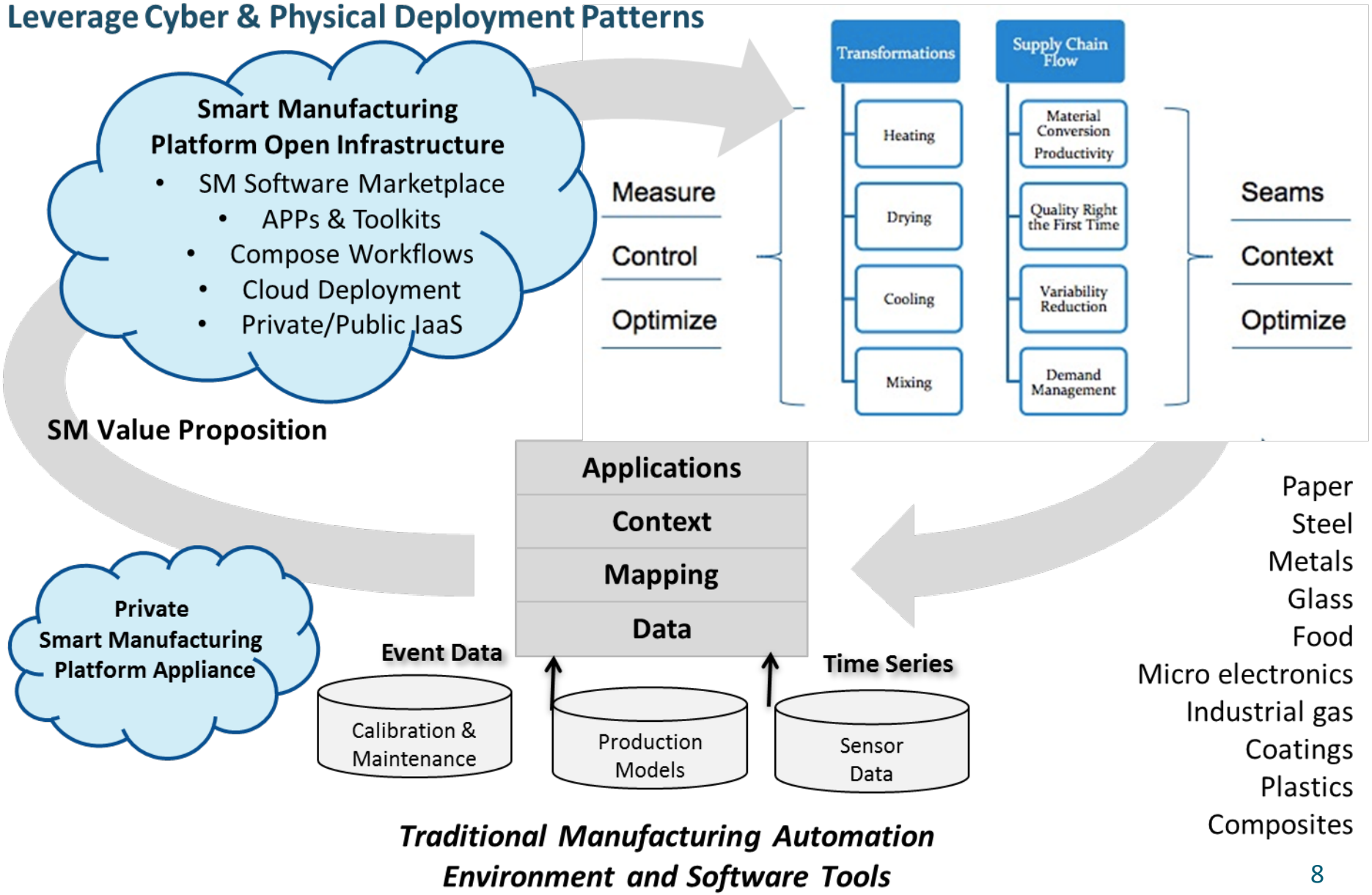
Reduce defects destructive tests

Dynamic machine configuration

Part quality

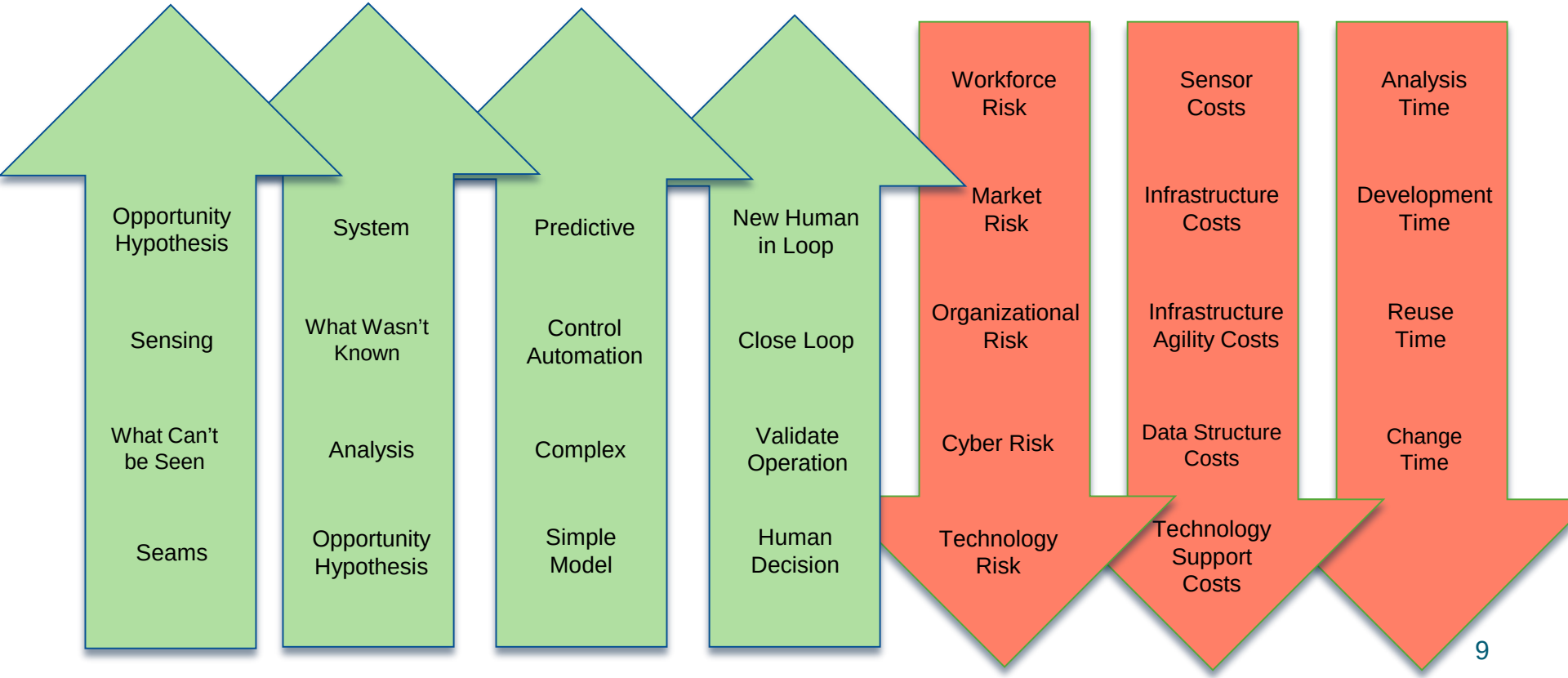
Reduce defects

Transition and Deployment



Measure of Success

- Significant untapped energy gains in minimizing wasted energy for two diverse test beds through the application of advanced sensing, controls, platforms and modeling
- Applied metrics: waste heat minimization, energy efficiency and energy productivity
- Accelerated and lowered cost deployment of sensor-based enterprise analytics and optimization systems; shared/scaled platform investment far less costly than sum of individual platform; phased progressive development and deployment



Project Management & Budget

- Three year project (9/1/2013 – 11/30/2016)
- 8 project tasks and 9 milestones
  - SM Platform Designs-Infrastructure, Security, Software Protocols
  - Test Bed Measurements/Sensors, Data Collection, Math Models
  - Productivity Metrics, Dashboard
  - Commercial Outreach, Marketplace, Website, Workshops, Webinars
  - Market Environmental and Energy Benefit

Total Project Budget

DOE Investment		$7,798,383
Cost Share		$3,437,836
Project Total		$11,236,219

Results and Accomplishments

Praxair

•Praxair Test Bed on track 25% reduced waste energy – unit already 88% efficient

•Value $1.2 million per year on a 100 MMSCF plant

•Reusable harsh environment sensor system; reusable/flexible model system

•High fidelity modeling new opportunity for further gains

•For more typical 75 - 80% efficient units, impressive gains projected

General Dynamics

•Projecting 30% reduction in waste energy - comprehensive management of properties, precision, energy efficiency

•Start with training and testing SM Platform for live data development

SM Platform and Marketplace

•Decrease cost of first-of-a-kind system > 25%
•Acceleration 2x
•Decrease replication costs > 50%
•Production prototype