Building Meaningful Use Priorities, Consensus and an Actionable Program Agenda for Smart Process Manufacturing

Jim Davis, UCLA
Sujeet Chand, Rockwell Automation
SPM Steering Committee
July 2010
Definition of SPM

Smart Process Manufacturing (SPM) is a dramatically intensified knowledge-enabled industrial enterprise in which ALL business and operating actions are executed to achieve substantially enhanced energy, sustainability, environmental, safety and economic performance.

Implies Infrastructure and Application
Simulation Based Engineering & Science (SBE&S)
Networked Information & Control Technologies (NICT)
Smart Manufacturing Transformation

• Ultimate vision is to create significant and measurable improvements in U.S. manufacturing competitiveness through innovative, highly-optimized, demand-dynamic and sustainable industrial plants and supply chains enabled by information and knowledge technologies

• Key goals:
  – Move to proactive operations and life-cycle management to optimize production economics, quality, safety and efficiency
  – Drive energy, sustainability, EH&S and economic agility into meaningful integrated performance criteria
  – Transform manufacturing from fixed, supplier-driven production to flexible, demand-dynamic production
  – Enable sustainable production of nationally strategic goods (e.g., Bio/Nano, Clean Energy, Green/Tech, and DOD needs.)
  – Build manufacturing intelligence

Increase U.S. manufacturing competitiveness and exports
Revitalize the 21st Century industrial community model
Bending the Curve Toward Smart Manufacturing

Achieving Meaningful Use of Production Data

These goals can be achieved only through connected information, model-based decision-making and knowledge-enabled processes that improve manufacturing outcomes and accelerate the generation of manufacturing intelligence.

“Phased steps to improve manufacturing intelligence and drive new efficiencies.”
Resilient Proactive Plant Operations

Knowledge-enabled Workforce in Global Operation

Smart Manufacturing Process

Key Plant Assets to Global Application

People, Knowledge and Models to a Combined Key Performance Indicator

Knowledge to Operating Models

Key Plant Assets to Enterprise Application

Data To Knowledge

Smart Process
Smart Manufacturing 1.0: Integrated Decision-Making

- Networked sensors
- Data interoperability standards
- Systems communications standards
  - Automated control systems
    - Data fusion
  - Production management modeling

End-to-end data and information connectivity across the plant floor
Develop knowledge and data models for data-driven equipment asset life-cycle management

Develop intelligent real-time tools to manage transitions and respond to process and performance threats

Develop and maintain models as key corporate assets

Enable equipment assets in process operations to autonomously recognize and respond to situations

Develop plant-wide status data visualization

Lane 3
Smart Manufacturing 2.0: Enterprise-wide End-to-end Connectivity

Modern, smart factories will be interconnected with supply chain, distribution and business systems.
Highly-optimized Production and Demand-Dynamic Supply Chain Efficiency

- Customers “pushing” demands
- Flexible production of smaller volumes of custom products
- Less vertically integrated
- More information driven and automated

Efficiency Metrics
Change from output/input productivity measures to customization, flexibility, responsiveness, energy performance and reuse
Create universal metrics to evaluate and integrate global processes

Integrate enterprise- and plant-level planning for multi-objective optimization

Develop techniques and standards for integrating across the supply chain

Models as Key Plant Assets to Global Applications

Standardize cross-industry best practices and tools
The Consumer in the Optimized, Demand-Dynamic Plants and Supply Networks?

A demand-driven supply chain can provide consumers with the information necessary to choose products produced with less carbon-intensive manufacturing processes.

Consumer Information:
Could drive less carbon-intensive production as an effective alternative to Cap & Trade regulations.
Closing the loop in Pulp & Paper Supply Chains

Recycling closed the loop in Supply Chains as consumers demanded Recycled Paper

- Renewable Forests
- Supply Chain
- Recycling Plant
- Pulp & Paper Processing Plant
- Printing or Packaging Manufacturer
- Customer
International Center for Industrial Ecology

• Whereas productivity measures are used to improve a “linear” process

• Efficiency measures are used to improve a “closed loop” process

  • Advanced modeling and software simulation are critical to improve the efficiency of very complex closed loop processes

Source: Yale University’s School of Forestry & Environmental Studies’ Center for Industrial Ecology

The transformation of IT-connected manufacturing to optimized plants & supply networks may be essential to efficiently manage this vision
Jobs Surround The Smart Factories In The Optimized Plant & Supply Chain Network

21st Century Industrial Community

Greater Economic Multiplier

Suppliers

Suppliers - Raw Materials

Services & Support

Education & Government

Smart Factory
- Electric car “lights out”
- 100% automated smart factory

Tier 2 Suppliers
- Batteries, motors, seats, tires
- 75% automated, 25% labor

Tier 3 Suppliers
- Raw materials
- 50% automated, 50% labor

Services & Support
- Financial, IT/Telecom, transportation, etc.
- 25% automated, 75% labor

Education, Health Care & Government
- Financial, IT/Telecom, transportation, etc.
- 100% labor
SMART Manufacturing Transformation

2009

Smart Mfg. Policies

2011

2011 Meaningful Use Criteria
Establish efficiency measures: e.g., competitiveness, energy/env., sustainability, track/trace, safety

2013

2013 Meaningful Use Criteria
Smart manufacturing processes with demand-dynamic, highly optimized decision support

2015

2015 Meaningful Use Criteria
Improved Sustainability and Competitiveness
Actionable Program Agenda

• **CTO/CXO Roundtable and Leadership Workshop**
  – Meaningful Use criteria
  – Roadmap actions
  – Technology development
  – Collaboration model

• **Industries**
  – Continuous, batch and discrete
  – Large and small companies
  – Practitioner and supplier
  – Information technology. NICT and SBE&S

• **Academia, Government and Manufacturing Consortia**

  [http://www.oit.ucla.edu/smart_process_manufacturing](http://www.oit.ucla.edu/smart_process_manufacturing)