SMART MANUFACTURING:
Optimized Plant & Supply Networks

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Why Smart Manufacturing?

- A new, bold strategy for U.S. competitiveness that marries information, technology and human ingenuity and transform manufacturing from fixed, supplier-driven production to flexible, demand-driven production

- Enable sustainable manufacturing

- Enable sustainable production of nationally strategic goods (e.g., Bio/Nano, Clean Energy, Green/Tech, and DOD needs.)

- Increase U.S. manufacturing competitiveness by fundamentally changing how products are invented, manufactured, shipped and sold; it will improve worker safety and protect the environment by making zero-emissions and zero-incident manufacturing possible

- Revitalize the 21st Century industrial community model (jobs!) and U.S. manufacturing
Current Situation: Islands of Efficiency

Today, most plants use multiple separate manufacturing technologies:

- Batch
  - Combined Heat & Power (CHP)
- Continuous
  - Distributed Control Systems (DCS)
- Motion
  - Smart Machines
- Drive
  - Energy-efficient Motors
- Discrete
  - Programmable Logic Controllers (PLC)
- Safety
Plant and Enterprise-Wide Integration

- Integrate and correlate plant-wide manufacturing data
- Improve cost competitiveness +10%
- Reduce safety incidents 25%
- Lower environmental impact
- Develop a pilot project of the first completely IT-powered factory

Essential first step to creating “Manufacturing Intelligence”
Plant-wide Optimization

- Multi-fold energy savings
- Improvement in energy efficiency
- Reduction in cycle times
- Complete production lines operate with real-time flexibility
- Higher productivity and yield

Use Plant-wide Data with Advanced Modeling & Simulation
Using Manufacturing Intelligence

- IT-enabled, next generation manufacturing systems will utilize Internet 2.0 for optimization and control
  - High speed data collection, secure transmission, data mining
  - Advanced process models and simulation to optimize yield, sustainability (e.g., energy consumption)
- High performance computing platforms connected to manufacturers data enable use of advanced models and simulation
- An open platform approach could reduce the cost of modeling and simulation 80%

Internet 2.0 links Smart factory data to HPC collaboration test beds
Sustainability: Industrial Energy Management

- Conventional: Coal, Nuclear, Oil / Gas, Hydro
- Renewable: Solar, Wind

- Machine / process level energy sensing, measurement, analysis, optimization, control
- Econometric models
- Low-cost “embedded” energy sensors
- Integrated control & energy mgmt.
- Standards for process equipment energy

Transform factories from passive to active energy management

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Current Supply Chains: Production Driven

Tier 1 – Component Suppliers
- Prime Manufacturing Factories
- Distribution and Dealers

Tier 2 – Raw Material Processing Plants

Productivity: the key economic metric
\[ P = \frac{\text{output}}{\text{input}} \]
Phase 2: Supply Chain-wide Optimization

- Customers “pushing” demands
- Agile production of smaller batches of custom products
- Much less vertically integrated
- More information driven and automated

Efficiency Metrics
Change from output/input productivity measures to efficiency metrics such as customer responsiveness, agility, energy and environmental performance
Optimized Plant & Supply Networks: Smart Manufacturing Applied Research Opportunities

- Combined product-process design
- Advanced process control
- Flexible, modular automation
- Integrated safety solutions
- Smart devices with energy monitoring
- Waste & emissions optimization
- Secure Ethernet
- Wireless
- Modeling and simulation
- Unified information between plant & enterprise
- Production optimization to meet real-time global customer demand
- Agile, demand-driven
- Sustainable Optimization
- Plantwide
- Supply Chains
- Production
- Distribution Center
- OEM Machine Builders
- Enterprise Business System
- Suppliers
- Smart Grid
- Manufacturing
Where are we today and what can we accomplish?

• At a crossroads

• U.S. Government participation
  – R&D Needs

• Workforce development

• Headwinds
  – Budget
  – Regulatory environment
  – Global competition