UCLA

National Manufacturing Initiatives Underpinned by SBE&S

Jim Davis

Vice Provost &

Chief Academic Technology Officer

UCLA

Manufacturing creates substantial economic activity

- 70 R & D spending by industry
- 69 % of exports
- National security

Cost drive locations

Environmental impact responsibilities opportunities

Productivity growth is essential for high wage jobs

U.S. manufacturing internationally competitive in sectors due to productivity gains

EXECUTIVE OFFICE OF THE PRESIDENT

A FRAMEWORK FOR REVITALIZING AMERICAN MANUFACT

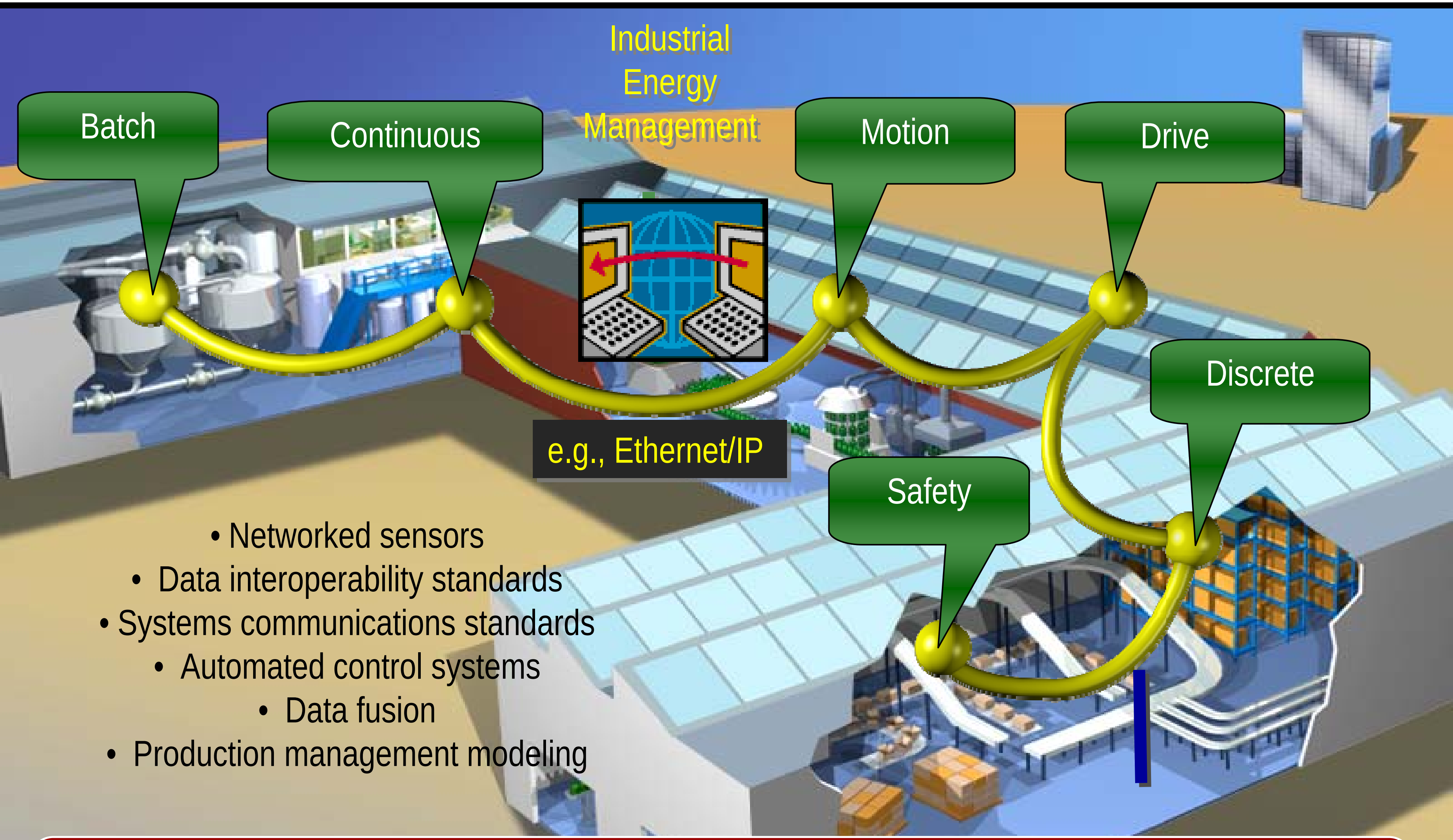
DECEMBER 2009

7 Areas of Emphasis

2. New technologies and business practice

- **Basic research and leading technologies**
- **New options to stimulate innovation**
- **Research tax credit**
- **Spur innovation in manufacturing**
- **Structural reforms to support innovation and production**
- **Protect Intellectual Property**
- **Double MEP**

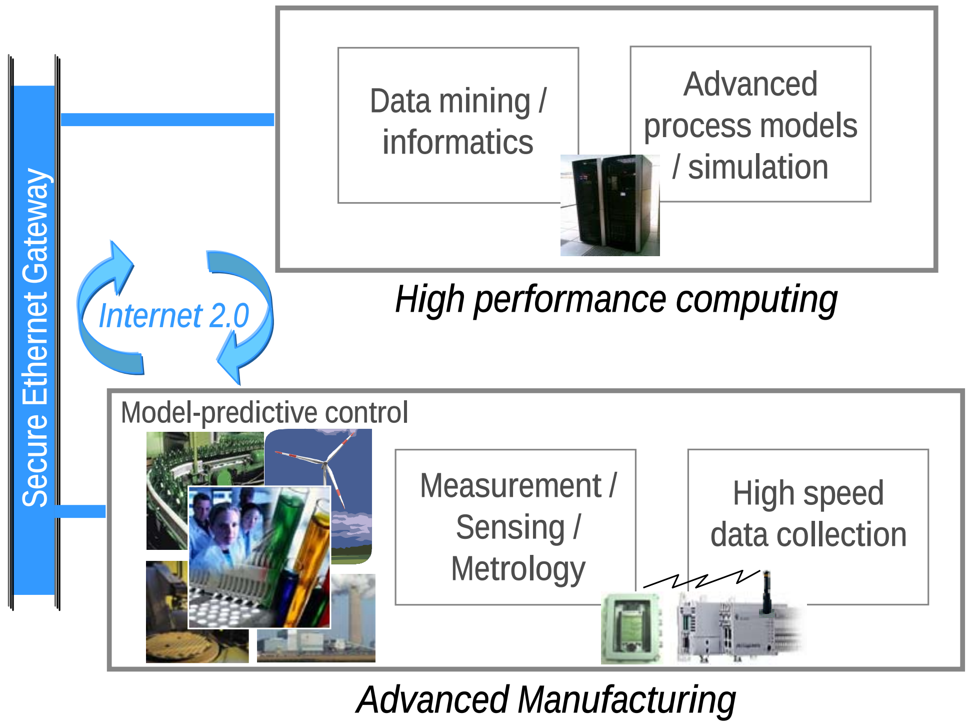
Smart Manufacturing 1.0: Integrated Decision-Making



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

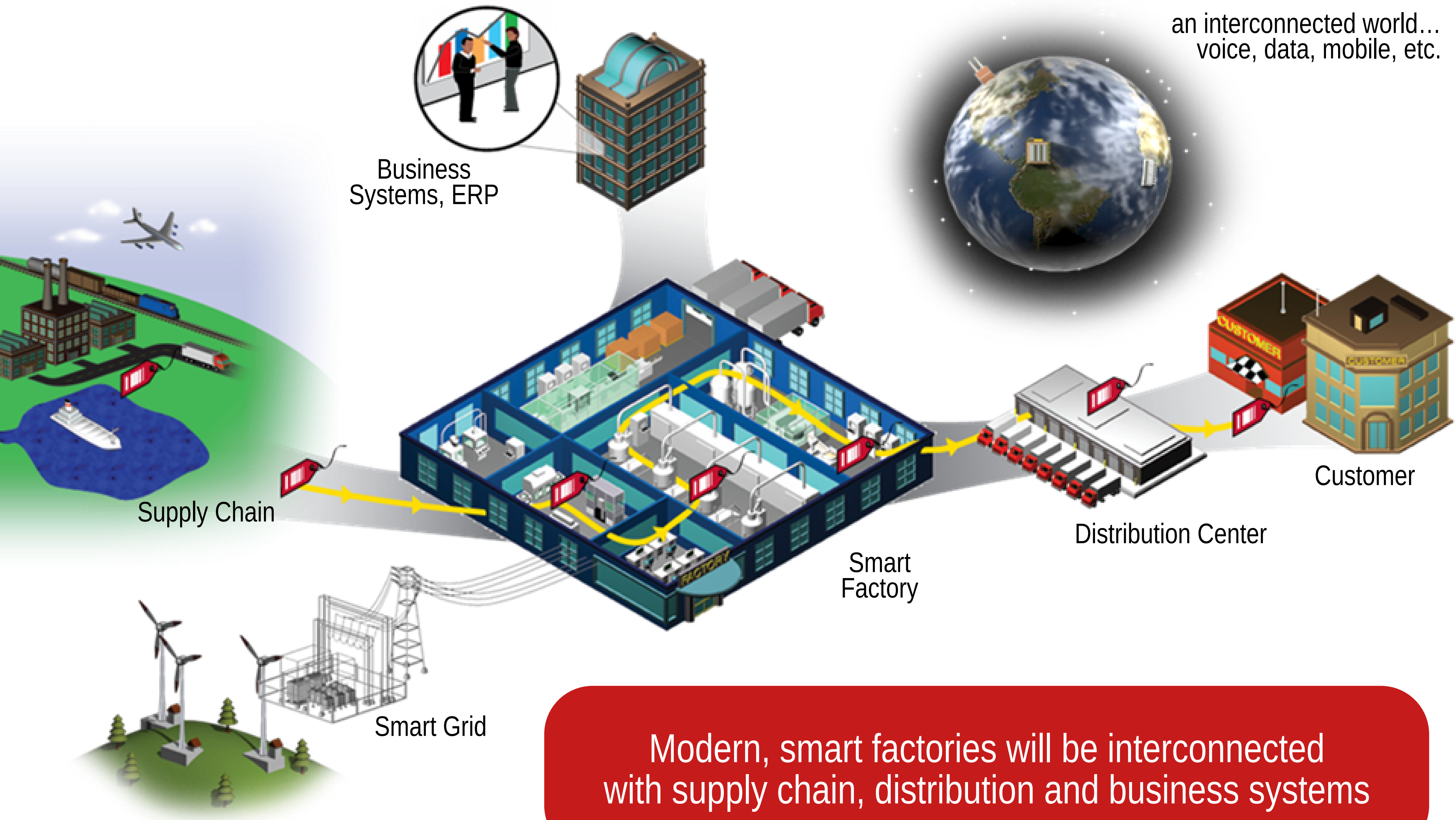
End-to-end data and information connectivity across the plant floor

Advanced Manufacturing Is Enabled by Internet 2.0



Internet 2.0 links data to Smart Manufacturing Collaboration Test Beds

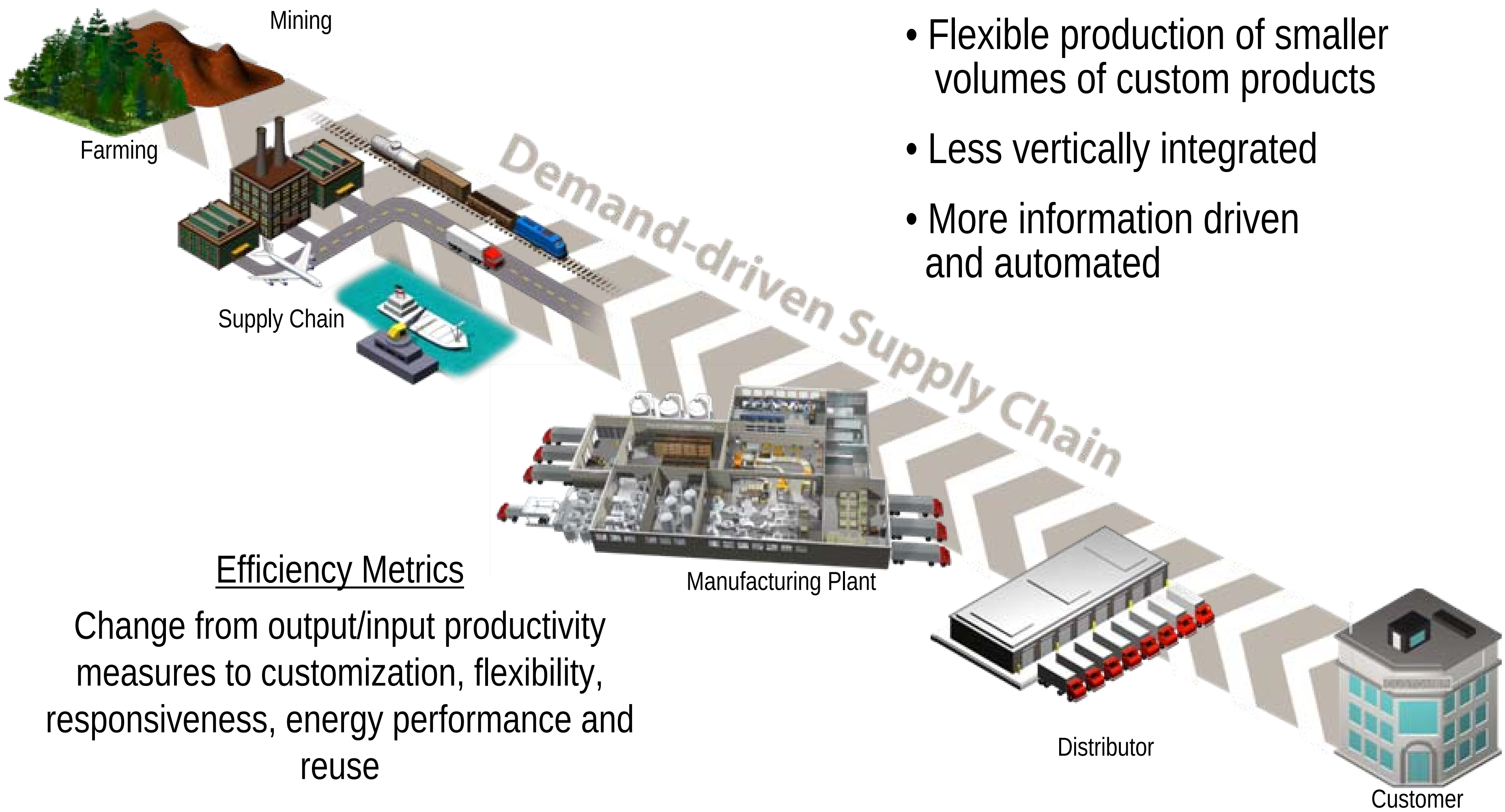
Smart Manufacturing 2.0:
Enterprise-wide End-to end Connectivity



Modern, smart factories will be interconnected
with supply chain, distribution and business systems

Highly-optimized Production and Demand-Dynamic Supply Chain Efficiency

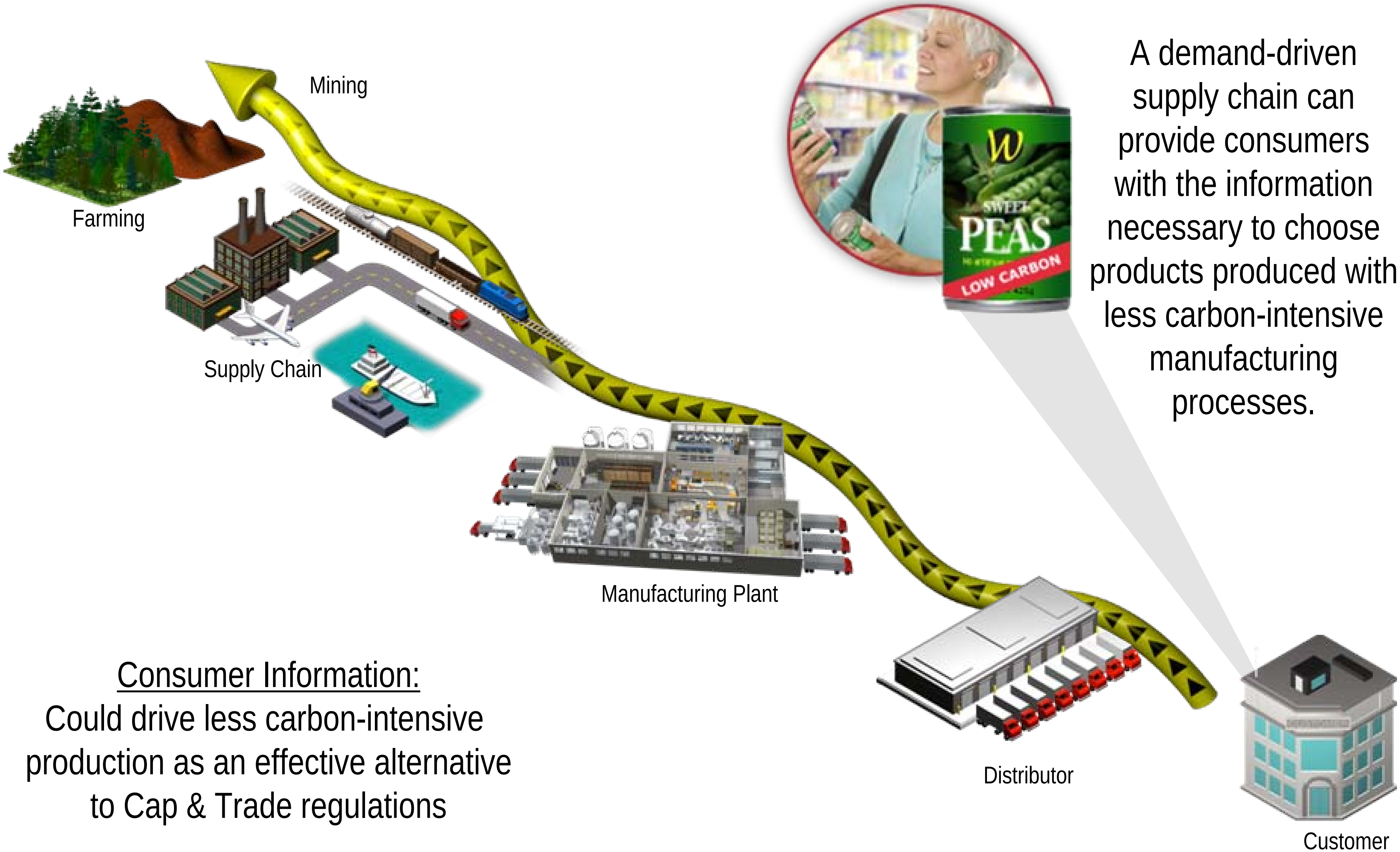
- Customers "pushing" demands
- Flexible production of smaller volumes of custom products
- Less vertically integrated
- More information driven and automated



<u>Efficiency Metrics</u>

Change from output/input productivity measures to customization, flexibility, responsiveness, energy performance and reuse

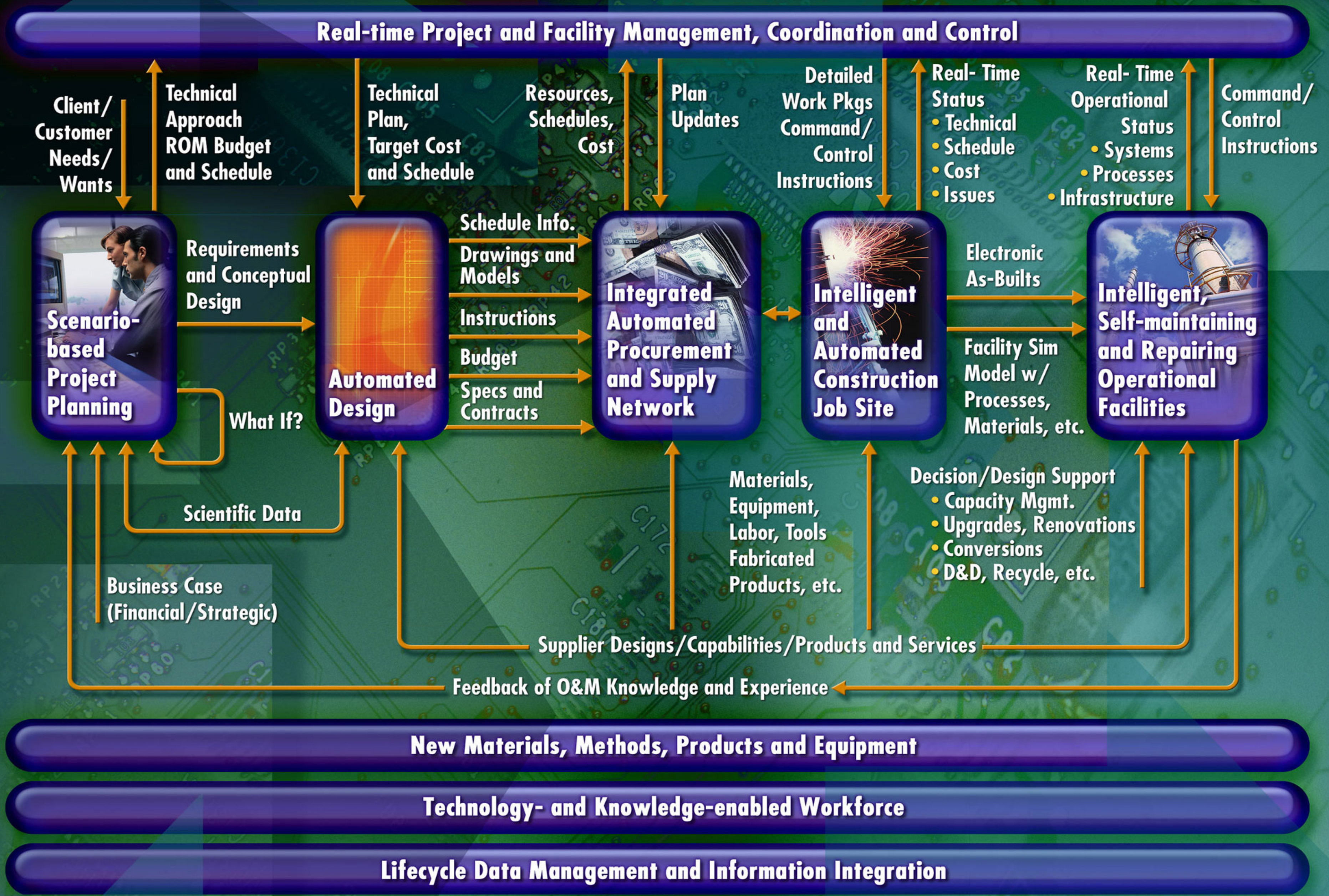
The Consumer in the Optimized, Demand-Dynamic Plants and Supply Networks?



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

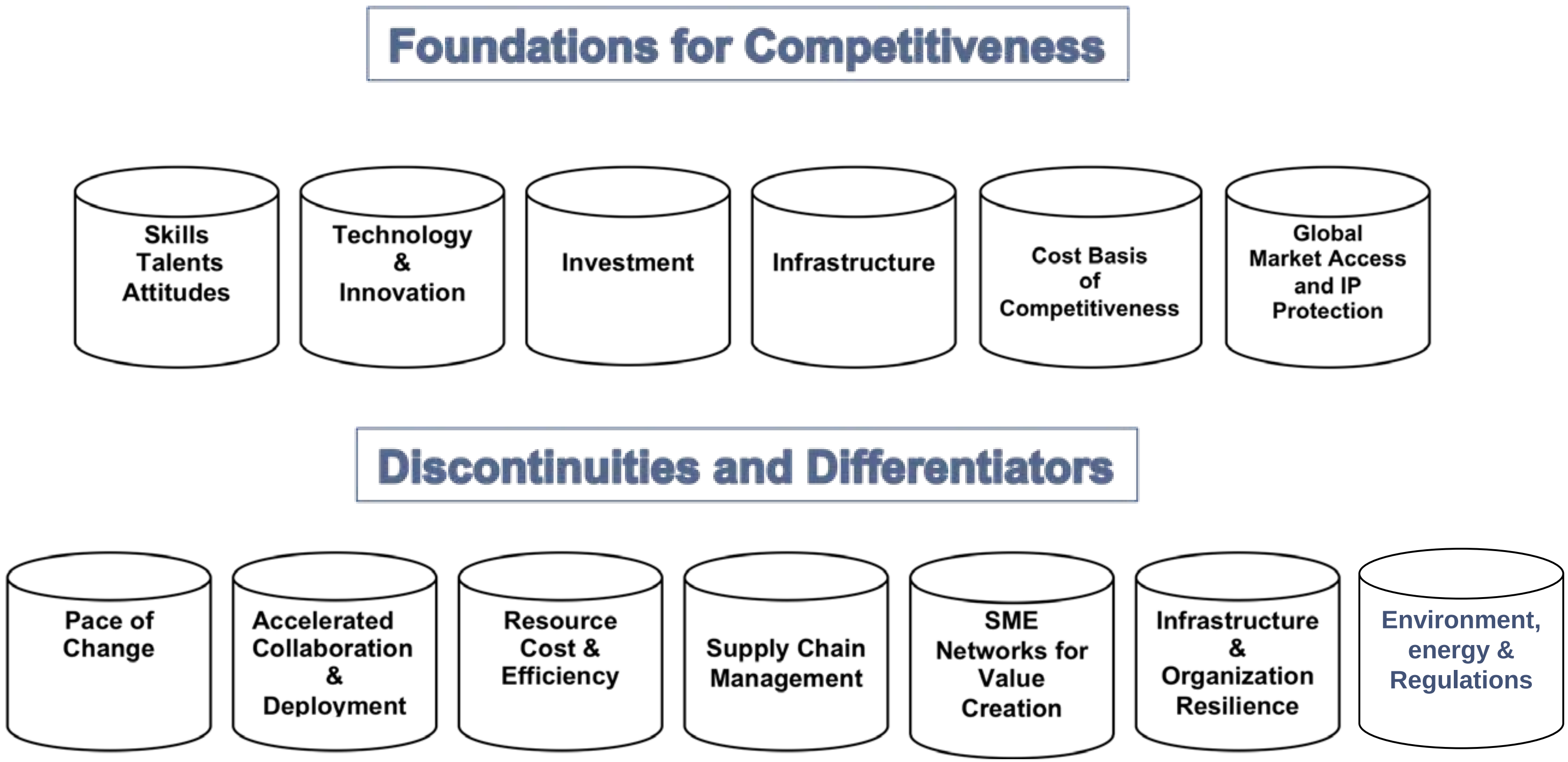
<u>Consumer Information:</u>
Could drive less carbon-intensive production as an effective alternative to Cap & Trade regulations

FIATECH's Vision of an Integrated and Automated Capital Projects Industry



Fully integrated and highly automated project processes coupled with radically advanced technologies across all phases and functions of the project/facility lifecycle

Council on Competitiveness
21st Century Manufacturing



1. Talent-driven innovation

2. Cost of labor & materials

3. Energy cost & policies

4. Economic, trade, financial & tax systems

5. Quality of physical infrastructure

6. Government investments in manufacturing & innovation

7. Legal & regulatory system

8. Supplier network

Accelerating Innovation

Regulation & Policy

Talent

Innovation Outreach

Regional Collaborations

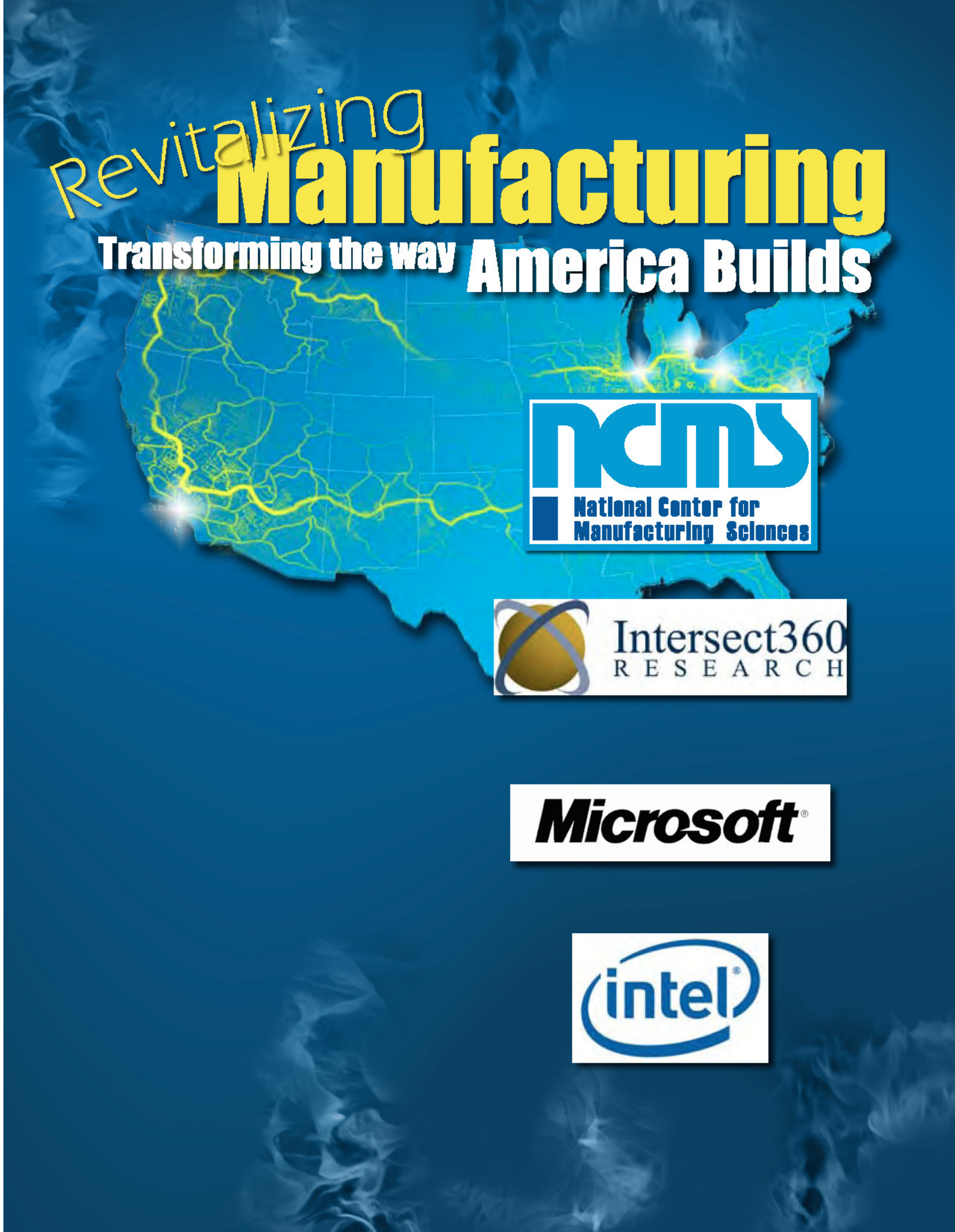
Study of
Innovation Clusters

1/26/2011

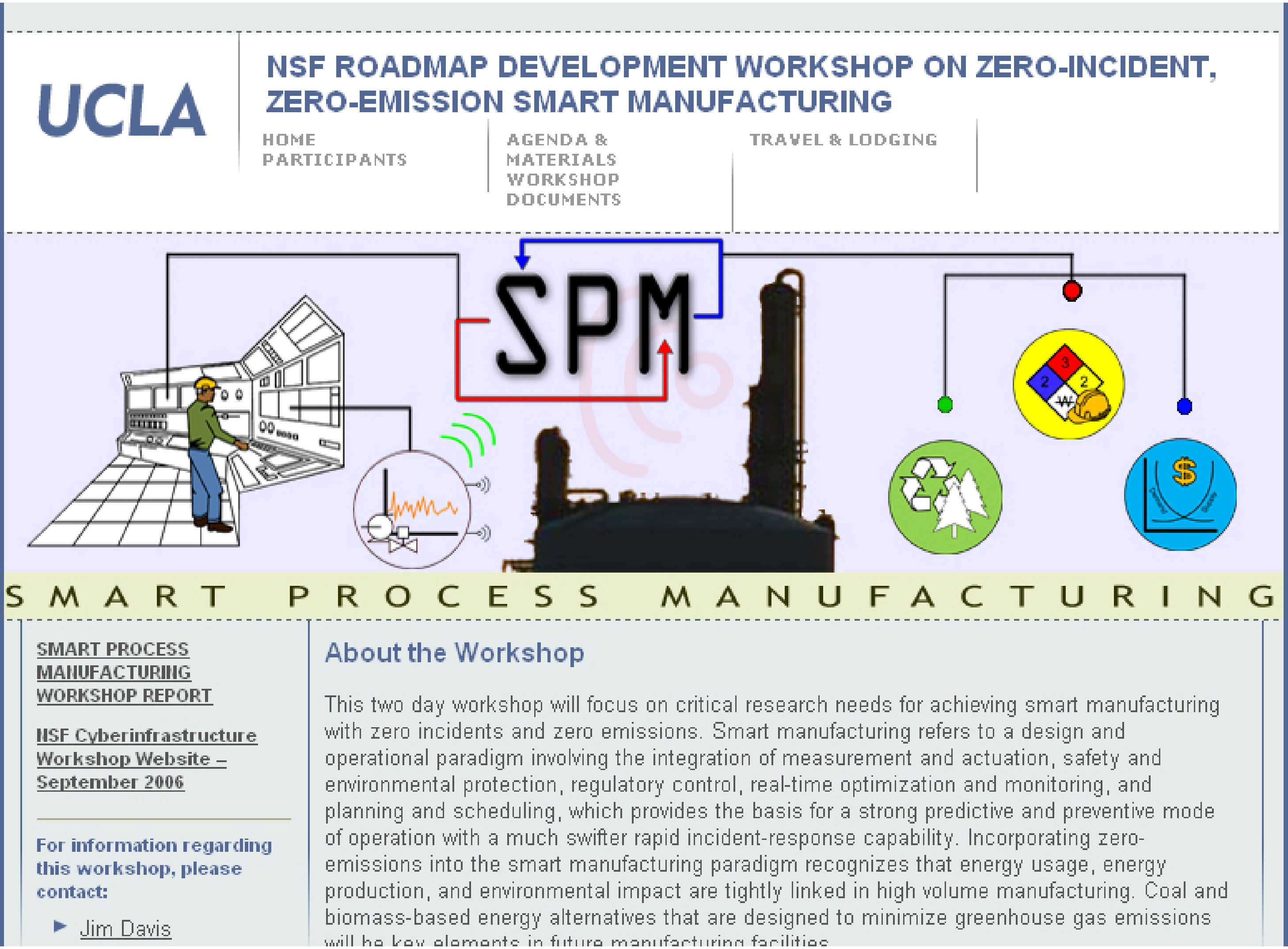
300,000 Small & medium sized Manufacturers (SMEs)

HPC Modeling & Simulation – Advanced computational methods competitive advantage

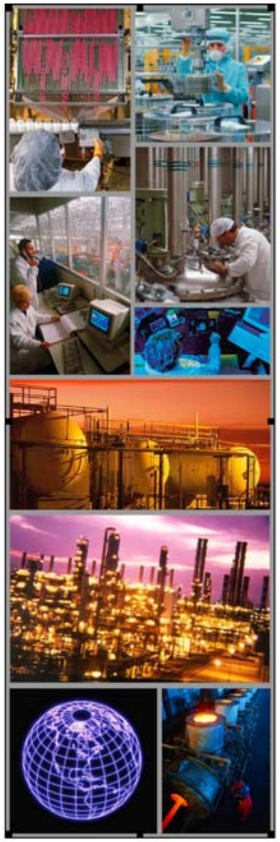
Offer affordable digital manufacturing technologies to drive economic growth



April 21-22 NSF Roadmap Development Workshop



Technology Roadmap Report



SMART PROCESS MANUFACTURING

EXECUTIVE SUMMARY AND FRAMEWORK FOR AN OPERATIONS AND TECHNOLOGY ROADMAP

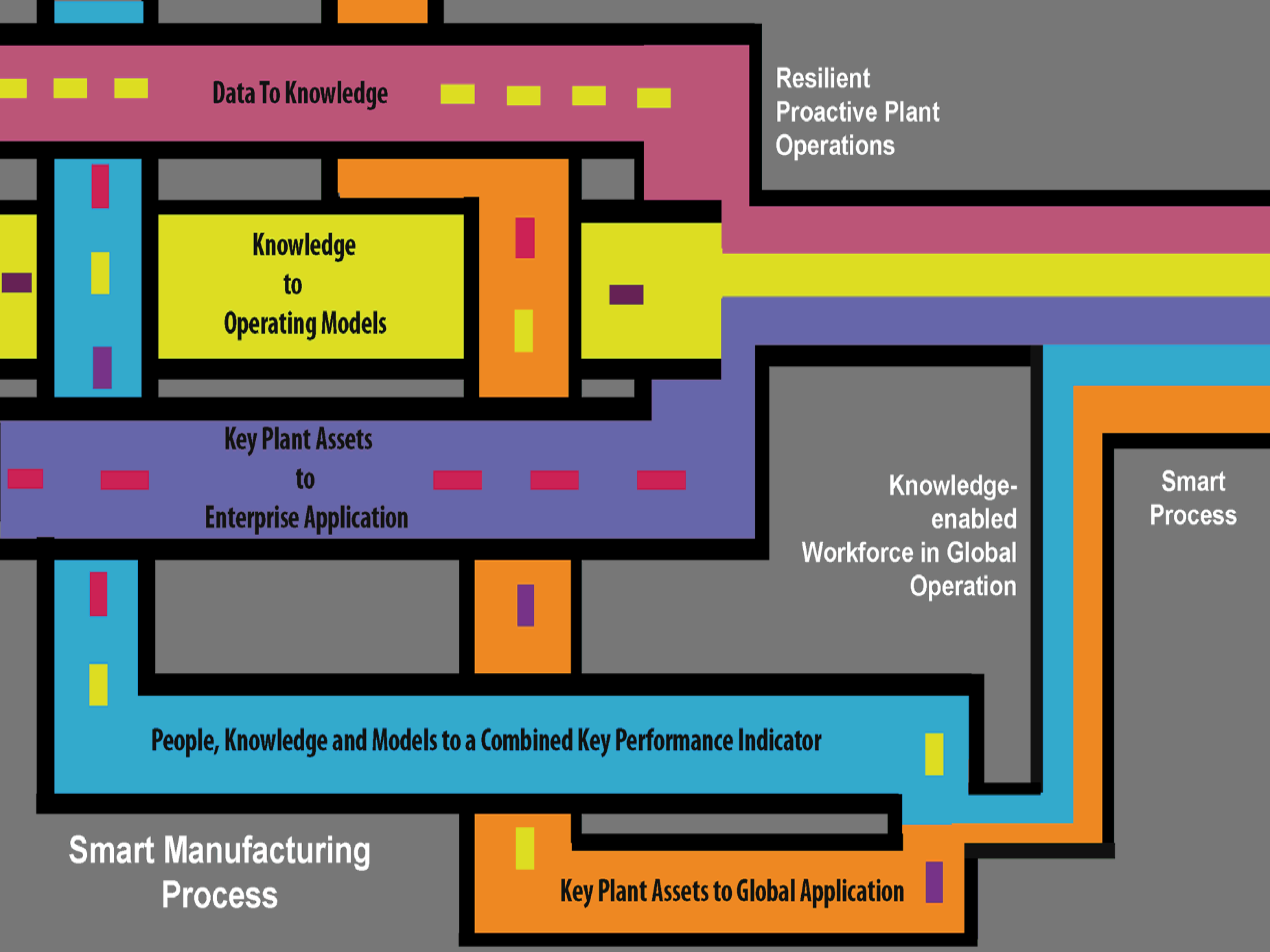
WORKING DRAFT

PREPARED BY:
SMART PROCESS MANUFACTURING ENGINEERING VIRTUAL ORGANIZATION STEERING COMMITTEE

JULY 2009

1. Motivating Smart Process Manufacturing
2. The Business Case and the Business Transformation
3. The Technical Transformation
4. The Smart Process Manufacturing Roadmap
5. The Path Forward

http://smart-process-manufacturing.ucla.edu


Data To Knowledge
Resilient Proactive Plant Operations
Knowledge to Operating Models
Key Plant Assets to Enterprise Application
Knowledge-enabled Workforce in Global Operation
Smart Process
People, Knowledge and Models to a Combined Key Performance Indicator
Smart Manufacturing Process
Key Plant Assets to Global Application

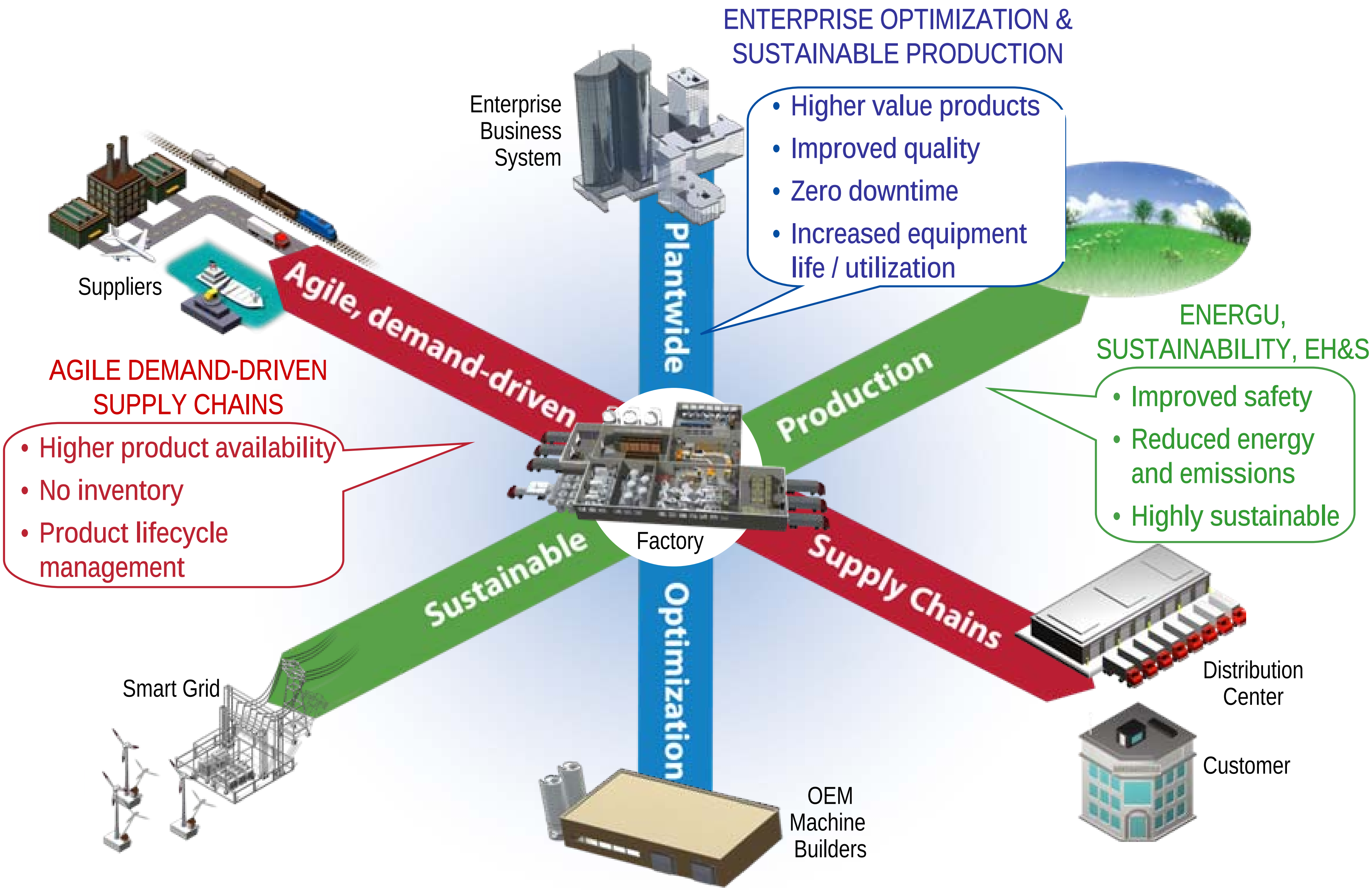
Implementing 21st Century Manufacturing – September 2010

- Executive Office Leads:
  - Ron Bloom, Senior Advisor for Manufacturing Policy
  - Aneesh Chopra, Chief Technology Officer, OSTP
  - Sridhar Kota, Assist Director Adv. Manufacturing, OSTP
- Agency Executive Leads:
  - Kristina Johnson, DOE UnderSecretary
  - Henry Kelly, DOE, Principle Deputy Assistant Secretary
  - Patrick Gallagher, DOC NIST Director
- Smart Manufacturing Leadership Coalition
  - 23 Companies
  - 28 Practitioner Participants
  - 12 Supplier Participants
  - 5 Universities – systems, control, optimization, manufacturing, high performance computing
  - 4 High Performance Computing centers – government lab and university
  - 5 Manufacturing consortia/institutions
- Federal
  - OSTP, DOE, NIST, DOD, NSF US Senate Committee

Implementing 21st Century Smart Manufacturing

- Alcoa
- American Council for Energy Efficient Economy
- Applied Materials
- CH2MHill
- Cisco
- Council on Competitiveness
- Dow
- DuPont
- Eastman
- Eli Lilly
- Emerson
- Exxon Mobil
- Ford
- General Mills
- General Motors
- Honeywell Solutions
- Merck
- National Council for Advanced Manufacturing
- Oak Ridge National Laboratory
- Owens Corning
- Procter & Gamble
- Pfizer
- Praxair
- Purdue
- Rockwell Automation
- Sematech
- Shell
- Spitzer and Boyes
- UCLA
- U North Carolina - RENCI
- U Wisconsin
- U Texas Austin

Optimized Plant & Supply Network: Meaningful Uses / Benefits



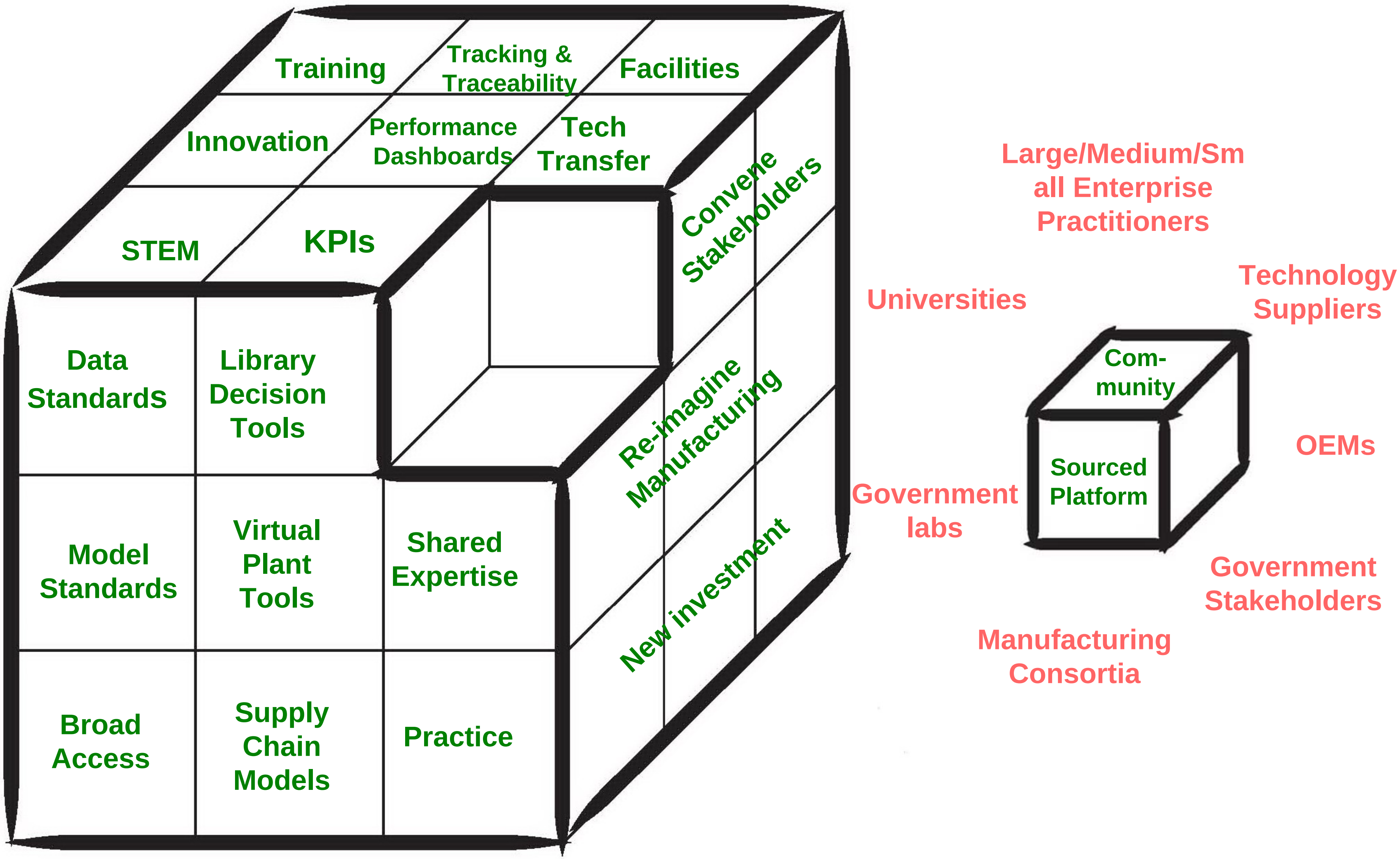
Achievable Meaningful Use Goals and Magnitude of Impact

- Demand-driven efficient use of resources and supplies in more highly optimized plants and supply
  - 80% reduction in cost of implementing modeling and simulation
  - 25% reduction in safety incidents
  - 25% improvement in energy efficiency
  - 10% improvement in overall operating efficiency
  - 40% reduction in cycle times
  - 40% reduction in water usage
- Product safety
  - Product tracking and traceability throughout the supply
- Sustainable production processes for current and future critical industries
  - 10x improvement in time to market in target industries
  - 25% reduction in consumer packaging
- Maintain and grow existing U.S. industrial base
  - Environment for broad innovation
  - 25% revenue in adjacent industries
  - 25% revenue in new products and services
  - 2x current SME's addressing total market
  - More highly skilled sustainable jobs created
- Positive public perception about U.S. Manufacturing
  - Americans feel our continued leadership as the world's largest manufacturer has strategic national importance

The Return on an Investment Vision 2020

Natural Gas	Petroleum	Electricity	GHG	Revenue	Jobs
Trillion BTUs saved per year	Million barrels of oil saved per year	MW saved	Million metric tons avoided per year	Million dollars per year	New direct jobs supported
907	275	7,383	166	7,263	242,104

Comprehensive Public-Private Partnership Program



ICT and Energy Efficiency
The Case for Manufacturing

··· Recommendations of the Consultation Group

Information and Communications Technologies

European Commission
Information Society and Media

Game Changing Computational Thinking

Dynamic enterprise planning from business to operation

Distributed intelligent models; distributed management

HPC
Compute reliability
Manage data
Interpret, mine, extract
Software
Community-based
Security tools

Integrated optimization; supply chain planning; scale beyond local unit; industry, region, country, global

High fidelity modeling; more complexity; coupling models; physical prediction

End-to-end prediction systems; demand response to regulation; manage economics of change

Networked sensors; wireless and wired; data interoperability more data sets; more parameters;

Assessment of US innovative capacity in SBE&S

- Nine-person team led by Prof. Sharon Glotzer of U. Michigan visited 59 academic, industrial and government sites in China, Japan, Europe.

- Report: “International Assessment of R&D in Simulation-Based Engineering and Science” (2009)
- Co-sponsored by:


Inventing a New America through Discovery and Innovation in Science, Engineering and Medicine
A Vision for Research and Development in Simulation-Based Engineering and Science in the Next Decade

Source of Disruptive Innovation: Multi-core, hyperparallel processing.

- At Oak Ridge National Lab: NSF's Kraken (Cray XT-5, 66,048 cores) & DOE's Jaguar (Cray XT-5, 181,504 cores, 1.6 petaflops):

960 processors, 4 teraflops, and under $10K.

- Just appearing: Hyperparallel desktop computers.

UCLA

SPM http://www.oit.ucla.edu/nsf-evo-2008/