



Technology Development and Manufacturing Competitiveness

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Revitalizing American Manufacturing



“When new technologies are developed and new industries are formed, I want them made right here in America. That's what we're fighting for.” - President Obama, August 16, 2010



- Manufacturing Tax Credits; Loan Guarantees – Renewable Energy
- FY 11 Budget- Univ. Innovation Ecosystem; Nano manufacturing; NIST-TIP, NSF, DOE
- DARPA's \$200M/yr investment in Manufacturing
- FY 12 Budget Guidance on Advanced Manufacturing
 - Support R&D in **advanced manufacturing** to strengthen U.S leadership in areas of robotics, cyber-physical systems, and flexible manufacturing.
- PCAST- Advanced Manufacturing Study
- On Jan 4, 2011 President Obama signed H.R. 5116 America COMPETES Act into law



Innovation

According to the recent National Academies report

Rising Above the Gathering storm, Revisited – Rapidly Approaching Category 5,



“Innovation commonly consists of being **first to acquire** new knowledge through leading edge research, being **first to apply** that knowledge to create sought-after products and services, often **through world-class engineering**; and being **first to introduce** those products and services into the marketplace through extraordinary entrepreneurship.”

We have been steadily falling behind in “application of knowledge”



Going...Going...Gone

Many high-tech products can no longer be manufactured in the United States because critical knowledge, skills, and suppliers of advanced materials, tools, production equipment, and components have been lost through outsourcing. Many other products are on the verge of the same fate.



<p>Semiconductors ALREADY LOST “Fabless” chips</p> <p>AT RISK DRAMs Flash memory chips</p>	<p>Electronic displays ALREADY LOST LCDs for monitors, TVs, and handheld devices like mobile phones</p> <p>Electrophoretic displays for Amazon’s Kindle e-reader and electronic signs</p> <p>AT RISK Next-generation “electronic paper” displays for portable devices like e-readers, retail signs, and advertising displays</p>	<p>Energy storage and green energy production ALREADY LOST Lithium-ion, lithium polymer, and NiMH batteries for cell phones, portable consumer electronics, laptops, and power tools</p> <p>Advanced rechargeable batteries (NiMH, Li-ion) for hybrid vehicles</p> <p>Crystalline and polycrystalline silicon solar cells, inverters, and power semiconductors for solar panels</p> <p>AT RISK Thin-film solar cells (the newest solar-power technology)</p>	<p>Computing and communications ALREADY LOST Desktop, notebook, and netbook PCs</p> <p>Low-end servers Hard disk drives Consumer-networking gear such as routers, access points, and home set-top boxes</p> <p>AT RISK Blade servers, midrange servers Mobile handsets Optical-communication components Core network equipment</p>	<p>Advanced materials ALREADY LOST Advanced composites used in sporting goods and other consumer gear</p> <p>Advanced ceramics Integrated circuit packaging</p> <p>AT RISK Carbon composite components for aerospace and wind energy applications</p>
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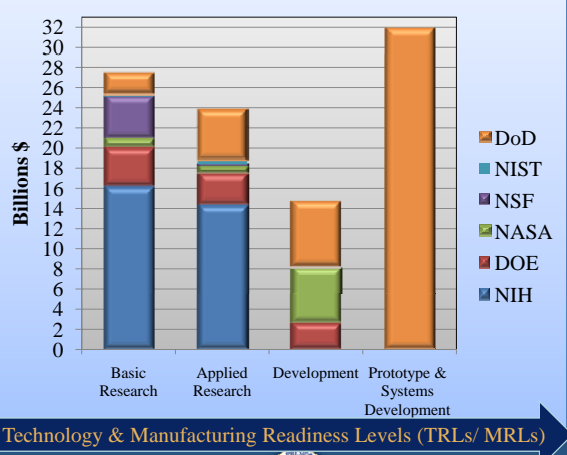
Taken from Gary Pisano and Willy Shih, “Restoring American Competitiveness”, Harvard Business Review, July 2009



Innovation is the Missing Middle



INPUT
\$100 Billion Annual
Federal Investment

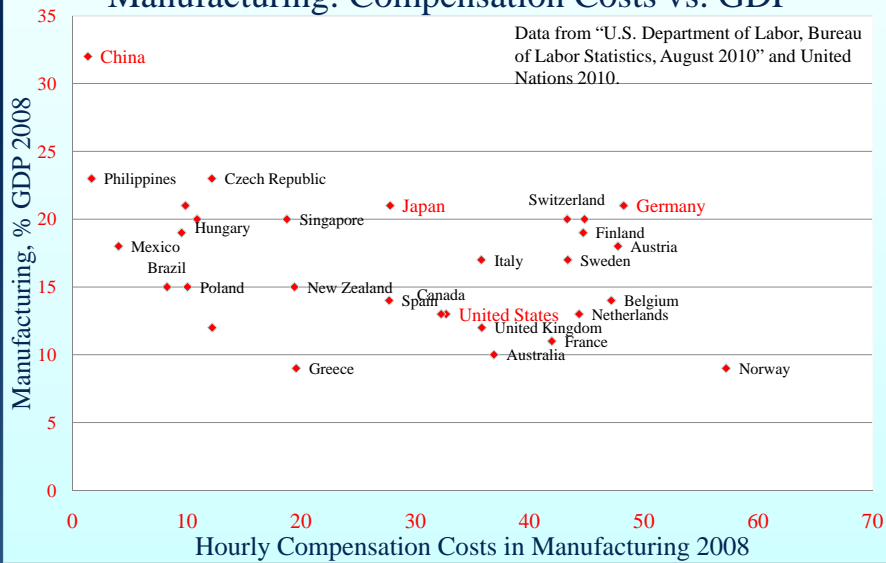


OUTPUT
- \$100 Billion
Annual Trade
Deficit in
Advanced
Technology
Products



Manufacturing: Compensation Costs vs. GDP

Data from "U.S. Department of Labor, Bureau of Labor Statistics, August 2010" and United Nations 2010.



Economic Output Figures and Structural Costs

Sources: 1. Bureau of Economic Analysis; 2. Daniel S. Hamilton and Joseph P. Quinlan, *Germany and Globalization*, 2008; 3. NSF Science and Engineering Indicators 2010; 4. World Development Indicators database, World Bank, 2005; 5. Organization for Economic Cooperation and Development, Main Science and Technology Indicators, 2008; 6. Bureau of Labor Statistics, 2010; 7. Jeremy A. Leonard, "The Tide is Turning – An Update on Structural Cost Pressures Facing U.S. Manufacturers," *Manufacturers Alliance/MAPI and the Manufacturing Institute*, November 2008.

	U.S	Germany	Japan	China	Source
Trade balance (\$ B) (2007)					1, 2
• goods	-823	+199			
• services	+121	-16			
• net	-702	+183			
Manufacturing as % GDP -	13	20.5	21	33.4	4
Hourly Compensation of Manufacturing Workers	\$32.26	\$48.22	\$27.80	\$1.36	6
Govt. Research budget in millions of dollars: Industrial Production & Technology / Total expenditure	427/116663 (0.4%)	2267/18542 (12%)	1861/2532 (74%)		3
Share (%) of Business R&D expenditures on Manufacturing	69.6	90.0	89.9	84.6	3
R&D as % GDP	2.68	2.53	3.39		5
Raw Cost Index of Manufacturers	\$0.47	\$0.52	\$0.30	\$0.13	7
Statutory Corporate Tax Rates	40.0	38.3	40.7	25.0	7
Social Insurance Expenditures & Other Labor Taxes (% of compensation)	22.9	22.8	17.0	8.0	7
Industrial Pollution Abatement and Control Expenditures (% of value added)	6.2	6.0	5.5	2.8	7
End-User Industry Energy Costs (Index U.S. = 100)	100.0	124.7	122.8		7



Manufacturing Investments

Sector	Percent of US GDP	Government Investment
Health	14-16%	NIH: ~\$31 billion
Energy	8-10%	DOE: ~\$11 billion
Manufacturing	11-13%	Total federal investment ~ \$1 billion

Are current manufacturing investments sufficient?

Are they:

Too generic (no practical relevance)?

Too specific (crisis management)?

Commercially infeasible (defense-specific)?

Too late (large downstream costs of delayed action)?

Should we invest in establishing Technology Development Centers to develop systems engineering and manufacturing competencies?



Establishing a Robust Manufacturing Base

Creating *New* Industries

A. Innovation - Radical Technological Innovation

Discoveries, Inventions, **Technology Development**, **Scaling**, Manufacturing and Commercialization

B. Early Adoption

C. Access to Capital

Strengthening *Existing* Industries

A. Technology Innovation

Incremental and Radical Innovations

B. Business Innovation

Adjacent markets and adjacent products

C. Tools and Resources

Skilled workforce at all levels. **Tools to improve quality, mfg flexibility, reduce costs and timing**

D. Low Structural Non-production Costs

Taxes, Regulations

Focus of this workshop



Global Models for Technology Development

Successful Models in Other Countries



Fraunhofer

- 59 Institutes, 17 000 employees
- Non-profit organisation
- 33 % basic funding by government
- 33 % public funded projects
- 33 % direct contracts by industry

- Information and Communication Technology
- Life Sciences
- Microelectronics
- Light & Surfaces
- Production
- Materials and Components - MATERIALS
- Defense and Security

ITRI
Industrial Technology Research Institute

- Information and Communications
- Material, Chemical and Nanotechnologies
- Biomedical Technologies
- Advanced Manufacturing and Systems
- Energy and Environment

Total Patents: 10,132
Start-Ups: 158



ITRI is the Winner – Wall Street Journal Technology Award Sept. 2010.

Fraunhofer-Gesellschaft: Undertakes applied research of direct utility to private industry. Clustered approach with pilot production centers to close the gap between research and products

Korea's Industrial Core Research Projects Program



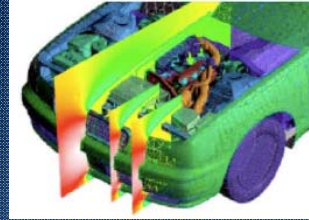
“Bell Labs”?
Federal Labs?
University Research Centers?
FFRDCs?
Non-profit institutes?

Enhancing Manufacturing Competitiveness

IT-Enabled Manufacturing

Modeling and Simulation

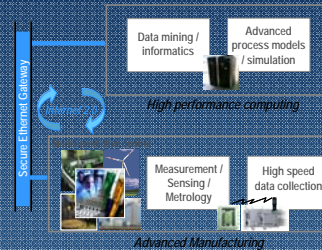
- Broaden and accelerate use of M&S tools by SMEs
- Cloud computing platforms
- Incorporate verification, validation, and uncertainty quantification



Smart/Net Centric Manufacturing

Enables part genealogy; captures errors before they propagate, etc.

1. Data interoperability
2. Networked sensors
3. Material properties and models
4. Multi-scale dynamic modeling & simulation and large scale optimization – for real-time process control
5. Scalable, requirements-based multi-level security



Suggested Workshop Outcomes

Develop a Multiagency National Manufacturing Initiative to

1. Establish a Pilot Technology Development Center to mature Manufacturing Readiness of a specific emerging (platform) technology.
2. Demonstrate a Scaled IT-enabled Manufacturing facility that rivals the most advanced manufacturing facility in the world.
 - Public Private Partnerships
 - Strategic investment by leveraging strengths and resources of multiple agencies including leveraging early procurement opportunities
 - OSTP can help convene and coordinate

