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”_

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**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.

**Semiconductors**

_ALREADY LOST_

*“Fabless*” chips

AT RISK

DRAMs

Flash memory chips

**Lighting**

_ALREADY LOST_

Compact fluorescent lightbulbs

AT RISK

LEDs for solid-state lighting, signs, indicators, and backlights

**Electronic displays**

_ALREADY LOST_

LCDs for monitors, TVs, and handheld devices like mobile phones

Electrophoretic displays for Amazon’s *Kindle* e-reader and electronic ink

**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

Advanced rechargeable batteries (NiMh, Li-ion) for hybrid vehicles

Crystaline and polycrystalline silicon solar cells, inverters, and power semiconductors for solar energy

**Computing and communications**

_ALREADY LOST_

Desktop, notebook, and netbook PCs

Low-end servers

Hard disk drives

Consumer-networking gear such as routers, access points, and home networking boxes

_AT RISK_

Blade servers, midrange servers

Mobile handsets

Optical-communications components

Core network equipment

**Advanced materials**

_ALREADY LOST_

Advanced composites used in sporting goods and other consumer gear

Advanced ceramics

Integrated circuit packaging

_AT RISK_

Carbon-composite components for aerospace and wind energy applications

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

**Technology & Manufacturing Readiness Levels (TRLs/ MRLs)**

INPUT
$100 Billion Annual Federal Investment

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

**Manufacturing: Compensation Costs vs. GDP**

### Economic Output Figures and Structural Costs

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<tbody>
<tr>
<td>U.S.</td>
<td>-823</td>
<td>$32.26</td>
<td>427/116663 (0.4%)</td>
<td>69.6</td>
<td>$0.47</td>
<td>40.0</td>
<td>22.9</td>
<td>6.2</td>
<td>100.0</td>
</tr>
<tr>
<td>Germany</td>
<td>+199</td>
<td>$48.22</td>
<td>2267/18542 (12%)</td>
<td>90.0</td>
<td>$0.52</td>
<td>38.3</td>
<td>22.8</td>
<td>6.0</td>
<td>124.7</td>
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<tr>
<td>Japan</td>
<td>-702</td>
<td>$27.80</td>
<td>1861/2532 (74%)</td>
<td>89.9</td>
<td>$0.30</td>
<td>40.7</td>
<td>17.0</td>
<td>5.5</td>
<td>122.8</td>
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<tr>
<td>China</td>
<td>+383</td>
<td>$1.36</td>
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<td>84.6</td>
<td>$0.13</td>
<td>25.0</td>
<td>8.0</td>
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### Manufacturing Investments

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

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**Global Models for Technology Development**

*Successful Models in Other Countries*

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<th>Universities, Federal Labs</th>
<th>Industrial R&amp;D</th>
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**German Fraunhofer Institutes**

**Taiwan’s Industrial Tech Research Inst.**

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<th>Technology and Manufacturing Readiness Levels</th>
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*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

Taylor’s ITRI

Korea’s Industrial Core Research Projects Program

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*“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

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**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