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Advanced Manufacturing: Today, Tomorrow, and Beyond

Policies to Support Advanced Manufacturing

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Core Principles for U.S. Manufacturing Renewal

- Focus on traded sector competitiveness.

- Recognize that science-based innovation isn’t enough; U.S. needs to re-embrace an engineering culture.

- Recognize that U.S. manufacturing has not been healthy.
Germany Has Experienced a Fraction of U.S. Manufacturing Job Loss

Percent Change in Manufacturing Jobs in Select Countries, Adjusted for Population Growth, 1997-2010
While Paying Over 40% More Per Labor Hour

Hourly Manufacturing Compensation Costs (United States = 100), 2008
- U.S. Manufacturing Lags in Technological Intensity

**Manufacturing Sector Composition by Technological Intensity**

Australia | Canada | Germany | Japan | Korea | United Kingdom | United States
---|---|---|---|---|---|---
Low-technology | Medium-low technology | Medium-high technology | High-technology

The chart shows the composition of the manufacturing sector by technological intensity for various countries, highlighting that the United States lags behind in technological intensity compared to other countries.
The U.S. has been the “first mover” and then lost virtually all market share in a wide range of material and product technologies, including:

- Semiconductor memory devices
- Semiconductor production equipment such as steppers
- Lithium-ion batteries
- Flat panel displays
- Robotics
- Solar cells
- Advanced lighting
- Oxide ceramics
Two Camps About What to Do About This

1. If we just get our costs low enough, American manufacturing will be fine
U.S. Manufacturing Costs Not the Problem


Manufacturing Costs per Worker Hour

Germany: $48.93
UK: $44.08
Japan: $41.36
Canada: $35.94
France: $32.42
U.S.: $29.83
Korea: $24.71
Taiwan: $18.53
Mexico: $15.80
China: $10.70

Two Camps About What to Do About This

2. Put in place a robust manufacturing and innovation infrastructure.
What To Do: We Need a “RAFTTTT”

- Regulatory reform
- Analysis
- Financing
- Technology
- Tax
- Talent
- Trade
Technology: Increase Federal Investment in R&D

The federal R&D portfolio is not optimized for economic growth:

- 81% goes to “mission-oriented” activities in defense and health.

- 75% of fed R&D $ allocated to manufacturing goes to just two industries: aerospace and instruments.

- Academic R&D spending in engineering and physical sciences flat.

- If investing as much as we did in 1983 (as a share of GDP), federal government would invest $60 billion more in R&D annually.

- Underinvesting in applied/translational research.
Lacking an Institutional Framework for Pre-competitive, Industrially Relevant Applied Research
Approach Being Increasingly Adopted Internationally

- Germany invests $2.5 billion/yr in Fraunhofer System
  - 60 Centers and 18,000 staff for 80M Germans

- Japan’s New $117B Stimulus Package (1/10/13)
  - $2 billion to promote university-industry collaboration, including $ to equip universities to conduct industrially relevant research

- UK Catapults (January 2013)
  - £1bn investment in technology and innovation centers
  - The High-Value Manufacturing Catapult will be “a catalyst that transforms brilliant manufacturing ideas into valuable products and services”

- Finland’s SHOKs (Strategic Centers of Science, Tech, and Inn)
Create a National Network for Manufacturing Innovation

- 15-20 Manufacturing Institutes bringing together cutting-edge research in an industrially relevant way across key sectors and manufacturing process technologies.

- Mission: Enhance U.S. industrial competitiveness by supporting development of technologies enabling U.S. production facilities to gain global market share.

- Industry should bring NNMI proposals forward and provide at least 50% funding (matched by feds and states).
What NNMIs Would Do

- Provide a platform for joint pre-competitive applied research;
- Develop sector & technology-specific roadmaps that identify technical hurdles and work to solve them;
- Provide shared facilities for rapid prototyping and demonstration; libraries & databases; and validation and testing equipment;
- Develop and disseminate training technologies/curricula; support credentials, certifications, and skills standards development;
- Help restore the industrial commons in key manufacturing product and process technologies.
NNMIs Could be Established Across a Range of Key Cross-Cutting Technologies

- Advanced Materials/Composites
- Additive Manufacturing
- Bio Manufacturing and Bioinformatics
- Nano-Manufacturing
- Flexible Electronics Manufacturing
- Industrial Robotics
- Advanced Forming/Joining/Welding Technologies
- Advanced Sensing, Measurement, & Process Control
- Visualization, Informatics and Digital Manufacturing Technologies
- Advanced Manufacturing & Testing Equipment
- Chemical Processing
Why America Needs an NNMI

Numerous market failures afflict manufacturing innovation:

- Firms underinvest in risky technologies with long-term time horizons.
- Substantial externalities from firms’ investments in capital equipment and machinery.
- Complementarity between public and private R&D investment.
Technology: Designate 25 Manufacturing Universities

- Revamp engineering programs to focus on manufacturing engineering and work that is more relevant to industry.

- More joint industry-university research projects and student training incorporating manufacturing experiences (co-ops).

- Receive annual award of at least $25M from NSF plus priority on universities’ applications for NSF grants.
Technology: Ramp up ERC & I/UCRC programs

- Get more ERCs & I/UCRCs focused on manufacturing:
  - Currently only 4 of 17 ERCs and 7 of 56 I/UCRCs are.
- Double funding for both programs.
- Require all ERCs to have at least a 40% industry match by 2017 or lose their federal funding.
Technology: Increase Funding for MEP

- Despite tremendous returns, U.S. underinvests in MEP compared to peer countries (and historical U.S. levels).
Tax Policies

- Preserve and enhance key manufacturing tax incentives (e.g., R&D tax credit; accelerated depreciation; domestic production deduction).

- Implement a quasi-incremental *American Innovation and Investment Tax Credit*. 
Talent Policies

- Increase adoption of industry-recognized, nationally portable credentials, such as those produced by the MSSC.
- Fund engineering co-op programs between universities and industry.
Conclusion: Smart Policies Matter

30% of all German companies attribute their innovations “to improved research and innovation policies at the federal level.”

The High-Tech Strategy for Germany

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<th>Strengths</th>
<th>Opportunities</th>
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<td>• Strong user industries: Automobile industry, medical technology, mechanical engineering and, increasingly, biotechnology, agriculture and logistics are technology drivers.</td>
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<tr>
<td>• Materials and equipment suppliers: High level of expertise.</td>
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<td>• Highly competitive: Operations are seldom relocated to other countries.</td>
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<td>• Skilled labour: Germany has a unique initial and continuing education and training system at both industrial and academic level.</td>
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<td>• New research fields: Enormous potential offered by polymer microsystems and micro/nano integration.</td>
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<td>• Growth market: Large number of SMEs with above-average, often double-digit growth rates. High-volume markets for security technology, logistics and health monitoring.</td>
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<th>Weaknesses</th>
<th>Threats</th>
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<td>• Mass markets: There is no mass production in Germany except in the automobile sector.</td>
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<td>• Integration of microsystems technology in products: Many SMEs in potential user sectors lack the necessary expertise.</td>
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<td>• Provision of capital: Technology companies – which are generally capital-intensive – have cautious, national-level financial backers.</td>
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<td>• Shortage of skilled labour: Early action must be taken to prevent a possible shortage of new recruits.</td>
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<tr>
<td>• Product-oriented R&amp;D infrastructure needed: Support on the basis of developed microsystems technologies needed, particularly for SMEs.</td>
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<td>• Establishment of more networks: Germany needs more collaborative, production-oriented networks between research units, suppliers and systems producers.</td>
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Thank You

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