Capturing Domestic Competitive Advantage in Advanced Manufacturing

Theresa Kotanchek-Dow Chemical
Martin Schmidt-MIT
Why Should We Care?

U.S. should strive to revitalize advanced manufacturing because:

- **Jobs**: Manufacturing provides high-quality, good-paying jobs for American workers.

- **Innovation**: By keeping manufacturing local, design, engineering, scale-up, and production processes feed back on the conception and innovation sectors to generate new ideas and novel second- and third-generation products.

- **Security**: Domestic manufacturing capabilities using advanced technologies and techniques are vital to maintaining national security and critical resources.
Advanced Manufacturing involves the manufacture of conventional or novel products through processes that depend on the coordination of information, automation, computation, software, sensing, and networking, and/or make use of cutting edge materials and emerging scientific capabilities.

— From PCAST REPORT
AMP Mission Statement

The Advanced Manufacturing Partnership identifies collaborative opportunities between industry, academia and government that will catalyze development and investment in emerging technologies, policies, and partnerships with the potential to transform and reinvigorate advanced manufacturing in the U.S.

AMP Outcomes

1. Develop a permanent model for evaluating, prioritizing, and recommending federal investments in advanced manufacturing technologies

2. Recommend a set of ‘partnership projects’, focused on advancing high-impact technologies and creating models for collaboration that encompass technology development, innovation infrastructure, and workforce development

3. Provide recommendations to the Administration on the actions required to support investment in advanced manufacturing in the U.S.
# AMP Steering Team

<table>
<thead>
<tr>
<th>Industry</th>
<th>University</th>
<th>Government</th>
</tr>
</thead>
<tbody>
<tr>
<td>Allegheny Technologies</td>
<td>University of California, Berkeley</td>
<td>OSTP</td>
</tr>
<tr>
<td>Caterpillar</td>
<td>Carnegie Mellon</td>
<td>Department of Commerce</td>
</tr>
<tr>
<td>Corning Glass</td>
<td>Georgia Tech</td>
<td>Department of Defense</td>
</tr>
<tr>
<td>Dow Chemical</td>
<td>MIT</td>
<td>Department of Education</td>
</tr>
<tr>
<td>Ford</td>
<td>University of Michigan</td>
<td>Department of Energy</td>
</tr>
<tr>
<td>Honeywell</td>
<td>Stanford</td>
<td>Department of Labor</td>
</tr>
<tr>
<td>Intel</td>
<td></td>
<td>National Economic Council</td>
</tr>
<tr>
<td>Johnson &amp; Johnson</td>
<td></td>
<td>National Science Foundation</td>
</tr>
<tr>
<td>Northrop Grumman</td>
<td></td>
<td></td>
</tr>
<tr>
<td>P&amp;G</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Stryker</td>
<td></td>
<td></td>
</tr>
<tr>
<td>United Technologies</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
## Advanced Manufacturing Work Stream Objectives

<table>
<thead>
<tr>
<th>Work Stream</th>
<th>Objectives</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Technology Development</strong></td>
<td>• Determine a permanent mechanism to be used for identifying and developing key manufacturing technologies</td>
</tr>
<tr>
<td></td>
<td>• Determine a set of top technology areas that would ensure U.S. manufacturing competitiveness</td>
</tr>
<tr>
<td><strong>Shared Infrastructure &amp; Facilities</strong></td>
<td>• Assess opportunities to de-risk, scale-up and lower the cost of accelerating technology from research to production through unique capabilities and facilities that serve all U.S. based manufacturers, in particular small and medium sized manufacturers</td>
</tr>
<tr>
<td><strong>Education &amp; Workforce Development</strong></td>
<td>• Identify tangible actions that AMP can implement to support a robust supply of talented individuals to provide human capital to companies interested in investing in advanced manufacturing activities in the U.S.</td>
</tr>
<tr>
<td><strong>Policy</strong></td>
<td>• Make recommendations to the Administration on economic and innovation policies that can directly impact the overall climate and the ability to improve research collaboration and the pathway to commercialization in support of U.S. based manufacturing and jobs</td>
</tr>
<tr>
<td><strong>Outreach</strong></td>
<td>• Conduct stakeholder outreach and reviews</td>
</tr>
<tr>
<td></td>
<td>• Conduct &amp; consolidate findings of regional meetings</td>
</tr>
</tbody>
</table>
AMP in Action

- **Four Regional Meetings**
  ~ 1200 attendees

- **Work Stream Outreach**
  - Surveys through NAM, NCMS, MAPI and APLU
  - Interviews with leaders at Department of Labor, SBA, Veterans Associations, Community Colleges, Manufacturing Institutes, and Technical, Education, Labor & Policy Subject Matter Experts

- **Targeted Outreach**
  - Trade Groups: NAM, Sematech, US Chamber of Commerce, NCMS
  - Capitol Hill: Ryan & Manzullo of House Manufacturing Caucus, House & Senate Committee Staffs
  - Agencies: DOE, DOD, NSF, DOL
AMP ‘Top Line’ Recommendations

• **Enabling Innovation**
  – Establish a National Advanced Manufacturing Strategy
  – Increase R&D Funding in Top Cross-Cutting Technologies
  – Establish a National Network of Manufacturing Innovation Institutes
  – Enhance Industry/University Collaboration in Advanced Manufacturing Research
  – Foster a Robust Environment for Commercialization of Advanced Manufacturing Technologies
  – Establish a National Advanced Manufacturing Portal

• **Securing the Talent Pipeline**
  – Correct Public Misconceptions about Manufacturing
  – Tap the Talent Pool of Returning Veterans
  – Invest in Community College Level Education
  – Develop Partnerships to Provide Skills Certifications and Accreditation
  – Enhance Advanced Manufacturing University Programs
  – Launch Advanced Manufacturing Leadership Fellowships & Internships

• **Improving the Business Climate**
  – Enact Tax Reform, Streamline Regulatory Policy, Improve Trade Policy; Energy Strategy

http://www.whitehouse.gov/administration/eop/ostp/pcast
Permanent Mechanism: The Technology Lifecycle Process

Create National Strategy & Objectives
- Prioritized list of strategic needs and required technologies

Create Technology Roadmaps
- Technology roadmaps for each of the prioritized technologies

Create and Manage Programs
- Technology programs established & executed

Review Progress and Correct Course
- Periodic review of program portfolio by key stakeholders
Recommended Criteria for Assessing & Prioritizing

- National Strategic Needs
  - Defense Security
  - Energy Security
  - Food Security
  - Health Security
  - Homeland Security
  - Economic Security

- Global Market Demand

- US Industry Competitiveness

- Technology Readiness

The significance of national need, size of global market opportunity & state of technology readiness determines the scale & role of Industry-Academia-Government partnerships
# Framework for Nurturing and Developing Technologies

<table>
<thead>
<tr>
<th>USA National Strategic Needs</th>
<th>Global Market Demand</th>
<th>USA Industry Maturity/Competitiveness</th>
<th>Global Tech Readiness</th>
<th>Implication</th>
<th>Technology Required to Drive USA Competitiveness</th>
<th>Role of USA Government</th>
<th>Role of Industry</th>
<th>Role of University</th>
</tr>
</thead>
<tbody>
<tr>
<td>High</td>
<td>High</td>
<td>Low</td>
<td>Low</td>
<td>Greenfield opportunities. New technology &amp; infrastructure required. Need to forecast economic competitiveness.</td>
<td>Basic Research</td>
<td>Government demand drives fundamental research &amp; infrastructure build</td>
<td>Partner with national labs &amp; universities to conduct basic &amp; applied R&amp;D &amp; establish required infrastructure</td>
<td>Conduct basic research</td>
</tr>
<tr>
<td>High</td>
<td>High</td>
<td>Low</td>
<td>High</td>
<td>Situation only exists if US not global leader, e.g., energy storage &amp; power electronics.</td>
<td>Applied R&amp;D; Breakthrough Technologies</td>
<td>Government demand drives infrastructure build &amp; incentives</td>
<td>Establish globally competitive infrastructure. Conduct breakthrough R&amp;D to establish global leadership.</td>
<td>Develop breakthrough technologies</td>
</tr>
<tr>
<td>High</td>
<td>High</td>
<td>High</td>
<td>Low</td>
<td>Consortium lead roadmapping</td>
<td>Basic Research</td>
<td>Government demand drives research &amp; incentives, e.g., energy efficiency</td>
<td>Industry defines roadmaps, develops technologies and establishes infrastructure.</td>
<td>Conduct basic research</td>
</tr>
<tr>
<td>High</td>
<td>High</td>
<td>High</td>
<td>High</td>
<td>Research is driven by industry based on government demand</td>
<td>Applied R&amp;D</td>
<td>Government demand drives future requirements</td>
<td>Leads research &amp; infrastructure build</td>
<td>Participate in applied research</td>
</tr>
<tr>
<td>High</td>
<td>Low</td>
<td>Low</td>
<td>Low</td>
<td>Government roadmap drives research and infrastructure investment</td>
<td>Basic Research Required</td>
<td>Government demand drives research</td>
<td>Establish infrastructure to demonstrate technology &amp; meet national demand</td>
<td>Conduct basic research</td>
</tr>
<tr>
<td>High</td>
<td>Low</td>
<td>Low</td>
<td>High</td>
<td>Government roadmap drives research and infrastructure investment</td>
<td>Not Applicable</td>
<td>Not Applicable</td>
<td>Not Applicable</td>
<td>Not Applicable</td>
</tr>
<tr>
<td>High</td>
<td>Low</td>
<td>High</td>
<td>Low</td>
<td>Government roadmap drives future infrastructure investment</td>
<td>Basic Research Required</td>
<td>Government demand drives infrastructure build &amp; incentives</td>
<td>Establish infrastructure to meet national demand</td>
<td>Conduct basic research</td>
</tr>
<tr>
<td>High</td>
<td>Low</td>
<td>High</td>
<td>High</td>
<td>Government roadmap drives future infrastructure investment</td>
<td>Infrastructure Investment</td>
<td>Government demand drives infrastructure build &amp; incentives</td>
<td>Establish infrastructure to meet national demand</td>
<td>Conduct basic research</td>
</tr>
</tbody>
</table>
Enabling Innovation:
National Advanced Manufacturing Strategy

Need:

– Establish US as global advanced manufacturing leader

Recommendation:

– Establish 5 year National Advanced Manufacturing Strategic Plan
– Utilize to prioritize technologies, programs & public-private partnership investments

Who:

– Advanced Manufacturing National Program Office coordinates and aligns interagency programs
– Industry+University+Government Agency partner to develop, manage & execute the plan
Establish partnerships in top cross-cutting technologies:

• Additive Manufacturing
• Advanced Forming and Joining Technologies
• Advanced Materials Design, Synthesis and Processing
• Advanced Sensing, Measurement, & Process Control
• Visualization, Informatics and Digital Manufacturing Technologies
• Sustainable Manufacturing
• Nano-Manufacturing
• Flexible Electronics Manufacturing
• Bio Manufacturing and Bioinformatics
• Advanced Manufacturing & Testing Equipment
• Industrial Robotics
Filling the Gap

Gap in Manufacturing Innovation

Investment

Government & Universities

Private Sector

Technology Readiness Level

1 2 3 4 5 6 7 8 9

Basic Technology Research
Research to Prove Feasibility
Technology Development
Technology Demonstration
System/Subsystem Development
System test, Launch & Operations
Enabling Innovation

Manufacturing Innovation Institutes

Need:
- Expedite filling existing technology and workforce development gaps through network of shared facilities

Recommendation:
- Establish a network of Manufacturing Innovation Institutes

Who:
- Federal, State and Regional Agencies Sponsor
- Industry-University- Community Colleges Manage & Lead
- Advanced Manufacturing National Program Office coordinates
Enabling Innovation

Manufacturing Innovation Institutes

Universities & National Labs
- Faculty, Students & Graduates
- Student Projects & Algorithms
- Funding for High Priority Research & Development

Manufacturing Innovation Institute
- Prototype Labs/Shops
- Commercial HPC Mfg. Software Development
- Technology Development
- Train Manufacturing Service Personnel

Other MILs

Community College Mfg. Programs
- High Tech Start-up Companies
- Large Manufacturing Companies

Multiple Manufacturing Support Centers
- Technology Needs Analyses
- Technology Workshops
- Mfg. Technology Services

SME 1 .......................................................... > SME N
Additive Manufacturing Innovation Institute

$30 MM Federal + $40 MM Partners

- 40 Companies
- 9 Universities
- 5 Community Colleges
- 11 Non-Profits
Enabling Innovation

Waiver or Exception to Revenue Procedure 2007-47

Need:
- To modify tax policies which prohibit greater industry investment & partnership with nations top universities

Recommendation:
- Create Waiver or Exception to Revenue Procedure 2007-47 to remove the cap on private use activities in buildings constructed with tax exempt bonds for activities specifically related to industry research collaborations and supporting dynamic research partnerships between industry and university startups.

Who:
- Department of Commerce
- Department of Treasury
Enabling Innovation
Policy to Enhance University-Industry Partnerships

Need:
– Foster more robust environment for access to capital & commercialization of Advanced Manufacturing Technologies

Recommendation:
– Create new section of SBA Small Business Innovation Research Program to support early stage funding activities
– Extend nation-wide work of NSF created 501(c)3 Innovation Accelerator to support startups emerging from federal advanced manufacturing programs
– Clear pathway from startup to pilot scale production by greater interagency coordination & procurement
– Incorporate manufacturing impact measures into annual performance reports issued by Association of University Technical Managers

Who:
– Small Business Administration
– NSF and Advanced Manufacturing Interagency Representatives
– University Tech Transfer Offices
Enabling Innovation
National Manufacturing Portal

Need:

– Easy, user friendly portal connecting SME’s to national network of Advanced Manufacturing resources

Recommendation:

– Create National Manufacturing On-Line Portal

Who:

– NIST or MEP coordinate
– Agencies & Public Funded Laboratories & Universities populate
Securing the Talent Pipeline

• **Image of Manufacturing: Ad Council Campaign**
  – A national campaign with local flavor to correct public’s misconceptions from “Dull, Dirty & Dangerous” to “Exciting, Engaging, Essential & Environmentally Sustainable”

• **Tap the Talent Pool of Returning Veterans**
  – Use the TAP program to educate veterans about the career possibilities

• **Invest in Community Colleges**
  – Standardized national curricula with project-based learning, internships and apprenticeships. Use partnerships with industry to achieve maximum results

• **Adopt Stackable Credentials**
  – Adapted to life-long learning, these credentials give employers a sense of the candidates’ competencies & are recognized nationally.

• **Improve University Programs**
  – Engage ABET & Universities to add manufacturing content to engineering programs and create new degrees at BS, MS, and PhD levels

• **National Manufacturing Fellowships & Interns**
  – Establish coordinated interagency fellowship program
Improving the Business Climate

1. Tax Reform
   • Strengthen & Make Permanent R&D Tax Credits
   • Lower corporate tax rate to bring it line with other advanced economies
   • Create an internationally competitive corporate tax system

2. Smarter Regulations
   • Early Engagement & Better Cost-Benefit Analyses using Best Available Science & International Best Practice

3. Trade Policy
   • Focus on non-tariff barriers and export control standardization

4. Energy Policy
   • Focus on energy efficiency & conservation
   • Increase and diversify domestic supplies
   • Speed the development of cost competitive, renewable sources of energy
   • Transition to low carbon economy
AMP ‘Top Line’ Recommendations

**Enabling Innovation**
- Establish a National Advanced Manufacturing Strategy
- Increase R&D Funding in Top Cross-Cutting Technologies
- Establish a National Network of Manufacturing Innovation Institutes
- Enhance Industry/University Collaboration in Advanced Manufacturing Research
- Foster a Robust Environment for Commercialization of Advanced Manufacturing Technologies
- Establish a National Advanced Manufacturing Portal

**Securing the Talent Pipeline**
- Correct Public Misconceptions about Manufacturing
- Tap the Talent Pool of Returning Veterans
- Invest in Community College Level Education
- Develop Partnerships to Provide Skills Certifications and Accreditation
- Enhance Advanced Manufacturing University Programs
- Launch Advanced Manufacturing Leadership Fellowships & Internships

**Improving the Business Climate**
- Enact Tax Reform, Streamline Regulatory Policy, Improve Trade Policy; Energy Strategy
Advanced Manufacturing Summary

• AMP recommendations aim to re-invent manufacturing in a way that ensures our competitiveness, feeds our innovation economy & grows a robust domestic manufacturing base.

• The recommendations focus on our future & the opportunity to lead the world in new disruptive advanced manufacturing technologies which are changing the face of manufacturing and in which the inherent strengths of US’s innovation economy can be brought to bear to create new opportunities for making things in America.

• We—industry, academia, communities and Federal, State & Local governments—must unite to ignite our ingenuity to make it in America.