National Network for Manufacturing Innovation

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GUIRR
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Interagency Advanced Manufacturing National Program Office (AMNPO)

Executive Office of the President

Advanced Manufacturing
Agency Leaders (NSTC)

Advanced Manufacturing
National Program Office
(housed at DOC - NIST)

Advanced Manufacturing
Partnership (AMP)

Advanced Manufacturing National Program Office
Agenda

- US Manufacturing Challenge
  - The Missing Middle – NNMI Positioning
  - NNMI Design
  - NNMI Characteristics
  - Next Steps
U.S. Trade Balance of Advanced Technology

- 12% of U.S. GDP
- 12 million U.S. jobs
- 60% of U.S. engineering and science jobs
- 47% of U.S. Exports
- Nearly 20% of the world’s manufactured value added

Source: Census Bureau
Products invented here, now made elsewhere - not driven by labor cost
Manufacturing Economic Impact

Manufacturing drives jobs throughout the economy, including in services.

Manufacturing has a higher multiplier effect on the economy than any other sector. For every $1 in manufacturing value added, $1.48 in additional value is created in other sectors.

Source: U.S. Department of Commerce, Bureau of Economic Analysis Council on Competitiveness
Manufacturing Innovation Impact

U.S. manufacturers

- Employ over half of all R&D personnel in domestic industry
- Employ over a third of all engineers
- Account for 70% of patents issued to U.S. entities

10% of employment

12% of gross domestic product

47% of exports

70% of private R&D spend
US Manufacturing Policy Milestones

January 2012

June 2011

REPORT TO THE PRESIDENT ON ENSURING AMERICAN LEADERSHIP IN ADVANCED MANUFACTURING

Executive Office of the President
President's Council of Advisors on Science and Technology

February 2012

A NATIONAL STRATEGIC PLAN FOR ADVANCED MANUFACTURING

Executive Office of the President
National Science and Technology Council

March 2012

July 2012

REPORT TO THE PRESIDENT ON CAPTURING DOMESTIC COMPETITIVE ADVANTAGE IN ADVANCED MANUFACTURING

Executive Office of the President
President's Council of Advisors on Science and Technology

August 2012

January 2013

NATIONAL NETWORK FOR MANUFACTURING INNOVATION: A PRELIMINARY DESIGN

Advanced Manufacturing National Program Office
National Network for Manufacturing Innovation

“institutes of manufacturing excellence where some of our most advanced engineering schools and our most innovative manufacturers collaborate on new ideas, new technology, new methods, new processes.”

President Obama announces NNMI, March 9, 2012

- Up to 15 institutes to underpin regional clusters of manufacturing innovation across the country, each with a unique focus
- Shared approaches to infrastructure, intellectual property, contract research, and performance metrics
- Also announces FY12 pilot institute
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The Missing Middle – Valley of Death

Not about government spend in TRL 4-7 projects!

Credit: Jack Hu

Advanced Manufacturing National Program Office
Focus on Scale Up – The Missing Middle

Basic science
Largely government funded

Commercialization
Private sector owned/funded

Basic science
$100M
DOE Energy Innovation Hub

$10M
NSF Engineering Research Center

$1M
NSF I/UCRC Center

$100K
State or Regional Center

Manufacturing Maturity
The Federal investment in the National Network for Manufacturing Innovation (NNMI) serves to create an effective manufacturing research infrastructure for U.S. industry and academia to solve industry-relevant problems. The NNMI will consist of linked Institutes for Manufacturing Innovation (IMIs) with common goals, but unique concentrations. In an IMI, industry, academia, and government partners leverage existing resources, collaborate, and co-invest to nurture manufacturing innovation and accelerate commercialization.

As sustainable manufacturing innovation hubs, IMIs will create, showcase, and deploy new capabilities, new products, and new processes that can impact commercial production. They will build workforce skills at all levels and enhance manufacturing capabilities in companies large and small. Institutes will draw together the best talents and capabilities from all the partners to build the proving grounds where innovations flourish and to help advance American domestic manufacturing.
Partnerships are Essential

Participation and Co-investment by partners is essential

- Large companies
- Small and medium enterprises

- State
- Regional
- Local

- Professional / industry associations
- Other

- Universities
- Community Colleges
- Career and Technical Institutes
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Public Engagement on Design
Workshops & Request for Information

Broad and Diverse Stakeholder Input

Industry 31%
Academia 31%
Economic Development 6%
Research & non-profits 8%
Federal State & Local Gov’t 14%
All Other 10%

Rensselaer Polytechnic Institute
Troy New York

Cuyahoga Community College
Cleveland Ohio

University of Colorado
Boulder, Colorado

National Academies Beckman Center
Irvine California

U.S. Space and Rocket Center
Huntsville, Alabama

Advanced Manufacturing National Program Office
NNMI Design Authors: ~1200 strong!
Institute Structure

**Institute for Manufacturing Innovation**
- Applied Research
- Technology Development
- Prototype Labs/shops
- Mfg. Software Development
- Education and Workforce Development

**Shared Use Facility**
- Manufacturing Demonstrations
- Technology Workshops
- Mfg. Technology Services

**National Network of IMIs**

**Academia**
- Universities & National Labs
- Community Colleges

**Industry**
- Large Manufacturing Companies
- Small & Medium Enterprises
- Start-ups

**Government**
- Federal Government
- State/Local Government
- Economic Development Organization
Detail: Industry Interactions

- Interactions are through **funding (green)**, **information (blue)** and **personnel (red)**.

- Institutes will have a low barrier to entry, and will interact with start-ups and SMEs.

- Information transfer is not limited to project results; an Industrial Commons promotes cross-talk.
Academia Interactions

- Interactions are through **funding (green), information (blue)** and **personnel (red)**.
- Community colleges are essential for workforce development tasks.
- Academia interactions are facilitated by the IMI.
Government and Network Interactions

- Each Institute will participate in the NNMI, web portal.
- Institutes will share resources.
- Institutes will direct projects to other institutes as appropriate.
- Government (federal and state) will provide funding and disseminate research results through manufacturing.gov.
Government Is Only Part of the Solution

• Federal investment of $70-120 million, with at least 50% match to establish a presence, at scale, in the “missing middle”.
• Designed to maximize industry impact, through a partnership between all stakeholders.
• Encourage participation of startups and SMEs
• Consortia of research universities, companies, community colleges, and others.
• Establishment of infrastructure for long-term sustainability.

Courtesy of John Vickers, NASA
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IMI Key Characteristics

- Institutes will be the anchor to a regional innovation ecosystem, with a vision for national and international preeminence.
- Institutes will be partnerships between all stakeholders: industry, academia, government, industry development organizations. Collaboration is critical.
- Each institute will have its own unique focus area, one of:
  - Manufacturing process
  - Advanced Materials
  - Enabling Technology
  - Industry Sector
- Institutes should be proposed by an industry-based non-profit organization. Focus areas will be ideally defined by proposing teams.
- Institutes will be self-sustaining after 7 years.
Suggested Technology Focus Areas from the RFI and Workshop

Flexible electronics, nano/micro, lightweight materials, personalized medicine, alternative energy, additive manufacturing, smart machining, pharmaceuticals, modeling and simulation, composite materials, coatings, energy storage, sensors, metal casting, advanced forming, advanced joining, robotics, peening, machining, other surface finishing, coal compact internal burning, convert truck fleets to natural gas, thermoplastic recycling, sensors for harsh conditions, machining, forming, molding, casting, assembly, forgings, joining, surface engineering, electro-optics, nanomanufacturing, miniaturized electronics, design tools and informatics, nanoelectronics, autonomy, superalloys, precision machining, rapid prototyping, organic electronics, nanocomposites, sensors, embedded technologies, remote sensing, renewable energy, strategy development, printed electronics, sustainable manufacturing, bioprocessing, nanomedicine, nanomaterials, micromanufacturing, stoichiometry in thin films and bulk materials, photonic integrated circuits, electro-optic materials and devices, polymeric-based web converting manufacturing platforms, sensors for diagnosis and control of manufacturing, renewable energy, biofuels, nano/bio manufacturing, digital model-based manufacturing, advanced materials, medical technology manufacturing, additive manufacturing, smart manufacturing, advanced/intelligent machining and fabrication, advanced metrology, digital manufacturing, advanced joining, near-net shape technologies, forging, extrusion, rolling, casting, powder, molding, hydroforming, composites manufacturing, advanced nanomaterials, next generation semiconductor technologies, MEMS/NEMS and embedded sensors, energy efficient technologies, dynamic machine tool management, Big Data, robotics, automation technologies, advanced magnets, joining technologies, in-situ metrology, powder metallurgy, electron beam, cryogenic techniques, coatings, repair welding, composites, maritime technologies, photovoltaics, biomimetic engineering (related to solar), materials characterization, laser-based processing, non-destructive evaluation, wafer fab and equipment, ceramics, sustainable manufacturing, digital manufacturing, mechatronics and cyberphysical manufacturing, optics and imaging, electronics assembly, IT systems, metamaterials, rapid prototyping via flexible manufacturing, wide bandgap manufacturing, advanced batteries...

All ideas are viable! Make the technical and business case...
Shared RD&D Facilities

INPUT: Innovators with **new production-enabling technologies**

- Advanced Manufacturing Technologies
- Traditional Manufacturing Technologies
- Modeling and Simulation Tools
- Process control / metrology
- Characterization and Testing Equipment
- Design Capabilities

OUTPUT: Data to demonstrate **business case** for manufacturing new materials or products:
- Processes established
- Production rate data
- Cost estimates based on production data
- Risks understood / quantified
- Partners Identified

OUTPUT: **Market adoption** of innovative new production-enabling technologies

INPUT: Innovators with ideas for **new materials or products**
Workforce Development and Education

• Each Institute will interact with academia (research universities and community colleges) to positively affect manufacturing curricula.

• Applied research, development, and demonstration projects will consider the potential to collaborate with educators as part of the design.

• Institutes will provide shared facilities to local industry, especially SMEs and startups, with the goal of scaling up laboratory demonstrations and making technologies ready for manufacture.

• To support education and training objectives of each IMI, facility sharing must include planning for the uses of facilities for education and training—both for advanced-knowledge workers and mid-level technicians.
IMI Proposal

• Proposing teams should demonstrate their focus area:
  • Has the potential to deliver regional and national improvements in advanced-manufacturing capabilities
  • Meets national needs
• IMIs should leverage existing regional or national innovation ecosystems or catalyze the formation and sustainability of new innovation clusters.
• IMIs will have a specific physical location and a clear lead organization; they will not be distributed or virtual.
• IMIs will have a regional focus with a plan for national and international preeminence.
• Activities will include
  • Applied research, development and demonstration projects
  • Education and training at all levels
  • Development of innovative methodologies and practices.

Multiple universities and Community colleges

Large companies and SMEs
Proposed Selection Criteria

- Technology focus
- RD&D plan
- Co-investments
- Broad Impacts
- Partner resources
- Financial Plan
- Education and Workforce Development Plan
- Adequacy of Governance and Oversight
Federal Funds: $70-120 million, over 5-7 years

Categories:
- Equipment, especially in first years
- Startup, administrative costs
- Base project grants, commitment with funded proposal
- Competitive project grants, allows a gate system to reward performance.

Institute investment of federal-only funds (does not illustrate matching funds or other revenue streams)
Importance of Creating the Network

- Promote collaboration between institutes
- Provide a forum for sharing best practices
- Establish common IMI Policies when appropriate
- Link activities through the Manufacturing Portal
Summary: Game Changing Characteristics

- Establish a presence, at scale, in the missing middle
- Partnering between all stakeholders
- An Industrial Commons
- Emphasizing/supporting longer-term investments by industry
- Combining R&D with workforce training
- A national network of Institutes
- Overarching mission: Create new U.S. manufacturing capabilities and industries - to grow high paying manufacturing jobs of the future
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Our first priority is making America a magnet for new jobs and manufacturing.

Last year, we created our first manufacturing innovation institute in Youngstown, Ohio. A once-shuttered warehouse is now a state-of-the-art lab where new workers are mastering the 3D printing that has the potential to revolutionize the way we make almost everything. There’s no reason this can’t happen in other towns.

So tonight, I’m announcing the launch of three more of these manufacturing hubs, where businesses will partner with the Departments of Defense and Energy to turn regions left behind by globalization into global centers of high-tech jobs.

And I ask this Congress to help create a network of fifteen of these hubs and guarantee that the next revolution in manufacturing is Made in America.

President Obama
State of the Union Address, February 13, 2013
Next Generation Power Electronics Manufacturing

Wide bandgap (WBG) semiconductors

- operate at much higher temperatures, voltages, and frequencies compared to Si.
- allow for smaller, lighter, faster, and more reliable power electronic components.
- enable more efficient distribution and use of electric power.
- need cutting-edge manufacturing processes that can produce high-quality, affordable devices.

<table>
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<th>Material</th>
<th>Chemical Symbol</th>
<th>Bandgap Energy (eV)</th>
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<tbody>
<tr>
<td>Germanium</td>
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<tr>
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<tr>
<td>Gallium Nitride</td>
<td>GaN</td>
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Poised to revolutionize the next generation of power electronics and clean energy innovations.
Lightweight and Modern Metals Manufacturing Innovation (LM3I) Institute

- New structural alloys face tremendous barriers to application due to lack of design guides and certifications as well as cost and scale-up challenges.

- The goal is to develop an advanced lightweight-metal supplier base for the U.S. to compete in the global market.

- Enable DOD to realize significant fuel reduction, increased payloads, and greater speed and agility of manned, unmanned, and soldier systems as well as benefits for commercial applications and energy savings.
Digital Manufacturing and Design Innovation (DMDI) Institute

• The DMDI Institute will provide the proving ground to link promising information technologies, tools, standards, models, sensors, controls, practices and skills, and then transition these capabilities to the industrial base for full-scale application.

• For example, proving and progressing intelligent electro-mechanical design and manufacturing capabilities from laboratory to prototype factory environments would improve production efficiencies and costs.

• Focus is the smart and comprehensive use of the ‘digital thread’ throughout design, production and support.
Next steps

• Solicitations and awards for three full scale manufacturing institutes this year
• DOE’s Clean Energy Manufacturing Initiative
• DOC’s solicitation for AMTech (Advanced Manufacturing Technology) Consortia Program
  • New program with initial funding in FY13
  • Grants for industry-led roadmapping and R&D consortia development
• NNMI design actively continues
Thank you

For questions or comments, please contact the Advanced Manufacturing National Program Office

amnpo@nist.gov

www.manufacturing.gov

301-975-2830

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