



**NCDMM**

NATIONAL CENTER FOR DEFENSE  
MANUFACTURING AND MACHINING

**delivering  
manufacturing  
innovation**

**Ralph Resnick  
President & Executive Director**

*Photo by U.S. Army*

[ncdmm.org](http://ncdmm.org)

# who are we?

- non-profit
- mission focused
- project based
- collaboration
- manufacturing solutions



*Photo by U.S. Navy*

[ncdmm.org](http://ncdmm.org)

**...since 2003**



**NCDMM**  
NATIONAL CENTER FOR DEFENSE  
MANUFACTURING AND MACHINING



**celebrating a decade & innovating the future**

*Photo by U.S. Army*

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# how do we do it?

collaborate...

*...with government, industry,  
and academia to promote  
best practices and deliver  
them to key stakeholders*

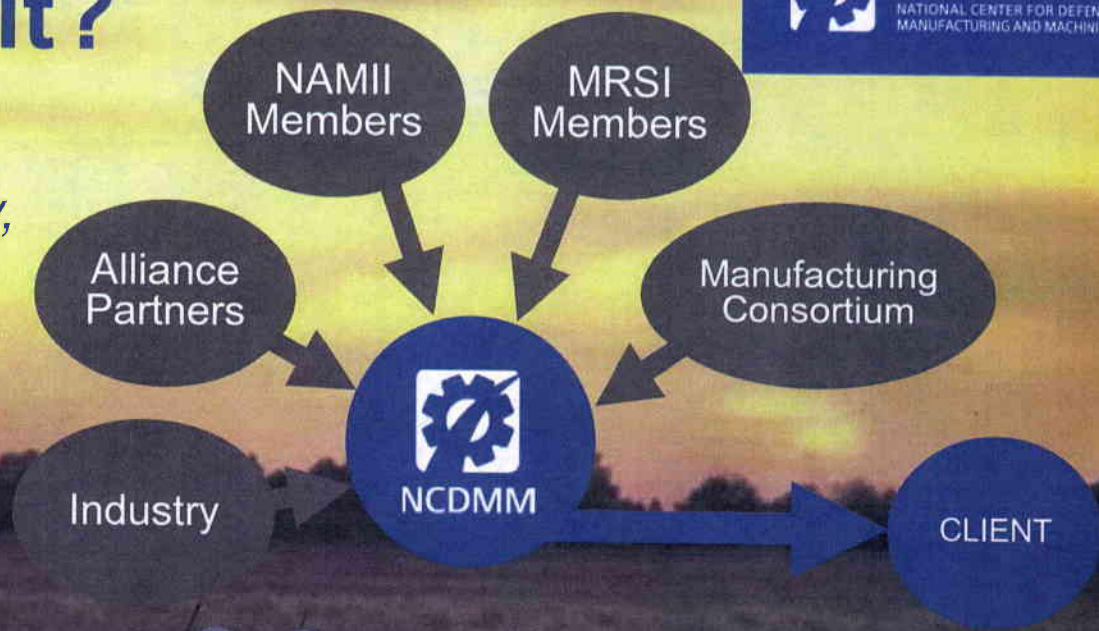
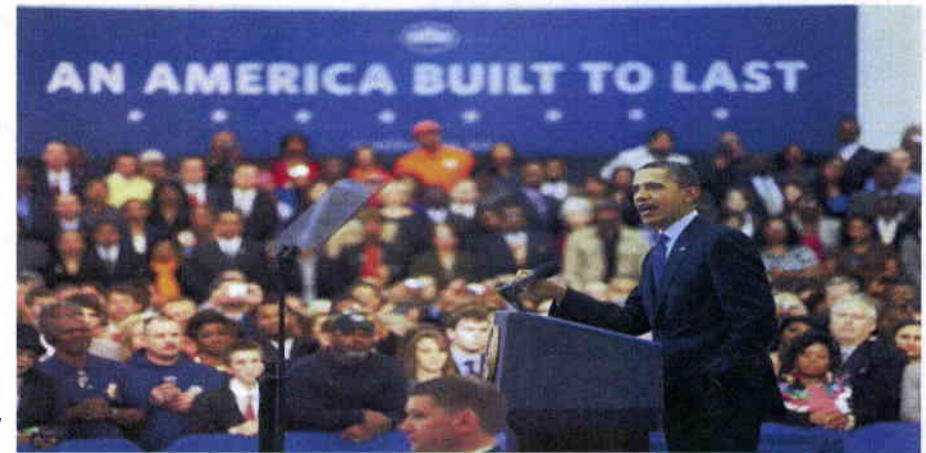


Photo by U.S. Army

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## National Network for Manufacturing Innovation (NNMI) and pilot institute Announcement

- Proposed one-time, \$1B investment (FY13) for up to 15 institutes
- Close the gap between R&D and deployment of technological innovations in domestic production of goods  
*"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 at Rolls-Royce Crosspointe Petersburg, VA – March 9, 2012

*"We Can't Wait"* – use existing resources and authorities to demonstrate concept through a pilot institute – select competitively – fit within agencies missions

NATIONAL  
**NAMII**  
 ADDITIVE MANUFACTURING  
 INNOVATION INSTITUTE

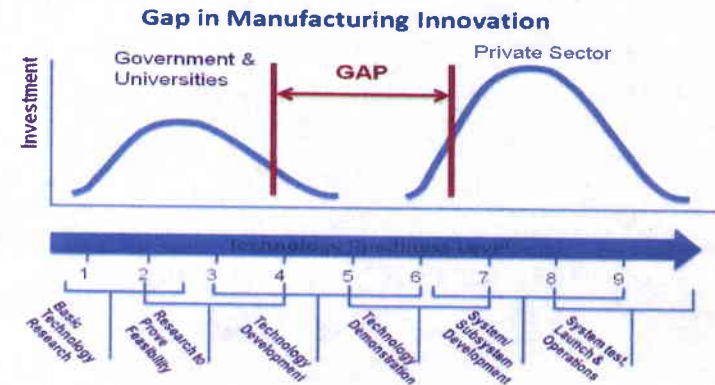
driven by



- A Defense-wide Manufacturing S&T team-led, Multi-agency collaboration between industry, government and universities
- Public-private partnership



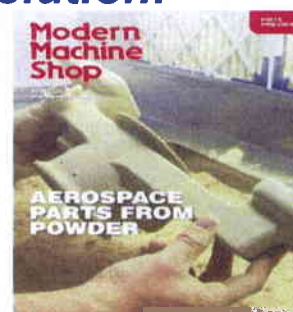
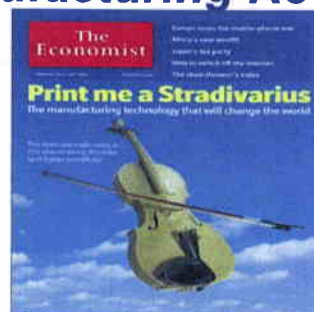
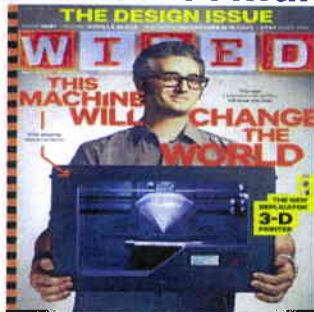
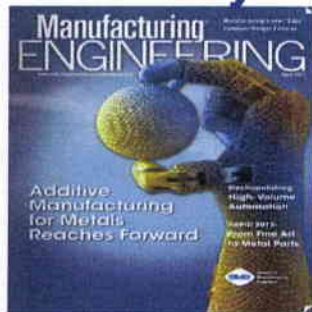
- Shared facilities open to industry
  - Especially attractive to small businesses
- Enabling technology transition and commercialization
- Addressing Technology Readiness Level (TRL) / Manufacturing Readiness Level (MRL) 4-7
  - Bridge the gap in Manufacturing Innovation
- Educational plan to train the future workforce
- Sustainable within 3 years



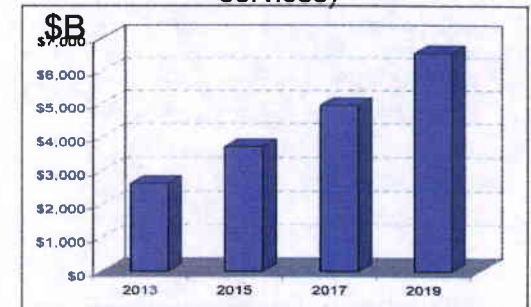
*A Model for Manufacturing Innovation Institutes within NNMI*



## Why Additive? A Manufacturing Revolution!



Projected AM Sales (products and services)



Source: Wohlers Associates, Inc.

"20% of output of 3D printers is now final products, rather than prototypes. By 2020 it may be 50%." – *The Economist* (2011)



Government agency investments and interest - throughout NASA, DoD, and DOE

Consumer Product Market



GE Aviation

**100k** Additive parts will be manufactured by GE Aviation by 2020



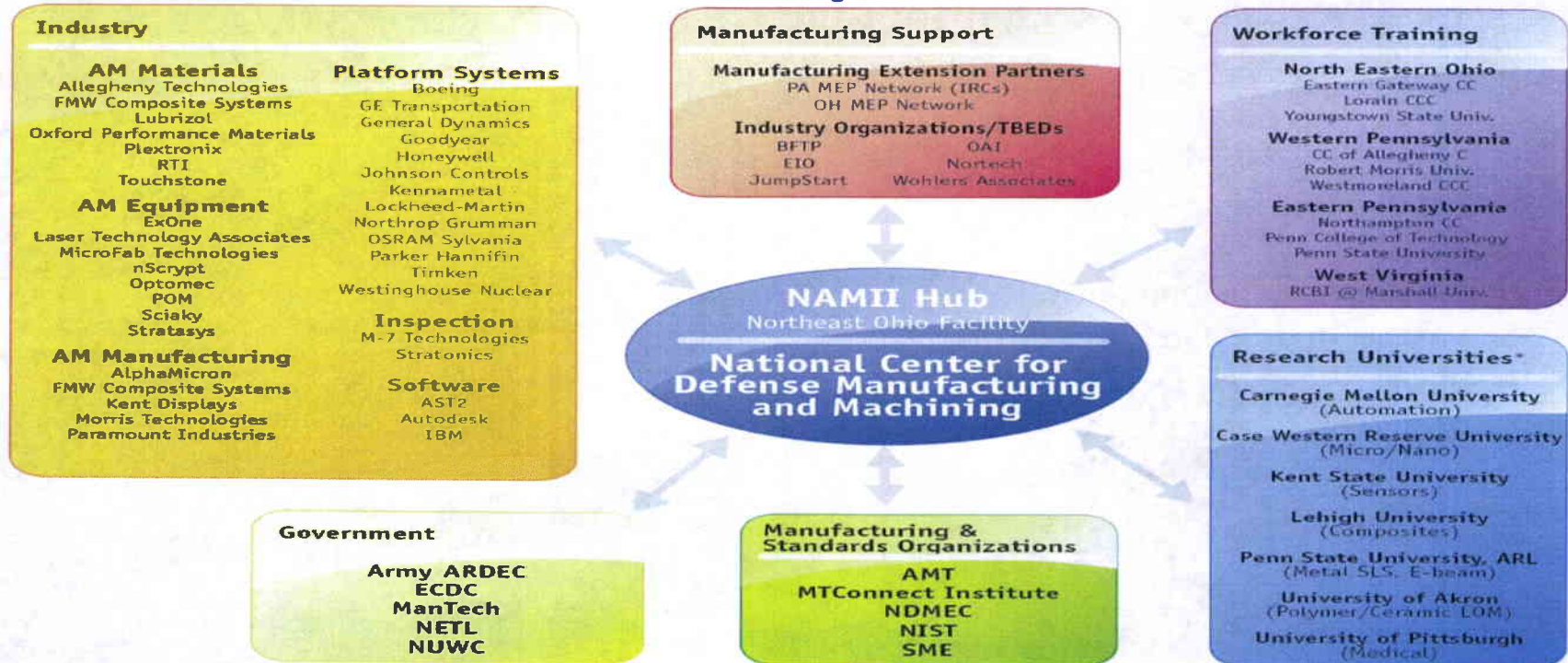
**1k lbs.** Potential reduction in weight of a single aircraft engine through additive production

**300+** 3D Printing Machines currently in use across GE

<http://www.ge.com/stories/additive-manufacturing>



# NAMII Initial Proposal Partners





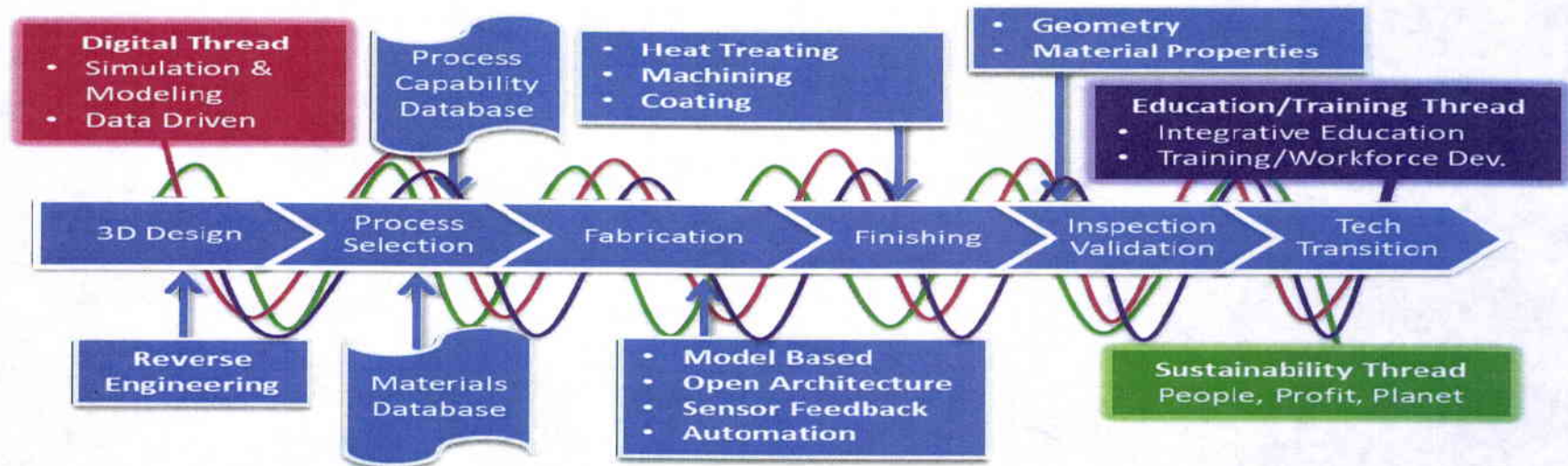
## Announcement: Aug 16, 2012

### Prime Awardee: National Center for Defense Mfg. & Machining (NCDMM)

- Providing ~\$40M cost share
  - ~ \$20M from industry
  - ~ \$48M available for projects
- Strong leveraging of equipment and existing resources
- Strong business development
- Ties to many organic facilities
- Tiered membership based model

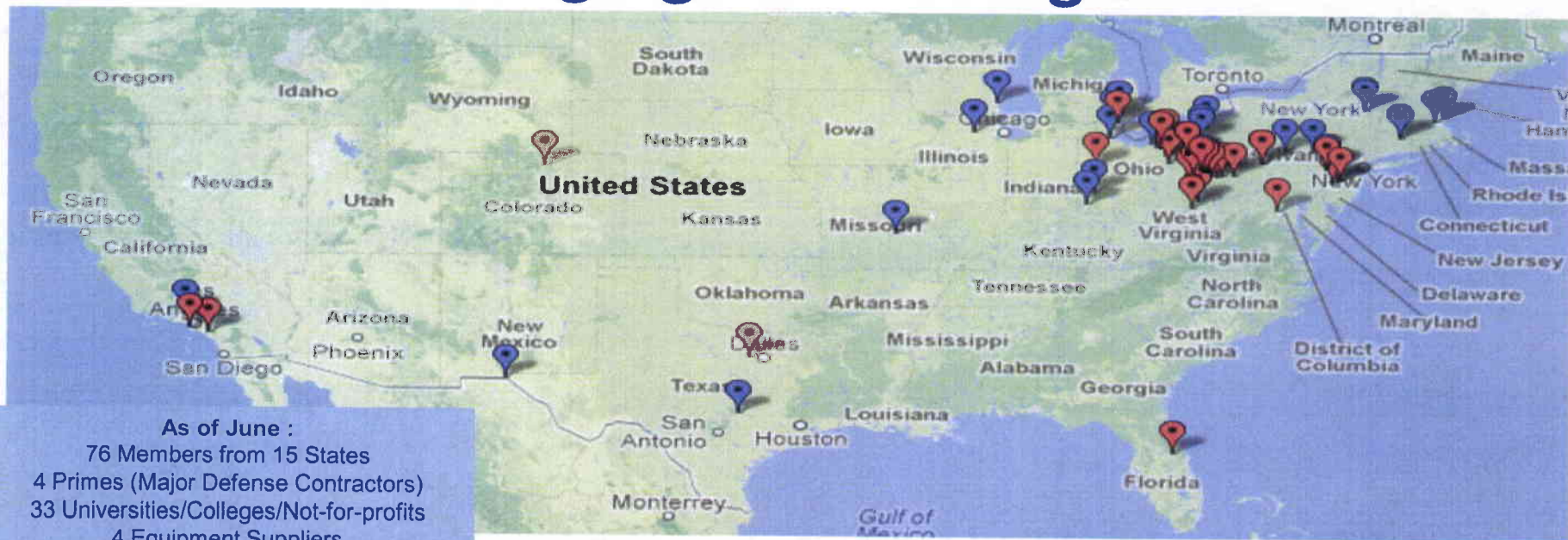


## Strong, Holistic, Integrated Technology Plan



- Process development: metals, polymers, ceramics, electronics, hybrid
- Digital thread / Advanced Mfg Enterprise
- Specialized, portable AM systems
- Open Architecture
- Process planning
- Process Control
- Material Development
- Component Design

## Teaming Agreement Signees



As of June :

- 76 Members from 15 States
- 4 Primes (Major Defense Contractors)
- 33 Universities/Colleges/Not-for-profits
- 4 Equipment Suppliers
- 17 Small & Medium Businesses
- \$39.9M Cost Share Proposed
- \$5.0M Project Call 1 Cost Share

📍 Original Member   
 📍 New Member

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**Technology Innovation Factory (9/27/13 Ribbon Cutting)  
Youngstown Business Incubator Annex Building**

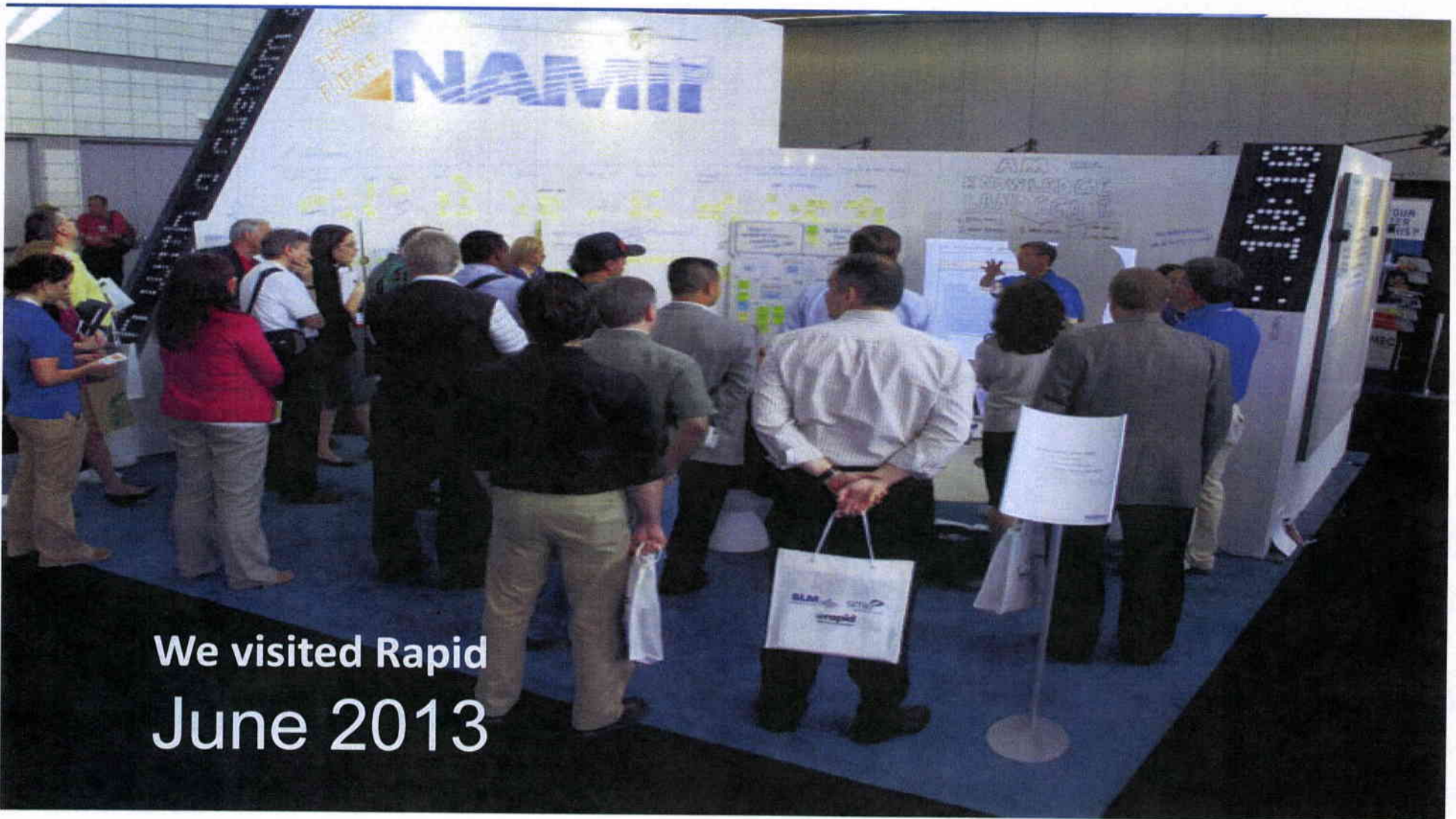


**Project Call #1: 6 Projects with 35 Partners**  
**\$9.5M (\$4.5M gov't share)**

Title	Lead Organization	Key Outcomes
<i>Maturation of Fused Depositing Modeling (FDM) Component Manufacturing</i>	<b>Rapid Prototype + Manufacturing LLC (rp+m)</b> 	Design guide; critical materials and processing data; and machine, material, part and process certification for ULTEM™ 9085
<i>Maturation of High-Temperature Selective Laser Sintering (SLS) Technologies and Infrastructure</i>	<b>Northrop Grumman Aerospace Systems</b> 	Development of lower-cost, high-temperature selective laser sintering (SLS) process for making air and space vehicle components and other commercial applications. Ability to recycle material
<i>Sparse-Build and Complex Rapid Tooling by Fused Depositing Modeling (FDM)</i>	<b>Missouri University of S&amp;T</b> <b>Northrop Grumman Aero Systems</b>  	Lower-cost, energy-saving, sparse-build tooling for composite manufacturing and metal hydroforming using ULTEM™ 9085
<i>Rapid Qualification Methods for Powder Bed Direct Metal Additive Manufacturing Processes</i>	<b>Case Western Reserve University</b> 	Understand and control of microstructure and mechanical properties across Laser Sintering and Electron Beam Melting (EBM*) processes.
<i>Thermal Imaging for Process Monitoring and Control of Additive Manufacturing</i>	<b>Penn State University</b> 	Thermal imaging for process monitoring and control of electron beam direct manufacturing (EBDM) and laser engineered net shaping (LENS) additive mfg
<i>Qualification of Additive Mfg Processes and Procedures for Repurposing/Rejuvenation of Tooling</i>	<b>Case Western Reserve University</b> 	Development, evaluation, and qualification of methods for repairing and repurposing tools and dies

# Project Call 1 Participants





We visited Rapid  
June 2013



## Project Call #2

- Allocate \$10-15 M government funding
- Incorporate technical strategy development
- Challenges/Prizes in consideration
- Complete gov't AM program baseline
- Crowdsourcing input from RAPID
- Incorporating Lessons Learned from Project Call #1
  - Greater emphasis on small business benefit
  - Emphasize need for greater impact to industrial base
  - Larger teaming



## Recent Public Acknowledgements

### “State of the Union” – 12 Feb 2013

“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.”



### Brookings Institute / Rockefeller Foundation

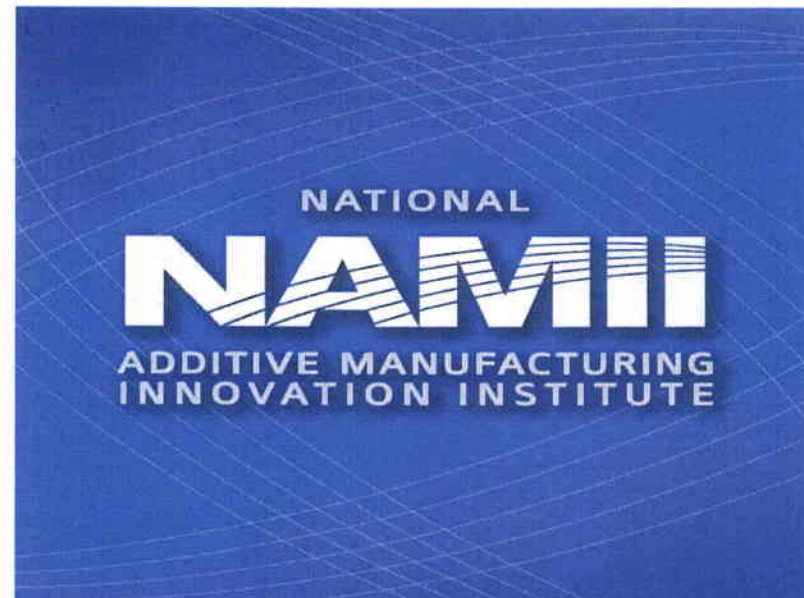
This year’s list of “Innovations to Watch” represents the most forward-thinking and effective solutions that are now being implemented by America’s states and metropolitan areas

#### NAMII IN THE NEWS

NAMII named as one of the  
Top Ten Most Innovative Initiatives  
to watch in 2013

BROOKINGS METROPOLITAN POLICY PROGRAM  
ROCKEFELLER FOUNDATION

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