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Manufacturing USA Program Update
NIST Visiting Committee On Advanced Technology

June 6, 2018

Frank W. Gayle, Deputy Director
NIST Office of Advanced Manufacturing and the
Advanced Manufacturing National Program Office

An interagency team building partnerships with U.S. industry and academia

Topics

1. Background and status
2. NIST Role Overseeing Manufacturing USA®
3. How an Institute Works: NIIMBL
4. What's Ahead

Manufacturing USA Background

Mission

Connecting people, ideas, and technology to solve industry-relevant advanced manufacturing challenges, thereby enhancing industrial competitiveness and economic growth and strengthening our national security.

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Vision

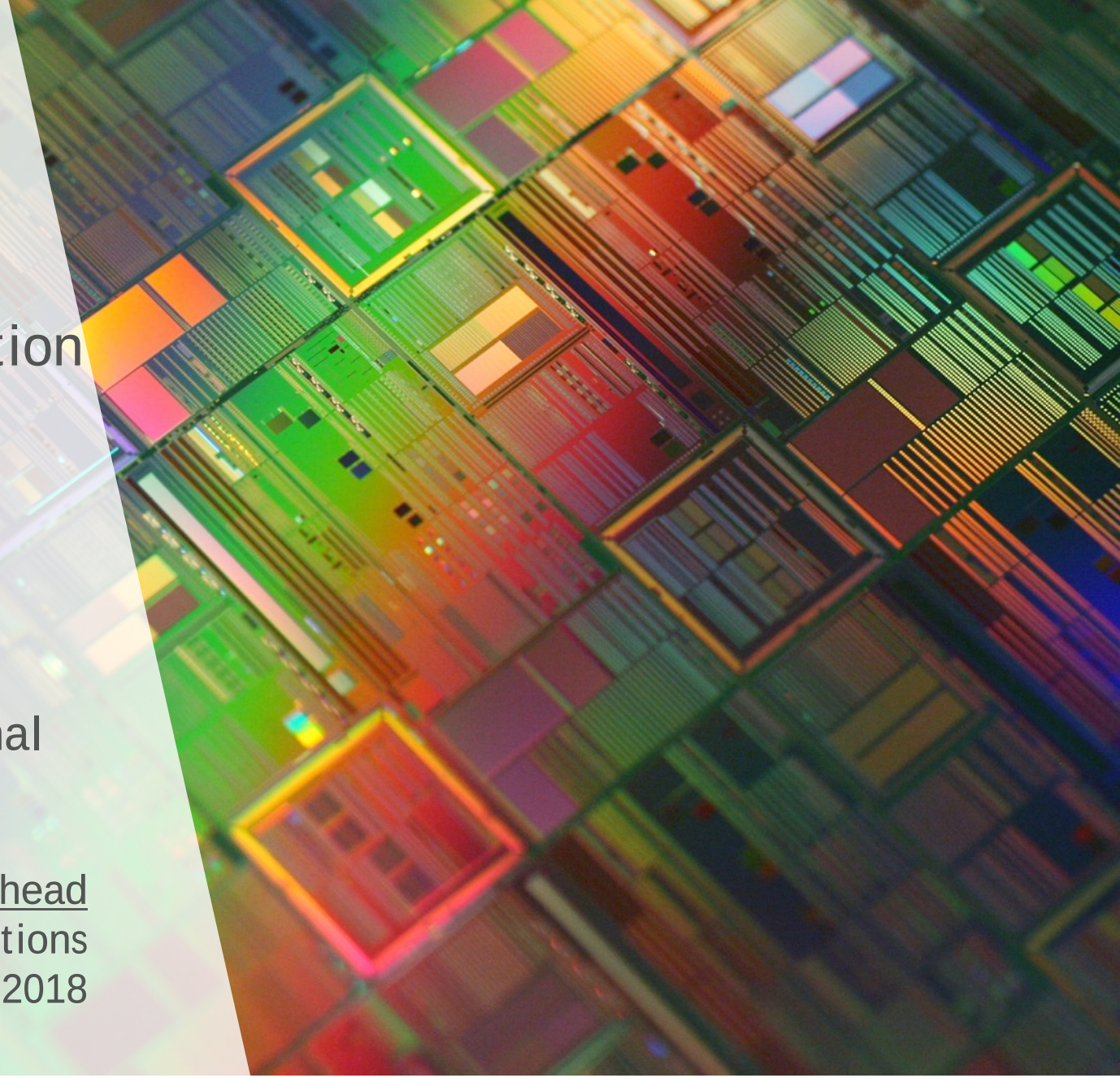
U.S. global leadership in advanced manufacturing

Addressing **National Needs**

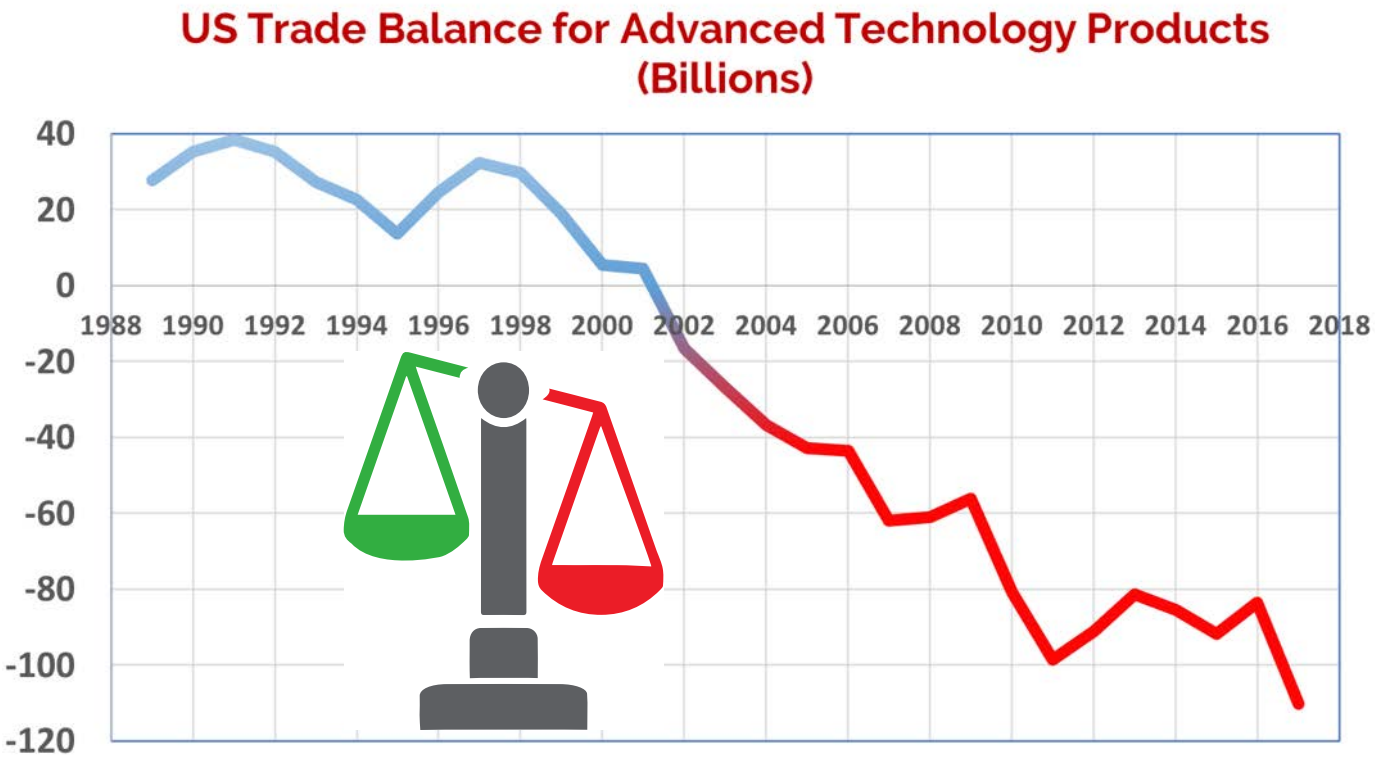
- The U.S. leads the world in innovation and inventions
- But the manufacturing capabilities and new products get developed in other countries instead

"Embracing technological innovation and speeding adoption are critical for U.S national security and economic competitiveness."

The Work Ahead
Council on Foreign Relations
April 2018

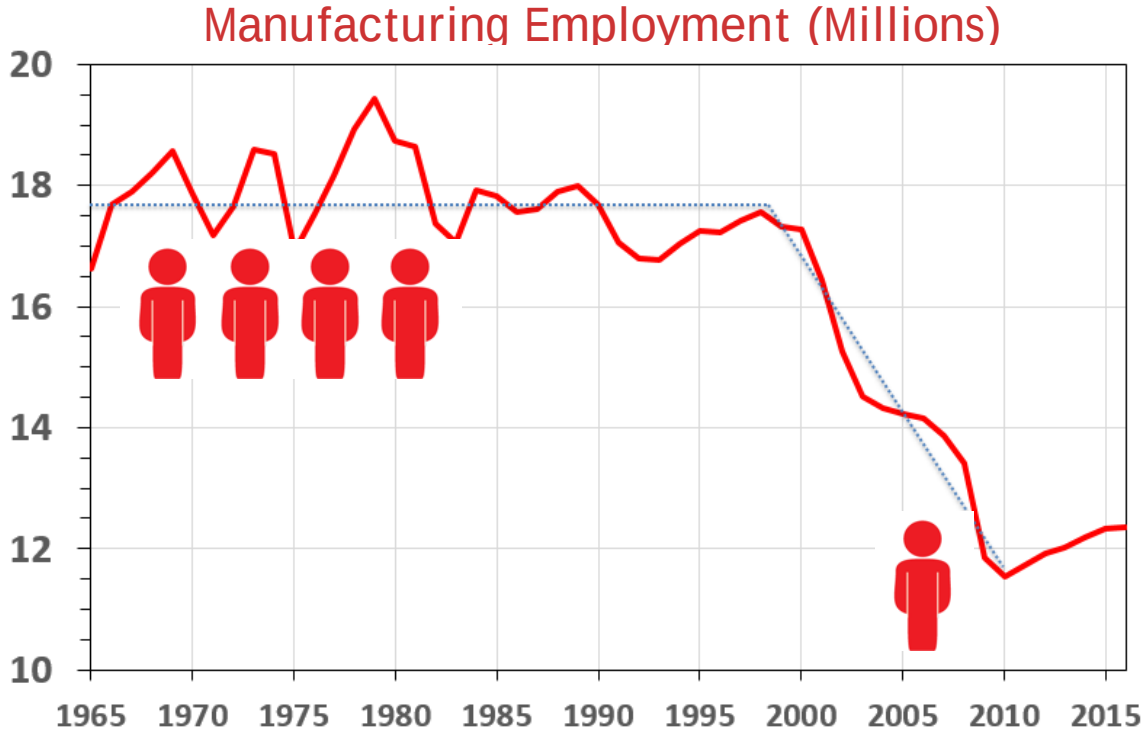


Why Manufacturing USA



Revitalize American Manufacturing and Innovation (RAMI) Act

- 118 bipartisan co-sponsors
- Signed into law December 16, 2014



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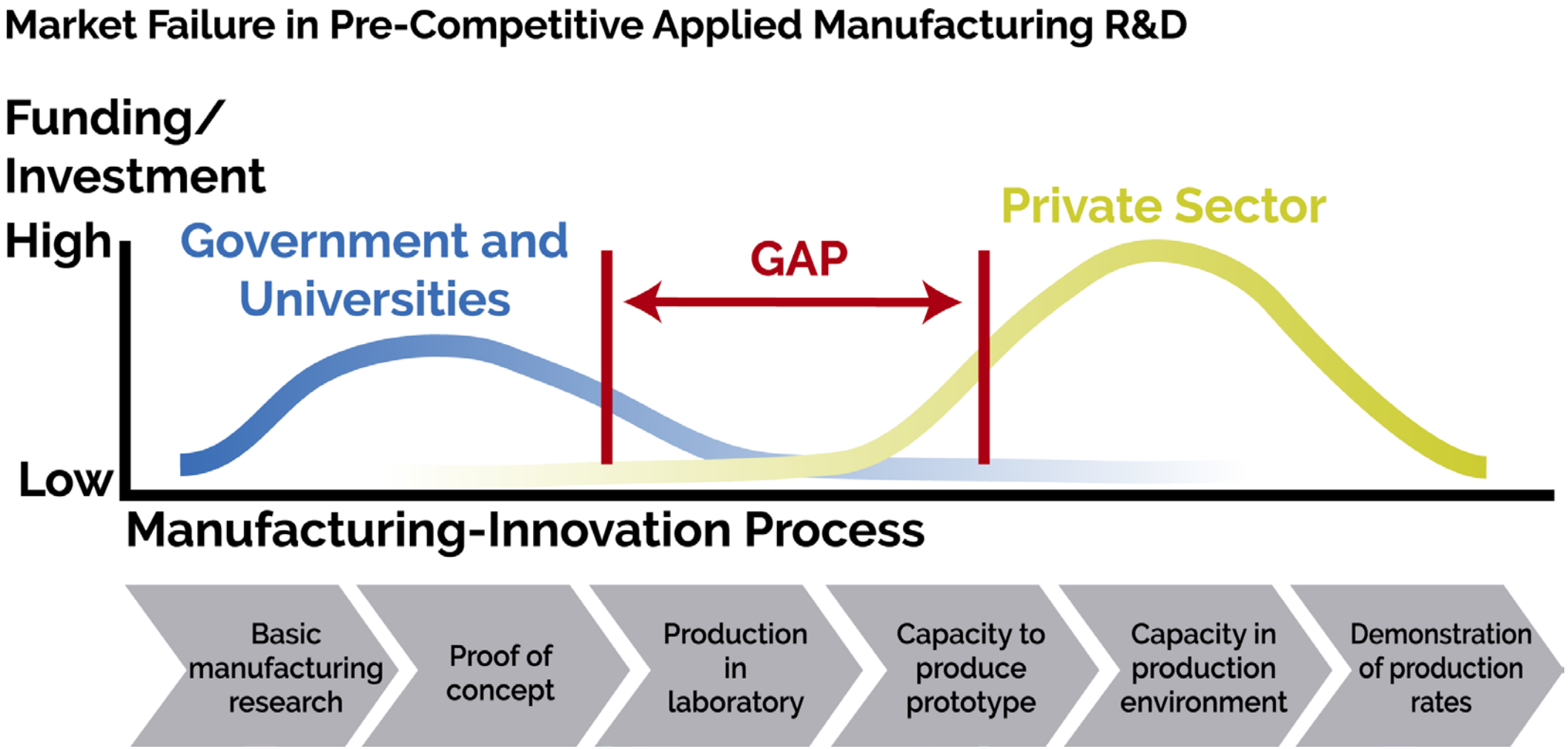
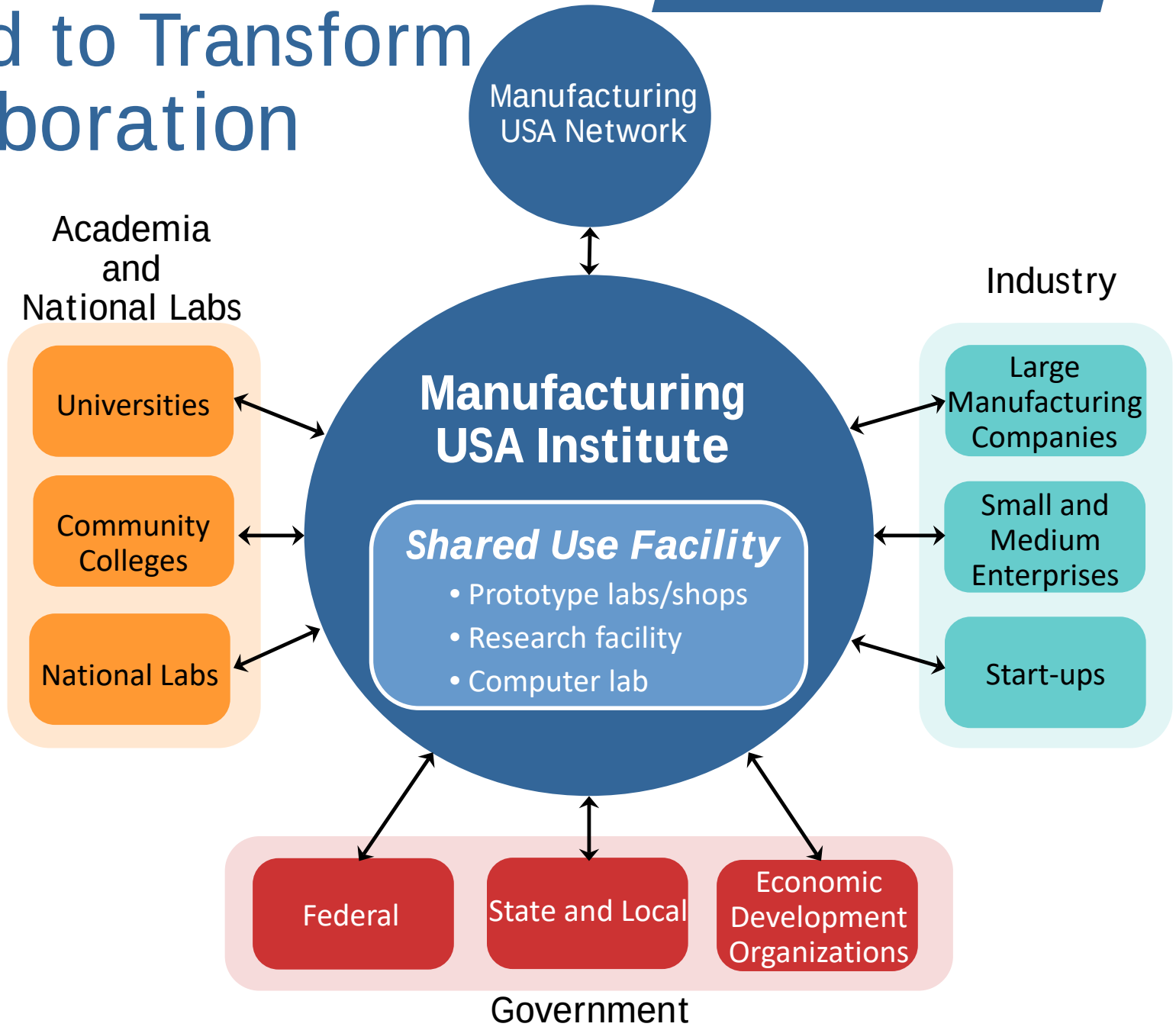
Manufacturing USA Technology Projects
Bridge Gaps



Institutes Designed to Transform Technology Collaboration



Institute Technologies

* New in FY17

Electronics

Integrated Photonics
Albany, NY
Rochester, NY

Flexible Hybrid Electronics
San Jose, CA

Wide Bandgap Semiconductors
Raleigh, NC

Materials

Advanced Fibers and Textiles
Cambridge MA

Advanced Composites
Knoxville, TN
Detroit, MI

Lightweight Metals
Detroit, MI

Bio-Manufacturing

Regenerative Manufacturing *
Manchester, NH

Bio-pharmaceutical Manufacturing *
Newark, DE

Energy Usage / Environmental Impact

Modular Chemical Process Intensification *
New York, NY

Sustainable Manufacturing *
Rochester, NY

Smart Sensors and Digital Process Control *
Los Angeles, CA

Digital Automation

Additive Manufacturing
Youngstown, OH
El Paso, TX

Advanced Robotics *
Pittsburgh, PA

Digital Manufacturing & Design
Chicago, IL

<u>14 institutes</u>
- 8 DOD
- 5 DOE
- 1 DOC/NIST

<u>Commitment</u>
$1 B Federal
$2 B non-federal

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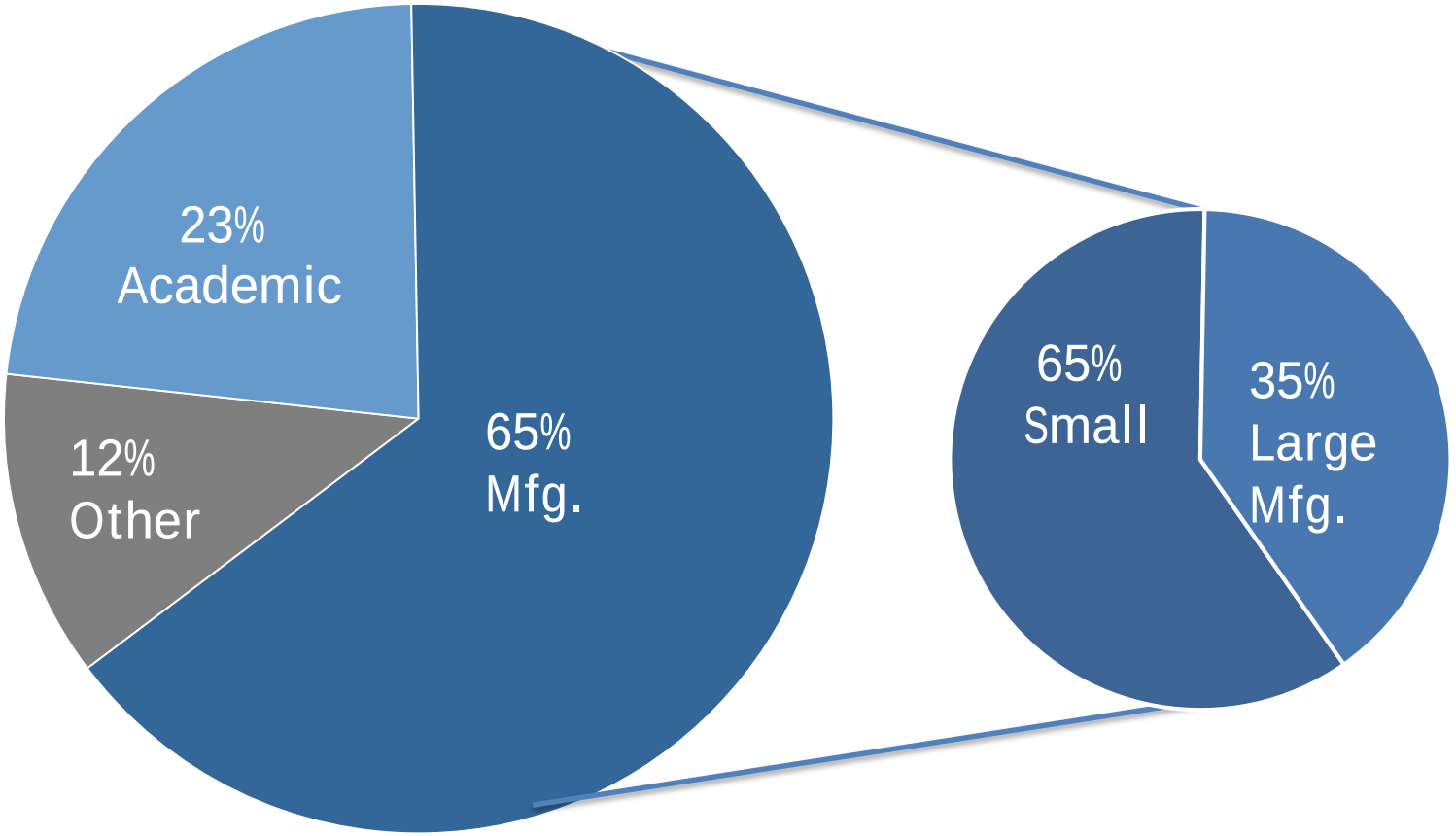
Led by Industry: Impact to U.S. Innovation Ecosystem



1,291 members (FY 2017)

- **+50% increase** in membership over 2016
- **65% from industry**
  - 65% of manufacturers are small and medium-sized
- **297** universities, community colleges, and other academic institutions
- **150** federal, state, and local government, federal laboratories, and not-for-profits

Membership breakdown of 12 institutes in FY 2017

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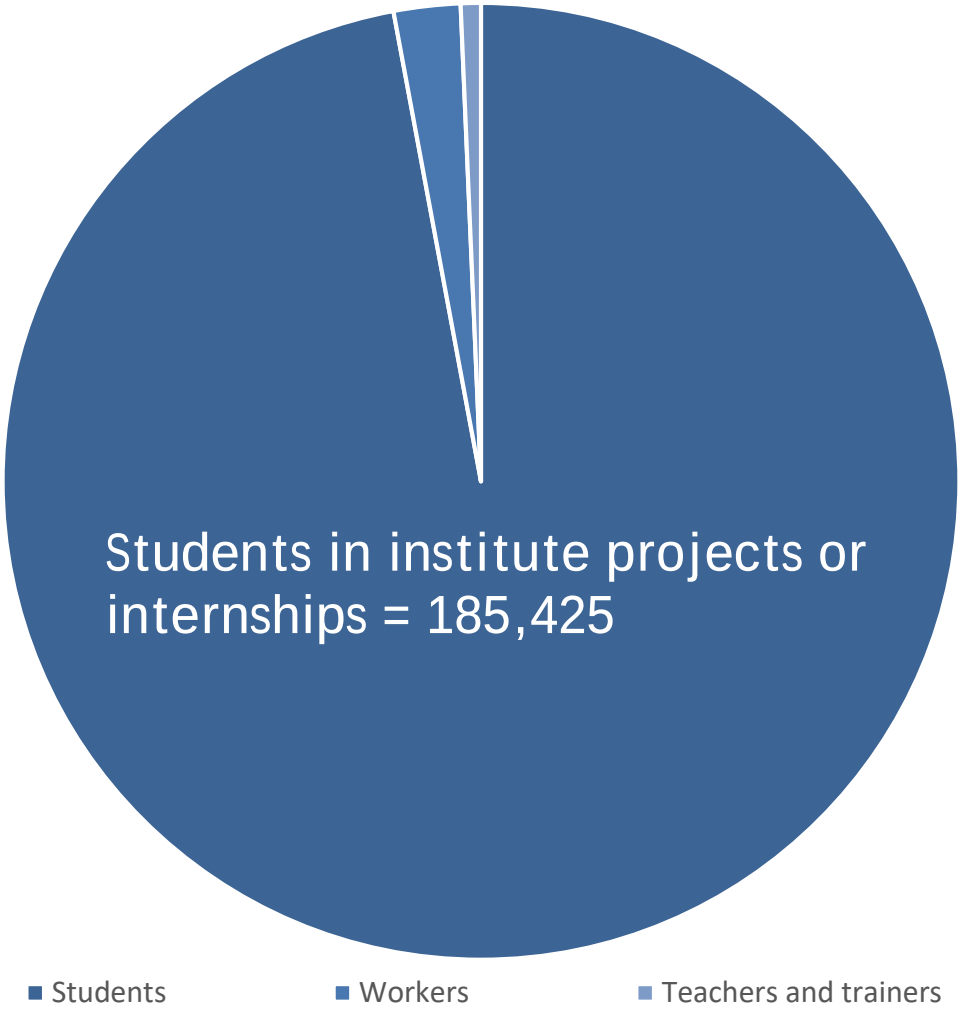
Developing an Advanced MFG Workforce



Nearly **200,000 people** participated in workforce development training programs

→ **7X increase** from 2016

- **185,425 students** in institute research and development projects, internships, or training
- 4,302 workers completed institute-led certificate, apprenticeship, or training programs
- 1,299 teachers and trainers in institute-led training for instructors

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Technology Advancement

273 Major Collaborative R&D Projects in FY 2017

- Many collaborative technology R&D projects can take several years to conclude
- High level of participation by industry + progress in meeting technical objectives are early indicators of success

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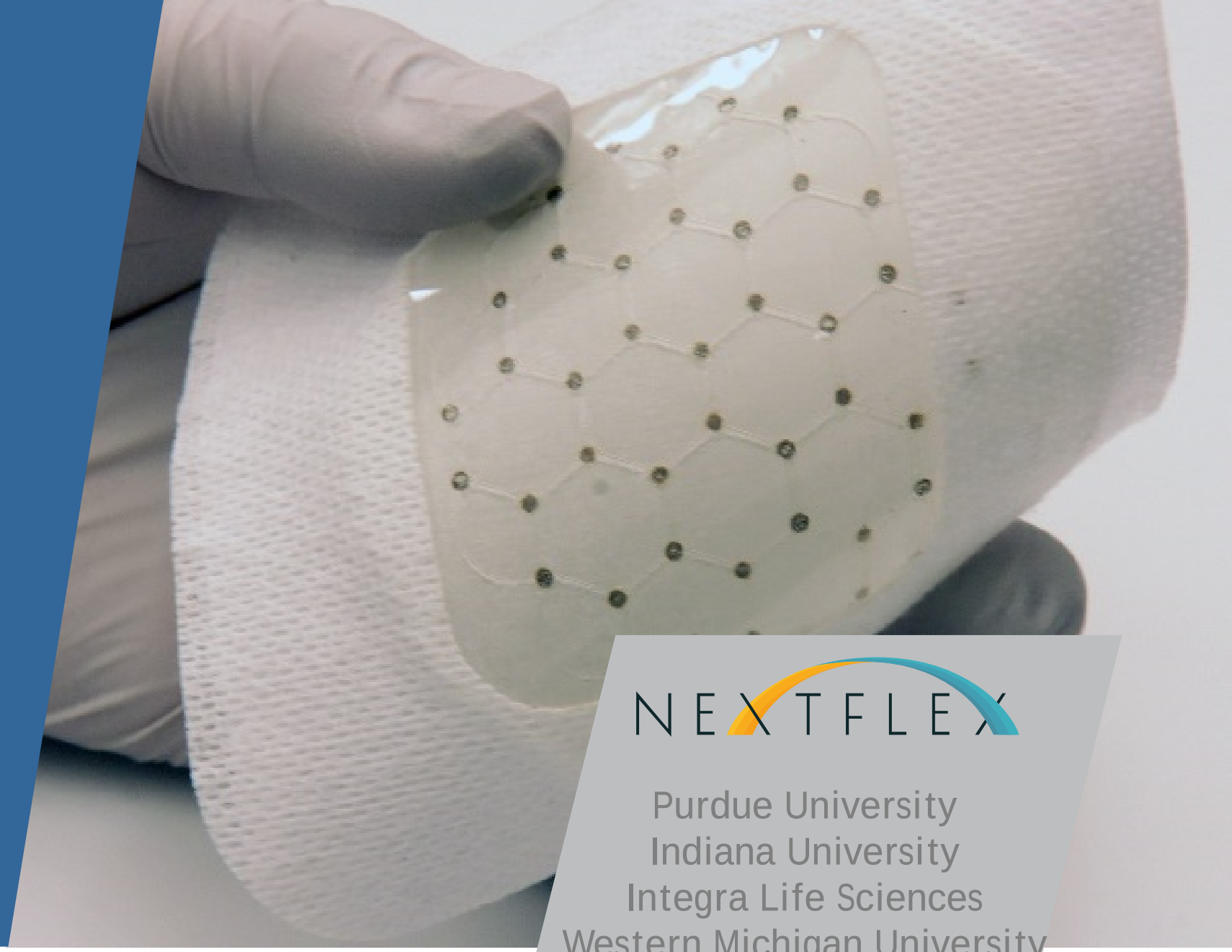
Project Highlight

Smart Bandage

Partners Collaborate on New Medical Products

- Flexible and conformable smart wound dressing
- Senses and controls oxygen to speed healing at low cost
- Sensing system provides medical staff continuous data about the patient



NEXTFLEX

Purdue University
Indiana University
Integra Life Sciences
Western Michigan University

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Project Highlight

Partnering to Accelerate Energy Innovation

9 meter wind turbine blade is

- Lighter
- Less expensive
- Stronger
- More energy-efficient

Manufacturing

- Production time is reduced
- Costs are reduced

The Institute for iacmi Advanced Composites Manufacturing Innovation

THE COMPOSITES INSTITUTE

Oak Ridge National Labs
Colorado Office of Economic Trade and Development
SMMs

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Project Highlight

Digitizing Legacy Equipment

Partners Develop New Computer Vision Toolkit

- Cameras read legacy displays + control dials to digitize information for emerging industry-standard format
- Software and hardware toolkit will cost <$1,000 per machine
- Even the smallest manufacturer can update processes without replacing costly legacy equipment
- Open source framework

DMDII
a UI LABS Collaboration

University of Cincinnati
Raytheon
Faurecia
ITI
TechSolve

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Project Highlight

Reaching the Next Generation: Girls of Steel Robotics®

- Founded in 2010 at Carnegie Mellon University
- Participates in *FIRST* competitions
- Building a pipeline through programming for middle school girls
- Summer camps also offered in underserved areas
- **65 Girls of Steel alumnae, 85% pursuing STEM fields in college**
- Plans to expand the program nationally through ARM's Regional Collaboratives

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NIST Role with **Manufacturing USA**

NIST Congressional Responsibilities

Revitalize American Manufacturing and Innovation Act

RAMI Calls Upon the U.S. Secretary of Commerce to Establish:

Manufacturing USA Program: to convene and support a network of institutes (network function)

National Program Office at NIST: to oversee and carry out the Program

New Institutes: using open topic competitions

***And*, established role of MEP**

NIST Functions Leading the **National Program Office**

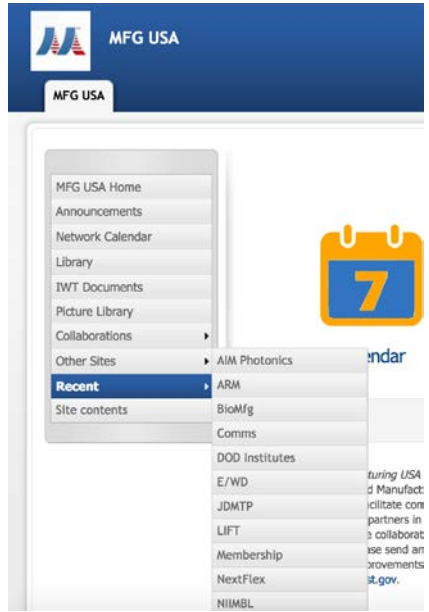
Coordination

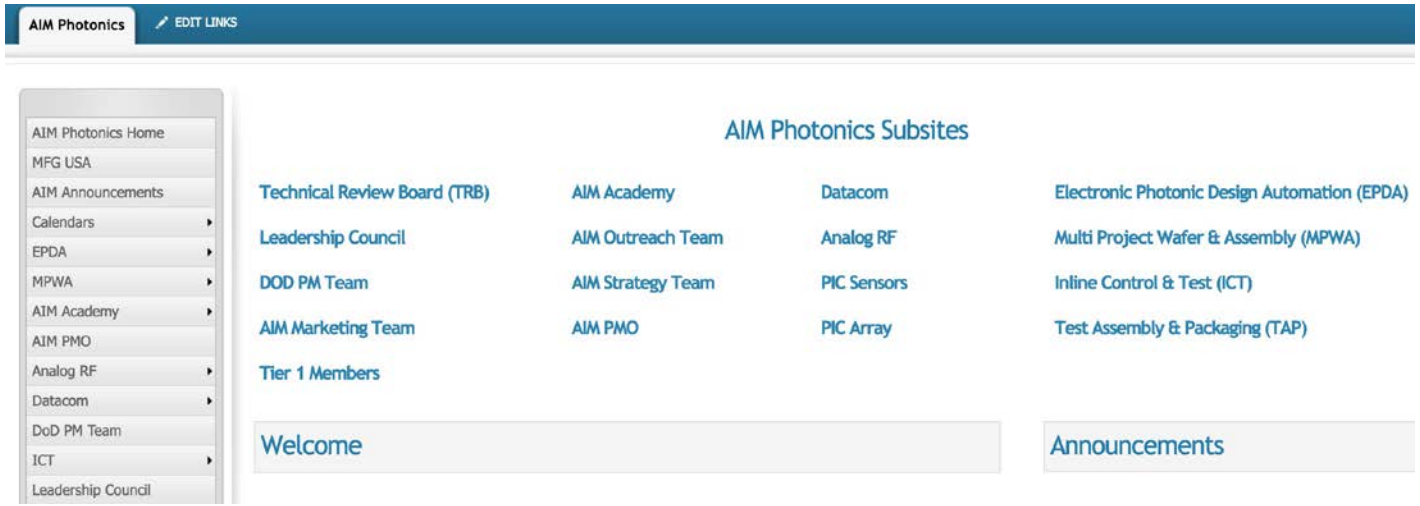
- Network meetings (biannual)
- Institute Directors (monthly)
- Interagency meetings (biweekly)
- Communications Team (biweekly)
- Education/Workforce Team (biweekly)
- Task Teams (three)
- Institute Directors Council

NIST Functions Leading the **National Program Office**

Network Support

- Online Shared Services
  - Resource of best practices, reference materials, program calendar
- Secure Collaboration Sites
  - Provided to all institutes and agencies
  - Used by cross-institute teams, interagency teams
  - Five institutes use this as their internal institute collaboration





NIST Functions Leading the **National Program Office**

Communications

- ManufacturingUSA.com
- Manufacturing.gov
- Manufacturing USA Annual Report
- Manufacturing USA Strategic Plan

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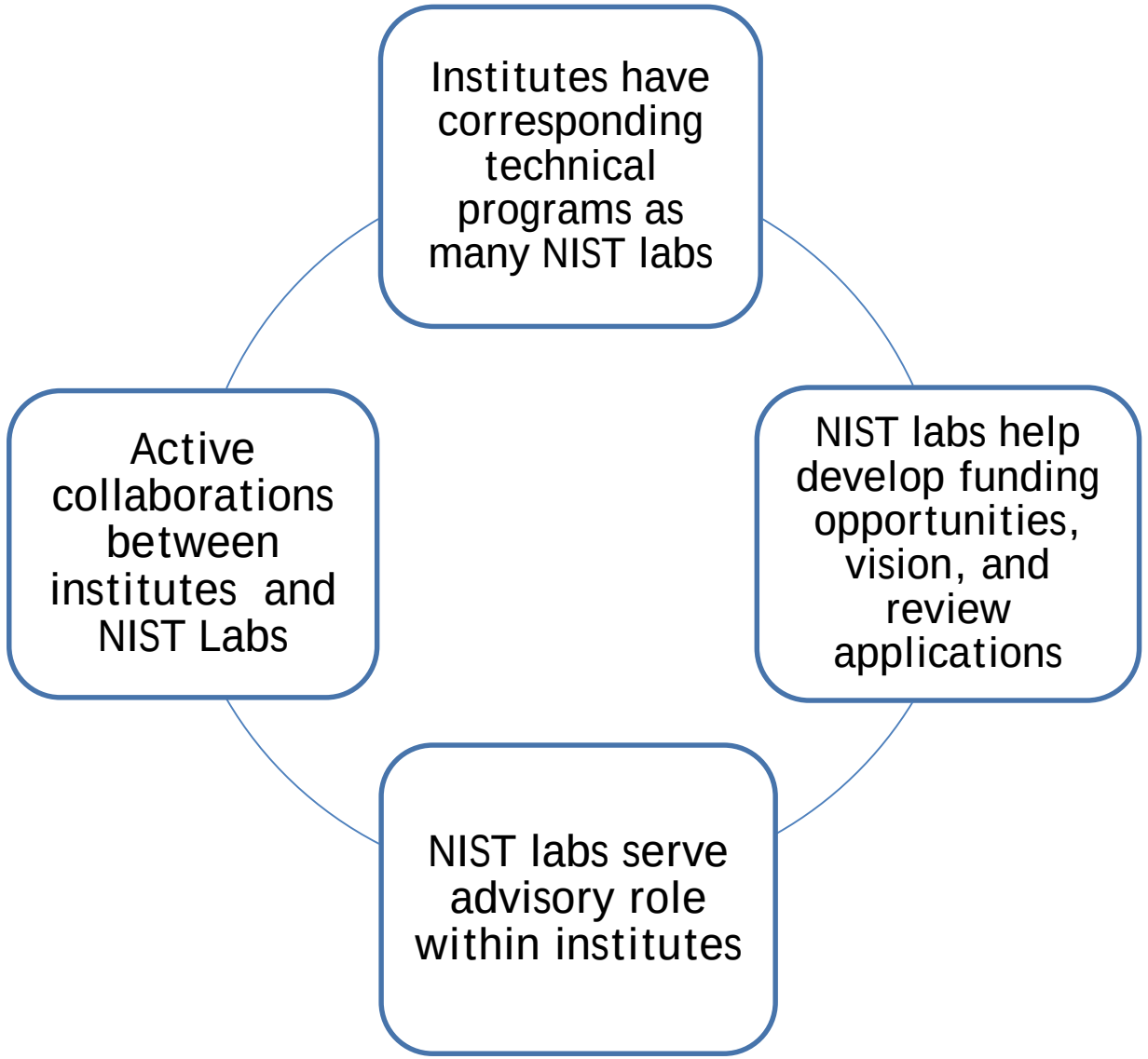
NIST Laboratory Programs Well **Engaged with Institutes**



AMTECH
Advanced Manufacturing Technology Consortia

- 35 awards 2013 – 2015
- 22 Roadmaps published
- Program to catalyze industry-driven technology consortia in areas of national importance
- Many projects and roadmaps were leveraged to form Manufacturing USA institutes
- Consortia formed from AMTech projects are still involved in Manufacturing USA institutes

Manufacturing USA Institutes	Number of Interactions with AMTech
AIM Photonics	2
America Makes	9
DMDII	1
IACMI	4
LIFT	1
NextFlex	1
NIIMBL	3
Power America	1
REMADE	2

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AMTech Projects Underpin
Formation of Manufacturing USA Institutes

Manufacturing USA Institutes	Foundational Documents
AIM photonics	• National Technology Roadmaps for Photonics • Photonic System Manufacturing Consortium
DMDII a UI LABS Collaboration	• MTConnect Roadmap Strategy to Promote Advanced Manufacturing in the US
lift	• Consortium for Innovation in Sheet Metal Forming
NIMBL	• Cell Manufacturing Consortium • Advanced Lyophilization Technology • Biomanufacturing Science and Technology Consortium to Advance U.S. Manufacturing of Biopharmaceuticals
REMADE INSTITUTE	• Consortium Formation and Technology Roadmap Development for Remanufacturing in the Circular Economy

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Manufacturing USA
Institutes & MEP

NEXTFLEX
Flexible Hybrid Electronics
San Jose, CA

DMDII a UI LABS Collaboration
Digital Manufacturing & Design
Chicago, IL

REMADE INSTITUTE
Sustainable Manufacturing
Rochester, NY

AIM photonics
Integrated Photonics
Albany, NY
Rochester, NY

biofabusa
Regenerative Manufacturing
Manchester, NH

affoa
Advanced Fibers and Textiles
Cambridge, MA

RAPID Transforming Process Industries
Modular Chemical Process Intensification
New York, NY

CLEAN ENERGY SMART MANUFACTURING INNOVATION INSTITUTE
Smart Sensors and Digital Process Control
Los Angeles, CA

NIIMBL The National Institute for Innovation in Manufacturing Biopharmaceuticals
Bio-pharmaceutical Manufacturing
Newark, DE

lift
Lightweight Metals
Detroit, MI

America Makes
Additive Manufacturing
Youngstown, OH
El Paso, TX

THE COMPOSITES iacmi INSTITUTE
Advanced Composites
Knoxville, TN
Detroit, MI

ARM
Advanced Robotics
Pittsburgh, PA

POWERAMERICA
Wide Bandgap Semiconductors
Raleigh, NC

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MEP Center Staff Embedded at **All 14 MFG USA Institutes**

14 NIST MEP-funded projects

~$17M NIST investment

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How an Institute Works

Each Institute **ADVANCES U.S. MANUFACTURING**

1. **Industry-led consortium with a clear mission based on critical industry need**
2. **Effective collaboration space for pre-competitive applied R&D, solving big challenges**
3. **Creates value for industry participation and funding**
4. **Federal start-up funding must catalyze at least 100% co-investment**
5. **Addresses the skills gap on education and workforce skills for their technology areas**

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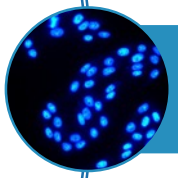
NIMBL

The National Institute for Innovation in Manufacturing Biopharmaceuticals

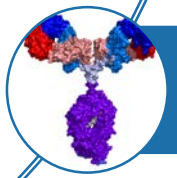
- NIST-sponsored, University of Delaware led
- 90+ members, including major biopharma and suppliers
- $70 M from NIST, matched by > $129 M from partners
- Focus on enabling manufacturing technology, not products


Industry led for industrially-relevant innovation


Flexible, scalable, and agile bioprocesses


Existing and emerging classes of therapeutics


World-leading biomanufacturing workforce


Standards development to accelerate deployment

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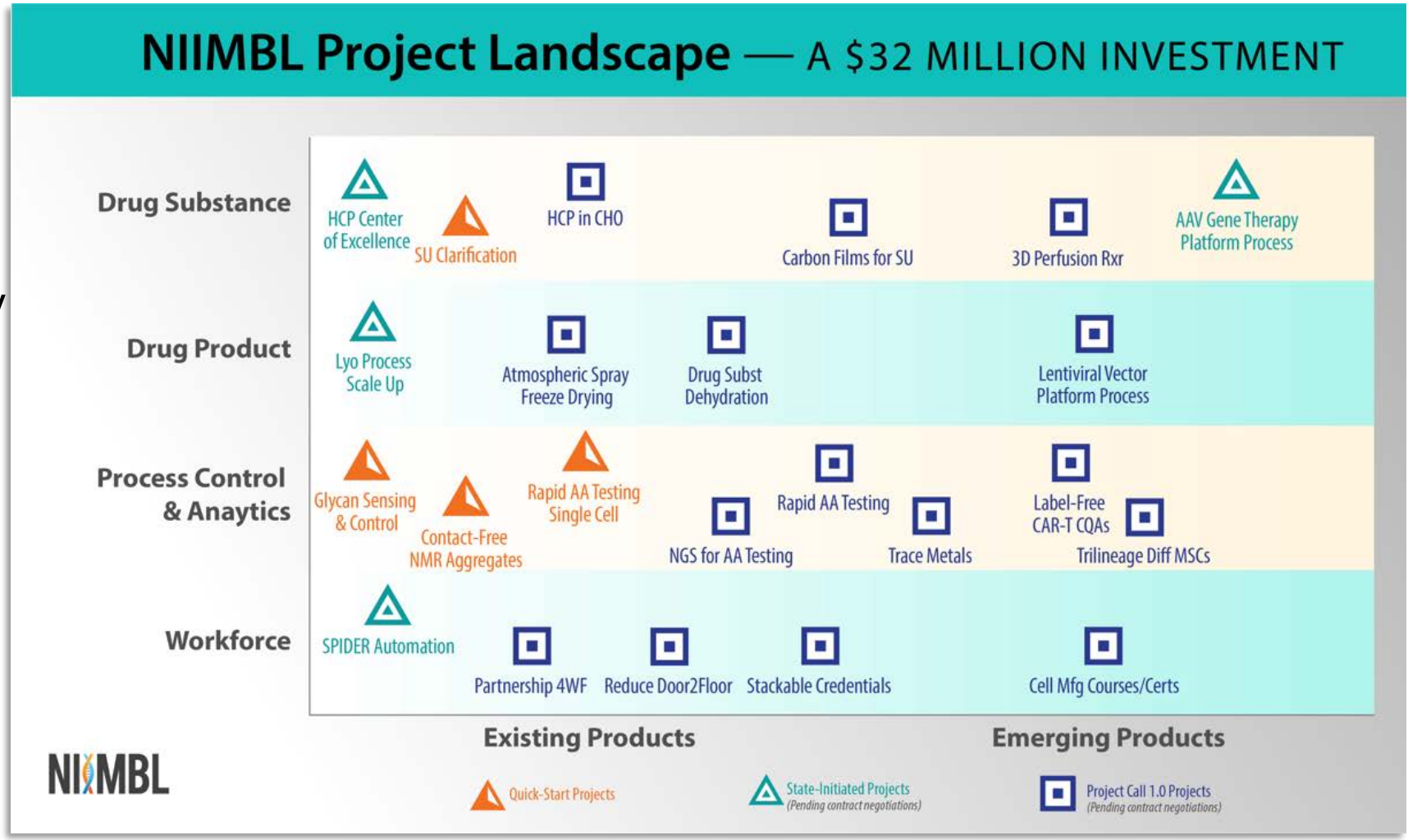
NIST National Institute of Standards and Technology U.S. Department of Commerce

NIIMBL: One Year Post-Launch

- $32M in technical and workforce projects awarded
- Project Call 2.1 released in May
- Ongoing technology workshops
- Roadmapping in Gaps
  - Gene-therapies
  - Antibody Drug Conjugates & Biospecifics
  - Vaccines



NIIMBL: Up Next

- Annual Report for Secretary of Commerce in June 2018
- Completion of HQ building in 2019 (funded by University of Delaware and private philanthropy)
- Hit steady state goal of 20 ongoing projects
- Leverage MEP connection through embedded staff to strengthen supply chain for SMMs

Contact www.niimbl.org

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NIST National Institute of Standards and Technology U.S. Department of Commerce

What's Ahead

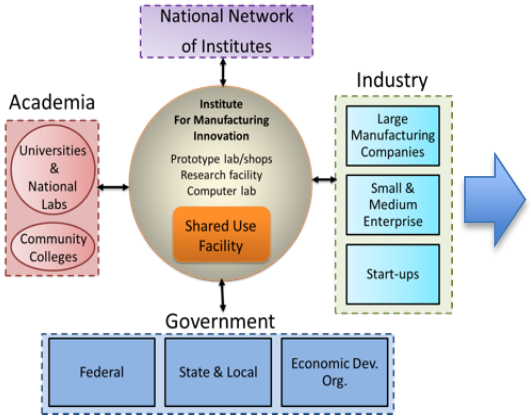
Global Competition:
Reproducing MFG USA Elsewhere

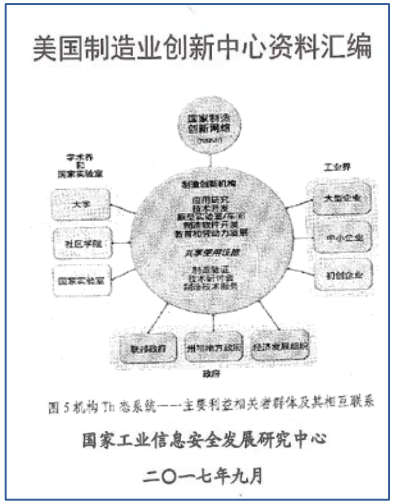
China started up MFG USA-like institutes

- **Now:** additive manufacturing, batteries
- **Next**: Flexible electronics, robotics, digital, photonics, light-weight materials
- Planning 40 institutes by 2025
- **China's 13th national 5-year plan puts China Manufacturing 2025 as one of six national priorities**

Canada: "advanced manufacturing superclusters"

- $950 million for five innovation 'superclusters' awarded 2018
- consortia of small and large businesses, academia, other groups
- 1:1 match required; actual $1.5 B match to date





Manufacturing USA reports promptly translated into Chinese

After Network and Institute Start-Up

Questions coming up

1. Post-cooperative agreement institute performance
    - Federal involvement necessary for credibility
    - Maintain focus on U.S. competitiveness and workforce efforts?

Federal engagement in the long term

1. NIST-led institutes limited to 7 years of federal support
    - Other agencies have no limitations imposed by RAMI
    - DOD likely to continue support
    - DOE unlikely to continue support
2. Support of Network functions
    - Continued support by NIST; supported by Administration and Congress
3. Reauthorization of RAMI? Options for support of operations and workforce development?

New institutes

1. Near and long-term – dependent on appropriations to agencies
    - NIST FY 2018 appropriation reduced to $15M from $25M
        - NIST competition closed out with only one award – NIIMBL
    - DOE – new competition summer 2018
2. Long term – "franchise" model authorized by RAMI

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Metrics are Proxies for Measuring Success: **"Program Purposes" Defined by RAMI**

Metric Category	Specific Metric	Unit
Technology advancement	1. Number and value of active R&D projects	Total number, total value
	2. Percentage of projects meeting key technical objectives	Percentage
Catalyzing co-investment	1. Non-Manufacturing USA contribution (membership fees, etc.)	Total value
Advanced manufacturing workforce	1. STEM activities	Total number of student participants
	2. Educator/trainer engagement	Total number of educators/trainers
U.S. innovation ecosystem	1. Partner organizations with Institute membership agreement	Total number of members
	2. Diversity of members	Total percentage SMM (<500 employees)

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Phased Short and Long-Term Metrics?

Need: Develop metrics at the institute and program levels, focusing on U.S. national priorities

Institute-Level: Three Phases

- Start-Up: recruit membership, lay groundwork for R&D and workforce efforts
- R&D Execution: complete projects, where the results can begin to be measured
- Long-Term: achievement of goals on industry and regional basis:
  - technology advancement
  - industry competitiveness
  - regional macroeconomic results
  - industry and regional workforce results

Program-Level: Two Phases

- Start-Up Support and Shared Services
- Long-Term: achievement of program goals on manufacturing sector-wide and national basis:
  - economic competitiveness
  - macroeconomic results
  - workforce results
  - fulfillment of agency-specific missions.

Two parallel task teams:

1. institute director team for developing institute-level metrics

2. federal agency team for program-level metrics

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Seeking Feedback

How can we design performance metrics that more directly predict or measure impact and accomplishment of program goals, especially technology diffusion? E.g.,

- How to measure diffusion of technology beyond institute members?
- How to measure development of the ecosystem?

Securing AMERICA'S FUTURE

Making an Impact

- **14 institutes** developing new manufacturing techniques
- **65%** of members are from industry
- **~300 ongoing major collaborative R&D projects**
- **200,000 people trained** in advanced manufacturing
- $1B federal investment matched by over **$2B non-federal funds**