Quantum Initiatives at NIST and their Applicability to Advanced Manufacturing

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NIST NATIONAL INSTITUTE OF STANDARDS AND TECHNOLOGY
U.S. DEPARTMENT OF COMMERCE

Manufacturing USA®

NIST Structure

Services & Resources

- Official U.S. Time
- Standard Reference Materials
- Standards Reference Data
- Measurement Services
- Publications
- Software

Laboratories

- Communications Technology Laboratory
- Engineering Laboratory
- Information Technology Laboratory
- Material Measurement Laboratory
- NIST Center for Neutron Research
- Physical Measurement Laboratory

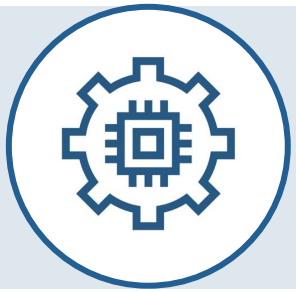
Extramural Programs

- **Office of Advanced Manufacturing Manufacturing USA®**
- Hollings Manufacturing Extension Partnership and MEP National Network™
- Baldrige Performance Excellence Program
- Technology Partnership Office
- NVLAP Accreditation

What is the **Office of Advanced Manufacturing (OAM)**

National Program Office at NIST:

Oversee and coordinate advance manufacturing, support the NSTC SAM



Manufacturing USA Program:

Convene and support network of institutes and interagency partners

Funding: Advanced Manufacturing Technology Roadmaps, Manufacturing USA institute competitions, Public Service Awards

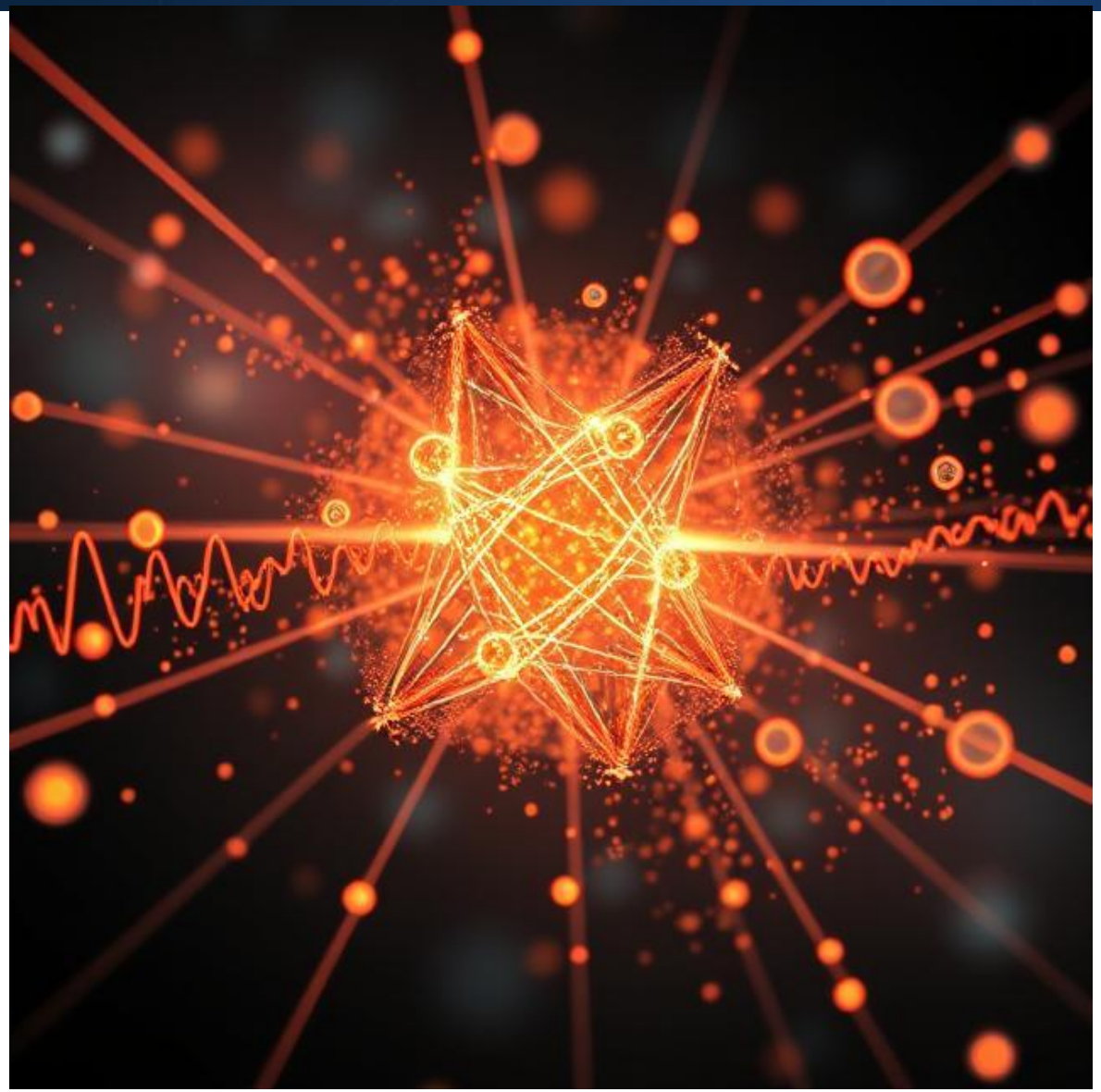
What is a “Quantum Initiative”?

(Credit Google Quantum AI)

- **Research into or using quantum mechanics**

- **Research into technologies leveraging quantum phenomena to accelerate manufacturing**

Research Focus

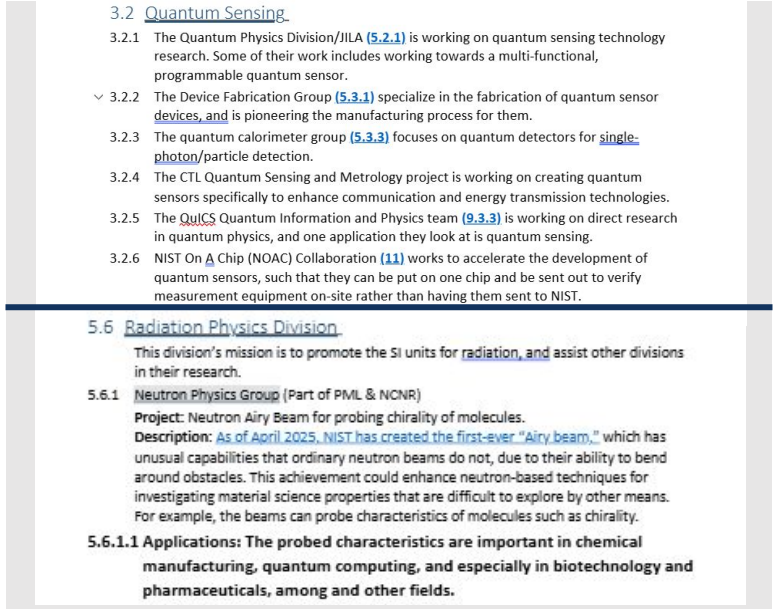


(Photo Credit by DeepAIML)

1. Creating Catalog of Ongoing NIST quantum initiatives
2. Assess each project's applicability to advanced manufacturing
3. How do the projects overlap with other programs?

Key Products

Main Report



3.2 Quantum Sensing

3.2.1 The Quantum Physics Division/JILA (5.2.1) is working on quantum sensing technology research. Some of their work includes working towards a multi-functional, programmable quantum sensor.

3.2.2 The Device Fabrication Group (5.3.1) specialize in the fabrication of quantum sensor devices, and is pioneering the manufacturing process for them.

3.2.3 The quantum calorimeter group (5.3.3) focuses on quantum detectors for single-photon/particle detection.

3.2.4 The CTL Quantum Sensing and Metrology project is working on creating quantum sensors specifically to enhance communication and energy transmission technologies.

3.2.5 The QuICS Quantum Information and Physics team (9.3.3) is working on direct research in quantum physics, and one application they look at is quantum sensing.

3.2.6 NIST On A Chip (NOAC) Collaboration (11) works to accelerate the development of quantum sensors, such that they can be put on one chip and be sent out to verify measurement equipment on-site rather than having them sent to NIST.

5.6 Radiation Physics Division

This division's mission is to promote the SI units for radiation, and assist other divisions in their research.

5.6.1 Neutron Physics Group (Part of PML & NCNR)

Project: Neutron Airy Beam for probing chirality of molecules.

Description: As of April 2025, NIST has created the first-ever "Airy beam," which has unusual capabilities that ordinary neutron beams do not, due to their ability to bend around obstacles. This achievement could enhance neutron-based techniques for investigating material science properties that are difficult to explore by other means. For example, the beams can probe characteristics of molecules such as chirality.

5.6.1.1 Applications: The probed characteristics are important in chemical manufacturing, quantum computing, and especially in biotechnology and pharmaceuticals, among and other fields.

26 pages, sorted by application area and by organization

Sub-Reports to Institutes

NIMBL®

SMART USA™

4 pages each, highlighting work in the main report

Sub-Report on Tech Hubs & NSF Engines

NSF

TECH HUBS

U.S. Economic Development Administration

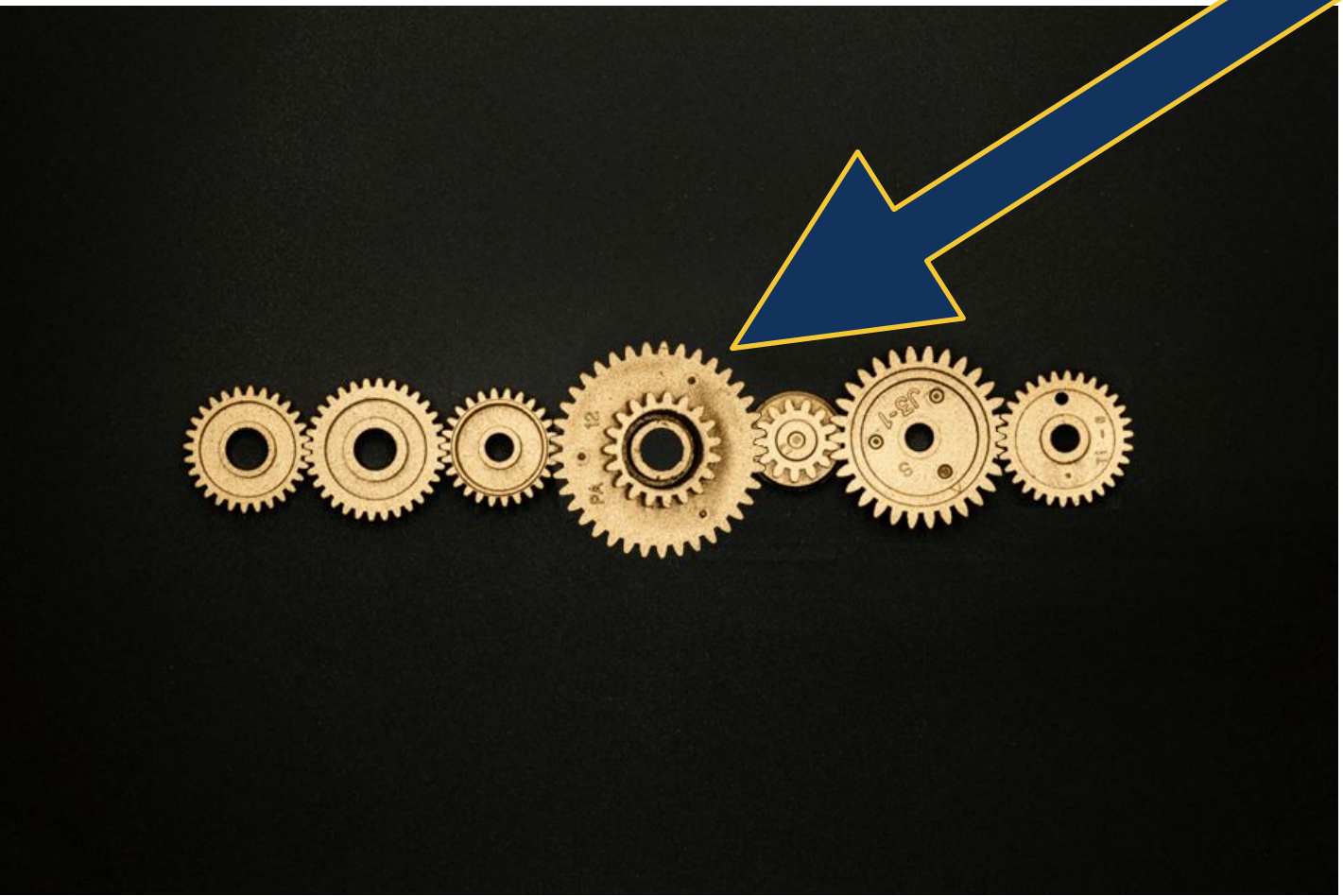
OFFICIAL DESIGNEE

TECHHUBS.GOV

7 pages, Mapping EDA TechHub and NSF Engine work to NIST work in main report

Why Does It Matter?

(Photo Credit by Miguel Á. Padriñán)



- OAM is a Coordinating Office
  - Needs info to monitor relevant work & disseminate
- No such list available, assesses for manufacturing applications

Findings: Categories

Materials Science

Quantum Sensing

Biomedical & Pharmaceutical

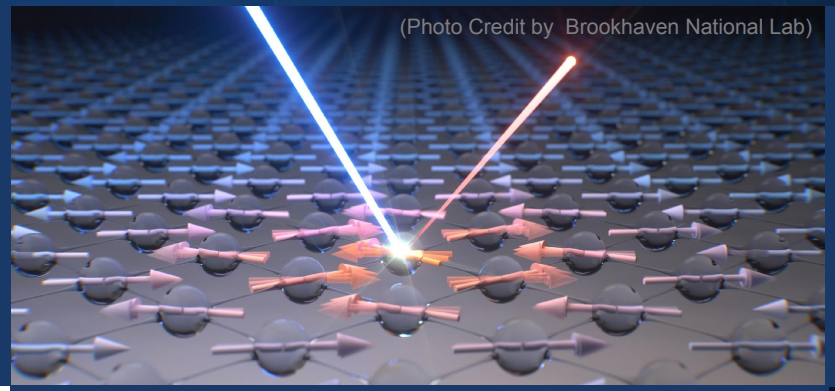
Photonics, Communications, and Quantum Networking

Semiconductors & Quantum Computers

Examples

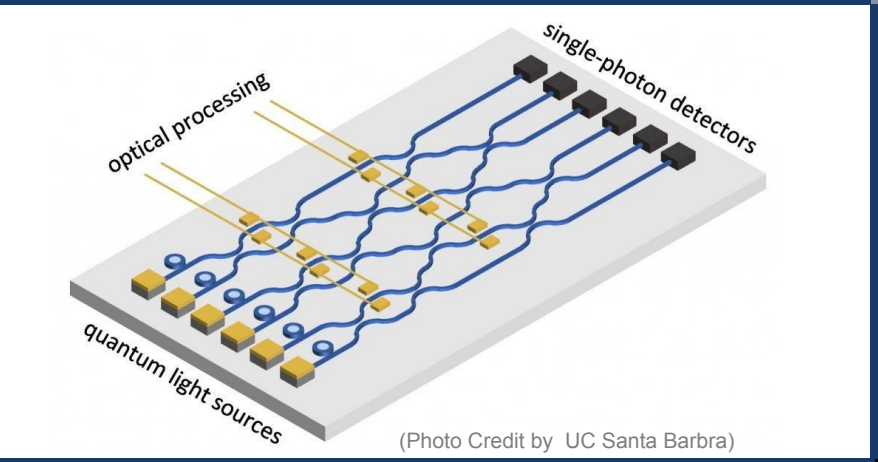
Materials Science

- Optical & Electrical Property Research
- Magnetic Materials Project



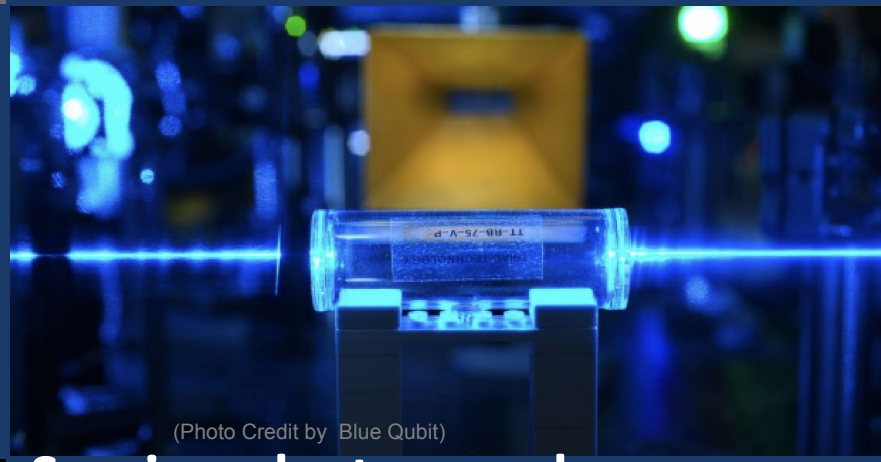
Biomedical & Pharmaceutical

- Airy Beam
- Microchips & Nanostructures for Cellular Monitoring



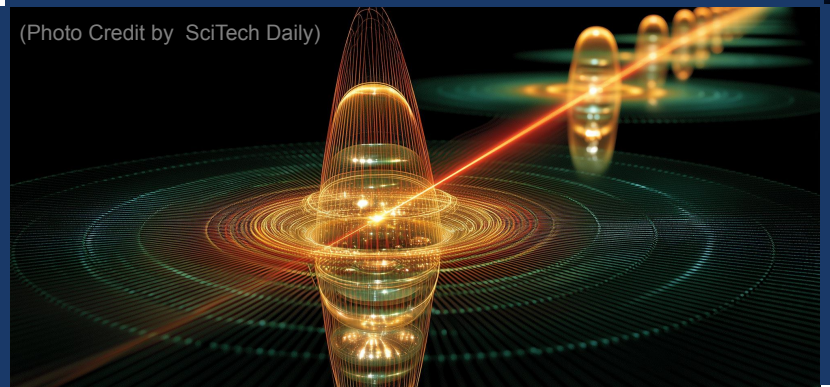
Quantum Sensing

- Advanced Calorimeters
- Multifunctional Quantum Sensors



Photonics & Communications

- Faint Photonics
- Quantum Repeaters



Semiconductors and Quantum Computing

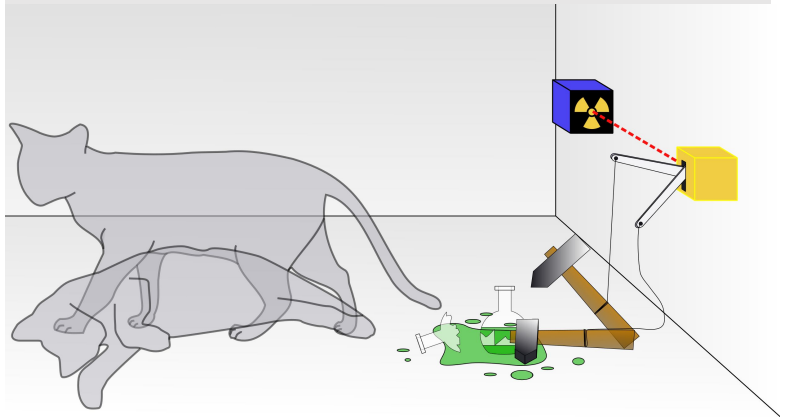
- Integrated Photonic Circuits
- Scaling Quantum Computing

Timelines

Now	Soon	Later
Biomedical & Pharmaceutical Materials Science	Quantum Sensing	Photonics & Communications Quantum Computers

(Photo Credit by Marko Blazevic)

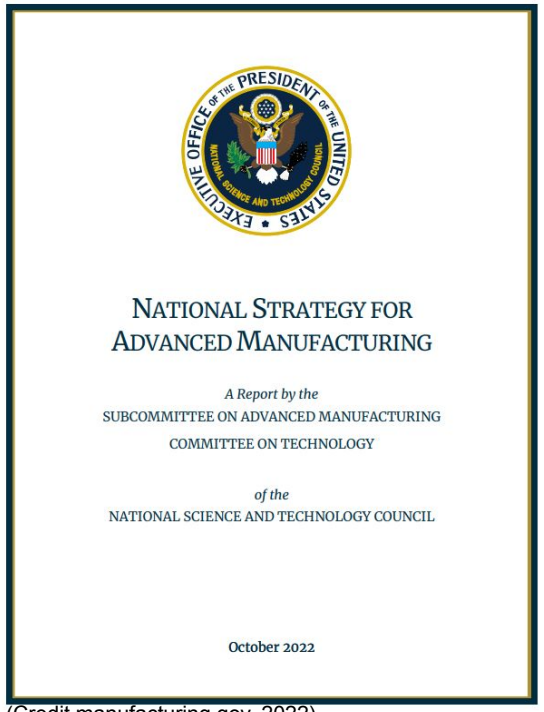
(Photo Credit by Bayram Yalçın)



(Photo Credit By Dhatfield, Wikimedia, CC BY-SA 3.0)

How will this work be used?

(Photo Credit by Christina Morillo)



(Credit manufacturing.gov, 2022)

(Credit National Cancer Institute)

1. Planning for increasing focus in quantum research;

   Advising on what aligns with our goals

2. Promoting cross-divisional and interagency collaboration

3. Promoting collaboration between scientists and policymakers

Reflections

1. Small Cog in a Big Machine;
   Agencies Have Interesting Customs and Personalities
2. This Work Needs Physicists
3. Pursuing Public Policy

Acknowledgements

Thank you to my:
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AIP & SPS Staff
Fellow SPS Interns

Thank You!
Any Questions?

Contact Info
& LinkedIn

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Michigan State University, 2027

Political Theory and Constitutional Democracy
Physics
Philosophy of Science

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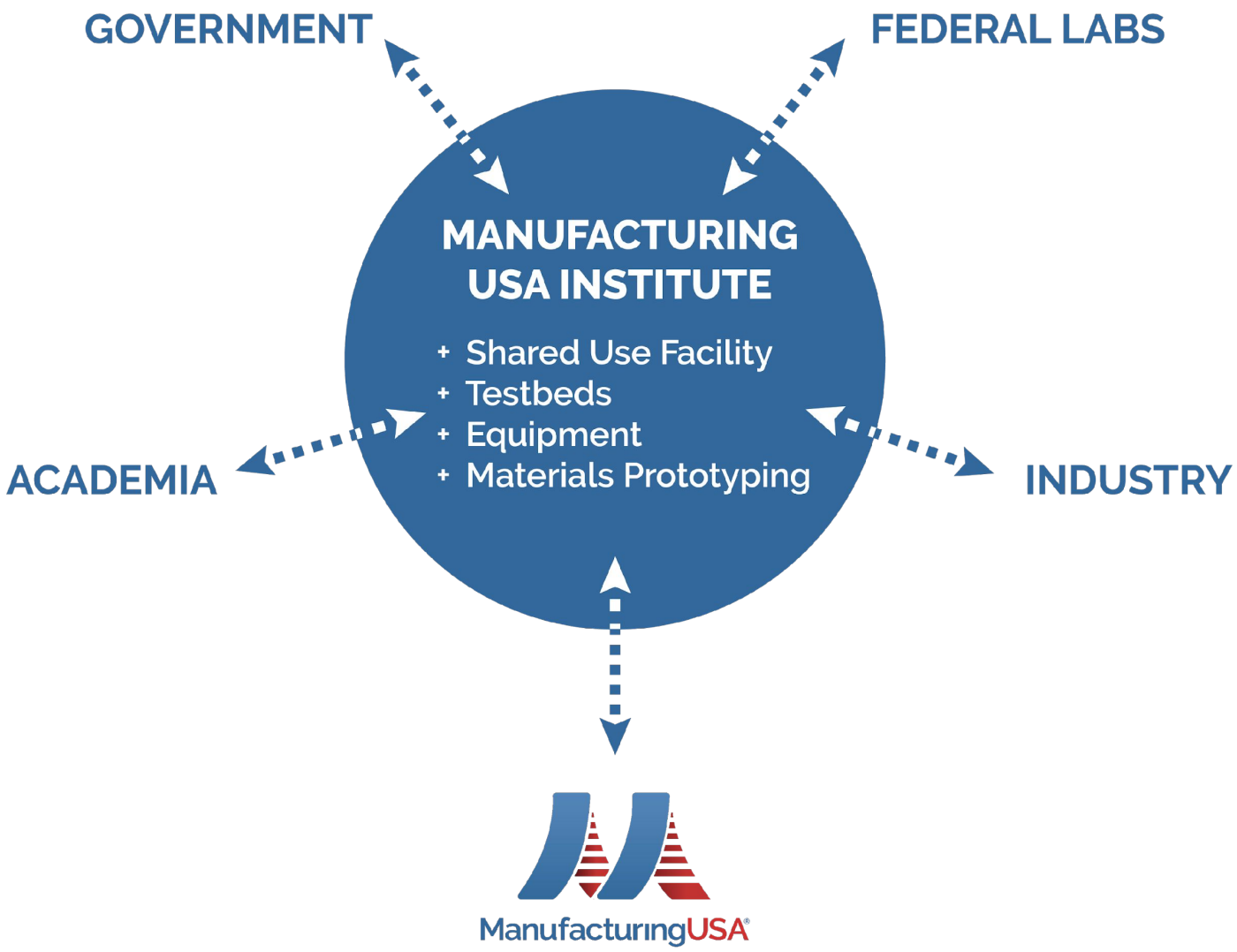
U.S. DEPARTMENT OF COMMERCE

What is Manufacturing USA?



Common Institute Functions:

- \+ Public-private partnership with industry-driven focus
- \+ Typically, $70M-$120M federal investment
- \+ At least 1:1 (federal to non-federal resources) co-investment
- \+ Neutral convener for collaborations

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