

# Public-Private Innovations to **PROPEL THE JOINT FORCE**



**Department of Defense Manufacturing Innovation Institutes**

December 2023

## Department of Defense Manufacturing Innovation Institutes

*Industry-driven, public-private partnerships serving the Warfighter and Nation*

**WHAT?** Public-private partnerships that increase economic and national security by maturing manufacturing processes, building sustainable supporting ecosystems, and providing manufacturing education and workforce development.

**WHY?** To grant the Department of Defense (DOD) access to advanced manufacturing technologies, address DOD modernization priority needs, and further the national imperative to ensure future products are made in the United States.

**HOW?** Catalyze the establishment, effective operation, and integration of industry-led public-private partnerships that connect and develop people, ideas, and technology in ways that accelerate the transition of new capabilities into defense and commercial products and systems.

*While each institute operates in its own unique ecosystem,  
they all share common business model tenets...*

Regional hubs with national impact to U.S. ecosystem	Led by non-profit acting as “honest broker,” accountable for viability	Industry-led, DOD-informed technical road-mapping
Industrially relevant, DOD-oriented research and development (R&D) to “bridge the gap” (Technology Readiness Level / Manufacturing Readiness Level 4-7)	Access to shared assets for U.S. companies including intellectual property and infrastructure	Education and training for sufficient, skilled manufacturing workforce
Significant initial federal investment (\$70-\$120M per institute) over 5-7 years	Leverage minimum of 1:1 cost share from non-federal sources	Formal evaluation prior to continued DOD engagement and funding



## DOD's Formal Relationship with the DOD MIIs

**Program Office:** The Office of the Secretary of Defense Manufacturing Technology Program (OSD ManTech) oversees DOD's relationship with the institutes. The DOD Manufacturing Innovation Institutes (MIIs) are considered an integral part of the wider DOD Manufacturing Technology Program.

**Legislative Authorities:** 10 U.S.C. § 4841

**Partnership Mechanism:** Cooperative Agreements or Technology Investment Agreements

### Program Management:

- The U.S. Army, Navy, and Air Force provide program managers and subject matter experts committed to helping the DOD MIIs meet Department-wide needs while equipping the Warfighter
- The Joint Defense Manufacturing Council conducts formal evaluations of each DOD MII every five years.
- The Joint Defense Manufacturing Technology Panel regularly engages with the DOD MIIs by funding government-directed projects, participating in institute events, and collaborating with institutes to support subpanel priorities.

*Compared with DOD's traditional acquisition model, the DOD MIIs are an INNOVATIVE way of doing business within the Department. They offer the DOD a new avenue for engaging with potential partners across the private sector.*

Strategy	Traditional Model for Engaging with Industry <i>DOD &amp; industry invest independently</i>	Manufacturing Innovation Institutes <i>DOD partnership with industry</i>
Access to Technology	<b>Limited</b> DOD engagement with non-traditional contractors	<b>Expanded</b> partnerships with entrepreneurs, students, startups, and manufacturers to innovate
	<b>Disparate</b> time spent on understanding the domestic ecosystem and commercial supply chain capabilities	<b>Organized</b> ecosystems and technology roadmaps enable DOD to leverage commercial technologies
Cycle Time	<b>Long</b> Technology often out of date by the time it's fielded	<b>Agile</b> Commercially validated capabilities reduce or eliminate the need for a longer research and development phase
Cost	<b>Not Affordable</b> High likelihood that DOD replicates and invests in technology already commercially available	<b>Saves R&amp;D Dollars</b> Validates and gains commercial buy-in for DOD dual-use technology
Education & Workforce Development	<b>Minimal</b> ability for DOD to significantly effect change in the career trajectory of students	<b>Integrated</b> partnerships with industry and academia to train and inspire students to engage in defense manufacturing



# DOD MIIs' National Reach

## Headquarters and Hubs



**BioMADE**  
**Bioindustrial Manufacturing**  
 Minneapolis, MN  
 Emeryville, CA



**Digital Manufacturing & Cybersecurity**  
 Chicago, IL



**Hybrid Electronics**  
 San Jose, CA



**Advanced Materials**  
 Detroit, MI



Institute Funding	
<b>DoD strategic commitment of \$954M has resulted in...</b>	<b>Committed Cost Share and Project Funding Breakdown</b>
<b>\$2B</b> in committed non-federal cost share	<b>\$1.8B</b> industry, academia, non-profit, state strategic cost share
<b>\$1.2B</b> in committed federal project work	<b>\$143M</b> industry, academia, non-profit funded projects
	<b>\$24M</b> state/local government funded projects
	<b>\$1B</b> DoD-directed projects
	<b>\$154M</b> other Federal-directed projects

*All metrics as of September 30, 2023*



**Institute Participation**

**2,000+** members from 49 states, DC, and Puerto Rico

**360+** industry, academic, and federal leaders on MII boards, committees, councils

**108,000+** students, teachers, workforce trained in FY23 alone

**1,500+** research and development projects completed or ongoing

**620+** education and workforce development projects completed or ongoing

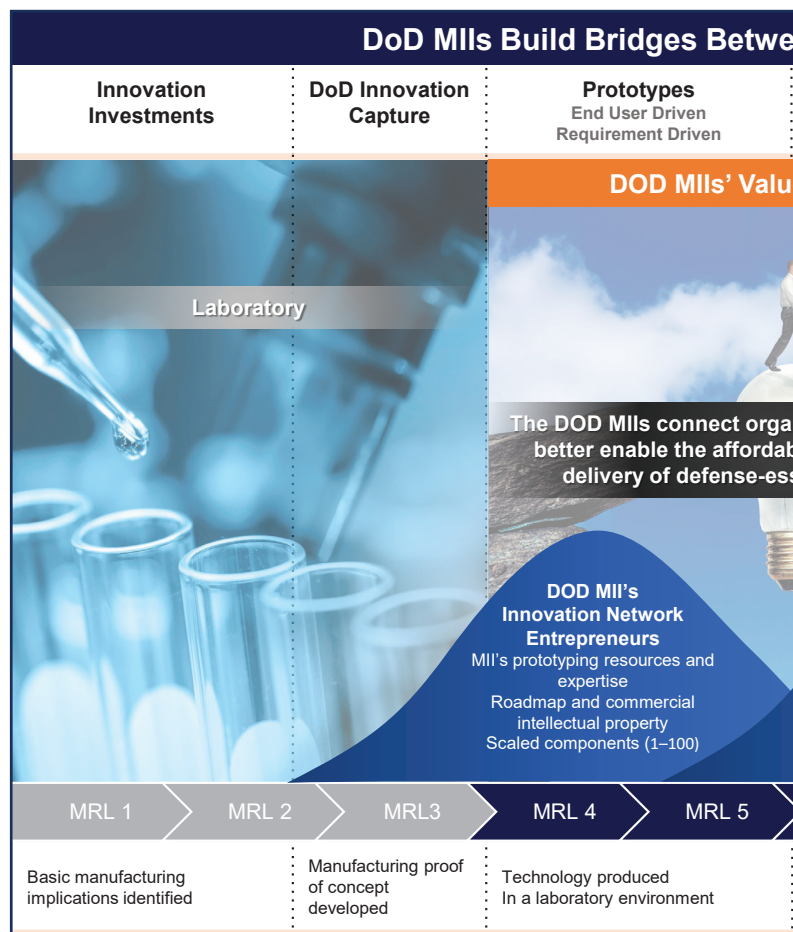
*All metrics as of September 30, 2023*



## Supporting the Joint Force

The DOD MIIs offer the military services and DOD agencies access to road-mapping activities with industry, pilot manufacturing facilities, and responsive project contracting. DOD utilizes the institutes' pre-competitive federal assistance agreements to perform technology projects, provide access to cost share, and ensure competition. From an operations and sustainment perspective, the DOD MIIs are a source for producing quick-turn complex parts and low-cost research and development.

- **Facilitate rapid transition of technical advances** to industry by sponsoring government-directed projects to advance concepts through prototype development and by providing rapid, flexible contracting
- **Lower the risks of technology transition** by using innovative tools to support legacy systems and applying new manufacturing processes to reduce cycle times
- **Help scale advanced manufacturing** by identifying domestic sources for components and materials, and by advancing technologies from the prototype stage to limited-scale production
- **Facilitate access to the advanced manufacturing ecosystem** by engaging with leaders in industry and academia to create and participate in training programs.

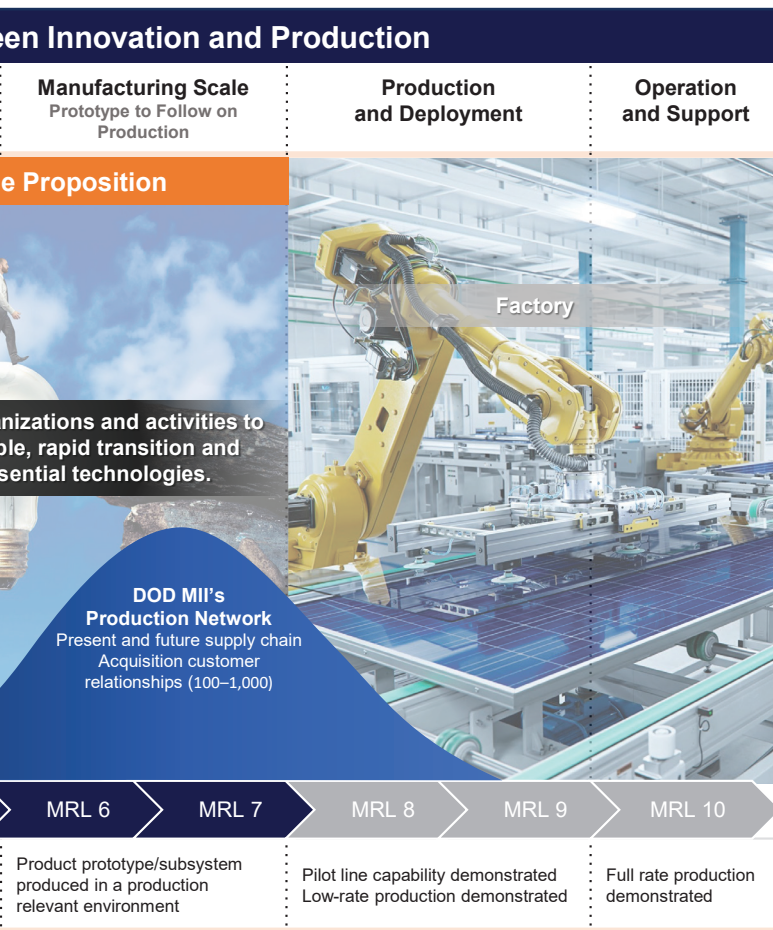


## The DOD's Long-Term Strategy for the DOD MII's

The DOD MII's are game-changers that build enduring advantages for the future Joint Force by connecting innovative industrial ecosystems with emerging technology and domestic market sectors.

The nine DOD MII's provide value to the nation by helping to secure manufacturing supply chains and growing a skilled workforce, prompting the Department's continued strategic engagement with them. Through the DOD ManTech Program, the Department continues to:

- Maintain active partnerships with the DOD MII's ensuring DOD equities are met contingent through periodic evaluation of performance and progress toward the MII's' chartering principles
- Establish follow-on agreements, as appropriate, and in the Department's best interest, at the Department's discretion
- Integrate DOD MII project portfolios with the Department's critical technology areas



## Demonstrated Value to the Army

- MxD**, the digital manufacturing and cybersecurity institute, convened industry partners to assess and modernize operations at Rock Island Arsenal's Joint Manufacturing and Technology Center in Rock Island, IL. The team is implementing solutions to enhance digital capabilities today such as network monitoring of machine status and health, documenting and improving connectivity of the industrial network, and optimizing part quality inspection. The team has also scoped the efforts to implement a next generation automated paint system and to transition computer-aided design and computer-aided manufacturing systems to reduce rework and retain supplier part data.
- AFFOA**, the advanced fabrics and textiles institute, partnered with the U.S. Army Program Manager for Soldier Survivability to support the Army's cold weather/Arctic mission. Within less than a year, AFFOA leveraged the design, novel prototype, and scaling capabilities of its member network to develop the Cold Temperature and Arctic Protective System (CTAPS) for rapid evaluation by the Army.



## Demonstrated Value to the Navy

- BioMADE**, the bioindustrial manufacturing institute, collaborated with the Naval Research Laboratory and Technology Holdings to scale up and purify the biomolecules melanin and resveratrol, both of which have "protective" properties. Melanin has possible radiation protectant qualities and could be used as a fire protectant, replacing phenolic resins and other materials. Resveratrol has shown potential to serve as an optic shield and flame-retardant material for eyewear and drone wings, respectively. BioMADE's project could help with obtaining larger quantities of the pure material from natural sources – a difficult task.
- The ARM Institute**, the advanced robotics for manufacturing institute, collaborated with the Joint Robotics Organization for Building Organic Technologies Working Group to develop autonomous swarm capabilities to significantly enhance the inspection quality and visualization of critical Navy assets. The project reduces costs for sustainment operations, diminishes time to execute inspection processes in complex environments with little infrastructure support, and increases safety by eliminating manual processes in complex or difficult environments.
- America Makes**, the additive manufacturing institute, is leading a team of fellow DOD MIIs to help modernize Marine Depot Maintenance Command by mapping opportunities to better integrate advanced manufacturing technologies. The assessment is one of many activities on which the DOD MIIs are collaborating to improve the efficiency and effectiveness of DOD's Organic Industrial Base.





## Demonstrated Value to the Air Force

- **NextFlex**, the hybrid electronics institute, designed and produced a wearable chemical sensor capable of detecting ambient oxygen, volatile organic compound, temperature, and humidity levels. The project offers a means of monitoring Air Force maintainer health and safety while reducing cost, increasing productivity, and improving morale.
- **AIM Photonics**, the American Institute for Manufacturing Integrated Photonics, is accelerating the work of researchers in the Air Force Research Laboratory's Information and Sensors Directorates by almost five years. By developing novel integrated photonic circuits and new integrated photonic platforms, AIM Photonics is reducing waveguide losses, supporting work with light in the visible wavelength regime, and increasing material thicknesses. These developments are being applied to innovative devices and systems for quantum photonics, sensors, and atomic physics.



## Demonstrated Value to Joint Forces and Other Defense Agencies

- **LIFT**, the advanced materials manufacturing innovation institute, has prepared over 600 departing servicemembers to transition into civilian careers in the most in-demand, high-paying manufacturing jobs. Operation Next is a self-paced and skills-based curriculum that enables active-duty and veteran servicemembers to learn on their own time and receive credit for knowledge they already possess. These credentials help fill the manufacturing skills gap with American heroes.
- **BioFabUSA**, the Advanced Regenerative Manufacturing Institute, and its members have developed and implemented multiple automated platform technologies to advance the scalable, consistent, affordable manufacturing of cell-based therapies for the warfighter. These include:
  - a groundbreaking tissue foundry platform,
  - a Deep Tissue Characterization Center,
  - a novel liquid-handling platform that enables the scalable, automated, and sterile filling of manufactured cell-based products into vials, and
  - a cryostorage device.



These capabilities are vital to restoring our warfighters and veterans to form, function, and quality of life.



## MIIs in Action: Manufacturing at the Point of Need

In 2023, the OSD ManTech Program facilitated the “Point of Need Challenge Pitch Event” to rally the DOD MIIs and their members to provide quick-turn solutions to support forward-deployed forces in austere environments. OSD ManTech invested ~\$2.5 million, with \$700,000 cost-matched by industry partners.

The event was held March 8-9, 2023, for member companies of the DOD MIIs to pitch their technologies. It featured 11 presentations that had been selected from 63 concept papers submitted by the DOD MIIs and reviewed by 72 DOD reviewers. A panel of 13 judges from the military services, Defense Logistics Agency, Defense Innovation Unit, OSD ManTech, and Joint Staff reviewed the pitches and recommended the funding of six projects from five DOD MIIs.

Follow-on demonstrations of each project were held December 4-8, 2023, in a simulated cold weather environment, supported by the U.S. Army Combat Capabilities Development Command. The winning projects are:

- Portable Manufacturing Station for a Self-Administrable Injectable Applicator (BioFabUSA):** DEKA, a BioFab USA member since 2017, has developed a novel, hollow, microneedle-based intradermal delivery applicator for self-administering therapeutic agents. Through the award, BioFabUSA and DEKA will develop a portable, ruggedized manufacturing station that can fill the required therapeutic agent at a forward operating base and then send the applicator forward to warfighters to administer.
- Austere nField Repair (NextFlex):** Utilizing the nRugged™ tool, an integrated and ruggedized “factory in a box” developed by nScript, the project employs additive electronics and mechanical part manufacturing to replace and repair damaged hardware at austere points of need.
- Craitor Expeditionary 3D Printer (America Makes):** The Craitor Expeditionary 3D Printer can print critical parts in the field. This project, led by Craitor, utilizes current capabilities as the foundation to de-risk manufacturing at the point of need.
- Securing the Digital Backbone with Corsha’s Zero-Trust Platform for Machines (ARM Institute):** A platform developed by Corsha manages cybersecurity challenges by addressing security limitations and providing zero-trust network access, even to legacy manufacturing equipment, thereby mitigating the risk of a security breach by implementing an additional, out-of-band layer of access control.
- Demonstration of Use of Sciperio Austere Bioreactor to Produce Blood in a Forward Environment from CONUS Cryopreserved Starting Material (BioFabUSA):** The ability to “manufacture” blood on-demand and near the point of conflict will eliminate both source and logistics concerns. With member Safi Biotherapeutics and collaborators, BioFabUSA is building on progress made through DOD’s current On-Demand Blood Program, which is operated through the Uniformed Services University of the Health Sciences, and will demonstrate the ability to deliver cryopreserved blood precursor cells transported in a fraction of the volume of traditional units, as well as expansion of these cells in an austere-capable bioreactor.
- Expeditionary Manufacturing Unit for Battlefield Repair and Readiness (LIFT):** SPEE3D’s 3D Metal Printing Technology is an industry-proven, military-tested, expeditionary, all-in-one solution. The system uses existing cold-spray technology to create complex 3D parts quickly.



## Get Involved

The DOD MIIs are essential components of a national strategy to build a strong and vibrant U.S. defense industrial base. Each DOD MII creates a much needed “industrial commons” that helps accelerate the delivery of both defense-relevant and commercially promising technologies.

The DOD MIIs are public-private partnerships where both large and small domestic manufacturers and designers can pool their risk – cost shared by the federal government – to advance manufacturing so the next generation of products and systems are produced in the United States. Each MII provides high-value access to world-class pilot manufacturing facilities that complement member capabilities and yield a robust and sustainable innovation ecosystem in a promising technology area. Also critical to U.S. competitiveness is the availability of a well-trained, qualified workforce with manufacturing skills matched to the nation’s current and emerging production needs. Each DOD MII has a set of education and workforce development activities that can be leveraged by all participants.

These public-private partnerships are defense-relevant, industry-led, critical to our economy, and positioned to deliver value to you, their customers, and our nation.

*To get involved, please contact:*



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## **AMERICA MAKES: NATIONAL ADDITIVE MANUFACTURING INNOVATION INSTITUTE**

America Makes is the nation's leading public-private partnership for additive manufacturing (AM) technology and education through accelerating AM adoption and the nation's global manufacturing competitiveness.



## **MANUFACTURING TIMES DIGITAL (MxD): DIGITAL MANUFACTURING AND CYBERSECURITY INSTITUTE**

MxD equips U.S. factories with the digital tools, cybersecurity, and workforce expertise needed to begin building every part better than the last. As a result, its nearly 300 partners increase their productivity, win more business, and strengthen U.S. manufacturing. MxD is also the National Center for Cybersecurity in Manufacturing.



## **LIFT: NATIONAL ADVANCED MATERIALS MANUFACTURING INNOVATION INSTITUTE**

LIFT is driving American advanced manufacturing into the future through technology and talent development by connecting advanced materials, manufacturing processes, systems engineering, and talent development in support of our national security and economy.



## **AIM PHOTONICS: AMERICAN INSTITUTE FOR MANUFACTURING INTEGRATED PHOTONICS**

AIM Photonics enables a complete photonic integrated chip manufacturing ecosystem. The system provides the photonic community and DOD access to advanced technology, capabilities, and resources throughout the entire product development cycle.



## **NEXTFLEX: AMERICA'S HYBRID ELECTRONICS INSTITUTE**

NextFlex designs, prototypes, and pilot-scale manufactures hybrid and additively manufactured electronics aligned with multiple DoD priorities through its nationwide membership and its International Traffic in Arms Regulations and Food and Drug Administration compliant end-to-end manufacturing facility.



## **AFFOA: ADVANCED FUNCTIONAL FABRICS OF AMERICA**

AFFOA enables a manufacturing-based revolution through the transformation of traditional fibers, yarns, and textiles into sophisticated, integrated, and networked devices and systems.



## **BIOFABUSA: ADVANCED REGENERATIVE MANUFACTURING INSTITUTE**

BioFabUSA integrates life science, engineering, automation, robotics, and analytical technologies to advance the scalable, consistent, cost-effective manufacture of cell-based products – transforming healthcare for injured warfighters and propelling the United States to preeminent global leadership in biofabrication.



## **THE ARM INSTITUTE: ADVANCED ROBOTICS FOR MANUFACTURING**

The ARM Institute strengthens and stabilizes the DOD manufacturing supply chain by advancing robotic and artificial intelligence technologies and supporting workforce needed to efficiently supply the U.S. warfighter from domestic sources.



## **BIOMADE: BIOINDUSTRIAL MANUFACTURING AND DESIGN ECOSYSTEM**

BioMADE's mission is to enable domestic bioindustrial manufacturing at all scales, develop technologies to enhance U.S. bioindustrial competitiveness, de-risk investment in relevant infrastructure, and expand the biomanufacturing workforce to realize the economic promise of industrial biotechnology.