



RESEARCH
AND ENGINEERING

UNDER SECRETARY OF DEFENSE
3030 DEFENSE PENTAGON
WASHINGTON, DC 20301-3030

19 OCT 2022

MEMORANDUM FOR THE DEFENSE MANUFACTURING COMMUNITY

SUBJECT: Recognizing 10 Years of the Department of Defense Partnership with its
Manufacturing Innovation Institutes

The accomplishments of the nine Department of Defense (DoD) Manufacturing Innovation Institutes (MIIs) demonstrate the powerful benefit of public-private partnerships to the Defense Industrial Base and the Nation. In August 2012, DoD launched the first DoD MII, America Makes, to enhance America's strategic competitiveness while advancing DoD critical technologies. Today, there are nine DoD MIIs with over 1,580 members collectively. These members include commercial manufacturers of all sizes, start-ups, universities, and community colleges, along with state and local economic developers. The DoD MIIs have leveraged \$1.5 billion in Federal funding and \$2.2 billion in private-sector cost share, executing more than 1,110 applied research projects and over 480 education and workforce development projects. Such projects include a secure, DoD-wide additive manufacturing model exchange; America's first integrated silicon photonic circuit offering; and the world's only continuously cleaning antimicrobial mat.

The DoD MIIs are game-changing catalysts intended to build enduring advantages for the future Joint Force by connecting innovative industrial ecosystems with emerging technology and domestic market sectors. The DoD MIIs' increasing value to the Nation includes secure manufacturing supply chains and a growing skilled workforce. Their value prompts the Department's continued strategic engagement with the nine DoD MIIs. Through the DoD Manufacturing Technology Program, the Department commits to:

- Maintain active partnership with the DoD MIIs to ensure DoD equities, contingent upon periodic evaluation of performance and progress towards their 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.

I encourage the defense manufacturing community to leverage the DoD MIIs' technology development and manufacturing education resources. Through DoD's sustained partnerships, the DoD MIIs will continue to develop innovative advanced manufacturing solutions for greater national and economic security. I am proud of what we have accomplished in the past 10 years and look forward to strengthening our public-private partnerships for years to come.

A handwritten signature in cursive script, reading "Heidi Shyu".

Heidi Shyu



Department of Defense
Manufacturing Innovation Institutes
Executive Directors

MEMORANDUM FROM THE DOD MANUFACTURING INNOVATION INSTITUTES

SUBJECT: Public-Private Partnership – Advancing the Industrial and Organic Manufacturing Base

In 2012, a group of diverse and visionary leaders and champions of manufacturing launched an effort to advance a common vision of an incomparably innovative and globally competitive U.S. manufacturing sector.

Ten years into that work, we, the leaders of the DoD Manufacturing Innovation Institutes realize that the public-private partnerships we have established and grown have catalyzed the significant progress made to date and will propel our future impact. Central to that partnership is our foundational relationship with the DoD, which provides a productive environment for collaboration to tackle national manufacturing challenges in support of our National and economic security.

The commitment from the DoD allows our institutes to advance research and development, grow manufacturing ecosystems, and further education and workforce development to train Americans of all ages and backgrounds for the constantly evolving manufacturing jobs of today and tomorrow.

Together, our nine institutes are catalyzing technology advancements in additive manufacturing, cybersecurity, digital manufacturing, integrated photonics, flexible hybrid electronics, advanced materials manufacturing, robotics, advanced functional fabrics, biofabrication, and bioindustrial manufacturing. We all share the same mission of growing U.S. manufacturing and supporting national defense.

Nearly 1,600 manufacturing, academic, technology, and non-profit organizations throughout the United States choose to work with our institutes because they understand that the collective outcome is greater than the sum of its parts. Our common consortium model allows us to connect start-ups, technologists, researchers, and manufacturers with each other – and the DoD – to identify, prioritize, and implement practical and innovative solutions for economic benefit at every level.

As we recognize the 10-year anniversary of the formation of our institutes, we celebrate the accomplishments of our respective organizations and look forward to a robust, continuing partnership with the DoD and our members to build an even stronger U.S. manufacturing base.

America Makes

MxD

Nigel Francis

LIFT

AIM Photonics

NextFlex

AFFOA

BioFabUSA

ARM

BioMADE

WHAT ARE THE DEPARTMENT OF DEFENSE MANUFACTURING INNOVATION INSTITUTES?

Industry driven, public-private partnerships serving as resources for the DoD and Nation

The Office of the Secretary of Defense Manufacturing Technology Office sponsors nine Manufacturing Innovation Institutes with headquarters and hubs across the country. Each institute is a public-private partnership designed to overcome the challenges faced by American manufacturers in a variety of technology areas. While each institute operates in its own unique ecosystem, they all follow three common principles.

Chartering Principles

Advanced Research & Technology	Establish & Grow Manufacturing Ecosystems	Secure Human Capital
Partner with industry and academia to invest in applied research and industrially-relevant manufacturing technologies	Establish regional manufacturing hubs and ecosystems for long-term, national impact	Develop manufacturing-specific education and workforce development resources to ensure innovative technology is manufacturable



BioMADE
Bioindustrial
Manufacturing
St. Paul, MN



M & D
Digital Manufacturing
& Cybersecurity
Chicago, IL



NEXTFLEX
Flexible Hybrid
Electronics
San Jose, CA



lift
Advanced Materials
Detroit, MI



INSTITUTES BY THE NUMBERS

10 years since the launch of first DoD MII, America Makes

1,700+

Members from 49 states, DC, and Puerto Rico

300+

Members on DoD MII Boards, Committees, and Councils

860+

Completed research and development projects

370+

On-going research and development projects

212,200+

Students, teachers, workforce trained by DoD MIIs between FY20-FY22

\$703+M

Initial DoD investment

Plus \$266+M follow-on agreements investment from OSD ManTech

Additional \$600+M for DoD sponsored projects

\$1.6+B

Initial committed industry, academia, non-profit cost share

Additional \$138+M for academia/ industry-sponsored projects

Additional \$20+M for State/local government-sponsored projects

All metrics are as of the end of FY22 unless otherwise specified



Regenerative Manufacturing
Manchester, NH



Advance Fibers & Textiles
Cambridge, MA



Photonics
Manchester, NH
Rochester, NY



ARM INSTITUTE
Advanced Robotics
Pittsburgh, PA



America Makes Additive Manufacturing
Youngstown, OH



DOD MIIS' VALUE TO FEDERAL AGENCIES

The DoD MIIs offer the Federal government – not limited to their sponsoring agency – access to road-mapping activities with industry, non-traditional companies, pilot manufacturing facilities, and responsive project contracting. From an acquisition perspective, these pre-competitive federal assistance agreements can be utilized to perform technology-related projects, provide access to cost share and ensure competition. From an operations and sustainment perspective, they can be a source for producing quick-turn complex parts and low cost research and development (R&D).

Value to Federal Government	
Rapid Transition Science and Technology <ul style="list-style-type: none"> • Advance concepts through prototype development • Sponsor government-directed projects to meet specific mission needs • Contracting meeting all competitive requirements • Rapid, flexible contracting 	Lower Risk for Technology Insertion <ul style="list-style-type: none"> • Apply new manufacturing processes to reduce cycle time • Utilize tools to support legacy systems • Reduce risk in transition (example: DoD Programs of Record)
Scale-up Advanced Manufacturing <ul style="list-style-type: none"> • Identify domestic sources for components and materials • Advance from prototype to pilot-scale production 	Lower Risk for Technology Insertion <ul style="list-style-type: none"> • Hone expertise and engage with the best in industry and academia • Participate in institute and member-led training programs

- America Makes collaborated with the Defense Logistics Agency (DLA) to transition a Joint Additive Manufacturing Model Exchange (JAMMEX), providing an accessible, but secure, way to share 3D printing files across the DoD Enterprise.

- Following a successful project with LIFT to develop Antilock Brake and Electronic Stability Control Systems for Humvee, the Army awarded Ricardo Defense Systems LLC a three-year, \$89 million contract to provide 9,480 critical safety improvement retrofit kits. The new system prevents Humvee rollovers by 74%.



A new system prevents Humvee rollovers by 74%.

- BioMADE is working with members and the Air Force Research Lab (AFRL) to develop a domestic source of natural rubber from dandelions. More than 90 percent of the world's natural rubber is made from latex derived from rubber trees and is primarily sourced from tropical locations outside of the U.S. BioMADE's program uses taraxacum kok-saghyz, a species of dandelion, to onshore the production of rubber and reduce the risk of supply chain disruptions.

- AFFOA partnered with the US Army U.S. Army Combat Capabilities Development Command Soldier Center to identify, down select, contract and manage the rapid prototyping and delivery of 300 next generation Cold Temperature Arctic Protection System ensembles for a limited user evaluation with Soldiers in Alaska, all within only a 6-month period.



DOD MIIS' VALUE TO STATE AND LOCAL GOVERNMENTS

The DoD MIIs are innovation clusters comprised of numerous partners with a singular technology focus - all committed to building a convergence of expertise. Because these clusters contain all of the elements necessary for product realization (research, design, prototyping and production), they feed off each other's success and become deeply entrenched locally and regionally. Clusters formed around advanced manufacturing facilities inherently persist due to the ability to accelerate product to market using a co-located supply chain. All of this growth provides phenomenal opportunities to the region's students and workforce.

Value to State and Local Governments	
See Returns from Advanced Manufacturing	Raise Your National Prominence
<ul style="list-style-type: none"> • Manufacturing generates the highest community economic multiplier for jobs and Gross Domestic Product • Institute members from community compete for manufacturing project grants 	<ul style="list-style-type: none"> • Institutes provide a means to increase state and local preeminence through ecosystem expansion • Institutes convene regional members associated with next generation technologies • Clustering helps bring additional Federal grants
Grow a Qualified Workforce	Attract Direct Investment
<ul style="list-style-type: none"> • Workforce development is a key objective at each institute • Deliver unique opportunities for regional students, leveraging relationships with community colleges and universities 	<ul style="list-style-type: none"> • Institute hub or node pilot facilities appeal to first adopters • Small businesses receive mentoring and become key suppliers as spin outs

- BioMADE initiated a campaign to assist rural communities in the Midwest build capacity for workers and public-private partnerships. This includes building a network of legislators, industry partners, institutes of higher education, and workforce development agencies in a pilot scale of 6 states in the Midwest region (Minnesota, Nebraska, Iowa, Ohio, Wisconsin, and South Dakota).

- New York has invested significantly into AIM Photonics manufacturing infrastructure, specifically in standing up a state-of-the-art, one of a kind, open-access 300 mm Test, Assembly, and Packaging facility in Rochester. In addition, AIM Photonics' multi-project wafers are fabricated through the state's Albany Nanotech Complex, the most advanced publicly owned 300 mm wafer R&D facility in the world, including over 150,000 square feet of Class 1 capable cleanrooms.

- Recognizing the value of the DoD MIIs, the Commonwealth of Massachusetts has made a substantial commitment to developing the

institutes' infrastructure. Through the creation of sector-specific MII centers, the Massachusetts Manufacturing Innovation Initiative (M2I2) is advancing innovations and job growth within the state through cross-collaboration. To date, the state has invested over \$85M in 60+ collaborative projects focused on business expansion and educational projects that connect manufacturers with universities, companies, R&D Centers, and the MII communities. M2I2 initially focused on investments in four DoD MIIs – AIM Photonics, AFFOA, ARM, and NextFlex – but has expanded to include 12 Manufacturing USA institutes.



The State of Massachusetts works closely with 12 manufacturing institutes.



INSTITUTES' VALUE TO INDUSTRY

In the global marketplace, developing the next generation of advanced manufacturing capabilities requires the U.S. to encourage collaboration between companies, customers, and the government in order to conduct the pre-competitive applied R&D necessary for profitable commercialization. A modern 'industrial commons' is essential, where R&D facilities and key manufacturing information are available to U.S. companies of all sizes, allowing them to affordably develop products for commercial or defense needs. The DoD MILs convene that commons through offering companies the ability to leverage pre-competitive R&D into the manufacturing processes that underpin these future product opportunities. This includes materials and manufacturing R&D, product design and development, production capacity, visibility into new markets, and manufacturing workforce training and education.

Value to Industry	
High Value Collaboration	Supply Chain Multiplier
<ul style="list-style-type: none"> • Technology roadmapping • Manufacturing pilot lines • Extensive lab, testing, and prototyping equipment • Industry apprenticeships 	<ul style="list-style-type: none"> • Collaborative environment brings in new, diverse partners • Small business incubators • Network with industry, academia, and Federal gov.
Capabilities and Markets	Increased Performance and Returns
<ul style="list-style-type: none"> • Small business access to primes and vice versa • Access to intellectual property • Commercialize technology from Federal laboratories and academia • Awareness of Government. requirements and future needs 	<ul style="list-style-type: none"> • Risk reduction through pooled R&D • Participation in Federally cost-shared R&D projects • Develop cutting edge technology • Better trained workforce

- AFFOA prevented the manufacturing offshoring of compression sleeves and other textiles with controlled delivery of active medical ingredients. By partnering with Nufabrx, AFFOA successfully kept the small, 25-person U.S. company in the U.S. The company now has broad distribution (Walmart and Target), has created an entirely domestic supply chain, and in 2021 ranked number eight in the Deloitte Technology Fast 500 list of the fastest-growing companies in North America.
- AIM Photonics established the world's first complete end-to-end silicon photonic manufacturing ecosystem, including design enablement, multi-project wafer fabrication, and advanced microelectronic and photonic packaging capabilities. The institute's prototyping services enable small and medium enterprises to develop innovative products



AIM Photonics' TAP facility.

and services by providing them with technology on-ramps at all stages of development, as well as critical access to strategic U.S. government, industry, and academic communities.

- Regulatory and preclinical consulting are some of several member support services BioFabUSA provides to its members. These regulatory and preclinical consulting services support this diverse group as part of the larger mission to sustain existing industries and grow new ones. In response to the COVID-19 pandemic, BioFabConsulting assisted BioFabUSA members with Food and Drug Emergency Use Authorizations and other regulatory challenges as they brought COVID response technologies on-line.
- MxD released the Cybersecurity Maturity Model Certification (CMMC) 2.0 Playbook. The playbook delivers a quick start guide to achieving the first of three levels of compliance—labeling the security practices by degree of difficulty, clarifying instructions, and providing tips from lessons the MxD team learned while implementing these same security practices. It also helps small businesses assess their CMMC compliance in manageable segments to ensure they remain competitive for work with the DoD.



INSTITUTES' VALUE TO **ACADEMIA AND EDUCATORS**

Networking with the DoD MIIIs is a unique method for universities, community colleges, and other educational institutions to engage with and understand the needs of industry and government, so that targeted manufacturing research can be undertaken for the benefit of the institution, individual, and students. Cutting edge sponsored research enhances the reputation of the institution. For students, institutes provide opportunities for hands-on training, access to internships and apprenticeships, and increased connections to industry and job opportunities.

Value to Academia and Educators	
Strong Collaboration	Supply Chain Multiplier
<ul style="list-style-type: none"> • Collaborate with industry, academia, and government • Collaborate to design and execute innovative apprenticeship and education programs • Roadmap future technologies and manufacturing requirements 	<ul style="list-style-type: none"> • Create intellectual property through institute-funded research • Utilize your own organization's research • Use institute state of the art facilities to further manufacturing technologies
New Capabilities and Markets	Increased Performance and Returns
<ul style="list-style-type: none"> • Enhance department reputation by providing employable students trained in line with industry needs • Create content consistent with the latest technologies 	<ul style="list-style-type: none"> • Create ecosystems that positively impact the U.S. economy • Enable industry to solve applied research problems

- MxD's "Digital Jobs Taxonomy: Defining Manufacturing Jobs of the Future" and the "Hiring Guide: Cybersecurity in Manufacturing" is transforming how universities and community colleges educate and how companies identify needed skills for hiring and retraining workers for Industry 4.0. MxD's curriculum and workforce programs have impacted more than 30,000 learners to date.

- NextFlex's workforce and education program, FlexFactor®, has grown from an initial San Jose high school to having a national impact across 14 States, 34 community colleges, 50 industry partners, and 10,682 participants to date. A FlexFactor expansion over the next three years is projected to reach another 10,000 students, of which: ~82% will be minority, 60% low income, and 15% military connected.

- LIFT's headquarters feature a one-of-a-kind immersive Learning Lab to educate and train the next generation of high-level advanced

manufacturing technicians to fill the existing skills gap in the U.S., and provides a curriculum to prepare students for the advanced manufacturing jobs of tomorrow. A state-of-the-art, immersive learning facility, the LIFT Learning Lab features seven unique labs equipped to prepare students for the most in-demand manufacturing careers.

- The ARM Institute launched Roboticscareer.org – the only national resource that features robotics for manufacturing trainings vetted by industry experts. The website assists students new to robotics, students looking to upskill, employers, and education providers.



Young robotics experts working on a project launched by ARM.



MIIS IN ACTION: COVID-19 RESPONSE

In 2020, COVID-19 posed a serious national security threat. As the pandemic spread, there was an overwhelming need for personal protective equipment (PPE) supplies, testing, and pre-cursor elements of the vaccine development process. Supply chain challenges necessitated that the best in government, academia, and industry gather together at an unprecedented pace to accelerate innovations that address the needs of our nation.

The DoD launched its nine institutes with this very intent – to convene the industrial base and enable a rapid response to the developing needs across America. Many of the MIIs were already working on related manufacturing challenges, so they were in an ideal position to address needs caused by the pandemic. The fact that ecosystems were already established and working on related manufacturing challenges was a key contributor the quick and relevant response of the MIIs.



- Congress appropriated funding to DoD and the Under Secretary of Defense for Research and Engineering (R&E) quickly released requests for COVID-19 response projects.
- Within 2 days of requesting inputs, the OSD ManTech Office received 13 COVID-19 response project proposals from the DoD MIIs.
- The DoD MIIs' tight network of over 1400 members across 45 states* and close relationship with their DoD program office equipped them to rapidly and effectively respond to COVID challenges.
- DoD ultimately awarded over \$60.78M in funding for 13 projects. NIST funded an additional \$3.5M for projects at four of the DoD MIIs.
- Through their Cooperative or Technology Investment Agreements with the government, the institutes offer the government an expedited contracting option.
- For the DoD's CARES Act funding, money was released and first project work initiated within 5 weeks of OSD ManTech approval.

Project Examples

- America Makes rapidly partnered with the Food and Drug Administration, National Institutes of Health (NIH), and Veterans Affairs to connect the additive manufacturing industry with medical care providers to accelerate design and clinical review of 3D-printed personal protective equipment (PPE) and medical devices in short supply. The project resulted in over 200,000 downloads and more than 2.5 million views of PPE designs. Through the effort, America Makes assisted front line workers in obtaining hundreds of thousands of pieces of critical PPE supplies from qualified manufacturers across the U.S.



Critical PPE supplies 3D-printed using America Makes' Advanced Manufacturing Crisis Production Response platform.

- NextFlex's ability to print circuits on flexible substrates enabled Aionx's CleanSURFACES® - the world's only continuously cleaning antimicrobial mat. The mat's continuous cleaning significantly reduces disease transmission to fight hospital-acquired microbial infections, including COVID-19 and its variants.
- BioFabUSA developed a drug delivery platform simple enough for people with no specialized knowledge to administer a vaccine completely and accurately according to protocol. The delivery system includes an easy-to-manufacture and fill reservoir for drugs atop a microneedle delivery system. When placed on the skin, the reservoir is pressed, delivering the drug across the skin. The product is currently awaiting clinical trial.












CALL TO ACTION

The DoD Manufacturing Innovation Institutes (MII) 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 U.S. 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. The DoD MIIs each have 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:

 America Makes www.americamakes.us Dawn Marzano Communications Manager dawn.marzano@ncdmm	 MxD www.mxdusa.org membership@mxdusa.org	 LIFT <small>Where Manufacturing Technology and Talent Matter</small> www.lift.technology communications@almmii.org
 www.aimphotronics.com Susan Rogers Director, Marketing and Communications srogers@aimphotronics.com	 www.nextflex.us Karen Savala Director of Marketing, Membership and Events ksavala@nextflex.us	 https://affoa.org/ Natasha Spackey Vice President of New Business Development & Partnerships natasha@affoa.org
 armiusa.org Maureen Toohey, Esq. Deputy Executive Director mtoohey@armiusa.org	 ARM INSTITUTE www.arminstitute.org membership@arminstitute.org	 www.biomade.org Christine Lee Communications Manager clee@biomade.org





The DoD Manufacturing Innovation Institutes



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 is where innovative manufacturers forge their futures. MxD brings together the U.S. manufacturing industry, government, and academia around project opportunities, a 22,000 square-foot future factory floor, workforce development tools, and workshops to advance the digital transformation of U.S. manufacturing.



LIFT: CONNECTING TECHNOLOGY AND TALENT

LIFT rapidly contracts, designs, develops, prototypes, and tests innovative technologies for the DoD to speed technology transition to the warfighter while building the future workforce of America.



AIM PHOTONICS: AMERICAN INSTITUTE FOR MANUFACTURING INTEGRATED PHOTONICS

AIM Photonics enables a complete Photonic Integrated Chip (PIC) 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 FLEXIBLE HYBRID ELECTRONICS INSTITUTE

NextFlex engages design, development, prototyping, and pilot-scale manufacturing of Flexible Hybrid Electronics aligned with multiple DoD priorities at a single International Traffic in Arms Regulations (ITAR) and Food and Drug Administration compliant location.



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 TISSUE BIOFABRICATION INSTITUTE

BioFabUSA integrates innovative cell and tissue cultures with advances in biofabrication, automation, robotics, and analytical technologies to create disruptive research and development tools and Food and Drug Administration (FDA)-compliant volume manufacturing processes.



ARM: ADVANCED ROBOTICS FOR MANUFACTURING

ARM strengthens and stabilizes the DoD manufacturing supply chain by advancing the robotic and Artificial Intelligence (AI) 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.