Department of Defense Manufacturing Innovation Institutes

December 2021

DoD Manufacturing Innovation Institutes

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

WHY? Give 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.

NATIONAL PRESENCE: With the launch of BioMADE in October 2020, the nine DoD Manufacturing Innovation Institutes (MIIs) current membership total is over 1550 organizations from academia (19%), industry (51%), small and large business (17%), non-profits (10%) and government (3%) located in 49 states, Washington DC, and Puerto Rico. Over 115 of the national universities are members of one, or multiple institutes, along with 18 community college systems.

Department of Defense Manufacturing Innovation Institutes and Vision Chartering Principles		
Advancing Research & Technology	**Establishing & Growing Manufacturing Ecosystems**	**Securing Human Capital**
Partner with industry 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

COVID-19 RESPONSE: Institutes were able to immediately pivot and mobilize their current member and partner network to tackle pandemic-related challenges. They mitigated gaps in personal protective equipment supply chain, medical testing and manufacturing roadmaps. As an example, ***America Makes*** rapidly partnered with the Food and Drug Administration, National Institutes of Health, 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 200K downloads and more than 2.5M 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 manufacturing across the U.S. Additionally, ***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.

PUBLIC-PRIVATE PARTNERSHIP: To ensure equitable representation and active partnership between the government and industry, a minimum of one-to-one cost match from industry, states, or academia to DoD's strategic investment is required. To date, the DoD has committed approximately $950M on the DoD MII agreements; Members (industry, academia, non-profits) have committed almost $2B in cost share. This level of cost-share demonstrates the institutes' value to industry.

MEETING DIRECT MILITARY NEEDS: The initial strategic funding from Office of the Secretary of Defense (OSD) demonstrated clear value in meeting DoD priorities, which prompted the Services to directly invest. As of the third quarter FY21, the Services committed an additional $487M, in DoD-directed projects. OSD's investment continues to fund strategic and joint technical, workforce, and ecosystem initiatives.

EDUCATION AND WORKFORCE DEVELOPMENT: 62.5K+ students, teachers, and workforce were trained in science, technology, engineering, mathematics and advanced manufacturing skills by the DoD MIIs and their partner organizations in FY21.

www.americamakes.us

America Makes

The National Additive Manufacturing Innovation Institute

Established: August 2012 **Website:** www.americamakes.us

Headquarters: Youngstown, OH

Mission: *Accelerate the adoption of additive manufacturing (AM) by **convening, coordinating** and **catalyzing** the AM industry to help advance U.S. manufacturing competitiveness and security.*

Consortium Organizer: National Center for Defense Manufacturing and Machining **240** Members

Satellite Locations:

The W.M. Keck Center for 3D Innovation at The University of Texas at El Paso (El Paso, TX)
Texas A&M Engineering Experiment Station at Texas A&M University (College Station, TX)
National Institute for Aviation Research at Wichita State University (Wichita, KS)

Total Committed Funding DoD Agreements:

$83M Base Federal Funding
$153.3M Base Non-Federal Cost Share

Additional Committed Project Funding:

$168.4M DoD Sponsored Projects
$56.1M Academia & Industry Sponsored Projects
$2M State/Local Government Sponsored Projects

Total On-going and Completed Projects:

173 Technology Projects

125 Education & Workforce Development Projects

ACHIEVEMENTS

- ***America Makes*** is the nation's lead collaborative partner in additive manufacturing/3D printing technology research, discovery, creation, and innovation convening over 230 members or ~22% of the additive manufacturing market – an $11.8B industry.

- ***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.

- ***America Makes*** and the American National Standards Institute (ANSI) launched the Additive Manufacturing Standards Collaborative (AMSC) to coordinate/accelerate the development of industry-wide additive manufacturing standards.

DEPARTMENT OF DEFENSE MANUFACTURING INNOVATION INSTITUTES

www.mxdusa.org

Manufacturing times Digital

Established: February 2014 **Website:** www.mxdusa.org

Headquarters: Chicago, IL

Mission: *Provide the government and U.S. manufacturers with the digital tools needed to transform American manufacturing.*

Consortium Organizer: MxD **319** Members

Total Committed Funding DoD Agreements:
$84.5M Base Federal Funding
$131M Base Non-Federal Cost Share

Additional Committed Project Funding:
$32.2M DoD Sponsored Projects
$58.6M Academia & Industry Sponsored Projects

Total On-going and Completed Projects:
83 Technology Projects
17 Education & Workforce Development Projects

MxD headquarters, Chicago, IL. Credit: *MxD.*

ACHIEVEMENTS

- **MxD's** Jobs Taxonomy Digital and Cyber Hiring Guide are transforming how universities and community colleges educate and how companies identify needed skills for hiring and retraining workers for Industry 4.0. Their curriculum and workforce programs have impacted more than 30K learners to date.

- **MxD** established the National Center for Cybersecurity in Manufacturing, launching programs that are strengthening small/mid-size manufacturers through awareness building and a marketplace offering low cost assessments, tools, and services.

www.lift.technology

Where Manufacturing Technology and Talent Matter

LIFT

Established: February 2014 **Website:** www.lift.technology

Headquarters: Detroit, MI

Mission: *Advancing American Manufacturing Into the Future through technology and talent development and driving rapid implementation of smarter manufacturing by connecting the materials, processes, and systems together with the talent needs of the future.*

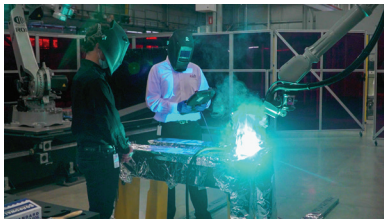
Consortium Organizer: American Lightweight Materials Manufacturing Innovation Institute
129 Members

Total Committed Funding DoD Agreements:
$88M Base Federal Funding
$84.1M Base Non-Federal Cost Share

Additional Committed Project Funding:
$68M DoD Sponsored Projects
$1.7M Academia & Industry Sponsored Projects
$12.6M State/Local Government Sponsored Projects

Total On-going and Completed Projects:
85 Technology Projects
46 Education & Workforce Development Projects

ACHIEVEMENTS



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

- With a success rate of over 90%, LIFT's Operation Next is an innovative training and credentialing program that provides a blended learning curriculum to active duty soldiers within their last six months of service, enabling them to earn one or more nationally portable, standards based, industry recognized credentials in high demand manufacturing fields.

- **LIFT** developed a new alloy and manufacturing innovations to produced thin-walled ductile iron castings for lightweight automotive transmission casings (reduced casing weight by ~ 40%).

DEPARTMENT OF DEFENSE
MANUFACTURING INNOVATION INSTITUTES

www.aimphotonics.com

American Institute for Manufacturing Integrated Photonics

Established: July 2015 **Website:** www.aimphotonics.com

Headquarters: Albany, NY

Mission: *Advance integrated photonic circuit manufacturing technology development while simultaneously providing access to state-of-the-art fabrication, packaging, and testing capabilities for small-to-medium enterprises, academia, and the government; create an adaptive integrated photonic circuit workforce capable of meeting industry needs and further increase domestic competitiveness; and meet participating commercial, defense, and civilian agency needs in this burgeoning technology area.*

Consortium Organizer: Research Foundation for the State University of New York **60** Members

Total Committed Funding DoD Agreements:
$275M Base Federal Funding
$659.1M Base Non-Federal Cost Share

Additional Committed Project Funding:
$14.2M DoD Sponsored Projects
$1M Academia & Industry Sponsored Projects

Total On-going and Completed Projects:
80 Technology Projects
46 Education & Workforce Development Projects

ACHIEVEMENTS

- **AIM Photonics** established the first integrated silicon photonic circuit offering in the U.S. and the first 300-mm offering anywhere in the world. To reduce costs and accelerate the speed of development, prototyping, and transition, AIM Photonics also established the U.S.'s first test, assembly, and packaging open access offering for state-of-the art 300-mm based silicon wafers.
- To reduce the barrier to entry in this complex technology field and rapidly grow the U.S.-based ecosystem, **AIM Photonics** developed computer-based component models to enable the rapid design and simulation of integrated photonic circuits such that it no longer requires a PhD to design an integrated photonic circuit.

Photonic Integrated Chips from AIM Photonics 300mm MWP programs ready to ship to TAP facility for final test and packaging.

Credit: *AIM Photonics*

www.nextflex.us

NEXTFLEX®

America's Flexible Hybrid Electronics Manufacturing Institute

Established: August 2015 **Website:** www.netflex.us

Headquarters: San Jose, CA

Mission: *Pioneer flexible hybrid electronics manufacturing to serve our nation's Warfighters and the U.S. economy.*

Consortium Organizer: Flextech Alliance **105** Members

Total Committed Funding DoD Agreements:
$102M Base Federal Funding
$123.2M Base Non-Federal Cost Share

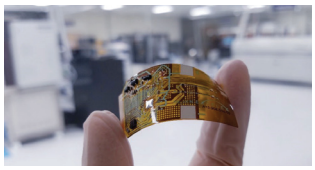
Additional Committed Project Funding:
$142.3M DoD Sponsored Projects
$2.7M Academia & Industry Sponsored Projects
$5.8M State/Local Government Sponsored Projects

Total On-going and Completed Projects:
85 Technology Projects
46 Education & Workforce Development Projects

ACHIEVEMENTS

- **NextFlex** has the only end-to-end hybrid electronics pilot line in the U.S., integrating more than 60 member-led technology and equipment projects to enable flexible electronic packaging and assembly. Their world-class technology hub and member-led supply chain have delivered 24+ prototypes against DoD modernization priorities, allowing direct assessment by the DoD.

- **NextFlex's** workforce and education program, FlexFactor, has grown from an initial San Jose high school to have national impact, across 14 States, 35 community colleges, 43 industry partners, and 7,240 participants to date. A FlexFactor expansion over the next 3 years will reach another 7,000 students, of which: ~82% will be minority, 75% low income, and 20% military-connected.



DEPARTMENT OF DEFENSE
MANUFACTURING INNOVATION INSTITUTES

www.affoa.org

Advanced Functional Fabrics of America Institute

Established: April 2016 **Website:** www.affoa.org

Headquarters: Cambridge, MA

Mission: *Rekindle the domestic textiles industry by leading a nationwide enterprise for advanced fiber and fabric technology development and manufacturing, enabling revolutionary system capabilities for national security and commercial markets.*

Consortium Organizer: Massachusetts Institute of Technology **133** Members

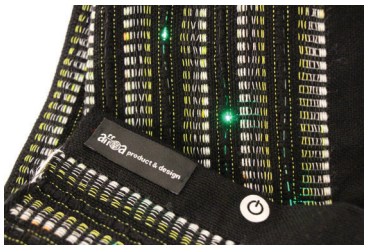
Total Committed Funding DoD Agreements:
$75M Base Federal Funding
$272M Base Non-Federal Cost Share

Additional Committed Project Funding:
$15.8M DoD Sponsored Projects
$3M Academia & Industry Sponsored Projects

Total On-going and Completed Projects:
152 Technology Projects
52 Education & Workforce Development Projects

The Defense Fabric Discovery Center enables researchers from Lincoln Laboratory to develop advanced fiber and fabric technology.

Credit: *MIT Lincoln Laboratory*



ACHIEVEMENTS

- **AFFOA**'s Advanced Functional Fabric ecosystem has prototyped and scaled technologies/products that meet DoD/Service-specific requirements for cold weather clothing, advanced headborne systems, novel ballistic protection, biosafety, and more.

- **AFFOA** prevented the manufacturing offshoring of compression sleeves and other textiles with controlled delivery of active 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, Target) and has created a supply chain located entirely in the U.S.

- **AFFOA**'s investment in product demonstration projects and an Entrepreneur in Residence (EIR) program has led to a former EIR spinning off a company. This startup is licensing AFFOA-developed software (LOOks technology) to sell programmable digital tape to the construction market.

DEPARTMENT OF DEFENSE
MANUFACTURING INNOVATION INSTITUTES

www.armiusa.org

biofabusa

Advanced Regenerative Manufacturing Institute

Established: December 2016 **Website:** www.armiusa.org

Headquarters: Manchester, NH

Mission: *Make practical the scalable, consistent and cost-effective manufacturing of engineered tissues and tissue-related technologies, to benefit existing industries and grow new ones.*

Consortium Organizer: Flextech Alliance **105** Members

Total Committed Funding DoD Agreements:
$80M Base Federal Funding
$214M Base Non-Federal Cost Share

Additional Committed Project Funding:
$32.8M DoD Sponsored Projects
$6M Academia & Industry Sponsored Projects

Total On-going and Completed Projects:
45 Technology Projects
13 Education & Workforce Development Projects

ACHIEVEMENTS

- **BioFabUSA** developed the first-ever, modular and enclosed tissue foundry. This tissue foundry features the entire Tissue Engineered Medical Product (TEMP) manufacturing process, from tissue cell cultures to final product packaging. Modularity allows users to scale-up and reconfigure the platform to facilitate the manufacturing of any TEMP. The enclosed system-feature eliminates the need for costly capital investments in clean room facilities.

- **BioFabUSA** created hands-on biofabrication activity kits for 6-12th graders. The kit features complete instructions, teacher and student guides, questions aligned to the Next Generation Science Standards, Common Core Standards, and Framework for K-12 Science Education. Over 5K students have participated in the developed activities.

BioFabUSA's tissue foundry.

Credit: *BioFabUSA*

Students using BioFabUSA's activity kits.

DEPARTMENT OF DEFENSE MANUFACTURING INNOVATION INSTITUTES

www.arminstitute.com

Advanced Robotics for Manufacturing Institute

Established: January 2017 **Website:** www.arminstitute.com

Headquarters: Pittsburgh, PA

Mission: *Accelerate the development and adoption of robotics technologies that are the foundation of every advanced manufacturing activity today and in the future. The institute leverages a unique, robust, and diverse ecosystem of partners across industry, academia, and government to make robotics, autonomy, and artificial intelligence more accessible to U.S. manufacturers – large and small, train and empower the manufacturing workforce, strengthen the U.S. economy and global competitiveness, and elevate the nation's security and resilience.*

Consortium Organizer: Carnegie Mellon University **323** Members

Total Committed Funding DoD Agreements:
$80M Base Federal Funding
$173M Base Non-Federal Cost Share

Additional Committed Project Funding:
$8M DoD Sponsored Projects
$275M Academia & Industry Sponsored Projects

Total On-going and Completed Projects:
63 Technology Projects
40 Education & Workforce Development Projects

Credit: *ARM Institute*

ACHIEVEMENTS

- **ARM** has developed a robotic wire harness assembly and connector pinning workcells for manufacturers or DoD depots that build or repair military air, land, or sea vehicles. This capability is demonstrated in ARM's 60,000 square foot facility in Pittsburgh.

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

www.biomade.org

BioMADE

Bioindustrial Manufacturing and Design Ecosystem

Established: October 2020 **Website:** www.biomade.org

Headquarters: St. Paul, MN

Mission: *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.*

Consortium Organizer: Engineering Biology Research Consortium (EBRC) **80** Members

Total Committed Funding DoD Agreements:
$87.5M Base Federal Funding
$187.5M Base Non-Federal Cost Share

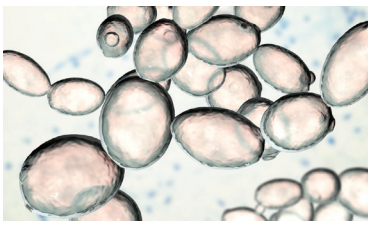
Additional Committed Project Funding:
$337K DoD Sponsored Projects

Total On-going and Completed Projects:
3 Technology Projects

ACHIEVEMENTS

- **BioMADE** completed their Technical Roadmap. Crafted by the Transition Technical Working Group, the roadmap incorporates insights from 19 industry and academic partners, and 8 subject matter experts from the U.S. Government. Through a close relationship with DoD and the Military Services, BioMADE will create a critical and organic domestic manufacturing system ensuring secure end-to-end supply chains to meet strategic needs.

- **BioMADE** conducted a workshop for EWD stakeholders. Panels discussed training gaps identified by industry and success stories from other EWD programs. Feedback and discussions from this meeting were used to craft BioMADE's first EWD project call.



DEPARTMENT OF DEFENSE MANUFACTURING INNOVATION INSTITUTES

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.