Department of Defense

# Manufacturing Technology Program

# STRATEGIC PLAN

November 2022

The Office of the Under Secretary of Defense
for Research and Engineering
Washington, D.C.

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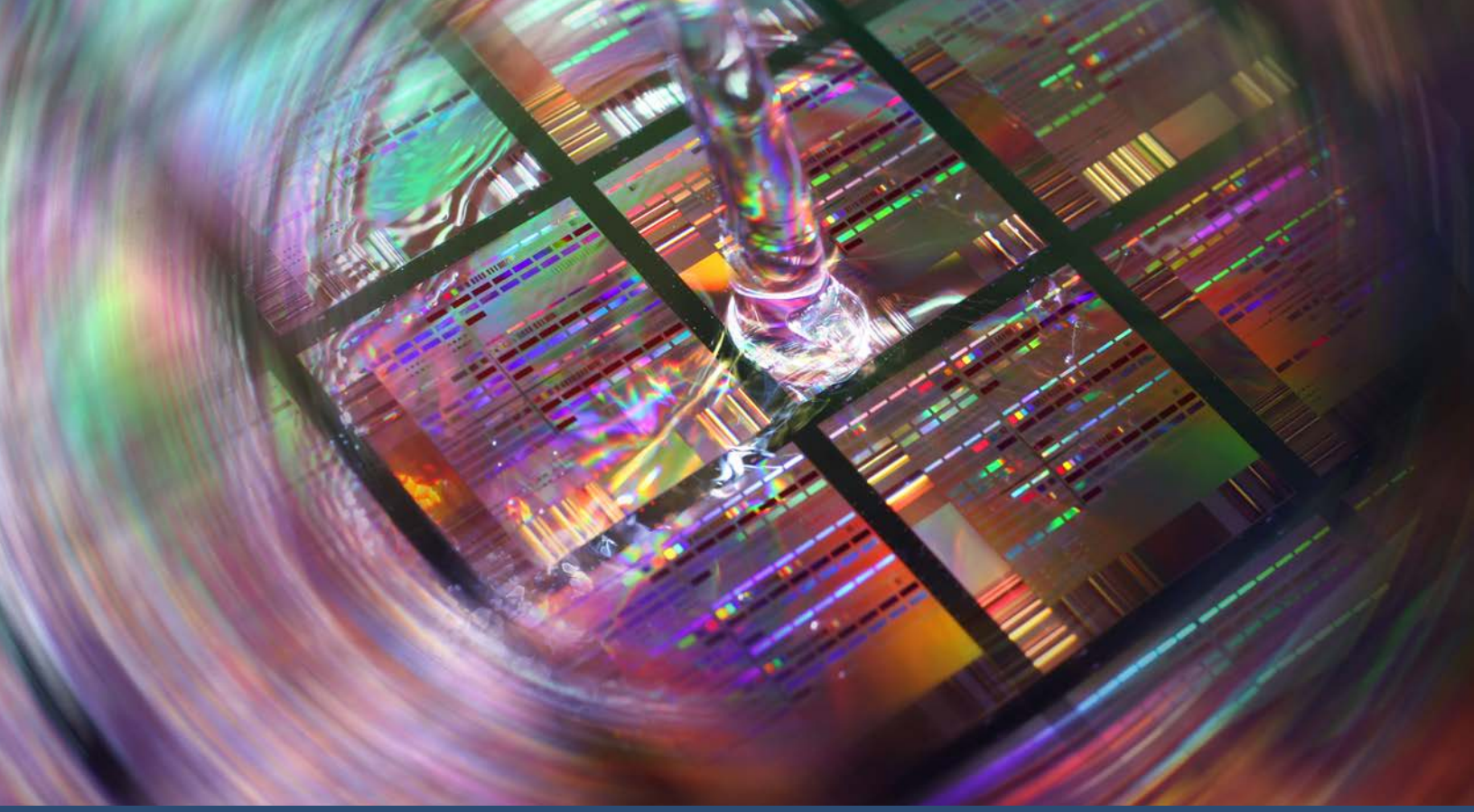

# PREFACE

Our country faces diverse, complex challenges that include sophisticated cyber-attacks, supply chain risks, defending against hypersonic missiles, and responding to biological threats. In a dynamic global environment, America's technological advantage requires constant renewal. The Department of Defense (DoD) cannot rely on today's technology to ensure military technological dominance tomorrow.

The DoD Manufacturing Technology (ManTech) Program is one effective mechanism for maintaining our technological edge by promoting innovative manufacturing capabilities and an industrial base that can deliver them. To ensure technological advantage over our adversaries, the DoD ManTech program provides an innovative, agile, resilient, responsive, and affordable industrial base by:

- serving as the Department's investment mechanism for identifying, developing, and maturing manufacturing processes that enable affordable production and repair of defense systems and equipment;
- disseminating results to the defense industrial base (DIB);
- striving to enhance the resilience of the supply chain; and
- promoting education and training of the manufacturing workforce.

Section 4841 of Title 10, United States Code (USC) (previously 10 USC § 2521), provides that the Office of the Under Secretary of Defense for Research and Engineering (OUSD[R&E]) administers the DoD ManTech Program, while the Secretaries of the Military Departments and the heads of Defense Agencies execute the program.

This Strategic Plan focuses on four thrust areas for the next five years. It provides the basis for the coordination of DoD Service and Agency ManTech efforts and provides plans to our stakeholders, other government entities, industry, and academia.

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RESEARCH
AND ENGINEERING

MEMORANDUM FOR THE DEFENSE MANUFACTURING COMMUNITY

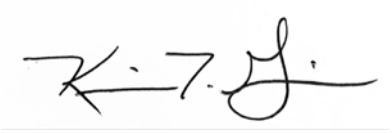
SUBJECT: Department of Defense Manufacturing Technology Program Strategic Plan

The United States Military's technological edge has provided an enduring advantage for the Joint Force. However, our strategic competitors enjoy increased access to commercial state-of-the-art, disruptive technologies that endanger America's interests and national security. Increasingly sophisticated cyber-attacks, new supply chain risks, hypersonic weapons and biological threats make the consequences of technological stagnation more severe than ever. The Department of Defense (DoD) must innovate to ensure future Military dominance.

As the Director for Science and Technology Futures, my office helps the Department preserve DoD's technology advantage. A central element of that effort is the DoD Manufacturing Technology (ManTech) Program, which convenes and administers the joint planning and coordination for the Service and Agency ManTech programs.

For over 66 years, the DoD ManTech Program has helped develop responsive, world-class manufacturing capabilities to affordably and rapidly meet Joint Force needs throughout the defense system life cycle. This Strategic Plan lays out the vision and plans needed to ensure DoD best leverages the latest innovations in advanced manufacturing. It introduces four thrust areas, addressing our Nation's ability to produce the needed parts and systems for the Military, the need for healthy and secure supply chains, and the skills needed by the United States manufacturing workforce.

The DoD ManTech Program is an effective mechanism for maintaining the United States' technological edge by promoting innovative manufacturing capabilities and an industrial base that can deliver them. I encourage the defense manufacturing community to continue to leverage the program, building an enduring advantage.



Kevin T. Geiss
Director, Science and Technology Futures

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DEPARTMENT OF DEFENSE
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INNOVATING MANUFACTURING

# DOD MANTECH PROGRAM'S ROLE IN DEFENSE MANUFACTURING

The DoD Manufacturing Technology (ManTech) Program furthers national security objectives through the development and application of advanced manufacturing technologies and processes. Section 4841 of Title 10, USC, provides that the DoD ManTech Program will further national security objectives through the development and application of advanced manufacturing technologies and processes that:

- reduce the acquisition and supportability costs of defense weapon systems; and
- reduce manufacturing and repair cycle times across the life cycles of such systems.

The DoD ManTech Program serves as an important mechanism for technology transition by:

- identifying, developing, and maturing *new or improved* manufacturing and repair processes;
- providing *affordable* technologies to acquisition program managers; and
- *bridging the gap* between discovery and implementation of new capabilities for the warfighter.

The program is executed by five Military Service and Defense Agency ManTech program offices: Army, Navy, Air Force, the Defense Logistics Agency (DLA), and the Office of the Secretary of Defense (OSD) with oversight by the Office of the Under Secretary of Defense for Research and Engineering (OUSD [R&E]).[1] The Joint Defense Manufacturing Technology

[1] The Missile Defense Agency (MDA) is a research and development organization with a challenging acquisition function for missile defense. As the MDA works to meet the ever-evolving threat, the MDA is moving to an ex-officio membership that better aligns the Agency to DoD activities. The MDA will continue participation in the JDMTP and the manufacturing technology community.

Panel (JDMTP), its technical subpanels, and working groups identify cross-cutting technologies, develop joint strategies, and provide peer review of DoD ManTech projects.

Individual Service/Agency strategic approaches to ManTech are outlined below.

- **Army ManTech** facilitates a partnership among the Science and Technology (S&T) community, industry, the Army's organic industrial base (OIB), the Program Executive Offices and Product Managers to ensure viable and realistic transition of technology to a program of record. The Army uses a broad spectrum of applications with a focus on initiatives for ground, air, network, Soldier, and weapon systems and platforms.
- **Navy ManTech** concentrates resources on reducing both the acquisition and life-cycle costs of key Navy acquisition programs. Navy ManTech transitions manufacturing technology which, when implemented, results in a cost reduction or cost avoidance. Navy ManTech develops an integrated investment strategy that is approved annually by the Office of Naval Research (ONR) leadership.
- **Air Force ManTech** invests in five technology pillars: Advanced Concepts; Hypersonic Strike; Attritable and Low Cost Systems; Networked Command, Control, and Communication Systems; and Emerging Technology.
- **DLA ManTech** employs two major lines of effort: Industrial Base and Aging Weapon System Support and Three-Dimensional (3D) Technical Data Modernization/Model Based Enterprise. Focus areas include: Advanced Microcircuit Emulation, Batteries, Digital Twin/Digital Thread, Additive Manufacturing, Castings and Forgings, Subsistence, and Clothing and Textiles.
- **OSD ManTech** focuses on a diverse set of identified joint, defense-critical, and sometimes high-risk manufacturing technology areas. The portfolio works on cross-cutting national security manufacturing needs to stimulate the early development of manufacturing processes concurrent with technology development and workforce training.

OUSD(R&E) groups 14 critical technology areas—each of which is vital to maintaining the United States' national security—into three categories. While many technologies cross between these categories, these groupings represent the broad and varied approaches that are required to advance technologies crucial to the Department. By focusing efforts and investments into these 14 critical technology areas, the Department will accelerate the transition of key capabilities to the Military Services and Combatant Commands. As the Department's technology strategy evolves and technologies change, the Department will update its critical technology priorities.

The categories and associated technology areas appear below.

1. Seed Areas of Emerging Opportunity
    - Biotechnology
    - Quantum Science
    - Future Generation Wireless Technology
    - Advanced Materials

2. Effective Adoption Areas – where there is existing, vibrant commercial sector activity
    - Trusted Artificial Intelligence and Autonomy
    - Integrated Network Systems-of-Systems
    - Microelectronics
    - Space Technology
    - Renewable Energy Generation and Storage
    - Advanced Computing and Software
    - Human-Machine Interfaces
3. Defense-Specific Areas
    - Directed Energy
    - Hypersonics
    - Integrated Sensing and Cyber

# DOD MANTECH PROGRAM STRATEGY

As the primary technology office for OUSD(R&E) has established a distinct strategy, vision, and mission for the ManTech Program (Figure 1). The strategy is implemented through four thrust areas (Figure 2) that support the joint ManTech enterprise. The thrust areas focus on responsive and effective delivery of high-priority solutions across the portfolio of manufacturing technology investments to meet broader defense manufacturing needs.

## Strategy

**Meet Service and Agency mission requirements for advanced manufacturing technologies by pursuing joint manufacturing technology opportunities to accelerate adoption of defense critical technologies that enhance value to the industrial base, the resilience of the supply chain, and the capabilities of the workforce.**

## Vision

**A responsive, world-class manufacturing capability to affordability and rapidly meet warfighter needs throughout the defense system life cycle, within the Defense Industrial and Organic Base.**

## Mission

**Anticipate and close gaps in manufacturing capabilities for affordable, timely, and low-risk development, production, and sustainment of defense systems through technology development and adoption and training.**

Figure 1. DoD ManTech Strategy, Vision, and Mission

## DoD ManTech Strategic Plan Thrust Areas

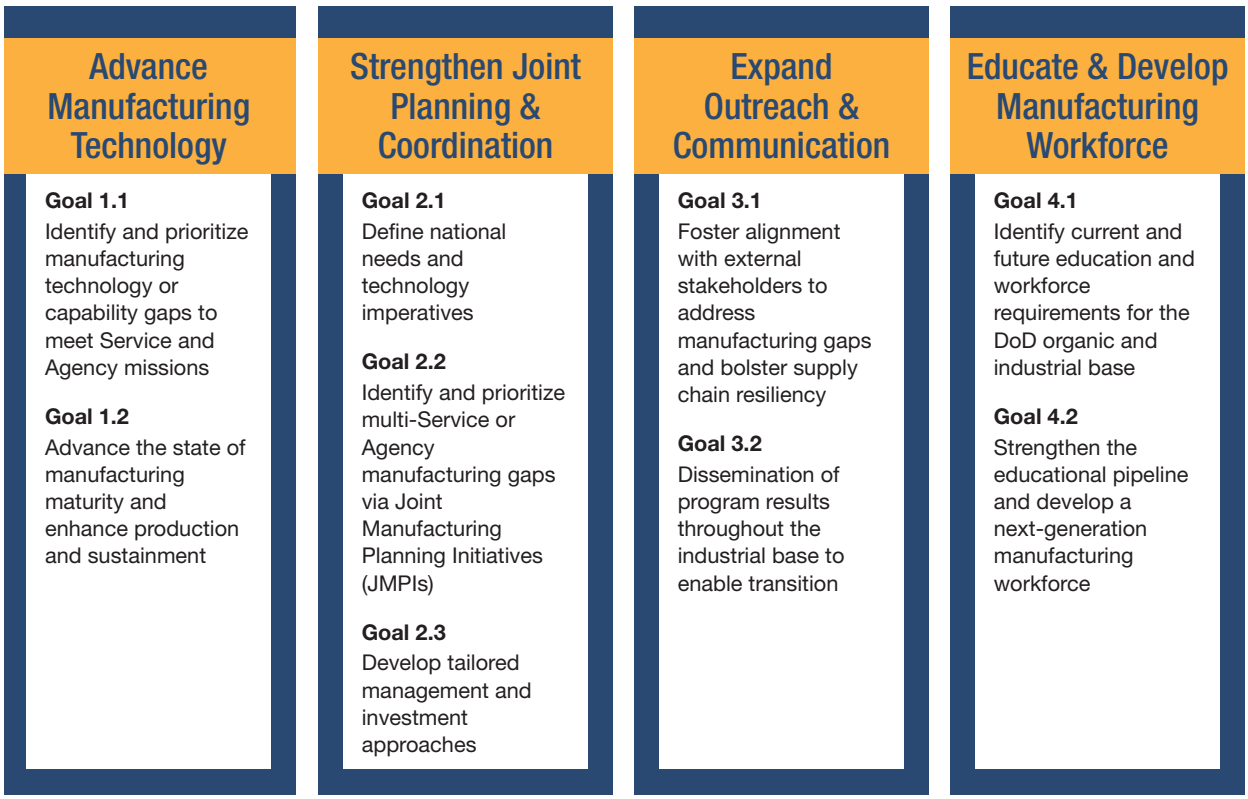



Figure 2. DoD ManTech Strategic Plan Thrust Areas

The FY 2023 President's Budget funds DoD ManTech at $502 million, which equates to less than one-half percent of annual research, development, test, and evaluation (RDT&E) spending. The DoD ManTech Program addresses the transition of RDT&E ($130 billion fiscal year [FY] 2023) for rapid, affordable, and capable procurement ($146 billion FY 2023) and operations and maintenance ($309 billion FY 2023).

Therefore, the DoD ManTech Program must focus and execute its relatively small investment (Table 1) for maximum effectiveness. This approach recognizes the importance of the broader needs while realizing it is beyond the program's resources to fully satisfy them.

**Table 1. DoD ManTech Funding by Program (Dollars, in Millions)**

| | DoD ManTech Component | FY 2022 Enacted Budget | FY 2023 President's Budget | | | | |
|---|---|---|---|---|---|---|---|
| | | FY 2022 | FY 2023 | FY 2024 | FY 2025 | FY 2026 | FY 2027 |
| Army | Budget | $61.7 | $91.3 | $75.0 | $66.7 | $66.7 | $67.3 |
| | Congressional Adds | $42.0 | | | | | |
| | Total Army (0708045A) | **$103.7** | | | | | |
| Navy | Budget | $57.2 | $60.7 | $61.8 | $63.1 | $63.1 | $64.4 |
| | Congressional Adds | $20.0 | | | | | |
| | Total Navy (0603680N) | **$77.2** | | | | | |
| Air Force | Budget | $45.3 | $47.8 | $43.3 | $43.9 | $44.5 | $45.0 |
| | Congressional Adds | $130.9 | | | | | |
| | Total Air Force (0603030F / 635280) | **$176.2** | | | | | |
| OSD | Budget | $133.6 | $256.1 | $248.6 | $153.4 | $143.2 | $145.7 |
| | Congressional Adds | $121.6 | | | | | |
| | Total DMS&T (PE 0603680D8Z) | **$255.2** | | | | | |
| DLA | Budget | $37.5 | $46.2 | $45.2 | $46.2 | $47.1 | $47.9 |
| | Congressional Adds | $46.0 | | | | | |
| | Total DLA (0603680S) | **$83.5** | | | | | |
| **Total** | **Total DoD ManTech Budget** | **$335.4** | **$502.0** | **$473.9** | **$373.2** | **$364.6** | **$370.3** |
| | **With Congressional Adds** | **$695.9** | | | | | |

# THRUST AREA 1: ADVANCE MANUFACTURING TECHNOLOGY

Service and Agency priorities guide investments to both accelerate S&T into developmental programs as well as improve the affordability and readiness of current systems. Each component's mission needs and priorities are the primary drivers shaping that component's ManTech investments. Component ManTech programs identify manufacturing gaps associated with either transitioning novel technology into developmental systems or improving the existing production and sustainment capabilities. Programs execute their projects with a focus on delivering essential processing, fabrication, and enterprise technologies ready for application across the supply chain.

Goals and their corresponding activities include:


### *Goal 1.1: Identify and prioritize manufacturing technology or capability gaps to meet Service and Agency missions*

- Identify and prioritize manufacturing technologies required to transition science and technology advancements into development or acquisition programs
- Identify and prioritize manufacturing process or fabrication technologies to improve production or sustainment of defense systems
- Enable prospective users to participate in setting requirements and ranking importance of proposed projects

### *Goal 1.2: Advance the state of manufacturing maturity and enhance production and sustainment*

- Execute and manage each selected ManTech project against technical and financial goals to ensure performance necessary for transition
- Conduct rigorous project reviews with prospective users to assure completion and transition on the schedule required for implementation
- Improve the use of implementation plans required for projects to maximize timely transition of the technology or process to the user

# THRUST AREA 2: STRENGTHEN JOINT PLANNING AND COORDINATION

Joint planning and coordination activities identify common manufacturing challenges and solutions to combine or leverage investments for greater impact by expanding opportunities for implementation. While each component establishes priorities that drive its investments, strategic coordination combines individual Service requirements into joint manufacturing technology roadmaps. Roadmaps highlight overlaps and gaps that ultimately define joint investment initiatives.

Fundamental purpose of the JDMTP are to integrate requirements, conduct joint planning, and develop joint strategies. Activities supporting this thrust operate at the panel, subpanel, and working group level. This leads to significant increases in broad benefits rather than single-service solutions. The JDMTP identifies and eliminates duplication and shares individual service achievements across the Military Services.


Portfolio reviews are the centerpiece of the annual implementation cycle, allowing principals to share their investment priorities with one another. Subpanels examine every investment to identify and leverage potential successes. Shared interest can influence individual Service and Agency investments.

Goals and their corresponding activities include:

### *Goal 2.1: Define national needs and technology imperatives*

- Identify and connect the National Security and Defense Strategies with Service and Agency priorities, including USD(R&E) Critical Technology Areas
- Analyze manufacturing technologies required to enable these strategic requirements and integrate roadmaps

### *Goal 2.2: Identify and prioritize multi-Service or -Agency manufacturing gaps via Joint Manufacturing Planning Initiatives (JMPIs)*

- Subpanels and technical working groups address multi-Service technology gaps by developing Joint Technology Pursuit Areas, roadmaps, and transition targets
- Panel principals identify final JMPIs by analyses of impact, joint transition potential, and portfolio alignment

### *Goal 2.3: Develop tailored management and investment approaches*

- Joint investment opportunities inform Service, Agency, and OSD annual planning processes to identify management lead and technical support
- Management lead tailors contracting vehicle and team based upon component investment profile and primary and secondary transition targets
- Coordinate across the federal enterprise to reduce barriers and promote adoption; partner with other federal programs and international partners

## THRUST AREA 3: EXPAND OUTREACH AND COMMUNICATION

Through outreach and communication, the JDMTP promotes the adoption of program successes by industrial base manufacturers. To this end, the DoD ManTech Program will collaborate with external partners to close manufacturing gaps, improve supply chain resiliency, and increase program effectiveness. Current defense manufacturing challenges cannot be solved solely through DoD ManTech Program investments; there is advantage in partnering with the larger innovation ecosystem, including DoD, industry, universities, and allies.

Goals and their corresponding activities include:


### *Goal 3.1: Foster alignment with external stakeholders to address manufacturing gaps and bolster supply chain resiliency*

- Engage DoD's manufacturing stakeholders, including the OUSD for Acquisition and Sustainment, Program Executive Officers, and the OIB
- Demonstrate how products and enabling manufacturing processes from DoD Manufacturing Innovation Institutes (MIIs) address Service and Agency manufacturing technology opportunities

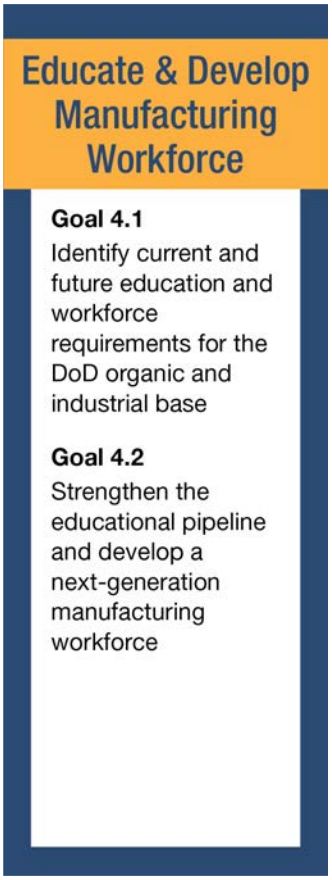
### *Goal 3.2: Disseminate program results throughout the industrial base to enable transition*

- Communicate results of collaboration, joint planning, program results and effectiveness through DoD manufacturing conferences, industry association meetings, and appropriate online media

# THRUST AREA 4: EDUCATE AND DEVELOP MANUFACTURING WORKFORCE

The DoD ManTech Program has a responsibility to attract and build a strong, talented future manufacturing workforce, which requires investment in both foundational manufacturing knowledge and special manufacturing skills. Defense manufacturing is facing a workforce crisis shaped by increased retirement, lagging student interest, and the requirement for basic digital engineering literacy. Advanced manufacturing processes and technologies cannot transition without an associated skilled workforce. The DoD ManTech Program will both directly invest in manufacturing education and workforce development and engage with universities, community colleges, and vocational technical schools to deliver advanced skills.

Goals and their corresponding activities include:




### *Goal 4.1: Identify current and future education and workforce requirements for the DoD organic and industrial base*

- Perform workforce gap analysis to establish baseline and threshold goals for high demand manufacturing sectors, in concert with the OSD workforce office
- Utilize the Manufacturing Readiness Level body of knowledge, manufacturing risk assessment tools, and associated criteria developed by the JDMTP Manufacturing Readiness Level (MRL) Working Group as a source of subject matter expertise

### *Goal 4.2: Strengthen the educational pipeline and develop a next-generation manufacturing workforce*

- Invest in high demand industrial skills in partnership with similar Federal programs at the Departments of Labor, Education, and Commerce
- Leverage activities at DoD MIIs with workforce development as well as primary and secondary school programs to promote early interest in manufacturing careers

# MANUFACTURING TECHNOLOGY PRIORITIES

The manufacturing technology priorities for the DoD ManTech Program are in several locations within this strategy. Military Service and Agency manufacturing priorities are captured within Appendix A, "JDMTP and the Service and Agency ManTech Programs," where Service and Agency priorities are accompanied by parallel investment strategies. Additionally, Appendix B outlines each JDMTP Technical Subpanel's joint manufacturing technology priorities along with a thrust areas and a taxonomy for metals, composites, electronics, and the advanced manufacturing enterprise.

Appendix C describes nine DoD MIIs established by DoD and administered in accordance with Section 227 of the Public Law 116-92. The DoD MIIs focus on nine technology priority areas:

1. additive manufacturing;
2. digital manufacturing, design, and manufacturing cybersecurity;
3. lightweight materials;
4. integrated photonics;
5. flexible hybrid electronics;
6. smart fibers and textiles;
7. advanced tissue biofabrication;
8. advanced robots for manufacturing; and
9. bioindustrial manufacturing.

# ASSESSING PROGRESS AND EFFECTIVENESS OF THE DOD MANTECH PROGRAM

DoD ManTech investments deliver manufacturing solutions at the speed of relevance. Measures of effectiveness include quantifiable cost benefits, industrial base productivity enhancements, increased competition through addition of qualified suppliers, increased system performance, and improved quality and sustainment of defense systems. They assure program fiscal, technical, and project accountability.

Key tools, measures, and metrics used to assess fiscal, technical, and project accountability may include the following:

**Accountability**

**Fiscal**
JDMTP Principals

**Technical**
Subpanels and TWGs

**Project**
PMs, Industry, Academia, Key Stakeholders

- Return On Investment
- Cost
- Schedule
- Transition
- MRL/Technological Readiness Level
- Risk Assessment
- Affordability/Cost Reduction
- Exit Criteria
- Earned Value Management

### *Fiscal Accountability*

Each Service and Agency has its own process to assess progress and effectiveness for its respective ManTech Program. Some meet quarterly, biannually, or annually to review the projects that support their investment strategy. At a minimum, each Service and Agency will meet annually to conduct a program management review (PMR). A PMR is designed to check project status and transition plans as well as to track costs, schedule, and performance. The results of each Subpanel's portfolio review are briefed to each Service and Agency principal in the JDMTP. The principals determine what the appropriate follow-up actions are and have the authority to do so.

### *Technical Accountability*

JDMTP Subpanels conduct annual portfolio reviews to provide awareness of the current state of the technology, inform partners, industry, and program offices as potential users, and ensure best practices. During reviews, Subpanels assess program risks to capture emerging financial and technical liabilities. Portfolio reviews include the key function of identifying potential gaps and additional work required before implementation. Ideally, portfolio reviews smooth the path to transition new technologies and prevent duplication of effort, resulting in more effective joint efforts. Subpanel portfolio reviews track cost, schedule, and technical performance. Each Subpanel conducts its portfolio review in the fourth quarter of each fiscal year and briefs it to the JDMTP principals during the first quarter of the next FY.

### *Project Accountability*

Integrated Project Teams are composed of program managers, industry, academia, and other key stakeholders that meet regularly to coordinate and review individual projects to ensure they are on time and budget. Regular meetings ensure engagement by team members and stakeholders, provide an opportunity to network, and grow ecosystems. Program and/or project managers use these meetings to articulate the health or status of an individual project. Goals, expectations and deliverables are clearly set and milestones are tracked. The focus is on performance.

# SUMMARY

The DoD ManTech Program is an effective mechanism to maintain the United States' technological edge by promoting innovative manufacturing capabilities and an industrial base that can deliver them.

This Strategic Plan provides the basis for the coordination of the Service and Agency ManTech efforts and provides plans to our stakeholders, other government entities, industry and academia. Guided by four thrust areas, the DoD ManTech enterprise focuses on delivering high-priority solutions across the portfolio of manufacturing technology investments to meet defense manufacturing needs. To guide the program and ensure results, DoD ManTech employs an array of management tools, measurements, and metrics. In short, this strategic plan explains how the DoD ManTech Program aids swift technology transition from concept to successful fielding.

# APPENDICES

# APPENDIX A: JOINT DEFENSE MANUFACTURING TECHNOLOGY PANEL AND THE SERVICE AND AGENCY MANTECH PROGRAMS

The Military Departments and Defense Agencies collaborate and coordinate their Manufacturing Technology (ManTech) efforts through the Joint Defense Manufacturing Technology Panel (JDMTP). As specified in 10 United States Code (USC) Section 4842 (previously 10 USC § 2521), the purpose of the JDMTP is to identify and integrate requirements, conduct joint planning, and develop joint strategies for the Department of Defense (DoD) ManTech Program.

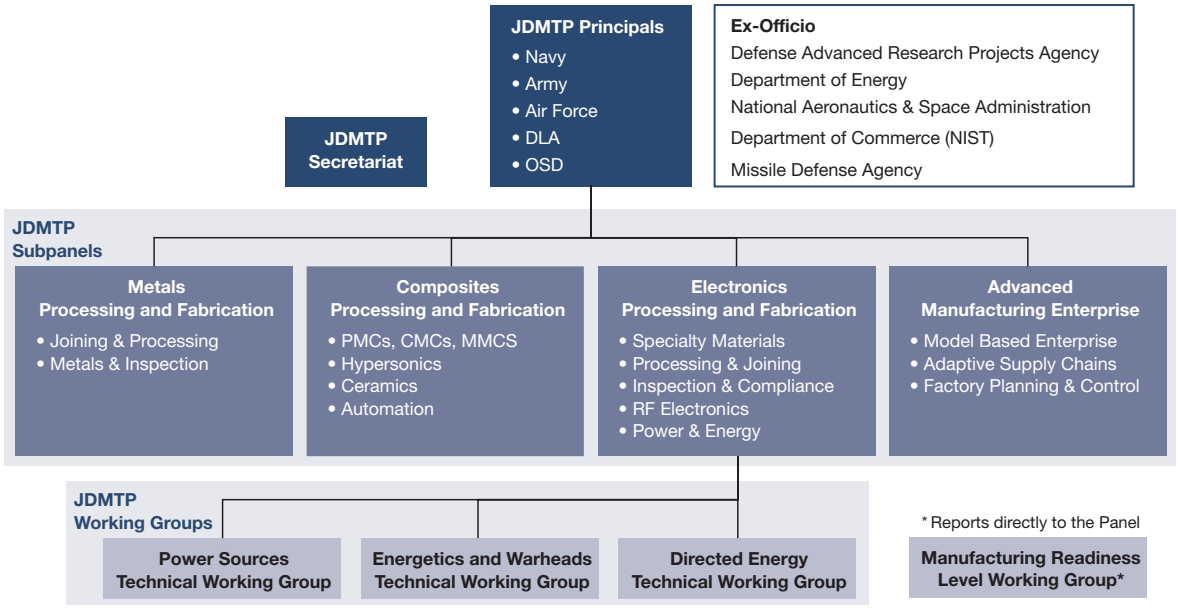



Figure 3. JDMTP Organizational Chart

The JDMTP is composed of one Principal member from each Military Department and Defense Agency with a ManTech program. Principals are senior leaders able to represent their components' position on technical and financial matters within the scope of the JDMTP.

Current Principals represent ManTech programs from the Army, Navy, Air Force, Defense Logistics Agency (DLA), and the Office of the Secretary of Defense (OSD) Manufacturing Science and Technology Program (MSTP). The JDMTP may include as ex-officio members representatives from other government organizations, academia, and industry as agreed by the Principals.[2] The JDMTP Chair is one of the Principals, chosen by Principal consensus. The Principals have agreed that the OSD Principal cannot serve as the chair of the JDMTP as the OSD ManTech Program Office within the Office of the Under Secretary of Defense for Research and Engineering (OUSD[R&E]) has responsibility for oversight of the DoD ManTech Program.

In FY 2020, OUSD(R&E) and the OUSD for Acquisition and Sustainment chartered the Joint Defense Manufacturing Council (JDMC), a forum for senior leaders to maximize the value of DoD's manufacturing efforts by identifying and supporting cross-cutting initiatives in manufacturing in support of the entire Department. As one of the internal DoD elements that may be supported by the goals of the JDMC, the OSD ManTech Program Office participates in JDMC meetings, provides information as requested to the JDMC, and supports the objectives of the JDMC through council activities.

When deemed appropriate, the JDMTP may add or remove Subpanels as well as Working Groups to carry out specific assignments supporting the JDMTP's purpose, roles, and responsibilities. Current JDMTP Subpanels cover four critical technology areas: metals, composites, electronics, and Advanced Manufacturing Enterprise (AME). There are Technical Working Groups within subpanels, of which some may be elevated to the JDMTP level for more visibility within the JDMTP. The Manufacturing Readiness Level (MRL) Working Group reports directly to the JDMTP and is on the organization chart with three of the Electronics Working Groups (Power Sources; Energetics and Warheads; and Directed Energy) due to the desire for increased visibility into these three technical areas.

To provide peer review and support technology transfer, the Subpanels conduct an annual review and assessment of all defense-related ManTech projects and the issues they address. Each DoD ManTech project belongs to a specific Subpanel based on technical content and alignment with the Subpanels' scope. This comprehensive review of issues and projects provides the Subpanels with an opportunity to understand and document changes in shaping factors, trends, and technology gaps within their technology scope that may provide strategic opportunity indicators for the JDMTP.

The Subpanels and Technical Working Groups identify and document common areas of interest for new initiatives through Joint Technology Pursuit Areas (JTPAs). The component ManTech programs utilize JTPAs to inform Joint Manufacturing Planning Initiatives (JMPIs). JMPIs represent a high level of joint investment interest and connect more directly to USD(R&E) modernization priorities and JDMC manufacturing priorities.

[2] The Missile Defense Agency (MDA) is a research and development organization with a challenging acquisition function for missile defense. As the MDA works to meet the ever-evolving threat, the MDA is moving to an ex-officio membership that better aligns the Agency to DoD activities. The MDA will continue participation in the JDMTP and the manufacturing technology community.

JDMTP actions include:

- **Strategic Planning:** Conduct comprehensive reviews and assessments of defense-related manufacturing issues, DoD activities addressing those issues, and ManTech programs. Identify joint planning opportunities for increased cooperation to develop and implement technological products and leverage funding for such purposes with the private sector and other government agencies.
- **Strategic Engagement and Communication:** Integrate and coordinate the DoD ManTech Program requirements and projects with OSD and other national-level initiatives, to include establishing information exchange processes with other government agencies, private industry, academia, and professional associations. The annual Defense Manufacturing Conference hosts both plenary and technical sessions and is a major mechanism for information exchange.
- **Supporting Activities:** Conduct supporting activities such as providing presentations for Congressional staffers and contributing to the quadrennial DoD ManTech Program Strategic Plan.

JDMTP and Subpanels foster coordination. At the JDMTP level, representatives from government and industry organizations participate in the all-hands and Principals meetings. Participants have included the Department of Energy, National Institutes of Standards and Technology, Department of Commerce, National Aeronautics and Space Administration, Defense Advanced Research Projects Agency, National Center for Advanced Technologies, DoD Manufacturing Innovation Institutes (MIIs), and Materials and Manufacturing Processes Community of Interest.

In addition, JDMTP Principals participate in outreach activities with industry and government organizations—such as the National Defense Industrial Association, Society of Manufacturing Engineers, Society of Materials and Process Engineering, and others—through presentations on JDMTP purposes and functions.

Subpanels periodically engage with industry and government representatives including original equipment manufacturers, suppliers, industry organizations, program office representatives, and government engineering offices. DoD MII representatives coordinate their activities through the JDMTP Subpanels, Defense Manufacturing Conference, and JDMTP meetings as deemed appropriate.

These coordination activities enable the alignment of goals, objectives, technical outcomes, and future planning to enhance the benefits of the DoD ManTech Program through concerted and synergized efforts. Of course, the primary responsibility for each of the component ManTech programs is to address the specific requirements of its entity. The following pages provide a brief overview of the investment strategies and objectives of each of the Service and Agency ManTech programs.

# ARMY MANTECH

The U.S. Army ManTech Program's mission is to support Army readiness and modernization priorities by improving and maturing manufacturing technologies to ensure overmatch and fulfill national security objectives. The Army ManTech Program addresses manufacturing solutions that enable and improve the efficiency and affordability of manufacturing processes to advance the Army's technological capabilities while reducing life-cycle costs for current and future Army acquisition programs. There are three objectives of this program: (1) material development to meet performance requirements; (2) improve manufacturability and reduce the cost to programs of record; and (3) advance the Organic Industrial Base. Critical technology maturation and transition is accomplished by coordinating efforts between the Army Science and Technology (S&T) community, the Program Executive Offices and their supporting program managers, and the defense industrial base through effective, efficient, affordable, and adaptable manufacturing processes. Additionally, the Army, through Army ManTech, actively participates in the OSD's DoD ManTech Science & Technology Program for efforts with Defense-wide impacts.

## *Organization*

The Army ManTech Program supports Army-wide manufacturing requirements with current coordinated efforts across the Assistant Secretary of the Army for Acquisition, Logistics, and Technology Program Executive Offices. Participation in the program competitive selection process includes leaders from the U.S. Army Materiel Command; Army Futures Command; Army Space and Missile Defense Command; Army Medical Research and Development Command; and Army Rapid Capabilities and Critical Technologies Office. The Deputy Assistant Secretary of the Army for Research and Technology provides oversight and management of the Army ManTech Program.

## *Investment Strategy*

Army ManTech projects are competitively awarded to Army S&T organizations and are required to have Program Executive Office/Program Manager (PEO/PM) partnerships to ensure impact to the Programs of Record. The executing organizations and their PEO/PM partners are responsible for coordinating capability goals, deliverables, projected cost and benefit data, and conducting transition and implementation planning to execute ManTech projects. The Army ManTech process provides a balanced portfolio aligned with S&T, PEO/PM, and Army priorities. Additionally, it enables the Army to maximize technology transition by leveraging both technical and acquisition subject matter expertise for specific weapon systems.

The Army ManTech program utilizes budget activity 7[3] funds and focuses investments on the following specific Army related weapons systems:

[3] Budget Activity 7, Operational System Development. Includes those development projects in support of development acquisition programs or upgrades still in engineering and manufacturing development but which have received Defense Acquisition Board (DAB) or other approval for

- **Networks/Command, Control, Communications, and Intelligence Platforms**

  Army ManTech efforts focus on an integrated system of hardware, software and infrastructure that is sufficiently mobile, reliable, user-friendly, discreet in signature, expeditionary and appropriate for any environment where the electromagnetic spectrum is denied or degraded. It also focuses on dependable communication or assured position, navigation, and timing; tactical space; navigation warfare; and Cyber operations. Additionally, it covers virtual and immersive Common Operation Environments in support of faster decision-making. These efforts support the Army modernization priority for future systems and enabling areas for assured positioning, navigation, timing, and synthetic training environments. Efforts align to programs within the executive offices of Intelligence Electronic Warfare and Sensors and Command Control Communications-Tactical PEOs.

- **Weapon Systems**

  Army ManTech efforts focus on comprehensive weapons system platforms that include munitions and formations that improve range, lethality, mobility, precision, target acquisition, and force protection capabilities within multi-domain operations. Additionally, these efforts support the Army modernization priorities for long-range precision fires, which focuses on strategic fires, precision strike missile capabilities, extended range cannon artillery, and air missile defense systems to include directed energy systems and interceptors focused on providing maneuverability for short range air defense, and indirect fire protection capabilities. Efforts align to programs within the executive offices of Missile and Space and the joint executive office Armaments and Ammunition.

- **Ground Systems**

  Army ManTech efforts focus on Army land maneuverability and ground system platforms. These efforts support the Army's ability to gain positions of relative advantage, overmatch the enemy, protect Soldiers from harm, and impose a tempo of event and multiple simultaneous dilemmas on the enemy to overwhelm enemy effectiveness through ground mobility. Additionally, these efforts support the Army's modernization priority for Next Generation Combat Vehicles, which integrate other close combat capabilities in manned and unmanned teaming and leverage semi-autonomous and autonomous platforms in conjunction with improved firepower, protection, mobility, and power generation capabilities. Efforts align to programs within the executive offices of Ground Combat Systems; Combat Support and Combat Service Support; and the joint program executive office, Armaments and Aviation.

- **Aviation Systems**

  Army ManTech efforts focus on Army manned and unmanned aviation platforms to improve maneuverability, range, speed, payload capacity, mission systems, survivability, reliability, and reduced logistical footprint. Additionally, these efforts support the Army Future Vertical Lift modernization priority through manufacturing technologies for next

production, or production funds have been included in the DoD budget submission for the budget or subsequent fiscal year.

generation Army vertical lift aircraft. Efforts align to programs within the joint executive office of Armaments and Ammunition PEO and Aviation PEO.

- **Soldier Systems**

  Army ManTech efforts focus primarily on integrated Soldier and Squad weapon platforms. These efforts provide manufacturing solutions that enhance integrated Soldier capabilities through their equipment, personal sustainment, performance, protection, and communication. Additionally, this effort supports the Soldier Lethality modernization priority. Efforts align to programs within the Soldier; Combat Support and Combat Service Support; Chemical, Biological, Radiological, and Nuclear Defense; and Armaments and Ammunition PEOs.

## *Assessment of Progress and Effectiveness*

The Army ManTech Program evaluates current and new investment progress semiannually to ensure continued viability for planned transition or address transition challenges. The program assessment process consists of at least one annual deep dive and one annual budget review for each ManTech project.

- Deep Dive: Each funded Army ManTech project will have a scheduled deep dive annually to inform the funding office and stakeholders of the progress, challenges, and potential impact. Each review evaluates current transition merit. Information presented includes addressing execution challenges, progress, and a robust question and answer session among the efforts stakeholders to provide transparency and structure to support success. PM participation is required to ensure each project's alignment to a Program of Record (PoR).
- Budget Review: Each funded Army ManTech project will have a scheduled budget review during the fourth quarter of each fiscal year that includes an overview of progress and budget status. PM participation is required to ensure each project's alignment to a program of record.
- Each project is required to have a transition plan that includes the following:
  - Purpose of the project
  - Maturation plan
  - Deliverables
  - Requirements being addressed
  - Key technical measures of readiness for transition
  - Program of Record entrance criteria
  - Planned transition schedule
  - PEO/PM office and laboratory or center funding
- Continuous assessment of funded efforts to ensure viability to the PoRs, meet fiscal reporting requirements, and any requirements from Congress, OSD, or Army leadership.
- Track Army ManTech close out efforts until they are absorbed into a program of record.

# NAVY MANTECH

The Navy ManTech Program is an industrial preparedness program focused on affordability improvements for key naval platforms as well as capability acceleration to get capabilities to the Fleet faster. Navy ManTech works closely with the PEOs, Program Offices, key industry partners, and the Navy ManTech Centers of Excellence to identify manufacturing affordability challenges; develop affordable manufacturing technology; and transition that technology to industry partners for implementation. Once implemented, the developed technology results in substantial affordability improvements—measured as either cost savings or cost avoidance—and strengthens the industrial base.

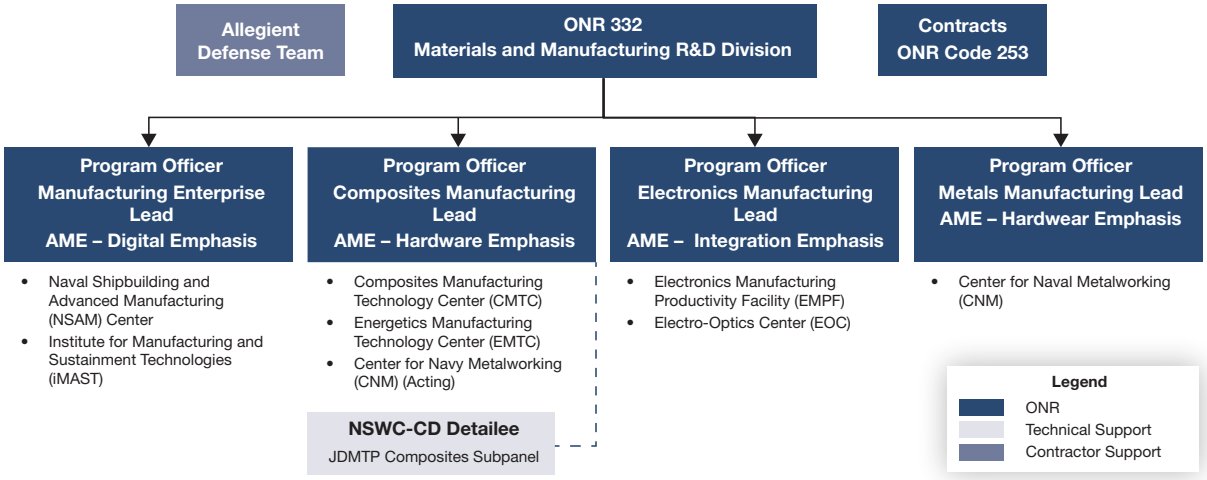



**Figure 4. Navy ManTech Organization Chart**

Navy ManTech executes through seven Centers of Excellence (COEs), which provide a focal point for the development and transfer of new manufacturing processes and equipment in a cooperative environment with industry, academia, and DoD agencies.

## *Investment Strategy*

Navy ManTech will execute an investment strategy in FY 2023-2027 based on the direction of the Office of Naval Research leadership and determined by total acquisition funding; stage in acquisition cycle; platform cost-reduction goals; cost-reduction potential for manufacturing; and other factors primarily associated with the ability of Navy ManTech

**Navy ManTech Centers of Excellence**

| | |
|---|---|
| CNM | Center for Naval Metalworking (CNM) |
| CMTC | Composites Manufacturing Technology Center (CMTC) |
| PennState Electro-Optics Center | Electro-Optics Center (EOC) |
| EMC Electronics Manufacturing Center | Electronics Manufacturing Center (EMC) |
| EMTC | Energetics Manufacturing Technology Center (EMTC) |
| PennState Institute for Manufacturing and Sustainment Technologies | Institute for Manufacturing and Sustainment Technologies (iMAST) |
| Naval Shipbuilding and Advanced Manufacturing Center of Excellence | Naval Shipbuilding and Advanced Manufacturing (NSAM) Center |

to deliver the technology when needed. Over the next five years, Navy ManTech will continue to improve the affordability of Navy platforms critical to the future force, focusing resources on the VIRGINIA Class Submarine (VCS), COLUMBIA Class submarine (CLB), DDG 51 Class destroyer, CVN 78 Class aircraft carrier, FFG 62 Class frigate, F-35 Lightning II aircraft, and select manufacturing technology projects that accelerate the delivery of capabilities to the Navy. The seven capability acceleration thrust areas include: swarm, unmanned, autonomous vehicle production; HEL weapon systems; advanced submarine fabrication technology; fleet sustainment technology; energetics production improvement; hypersonics fabrication; and manufacturing acceleration of other ONR activities.

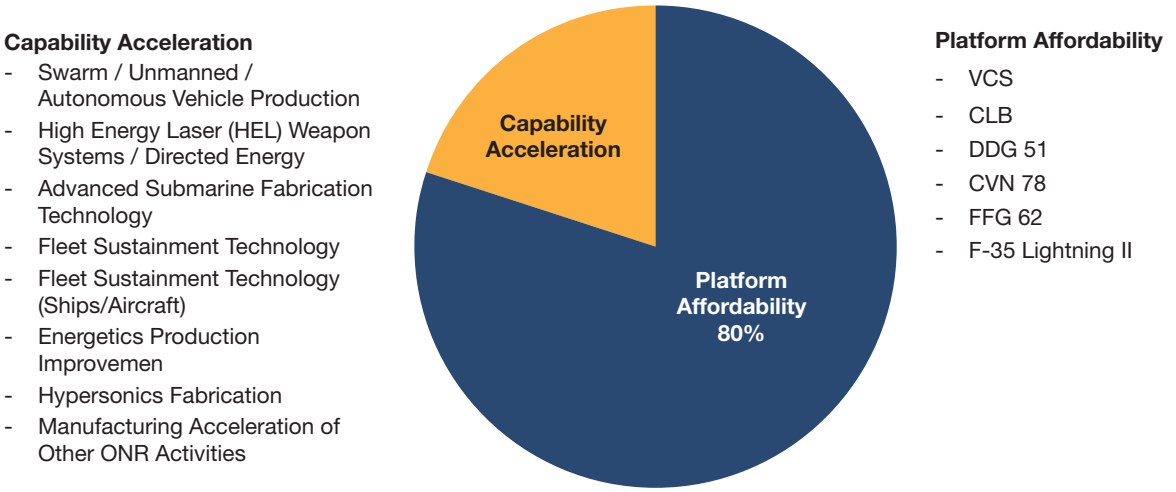



**Figure 5. FY 23 Navy ManTech Investment Strategy**

Navy ManTech investment in platforms typically range from $3-8 million annually and varies from year to year based on many factors, such as funding required for existing projects, past implementation record, cost savings, and potential of planned projects.

Strategic planning for Navy ManTech is an ongoing effort. Navy ManTech analyzes acquisition scenarios and plans to determine major acquisition programs for potential investment annually. As the current platforms ManTech supports mature through their respective acquisition cycles, ManTech's investment targets change. In FY 2023-2027, Navy ManTech will develop enabling manufacturing technology (e.g., new processes and equipment) for implementation on Navy weapon system production lines. Navy ManTech anticipates delivering recognized cost savings to platforms in its investment strategy.

### *Assessment of Progress and Effectiveness*

Navy ManTech employs a number of best practices to assess the progress and effectiveness of its program. A signed Technology Transition Plan (TTP) is required for every project that specifies what the ManTech funds will accomplish, the exit criteria to complete a project, and the resources that other entities will fund to implement the technology. Navy ManTech requires an annual review of all TTPs to ensure they are accurate, track the status of TTPs, and assess transition and implementation.

Navy ManTech also holds biannual program review meetings for projects that support its investment strategy. All projects use a standardized presentation template, which provides instructions regarding the desired content; different content may be requested depending on the maturity of the project. Because all projects have an inherent risk of not implementing, it is important that all parties recognize the risk early, understand it, and develop plans to manage it throughout the project execution phase. The Navy ManTech program review process emphasizes the importance of implementation by recognizing project risks to implementation upfront and then assessing and managing these risks through project execution.

In FY 2012, Navy ManTech formalized its focus on implementation and risks by instituting an implementation risk assessment management process for potential future projects (those in the planning stages) as well as ongoing projects.

Assessing the progress made to help platforms meet their affordability goals is an essential metric Navy ManTech uses to measure the program's success in terms of potential cost reduction and benefits of implementation. Navy ManTech COEs semi-annually update their affordability assessment information, which identifies cost reduction and avoidance per project and an estimated total savings per platform. Navy ManTech then uses a second metric—recognized cost savings—to validate the affordability assessment information and report cost-reduction potential of affordability projects and the maturity of the business case on which it is based. Recognized cost savings, which are calculated on a per-hull/-airframe basis, include only projects that that have implemented or have partially implemented, and are bought off by both the relevant Program Offices and industry.

## AIR FORCE MANTECH

Throughout its 60+-year history, the Department of the Air Force (DAF) ManTech Program has played a foundational role in maturing critical technologies and modern business practices for the DIB, including numerically controlled machining, organic matrix composites, and MRLs. DAF ManTech has also worked closely with PoR such as F-16, B-1, F-22, B-2, and F-35 to deliver billions of dollars in acquisition and sustainment cost savings and avoidance.

Over the last twenty years, the cost of computing power, data storage, and Internet bandwidth have all fallen exponentially, dramatically reshaping our economy with particularly transformational impacts to the manufacturing sector. Experts have called our current era the 4th Industrial Revolution (or Industry 4.0), which is characterized by an infrastructure built on digital manufacturing tools, such as robotics, Industrial Internet of Things (IIoT), and additive manufacturing.

DAF ManTech is managed by the Air Force Research Laboratory's Manufacturing and Industrial Technologies Division within the Materials and Manufacturing Directorate.

### *Investment Strategy*

Based on both DoD demand signals as well as technology trends driving rapid manufacturing innovations through Industry 4.0, DAF ManTech developed five technology pillars as depicted in the figure. Advanced Concepts includes programs that address procurement and sustainment needs of PoR. These Programs provide a new capability to


Figure 6. Digital Manufacturing Research

the weapons platform or provide a substantial return-on-investment (ROI) in the form of reduced cost or increased platform availability. The middle three columns, Hypersonic Strike, Attritable & Low-Cost Systems, and Networked C3 Systems—generally include enabling technologies that are more pervasive in nature and therefore impact multiple weapons platforms, and are often directed at emerging operational capabilities to which there isn't currently a baseline technology. The final pillar, Emerging Technology, includes Biomanufacturing, Quantum Technology, and Directed Energy. DAF ManTech anticipates that each of the areas will provide transformational capabilities to the DAF in the future.

In addition to the technology pillars, our investment portfolio includes two crosscutting emphasis areas, Advanced Manufacturing Technologies (AMT) and Digital Manufacturing Research. AMT (Technology Readiness level (TRL) or MRL 4-7) and Digital Manufacturing Research (TRL or MRL 2-4) represent pervasive opportunity areas to deliver capabilities across all the DAF ManTech technology pillars. Largely, DAF ManTech programs in these areas drive additional agility for defense manufacturing by focusing on opportunities to reduce costs and timelines associated with the high-mix, low-volume aerospace manufacturing environment by developing and employing Industry 4.0 technologies and demonstrating value of such approaches broadly throughout the community. DAF efforts in AMT and manufacturing research heavily leverage the DoD MIIs as well as partnerships with academia and industry.

Within the strategic framework described above, DAF ManTech regularly considers demand signals from a number of sources, including strategic policy documents, DAF Programs of Record, the Air Force Research Laboratory's (AFRL) technical directorates, the AFRL Transformational Capabilities Office (TCO), industry roadmaps, and the JDMTP among others. DAF ManTech also reaches stakeholders through numerous engagement activities including technical interchange meetings, workshops, and conferences. Based on these myriad inputs, the DAF crafts programs with core 6.3 funding and leverages other resources and programs, including the OSD MSTP, DoD MIIs, and the Industrial Base Assessment program. Portfolio roadmaps capture all DAF ManTech projects. DAF ManTech thoroughly reviews these throughout the year to ensure alignment with Warfighter needs. Finally, the Division also acts as the Defense Production Act Title III Executive Agent Program Office.

## *Assessment of Progress and Effectiveness*

Between program formulation and execution, DAF ManTech evaluates whether the proposed work: addresses the basic tenets of a manufacturing technology investment, will enhance manufacturability or reparability, is beyond reasonable industry risk, addresses an essential or unique defense need, and is feasible. The DAF also evaluates impact (including significance to warfighting capability, ROI, etc.), stakeholder support, and the pervasiveness of the technology. DAF ManTech conducts this assessment process each spring, with investment priorities finalized by June for the following fiscal year.

DAF ManTech reviews projects on an ongoing basis to track progress toward meeting key performance parameters and the target MRLs. Most of the reviews are formal, to include Program Management Reviews (PMRs), Laboratory Management Reviews, Financial Execution Reviews, and New Program/Start Kickoff Reviews. DAF ManTech projects

have historically delivered a greater than ten to one ROI. The DAF evaluates projects that do not transition successfully for lessons learned to preclude recurrence and prepares success stories for efforts that transition to Programs of Record.

DAF ManTech aligns with the AF TCO and assists with subject matter expertise and transition as TCO initiatives mature through the development cycle to provide a smooth, seamless implementation. AF ManTech has pledged to provide resources where needed to ensure the manufacturing capability exists and is at a sufficient MRL. Senior officials in the Secretary of the Air Force for Acquisition (SAF/AQ) staff, Air Force Materiel Command, and AFRL will be closely monitoring the success of TCO efforts to reach the field.

# DEFENSE LOGISTICS AGENCY MANTECH

Working with the Defense Logistics Agency (DLA) diverse supply chains, the DLA ManTech Program funds the advanced technology development needed to improve manufacturing capability throughout a product's life cycle. As illustrated, DLA ManTech is part of the DLA Research and Development (R&D) Enterprise Service Activity (ESA). DLA's R&D programs deliver responsive, innovative solutions that improve DoD readiness, support current strategies and operations, and anticipate future logistics and manufacturing needs while aiming to reduce cost and risk.

DLA ManTech provides a crucial link between invention and application by maturing, scaling up, and validating advanced manufacturing technology in "real-world" environments. DLA ManTech developments provide a path to low-risk technology implementation for many small businesses, and defense-unique suppliers, depots, and shipyards that are critical to DLA. By anticipating and addressing production and sustainment problems before they occur, readiness levels increase, and sustainment costs are decreased.

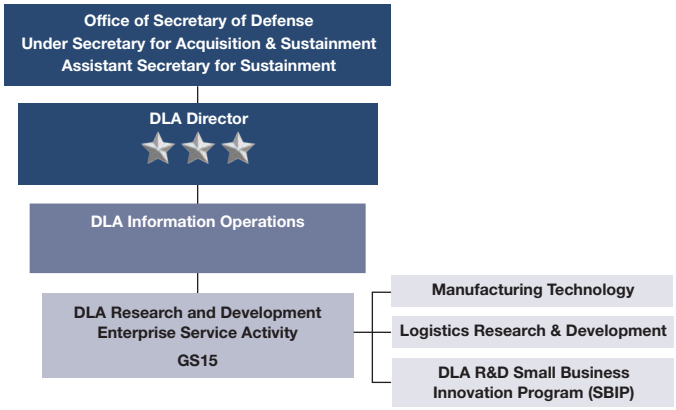



**Figure 7. DLA R&D Man Tech Organizational Alignment**

## *Investment Strategy*

DLA R&D's ManTech program supports two lines of effort (LOE) that ensure the industrial base provides agile, innovative solutions to help the Warfighter.

1. ***DLA R&D LOE 1, Industrial Base and Aging Weapon System Support.*** Implement innovative and proactive technology solutions to ensure a robust, reliable industrial base that provides affordable and previously hard-to-procure critical parts for DoD weapon systems through:
    - a **viable and responsive industrial base** to maximize DIB capability and capacity and improve availability, quality, and affordability to support the Warfighter;
    - **obsolescence solutions** to establish a trusted manufacturing capability for qualified microcircuits in support of DoD weapon system lifecycles; and
    - **advanced manufacturing** to introduce and integrate additive and advanced manufacturing concepts into the DoD supply chain.

2. ***DLA R&D LOE 2, Three Dimensional (3D) Technical Data Modernization/Model Based Enterprise.*** Integrating 3D technical and knowledge-based data can transform and streamline responsiveness for specific DLA-managed commodities through:
    - **technical data transformation into 3D machine usable, neutral formats** to support DoD's digital modernization efforts and provide significant readiness improvements; and
    - the **creation of a model-based (digital as master) system** where DLA, the Military Services, and industry streamline the delivery of accurate requirements, high-quality material, and end-items throughout the supply chain.

The R&D LOEs guide DLA ManTech investments and research. The combination of periodic and annual reviews and assessments provides an opportunity to adapt the portfolio of investments to meet the changing needs of DLA and the Warfighter. Annually, the R&D ESA conducts strategic assessments to review the current alignment of resources and identify new priorities and potential solutions. The figure below shows the current allocation of DLA ManTech investments and key technology areas.

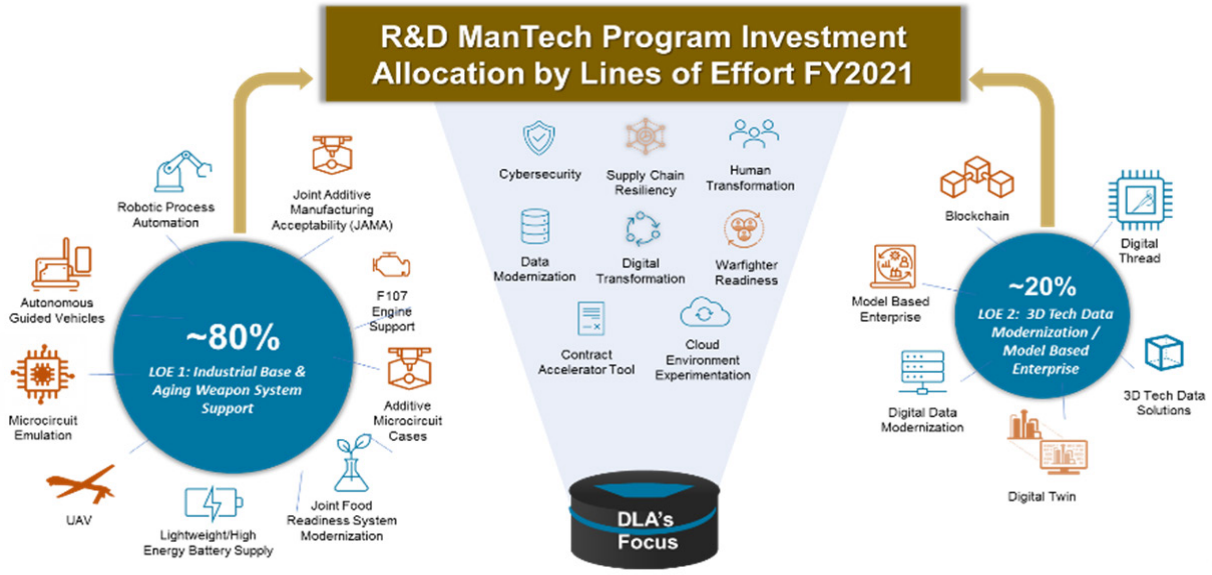



**Figure 8. R&D ManTech Program Investment Allocation by Lines of Effort FY2021**

As illustrated above, DLA is focusing on advanced capabilities in digital and technical data modernization, data management, and analytics to fulfill the DLA role in the DoD Digital Engineering Strategy and improve data sharing with the industrial base and supported organizations. Investment explores technologies to lower the Agency's material acquisition and operations costs and improve weapons systems support.

## *Assessment of Progress and Effectiveness*

During project execution, the Program Manager maintains a dialog with project sponsors, stakeholders, and business process owners. In addition, DLA internal processes track project performance and transition. The Enterprise Operations Council reviews progress, approves "go/no-go" milestone decisions, and oversees transition from R&D to a production environment. Quarterly PMRs track project status, milestones, transition plans, cost, schedule, performance, and financial execution. DLA also complies with internal and external audit readiness activities (e.g., Accounting and Financial Reporting (AFR), National Science Foundation and other DoD-wide audit readiness efforts).


**Figure 9. Assessing Progress and Effectiveness**

DLA R&D program assessments rely on robust processes that evaluate performance and delivery of effective solutions to the Warfighter, including specific project performance and alignment to priorities and investment strategies. While many variables contribute to program assessments, R&D also includes importance and timing. Importance refers to the criticality of the new solution for improving sustainment support to the Warfighter. Timing refers to organizational readiness to incorporate the new solutions into the manufacturing or business process. Conducting effective assessments requires coordinated integration of people, processes, and capabilities in assessing priorities, investment strategies, project development, project execution, and transition.

- **People:** Continuous stakeholder engagement ensures the successful articulation of requirements, progress evaluation during execution, and transitioning capabilities that benefit the Warfighter.
- **Processes:** A standard, repeatable process to guide and synchronize strategic assessments captures the latest information on requirements, the technological environment, the allocation of resources, and project performance. Annual priorities are reviewed and approved at a DLA enterprise-level through operational and enterprise Executive Boards.
- **Capabilities:** The DLA R&D SharePoint Knowledge Management Portal is used to share and track project progress and execution, to include workflows and information repositories. Virtual collaborative tools collect, analyze, and align priorities with stakeholders.

# OSD'S MANUFACTURING SCIENCE AND TECHNOLOGY PROGRAM (MSTP)

The Office of the Secretary of Defense (OSD) ManTech Program focuses on cross-cutting defense manufacturing needs—those that are beyond the ability of a single service to address—and stimulates early development of manufacturing processes and enterprise business practices. This is done concurrently with S&T development to achieve the largest cost-effective impact and to facilitate the developments enabling capabilities for our Warfighters.

The OSD ManTech Program focuses heavily on satisfying the manufacturing technology needs for the DoD's critical technology areas including: trusted artificial intelligence (AI) and autonomy, biotechnology, integrated network systems-of-systems, directed energy, microelectronics, quantum science, hypersonics, space technology, renewable energy generation and storage, advanced computing and software, human-machine interfaces, future generation wireless technology (FutureG), advanced materials, and integrated sensing and cyber.

## *Organization*

OSD ManTech is located within the Science and Technology Futures Program under the Office of Under Secretary of Defense for Research and Engineering OUSD(R&E). The program office has three main organizational components within it's Defense-wide Manufacturing Science and Technology Portfolio: Manufacturing Science and Technology Program (MSTP), DoD Manufacturing Innovation Institutes (MIIs), and Manufacturing Education and Workforce Development (M-EWD).

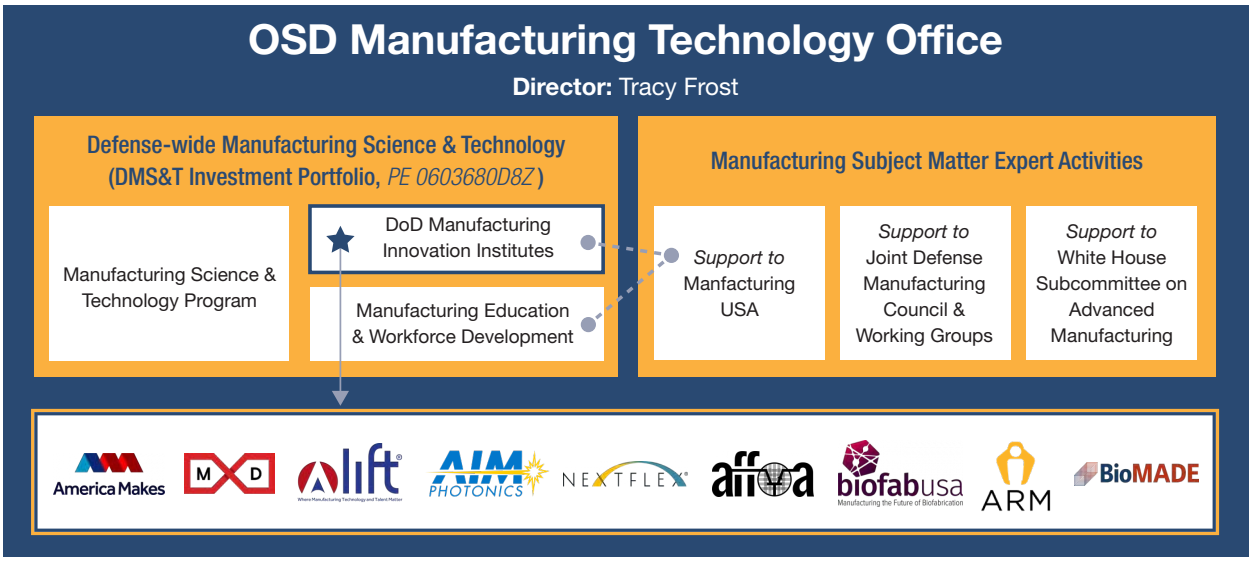



Figure 10. OSD Manufacturing Technology Office

OSD MSTP (funded under investment line P680) is an R&D investment portfolio focused on a set of identified joint, defense-critical, and sometimes high risk manufacturing technology areas.

The DoD MIIs (funded under investment line P350) are nine public-private partnerships with headquarters and hubs across the country designed to overcome challenges faced by manufacturing innovators in a variety of technology domain areas. The DoD MIIs exist to connect organizations and activities for affordable, rapid transition and delivery of defense-essential technologies.

M-EWD (funded under investment line P351) is a key element of the OSD ManTech Office as tasked by USD(R&E). Currently, the M-EWD team collaborates with DoD, DoD MIIs, and other Federal agencies to develop a National Manufacturing Workforce Strategic Framework for manufacturing education and workforce development.

## *Investment Strategy*

JDMTP identifies the Department's manufacturing technology gaps and assists in determining potential joint investment opportunities. OSD MSTP then assesses these opportunities against OUSD(R&E)'s critical technology areas and then issues a call for project proposals. Project tenets must include:

- Government office lead
- DoD Enterprise-wide issues
- Joint service applicability
- Enhances manufacturability and producibility of a process or component
- Beyond reasonable and normal industry and program office risk
- Requirement is defense-essential or defense-unique

Technology transition and joint-service or multi-system application are key factors in selecting OSD MSTP projects. To ensure investments have a long-term impact, the OSD ManTech Office requires all potential OSD MSTP projects to have a clear technology transition plan and target along with endorsement from the potential project team's program office.

Funding is typically a combination of OSD MSTP investment, component ManTech program investments, program office or transition office investments, and industry investment cost share. Additionally, technical experts come from the DoD Services or Agencies to serve as government program managers who support technical execution, financial management, and ultimately transition to fielded systems.

The MSTP investment portfolio is reported in the Congressional R2 report and broken down into four categories: Advanced Electronics and Optics, Advanced Materials and Manufacturing, Enterprise and Emerging Processes, and Advanced Energetics Manufacturing. Funding levels across these categories flexes based on annual project selections and completed efforts.

## *DoD Manufacturing Innovation Institutes*

OSD ManTech sponsors nine DoD Manufacturing Innovation Institutes (MIIs) with headquarters and hubs across the country. Each DoD MII is a public-private partnership with members from industry, academia, and Federal and state governments. Together the institutes work to mature manufacturing processes, build out a supporting ecosystem, and provide manufacturing education and workforce development. The consortia match DoD funding at a one-to-one ratio (or greater). They include small, medium, and large manufacturers and state-of-the-art pilot facilities. DoD MII technology domain focus areas are: (1) additive manufacturing; (2) digital manufacturing, design, and manufacturing cybersecurity; (3) advanced materials; (4) integrated photonics; (5) flexible hybrid electronics; (6) smart fibers and textiles; (7) advanced tissue biofabrication and regenerative medicine; (8) advanced robots for manufacturing; and (9) bioindustrial manufacturing.

## *Manufacturing Education and Workforce Development*

M-EWD provides strategic leadership of DIB advanced manufacturing talent development with three mission objectives: (1) invest in strategic education and workforce development capabilities, (2) expand the talent acquisition pool to promote diversity equity and inclusion, and (3) modernize M-EWD by driving action within DIB-critical regional economies with a focus on Career and Technical Education (CTE).

## *Assessing Progress & Effectiveness*

The OSD ManTech Program continuously evaluates MSTP projects and DoD MII performance, from establishment through maturation. The main approach consists of monthly technical and financial "quick looks," semi-annual PMRs, and periodically collecting performance measures and success stories. PMRs consist of both financial and technical performance presented by the DoD MII Government Program Manager. The financial evaluation tracks multi-year obligations and expenditures against plans and significant risks using a standard probability and consequence table with associated mitigation and responsibility. Technical evaluation includes status of technical planning (roadmaps), project execution, facilities status and usage, transition, and DoD involvement. In addition, OSD ManTech reviews DoD MII overall health including membership, revenue plans, and workforce development programs. Each program manager delivers an assessment of the MSTP project or DoD MII performance to the OSD ManTech leadership team, which decides whether to take action based upon that assessment. Each MSTP project is also evaluated as part of the annual JDMTP Subpanel portfolio review, which prevents duplication of effort and facilitates joint planning.

Within the DoD MII Program Management Reviews, various sets of performance measures are used to track the progress of each institute. The intended audiences for these metrics include the public, Congress, DoD leadership, and the OSD ManTech management team. As part of this long-term strategy, the OSD ManTech program will continue to collect performance measures as part of both annual and 5-year evaluations of the DoD MIIs.

# APPENDIX B: JOINT DEFENSE MANUFACTURING TECHNOLOGY PANEL SUBPANELS

Each JDMTP subpanel and working group coordinates DoD ManTech projects and promotes technology transition and transfer through a variety of avenues, including DoD manufacturing conferences and annual portfolio reviews. These portfolio reviews encompass all new, current, and recently completed DoD composites manufacturing technology projects as well as select high-value S&T projects. Potential industry users and government approvers come together to formally review projects to ensure their effectiveness. This appendix provides a summary of specific mission and taxonomy areas for each subpanel and respective working group.

Subpanels employ JTPAs to communicate joint technical priorities to the Manufacturing and Industrial Base Policy leadership and the collective DoD ManTech stakeholder community. These recommended joint service technology pursuits include priority manufacturing technology developments expected to produce the highest value, affordable, leading edge defense capabilities to meet the near-term needs of our Warfighters.

## METALS PROCESSING AND FABRICATION SUBPANEL MISSION, TAXONOMY, AND THRUST AREAS

The Metals Subpanel mission is to help to bridge the gap between technologies at MRL 4 to MRL 7-8 to support manufacturing technology advancement beyond the risk industry inherently takes.

The subpanel identifies manufacturing technologies that are applicable across multiple weapons systems and of interest across the Services. The subpanel has a taxonomy containing five major thrusts: metals affordability, high performance materials and processing, metals processing methods, joining and assembly, and inspection and compliance.

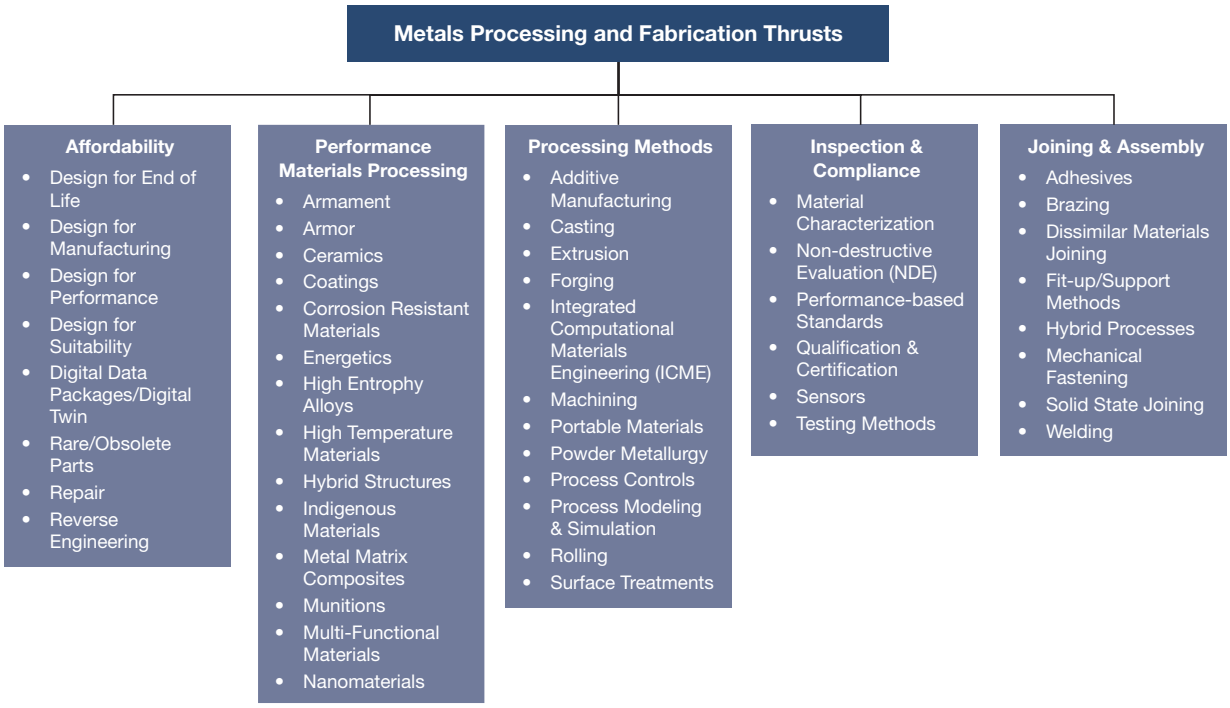



Figure 11. Metals Processing and Fabrication Thrusts

## COMPOSITES PROCESSING AND FABRICATION SUBPANEL MISSION, TAXONOMY, AND THRUST AREAS

The Composite Subpanel mission is to identify and integrate requirements for Composites ManTech leading to solutions with multi-Service/Agency application. The subpanel leverages common interests and needs, shares information, and coordinates technology maturation efforts to meet manufacturing requirements essential to reducing acquisition and sustainment costs for current and future systems. Key investment areas balance DoD strategic priorities with Service and Agency imperatives. Common themes include: technologies to accelerate the design to manufacturing process cycle; manufacturing cost reduction for manned and unmanned systems; increasing systems durability and mission readiness; and enabling cost effective, low-volume or high-mix remanufacturing and repair processes for the sustainment community.

The subpanel promotes improved technology transition and transfer through a variety of avenues, including DoD manufacturing conferences and annual portfolio reviews. These portfolio reviews encompass all new, current, and recently completed DoD composites manufacturing technology projects as well as select high-value S&T projects. Potential industry users and government approvers come together to formally review projects to ensure their effectiveness. During a recent review, the subpanel leveraged joint interest in the advancement of carbon-carbon composites to create a joint initiative "Manufacturing of Carbon-Carbon Composites for Hypersonic Applications" funded by OSD MSTP and supplemented by Service and Agency funded activities. This effort has a joint management structure.

The subpanel's scope includes manufacturing and related technologies for the fabrication of parts and assemblies from composite materials, to include polymer matrix composites, certain metal matrix composites, ceramic matrix composites, and other materials that have similar forms or use similar processes.

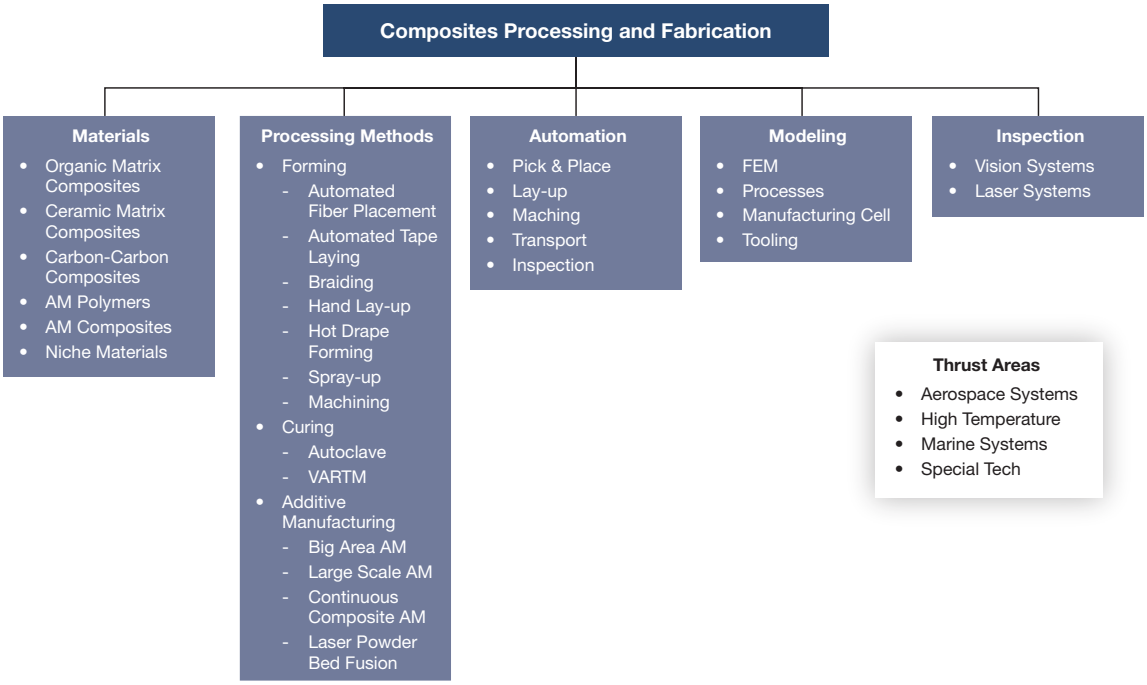


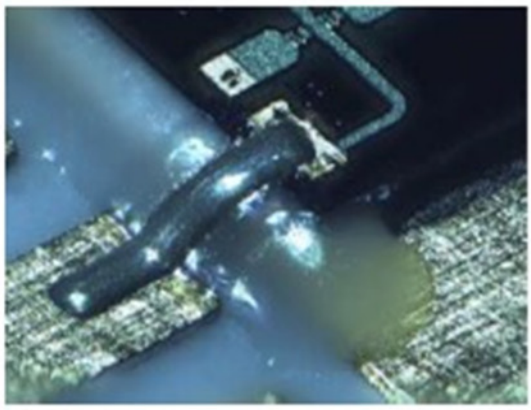

**Figure 12. Composites Processing and Fabrication**

Thrust areas include:

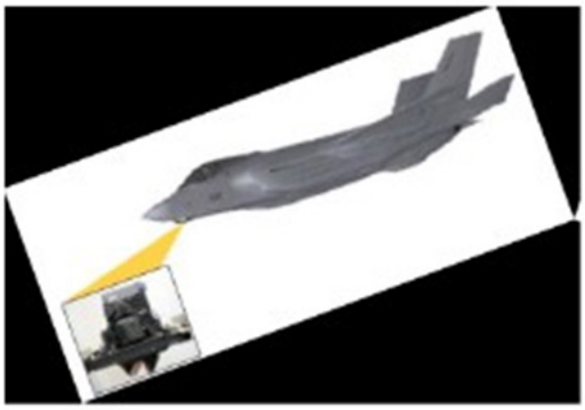
- Aerospace Systems:
  - Automation of manufacturing systems
  - Enabling bonded and integrated primary structures
  - Reduced variability for critical manufacturing processes
  - Automated inspection technologies
  - Enhancing process/product modeling and simulation tools
- High Temperature:
  - Maturation of processes tailored to higher temperature (>300oF) organic, ceramic, and metal matrix composites including carbon-carbon
- Marine System:
  - Improved design and manufacture of marine systems simultaneously improving acquisition and sustainment costs while increasing mission readiness
- Specialty Applications:
  - Ballistically tolerant systems and structures
  - Transparencies
  - Tires and treads

## ELECTRONICS PROCESSING AND FABRICATION SUBPANEL MISSION, TAXONOMY, AND THRUST AREAS

The Electronics Processing and Fabrication subpanel mission is to identify and integrate requirements for Electronics ManTech across the services, DLA, OSD, the Department of Energy (Sandia Labs), industry, and academia; discuss common needs and foster joint project planning; hold an annual portfolio review to coordinate all DoD electronics projects; and discuss and remain cognizant of national and international technology developments and innovative and disruptive technologies. This subpanel works with the DoD Manufacturing Innovation Institutes. It participates in the annual Microelectronics Integrity Meeting.



Advanced Manufacturing Processes included printed electronics



Joint initiatives address F-35 Electro-Optic Targeting System

The Electronics Subpanel conducts joint DoD component project planning and oversees project execution via assessments and annual portfolio reviews. The panel contributes to manufacturing technology transition from system development to production and sustainment, among DoD components, other government agencies, industry, and academia. The Subpanel also established five Technical Working Groups that assess critical Warfighter technologies needed in the areas of Power Sources, RF Modules, and Printed and Flexible Hybrid Electronics, Energetics and Warheads, and Directed Energy.

The Electronics Processing and Fabrication Subpanel taxonomy includes thrust areas for electro-optics, integrated photonics, RF system and vacuum tube component technologies, power and energy sources, energetics and warheads, electronics packaging and assembly, directed energy, printed electronics and innovative and disruptive electronics manufacturing, and electromagnetic windows and domes. The subpanel thrust areas address modeling, processes, and testing in support of both new production and sustainment/readiness activities for fielded systems.

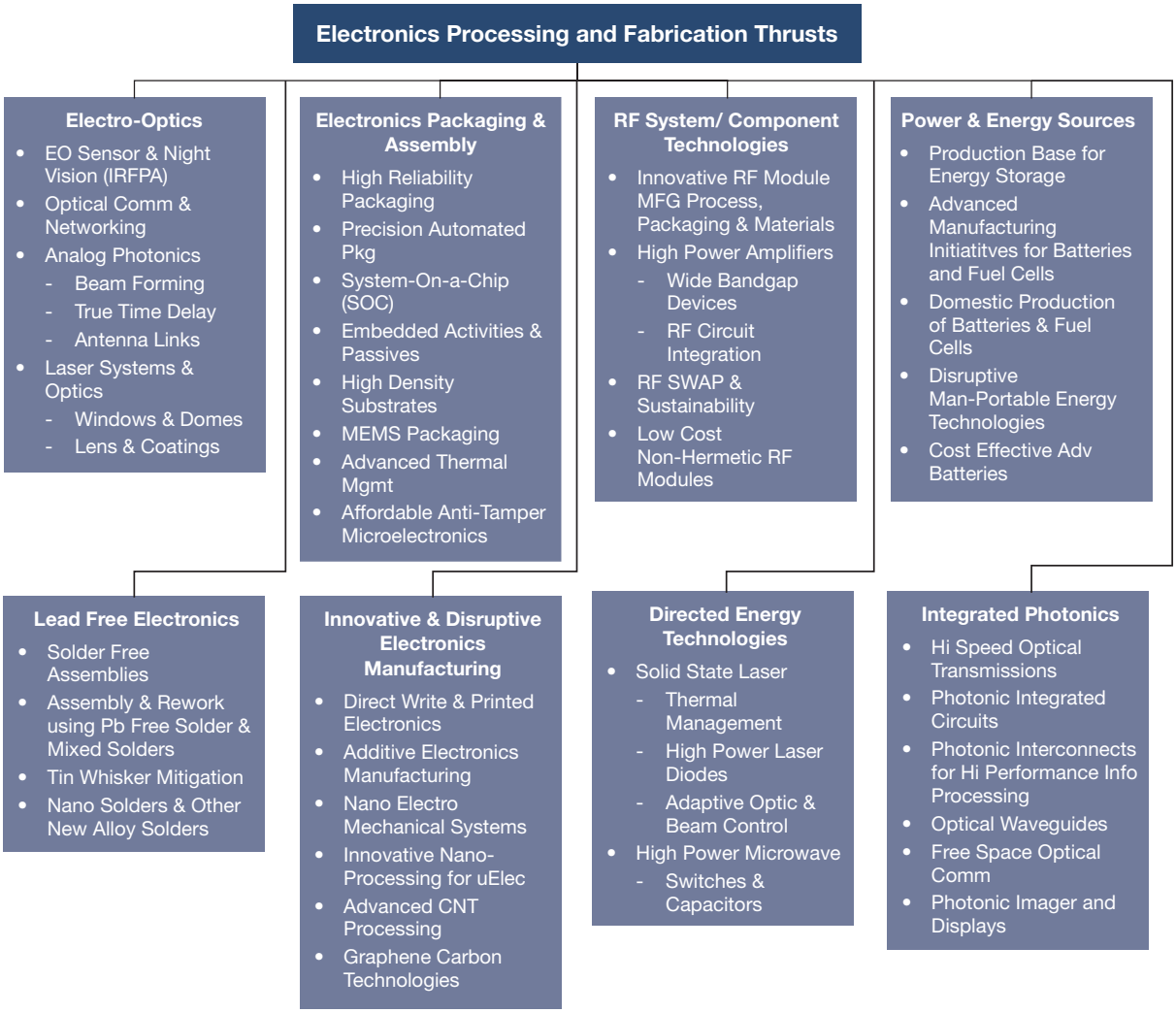



Figure 13. Electronics Processing and Fabrication Thrusts

## ADVANCED MANUFACTURING ENTERPRISE SUBPANEL MISSION, TAXONOMY, AND THRUST AREAS

The AME Subpanel encompasses the technologies, processes, and practices that foster rapid, superior execution of manufacturing enterprises across the life cycle. This subpanel focuses on issues that occur "above the factory floor," or overall processes. The AME Subpanel taxonomy consists of two focus areas: (1) enabling technologies and (2) implementing strategies.

Figure 14. Manufacturing support tools expedite tasks, verify status, and validate results within the industrial base

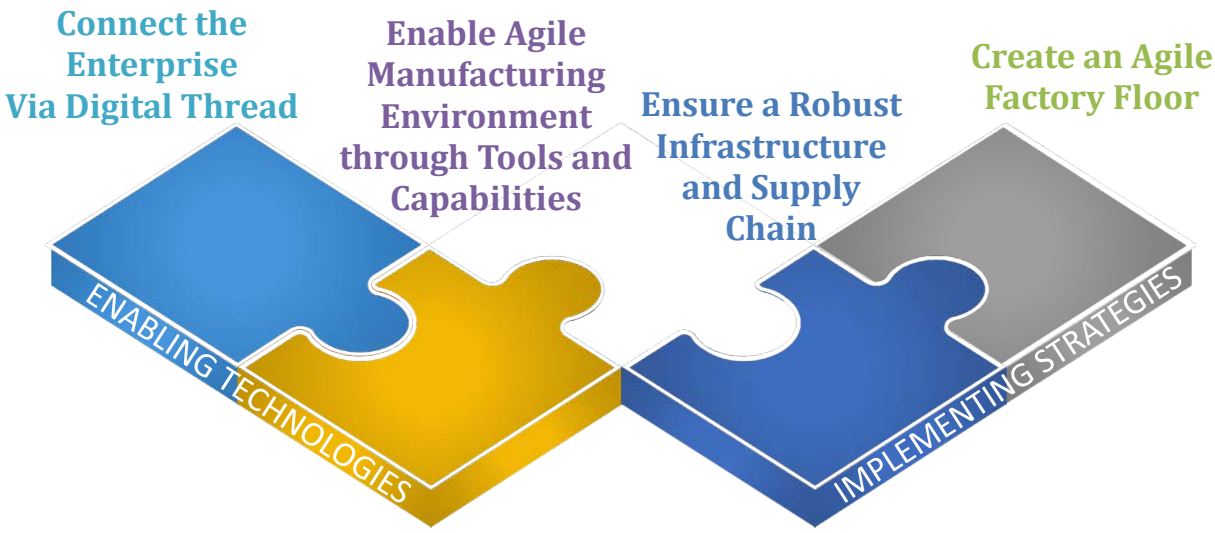



Figure 15. Enabling Technologies and Implementing Strategies

1. Connect the Enterprise via Digital Thread
    - Data Integration; Interoperability and Sharing
    - IT Framework to Support Model Based Enterprise
    - Product and Process Lifecycle
    - Operations and Maintainability (Sustainment)
    - Data and Taxonomy Standards

2. Enable Agile Manufacturing Environment
    - Feedback Loops for Real Time Decisions
    - Data Analytics
    - AI and Machine Learning
    - Mixed Realities Tools
3. Ensure a Robust Infrastructure and Supply Chain
    - Cybersecurity for Operational Technologies
    - Risk Analysis
    - Workforce Training and Education
    - Business Processes
    - Mixed Realities and Collaborative Environments for Manufacturing
4. Create an Agile Factory Floor
    - Rapid Response
    - Adaptive/Agile Manufacturing
    - Production Planning and Scheduling
    - Implementation of AI for Manufacturing Systems
    - Intelligent Factory
    - Automation

## MANUFACTURING READINESS LEVEL WORKING GROUP MISSION, TAXONOMY, AND THRUST AREAS

The Manufacturing Readiness Level Working Group (MRLWG) mission is to leverage DoD, industry, and academic manufacturing expertise to continually update and improve the MRL Body of Knowledge (BOK) for the user community.

DoD identified a need for improvements in manufacturing risk management. The Department has a history of cost, schedule, and quality problems in weapon system programs. In 2004, the JDMTP created an MRLWG comprised of government, industry, and academia representatives to develop and institutionalize the manufacturing readiness discipline. The MRLWG established an initial set of MRL criteria. AF ManTech used the criteria in Manufacturing Readiness Assessments (MRA) trials utilizing AFRL Advanced Technology Demonstration programs. SAF/AQ then directed them to demonstrate the process on an acquisition development program, the MQ-9 Reaper. The MRAs proved useful in identifying and mitigating manufacturing risk that was delaying successful technology transition and efficient

production. The success was shared jointly with the other services, industry, and academia through MRLWG meetings and documented in the first MRL Deskbook. By 2008, the MRL methodology was in wide use by all DoD services and the defense industry. Industry has since applied the methodology to its commercial enterprises successfully. The MRL methodology is now considered a best practice worldwide as a manufacturing risk identification and abatement tool.

The MRLWG is comprised of a chair, elected Service and Defense Agency representatives, as well as industry and academic members. A formal charter was established on January 27, 2022.

## *Taxonomy*

The MRLWG is responsible for the development, coordination, publication, and maintenance of a best practice BOK aimed at identifying, managing, and mitigating manufacturing risk for the timely development, production, modification, fielding, and sustainment of affordable products. The BOK is intended for use in the defense industry and is applicable and being used in commercial industries.

The MRLWG uses lessons learned, changes in manufacturing practices, DoD policy updates, and real-life manufacturing expertise to continuously update and improve the MRL BOK and post to https://dodmrl.com/. The MRLWG shall continue to ensure the following: (1) use of the MRL BOK identifies and minimizes manufacturing risk to transition hardware development effectively into production and provides a manufacturing voice in the decision and design process much earlier in the development process; (2) the MRL BOK is a best practice allowing for maximum flexibility in application by a diverse contractor community developing and producing various products; and (3) the BOK is in compliance with DoD policy. Since industry is the primary user, the MRL BOK shall be a joint DoD and industry product. The MRLWG strives to ensure that the MRL BOK:

- identifies areas of risks, issues, and opportunities;
- minimizes manufacturing risk in product development to transition effectively to production;
- provides earlier manufacturing input to the design and decision processes; and
- is an up-to-date best practice allowing for maximum flexibility in application by the diverse industry and contractor community developing and producing various products.

## *Recent Achievements*

1. December 2021: Presentation of the MRLWG Charter and Governance recommendations as well as training over 250 interested parties on MRLWG activities and the BOK.
2. January 2022: MRLWG Charter signed and first service reps assigned.
3. October 2022: Completed publishing of the updated 2022 BOK, establishing education and outreach as cornerstone priorities, and establishing a formal governance structure.

# APPENDIX C: DEPARTMENT OF DEFENSE MANUFACTURING INNOVATION INSTITUTES

## BACKGROUND

Over the past century, U.S. National and economic security have relied on a robust American industrial base armed with advanced manufacturing technologies needed to rapidly and affordably deliver critical products and systems.

Today, our country faces new challenges, not only from great powers and regional adversaries, but also from infectious disease, cyberattacks, and intellectual property theft. Despite unprecedented threats, we face unmatched opportunity.

America must lean forward to create the manufacturing capabilities needed to build back better our economic foundations and modernize our military. An innovative industrial base can only be accomplished through nationwide collaboration that fosters healthy, competitive technology ecosystems. That is where the DoD Manufacturing Innovation Institutes (MIIs) come in.

OSD ManTech sponsors nine DoD MIIs with headquarters and hubs across the country. Each institute is a public-private partnership designed to overcome the challenges faced by American manufacturing innovators in a variety of technology areas. While each institute operates in its own unique ecosystem, the institutes offer common capabilities that:

- provide access to state-of-the-art tools and equipment that are otherwise beyond the reach of most businesses;
- implement targeted education and workforce development training programs; and
- encourage project investments in applied research and industrially relevant manufacturing technologies.

### Mission

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

With a combined $969 million in initial and follow-on Federal investment and $2.0 billion in matching funds from industry, academia, and state governments, the DoD MIIs have convened a network of over 1,700 organizations across defense industry, commercial manufacturers of all sizes, start-ups, universities, community colleges, and state and local economic developers in active partnership with the U.S. Federal Government.[4]

| | | |
|---|---|---|
| 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 roadmapping |
| Industrially relevant, DoD oriented R&D to "Bridge the Gap" [TRL/MRL 4-7] | Access to shared assets for U.S. companies (i.e. intellectual property and infrastructure) | Education and training for sufficient, skilled manufacturing workforce |
| Significant initial federal investment ($70-$120M) over 5-7 years | Leverage minimum of 1:1 cost share from non-federal sources | Formal evaluation prior to continued DoD engagement and funding |

**Figure 16. DoD MII Business Model Tenets**

## LONG-TERM STRATEGY

The DoD MIIs are game-changing catalysts intended to build enduring advantages for the future Joint Force by connecting innovative industrial ecosystms 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 ManTech 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 principals.
- 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.

The long-term strategy is to utilize DoD MIIs to realize a higher impact on warfighting capabilities. This involves strategic interaction with Services and Agencies through the JDMTP and Subpanels to inform key investments.

[4] DoD MII metrics as of the forth quarter FY22

| America Makes<br>The National Additive Manufacturing Innovation Institute | |
|---|---|
| **Established** | August 2012 |
| **Website** | www.americamakes.us |
| **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* |
| **Headquarters** | Youngstown, OH |
| **Consortium Organizer** | National Center for Defense Manufacturing and Machining (NCDMM) |
| **Satellite Locations** | The W.M. Keck Center for 3D Innovation at The University of Texas at El Paso<br>Texas A&M Engineering Experiment Station at Texas A&M University<br>National Institute for Aviation Research at Wichita State University |
| **Institute Snapshot** | |
| *America Makes is the Nation's leading public-private partnership for AM technology and education. America Makes members from industry, academia, government, workforce, and economic development organizations work together to accelerate AM adoption and the Nation's global manufacturing competitiveness, focused on three areas: developing AM technology, developing an additive manufacturing workforce, and maintaining a collaborative AM ecosystem.* | |
| **Institute Capabilities** | |
| **Additive Manufacturing Ecosystem** | America Makes is deeply ingrained in the Youngstown, OH manufacturing ecosystem which is connected to a larger national network to provide members access to AM capabilities and expertise. America Makes expands that network through three Satellite Centers at the University of Texas El Paso, Texas A&M Engineering Experiment Station at Texas A&M University, and the National Institute for Aviation Research at Wichita State University in Kansas. Each Satellite Center focuses on mirroring and enhancing the efforts of America Makes to foster a collaborative infrastructure for the open exchange of AM information and research; engages with local companies and educational institutions to supply education and training in AM technologies; and focuses on transitioning AM technology from the research lab to commercialization. |
| **Roadmapping** | America Makes has spent considerable effort over the past eight years developing and maturing a technology roadmap development process. The roadmapping process is based on America Makes' membership and stakeholder interaction to develop, curate, and decompose technology needs. America Makes has developed member-driven roadmaps for technology, EWD, and additive manufacturing standards. These roadmaps identify measurable and meaningful challenges that, when met, promote inquiry, knowledge-sharing, and advancements across the industry. |
| **Standards Development** | America Makes and the American National Standards Institute launched the Additive Manufacturing Standards Collaborative (AMSC) in 2016 with the support of OSD. AMSC coordinates and accelerates the development of industry-wide additive manufacturing standards and specifications. |

| MxD<br>Manufacturing times Digital | |
|---|---|
| **Established** | February 2014 |
| **Website** | www.mxdusa.org |
| **Mission** | *Provide the government and U.S. manufacturers with the digital tools needed to transform American manufacturing.* |
| **Headquarters** | Chicago, IL |
| **Consortium Organizer** | MxD |

**Institute Snapshot**

*MxD is where innovative manufacturers forge their futures. In partnership with DoD, MxD provides manufacturers with digital tools and expertise to begin building every part better than the last. Institute members increase their productivity and win more business, powered by a workforce with the digital skills they need for a cybersecure industrial base. MxD also works with DoD manufacturers and contractors to assess and implement digital improvements throughout the industrial base.*

**Institute Capabilities**

| | |
|---|---|
| **Future Factory** | Through its robust network of industry, academic, and government partners, MxD provides the U.S. manufacturing industry with workshops, federally-funded project opportunities, workforce development tools, and a 22,000 square-foot future factory floor innovation center to advance the digital transformation of U.S. manufacturers to accelerate innovation so they produce "every part better than the last." |
| **Center for Cybersecurity** | MxD, with the support of DoD, established the National Center for Cybersecurity in Manufacturing, because ensuring manufacturing security against cyber threats and driving manufacturing competitiveness is critical to securing the Warfighter. The Center will bridge and build a more resilient industrial base and defense supply chain by adapting the best in cyber tools and training to the unique needs of manufacturers of all sizes, including SMEs. |
| **DOCENT** | DoD uses MRAs to identify, analyze, acknowledge, and mitigate risks associated with new manufacturing programs, but there currently are no modern tool sets to execute the MRA process. MxD's Docent project created an application that facilitates the execution of an MRA with flexible user interfaces. MxD has received significant interest from the DIB about utilizing Docent because of the benefit it provides prime defense contractors; MxD is engaged in active conversations with both Lockheed Martin and Northrop Grumman about deploying this tool in their organizations. |

| LIFT | |
|---|---|
| **Established** | February 2014 |
| **Website** | www.lift.technology |
| **Mission** | *Advancing American manufacturing 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.* |
| **Headquarters** | Detroit, MI |
| **Consortium Organizer** | American Lightweight Materials Manufacturing Innovation Institute |

**Institute Snapshot**

*LIFT – Leading Innovations For Tomorrow, the institute's technology program, develops and deploys new advanced materials manufacturing technologies and processes, including lightweighting and multi-material processing in support of our national economy and national defense.*
*LIFT – Learning Innovations For Tomorrow, the institute's talent program, delivers a new advanced manufacturing curriculum in its immersive Learning Lab environment and to schools across the Nation to address the skills gap in the U.S. workforce, providing workers with the skills, knowledge, and abilities required by new innovative technologies.*

**Institute Capabilities**

| | |
|---|---|
| **Ecosystem Development** | With its 100,000 square-foot headquarters in Detroit, Michigan, LIFT convenes an ecosystem of Fortune 500 companies; top academic research universities; small- and medium-sized manufacturers; and national education and workforce development partners to rapidly contract, design, develop, prototype, and test innovative technologies for DoD to speed technology transition to the Warfighter while building the future workforce of America.<br>**High Bay - Bringing the "Art of the Possible" to Reality:** The LIFT Technology Showcase houses the national premier advanced materials development facility featuring full-scale equipment and highlights connecting materials, processes, and systems for smarter manufacturing.<br>**Learning Lab:** LIFT features 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. |
| **IGNITE: Mastering Manufacturing** | Today's workforce necessitates a three-year foundational competency-based educational program for the "multi-skilled technician." The new curriculum will introduce students to advanced manufacturing materials, processes, and systems through online, interactive, multimedia and project-based learning built around real industry challenges. |
| **Operation Next** | This is an innovative training and credentialing program providing 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. The program was expanded to support small- and medium-sized organizations through a pilot in Detroit, MI and Pittsburgh, PA. |

| AIM Photonics<br>American Institute for Manufacturing Integrated Photonics | |
|---|---|
| **Established** | July 2015 |
| **Website** | www.aimphotonics.com |
| **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.* |
| **Headquarters** | Albany, NY (photonic chip fabrication facility) and<br>Rochester, NY (photonic chip test, assembly, and packaging facility) |
| **Consortium Organizer** | Research Foundation for the State University of New York |
| **Satellite Locations** | Santa Barbara, CA<br>Tucson, AZ<br>Cambridge, MA |
| **Workforce Location** | Massachusetts Institute of Technology (Cambridge, MA) |
| **Institute Snapshot** | |
| *AIM Photonics accelerates the transition of integrated photonics into DoD systems and commercial products by maintaining a U.S.-based integrated photonics ecosystem to provide the U.S. with access to the world's best integrated photonics fabrication, packaging, and testing capabilities, previously only available in Asia or Europe.* | |
| **Institute Capabilities** | |
| **PIC Manufacturing Ecosystem** | AIM Photonics has created a complete, first-of-its-kind Photonic Integrated Chip (PIC) manufacturing ecosystem, which provides the photonic community and DoD access to advanced technology, capabilities, and resources throughout the entire product development cycle at low risk and cost, thereby enabling reduced time to market and ensuring the strategic advancement of U.S. national security. |
| **Chip Fabrication Facility** | The chip fabrication facility located at NY CREATES in Albany, New York has developed a costeffective way for any size of organization to utilize the advanced node 300mm microelectronics chip facility. |
| **Test, Assembly, and Packaging Facility** | AIM has the world's only open-access 300mm integrated photonics packaging prototyping foundry, with domestic industry now on-shoring previous overseas efforts. The associated Test, Assembly, and Packaging Facility in Rochester, New York is also state-of-the-art and will be the only domestic facility of its kind—allowing export-controlled test, assembly, and packaging. |

| NextFlex<br>America's Flexible Hybrid Electronics Manufacturing Institute | |
|---|---|
| **Established** | August 2015 |
| **Website** | www.nextflex.us |
| **Mission** | *Pioneer flexible hybrid electronics manufacturing to serve our Nation's Warfighters and the U.S. economy.* |
| **Headquarters** | San Jose, CA |
| **Consortium Organizer** | FlexTech Alliance |

**Institute Snapshot**

*NextFlex is advancing the manufacturability of flexible hybrid electronics (FHE) devices and systems and driving manufacturing readiness levels toward commercialization—with an emphasis on device integration and packaging, printed flexible components and microfluidics, materials, modeling and design, standards, and testing and reliability. The manufacturing processes at the Technology Hub use production-level tools that, in some cases, deal with unique requirements (e.g., handling and attachment of ultra-thin die). NextFlex has demonstrated that the FHE manufacturing process reduces the number of process steps by two-thirds when compared to traditional circuit board production. Additionally, the process found the final board to be only one-third of the weight of a traditional board.*

**Institute Capabilities**

| | |
|---|---|
| **Technology Hub** | The NextFlex Technology Hub provides manufacturing-focused research and development (R&D), prototyping, and production capability for government and industry. Before the establishment of the institute, there was no comparable facility for FHE anywhere in the world. In 2019, the NextFlex pilot line began low volume production for two product lines. The Food and Drug Administration granted NextFlex certification for medical device manufacturing Quality Systems Regulations (QSR) for good manufacturing practices. Additionally, NextFlex is International Traffic in Arms Regulations (ITAR) compliant. |
| **Materials and Process Database** | The NextFlex Material and Process Database enables sharing of data from all members and Government partners to accelerate design cycles and process development across the FHE community. This database tool allows NextFlex members to share, search, and find structured data for material properties of FHE samples as well as the fabrication process details associated with those samples. This can accelerate the implementation time for new materials and processes in a fab and reduce design-build-test cycles. |
| **FlexFactor®** | NextFlex's FlexFactor helps inform, inspire, attract, and recruit participants into advanced manufacturing education and career pathways, targeting multiple segments including K-12 and Military Service audiences. FlexFactor layers onto an existing class or students and helps eliminates the "opt out" process that defines many other workforce development programs. FlexFactor challenges young people to develop a hardware device solution and build a business model to solve a real-world problem that they care about. Critical thinking and the ability to work effectively in teams are positive and transformative outcomes from the program as well as introducing young people to the education pathways associated with careers in the advanced manufacturing sector. |

| AFFOA<br>Advanced Functional Fabrics of America Institute | |
|---|---|
| **Established** | April 2016 |
| **Website** | affoa.org |
| **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.* |
| **Headquarters** | Cambridge, MA |
| **Consortium Organizer** | Massachusetts Institute of Technology |
| **Satellite Locations** | Drexel University (Philadelphia, PA)<br>Massachusetts Institute of Technology (MIT) Lincoln Laboratory (Lexington, MA)<br>University of Massachusetts, Lowell (Lowell, MA) |

**Institute Snapshot**

*AFFOA's vision is a globally competitive, domestic supply chain in advanced fibers and fabrics. The Institute delivers breakthrough capabilities and innovations for national security by de-risking university technologies, non-traditional defense contractor participation, and developing advanced textile systems. AFFOA centralizes the revolutionary fiber and fabric technology capabilities of startups, manufacturers, industry and academia and organizes them to produce and manufacture advanced textile systems for DoD and commercial markets.*

**Institute Capabilities**

| | |
|---|---|
| **Fabric Discovery Centers** | In support of AFFOA's mission to rekindle the domestic textile industry, the Institute has established regional centers of excellence, called Fabric Discovery Centers (FDCs). Their purpose is to spur innovation and regional economic development aligned with advanced fibers and fabrics. Funded in partnership with local universities and State governments, FDCs are innovation centers with capabilities including, advanced R&D, end-to-end prototyping, start-up incubation space, manufacturing process development and EWD activities that support both DoD and commercial needs. |
| **Advanced Fiber Development** | AFFOA has end-to-end advanced fabric prototyping capabilities at HQ including the ability to design, manufacture and integrate advanced fibers using a unique thermal draw process. This enables the institute to design complex multi-material structures that can be drawn down to fiber length scales. Additionally, AFFOA's team of 20 technical staffers and textile designers allows the institute to integrate multiple components into system level demonstrators. The Defense FDC has similar capabilities which are used for classified work. |
| **Fabric Innovation Network** | AFFOA's impact is amplified by the highly capable members comprising the FIN, which includes U.S. universities innovating in advanced fibers and fabrics, small and medium-sized businesses developing unique manufacturing know-how, startups and industry members engaged in shaping the textile marketplace of the future, and government labs and agencies helping to bring the most important national security problems to the forefront. |

| BioFabUSA<br>Advanced Regenerative Manufacturing Institute | |
|---|---|
| **Established** | December 2016 |
| **Website** | www.armiusa.org |
| **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.* |
| **Headquarters** | Manchester, NH |
| **Consortium Organizer** | Advanced Regenerative Manufacturing Institute (ARMI) |

**Institute Snapshot**

*Significant breakthroughs in cell biology, biofabrication, and materials science in the last decade have laid the foundation for large-scale manufacturing and commercialization of engineered tissues and tissue-related technologies. BioFabUSA has targeted the raw material, equipment, measurement, automation, logistics, and big data analytics challenges that hinder scalable, consistent, and cost-effective manufacturing. The development of tissue engineered medical products on an industrial scale enables DoD to accelerate the creation of numerous medical products for our wounded warfighters to support force readiness and save lives on the battlefield.*

**Institute Capabilities**

| | |
|---|---|
| **Tissue Foundry** | BioFabUSA developed the first-ever Tissue Foundry manufacturing platform. The Tissue Foundry is composed of a series of subsystems, or modules, each representing a different stage of the Tissue Engineered Medical Product (TEMP) manufacturing process, from culture of the cells that make up the tissue to packaging of the final product. Modular, automated, and closed manufacturing ensure the Warfighter and Nation have access to sufficient numbers of effective, consistent, and affordable TEMPs. |
| **Deep Tissue Characterization Center** | The Deep Tissue Characterization Center is an integrated system of analytical instrumentation that supports the in-depth analysis of cells, culture media, and engineered tissues, including characterization of cell count and viability, apoptosis, multi-omics, and other product-specific functional assays. This analysis of cells, culture media, and tissues correlates with successful production runs and positive clinical trial results to determine critical process parameters for the automated control of tissue manufacturing. |
| **Student Hands-on Learning Kit** | BioFabUSA is working to close educational skills gaps in tissue engineering and organ manufacturing through accessible educational and training opportunities. Over 5,000 students have already participated in the developed activities. The kit is "productized" with complete instructions, including a teacher guide and student guide, with questions aligned to the Next Generation Science Standards, Common Core Standards, and the Framework for K-12 Science Education. These kits provide opportunities to highlight essential manufacturing skills and processes and allow students to envision a career pathway for themselves in this emerging technology area, ultimately attracting the future workforce to the biofabrication industry. |

## ARM
## Advanced Robotics for Manufacturing Institute

| | |
|---|---|
| **Established** | January 2017 |
| **Website** | www.arminstitute.org |
| **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 large and small U.S. manufacturers, train and empower the manufacturing workforce, strengthen the U.S. economy and global competitiveness, and elevate the Nation's security and resilience.* |
| **Headquarters** | Pittsburgh, PA |
| **Consortium Organizer** | Carnegie Mellon University |

### Institute Snapshot

*The ARM Institute is leading the way to a future where people and robots work together to respond to our Nation's greatest challenges and to develop and produce the world's most desired products. Structured as a national consortium, ARM's members span industry, advanced technology, academia, and government organizations. ARM integrates diverse industry best practices and institutional knowledge about robotics technologies across many disciplines to realize the promise of a robust manufacturing innovation ecosystem. Key focus areas include human-robot interaction, interoperability, artificial intelligence, reconfigurable, agile and flexible robotics systems, and easier technology adoption and risk reduction. ARM also works to prepare the U.S. workforce for Industry 4.0 careers working with robotics. In defining the robotics career pathways, ARM is working to expand the size, diversity, and skill set of the U.S. robotics workforce.*

### Institute Capabilities

| | |
|---|---|
| **Mill 19** | The ARM Institute has a state-of-the-art headquarters in Pittsburgh's Hazelwood Green neighborhood, a thriving robotics community. The Institute is an integral part of Pittsburgh's strategy to define the future of the global manufacturing economy. This brand-new development provides high-bay space for ARM member collaboration, dedicated classrooms for workforce training, and more. |
| **Regional Collaboratives** | The ARM Institute's network of regional collaboratives is critical to ARM's national strategy. Eight regional collaboratives consist of volunteer members who serve as an extension of ARM in that area. These Regional Collaboratives are critical to ARM's national strategy. By working with a local regional collaborative, members stay actively engaged with other members in their area, have access to region-specific ARM events, and more. ARM leverages the insight provided by the eight collaboratives to guide their national strategy, capitalize on regional strengths, and address regional gaps. |

| BioMADE<br>Bioindustrial Manufacturing and Design Ecosystem Institute | |
|---|---|
| **Established** | October 2020 |
| **Website** | www.biomade.org |
| **Mission** | 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. |
| **Headquarters** | St. Paul, MN |
| **Consortium Organizer** | Engineering Biology Research Consortium (EBRC) |
| **Satellite Locations** | Berkeley, CA<br>Cambridge, MA |

**Institute Snapshot**

*BioMADE is building a sustainable, domestic, end-to-end bioindustrial manufacturing ecosystem. BioMADE has the mission and flexibility to propel new biotechnology products from the laboratory to the commercial market. In addition to supporting the development of technologies to strengthen American competitiveness, BioMADE is building the workforce of the future by partnering with K-12 schools, community colleges, universities, and professional development organizations.*

*BioMADE is committed to safety, security, sustainability, and social responsibility as it develops these new technologies and products. In partnership with its nationwide roster of member groups—which range from large corporations to education-based nonprofits—BioMADE will secure America's future through manufacturing innovation, education, and collaboration.*

**Institute Capabilities**

| | |
|---|---|
| **Developing Domestic Source of Rubber** | 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. |
| **Aiding Rural Communities** | 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). |

# APPENDIX D: REFERENCES

## DOD MANTECH PROGRAM GOVERNANCE DOCUMENTS AND DIRECTIVES


DoD Directive 4200.15, "Manufacturing Technology (ManTech) Program," September 2002

United States Code Title 10, Section 4841, "Manufacturing Technology Program"

United States Code Title 10, Section 4842, "Joint Defense Manufacturing Technology Panel"


## PUBLISHED PLANS, STRATEGY, AND GUIDANCE DOCUMENTS INFLUENCING THE DOD AND COMPONENT MANTECH PROGRAMS


Office of the Chief of Naval Research, "Naval Research and Development: A Framework for Accelerating to the Navy and Marine Corps After Next," 2018

Office of the Chief of Naval Operations, "NAVPLAN," January 2021

Office of the Director, Defense Logistics Agency, "Transforming Global Logistics, DLA Strategic Plan 2021-2026," April 2019

Office of the Secretary of the Air Force, "U.S. Air Force 2030 Science and Technology Strategy," April 2019

Office of the Secretary of the Army, "2019 Army Modernization Strategy: Investing in the Future," October 2019

Office of the Secretary of Defense, "2022 National Defense Strategy," October 2022

Office of the Secretary of Defense, "Missile Defense Review," January 2019


## RECENT REPORTS AND STUDIES


Office of the Under Secretary of Defense for Research and Engineering, "Department of Defense Additive Manufacturing Strategy," January 2021


## OTHER RELEVANT DOCUMENTS AND INFORMATION (INCLUDING KEY HISTORICAL REPORTS AND INITIATIVES)


Office of the Under Secretary of Defense for Acquisition, Technology, and Logistics, "Creating an Effective National Security Industrial Base for the 21st Century: An Action Plan to Address the Coming Crisis—Report of the Defense Science Board Task Force on Defense Industrial Structure for Transformation," July 2008

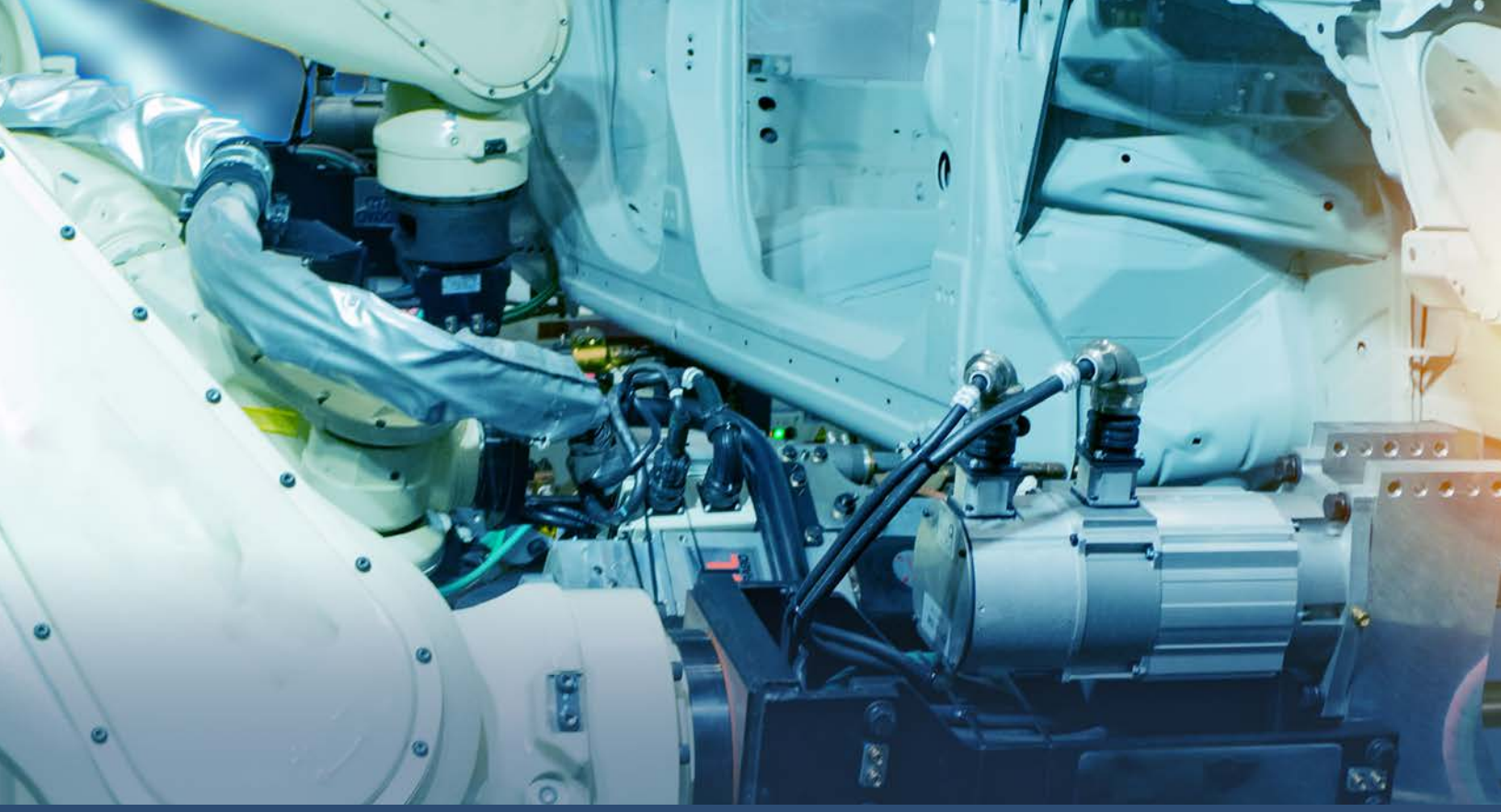
Office of the Under Secretary of Defense for Acquisition, Technology, and Logistics, "Defense Science Board Task Force on The Manufacturing Technology Program: A Key to Affordability Equipping the Future Force," February 2006

OSD Manufacturing Technology Program in collaboration with the Joint Service and Industry MRL Working Group, "Manufacturing Readiness Level Deskbook," 2022

# APPENDIX E: ACRONYMS

| | |
|---|---|
| AFFOA | Advanced Functional Fabrics of America Institute |
| AFRL | Air Force Research Laboratory |
| AI | Artificial Intelligence |
| AIM Photonics | American Institute for Manufacturing Integrated Photonics |
| AM | Additive Manufacturing |
| AME | Advanced Manufacturing Enterprise |
| AMSC | Additive Manufacturing Standards Collaborative |
| AMT | Advanced Manufacturing Technologies |
| ARM | Advanced Robotics for Manufacturing |
| ARMI | Advanced Regenerative Manufacturing Institute |
| BioMADE | Bioindustrial Manufacturing and Design Ecosystem |
| C3 | Command, Control and Communication |
| DAF | Department of the Air Force |
| DIB | Defense Industrial Base |
| DLA | Defense Logistics Agency |
| DMS&T | Defense-wide Manufacturing Science and Technology Program |
| DoD | Department of Defense |
| DV | Innovation, Science, and Technology Directorate |
| DVM | Industrial Manufacturing Technology Organization |
| E&W | Energetics and Warheads |
| ESA | Enterprise Service Activity |
| FDC | Fabric Discovery Center |
| FHE | Flexible Hybrid Electronics |
| FNC3 | Fully Networked Command, Control, and Communications |
| FY | Fiscal Year |
| JAMWG | Joint Additive Manufacturing Working Group |
| JDMC | Joint Defense Manufacturing Council |
| JDMTP | Joint Defense Manufacturing Technology Panel |
| JMPI | Joint Manufacturing Planning Initiative |
| JTPA | Joint Technology Pursuit Area |
| LOE | Lines of effort |

| | |
|---|---|
| ManTech | Manufacturing Technology |
| MDA | Missile Defense Agency |
| M-EWD | Manufacturing Education and Workforce Development |
| MII | Manufacturing Innovation Institutes |
| MRA | Manufacturing Readiness Assessment |
| MRL | Manufacturing Readiness Level |
| MSTP | Manufacturing Science and Technology Program |
| MxD | Manufacturing times Digital |
| NextFlex | America's Flexible Hybrid Electronics Manufacturing Institute |
| OSD | Office of the Secretary of Defense |
| OUSD (A&S) | Office of the Under Secretary of Defense for Acquisition and Sustainment |
| OUSD(R&E) | Office of the Under Secretary of Defense for Research and Engineering |
| PEOs | Program Executive Offices |
| PIC | Photonic Integrated Chip |
| PMR | Program Management Review |
| R&D | Research and Development |
| RF | Radio Frequency |
| RH | Radiation Hardened |
| ROI | Return on Investment |
| S&T | Science and Technology |
| SAF/AQ | Secretary of the Air Force for Acquisition |
| TCO | Transformational Capabilities Office |
| TEMP | Tissue Engineered Medical Product |
| TPS | Thermal Protection Systems |
| TRL | Technology Readiness Level |
| TTP | Technology Transition Plan |
| USC | United States Code |
| 3D | Three Dimensional |



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OSD DOPSR case #23-S-0480 (23 November 2022)