

STELLAR TEAM

NOBLE MISSION



MDA Engineering Overview

To: MDA University Innovation Summit (UIS)

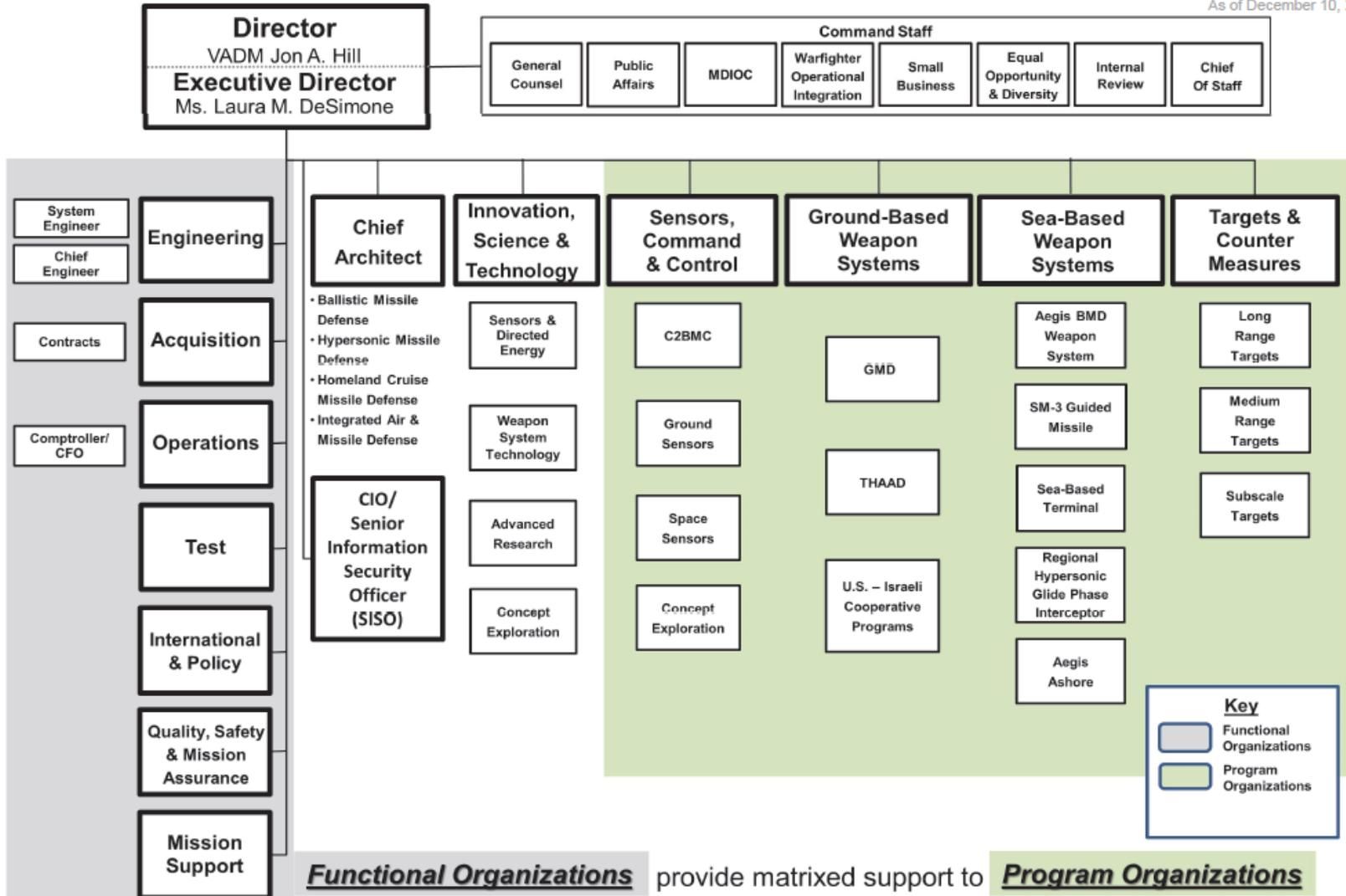
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Missile Defense Agency

As of December 10, 2020



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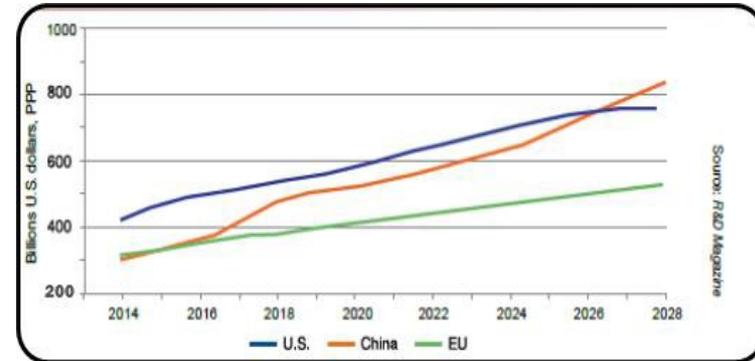
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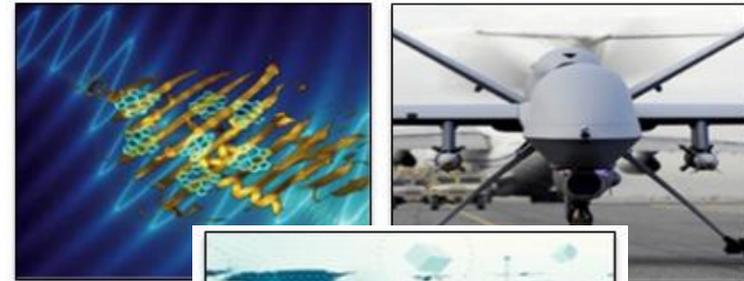
The World Today

Technology is Transforming the Battlespace

- **Proliferation of knowledge and offensive technology has eroded US historic advantages**
 - Increasing systems capabilities
 - Advanced production capabilities
 - Driving lower costs
 - Decreasing the “time to market”
- **Increased rate of investment in military R&D from near-peers**
- **Increasingly Competitive National Security Technical Environment**
- **Equal access to emerging technologies, such as autonomy, artificial intelligence and synthetic biology, will disrupt future conflicts**
- **The U.S. still possesses the best military, however our adversaries’ deliberate actions mandate change in what we buy and how we operate**



“China’s 2017 (R&D) growth is basically twice the percentage change and twice the dollar amount of change as the growth forecast for the U.S.’s 2017 R&D spending”



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Need to Modernize

- We must develop new lethal capabilities and accelerate the pace in which we get that capability to the warfighter
- We must ensure sufficient domestic industrial capacity to support DoD requirements across all of the services
- New technologies must be matured and transitioned to fielded systems regularly to permit the missile defense enterprise to keep up with advances in threat systems



To provide for our national security, America's manufacturing and defense industrial base must be secure, robust, resilient, and ready.



MDA Engineering Mission

- **Leads Missile Defense System (MDS) technical design and development, engineers and manages its integration and testing, and verifies and assesses its performance**
- **Provides integrated, multi-disciplinary technical intelligence to leadership and program managers**
- **Provides functional management of the Engineering and Technical Intelligence workforce**
- **Improves performance and reliability through improvements in design, test, manufacturing, and processes; within the MDS, Program Elements and Industry Partners**
- **Identifies and helps resolve technical issues in developing, testing, and fielding; works with academia and labs to identify technology opportunities**
- **Leads Engineering Technical Readiness Reviews**

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Capability Evolution by Epoch

Near Term Today - 2025

- Expanded THAAD
- Homeland defense (LRDR, Initial mid-term discrimination)
 - Initial hypersonic tracking & display
- Add'l mid-term discrimination
- Add'l hit assessment
- Expanded hypersonic tracking & reporting
- Improved sensing
- Updated layered homeland defense

Mid Term 2025 - 2035

- Add'l mid-term discrimination; homeland & regional threat space updates
- Accelerate demo, development & fielding of an HGV defense architecture with Glide & Terminal Defeat solutions
- Address most critical deficiencies in deployed weapons & sustain/increase capability
- Field a missile defense architecture that stresses all three phases of flight for the adversary: boost, midcourse/glide, & terminal
- Integrate automated engagement/ battle management into MDA's architecture
- Cruise Missile Defense architecture solution
- Integrate international partners' BMD sensors & weapon systems to extend sensor coverage, increase BMDS raid capacity, and reduce burden on the United States

Far Term 2035 - 2045

- Global layered missile defense to defeat all types of threats in all phases of flight
- Broaden capabilities
- Global integrated
- Substantial reduction in cost of weapon system production & ownership
 - Build to replace – shorten technology refresh cycle
 - Advanced manufacturing techniques & assembly lines
 - Automation, streamlined logistics, design for maintenance, & anomaly resolution
- Increased international burden sharing to increase coverage, persistence, & raid capacity
 - Integration of Allied sensors, weapons, & C2 assets
 - Relaxation of restrictions on data exchange



MDA/DE Research Needs (1 of 2)

R&D in technologies that enable concepts with new and enhanced capabilities to meet evolving missions, e.g.

Sensors and Phenomenology	Directed energy and space sensor technology, advanced and non-traditional radar technologies, threat signatures, aerothermochemistry, robust sensing in a contested environment
Kinetic interceptors	Boost-phase, air/space-based, multiple kill vehicles, hypersonics, radiation hardening, lethality, survivability
Non-kinetic Weapon Technologies	High power, diverse frequencies, electronic protection
Information processing and communications	Advanced networking resiliency concepts, algorithms, networking, RF/Lasercomm transmissions and beamforming, radiation hardening, optical computing, C2 algorithms for a contested environment
Decision Science	Multi-sensor data integration / fusion, target classification / identification, robust tracking / fusion algorithms, multi-domain battle management, many-on-many engagement planning for defense against hypersonic raids
Cyberspace	Active cyber defense, attack mitigation, cyber resiliency, cyber survivability, multi-domain security
Hypersonics	Thermal management, novel control methods, communications through challenging environments, high strength / low weight materials



MDA/DE Research Needs (2 of 2)

R&D in technologies that enable concepts with new and enhanced capabilities to meet evolving missions, e.g.

Power	Generation, storage, conversion, thermal management, high power/high current
Microelectronics	Assured design/pedigree, inherently secure, fault tolerant / radiation hardened advanced microelectronics
Materials	Electronics, photonics, fault tolerant / rad hard optics, advanced materials and manufacturing technologies, additive manufacturing of all materials and/or components
Propulsion and energetics	Shipboard safe controllable propulsion, increased rocket efficiency, insensitive munitions, energetic materials
Artificial Intelligence and Machine Learning (Automation)	Automation concepts for Command and Control / Battle management and defensive cyberspace operations, other potential applications of AI across missile defense missions (e.g. see Decision Science topics on previous slide)

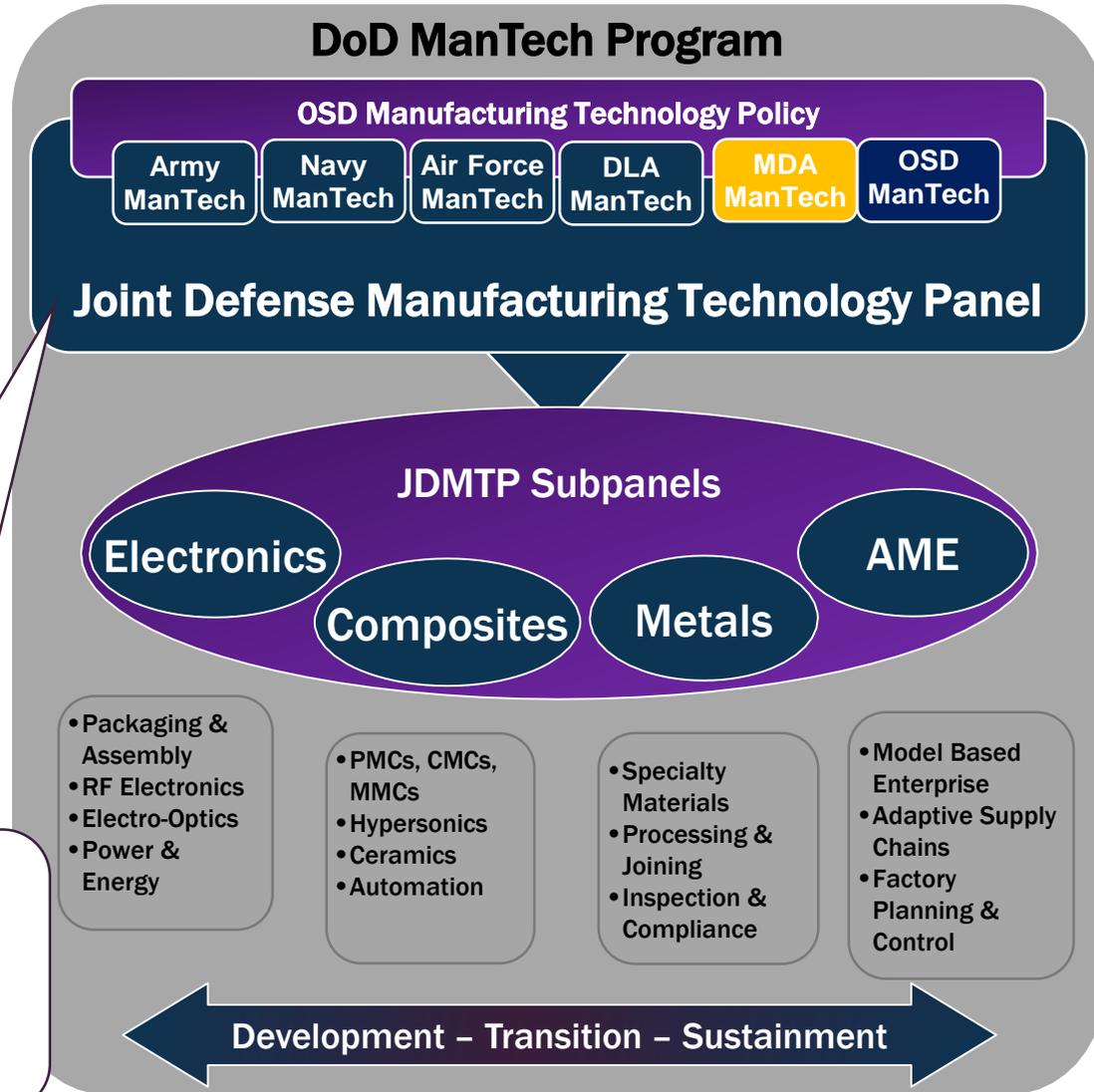


MDA Manufacturing Technology Program

DoD/MDA ManTech is a Congressionally Mandated Mission

- Crucial transition link between technology invention and industrial applications
- ManTech transitions TRL4-6 to TRL-7-8
- Key to affordable and timely acquisition and sustainment of weapon systems and components
- Overall \$300M in annual investments across DoD

- Represent Component requirements and S&T developments
- Joint strategic planning
- Optimize investments and reduce duplication
- Develop Joint Technology Pursuit Areas (JTPAs)





Manufacturing Technology Supports MDA Systems

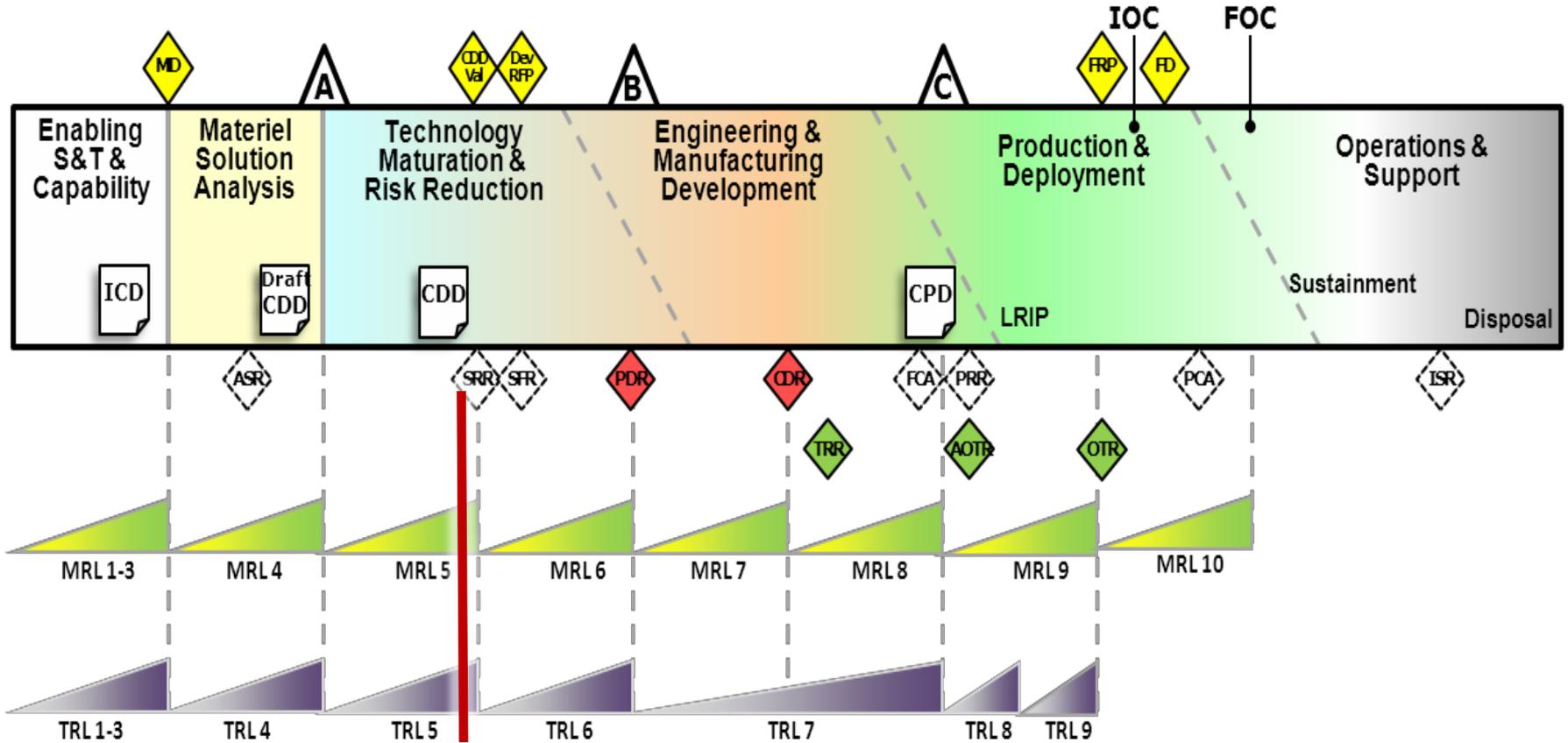
Missile Defense mission presents unique manufacturing challenges

- **Long service life**
 - Components may be fielded for 20+ years with limited opportunities for scheduled maintenance
- **Extreme operating environments**
 - Missile launches and exo-atmospheric regime stress hardware and materials
- **Limited pre-launch system testing capability**
 - “One shot” devices like thermal batteries and explosive components must perform flawlessly the first time
- **Limited payload sizes**
 - Increasing functionality requirements and payload quantities require continual miniaturization
- **Limited system quantities**
 - Increasing threat numbers means every interceptor must function perfectly

Manufacturing Excellence Helps Mitigate Operational Challenges



Technology Transition/TRL to MRL Relationship



TRL5-6 Inflection Point –transitions from mostly S&T to mostly ManTech

MRL and TRL development must occur concurrently, to support Transition to MDA Programs



Manufacturing Technology Focus Areas

- **Advanced Manufacturing Enterprise**
 - Certification of Additive Manufactured components
 - Space technology (electronics, cryocoolers, solar, etc)
- **Metals**
 - Additive Manufacturing (AM)
 - High temperature alloys
 - Novel use of historic alloys for AM
- **Electronics**
 - AM printed sensors/electronics
 - Next Generation RF chips
 - Integrated cooling for RF components
- **Composites**
 - High Temperature Ceramic Matrix Composites
 - Faster and cheaper production
 - Thermal protection materials
- **Other**
 - High power Directed Energy components
 - Low Size, Weight, and Power (SWAP) components
 - Adaptive Optics
 - System health monitoring
 - Production/Manufacturing efficiency improvements



Questions

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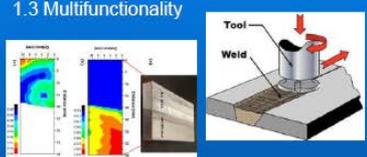


MDA Materials and Manufacturing Processes (MM&P) COI

- The MDA MM&P COI is an active member of the larger DoD MM&P COI.
- The COI enables cross-government (MDA, AF, Army, Navy, DLA, and NASA) meetings to enhance collaboration on materials research across the government agencies and services.
- Road mapping and collaboration efforts are pursued in the following Technical Area Teams (TAT's):

1. Structures and Protection

- 1.1 Platform
- 1.2 Survivable Structural
- 1.3 Multifunctionality



Tool
Weld

2. Propulsion and Extreme Environments

- 2.1 Missile Propulsion
- 2.2 Hypersonics
- 2.3 Reactive/Energetic
- 2.4 Turbine Propulsion
- 2.5 EM Launch/Guns



3. Sensors, Electronics, and Photonics

- 3.1 Sensors
- 3.2 Next Generation Devices
- 3.3 EM Transparencies
- 3.4 Photonics



4. Power and Energy

- 4.1 Power Generation and Energy Conversion
- 4.2 Energy Storage
- 4.3 Power Control and Distribution
- 4.4 Fuels



5. Readiness

- 5.1 NDE/I
- 5.2 Prognostics
- 5.3 Wear Resistance, Hard
- 5.4 Repair

Coatings, Fluids, and Lubricants



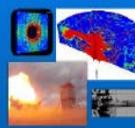
6. Individual Warfighter

- 6.1 Warfighter Protection
- 6.2 Warfighter Enhancement
- 6.3 Materials for Logistics
- 6.4 Bio/Bioinspired Materials



7. Civil Engineering

- 7.1 Expeditionary and Fixed Facility Protection
- 7.2 Force Projection and Maneuver
- 7.3 Resilient Critical Infrastructure



8. Corrosion

- 8.1 CPC Performance Prediction
- 8.2 Real Time Condition Assessment
- 8.3 Advanced Materials and Processes
- 8.4 Scientific Advances to Existing Processes





MDA ManTech Program

• Alignment with DoD ManTech Strategy

- MDA Directive 4200.01 Signed by MDA Director establishes policy to conduct a ManTech program consistent with DoD policy and strategy
- Identify, initiate, and monitor manufacturing technology projects to support economical and timely acquisition and sustainment of weapon systems
- Advance the maturity of manufacturing processes to accelerate their progression from research and development to implementation
- Partner with OSD and other DoD services and agencies on ManTech projects whenever possible to reduce cost and risk

• Program Guidance

- MDA's ManTech Council (MTC) collaborates with MDA Program Offices to ensure the alignment of the ManTech project planning process with Agency objectives and priorities, and recommends ManTech projects and resources

Mission

Address manufacturing challenges to help reduce cost, improve manufacture cycle time, increase performance, and accelerate development of MDA weapons systems.

MDA ManTech Council plans to execute its mission by partnering with Program Executive Offices, Directorates, and external offices