Navy ManTech Program

Institute for Manufacturing and Sustainment Technologies (iMAST)

NSRP Sustainment Panel Meeting

March 12, 2024

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PE 0603680N – Manufacturing Technology (ManTech)

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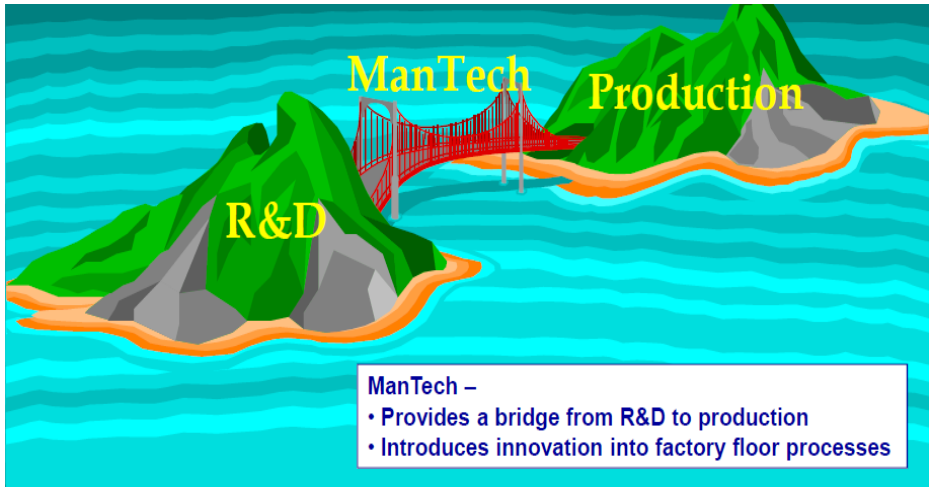
- **Established USC Title 10, Section 4841**

- **Mission:** Industrial Preparedness
  - Development of enabling manufacturing technology -- new processes and equipment -- for implementation on DoD weapon system production lines
  - DoD 4200.15 states investments should:
    - Transition emerging S&T results to acquisition programs
    - Improve industrial capabilities in production, maintenance, repair and industrial base responsiveness
    - Advance manufacturing technology to reduce cost, improve performance, and responsiveness

- **Execution:**
  - ManTech Centers of Excellence (COEs)

- **POCs:**
  - ONR Program Officers / COEs



FY25 Investment Strategy

Investment Strategy Updates:

- Highlighting PEO IWS efforts for ship platforms currently supported by Navy ManTech
- Highlighting sustainment across all platforms
- Added Future (Major) Acquisition Platform Support to Capability Acceleration thrust areas

FY25 Investment Strategy

1. Major Acquisition Platform Affordability and Sustainment

PEO SSN	PEO SSBN	PEO Ships	PEO Carriers	PEO USC	PEO JSF
VIRGINIA Class	*COLUMBIA Class*	*DDG 51 Class*	*CVN 78 Class*	*FFG 62 Class*	*F-35*

PEO IWS (*Integrated Warfare Systems*)

2. Capability Acceleration – enhancing / expediting the use of new technologies in the fleet

Thrust Areas			
-	Sustainment Technology	-	Unmanned / Autonomous Vehicle Production
-	Energetics Production Support	-	Directed Energy
-	Advanced Submarine Technology Fabrication	-	Hypersonics Fabrication
-	Future (Major) Acquisition Platform Support	-	Other ONR Manufacturing Maturation

Navy ManTech Organization

Code 33 – Sea Warfare and Weapons Department

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Gina Walker
Ellen Reed
Megan Gavarkavich
Stephanie Marsh
Stephen Gilligan
Kassia Rivera
Joana Haizel-Cobbina
Contracts – ONR Code 253

Dr. Thomas Fu
ONR 33 Department Head

Dr. Jennifer Wolk
Code 332 – Adv Naval Mat'ls and Systems Division Director

Sarah Mitchell
Denise Piastrelli
Karen Brown
Gabe Puente-Lay
Prince Adu-Jamfi
Matt Vincent
Bill Palko
Don Szczur
Allegient Defense Team

Neil Graf
ManTech Lead / Program Officer
Composites Manufacturing Lead

COR:
- CMTC
- EMTC

ManTech Portfolio Manager:
- Capability Acceleration
- Air Platforms (Affordability)
- Ship Platforms (Affordability)

JDMTP Navy Principal / JDMTP Chair

Scott Bartlett (NSWC-CD)
CMTC Technical / Programmatic Support
JDMTP Composites Subpanel - Chair

Paul Huang
Program Officer
Manufacturing Enterprise Lead

COR:
- NSAM
- iMAST

ManTech Portfolio Manager:
- Sustainment

JDMTP AME Subpanel

Tech. Advisory Committee Representative
- MxD / Mfg Institutes

Guest Researcher at NIST

Dr. Jeffrey Farren
Program Officer
Metals Manufacturing Lead

COR:
- CNM

JDMTP Metals Subpanel

NSWCCD Coordination

6.2 Development Lead

William Crespo
Program Officer
Electronics Manufacturing Lead

COR:
- EMC/EMPF
- EOC

ManTech Portfolio Manager:
- PEO (IWS)

JDMTP Electronics Subpanel Chair

Legend
- ONR
- Detailee / Tech Support
- Contractor Support

FY25 Investment Strategy

- **Centers of Excellence (COEs)**
  - Execute projects and manage project teams
  - Collaborate with acquisition program offices / industry to identify and resolve manufacturing issues
  - Develop and demonstrate manufacturing technology solutions for identified Navy requirements
  - Facilitate transfer of developed technologies

CNM Center for Naval Metalworking	Center for Naval Metalworking (CNM)
CMTC Composites Manufacturing Technology Center	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

Focus on Implementation

- ManTech, alone, cannot ensure implementation …
  - Need ONR / COEs / industry / Program Office all working together
- Technology Transition Plans (TTPs) for each project
  - Upfront agreement by all parties as to required actions / responsibilities from technology development through implementation (includes required resources for implementation)
  - Signed by Navy ManTech, COE Director, Industrial Facility Management, Program Office, and, if appropriate, the government technical authority
- Implementation Risk Assessment / Management Process
  - Recognize risks to implementation upfront and assess / manage through project execution
  - Risks discussed during Program Reviews to ensure ManTech on same page as acquisition / industry stakeholders

ManTech goal is technology implementation

iMAST Introduction

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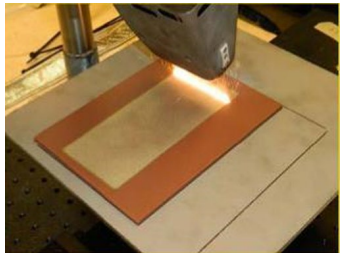
Institute for Manufacturing and Sustainment Technologies (iMAST) was established at ARL in February 1995 as one of the Navy ManTech program's Centers of Excellence (https://www.arl.psu.edu/imast/).

iMAST is a matrix organization executing ONR ManTech projects using ARL Materials and Manufacturing engineers and staff.


iMAST provides a focal point for the development and transition of cost saving ***Manufacturing Technology*** innovations, processes, hardware and software. Eligible platforms include CVN, VCS, CLB, DDG, FFG, and F-35.

iMAST supports the Navy with life cycle cost reduction projects within the ***Repair Technology*** (RepTech) program in support of shipyards and DON depots across the Navy's repair enterprise; NAVSEA, NAVAIR, MARCOR.

iMAST supports ***Capability Acceleration*** projects aimed at maintaining the Navy's technical superiority. Projects include new combat capability and sustainment initiatives with OEM's, public and private yards.

iMAST Technical Thrusts

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- iMAST areas of expertise cut across all of ARL Penn State's Materials and Manufacturing competencies
- Specific areas of expertise include:
  - Materials Science, Processes Development, and Characterization
    - Additive Manufacturing
    - Laser Processing
    - Advanced Composites / Hybrid Materials
    - Ceramics
  - Coating formulations (Cold Spray, Thermal Spray, and Electroplating)
  - Surface preparation, Coatings Removal, and Preservation
  - Complex System Health Monitoring and Condition Based Maintenance
  - Non-Destructive Testing/Inspection
  - Modeling and Simulation for Process, Design, and Manufacturing
  - Logistics and Applied Enterprise Systems
  - Component Analysis and Design
  - Prototype Fabrication

iMAST Success Stories

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- Selected projects have broad applicability across the shipbuilding and repair/sustainment community
- Projects categorized by:
  - Materials and Manufacturing Process Development
  - Advanced Manufacturing Enterprise
  - Repair/Sustainment Technologies
  - Relevant non-ManTech technologies and success stories

Materials and Manufacturing Process Development

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S2823 Laser Ablation of PCP from HSLA Steel

Pre-Construction Primer (PCP), must be removed prior to welding. Current methods, including needle guns and handheld or walk-behind grinders, are laborious, dangerous, and can cause material erosion

Objective: Develop and demonstrate laser ablation technology for the (semi- or fully-) automated removal of PCP from HSLA steels used in Navy ships.

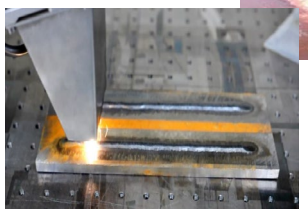
Team: iMAST, HII-NNS, PMS 379, ONR

Achievements: Completed and receipted TWH approval on qualification test plan; Completed parameter development and initiated testing; Optimized processing with new optic to expand range of processing conditions and prepared final test specimens (tensile, bend, and fatigue)

Focus Platform: CVN

Status: Active Project

Savings: $~15M (5-year)



RT2837 Submarine Large Diameter Ball Valve Improvement

The coating on large submarine valve balls is failing prematurely resulting in emergent repairs at significant cost. Damage to the surface finish of the valve ball coatings requires a full restoration.

Objective: Evaluate ceramic coatings with an overcoat for hydraulically actuated valves with high torque output; Identify the contributing coating system deficiencies (porosity, density, uniformity, adhesion, microstructure, friction, etc.) and the failure mechanism of the ceramic/ coated and Teflon coated Titanium valve balls and their repair processing parameters

Team: iMAST, GDEB, PMS 450, PMS 397, ONR

Achievements: Conducted spray trials to optimize parameters for required thickness, adhesion, and surface roughness; Developed durability test plan for Phase 2 execution; Preparing coated valve ball for durability test at GDEB

Focus Platform: VCS/CLB

Status: Active Project

Savings: $>175M (5-year)

RT2998 – SPEE3D for Rapid, Low Cost Additive Manufacturing of Navy Components

Shrinking casting supply chain is resulting in longer lead times and higher cost for casting parts for both VCS and CLB submarine programs

Objective: Develop the cold spray additive manufacturing process for three different material / components using the SPEE3D system and transition the process to the Navy or supporting industry.

Team: iMAST, NAVSEA05T, PMS450, PMS397, ONR

Achievements: Initial candidate components identified (Al-6061, Al-Bronze, 70/30 CuNi) for fabrication and test; Performance requirements established with NSWCCD; Custom powders delivered and prepared for initial fabrication; Phaser nozzle installed for processing of harder materials

Focus Platform: VCS/CLB

Status: Active Project

Savings: $>4M (5-year)

Advanced Manufacturing Enterprise

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S2957 Automated Product and Asset Tracking

During ship construction, modules and units must be lifted and moved throughout the shipyard. An accurate estimate of the weight and center-of-gravity (CG) is needed to ensure that the lifts and moves are safe and within capabilities of the resources.

Objective: Develop and transition a tool that more accurately estimates the weight and CG of a module as it moves throughout the stages of construction. The tool was developed as an improved tracking and information management tool that can accurately integrate with existing processes and information-management software.

Team: iMAST, Fincantieri Marinette Marine, PMS 515, ONR

Achievements: Evaluated alternative asset and item tracking tools and determined that the best approach was to develop a software tool that integrates design information with the planning and execution system to provide near real-time status of completed work to inform the weight and CG calculations

Focus Platform: FFG 62

Status: Pending Implementation

Savings: $5.6M (5 year)

S2963 Predictive Maintenance II Industrial Internet of Things

Critical path manufacturing assets have the potential to experience catastrophic failure despite preventative maintenance (PM) programs, resulting in unnecessary repair costs, lost production time, and rework.

Objective: Supplement conventional Predictive Maintenance methods (wired sensors, manual data collection) with advanced industrial internet of things (IIoT) technology to automatically communicate impending faults/failures; Follow on to S2750 Diagnostic Monitoring of Equipment &Capacity Planning

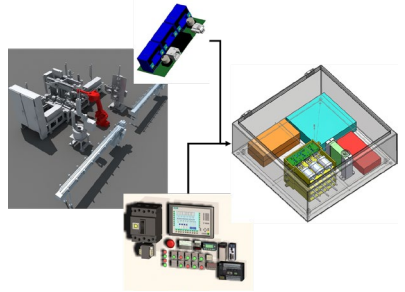
Team: iMAST, GDEB, PMS 450, PMS 397, ONR

Achievements: Identified critical pending faults in initial effort and avoided catastrophic failure; Completed Failure Mode and Effects Analysis; Developed decision matrix for evaluating hardware options; Addressed cybersecurity requirements for wireless condition sensing; IIOT pilot ongoing at GDEB

Focus Platform: VCS/CLB

Status: Active Project

Savings: $6.9M (5-year)



S2919 Drone Photogrammetry

Current photogrammetry inspections in submarine construction require the use of vertical manlifts and manual capture of images, resulting in disruptive module movement to prepare for inspection

Objective: Develop and demonstrate a drone outfitted with a photogrammetry camera and active gimbal system that can pan/tilt to capture required images and provide visual feedback.

Team: iMAST, GDEB, PMS 450, PMS 397, ONR

Achievements: Developed and conducted 4 system tests with drone and vibration analysis testing with GSI Camera; Demonstrated remote control and live stream of Nikon to laptop using CamRanger2 and backup shutter using Velo FreeWave; Conducted team drone pilot training; Conducted prototype drone photogrammetry evaluation with GDEB pilots; Completed final demonstration in late 2023

Focus Platform: VCS/CLB

Status: Pending Implementation

Savings: $2.1M (5-year)

Repair / Sustainment Technologies

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RTR2948 Shaft Blasting with Ultra-High Pressure Water Jets

Removal of GRP shaft coatings must occur at the beginning of the overhaul process. Conventional methods for shaft blasting include manual water blasting (lancing) to remove coatings but due to hazards, exhaustion, unpredictable production rate, and difficulty containing hazardous waste, shipyards began experimenting with mechanized systems to improve production and the work environment.

Objective: Create a purpose-built, minimal version of the mechanized water blasting tool carrier delivered with the Dual-Track system previously developed by the iMAST.

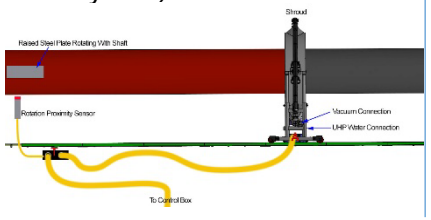
Team: iMAST, PNSY, ONR

Achievements: Developed hardware prototype shaft blasting system with integrated, protective shroud; conducted training events at PSNSY (all yards) and PNSY;

Focus Platform: VCS, CVN, SSBN

Status: Implemented (3 of 4 Navy SYs)

Savings: >60% reduction in in cost; ~70% reduction in cycle time



RT2964-2 S51 Motor Generator Rewind Optimization

Rewinding Closed Slot Motor Generators is a labor and time intensive process that requires significant rework. 80% of motor rewinds fail to pass qualification tests. Mean motor rewind experiences 3.1 failures before an acceptable build is produced

Objective: Reduce the time and cost required to rebuild motors and motor generators. The greatest benefits are achieved through a modified fabrication process/tooling which not only reduces the original labor required for a rebuild, but reduces the likelihood of a rework.

Team: iMAST, PSNSY, ONR

Achievements: Developed improved dacron slot-filling process; Identified methods for slot protection during rewinding; Began development of low-cost tooling for coil forming

Focus Platform: CVN, 688, SSGN, VCS

Status: Active Project

Cost Avoidance: $1.9M

RT2935 Cold Spray for CVN Sustainment

Many critical components no Navy ships have zero or limited repair reparability using conventional weld build-up. Weld repair can result in part distortion and extensive machining causing delays in returning parts to service, or total scrapping.

Objective: Develop repair processes for critical CVN components that have corrosion, wear, or other surface damage using Cold Spray-Based processes. Reduce repair time, eliminate part distortion, and improve system availability.

Team: iMAST, NAVSEA 05, PMS 378, ONR

Achievements: Developed approved Qualified Spray Procedure (QSP) for the CVN shaft rotating coupling covers; QSP recommendations for additional components developed; Repairs of RCCs completed at NAVSEA Cold Spray Pop-up Cell in Chesapeake, VA

Focus Platform: VCS/CLB

Status: Implemented

Multifunctional Automated Repair System

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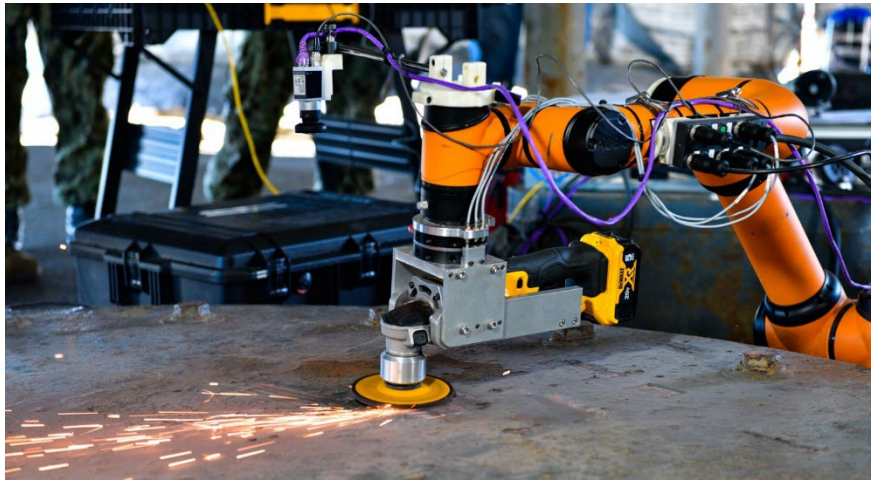
- Multifunctional Automated Repair System (MARS) provides an automated, turn-key, fully portable preparation, repair, and inspection capability for emergent facilities including forward operating bases, ships, and shipyards
- System is configurable for a variety of repair applications from in-theatre battle damage repair to shipyard maintenance
- Currently Developing >10 End Effectors on Quick Change Fittings with Automatic Tool Recognition
  - Scanning/Sensing: LiDAR, Thermal Imaging, Gas Sensing, and HD Camera
  - Surface Preparation: Grinder, Plasmablast, and Laser Ablation
  - Repair: Cold Spray, Welding, Laser Deposition, and Paint Touch-up
  - Inspection: Ultrasonic, Eddy Current, and X-ray Fluorescence (XRF)
  - Expandable for additional end effectors; robot agnostic
  - Quick change fittings allow for tool changes in seconds
  - User interface and control system adaptable to different robots with dynamic surface following
- Easily-configurable solution ships in as few as 4 Pelican cases; full system ships in 20' Conex container; Nitrogen Generator ships in additional 10' Conex container
- Video tutorials and augmented reality (AR) for quick, effective training and fielding
- MARS team seeking additional use cases and demonstration opportunities
- PSU ARL working with NAVSEA to transition technology to the DoD

2021 NCMS CTMA Technology Competition Overall Winner

https://www.ncms.org/ncms-announces-overall-and-peoples-choice-winners-2021-ctma-technology-competition/
https://www.psu.edu/news/research/story/applied-research-laboratory-wins-award-innovative-approach-maintenance
https://www.youtube.com/watch?v=BHAxVrll0F8

MARS Grinding Paint and Rust



Sailors Using Second Robot

Magnetic Base

COLD SPRAY
ADOPTION AND IMPLEMENTATION ACROSS NAVSEA AND THE DOD

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- NAVSEA is a DOD leader in Cold Spray implementation – ROI realized through repairs
- Cold Spray is a solid-state metal deposition technology to produce coatings or parts
- PSU ARL transitioning Cold Spray technology to NAVSEA and DOD – developed NAVSEA-approved cold spray training
- PSU ARL developed and rapidly fielded the Multifunctional Automated Repair System (MARS) which enabled expeditionary repairs
- Pop-up Cells operated by VRC Metal Systems in Chesapeake, VA and San Diego, CA
- Evaluating SPEE3D Cold Spray Additive Manufacturing (CSAM) for expeditionary AM part production

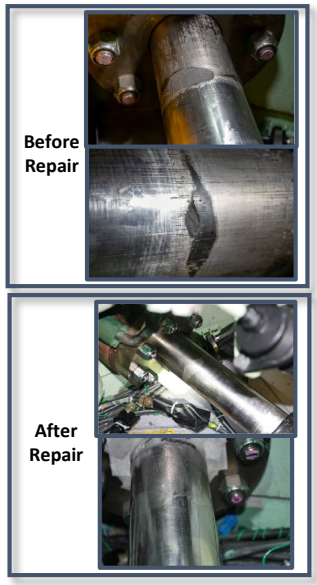
NAVSEA Cold Spray Training at PSU ARL

MARS Fielding Demonstration At REPTX

VRC Pop-up Cell in VA

SPEE3D Cold Spray AM

- First shipboard Cold Spray repair in US Navy history performed onboard a Submarine asset
- Avoided 5 month unscheduled dry docking
- Component showed crevice corrosion damage
- Repair need identified September 2022
- Cold Spray executed November 2022
- Rapid turnaround enabled by expeditionary Cold Spray repair equipment development
- Onsite team of NAVSEA, NNSY, PSU ARL, NRL, EBC, SSGR – 8 days to complete repair



- Largest Cold Spray repair in US Navy history – over 220 lb powder flowed to complete repair
- Completed repair of two rudder stocks for USS ESSEX – reduced technical risks of weld repair and cut down undocking delays by >24 days
- PSU ARL-developed MARS used for repairs
- VRC-developed prototype powder feeder hardware allowed for completion in ~24 hours of total spray time – 4 days to complete repair
- Onsite team of NAVSEA, MARMC, SWRMC, PSU ARL, VRC Metal Systems, and BAE Systems

Points of Contact
NAVSEA 05T1: Dan Stanley (daniel.p.stanley.civ@us.navy.mil), Jeff Campbell (jeffrey.d.campbell.civ@us.navy.mil)
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VRC Metal Systems: Aaron Nardi (Aaron.Nardi@vrcmetalsystems.com)

Questions?