Navy ManTech Program

Institute for Manufacturing and Sustainment Technologies (iMAST)

NSRP All Panel Meeting

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iMAST Introduction

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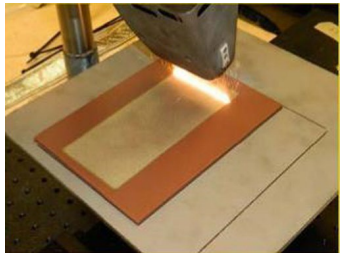
Institute for Manufacturing and Sustainment Technologies (iMAST) was established at ARL in February 1995 as one of the Navy ManTech program's Centers of Excellence (https://www.arl.psu.edu/imast/).

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.

Penn State Applied Research Laboratory

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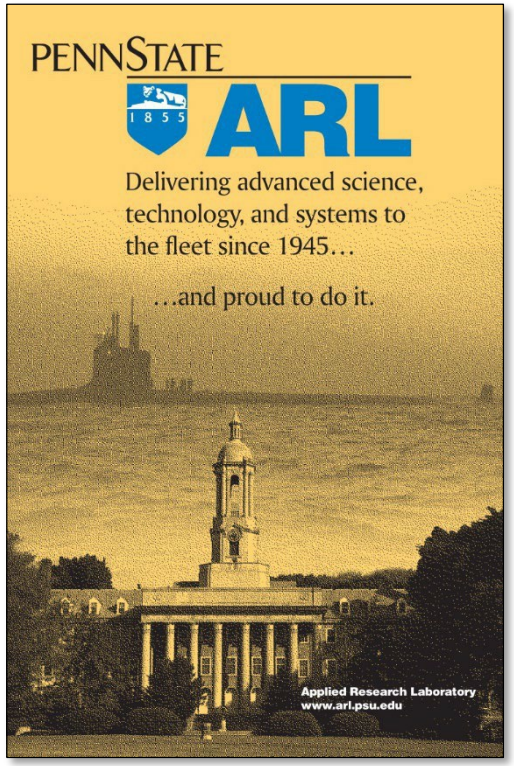

As a DoD designated University Affiliated Research Center (UARC) ARL Penn State …

"… maintains a special long-term strategic relationship with DoD."

Characteristics of this relationship include:

- responsive to evolving needs
- comprehensive knowledge of needs and problems
- access to information and proprietary data
- corporate knowledge and technical memory
- objectivity and independence from commercial interests
- quick response capability
- current operational experience
- freedom from real and perceived conflicts of interest

UARC: 10 USC 2304 (c)(3)(b) *"…to establish or maintain an essential engineering, research, or development capability to be provided by an educational or a federally funded research and development center and are designed UARC by the Director, Defense Research and Engineering (DDR&E)."*

Core Competencies include Materials and Manufacturing Technology

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**
- **Material and Material Process Development**
- **Material Characterization**
- **Coating Formulations**
- **Logistics/Enterprise System Software**
- **Complex System Health Monitoring**
- **Modeling and Simulation for Process, Design, and Manufacturing**
- **Component Analysis and Design**
- **Prototype Fabrication**

iMAST Success Stories

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- Selected projects have broad applicability across the shipbuilding and repair community
- Highlighted projects presented this week at the NSRP All Panel Meeting
- Projects categorized by:
  - Materials and Manufacturing Process Development
  - Advanced Manufacturing Enterprise
  - Sustainment Technologies

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 preliminary parameter development and initiated testing; Optimizing processing with new optic to expand range of processing conditions

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

Focus Platform: VCS/CLB

Status: Active Project

Savings: $>175M (5-year)

RT2019 TR-343 Isolation Ring Modernization

The legacy piezoelectric ring stacks in the TR-343 transducers rely on outdated materials and processes in addition to a shrinking commercial base. The material used is prone to reduced yield and failure.

Objective: To improve the isolation capabilities of the TR-343 piezoelectric ring stack through process and/or material improvements.

Team: iMAST, NSWC Crane, ONR

Achievements: Improved the manufacturability of the TR-343's isolation ring by investigating improved materials and processes to replace outdated practices; Developed an alternative isolation capability by combining two components, the isolation and centering rings, into one insulation component without degrading the transducers acoustic performance.

Focus Platform: DDG AN/SQS-53 hull mounted sonar system

Status: Implementation pending

Savings: $23M (5-year)

Advanced Manufacturing Enterprise

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S2797 Production Bill of Material Quality Assurance Using Artificial Intelligence

A ship's production/manufacturing bill of material is a complex hierarchical data structure. Due to this complexity and inability to identify through manual analysis, errors are inherently introduced, resulting in production disruption, incorrect part routing and excessive handling, and manufacturing rework.

Objective: Develop an Artificial Intelligence (AI) and Machine Learning (ML) based software application that integrated with live enterprise planning data and automatically detects patterns and anomalies with the PBOM data.

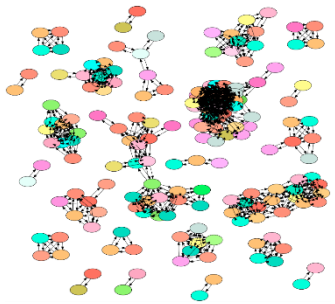
Team: iMAST, GB-BIW, PMS 400D, ONR

Achievements: Web-based, production-ready application developed and transitioned to BIW for PBOM error detection and dispositioning; Generalized approach allows for additional use cases

Focus Platform: DDG 51

Status: Implemented

Savings: $4.2M (5 year)



S2963 Predictive Maintenance II Industrial Internet of Things

Critical path manufacturing assets that 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

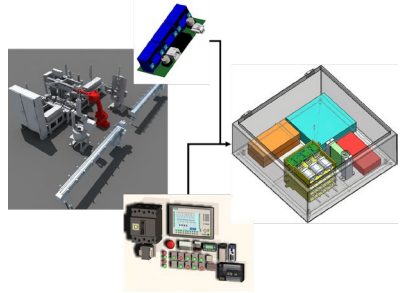
Team: iMAST, GDEB, PMS 450, PMS 397, ONR

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; Addressing cybersecurity requirements for wireless condition sensing.

Focus Platform: VCS/CLB

Status: Active Project

Savings: $7.1M (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 and 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; Preparing final demonstration in early 2023

Focus Platform: VCS/CLB

Status: Active Project

Savings: $3.8M (5-year)

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.

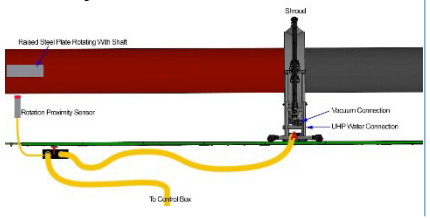
Team: iMAST, PNSY

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



RT2682 Improved Low Loss Launch Valve (ILLLV) Plug Maintainability Improvement

ILLLV Plugs are removed from service when their diameter drops below minimum. Thin bond coat requires substrate material removal, thus limiting the number of possible repair cycles.

Objective: Develop an improved coating system that is more durable to cracking and resulting corrosion (less repairs), and has thicker bond coat allowing for less removal of substrate material (longer service life).

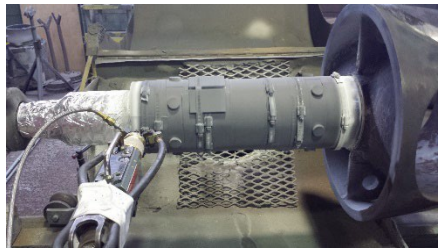
Team: iMAST, GDEB, PMS 450, PMS 397, ONR

Achievements: Developed optimized three part thermal spray coating system with thicker bond coat; NAVAIR Lakehurst certified a commercial vendor to conduct ILLLV plug repairs

Focus Platform: CVN

Status: Implementation Pending

Cost Avoidance: $4.5M



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

Achievements: Developed approved Qualified Spray Procedure (QSP) for the CVN shaft rotating coupling covers; QSP recommendations for additional components developed.

Focus Platform: VCS/CLB

Status: Implementation at NAVSEA Cold Spray Pop-Up Cell pending NNS approval

iMAST Key Staff and Contact Info

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Thank you, and enjoy the 2023 NSRP All-Panel Meeting!