CTMA CONNECTOR

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Innovative Engine Coatings to Reduce Maintenance Costs

P7

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NATIONAL CENTER FOR MANUFACTURING SCIENCES

CTMA Connector

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UPCOMING EVENTS

January 16-18, 2024
NCMS Technology Showcase: Pearl Harbor Naval Shipyard

March 20-22, 2024
Acceleration Summit – NCMS Technology Showcase
Newport News, VA

March 26-28, 2024
NCMS Industry Day at AMC Modernization Symposium
Huntsville, AL

May 7-9, 2024
CTMA Partners Meeting
Providence, RI

June 11-13, 2024
2024 Cold Spray Action Team
Worcester, MA

All NCMS events are subject to change. Please check the NCMS Events page for the latest updates. Don't hesitate to email eventsupport@ncms.org with any questions.

About NCMS

The National Center for Manufacturing Sciences (NCMS) is a cross-industry technology development consortium, dedicated to improving the competitiveness and strength of the US industrial base. As a member-based organization, it leverages its network of industry, government, and academic partners to develop, demonstrate, and transition innovative technologies efficiently, with less risk and lower cost.

About CTMA

The CTMA Program offers a unique contracting vehicle for industry, academia, and the DOD sustainment community to work collaboratively. Through these efforts they promote the demonstration, evaluation, and validation of new and innovative technologies that enhance warfighter readiness at optimal value and lowest risk. This non-FAR based contracting vehicle is the only DOD-wide program focused solely on maintenance and sustainment.

Advanced data analytics toolsets have been developed through a CTMA project to improve decision-making for workload planning, asset tracking, supply chain management, sustaining intellectual capital, and in-service logistics engineering. (US Marines photo by Sgt. Richard Blumenstein.)

DOD-Industry Collaboration Creates Analytics Tools to Optimize Maintenance and Sustainment

The Department of Defense (DOD) has access to virtually unlimited data regarding the past and present health and sustainment efforts of its assets, but this information is largely housed in disparate systems. Historically, analysis and visualization of this data occurred in stovepipes, inhibiting cross-organizational communication. To optimize maintenance and sustainment, it is essential to integrate these numerous datasets into single-source systems. To accomplish this objective within a number of DOD units, multiple DOD partners utilized the CTMA Program to collaborate on a project: Leveraging Data Analytics to Support Maintenance and Sustainment Activities.

"We started with what we saw as a relatively finite problem that we quickly saw was more encompassing than we had imagined," said Rob Willis, Vice President of Acquisition Support and Program Management at Andromeda Systems Incorporated (ASI), an industry partner on the project. "When we started, we had a more limited scope. We began by looking at the COMFRC [Commander Fleet Readiness Centers] enterprise and how that repair system is operating, but we ended up with 12 program offices within the Naval Aviation Enterprise being part of our project, so we really expanded our horizons. We looked at data across the entire integrated maintenance and supply chain."

The project brought together over 15 entities, including the Navy, Naval Air Systems Command (NAVAIR), COMFRC, Naval Supply Systems Command (NAVSUP), the Air Force, the Marine Corps, and the Defense Logistics Agency (DLA), plus industry partners Andromeda Systems Incorporated (ASI), Naval Systems Incorporated (NSI), Deloitte Consulting, VT Group, RTR Technologies, Systems Planning and Analysis, Razorleaf, and Saddle Butte.

Throughout three and a half years, the project team demonstrated over 150 prototyped analytics toolsets that are currently being utilized across five focus areas: workload planning, total asset visibility, supply chain management, sustaining intellectual capital, and in-service logistics engineering. These areas operate interdependently to provide the capabilities required to produce, maintain, and repair aircraft, engines, components, and support equipment for supported Naval Aviation Enterprise (NAE) operational users.

For workload planning, the team created a tool that predicts flight schedule execution based on maintenance capacity, training, qualifications, and equipment availability.

"Particularly in the COMFRC, there is a projected schedule of components, aircraft, and engine support equipment

that turns into a workload plan, which starts the process for ensuring that the right people, parts, skill sets, and capacities are aligned," said Willis. "All those factors need to be in place when a particular component shows up. The prototype we created pulls in the Naval Supply Command forecast schedule, artisan qualifications, manning documents, and gross demand plan for materiel, and puts all of that into a capacity optimizer to identify shortfalls and what we need to put into place to make sure we have the required support."

The team also created a dashboard visualization tool that provides total asset visibility (TAV) of all supplies at the retail and wholesale levels. This tool provides real-time visibility of component repair processes and materiel, and develops prioritized workloads based on readiness constraints. By providing metrics, the tool facilitates timely and accurate decision-making, optimizing the supply chain and minimizing aircraft downtime.

> **"The most successful outcome of this project is the ability to perform what-if scenarios with regard to repair capability and capacity across the organic depots."**
>
> *– Rob Willis, ASI*

"One of the 'what-if' analyses that we ran at the FRCs during COVID-19 was this: If Covid became worse, and we had to send home every employee over a certain age, what would that do to our productivity?" Willis said. "This tool enabled us to understand what would happen to the workforce if we had to shut down or limit the number of personnel performing repairs in the FRC."

To improve supply chain management, the team developed a web-based dashboard tool for consolidated tracking of supply chain management issues managed by the various supply chain processes at the program office, NAVSUP, and DLA. They also developed improved supply chain forecasting capabilities and techniques that are better aligned to the demand signal from Organizational-level (O-level) and Intermediate-level (I-level) repair sites.

"NAVSUP had a tool called supply end-to-end; they took a look at all levels based on 'stock on hand' and 'stock on order'," said Willis. "We wanted to see how materiel availability affects repair capability, so we built analytics tools. One tool identified discrepancies in the gross demand plan. Our tool found that adjusting replacement factor, lead times, and buffer stocks ensure that maintainers have what they need."

The team also conducted a fishbone analysis—a visualization tool for categorizing the potential causes of a problem that helps to identify a problem's root causes. Furthermore, the team improved the sustainment of intellectual capital by creating a tool to help identify the proper mix of labor qualifications, certifications, and training for personnel.

"We learned in phase one that it's not as easy as identifying that we have five artisans and three have college degrees; they have qualifications and certifications that expire on certain days," said Willis. "The workforce in our military is very dynamic, and it's important to capture the skills. In the second phase of this project, we're lining up the projected workload with materiel planning and resource planning. For example, if we have a 67-year-old artisan, the tool will ensure that there's someone else in the pipeline to get trained."

The project's final task—improving in-service logistics engineering—developed tools that identify the linkage between engineering, provisioning, failure, and material consumption data, as well as maintenance feedback to improve support for all levels of repair activities.

"The results of this task have unlimited potential to impact how aircraft work is scheduled and performed in the FRC of the future," said Willis.

While this project had multiple positive outcomes, one result in particular stands out.

"The most successful outcome of this project is the ability to perform what-if scenarios with regard to repair capability and capacity across the organic depots," said Willis. "That doesn't exist anywhere else, and this is a brand-new capability that we hope to utilize not only in the Navy but to brief OSD and try to get this in the Army and Air Force. We believe that the power of being able to quickly identify the impact of resource allocation is what the entire DOD needs."

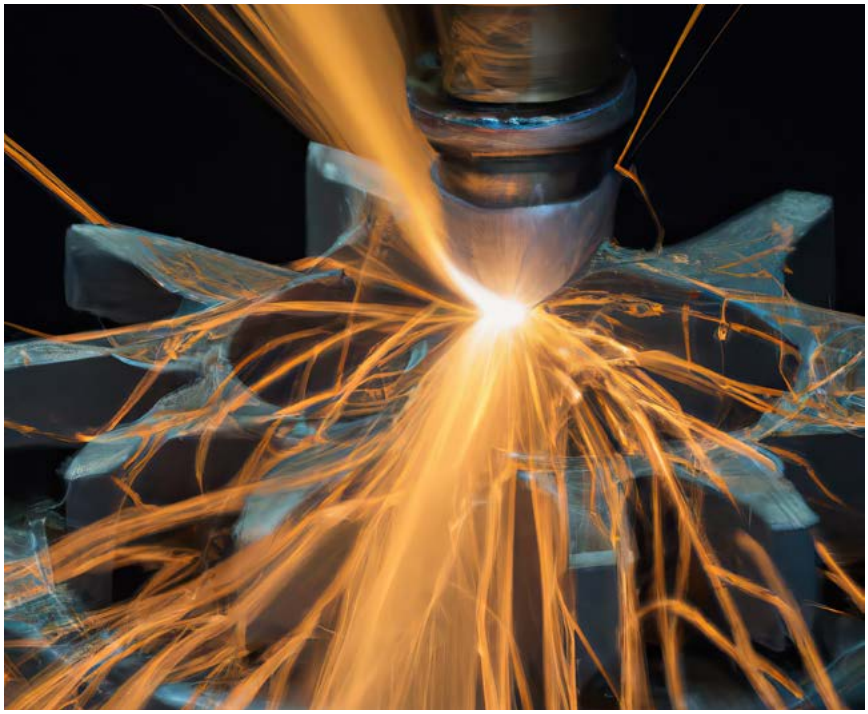
The tools created and lessons learned in this project can transfer to multiple industries, as many companies face the same challenges as the DOD: establishing a quantifiable and sustainable methodology for determining resource requirements, acquiring those resources, and ensuring optimal utilization of those resources.

The project's success has led to a second phase, which is ongoing. Currently, the team is at work expanding the demonstrations and continuing to integrate data into single-source systems so that DOD leadership at all levels will have the ability to collaborate more effectively to meet operational requirements. ■

Metal AM Parts Produced to Meet DOD Qualification and Certification Standards

Metal additive manufacturing (AM) is a game-changing technology with extensive applications in the defense, aerospace, industrial, maritime, automotive, and medical sectors. A current challenge with AM is establishing metal AM part qualification and certification processes to ensure that parts are safe, reliable, and cost-effective. The CTMA Program has been working on establishing common standards and formats to qualify and certify large metal AM parts for use in equipment and products across commercial and military sectors.

A current CTMA project—Qualification and Certification of Metal Additive Manufacturing to Replace Hard-to-Source Repair Parts—is additively manufacturing three components from problematic castings that have limited or extinct sourcing within the United States. The project team is focused on ensuring that AM can be effectively used as an alternative to casting and forging in the DOD sustainment supply chain.



Wire-arc directed energy deposition (DED) is the best-suited process for the production of large metal parts because the process has high deposition rates, and less feed material is required to complete the print in comparison with other AM methods. (Photo by Shutterstock.)

The project combines the expertise of DOD and Department of Energy (DOE) entities—the US Army Research Laboratory; US Army Combat Capabilities Development Command, Ground Vehicle Systems Center; US Naval Surface Warfare Center, Carderock Division; and Oak Ridge National Laboratory—along with several industry partners: Solvus Global, Materials Resources, and Carver Pump.

The project team began with an intensive study of legacy components.

"We looked at legacy components to establish how their atomic arrangements, what we call microstructure, was done using legacy methods," said Ayman Salem, Ph.D., President, Materials Resources, LLC (MRL). "We provide tools and methods that use a combination of advanced microscopy and models to help with understanding the relationship between the atomic arrangement of the 3D printed parts and the properties needed to accomplish the mission required. We work from the atomic level up to the components level. We provide the research collaborators, as well as the government, the data to decide which process in the 3D printing method can be used to maintain the integrity of the atomic level, regardless of the number of parts and the geometry of the part."

All properties of the final part tie back to the arrangement of atoms and inherent defects. Understanding the atomic structure provides insights into corrosion performance, mechanical properties, and even potential failure mechanisms.

The team additively manufactured multiple parts used in titanium gate valves, which are fluid control devices used in naval assets and in other industries such as petrochemical, agriculture, and industrial processing. Along with these parts, the team manufactured and machined several components for use in combat vehicles, artillery, and munitions for the Navy, Army, and the Program Executive Office Soldier (PEO Soldier).

The team used wire-arc directed energy deposition (DED) to additively manufacture the components. Wire-arc DED is a process where metal wires are melted during deposition using focused thermal energy from gas metal arc welding (GMAW), gas tungsten arc welding, or plasma arc welding (PA). The arc-welded

layers are deposited on top of one another to form three dimensional parts. Widely utilized in the defense, aerospace, and energy industries, wire-arc DED is the best-suited process for the production of large metal pieces because the process has high deposition rates, and less feed material is required to complete the print in comparison with other AM methods such as powder bed fusion.

"Wire-arc DED is a scalable solution that has an envelope, at the moment, of nearly two meters, by two meters, by two meters of volume with arrangements to increase size further, which is significantly larger than a powder bed facility," said Scott Hruzd, Principal Manufacturing Engineer, Solvus Global. "Wire-arc DED doesn't require a fully enclosed system and doesn't produce nearly as much waste as powder bed fusion. With wire-arc DED, you build it as you go, more along the lines of a printer that's an off-the-shelf unit."

MRL's Dr. Salem agrees regarding the power wire-arc DED can offer to AM parts production.

"Wire-arc DED is crucial to reduce the cost and to increase the volume of the products, using commercial off-the-shelf wires and robotic arms," said Dr. Salem. "We are supporting Solvus Global using wire-arc DED and we are working on wire laser directed energy deposition. The combination of these two is a good replacement for forgings and castings that will never fit inside a powder bed machine."

> **"Wire-arc DED is crucial to reduce the cost and to increase the volume of the products, using commercial off-the-shelf wires and robotic arms."**
>
> *– Dr. Ayman Salem, MRI*

The team has finished additively manufacturing the components. Currently, they are investigating and documenting material property data for AM-fabricated components, in particular the fatigue properties that are of critical importance for system safety.

"To achieve successful replacement for forgings and castings, we need to look not only at the shape, which is the form and the fit, we have to look at the functionality," said Dr. Salem. "A major element of the functionality is the atomic arrangement—how the atoms inside the materials are arranged after wire-arc DED, compared to forgings and castings. Based on that, we will have a good estimate of whether a replacement component will meet, the form, fit, and functionality. A lot of people can meet the form and the fit. The functionality is very crucial, especially in some of our DOD applications, and in particular Navy applications for our ships and warfighters."

The project team is ensuring that the AM parts, produced with commercial pure (CP) grade 2 titanium, meet DOD standards.

"We have taken the time to create all the documentation required for certification," said Hruzd. "It's a roadmap of how the parts will be qualified and acceptable for the Navy's certification process."

This documentation includes a data package describing material properties, the AM methods used, and potential applications for additional transition demonstrations.

The project team expects that, when the work is completed next year, the lessons learned will be further utilized to enhance the qualification and certification of AM components across the DOD. The use of AM will provide on-demand production, simplifying logistical demand planning forecasts and increasing weapon system availability.

The findings from this project will also be examined for how they can be implemented in multiple commercial industries using metal AM to fabricate spare parts that are no longer being mass-produced by conventional manufacturing techniques. With large metal AM, there is potential for a significant reduction in the length of supply chains as it offers manufacturing capabilities at regionally located, decentralized sites. This will minimize supply chain complexity, lower transportation costs, and reduce equipment downtime.

While the project is not scheduled to wrap up until September 2024, the work has already been successful, and the team is optimistic about the results.

"With NCMS, we had a tremendous amount of collaboration from each of the team members," said Hruzd. "Without that, we wouldn't be as successful as we have been so far. Continued collaboration will be critical for the success of getting products into the hands of the appropriate people." ■

A US Marine Corps avionics technician works on a CH-53K King Stallion at Marine Corps Air Station New River in Jacksonville, NC. (US Marines photo by Cpl. Makayla Elizalde.)

Innovative Engine Coatings to Reduce Maintenance Costs

When aircraft operate in harsh environments—especially oceanic and desert climates—their engines are subjected to sand, dust, and saltwater ingestion. This presents challenges for the maintenance professionals tasked with keeping both military and commercial aircraft engines in first-rate condition. The ingestion of harmful debris can cause erosion of airfoils, accumulation of sand and dust in cooling and flow path surfaces, corrosion, and the degradation and spallation of thermal protection coatings.

To solve these problems, NAVAIR utilized the CTMA Program to partner with GE Aviation on a project: Demonstration of Coating Techniques for Reduced Engine Maintenance Costs. The team applied GE Aviation's advanced engine coatings to several components of the T408 engine, which powers the Marine Corps' CH-53K King Stallion heavy-lift helicopter.

This initiative was the first-ever evaluation of these coatings in an operating environment relevant to the T408, as well as many other aircraft throughout the DOD and the commercial airline industry.

"In this effort, we advanced the technology readiness level of advanced coatings and demonstrated them on a military application," said Nathan Jones, Turboshaft Senior Basic Design Engineer – Naval Air Warfare Center Aircraft Division. "This opens the door for other military applications to look into adopting the technology and incorporating it—and that's across DOD, not just Navy."

The project team completed successful acceptance testing at NAVAIR and validated the technologies to Technology Readiness Level (TRL) 6 for this class of engines operating in austere environments. Achieving a TRL 6 is a major step up in a technology's demonstrated readiness. To achieve this level of maturity, the technology must be successfully tested in a high-fidelity laboratory environment or in a simulated operational environment.

The project applied three of GE Aviation's coating solutions—Thermal Barrier Coating (TBC) Slotting, TBC Shield, and next-gen TBC—to selected components of the T408 engine. These coatings prevent what is

known as "CMAS attack." CMAS stands for Calcium–magnesium–alumino-silicate, and CMAS attack occurs when atmospheric dust that has been deposited on the surface of turbine blades melts and wicks into the columns of the thermal barrier coatings (TBCs). This occurs at temperatures above 1240°–1260°C and results in the degradation of the columnar microstructure of the TBCs.

The three GE Aviation coatings selected for this project are CMAS-resistant. TBC Shield is a method of applying CMAS reactive particles to either coating or deposit surfaces. The CMAS reactive particles interact to change the properties of the deposits, leading to decreased CMAS infiltration into the TBCs. TBC Shield modifies sand, dust, and salt deposits to promote shedding of the deposits, thereby reducing deposit thicknesses.

"The TBC Shield technology is essentially a sacrificial coating that is applied on top of the TBC that interacts with the sand and salt to promote spallation," explained Jones. "It protects the base coating itself. After the shield wears away, it can be reapplied. Next-gen TBC is a surface treatment on top of a traditional thermal barrier coating that serves to help prevent the damage from dust, sand, or saltwater buildup from attacking the base coating."

> **"The TBC Shield technology is essentially a sacrificial coating that is applied on top of the TBC that interacts with the sand and salt to promote spallation [and] protects the base coating itself."**
>
> *– Nathan Jones, Naval Air Warfare Center Aircraft Division*

The third technology demonstrated in this project, TBC Slotting, is a method of machining the TBC to reduce strains within the coating and to stop the propagation of spallation, decreasing spall sizes.

"TBC Slotting is actually putting slots into the coating itself," said Jones. "The idea is that if the TBC starts to degrade, it'll spall in a very small section versus growing over a larger surface."

The team prepared an engine test vehicle to demonstrate coating technologies. They began with an engine teardown, a labor-intensive process that disassembled the engine into its separate components so they could apply the coatings on the first stage turbine nozzles and blades.

Then, they took those treated components and rebuilt a test engine to conduct a military durability test—a field mission-based test that simulated the various levels and concentrations of sand and saltwater ingestion encountered during fleet operations.

Next, the project conducted the acceptance test procedure (ATP), which achieved excellent results.

"The team found that the coatings conformed to NAVAIR quality standards," said Jones. "We've verified the technology readiness level (TRL) 6, for operating in the thermal conditions that we run our engines."

After this verification, the project moved onto its second phase when the team shipped the engine to the Navy for environmental testing, which is currently in process.

"The second phase involves running an environmental endurance test where we are exposing the coatings to mission-representative thermal cycles, with sand and saltwater ingestion, to see how the advanced coatings hold up in that environment," said Jones.

While the tests are still in process, the coating technologies hold promise for potentially expanded use in both airfoil and combustor TBCs. The coatings could also potentially be transferred into other coating systems such as environmental bond coats, which are typically used on ceramic matrix composite (CMC) components, and often used in applications requiring reliability at high temperatures that are beyond the capacity of metals.

These coatings have great potential benefits for the commercial airline industry, along with other industries utilizing aircraft. The coatings are expected to improve turbine engine performance—especially for operation in austere environments. This is critical for industries that depend on aircraft to deliver essential commodities such as medicine, supplies, fuel, and other important goods and services to remote areas that are near saltwater, or subject to heat, sand, and/or dust.

For the DOD, the coatings are expected to decrease TBC-coated hardware-related maintenance in sandy and corrosive saltwater environments to be nearer that of the clean environments. The advanced coatings are ultimately expected to reduce life cycle costs, increase DOD aircraft operational flexibility, decrease engine downtime, and improve readiness. ■

A container with an ADDiTEC ElemX liquid metal 3D printer is transferred aboard the amphibious landing dock USS San Diego (LPD 22) at Naval Base San Diego. Installation of the ElemX by NPS's Consortium for Advanced Manufacturing Research and Education (CAMRE) allows for further testing and evaluation of 3D printing capabilities in an at-sea environment. (US Navy photo.)

First-Ever Additive Manufacturing Printer Deployed on a US Naval Vessel Prints Hundreds of Parts

The Naval Postgraduate School (NPS) has partnered with ADDiTEC to speed the deployment of additive manufacturing (AM) to improve the readiness of frontline naval vessels. This partnership is familiarizing students, who are active duty officers from all branches of the military, with ADDiTEC's ElemX printer housing liquid metal jet technology.

In addition to NPS, additional units are being prepared for shipboard deployment to gather additional feedback for development. This follows a previous deployment on board the USS Essex (LHD 2) during the multinational Rim of the Pacific exercise in July 2022.

The ElemX printer uses aluminum alloy wire, which is both inexpensive and corrosion resistant. A spool of aluminum wire is loaded into the machine, then fed into a heated reservoir of about 4 milliliters in volume, which can reach temperatures above 800 degrees Fahrenheit. A graphite nozzle deposits molten metal droplets onto a build plate at high frequency; this nozzle can deposit up to 400 droplets per second. The build plate sub-system is designed to have motion in both X and Y directions. There is a wire feeding system in place which continuously feeds the aluminum wire as needed.

After the part is designed and verified for printability, it is sliced using a proprietary software and loaded onto the printer's computer for printing/manufacturing. As liquid metal drops coalesce on the heated substrate, the part builds, layer upon layer, until completion. Small parts take approximately an hour to build. When the part is complete, a technician removes the build plate and quenches it in a water tank to release the part from the build plate. The part is in hand within a few minutes of printing, unlike many other known additive manufacturing processes.

This technology is more cost-effective than using custom metal powders and does not require facility

modifications or personal protective equipment. Additionally, the ElemX printer necessitates minimal post-processing and provides a faster print-to-part production timeline. The technology is best suited for small- to moderate-sized parts.

"In the case of Navy, the technology has to be specific to Naval applications/requirements: ability to print on board ships at high seas with acceptable accuracy will be one of many. So, the technologies that we are developing are geared towards enabling such capability," said Satyajeet Sharma (Jeet), Senior Manager of System Testing, Quality, and Customer Service at ADDiTEC.

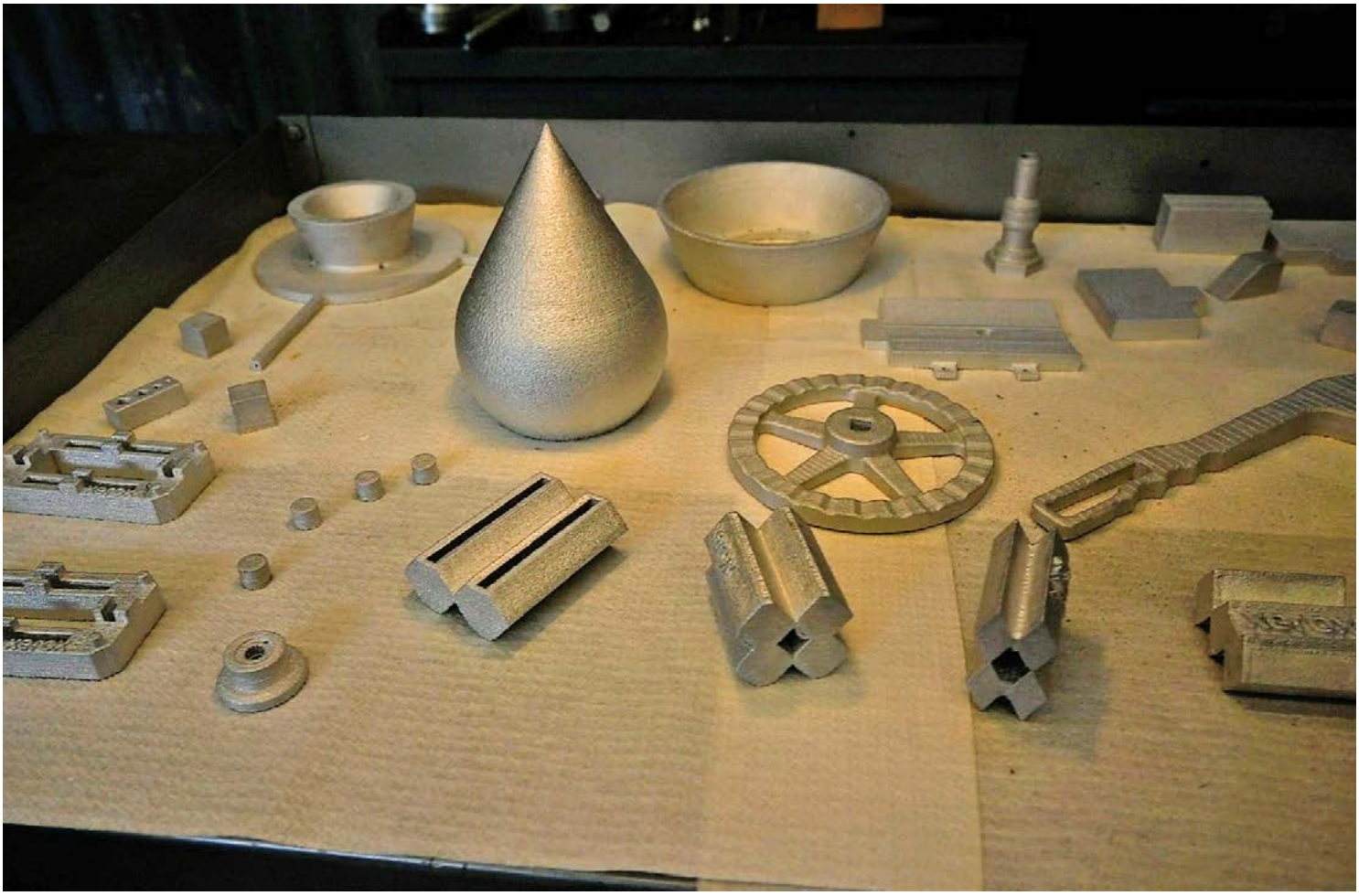
The ElemX printer could also be used on land, in forward-deployed locations, where warfighters need to be able to sustain and maintain equipment in the field for lengthy periods while potentially being cut off from supply chains.

This project addresses three key initiatives outlined in the DOD Additive Manufacturing Strategy: modernizing national defense systems to improve performance using AM-designed components; increasing materiel readiness to rapidly prototype and produce direct parts, thereby reducing the risk of obsolete hardware; and enabling warfighters to employ innovative solutions on the battlefield through AM capabilities.

Furthermore, the project allowed NPS to train sailors, marines, and graduate students on use of the ElemX and the ability to produce AM parts rapidly.

As the technology continues to develop, additive manufacturing will benefit a wide range of industries including aerospace, transportation, heavy equipment, and oil & gas.

"There is a lot of research and development going on from materials, hardware engineering, and software sides, to make this technology more user friendly and suitable for industrial manufacturing," said Jeet Sharma. "The more we collaborate, share, and bring young talent into AM workforce, will enable the AM ecosystem to thrive." ■



Aluminum parts printed by ADDiTEC's ElemX 3D Liquid Metal Printer in the Large Experiment Annex at the Naval Postgraduate School (NPS), which is the first site to receive installation of this new technology. (US Navy photo by Specialist 2nd Class Daniel C. Coxwest.)

Attendees at the 2023 NCMS Technology Showcase held at Puget Sound Naval Shipyard viewed technology displays and demonstrations highlighting the capabilities of 49 exhibiting companies. (Photo by NCMS Staff.)

World-Class Exhibitors Demonstrate Innovations at Puget Sound Naval Shipyard

A packed crowd of over 700 attendees gathered at the NCMS Technology Showcase at Puget Sound Naval Shipyard and Intermediate Maintenance Facility (PSNS & IMF) from September 27 to 28, 2023 to view and test out innovative maintenance and sustainment technologies demonstrated by 49 world-class exhibitors.

Held at the Kitsap Conference Center in Bremerton, WA, this showcase provided an unparalleled opportunity for industry partners to spotlight innovations and to hear directly from maintainers about challenges they would like help solving. PSNS requires a wide range of capabilities to provide high-quality, on-time maintenance, modernization, recycling, and support to ensure America's dominance at sea. These capabilities include 3D printing, blockchain, cybersecurity, machine learning, product lifecycle management (PLM), structural health monitoring, laser ablation, HAZMAT logistics, scanning and measurement tools, AI, tool repair, and many more.

Industry partners demonstrated technologies in multiple focus areas that were specifically requested: Advanced/Additive Manufacturing; Business IT and Analytics; CBM+/Predictive Maintenance; Coatings and Corrosion Prevention; Enhanced Inspection; Energy, Environmental, Health, and Safety; and Reliability Improvement (Hardware).

Multiple exhibitors expressed appreciation to have such broad access to maintenance practitioners and decision-makers all in one location.

"The NCMS Technology Showcase at Puget Sound Naval Shipyard offered InfoTech NorthStar (ITNS) the chance to showcase our Advanced Testing Technologies to a wide array of personnel from maintainers, to engineers, to program-level managers and project leads," said Nolan R. Wright, PE, Vice President of Operational Technology and Quality Assurance, InfoTech NorthStar, LLC. "It was a fantastic opportunity and we met and demonstrated to dozens of people. We are looking forward to discussions with several of these people at the next scheduled showcase in Honolulu," Wright said. His company, InfoTech NorthStar, is a full-service operational technology and information technology

engineering company that develops innovative testing tools and technologies for digital systems.

This event provided an intimate setting for industry partners to meet with key Navy decision-makers and to potentially work with the PSNS & IMF Technology Insertion Group, which is committed to transitioning needed technologies into the shipyard.

"Demonstrating at the NCMS Technology Showcase at Puget Sound Naval Shipyard has helped us gain traction with key decision-makers and move business forward," said Ivan Barrow, Account Manager-Technical Sales, FARO, which provides 3D measurement, imaging, and realization technology. "It's been valuable in giving clarification of contacts within departments and facilitating important conversations. I can confidently say that the showcase has been a key component to our recent success with the shipyard," Barrow said. FARO provides 3D measurement, imaging, and realization technologies that enable customers to measure their world quickly and easily, creating data that help to make smarter decisions faster.

"Demonstrating at the NCMS Technology Showcase at Puget Sound Naval Shipyard has helped us gain traction with key decision-makers and move business forward. I can confidently say that the showcase has been a key component to our recent success with the shipyard."

– Ivan Barrow, FARO

Another industry demonstrator, Floyd Martin, President of Greasweep, LLC, found the NCMS Technology Showcase to be so useful that he registered for the next one as well.

"This was our first NCMS Technology Showcase and it was a great experience," said Martin. "Meeting Steve McKee, the Director of Maintenance Technologies in the DOD, was the highlight of the show. I also had the pleasure to meet the NCMS leaders and learned the history and goals of NCMS. We have registered to attend the upcoming NCMS Technology Showcase at Pearl Harbor Naval Shipyard in January 2024," he said. Greasweep provides a fast and efficient process for cleaning up all liquid spills with custom-made containers to house and transport nuclear and liquid hazardous waste.

The team at Laser Photonics observed that NCMS's partnership with PSNS helped to provide a bridge between industry and the US Navy.

"Working with the NCMS team at the recent PSNS Technology Showcase was amazing," said Bryan Lee, Federal/DOD Account Manager at Laser Photonics. "Their team, as always, created the perfect bridge and forum between the DOD/federal ecosystem and Laser Photonics. Through this partnership, we were given the stage to exhibit, discuss, and demonstrate our products that are critically needed in the US Navy and DOD MRO commands. Working with NCMS has been a home run and we are excited about the bright future ahead," Lee said. Laser Photonics provides industrial-grade laser equipment, offering a full product line of standardized and specialized laser systems in the Clean Technology space.

To view the complete exhibitor directory, please visit https://www.ncms.org/events/ncms-technology-showcase-puget-sound-naval-shipyard-intermediate-maintenance-facility-imf/#exhibitor-directory.

NCMS would like to thank the entire PSNS & IMF team for their tireless efforts to make this event a great success. The shipyard's leadership supported maintainers who saw capabilities that might help them solve problems and accomplish work more safely and effectively by providing them with specific information about how to get these capabilities approved brought into shipyard to help support the mission.

The PSNS Public Affairs Office created a video that demonstrates the impact of the event. View the video here: https://www.ncms.org/ncms-technology-showcase-post-event-coverage-includes-psns-video. ■

FEATURED NEW MEMBERS

Astrolabe Analytics

Astrolabe Analytics works to accelerate battery innovation. The company services engineering teams in fields such as automotive and electric vehicles, aerospace, grid storage, and many more by providing solutions for battery health, safety, and predictive maintenance. Astrolabe has been funded by the US Air Force and the National Science Foundation to develop best practices for operating, maintaining, and retiring battery systems in electric aircraft and other applications where battery safety is mission critical. For full profile, see: https://www.ncms.org/astrolabe-analytics/.

Eontes Corporation

Eontes' (ee·aan-tuhs) core mission is to foster strategic alliances with enterprises, with the goal of empowering them to fully unleash the potential of their investments in their digital transformation and product life-cycle management (PLM) endeavors. This goal aligns with the genesis of Eontes' brand story, highlighting the convergence of advanced next-gen technology (EON) with its commitment to providing transformation enterprise solutions (TES). Located in Corsicana, Texas, with a global engineering talent pool, Eontes is a small disadvantaged business (with HUBZone HQ) that provides product engineering, manufacturing execution, and sustenance and support. For full profile, see: https://www.ncms.org/new-member-spotlight-eontes-corporation/.

Machina Labs

Machina Labs' manufacturing platform is the first and only commercially available robotic sheet-forming technology. By combining the latest advances in robotics and AI, the company rapidly forms and finishes large, complex, curved sheet metal parts without any custom tooling. Machina Labs serves multiple industries including defense, aerospace, automotive, electronics, and heavy machinery. Providing toolless sheet metal forming, scanning, finishing, and more, Machina Labs makes the development, production, and sustainment life cycle of vehicles, aircraft, and equipment faster and more cost-effective. For full profile, see: https://www.ncms.org/machina-labs/.

Main Sail

Main Sail is a nontraditional, veteran-owned small business focused on Maintenance and Logistics Optimization (MLO) for the federal government. The company's passion is to combine emerging technologies with process excellence to improve effectiveness and readiness for federal agencies with maintenance and logistics missions. Main Sail specializes in leading complex projects that integrate industrial engineering, maintenance and logistics expertise, and digital technologies to model, analyze, and optimize operational environments and processes. For full profile, see: https://www.ncms.org/new-member-spotlight-main-sail/.

Max^3 LLC

For over 35 years, Max^3 LLC has built custom plastic molds for multiple industries including the aerospace and commercial airline industry. Max^3 has the capabilities to provide high-tech precision tooling for the DOD, including engineering, reverse engineering, prototyping, cutting, welding, laser scanning, 3D capabilities, small-run production, sampling, and tryouts. The company produces thermoplastic injection molds, die-cast dies, injection thermoset and compression molds, and extrusion blow molds. Their glass encapsulation capabilities can serve the Navy, particularly for submarine maintenance and sustainment. Their capabilities for commercial airline fulfillment can serve multiple solutions. As a woman-owned business, Max^3 has several sister companies: Maximum Mold, Max^2 LLC, and Magnum Manufacturing. For full profile, see: https://www.ncms.org/max%c2%b3llc-new-member-spotlight/.

Pentecom

Pentecom is a full-service technical data consulting and document conversion partner, creating innovative solutions for business, industry, and US and international military customers across the globe. The company recently achieved HUBZone certification by the Small Business Administration. Pentecom's team includes subject matter experts who have in-depth knowledge of multiple sectors including military branches, defense contracting, and technical publication. Combined, their background includes influential roles in S1000D, along with a multitude of military specifications and standards. Pentecom continues to impact the technical data community and the standards that guide it. The company led the US adoption of S1000D, an international specification for the production of technical publications. For full profile, see: https://www.ncms.org/pentecom-new-member-spotlight/. ■