Dana Ellis, NCMS

TECHNOLOGY TRANSITION FOR 'PUBLIC GOOD'

One of the biggest impacts the CTMA Program delivers is that all initiatives have a focus on contributing to the public good and the ability to transition technology to benefit the general public. The military has a long history of developing and transitioning technology the public depends on such as weather radar, digital photography, the early Internet, GPS, and other inventions that have all profoundly enhanced our daily life.

"Achieving 'public good' is ultimately about transitioning military technology and benefits to industry and to the general public. The broad scope of these benefits are at the heart of the CTMA Program," said Debbie Lilu, Vice President Maintenance & Sustainment Business Development, NCMS. Some examples of these benefits include the reduced cost of goods, increased quality, job training, job creation, mitigation of environmental impacts, and workplace/public safety.

Understanding the industry's perspective on public good opportunities is vital to technology transition. In industry, the business case analysis is usually the most important element considered. Determining a technology developed by industry is sufficiently ready or mature to transition to the government or the general public, the Technology Readiness Level (TRL) is accessed and a transition plan developed for that technology. A transition plan is very detailed and requires a clear assignment of responsibilities, resources, and

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>
> -DEBBIE LILU, NCMS

communication with the end users. Demonstrations that show the benefits of technologies are key to transferring these solutions from the DOD organizations to the enterprise level. Without demonstrations and evaluations, there is a higher risk of non-implementation from the military and a lower chance of technology transition benefiting the general public.

Two CTMA initiatives that were recently completed are delivering public good benefits: *Intermittent Fault Detection & Isolation System* (IFDIS) and *Adapting Blockchain Technology for Additive Manufacturing (AM)*. IFDIS participants included Naval Surface Warfare Center (NSWC) Crane, the Joint Intermittence Test (JIT) Working Group, and Universal Synaptics. A host of participants were also involved in the Adapting Blockchain Technology for AM collaboration. Government partners included the Naval Undersea Warfare Center (NUWC) Keyport, Marine Corps Fabrication Lab, AMRDEC, Fleet Readiness Center (FRC) Southwest, Tinker Air Force Base, OSD-MPP/CIO, and the Rapid Tech Transition Office. The industry partners who participated were Moog, Guardtime Federal, Identify3D, and Microsoft.

IFDIS – Solving No Fault Found (TRL 9)

The IFDIS 2.0™ and portable Intermittent Fault Detector™ (IFD) are designed to address intermittent faults in line replaceable units/weapon replaceable assemblies (LRU/WRA) and system wiring through advanced artificial intelligence (AI), hardware neural network simultaneous and continuous circuit monitoring.

Operational testing on LRU/WRA at NSWC Crane, FRC Southwest, and Hill Air Force Base provided the benefits, return on investment, and operational readiness to adopt this technology to the commercial sector. Based on these demonstrations and field testing IFDIS technology is quickly being adopted by aircraft OEMs and the aviation industry that manufactures these military aircraft.

For those in the avionics and maintenance business, the acronyms NFF (No Fault Found) and CND (Cannot Duplicate) are unfortunately all too familiar. Intermittent faults are mechanical in nature and caused by cracked/unsoldered joints, loose crimp connections, loose wire wraps, corroded contacts, sprung connector receptacles, etc. These intermittent faults are a recognized failure mode and have been conclusively identified as a major contributor to the NFF cost and poor readiness status.

According to the Office of the Secretary of Defense for Materiel Readiness and published by the Government Accountability Office in January 2020, NFF in weapons systems LRU/WRA and system wiring is a long-time standing problem and a $2 billion annual non-value-added burden resulting in 278,000 days of end-item system non-availability.

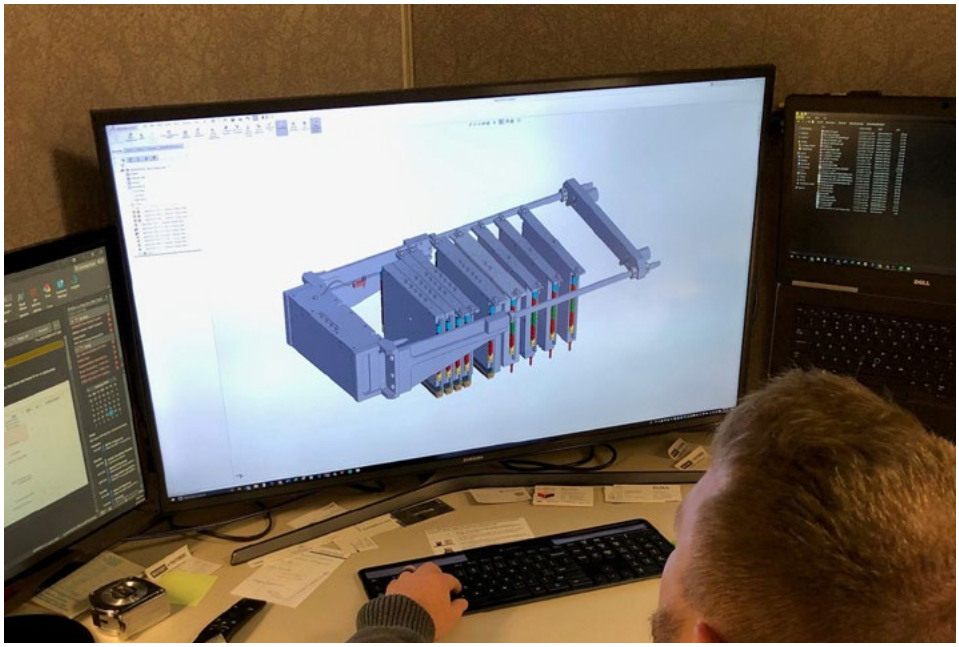
The JIT Integrated Product Team (IPT) formed in 2012 by the OSD issued “Electronic Test Equipment, Intermittent Fault Detection and Isolation” effort in March 2015 to address the intermittent fault “testing void.” LRU/WRA and system wiring with intermittent faults become known as “bad actors” and are repeatedly sent to the DOD and commercial repair facilities, but the legacy test equipment prevents accurate problem diagnosis—in many instances leading to condemnation of weapons systems components. Legacy test equipment is not designed and incapable of detecting and isolating intermittent faults that cause NFF due to single circuit scanning and sampling test limitations.

IFDIS technology has been evaluated for over 10 years through NAVAIR-led Limited Purpose Collaborative Research and Development Agreements (CRADA) and numerous CTMA collaborative projects. Minimal IFDIS and IFD technology investments by the DOD have produced a 1,600 percent return on investment and improved operational readiness by an average of 350 percent.

The adoption of the advanced technological capability contained in IFDIS IFD is to identify and then eliminate intermittent NFF. The commercial aviation industry wastes $250 thousand per year, per aircraft due to undetected unrepairable intermittent NFF, which equates to roughly $40 million per year for commercial carriers. These losses are passed on to the consumer with higher ticket prices. As a result of the demonstrations at various depots, the commercial aviation industry is actively engaged in adopting this technology in their maintenance programs to reduce these costs for the general public.

A recent report from Accenture stated "just 5 percent of consumer electronics returns are related to actual product defects, with 68 percent of returns characterized as NFF. Accenture calculated that a one percent reduction in NFF could save a typical electronics manufacturer $21 million a year, with an additional $16 million a year in consumer savings.

The implementation of this IFDIS IFD capability equates to a more streamlined and productive supply chain of electronic systems. As companies flow down the cost savings from the efficiencies and improvements derived from IFDIS efforts to the consumers, the general public will benefit by having expedient access to higher quality products at lower costs.



Universal Synaptics engineer developing Interface Test Adapters (ITAs) for the advanced IFDIS. Photo courtesy of Universal Synaptics.

VeriPart™ – Securing the Digital Supply Chain (TRL 8)

Like IFDIS, the Adapting Blockchain initiative is delivering on its promise of public good. While Universal Synaptics is targeting electronic anomalies, Moog is developing a secure future for AM utilizing blockchain technologies protecting the integrity and securely tracking the provenance of technical data packages for distributed AM parts with VeriPart.

This technology is going to create a new way of doing business in the aerospace industry and other markets. It reduces the counterfeit potential, ensures the OEM retains design ownership, and can aggregate and reward intellectual property from all the stakeholders.

In 2019, Moog completed demonstrations of their VeriPart point-of-use, time-of-need digital supply chain. These demonstrations allowed two different parts to be produced by AM at five DOD installations involving four Military Services. The overall result of this highly successful series of demonstrations was a user-friendly system that provided secure, trusted digital asset transactions enabling AM to be utilized to its full potential in support of the warfighter. The parts produced were able to achieve massive lead time reductions, taking the original part lead times from months down to hours. Throughout the process, part or origin was fully maintained from order placement to part production digitally across multiple organizations.

The use of VeriPart to enable the Digital Thread and Digital Twin in combination with advanced manufacturing processes like AM will provide many important benefits to the DOD and its partners. Benefits are drastically reduced lead times, increased supply chain visibility, improved counterfeit avoidance, increased sustainability, reduced physical inventory, increased mobility and flexibility for

AM link used in a helicopter autopilot. Photo courtesy of Moog.

forward-deployed units, improved traceability, and increased operational readiness.

After the demonstration and evaluation phases of this CTMA project, Moog was able to advance this technology to a TRL 8, and the general public is benefiting from these advancements. For example, following the military demonstrations, Moog conducted a world-first experiment in conjunction with Microsoft, Air New Zealand, and ST Engineering, utilizing a 3D printed part with Moog's blockchain-enabled VeriPart process to create a point-of-use, time-of-need digital supply chain for commercial aerospace applications. The proof-of-concept had Air New Zealand order a digital aircraft part file from Singapore-based ST Engineering. The digital file was immediately sent to an approved printer, operated by Moog in Los Angeles. The part was 3D printed and installed on an Air New Zealand Boeing 777-300 aircraft 30 minutes after landing. Lead times for the traditionally manufactured part would normally be greater than one month. By using VeriPart in conjunction with 3D printing, the lead time was reduced to hours, so much so that the identification of the bad part (simulated) through order placement and production all took place while the aircraft was in flight. The printed part was ready and waiting when the aircraft landed on the tarmac.

VeriPart technology eliminates the ability of hackers, or others with ill intentions, to infiltrate the digital systems, thereby stopping them from corrupting a file, making all parts safer. With the security of VeriPart technology, industries can rely on AM with confidence and turn more of their catalog toward just-in-time printing pieces. VeriPart provides validation of the manufacturing process, a history for all part interactions, and part qualification and certification. Organizations that need to share technical data packages for AM among organizations are protected using this technology. VeriPart will improve AM printing for all industries challenged with intellectual property and traceability of provenance of digital data when developing products in globally competitive markets.

Benefiting the General Public

Public benefit from new military technologies passed on to industry and consumers is at the heart of the CTMA Program. The most important public good outcome from both efforts is greater consumer safety. The IFDIS technology's ability to detect and isolate wiring faults has the potential to result in safer automotive, air, and train transportation, while the VeriPart technology stops cyber threats such as hacking and file corruption from affecting consumer parts. ◆