FINAL REPORT
AMUET 4.0
MILESTONE 07
AGREEMENT #2019-483 004

6 November 2022.

Project Overview

This project was initially filed as a 2021 Panel Project Panel as an extension of the National Shipbuilding Research Program (NSRP) Panel Project (2016-443), which successfully had proved Advanced Mobile Universal Electrical Tooling (AMUET) build and test capabilities with Austal USA on the Littoral Combat Ship (LCS). The panel project had been drafted to introduce new 4.0 digital capabilities developed by Solavitek with the Aerospace Industry, namely with aircraft Original Equipment Manufacturer (OEMs) to support aircraft manufacturing and modernization, and with United States Air Force (USAF) and US airlines to support aircraft sustainment. Concurrently, the Navy04 TILL innovation division funded another AMUET 4.0 program to support the sustainment of the government shipyards with a newly developed portable wireless 500V high voltage tester for insulation resistance.

When the NSRP issued the new Rapid Adoption Program (RAP), the AMUET 4.0 project became a good candidate to showcase how a TRL9 technology for the aerospace industry could be adapted rapidly to support the US Navy shipbuilding and repair programs. The RAP project was to showcase AMUET platform digital capabilities to support the manufacturing, installation, and testing of electrical cables with a private US shipbuilder on surface ship through the NSRP program with Austal USA on the LCS. Navy04 participated as an observer on this RAP.

From November 2021 through October 2022 this NSRP RAP team validated the AMUET platform's performance to use existing shipyard digital information into immediately available user-friendly intuitive to use to assist with shipboard cable termination and testing. These efforts proved how the AMUET 4.0 platform could reduce considerably manhours to perform these operations and directly improve the First Time Quality, where automation provides faster, more accurate, and better traceability than manual processes. The amount of rework is considerably reduced and improves the operational functional testing. Near the end of the RAP effort, the team confirmed AMUET 4.0 capabilities to use non-descript training structure 3D ShipConstructor model with the AMUET platform to support cable routing through Augmented Reality. This functionality is also available with other 3D CAD systems.

In way of the RAP, Austal USA's existing AMUET tooling was upgraded to AMUET 4.0 digital enterprise standards to showcase its performance in shipbuilding manufacturing environments; thus, ironing technological gaps/issues and technology insertion that are experienced when fielding new technology. The NSRP RAP also focused for the first time on the deployment of AMUET 4.0 suites of augmented reality studios to support ship manufacturing and inspection, available thru the Solavitek 2D studio for smart lenses and 3D studio for HoloLens 2, both were successfully demonstrated and showcased during the RAP Final Demonstration event.

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Overall, the RAP confirmed AMUET 4.0 agility to use existing client digital data to create an integrated paperless environment to support the planning, tasking, installation and testing of electrical cables and cabinets at shop level or shipboard with a smooth and efficient flow of manufacturing and quality control activities. The agility to configure AMUET organically and rapidly for different tasks by engineering, along with the portability of the platform given the pelican size footprint of testers/lenses for shipboard use by technician are game changers on how a ship will be built, modernized and maintained.

On December 1, 2022, SUPSHIP Gulf Coast authorized the official use of AMUET by Austal USA on the LCS/EPF with all of the capabilities demonstrated during this RAP project, see APPENDIX A. The demonstration and tests results of the shore power testing connector, incidental to this project, shall be shared with NAVSEA05Z for approval. The lessons learned and corrective adjustments made during this successful RAP program on the surface ship with Austal USA, also provided substantial risk management and cost savings for the NAVY04 TILL program with government facilities working the submarine and carrier platforms. This program will now effectively engage in a ''rapid'' adoption pace in Pearl Harbor and Norfolk Industrial Facilities from March to November 2023.

The project team is very proud that we were able to perform all of the activities and achieve complete success of all of the objectives noted in the RAP application within the 12 months' timeframe. We note that another significant element we had in our project was to have official US NAVY support and visibility to allow for a formal transition plan of the technology deliverables as an official US Navy tool/process going forward. There are numerous challenges to fielding Industry 4.0 technologies on operational weapon platforms, and then integrate them into an approved enterprise tool/process.

As an aside, Austal remains an active Industry participant with the Navy 04 TILL CTMA program that will now transition all of the RAP activities on the Virginia class submarines and carrier in 2023. The different observers from DoD, Navy and USAF have an interest to seek the potential of AMUET 4.0 to be a multi-requirement joint service tooling platform to support any weapon platform over their different phases of maintenance over their lifecycle.

The project team thanks the NSRP management, ATI, the US Navy and all participants for their effort and support.

Figure 1. Solavitek CEO's Alain Lussier presenting the AMUET 4.0 program to Rear Admiral Scott Brown (SEA 04) of the Naval Sea Systems Command's Industrial Operations Directorate on November 1, 2022. The AMUET 4.0 program to support the US shipbuilding, Naval sustainment and modernization consisted of the NSRP program, funding the AUSTAL demonstrations, and the NAVY04 CTMA innovation program, funding the Naval Sea Systems Command's Industrial Operations. The NAVY04 program will continue in 2023 on Virginia class submarine overhaul and carrier modernization environments.

NSRP Technical Project Participants and Contact Information

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NSRP Technical Project Leadership and Contact Information

Program Manager	Mark Smitherman	mark.smitherman@ati.org
Project Technical Rep	Jason Farmer	jason.farmer@hii-ingalls.com

Table 1. The NSRP Technical Project Participants

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Industrial Participants

National Center for Manufacturing Sciences
Solavitek Inc.
Solavitek Engineering Inc.
Austal USA
Huntington Ingalls Industries

The following Department of Defense (DoD) participants are:

Active participation:
Pearl Harbor Naval Shipyard (PHNSY) and Intermediate Maintenance Facility (IMF)
Norfolk Naval Shipyard (NNSY)
Naval Sea Systems Command (NAVSEA)
Supervisor of Shipbuilding (SUPSHIP)

Observer Participation:
Trident Refit Facility (TRF) Bangor
Puget Sound Naval Shipyard (PSNSY)
Department of Defense Foreign Comparative Testing (DOD FCT)
United States Air Force program officer (USAF-ATS)
United States Air Force Headquarters Material Command (AFMC/A4/10)
NAVAIR PMA260 ATS program office (PMA260)
US Army Automated Test Technologies CCDC Armaments Center (Army CCDC)

Table 2. NAVY04 TILL CTMA technical project participants and observers

Project Results

The AMUET 4.0 program under the NSRP RAP program Final Demonstration at Austal USA was completed with high success and received unprecedented visibility from both the shipbuilding community and the US NAVY.

The following activities took place either on the LCS and/or Alabama Industrial Development Training (AIDT) Maritime Training Center. The Austal USA participation with the RAP provided opportunities to deploy all of AMUET 4.0 capabilities in real manufacturing environments:

1. Agility of AMUET to use existing data to create working instructions
2. Agility of software to prepare and track task assignments
3. Performing the connectors pinout using AR assisted production
4. Reducing test time, accuracy and traceability of testing installed cables (continuity, resistance, Megger Insulation Resistance)
5. Agility and performance of AMUET 4.0 to import CAD models from ShipConstructor 3D design model into AMUET 3D studio using the Hololens2 for shipboard inspection and shipboard manufacturing assemblies
6. Performance to use AMUET 4.0 on shore power validation

Those who attended the project's Final Demonstration were provided the opportunity to use the AMUET 4.0 platform, the project's Final Demonstration provided hands-on experience in an authentic shipbuilding environment.

Figure 2. Industry attendees during the RAP Final Demonstrations from Austal USA, Halter Marine, Huntington Ingalls, Fincantieri Marinette Marine and ShipConstructor Software USA.

Figure 3. The US Navy was also very well-represented during RAP Final Demonstrations with SUPSHIP and NAVSEA04. Seen here is Rear Admiral Scott Brown wearing the HoloLens 2 to visualize working instructions for the cable routing of the AIDT demonstrator.

Figure 4. The AMUET 4.0 tooling footprint and agility are key design criteria to a successful adoption by their main user, the electrician. Seen here in a rolling carry-on size Pelican case are AMUET Toughpad tablet, 2 TBU300SAP and 1 TBU150HV testers, 2 interface cables and smart lenses. The full case weights under 40lbs and has capacity for additional electrician tools and parts for daily task.

Project activities - Build and Test

The onset of the project focused on introducing the new digital capabilities developed by Solavitek to improve the statement of work from a basic tester to a manufacturing tool. Figures 5 to 16 present images and diagrams of the AMUET 4.0 platform that supports electrical cable termination with smart lenses and testing.

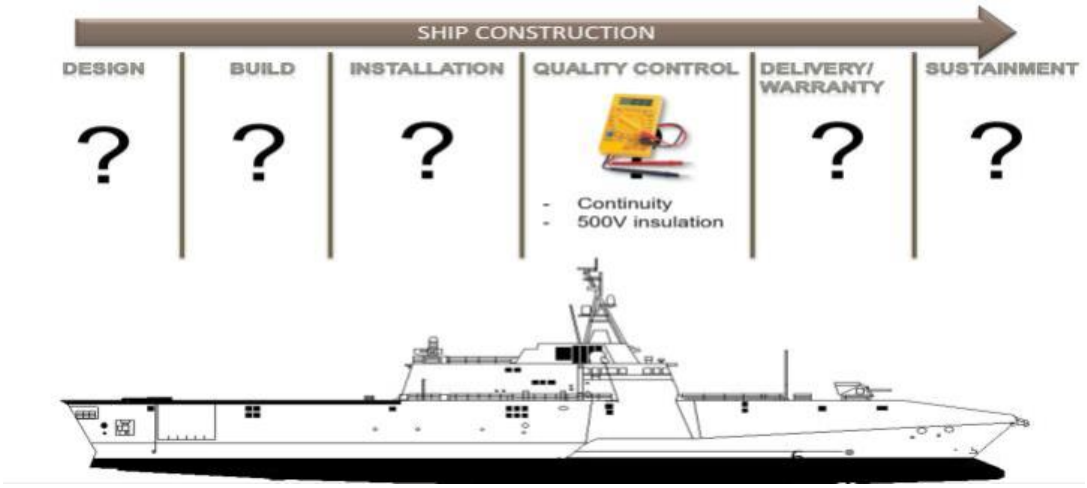

Figure 5. The first generation of the AMUET wireless standalone tester filled the gap to manual ringout testing of cables built and installed on the ship by technicians. It provided ATE capabilities in handheld size.

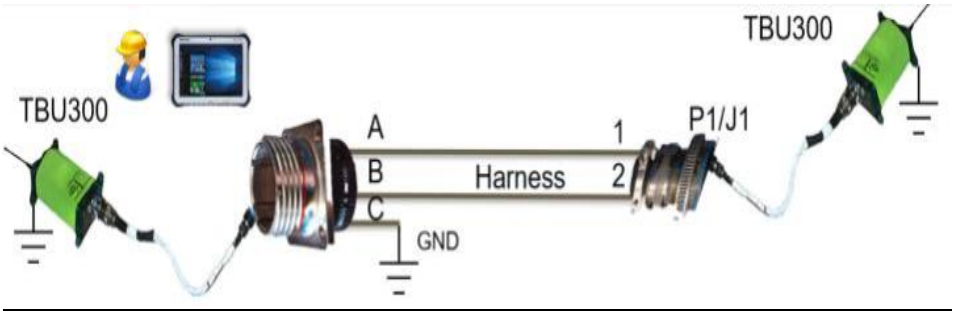

Figure 6. The distributed test method provides for terminating independent individual test box units (TBUs) at every connector location in-situ the ship. Shown is the wireless configuration. Gervais US Patents 7368919 and 7728605.

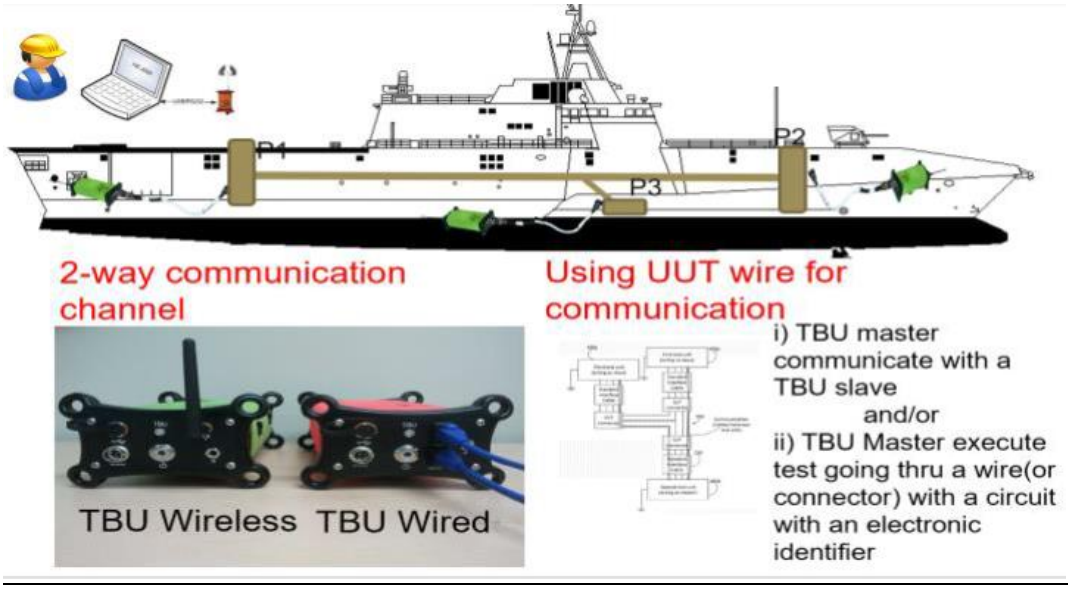

Figure 7. To facilitate the use of a distributed test system on large military ships, numerous proprietary secured protocols were developed. While the wireless communication methods is the fastest, its range is limited by the "cage of faraday" effect of the ship's metal structure; ranges of 300 feet were achieved with a single router. Considerations to expand the range with shipboard wireless networks as well as RG45 shipboard infrastructure technically proven in the commercial market were discarded in view of the considerable costs of set-up and maintenance across different manufacturing zones of the shipyard and cybersecurity concerns. The newest master/slave configuration of using the unit under test (UUT) to communicate between tester and tablet proved the most agile, least expensive and most secure process to support the lifecycle activities of shipyard building and maintenance. Its technical range specifications of 2,000 feet was provided by the PEO carrier. Lussier, Parenteau, Allain US Patents 9921263 and 10345355.

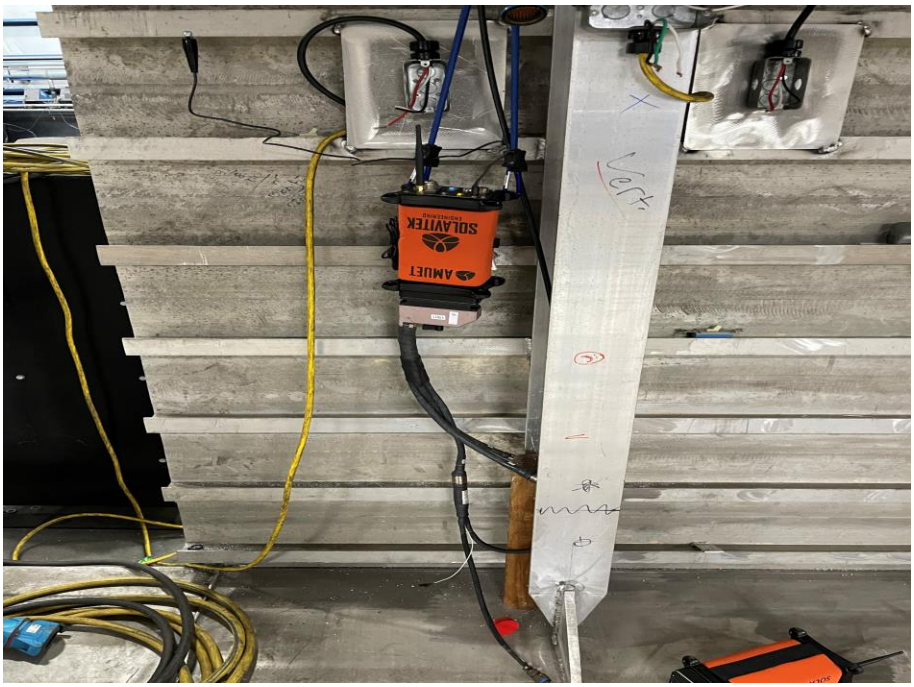

Figure 8. The AMUET tester is connected to one side of a cable to support conductor termination by the user using the smart lenses at the other end of the electrical cable. Once completed, a second identical tester will be used to complete end-to-end continuity testing for quality control.

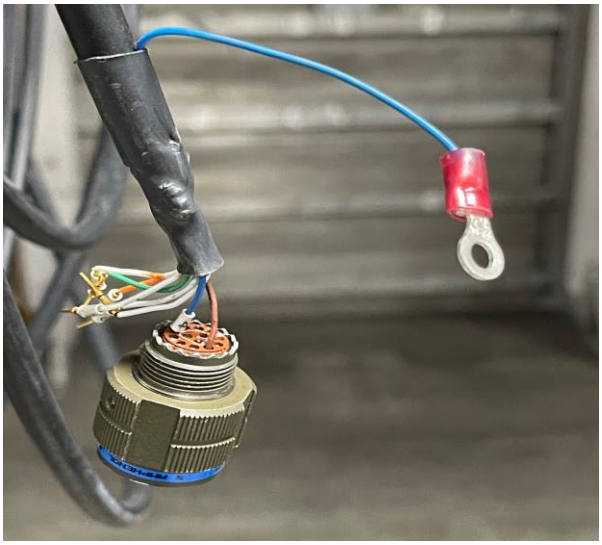

Figure 9. This picture illustrates a cable in preparation for connector termination and pin insertion

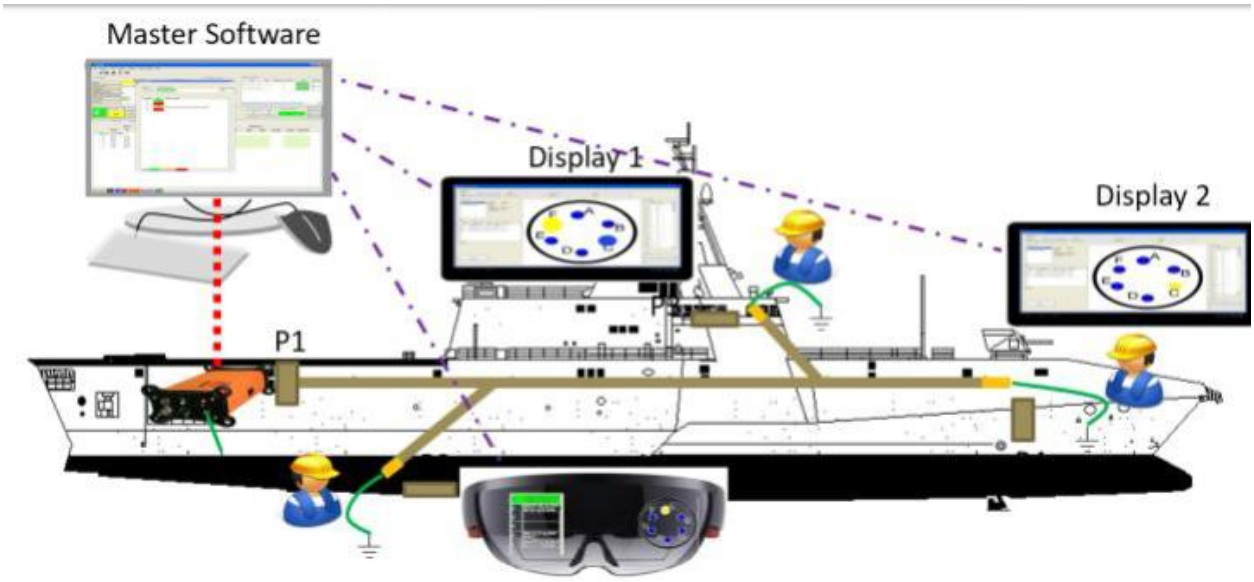

Figure 10. The test unit in orange is electrically simulating the conductors being installed by the technician, eliminating the reading process of the small print on the conductor. Lussier US patents 9817942 and 10705135.

Figure 11. AMUET 4.0 assists production, it allows a shipboard electrician to use a smart lens to prepare and perform the conductor insertion at the cable's connectors, using AMUET proprietary patented processes. This allows the technician to use both hands and reduces fatigue by avoiding repetitive readouts of wire numbers/colors from manuscript documents. No programming is required to use this feature. Lussier US patents 9817942 and 10705135.

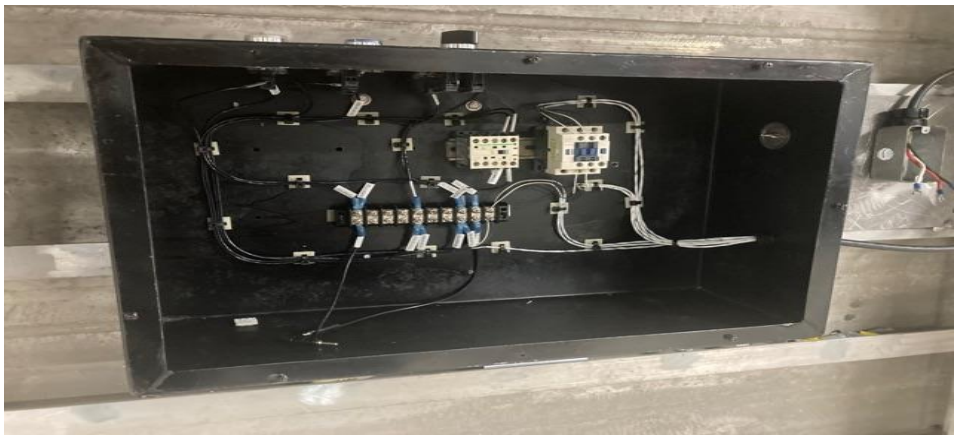

Figure 12. The electrical assembly of control panel, in-shop or shipboard, is another use case for the AMUET platform.

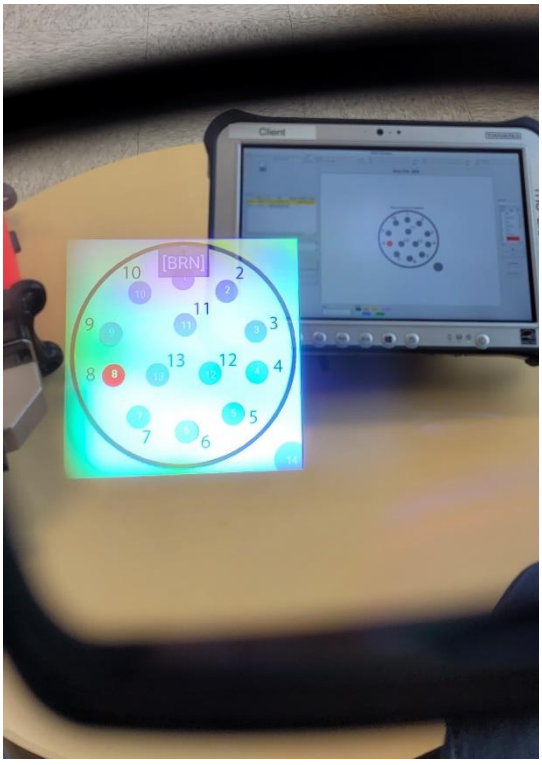

Figure 13. This capture as seen on the tablet is a view of what the electrician user sees through the smart lens using AMUET assisted production.

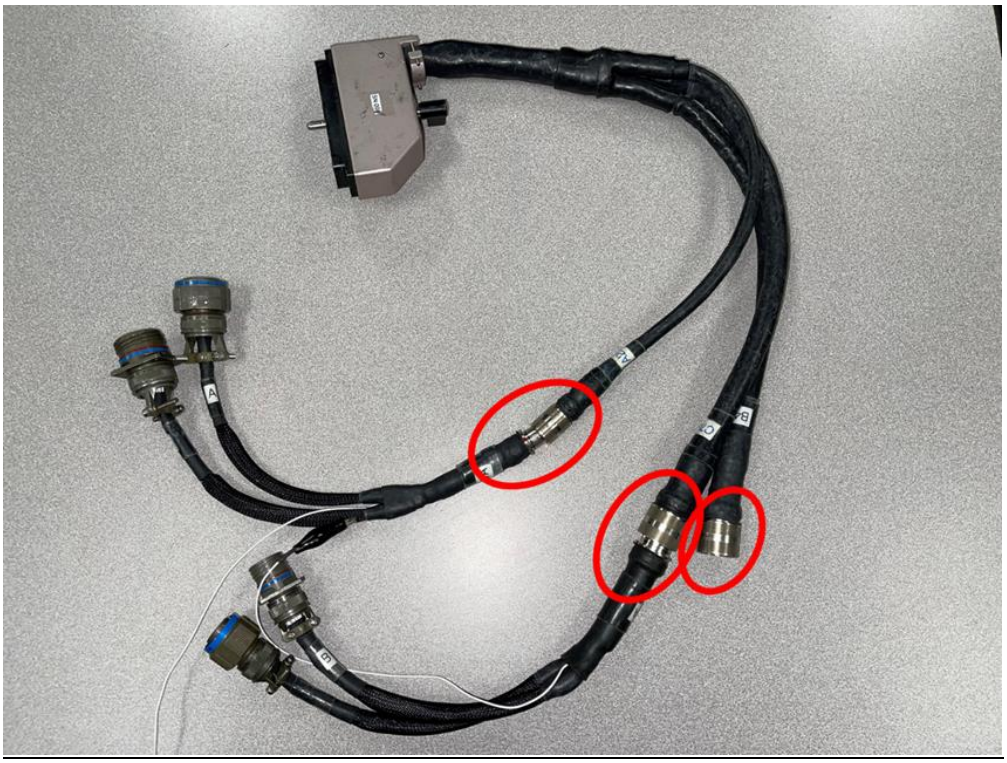

Figure 14. The proprietary serialized features of AMUET interface cables are key to the small footprint, inter-operability across platforms and programming avoidance. The interface cables can be built organically by the shipyard using the AMUET tooling. Lussier US patents 8912800, 8547108, 10088501, 10697999,10705135, app 17/220,426

Figure 15. The same technician just completed wire termination of a cable can then proceeds with the quality control acceptance testing using the AMUET TBU300SAP and AMUET TBU150HV testers to confirm continuity, DC resistance values and high voltage insulation resistance. Seen here is the technician installing an AMUET testers with bungee cable to reduce the stress on the cable installation.

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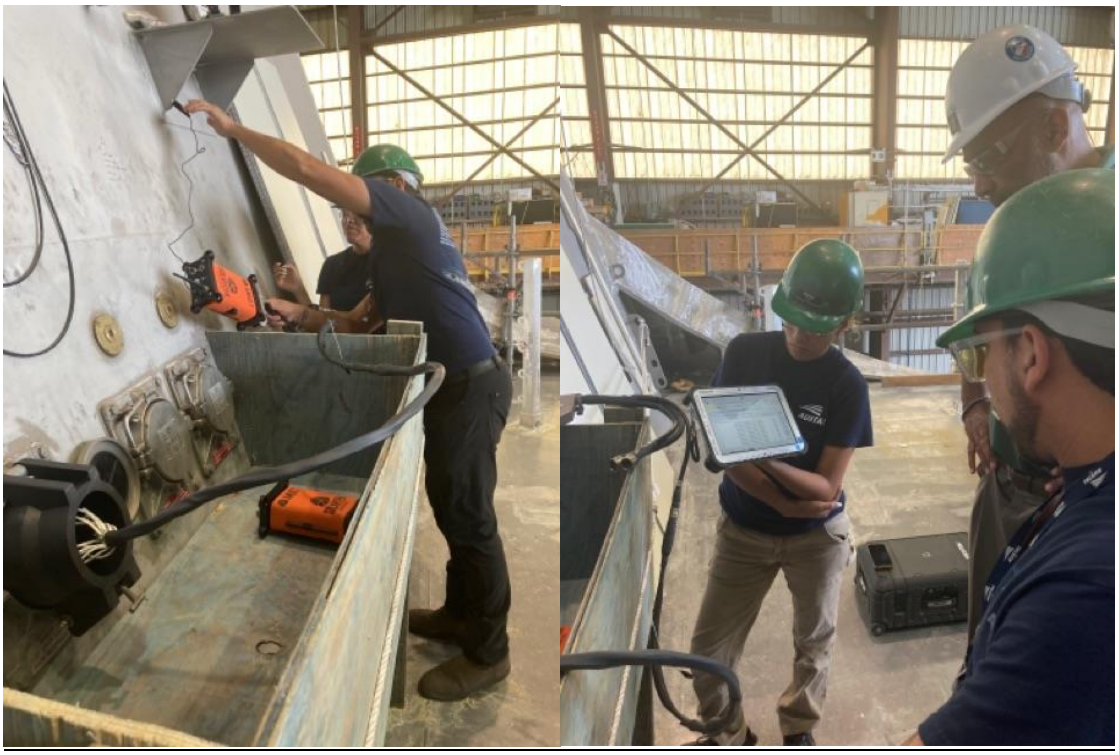

Figure 16. The AMUET tooling is generic to any shipboard system. During the course of this RAP and Navy04 program, it was adapted successfully to support the shore power connector high voltage insulation resistance on every contact point and phases.

Project Activities - Augmented reality to build the ship

The later part of the project introduced the new digital capabilities developed by Solavitek to import client digital models to make them useable instantly into manufacturing instructions and quality control activities. Figures 17 to 25 present images and diagrams of the AMUET 4.0 tooling that supports the integration of SSI ShipContructor Models or Lidar imports and load them into the AMUET 4.0 platform.

Figure 17. To reduce security approval timeline of using LCS drawings and demonstration access, the RAP team decided to create an electrical demonstrator at the Austal USA's Maritime Training Center. These are 2 of the ShipConstructor 3D model file of the Austal USA training area.

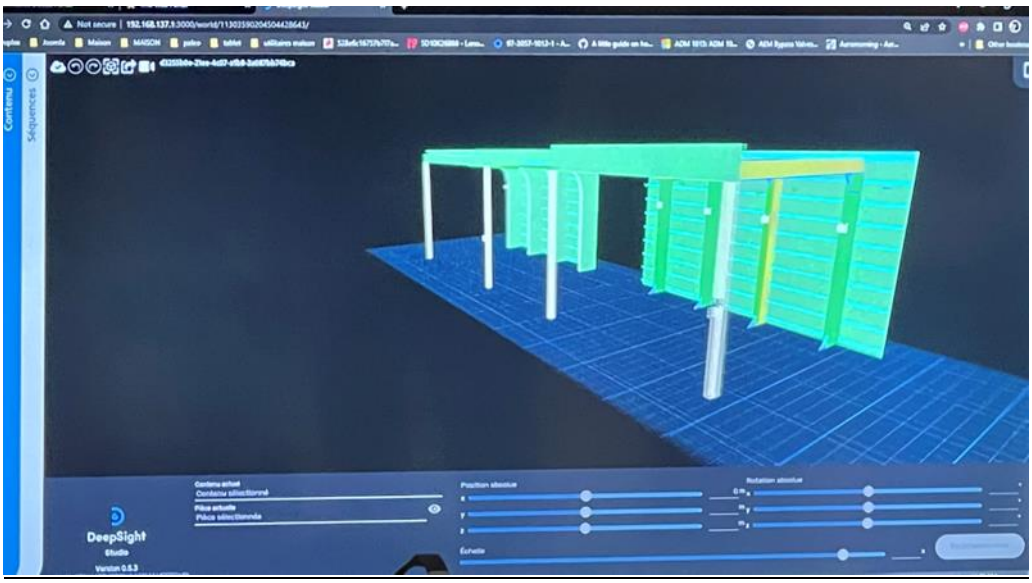

Figure 18. This is an actual screen capture of Austal USA's training area ShipConstructor 3D model file loaded into the AMUET software. The files are compatible and there is no programming, but a short processing operation is required.

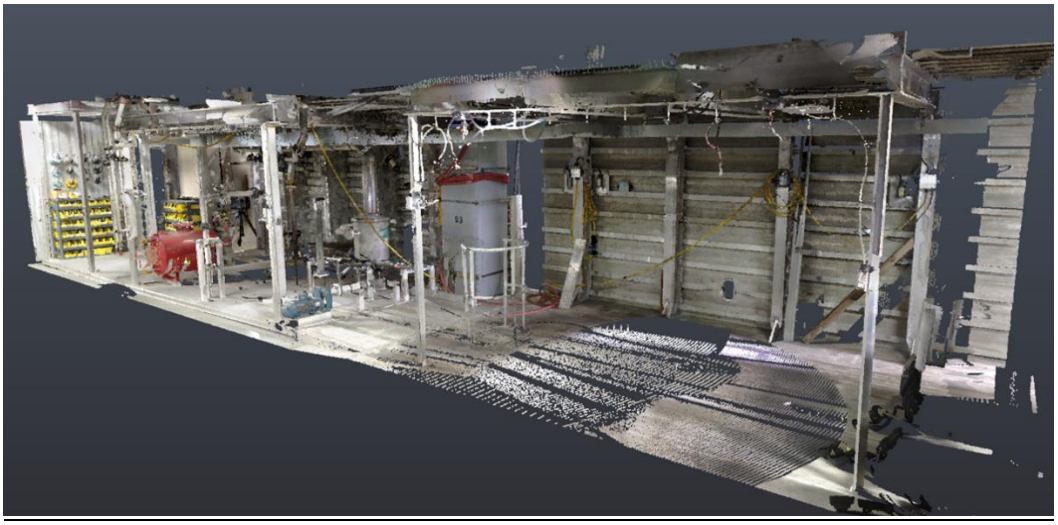

Figure 19. This is a LIDAR capture of the AIDT training center demonstrator using a IPad PRO, which is compatible with the AMUET 4.0 studio.

Figure 20. The AMUET use-case demonstrated at Austal USA's training center where people pulled cable using HoloLens goggles from the model import from the ShipConstructor 3D Model. In this set-up configuration, the users and attendees could see what the user was seeing in the HoloLens.

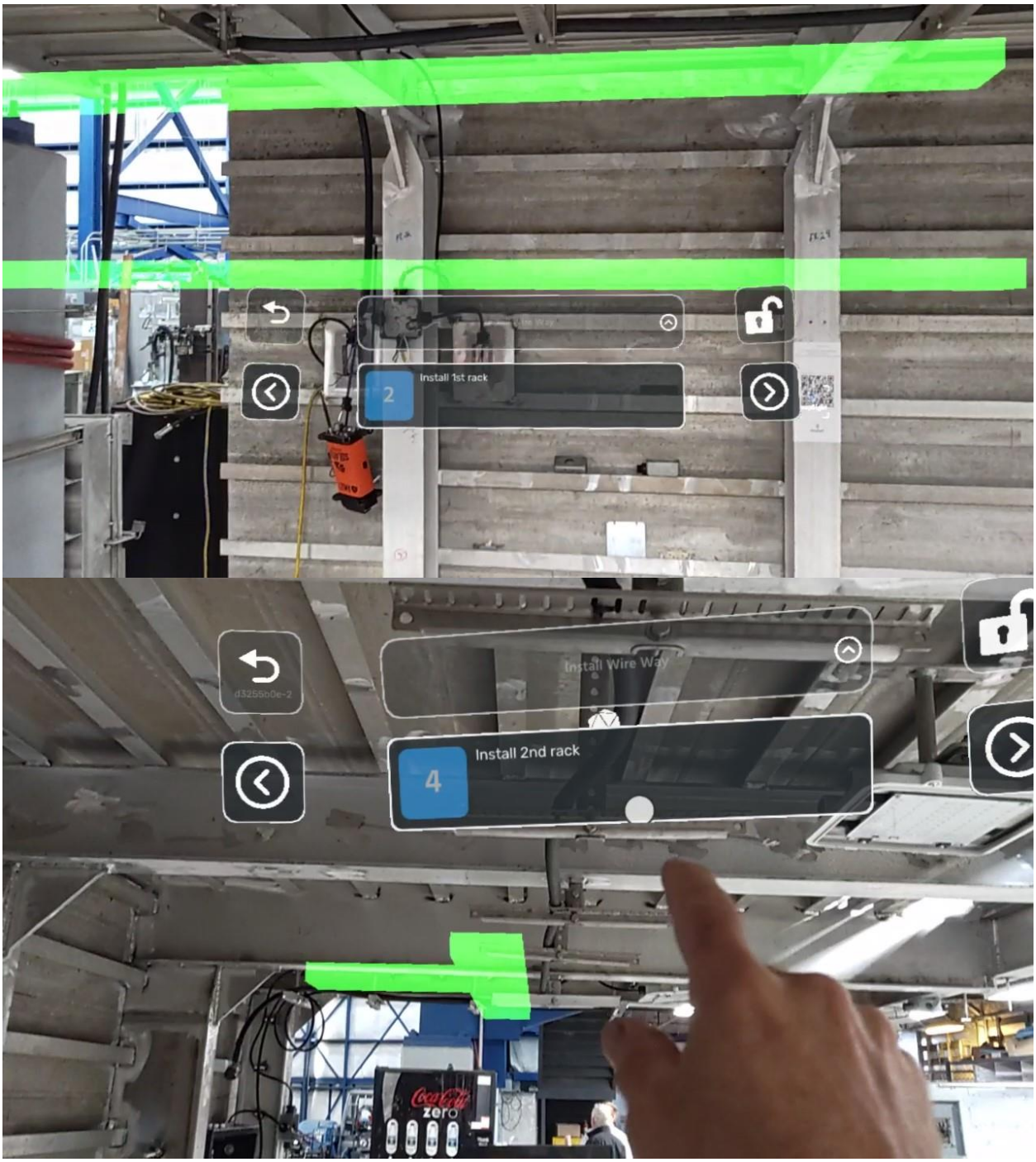

Figure 21. The AMUET 3D studio can be configured with build instruction steps for the electrician, in this case there were different captures of the HoloLens 2 that provides the electrician instructions to install cable tray

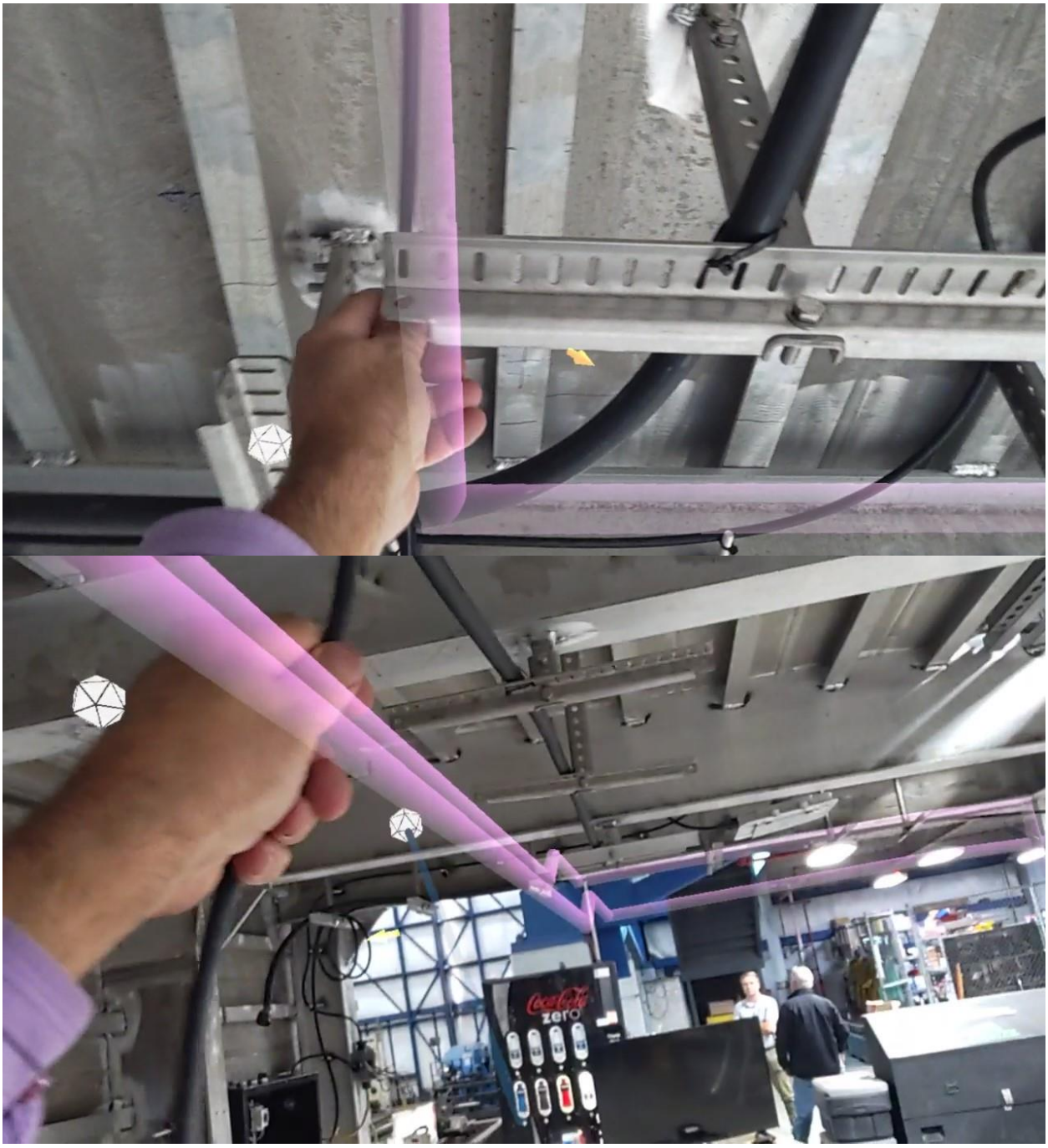

Figure 22. Once the cable trays are installed, the AMUET 3D studio will assign to other teams the sequences of instructions for the cable pulling into the proper cable tray.

Figure 23. The AMUET 3D studio can be configured with build instruction steps for the electrician. We note the AMUET 4.0 is an integrated enterprise platform with numerous digital capabilities. In this case, the cable tray and cables have been laid out. The technician is indicated the location to proceed to the assisted production pin-out of the connector. At this time, the electrician will proceed with the AMUET 4.0 smart lens to execute the conductor pinout and eventually the testing validation as showcased in figures 11 to 13.

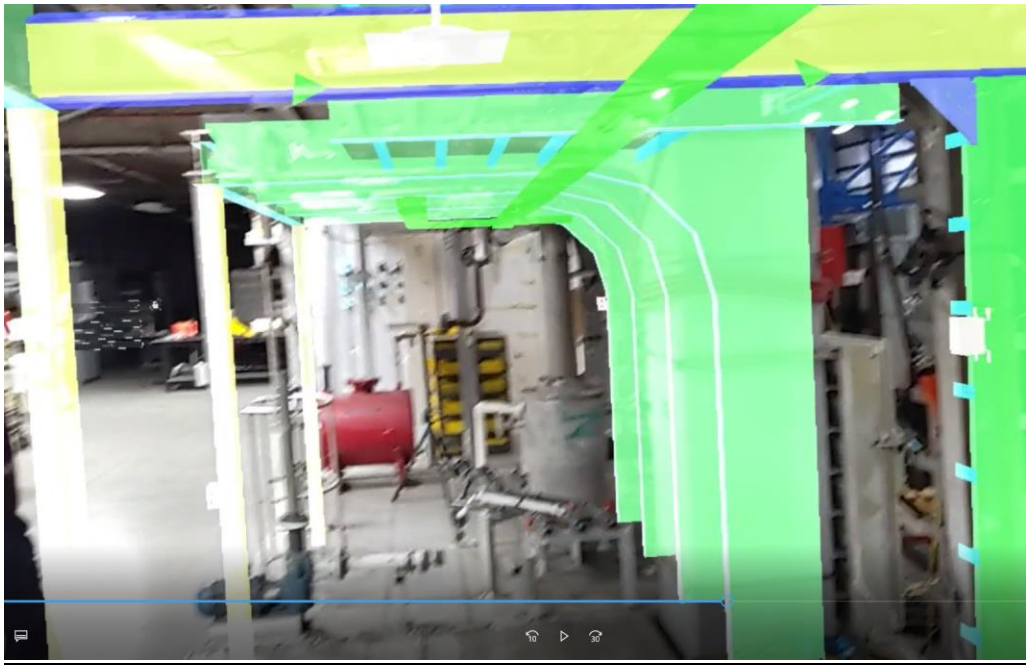

Figure 24. The AMUET 3D studio permits to view through the HoloLens of the 3D ShipConstructor model overlay on to the actual structure.

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Project Returns

The project returns are vast, and they are all integrated into one comprehensive platform:

1. Agility of AMUET to use existing data to create working instructions
2. Agility of software to prepare and track task assignments
3. Performing the connector pinout using AR assisted production
4. Reducing test time, increasing accuracy and traceability of testing on installed cables, including automated validation of continuity, resistance, and Megger insulation resistance for all combinations of wire-ground and wire-wire configurations
5. Agility and performance of AMUET to import existing 3D CAD models from ShipConstructor into AMUET 3D studio for use with the HoloLens 2 for shipboard inspection and shipboard manufacturing of cable assemblies
6. The proven ability to use AMUET for shore power validation

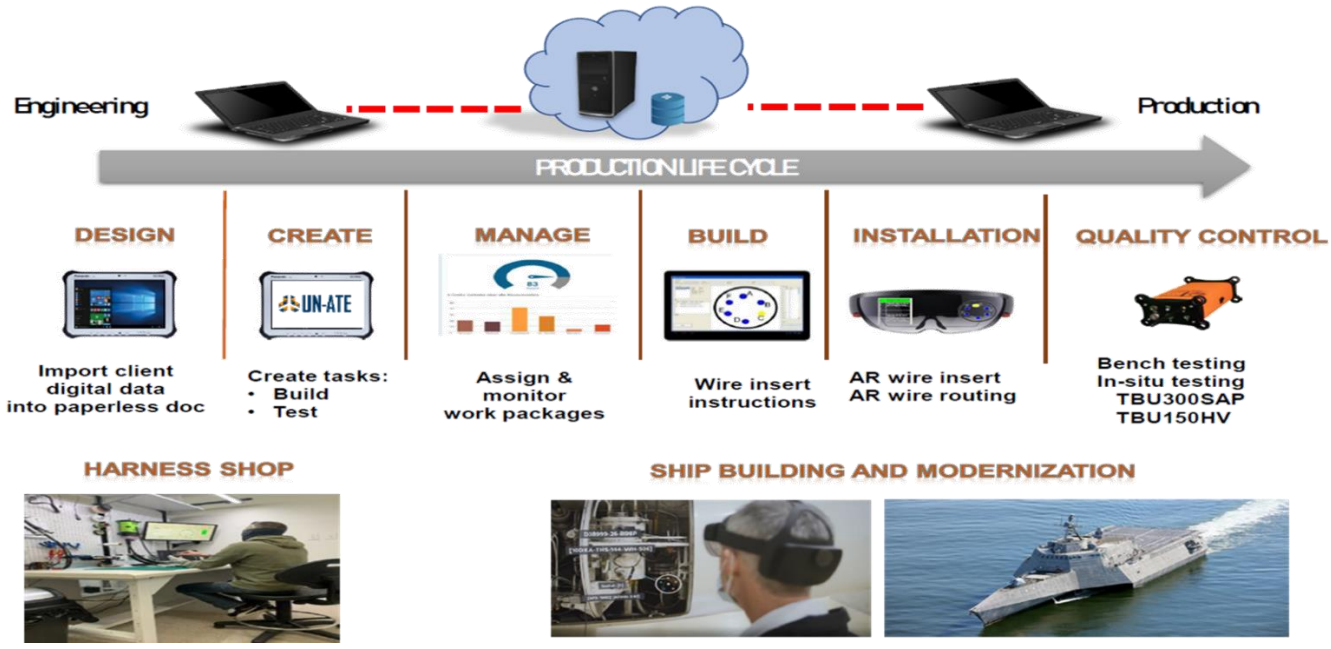

Figure 25. The AMUET 4.0 platform connects the engineering and production to the technician; it consists in a suite of modular design/application software that can be used by engineering to design tasks requested by production. The production manager will then assign tasks to the electrician, and track with engineering progression and tests results. The technicians use different applications that connects them with their testers, smart lens and HoloLens, as applicable to their task's activities. **Lussier US patents 9817942 and 10705135.**

From a macro corporate perspective, the AMUET 4.0 platform is very simple to set-up, implement, and use, which creates an opportunity for a rapid adoption:

1. Engineering has a software suite to create tasks in minutes
2. Production and planning can assign and track all tasks locally
3. Electrician's pelican case of tools is a low-footprint all-in-one solution for
    a. Visual aids for cable routing- faster and reduced errors
    b. Visual aids for wire pinout- faster (50% manhours savings) with reduced fatigue
    c. Automated testing- instant (75% manhours savings) with no errors
    d. Automated Megger IT- Instant (75% manhours savings) with no errors
4. Quality Assurance managers use of AMUET 3D augmented reality studio will be a game changer for production and quality inspection

Overall, the AMUET 4.0 smart capabilities are meant to use automation to build it right the first time with 100% traceability.

Ship Type	Location	Type of operation	Activities
Surface ship	Austal USA, Ingalls	Ship building	Cable install, build, test
Carrier	Norfolk	Modernization	Mods and maintenance
Submarines	PHNS-IMF	Overhaul	In-situ testing, shop

Table 3. The AMUET 4.0 program was a joint collaboration between Austal, Pearl Harbor Naval Shipyard, Norfolk Naval Shipyard and Solavitek under the NSRP RAP and NAVY TILL CTMA programs. Austal was the frontrunner participant from the NSRP 2016-443 project use of AMUET tester on LCS and EPF platforms. This table highlights the flexibility of AMUET 4.0 to support different requirements in different environment on any platform. The outstanding success of the RAP activities with AUSTAL reduces the technological risks to deploy AMUET onto the carrier and submarine platforms under the NAVY TILL program contract, running until November 2023.

The AMUET 4.0 capabilities noted above are modular where the tools and software can be tailored to the specific shipbuilding and/or maintenance activities.

From a testing perspective, the majority of the saving is the AMUET platform eliminates the need for the second person from the conventional method of 2 technicians using manual ring-out sheets and handheld multimeters to perform continuity tests, resistance checks, and insulation resistance using a megger tester. The AMUET platform automation reduces the typically required second person; thus, there is an immediate labor saving of 50%. It also performs and record all of the combinations and the measurements automatically, saving another 30 minutes to 2 hours of labor per connector, depending on the number of connection pins. The testing savings by using a tester instead of a second person translates easily to savings of 4-8 hours multiplied by the number of cables at the shipyard's labor rate.

As an example, let's assume a vessel has 25,000 cables with a shipyard hourly rate for a test electrician at $40/hr. The savings on just one hull would be $1,000,000. This figure does not include the rework to address issues found during ELO (Electrical Light-Off).

From a wire insertion perspective for cable connectorization, the process will improve labor efficiency and provide better progress status of work in progress. It will also reduce the fatigue on the electrician by avoiding reading paper instructions.

The enhanced operations element supporting production's task scheduling and subsequent progressing is estimated at improvements of 1 hour per circuit with production planning and QC traceability documentation. Here again using the same figures as previously mentioned, 25,000 circuits multiplied by 1 hour at a rate of say $35/hr. This equals a cost savings of $75,000 per vessel.

The ROI of the AMUET platform supporting cable pulling and wireway installation was not evaluated; however, it is estimated the platform's agility will significantly improve first time quality.

Technology Transfer Events

SNAME Maritime Conference 2021 Alain presented at SMC2021 in Rhode Island	October 2021
NSRP Electrical Panel The project team presented a status of the project at the April 28th Electrical Panel Meeting (virtually)	April 2022
NSRP Ship Warfare Systems Integration (SWSI) Technologies Panel The project team presented a status of the project at the June 13th SWSI Panel Meeting (virtually)	June 2022
NSRP Electrical Panel The project team presented a status of the project at the August 10th & 11th Electrical Panel Meeting in person in CT where Alain Lussier of Solavitek performed a hand-on demonstration of the AMUET 4.0 system on Thursday, 11 August.	August 2022

Final Demonstration(s)
There were several project demonstrations between Wednesday October 19th and November 2nd as detailed below:
• Wednesday October 19th
  ○ SUPSHIP Gulf Coast shipboard LCS
  ○ Fincantieri Marinette Marine
• Thursday October 20th - AIDT demonstrator
  ○ Official Demonstration
  ○ Attendees were from Bollinger shipyards, Halter Marine, Huntington Ingalls, Marinette Marine and ShipConstructor USA.
  ○ SUPSHIP Gulf Coast leadership
• Tuesday October 25th
  ○ Supporting SEA 04, SEA 00, SUPSHIP, and Austal USA executive leadership
• November 1st
  ○ Presentation to Naval Sea Systems Command's Industrial Operations Directorate Leadership and SUPSHIP Gulf Coast
• November 2nd
  ○ Shore power successful demonstration
	October 10
	November 2022

NSRP Electrical Panel Shawn Wilber of Austal USA and Alain Lussier of Solavitek presented a status of the project results at the Electrical Panel Meeting (virtually)	December 7 2022

Table 4. Technology Transfer Event Overview of the NSRP RAP AMUET 4.0

Implementation

New Construction:

- LCS 34
- LCS 36
- LCS 38
- Possible future classes at Austal USA
    - SSN
    - SSBN
    - OPC
    - T-ATS

Sustainment:

- LCS
- In process application in classes at Pearl Harbor and Norfolk
    - SSN
    - CVN

Conclusion and Recommendations

The ultimate conclusions of the Rapid Adoption Project (RAP) "AMUET 4.0" is that it was overwhelmingly successful in all aspects, achieving all of the performance objectives set at the beginning of the project and was well received by Industry and Government who attended the demonstrations. This project showcased the AMUET 4.0 platform, which provides the listed benefits below:

- ⇨ Enhanced production efficiencies resulting in quicker task development to build, install, test, and maintain electrical systems
- ⇨ Reduced training costs across platforms and potentially across shipyards with a common centralized platform supporting all types of electrical systems on new construction vessels, vessels undergoing large scale modernizations, and vessel undergoing minor system changes
- ⇨ Reduced Total Cost of Ownership by providing a common tool which can be used on any class of vessel for new construction, maintenance, and repair efforts of electrical systems over the vessel's lifecycle

The AMUET 4.0 platform eliminates the second person, required in current workflows, which by itself is a 50% labor savings. Additionally, the AMUET 4.0 platform provides the accuracy and first-time quality in shipboard electrical distribution rarely seen before and was achieved at an incredibly low cost. Further, the AMUET 4.0 platform is efficient and intuitive thereby saving schedule duration for cable installations, conductor terminations, and testing. And as an added bonus,

the AMUET 4.0 platform with its cable management system automatically performs physical progressing of deck plate activities seamlessly in the background as the electrician / user completes each assigned activity; thereby eliminating the planning / scheduling follow-up inquires for production reporting.

From a NAVY perspective, the RAP efforts reduced the risk and costs to execute the 2023 Navy TILL CTMA program activities for ship overhaul and modernization to a technology transition; albeit, there remain challenges associated with working on US Navy operational weapon systems.

Overall, the AMUET 4.0 platform should be considered as a standard tool for shipyards and marine electricians who wish to have a unique and substantial competitive advantage, especially on new programs and multi-hull projects for new constructor or ship repair

We thank the NSRP and ATI leadership and management, the US Navy, and all participants for their effort and support.

APPENDIX A

DEPARTMENT OF THE NAVY
SUPERVISOR OF SHIPBUILDING, CONVERSION AND REPAIR
GULF COAST
POST OFFICE BOX 7003
PASCAGOULA, MS 39568-7003

9074
201/01810
22 Nov 2022

From: SSGC Engineering
To: Austal, Advanced Shipbuilding Manager Shawn Wilbur

Subj: Use of Solavitek's Advanced Mobile Universal Electrical Test Platform (AMUET)

Encl: (1) Austal letter emailed on 28 OCT 2022

Enclosure (1) was forwarded to Supervisor of Shipbuilding, Gulf Coast (SSGC) Code 201 Deputy Chief Engineer with the subject "Approval Request for use of Solavitek's Advanced Mobile Universal Electrical Test Platform (AMUET) for stage two testing."

SSGC Engineering Department is aware of the testing and evaluation of the Advanced Mobile Universal Electrical Test Platform (AMUET) by Solavitek and the associated NSRP Project 2016-443 as described in Enclosure (1). SSGC Engineering technically agrees with the use of the AMUET tool as a viable means to meet contractual requirements.

The SSGC primary technical point of contact is Glenn Dickerson, Code 270, at email glenn.a.dickerson.civ@us.navy.mil and telephone (228) 935-0582.

The requirements of this letter do not authorize any change in the terms, conditions, delivery schedule, price or amount of any Government contract. In the event that you consider these requirements represent a change for which you are entitled to an equitable adjustment, you are to comply with the requirements of the "Notification of Changes" clause of the contract and take no action with regard to such changed requirements until notified, in writing, of the Contracting Officer's response.

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Jacob Davis
By direction
Deputy Chief Engineer
SSGC Code 201

Copy to:
LCDR Bohning, SSGC Detachment Mobile OIC
Mr. Clay Smith, LCS DPMR
SSGC 200, 270

AUSTAL

Supervisor of Shipbuilding
Conversion and Repair, USN
P.O. Box 7003
Pascagoula, MS 39568

Attention: Deputy CHENG, Jacob Davis

Subject: Approval Request for use of Solavitek's Advanced Mobile Universal Electrical Test Platform (AMUET) for stage two testing

Enclosures:

1. NSRP report on the use AMUET (non Megger)
2. Test Report of LCS 16 Cable RRQ5019
3. AMUET Calibration Procedure
4. AMUET Calibration Certificate
5. Current approved PROF300_Cable insulation Resistance Test Record
6. Example of a current stage two test report

Dear Mr. Davis:

Austal USA has completed a review of Solavitek's Advanced Mobile Universal Electrical Test Platform (AMUET) aboard multiple vessels of the LCS class. The AMUET is a portable Automated Test Equipment (ATE) that supports the installation and testing of electrical cables on ships. Austal USA requests approval for the use of the AMUET tool in new construction and service/repair of U.S. Navy vessels. Austal USA conducted 100's of successful tests with SSGC/Navy oversight and witness on several different cables on vessels. The AMUET tool has the capability to Megger test up to 500v. The AMUET system can support the following manufacturing steps:

1. Assist electricians with terminating connectors with augmented reality
2. Conduct resistance testing and creating a test report
3. Diagnosis of connector issues
4. Conduct a distance to fault location, open or short, using Time Domain Reflectometry (if needed)
5. Conduct insulation resistance testing using 500V Megger test

The AMUET tool has proven to greatly reduce the time for installation, termination and testing of cables. For example when used on the FLIR unit that has 100 pins, it reduced the termination/ connectorizing step by over 75% because it removed the need to have a second person at the other end of the cable and then the heads up display glasses made it much easier to complete the connectorizing. Once the connector was completed it took only 15 minutes to validate the integrity of the cable assembly with a detailed resistance check. The check is not just a simple pin to pin check but it also automatically validates every combination of every pin to every other pin and then every pin to ground. Once the test is complete it creates a detailed report per pin and stores the actual test resistance values. Once the report is complete, with a flip of a switch the tester can then begin the Megger test without changing any equipment. The Megger test takes another 15 minutes to complete, once done it creates another detailed report as before indicating the results per pin.

The agility and ease of use of this portable ATE reduces the pressure on our workforce and production management with better execution of all the tasks associated with cable building, maintenance, increasing quality and record keeping. This equipment goes above and beyond the current requirements and provides greater quality with reduced labor as well as better traceability and clarity of the as-built state of the cable. Overall, Austal USA and the Navy would both benefit from the use of this product.

Sincerely,

Shawn Wilber
Advanced Shipbuilding Manager

AUSTAL

Enclosures:

1. NSRP report on the use AMUET (non Megger)

2016-443 AMUET
Final Report and Te

2. Test Report of LCS 16 Cable RRQ5019

LCS 16 Cable
RRQ5019.pdf

3. AMUET Calibration Procedure

Solavitek
calibration-rev1.9.pc

4. AMUET Calibration Certificate

TBU_DEMO-Certific
ate of Conformance

5. Current approved PROF300_Cable insulation Resistance Test Record

PROF300_CableInsu
lationResistanceTes

6. Example of a current stage two test report

LCS36AF
LCS-0300-09-7001 Al

Cc: LCDR Ryan Bohning
Clay Smith