Department of the Navy SBIR/STTR Transition Program

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Topic # N192-124
Digital Twin Technology for Naval Maintenance Training and Operations
Qualtech Systems, Inc.

WHO

SYSCOM: ONR

Sponsoring Program: Office of Naval Research

Transition Target: CVN-78 Class, PEO Carriers

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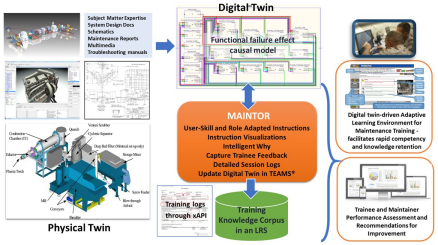
Other Transition Opportunities: Marine school houses for maintenance training, Army Remote Combat Vehicle program, Commercial customers in the medical and semiconductor equipment industry.



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Notes: The figure shows the MAINTOR solution architecture and illustrates the three key innovations of the proposed Model-based Adaptive and Intelligent Naval Training for Operational Readiness (MAINTOR) tool, namely:
• Comprehensive digital twin driven solution approach: Adapting QSI's TEAMS-based digital twin driven solution for guided troubleshooting for maintenance training facilitates generation of "ready and relevant" maintenance knowledge and training that gets adaptively and automatically updated from the underlying digital twin.
• Deeper exposition of knowledge and machine reasoning for intuitive human comprehension: Digital twin representation of the equipment and underlying AI reasoning that uses the digital twin to provide an intuitive understanding of the causal relationships between equipment failures and their effects that underlie optimal guided troubleshooting and maintenance and rapidly elevates the trainee to the level of an expert technician.
• Performance assessment, tracking and trainee capability-driven adaptive digital twin reasoning towards knowledge dissemination: Leverage well-established scaffolding approach and Learning Record Stores (LRS) for continuous performance assessment of the trainee, driving the training scenarios and knowledge dissemination for the Sailor based on her or his level of expertise.

WHAT

Operational Need and Improvement: The Navy is facing shortages of fully qualified technical personnel capable of diagnosing and addressing issues while training the next generation of maintainers prior to touching physical systems. In some instances, new systems are brought on-line for which no expertise exists. The Navy seeks to develop a modern training system that enables diagnosis and efficient repair through advanced modeling and provides much needed technology direction for maintenance training applied to complex, interconnected, advanced technology equipment.

Specifications Required: The key operational need and improvement in maintenance training can be realized through the adoption of modern technology that incorporates the knowledge of the equipment itself and is able to present the right information at the right time. Development of a cross-platform maintenance training system using advanced digital twin technology to facilitate the understanding of complex and idiosyncratic systems and afford powerful analytical tools to enable more efficient repairs will provide the necessary technology solution to Navy's operational needs for complex equipment maintenance.

Technology Developed: Advanced the state-of-art QSI's TEAMS® toolset for a digital twin-based maintenance training solution (MAINTOR) that allows easy development of adaptive learning sciences-enabled training, easy-to-integrate into existing training systems, easy-to-deploy, and positioned for ready transition and commercialization. QSI has developed a complete digital twin for maintenance training and operations for the selected target system, the CVN 78 - Plasma Arc Waste Destruction System (PAWDS) for deployment at C-ARTS facility.

Warfighter Value: As part of the Navy's Sailor 2025 roadmap, the Navy wants to provide Ready, Relevant Learning (RRL) to the Fleet, which will provide a career-long learning continuum where training is delivered at multiple points throughout a career by modern delivery methods to enable faster learning and better knowledge retention. MAINTOR, with its intelligent individualized training that focuses on comprehensive knowledge acquisition and retention, can be a key contributor to RRL through accelerated learning, minimization of knowledge atrophy, and provide on-the-job performance support that improves individual performance and enhances mission readiness. This will significantly reduce the cost and time for getting the training to the Fleet, increasing agility in the Navy's rapidly changing world.

WHEN

Contract Number: N68335-20-C-0828 **Ending on:** Sep 16, 2023

Milestone	Risk Level	Measure of Success	Ending TRL	Date
Complete initial version of PAWDS Digital Twin	Low	Improved troubleshooting steps for select set of PAWDS Error codes and Alarms	5	4th QTR FY22
Complete initial version of MAINTOR training application	Low	Technology demonstration to Navy and target system prime	6	3rd QTR FY23
Complete integrated PAWDS digital twin for troubleshooting with updates from the latest PAWDS documentation	Medium	Technology Demonstration to PEO Carriers leadership	6	4th QTR FY23
Provide demonstration unit to Navy warfighter and receive usage feedback and data	Medium	Sucessful demonstration of metrics such as first-time fix and improved equipment uptime	7	4th QTR FY23

HOW

Projected Business Model: QSI plans to provide the MAINTOR solution in the form of a licensed TEAMS® Toolset comprising of the TEAMS-Designer® modeling tool and the TEAMS-RDS® enterprise server that provides knowledge repository, intelligent reasoning, and model/content repository. TEAMS-Designer® is a Windows based software while TEAMS-RDS® can be deployed in any Windows and UNIX/LINUX based environment. TEAMS-RDS® will be augmented with the "Learning Sciences" MAINTOR Add-On module which will be provided to the Navy at no charge but will be licensed to commercial customers.

Company Objectives: QSI is positioning its technology for rapid introduction to the end-users, i.e., the Sailors who are currently acquiring knowledge and expertise for maintenance operations on the CVN-78 and the CVN-79. Currently, Huntington Ingalls Industries (HII) and Navy are developing the maintenance training curricula and package for the Plasma Arc Waste Destruction System (PAWDS) onboard CVN-78/79, and QSI's effort could lead to a timely introduction and usage for improving and augmenting the current maintenance training capabilities as they are being planned for Navy's Carrier-Advanced Reconfigurable Training System (C-ARTS) training environment.

Potential Commercial Applications: QSI has a long-standing record of successfully integrating the SBIR technology developed into its TEAMS® suite of COTS products. QSI's MAINTOR is a unique industry-agnostic offering that is readily commercializable with the TEAMS® COTS product. As initial commercial applications, QSI will target its existing commercial customer base with the MAINTOR training module as part of an add-on to TEAMS-RDS, the guided troubleshooting solution. Several of QSI's commercial customers has already expressed interest in adapting their equipment to digital twin for maintenance training and QSI's MAINTOR can readily fulfil their training needs.

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