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# CAD interoperability for Navy reuse in 3D printing, maintenance and training

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# CAD Interoperability for Navy Reuse in 3D Printing, Maintenance and Training



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## Project Summary

Additive Manufacturing (AM), 3D printing and CAD export are critical for Navy maintenance. Rapid change continues to occur across the design, engineering, manufacturing, and production process - many products can now be fabricated using AM methods. Iterative design processes require close collaboration of all entities involved from design to production; with AM, the lines between these previously stovepipe steps become blurred. A need to design, test and adopt different maintenance workflow becomes a necessity in cases of preventive and corrective maintenance of mechanical components on Navy ships and aircrafts where such operations have major impact on operational readiness. This project proposes to study and test elements that are identified as critical for effective deployment of AM in Navy operations, with specific emphasis on maintenance operations, while remaining sensitive to other Navy domains and activities where the use of AM could bring significant value. Our overarching goal is to provide a comprehensive approach that would lead towards reduction of energy costs, as well as reduction of materials and human resources engaged in that process.

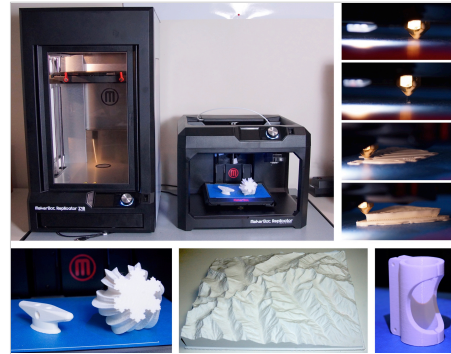


Fig. 1: 3D printing process



Fig. 2: 3D scanning

## Maintenance Workflow, Large Scale Adoption of Additive Manufacturing in Military Domain

- Proposed a conceptual model of a new maintenance workflow that includes collaboration of local team (Intermediate Maintenance Facility (IMF) or Ship's Intermediate Maintenance Activity (SIMA) with CAD expertise) and remote (off shore) team by the means of 3D scanning, 3D printing and stereoscopic viewing. Tested a feasibility of the proposed maintenance workflow (Fig. 1 and Fig. 2)
- Started design of a study focused on adoption of AM.

## X3D Graphics Standard for Navy Web Interoperability

- A widespread weakness of most defense modeling and simulation is that it remains completely disconnected from the CAD-based models used in maintenance systems.
- The X3D Graphics Standard allows import, export and interchange of many proprietary CAD formats for 3D printing and Web-based visualization.
- 3D printing and scanning capabilities are complementary. New work is defining technical requirements for an X3D Profile for 3D Printing and 3D Scanning.
- Fig. 3: Complex submarine models were reduced and "cut in half" to permit direct viewing of simulated operations and pier relationships.

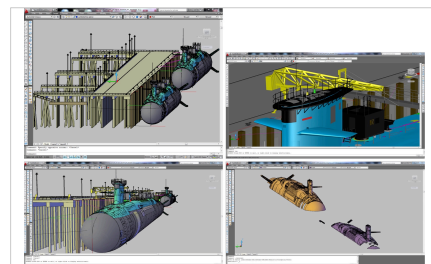


Fig. 3: CAD to X3D

## Field Trips, Conferences

- (1) USS BOXER, San Diego & USCGC HAWKSBILL, Monterey, CA
- (2) Port Hueneme, and SPAWAR, San Diego, CA
- (3) Web3D conference, Greece (presented two papers and a poster)

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## Established Collaborations

OPNAV N41 – Logistics Programs and Corporate Operations; SPAWAR & JAMR (SW); NAVFAC, Washington DC; NAVFAC Engineering and Expeditionary Warfare Center, Port Hueneme, CA; Lawrence Livermore National Laboratory (LLNL); NPS Center for Asymmetric Warfare.



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