



Long-term Knowledge Retention R&D

Long-term Knowledge Retention R&D for DoD Systems Systems Technology Panel 2007-07-31

Naval Surface Warfare Center, Carderock Division
Design Tool Development Branch, Code 2230

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Project Scope

The effort is a National Archives and Records Administration (NARA) R&D project over five years to look at the requirements and issues involved with the:

- transition from paper to digital 3-D product model data,
- aggregation of product models and related data from individual components to complete (representative) weapons systems, and
- long-term accessibility and interpretability of the archived digital weapon system data by future generations using neutral data standards for content and format.

Steering Group's Interests

- **NARA R&D - Long Term Knowledge retention of standards based product model data for historical data retrieval and future re-use for unanticipated needs**
- **NAVAIR (JEDMICS) - storage and retrieval of engineering drawings and 3-D product model data**
- **DLA (Supply Chain Management) - use of neutral 3-D product model data for weapons system support**
- **NAVSEA 05 (Product Data Integration/Exchange Warrant Holder) - use of standards based product model data for 3-D weapons system engineering evaluation and logistics support**

3-D Product Model Data Creates New Issues

Policy on how and what to buy

Transmission and storage of many large data files

Storage and management of redundant data (3-D product model data, 2-D drawings, cloud points, native CAD, pictures, video, manuals)

Reintegration of separate domain files for complete system descriptions

Bad CAD data (geometry) created in conversion processes

Rich data lost data during conversion to neutral data formats that support core industry data exchange/archiving requirements

Future interpretation of native file formats

Capturing data that will be useful for future problems and processes

Implementation agreements (will pump be exchanged in piping, electrical, or structural connection files, must be accessible through all views in the integrated model)

Data availability on shop floor (portable viewing hardware/software or paper drawing generation on the fly)

Viewers are needed for logisticians and others

Technical Data Guidance Referencing ISO 10303

STandard for the Exchange of Product model data (STEP)

DoD

- DoD Information Technology Standards Registry
(https://disonline.disa.mil/a/DISR/DISR_reports.jsp)
- DoD Acquisition Guidebook, Section 4.2.3.7.Data Management
(<http://akss.dau.mil/dag>)
- DLA ISO 10303 STEP Application Handbook 2.0, 21 December 2001
(<https://www.uspro.org>)
- MIL-DTL-31000C Technical Data Packages, 9 July 2004
- MIL-STD-1840C, Automated Interchange of Technical Information, 26 June 1997
- Joint Aeronautical Commanders Group, Strategy for Product Data Throughout the Life Cycle, 8 May 2002 (<https://www.uspro.org>)
- NATO STANdardization AGreement (STANAG) 4661 for ISO 10303 STEP AP 239 PLCS (DRAFT)

DON

- DON Policy on Digital Product/Technical Data, 23 Oct 2004
<http://navycals.dt.navy.mil/>)

NAVSEA

- NAVSEA INST 9040.3a Development, Maintenance, and Exchange of Product Model Data by Ship and Ship System Programs (Update in process)

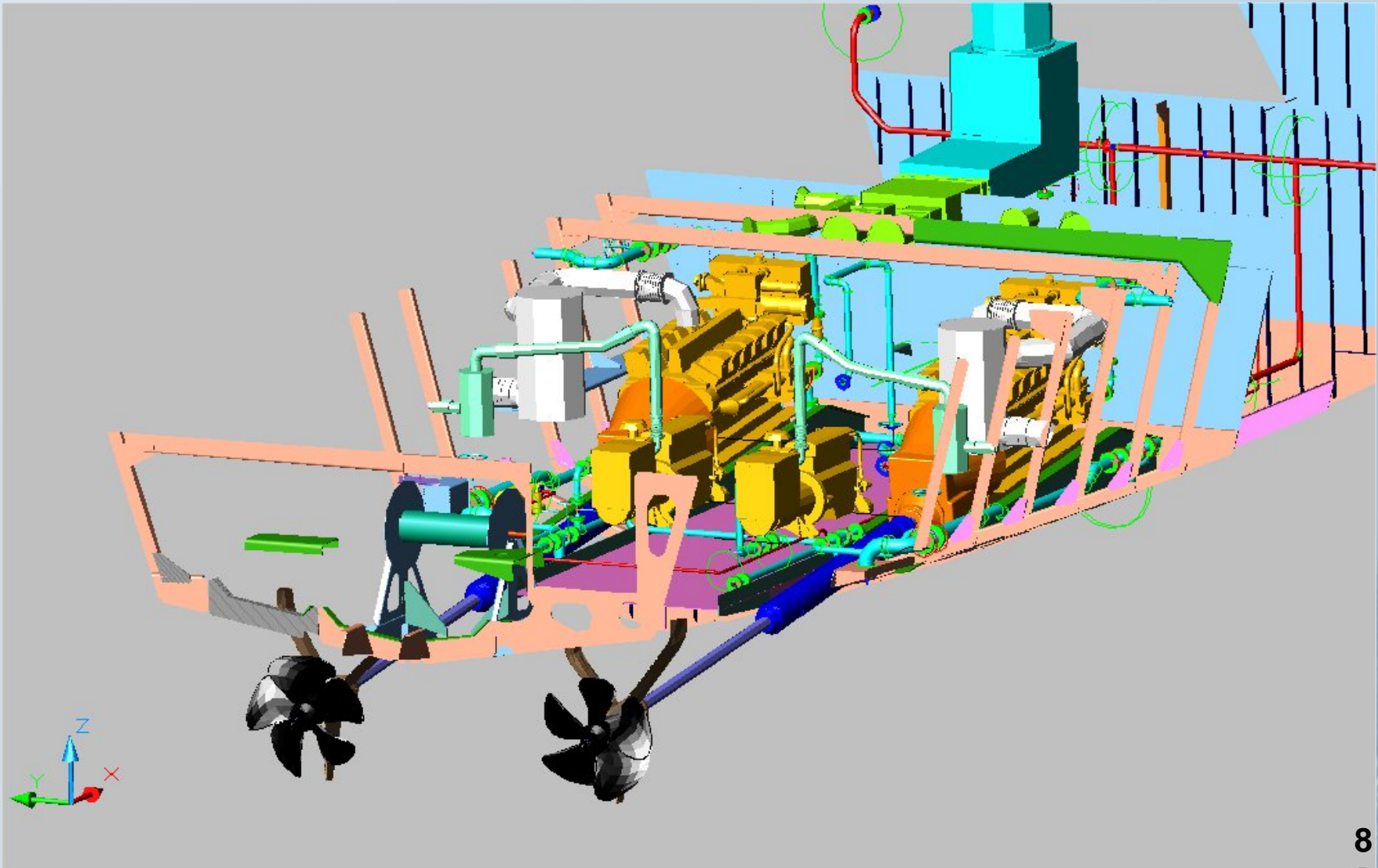
NSWC CD Interest

- **Demonstrate ISO 10303 STEP standards called out in the DON Technical Data Policy and other policies and the new issues they entail**
- **Construct a representative weapons system that can be used in demonstrating and testing the Leading Edge Architecture for Prototyping Systems (LEAPS) applications**
- **Continually reviewing CAD tools to determine best application to achieve the 5 year goal of creating a complete 3-D weapon system for use in R&D and software testing.**
- **Supports Code 2230 (Design Tool Development Branch) teams**
 - **Advanced Ship and Submarine Evaluation Tool (ASSET) team**
 - **Leading Edge Architecture for Prototyping System (LEAPS) team**
 - **Design Data Interoperability team**

Year 1 Accomplishments

- **Acquired and trained on multiple CAD software**
- **Developed test data using multiple CAD systems**
- **Reused TWR data from other CAD systems using STEP AP 203 as the import mechanism**
- **Reused TWR data from other projects (e.g. NSRP ISE demonstrations) to capture existing product model data**
- **Created basic use cases for archive to guide development of data required**
- **Initiated data requirement lists for discipline specific elements**
- **Initial data extraction from CAD system (SC)**

TWR modeled w/ ShipConstructor



ShipConstructor to STEP export process

- **ShipConstructor was initially chosen for development of the test model due to widespread use of SC in the shipbuilding industry coupled with significant DoD use of AutoCAD.**
- **Currently SC does not have any direct to STEP export capability. There is a SBIR PH II project working on AP 227 import / export .**
- **For our project we used the following process:**
 - **SC internal export command – to create AutoCAD data from the proprietary SC format**
 - **Opened AutoCAD data with AutoDESK Inventor**
 - **Save copy as STEP AP214 file**
- **This process addresses the geometry portion of the extraction for the Product Model.**
- **We are analyzing the extraction of additional data.**

Year 2 - Accomplishments

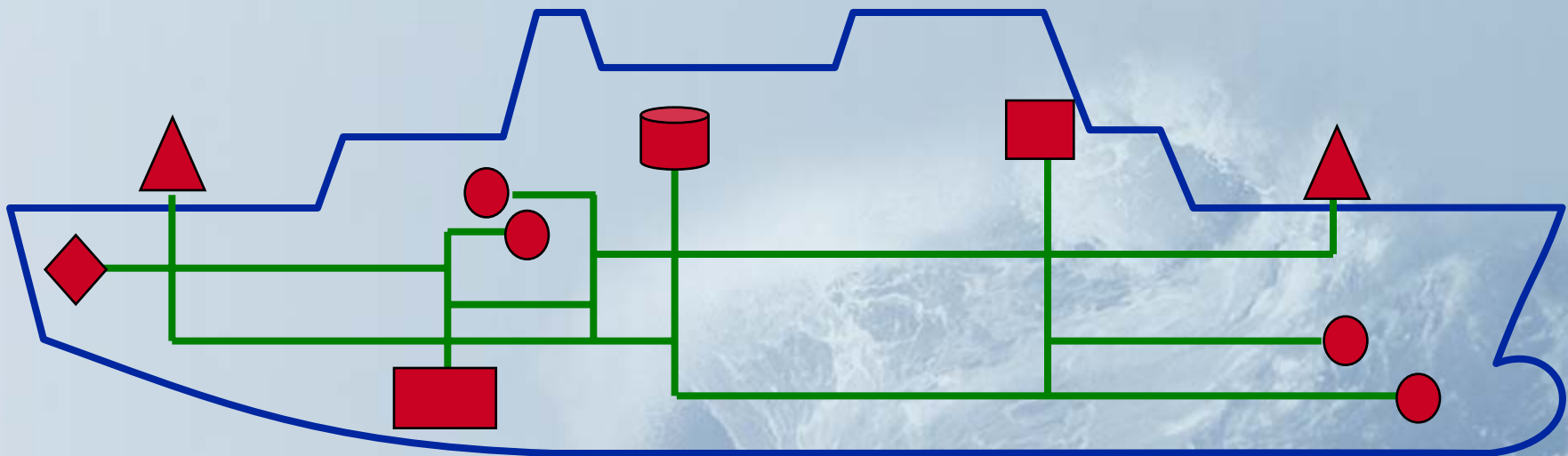
- **Continued refinement of archive data set**
- **Implemented alternate CAD systems to provide additional source of test data**
- **Determined the applicability of various STEP AP's (AP 232, 239) for use as part of long term storage solution.**
- **Investigation of down stream data consumers to expand use cases, data requirements and applicable data types.**

Year 3 – Plans

- **Continue refinement of archive data set**
- **Expansion of data requirements for other disciplines (e.g. electrical)**
- **Familiarization with AP 232 for packaging 3-D digital technical data packages**
- **Familiarization with AP 239 for organizing digital data for long-term lifecycle management.**
- **Investigation of down stream data consumers to expand use cases, data requirements and applicable data types.**

Representative Product Model Contents

- Ship Structural Envelope (moulded form, arrangements, structure)
- Distributed Systems (piping, electrical, HVAC, cableways, mechanical)
- Mission Subsystems/Equipment/Parts (mechanical, electronics, outfit and furnishings, weapons, vendor libraries/catalogs)



End of Project Target Deliverable

Representative product model of a DoD system (TWR 841) based on AP 239 Product Lifecycle Support

- native CAD mechanical data
- ISO 10303 AP 214 3D mechanical data
- parts libraries/catalogs
- raster drawings
- vector drawings
- photographs
- 3-D cloud points
- operation/maintenance/repair manuals (native, HTML, S1000D) and
- other data

Example AP 232 Technical Data Packages

Project Technical Challenges

Exporting data from ShipConstructor to get CAD file formats useful to NAVAIR and DLA

Exporting component data from ShipConstructor while retaining systems relationships

A draft Part Library/Catalog Exchange Implementers Agreement template needs to be organized by NSRP ISE, T 23, DoD, etc that rationalizes

- **ISO 13584 (Part Library)**
- **ISO 15926 (Integration of Lifecycle Data)**
- **ISO 22745 (Open Technical Dictionary) eOTD is the only instantiation of OTD in process and is codifying NATO cataloging requirements**
- **NSRP Common Parts Catalog (CPC).**

Management of operation/maintenance/repair manuals needs to be organized