

# Automating the Transition of Product Model Data



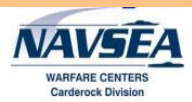
*Ben Kassel*

Naval Surface Warfare Center  
Carderock Division

# Who wants product data...

## What data do they want ...

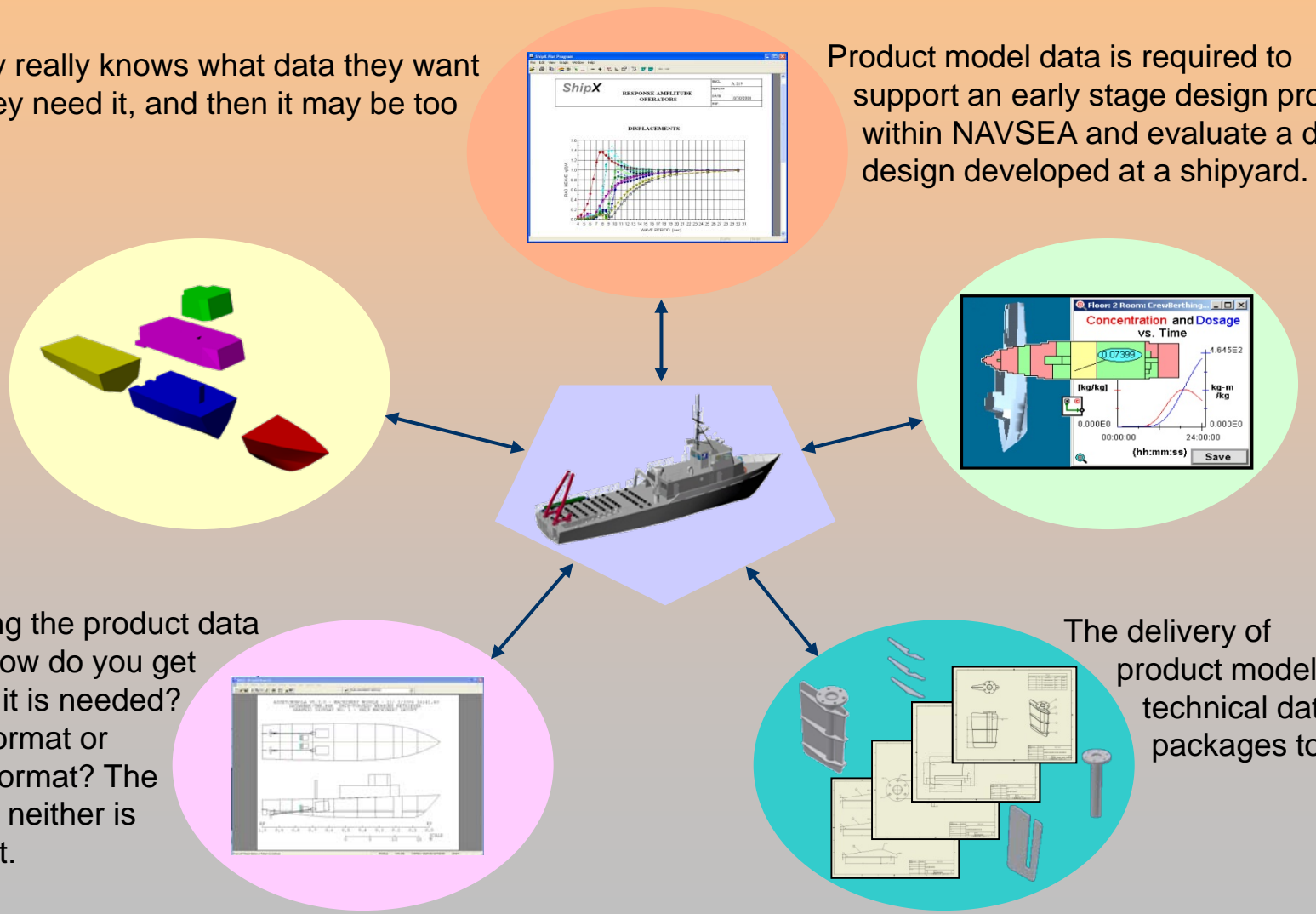
### When do they want it?



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Nobody really knows what data they want until they need it, and then it may be too late

Product model data is required to support an early stage design process within NAVSEA and evaluate a detail design developed at a shipyard.



Assuming the product data exists, how do you get it where it is needed? Native format or neutral format? The reality is neither is sufficient.

The delivery of product model based technical data packages to the Navy

# Digital Product Model Data

A brief review



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Product Model data is the combination of 3D geometry and non-graphic attributes to define ship objects such as a piece of equipment, deck, bulkhead, etc. Product Model data can be organized to define interim products and ultimately the entire ship.

**Part & System Definition** (Caterpillar 3512, Starboard Main Engine, Propulsion System)

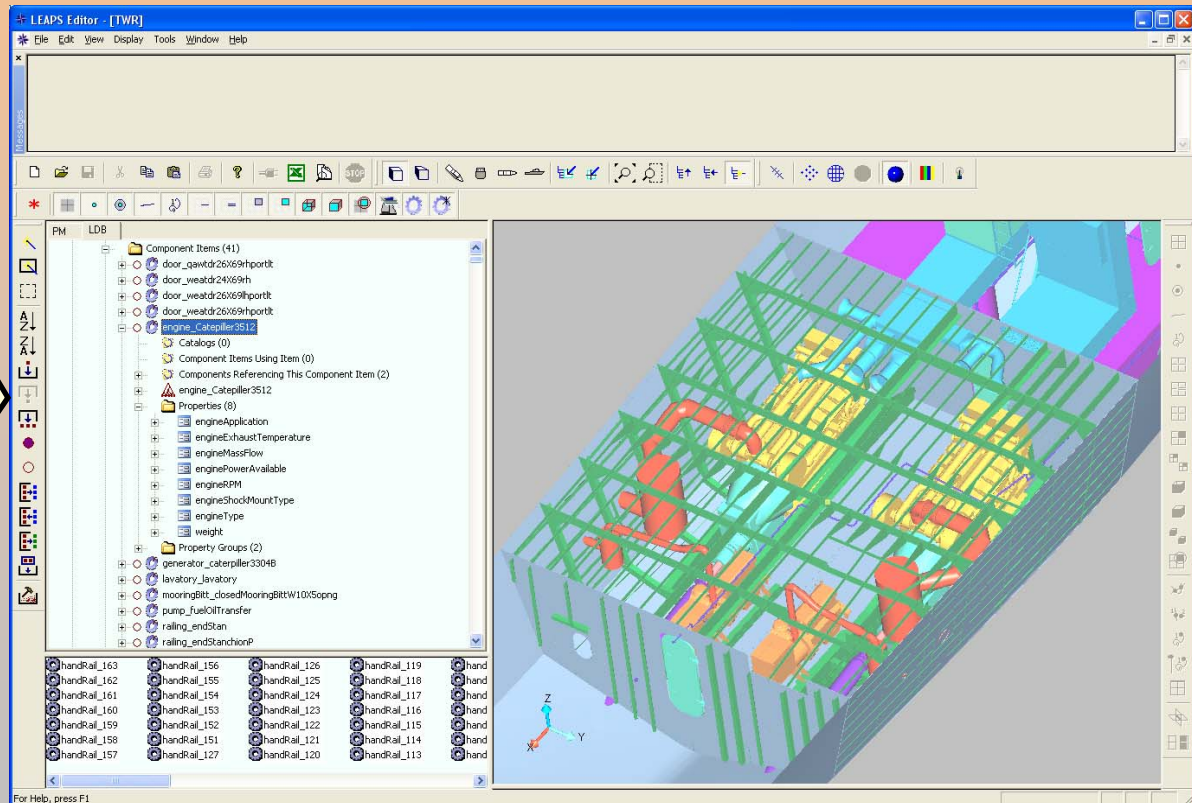
**Design Definition** (12 cylinder 4 stroke diesel engine )

**Physical** (Geometry, material connections, etc.)

**Engineering Definition** (1175 HP, 6464kg, 170mm bore, 190mm stroke)

**Process Definition** (Starting instructions, shaft alignment)

**Logistics Support** (FGC, SCLSIS, etc.)



Advocates anticipate substantial economies from Product-Model-based design, construction, and service-life support activities due to better integration and reduction of engineering effort to locate, verify, and transform information.

# Product Model Data and Exchange

## Current Policy



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**DON Policy stipulating that product model data should be delivered in STEP format**

**NAVSEA instruction for the development, maintenance, and acquisition of product model data**



THE ASSISTANT SECRETARY OF THE NAVY  
Research Development and Acquisition  
1000 Navy Pentagon  
Washington DC 20350-1000

OCT 2 3 2004

MEMORANDUM FOR DISTRIBUTION

Subj: DON POLICY ON DIGITAL PRODUCT/TECHNICAL DATA

- Ref:
- (a) DEPSECDEF Memorandum, "Policy for the Transition to a Digital Environment for Acquisition Programs", 2 July 1999
  - (b) USD (A&T) Management Reform Memorandum #2, "Moving to a Paper-free Contracting Process by January 1, 2000", 21 May 97 w/Addendum, 29 July 1997
  - (c) USD (A&T) Memorandum, "Guidance for the Transition to a Digital Environment for Acquisition Programs", 15 July 1997
  - (d) USD A&T Memorandum, "Transition to a Digital Environment for Acquisition Programs (Paperless Program Office)", 15 April 1999
  - (e) SECNAVINST 5000.36, Department of the Navy Data Management and Interoperability, 1 November 2001
  - (f) GENADM/CNO Washington DC/032300ZAPR2001, "Implementing the Web Enabled Navy"
  - (g) Web-Enabled Navy Logistics Integration (WEN-L) Plan, June 2001
  - (h) NAVAIR Itr Ser AIR-3.3/005, "Digital File Formats Required for Technical Data Repository and Distribution Management", 1 May 2003
  - (i) DoD Directive 5230.24, Distribution Statements on Technical Documents, 18 March 1987
  - (j) SECNAVINST 5000.2B, "Implementation of Mandatory Procedures for Major and Non-major Defense Acquisition Programs and Major and Non-major Information Technology Acquisition Programs", 6 December 1996
  - (k) DOD Directive 5000.1, "The Defense Acquisition System", 12 May 2003
  - (l) DoD Memorandum on the DoD Information Technology Standards Registry (DISR), 15 July 2004; DoD CIO, USD AT&L, and JS
  - (m) Joint Aeronautical Commanders Group, Strategy for Product Data Throughout the Life Cycle, 8 May 2002
  - (n) DISA DIICOE, Version 3.1, Baseline Specifications, 29 April 1997
  - (o) Global Information Grid, Overarching Policy, DoD Directive 8100.1, 19 Sept 2002
  - (p) ASN RDA Memorandum on Summary of FORCEnet EXCOM, 19 February 2004, ASN RDA
  - (q) SECNAVINST 4105.1A, Independent Logistics Assessment (ILA) and Certification Requirements
  - (r) DON Independent Logistic Assessment Handbook, NAVSO P-3692, December 2003

This memorandum updates existing DoN Policy for Digital Product/Technical Data. New business practices relying on the use of digital methodologies and products have generated significant cost savings, reduced process cycle times and expanded capability for



DEPARTMENT OF THE NAVY

NAVAL SEA SYSTEMS COMMAND  
2531 JEFFERSON DAVIS HWY  
ARLINGTON VA 22242-6160

IN REPLY REFER TO

NAVSEAINST 9040.3  
Ser 043/056  
4 Mar 98

NAVSEA INSTRUCTION 9040.3

From: Commander, Naval Sea Systems Command

Subj: DEVELOPMENT, MAINTENANCE, AND EXCHANGE OF PRODUCT MODEL DATA BY SHIP AND SYSTEM PROGRAMS

- Ref:
- (a) NAVSEAINST 4120.7
  - (b) NSRP Document No. 0424, NIDDESC Piping Application Protocol
  - (c) NSRP Document No. 0425, NIDDESC Electrical/Cableway Application Protocol
  - (d) NSRP Document No. 0426, NIDDESC Heating, Ventilation, and Air Conditioning (HVAC) Application Protocol
  - (e) NSRP Document No. 0428, NIDDESC Outfit and Furnishings Application Protocol
  - (f) NSRP Document No. 0429, NIDDESC Ship Structure Application Protocol
  - (g) NAVSEA Technical Manual T0750-AH-PRO-010/CAD 2, 3D Product Modeling Practices Manual
  - (h) MIL-PRF-28000
  - (i) MIL-STD-1840

### 1. Purpose

a. To provide policy for developing, maintaining, and using three dimensional (3D) computer generated product models and associated data files in support of Navy ships and ship systems during all phases of design, acquisition, construction, conversion, repair, maintenance, modernization, and in-service life cycle support.

b. To insure data transfer mechanisms and standards are implemented to effectively provide for the exchange of 3D Computer Aided Design (CAD) product model data, including digital design and engineering information between Department of the Navy (DON) activities, commercial shipbuilders, suppliers, and other marine industry organizations.

### 2. Applicability and Scope

a. This instruction applies to all ship and ship system design, acquisition, construction, conversion, repair, maintenance, modernization, and life cycle support programs under the cognizance of NAVSEA and/or supporting shore activities.



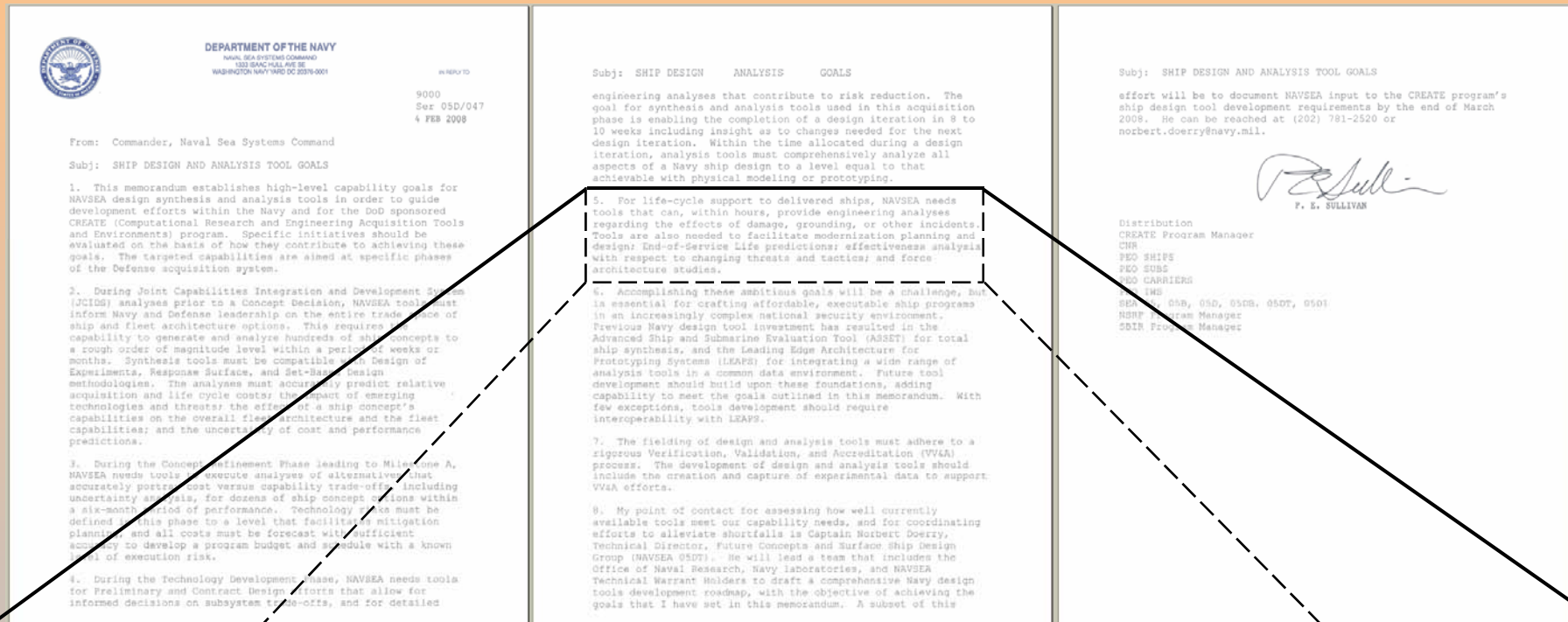
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# Uses of the Digital Product Model

## Vice Admiral Sullivan's vision



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5. For life-cycle support to delivered ships, NAVSEA needs tools that can, within hours, provide engineering analyses regarding the effects of damage, grounding, or other incidents. Tools are also needed to facilitate modernization planning and design; End-of-Service Life predictions; effectiveness analysis with respect to changing threats and tactics; and force architecture studies.

# Uses of the Digital Product Model

## Vice Admiral Sullivan's vision



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 <p>DEPARTMENT OF THE NAVY NAVAL SEA SYSTEMS COMMAND 1332 BRANCHDALE DRIVE WASHINGTON NAVY YARD DC 20376-0001</p> <p>IN NRPV 10 9000 Ser OSD/047 4 FEB 2008</p> <p>From: Commander, Naval Sea Systems Command</p> <p>Subj: SHIP DESIGN AND ANALYSIS TOOL GOALS</p> <p>1. This memorandum establishes high-level capability goals for NAVSEA design synthesis and analysis tools in order to guide development efforts within the Navy and for the DoD sponsored CREATE (Computational Research and Engineering Acquisition Tools and Environments) program. Specific initiatives should be evaluated on the basis of how they contribute to achieving these goals. The targeted capabilities are aimed at specific phases of the Defense acquisition system.</p> <p>2. During Joint Capabilities Integration and Development System (JCIDS) analyses prior to a Concept Decision, NAVSEA tools must inform Navy and Defense leadership on the entire trade space of ship and fleet architecture options. This requires the capability to generate and analyze hundreds of ship concepts to a rough order of magnitude level within a period of weeks or months. Synthesis tools must be compatible with Design of Experiments, Response Surface, and Set-Based Design methodologies. The analyses must accurately predict relative acquisition and life cycle costs; the impact of emerging technologies and threats; the effect of a ship concept's capabilities on the overall fleet architecture and the fleet capabilities; and the uncertainty of cost and performance predictions.</p>	<p>Subj: SHIP DESIGN ANALYSIS GOALS</p> <p>engineering analyses that contribute to risk reduction. The goal for synthesis and analysis tools used in this acquisition phase is enabling the completion of a design iteration in 8 to 10 weeks including insight as to changes needed for the next design iteration. Within the time allocated during a design iteration, analysis tools must comprehensively analyze all aspects of a Navy ship design to a level equal to that achievable with physical modeling or prototyping.</p> <p>5. For life-cycle support to delivered ships, NAVSEA needs tools that can, within hours, provide engineering analyses regarding the effects of damage, grounding, or other incidents. Tools are also needed to facilitate modernization planning and design; End-of-Service Life predictions; effectiveness analysis with respect to changing threats and tactics; and force architecture studies.</p> <p>6. Accomplishing these ambitious goals will be a challenge, but is essential for crafting affordable, executable ship programs in an increasingly complex national security environment. Previous Navy design tool investment has resulted in the Advanced Ship and Submarine Evaluation Tool (ASSET) for total ship synthesis, and the Leading Edge Architecture for Prototyping Systems (LEAPS) for integrating a wide range of analysis tools in a common data environment. Future tool development should build upon these foundations, adding capability to meet the goals outlined in this memorandum. With few exceptions, tools development should require interoperability with LEAPS.</p> <p>7. The fielding of design and analysis tools must adhere to a</p>	<p>Subj: SHIP DESIGN AND ANALYSIS TOOL GOALS</p> <p>effort will be to document NAVSEA input to the CREATE program's ship design tool development requirements by the end of March 2008. He can be reached at (202) 781-2520 or norbert.doerry@navy.mil.</p>  <p>F. E. SULLIVAN</p> <p>Distribution CREATE Program Manager CNR PEO SHIPS PEO SUBS PEO CARRIERS PEO IWS SEA 09, 05B, 05D, 05DB, 05DT, 05DI NRPV Program Manager CINCPACFLT Program Manager</p>
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# Product Model Data and Exchange

## Proposed Policy



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### NAVSEA instruction 9040.3A ACQUISITION AND MANAGEMENT OF PRODUCT MODEL AND OTHER TECHNICAL DATA

5. Policy. Product Model and other technical data shall be procured and accepted in accordance with reference (a), reference (c), and the following:

a. Ship and ship system design, acquisition, and fleet support activities shall procure and accept product model data in accordance with ISO 10303, Standard for the Exchange of Product model data (STEP) format, native Computer Aided Design (CAD) files, and/or Leading Edge Architecture for Prototyping Systems (LEAPS) format. This should be based on solutions that provide the best technical and cost performance as determined by a NAVSEA business case analysis.

# NAVSEA Instruction 9040.3A

## Acquisition and Management of Product Model Data



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- **Provide guidance for the acquisition of product model and related technical data.**
- **This instruction applies to product models and technical data derived directly from the product model such as engineering analysis, bills of material, and drawings.**
- **This instruction implements the DON POLICY ON DIGITAL PRODUCT/TECHNICAL DATA issued in 2004 and the NAVSEA SHIP DESIGN AND TOOLS GOALS issued in 2008.**
- **This instruction does not specify a format explicitly, but instead requires Navy stakeholders to reach consensus on the definition and delivery of product model data.**
- **Balances cost, data utility, and data exchange technology.**



**Getting the right data to the right place at the right time for the right cost**

# Product Model Data and Exchange

A NAVSEA perspective



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## A two level approach for the exchange of product model data

**First level :** Support configuration management, logistics support, provisioning, spares, and repairs through the use of STEP for geometry, product structure, non graphical attributes, and to manage configuration items of the as-built / as-maintained ship.

**Second level :** Deliver the as-designed class model of

- 1) molded forms suitable for defining a general arrangement
- 2) scantling level of detail of structure to support structural (and other types of) analysis
- 3) functional distributed systems model (i.e. path, components, and connections)
- 4) compartmentation, including accesses, opening, and tightness
- 5) plates, stiffeners, brackets, collars, and other structural components as parts
- 6) distributed system components, fittings, and equipment as parts.

# Product Model Data and Exchange

## Ships Specification 098 – 3D Product Model



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**The Digital Product Model shall be delivered in both a native and neutral format. The neutral format shall comply with the Department of the Navy Policy on Digital Product/Technical Data dated 23 October 2004. ISO 10303 Part 214 shall be used to define the Digital Product Model geometry. ISO 10303 Part 239 shall be used to define product structure, the relationship between objects, and configuration management data. The Builder shall provide a list in the PPM<sup>1</sup> of each data exchange specification (DEX) that will be used to support the ISO Part 239 exchange. In the event the contractor can demonstrate the need for an additional DEX, then the contractor shall develop a NAVSEA approved DEX.**

<sup>1</sup> Process and Procedures Manual

# Product Model Data and Exchange

## The Problem



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**Implementations of shipbuilding application protocol translators by the commercial CAD vendors, analysis, other tool suppliers, the shipyards, and NAVSEA is for all intensive purposes non-existent.**

**The Ship Common Information Model defines the minimum information that must be maintained within an IPDE and the format needed to exchange it to enable effective interoperability. It does not provide a means for storing or exchanging data.**

**Resources available to develop translator software are not readily available.**

# Product Model Data and Exchange Solutions



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**Translators can be developed by the supplier of the tool, the user or a third party. In order to increase the options available to the Navy shipbuilding industry, an SBIR was awarded to two companies.**

**ATA Engineering Inc. : Develop processes and interface tools to enable the bi-directional transfer of product model data between shipbuilders during the design and construction life cycle phases, and the delivery of the as-built product model to the Navy using a set of proprietary data exchange classes, independent of any standard but built around the LEAPS data models, since LEAPS is the target data repository.**

**CostVision Inc. : Develop processes and interface tools to enable the bi-directional transfer of product model data between shipbuilders during the design and construction life cycle phases, and the delivery of the as-built product model to the Navy using PLCS DEX (Product Life Cycle Support Data EXchange Specification) open source technology, and extend them to the integrated shipbuilding design and analysis environment.**

# Product Model Data and Exchange

The preferred solution



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## IT DOES NOT REALLY MATTER

**One approach directly generates data that complies with an ISO standard  
..... well sort of!**

- geometry is defined using STEP AP203 and AP214
- data exchange specifications are based on STEP AP239
- data exchange specification may be managed by NAVSEA 05
- reference data may be managed by NAVSEA 05
- requires an AP239 translator

**One approach generates proprietary data  
..... well sort of!**

- data classes are proprietary
- geometry is defined using STEP AP203 and AP214
- PLCS data is treated as any other data source
- AP239 translator can be developed, if warranted by a business case
- requires a ShipPDX translator

**Both solutions can generate PLCS data for long term archival.  
Both solutions can support end to end data delivery.  
Both solutions can implement the Ship Common Information Model.**

# STEP based Data Exchange NSRP Projects

Demonstration of value critical to future funding



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- **FY12 funding contingent on evidence of value to Navy shipbuilding/repair from ongoing projects**
- **look and detect value from NSRP projects and activities you are involved in ... implementation is key**
- **convey value message to Navy sponsors**
- **Connect with shipbuilding PMs wherever possible**
- **Cost is of no value until real costs can be identified and analyzed**
  
- **Show the path to goodness**

# Uses of the Digital Product Model

## Rear Admiral Eccles affirmation



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DEPARTMENT OF THE NAVY  
NAVAL SEA SYSTEMS COMMAND  
1333 ISAAC HULL AVE SE  
WASHINGTON NAVY YARD DC 20376-0001

IN REPLY TO:  
9000  
Ser 05T/015  
SEP 29 2010

### MEMORANDUM

From: Commander, Naval Sea Systems Command (SEA 05)

Subj: SHIP DESIGN AND ANALYSIS TOOL GOALS

Ref: (a) COMNAVSEA memo 9000 Ser 05D/047 of 4 Feb 08

1. This memorandum reaffirms the ship design and analysis tool goals detailed in reference (a) and updates the point of contact information. The goals in reference (a) should continue to guide ship design and analysis tool and ship design process development efforts within the Navy and for the DoD sponsored CREATE (Computational Research and Engineering Acquisition Tools and Environments) program. Specific initiatives should be evaluated on the basis of how they contribute to achieving these goals.

2. To achieve the time objectives of reference (a), tools development should continue to build upon previous Navy design and analysis tool investment in the Advanced Ship and Submarine Evaluation Tool (ASSET) and the Leading Edge Architecture for Prototyping Systems (LEAPS) for integrating a wide range of design and analysis tools in a common environment. Future tool development should build upon these foundations, adding capability to meet the goals outlined in reference (a). With few exceptions, tools development should require interoperability with LEAPS.

3. As stated in reference (a), the development of design and analysis tools should continue to include as needed the creation and capture of experimental data to support Verification, Validation, and Accreditation (VV&A).

4. NAVSEA is committed to creating and maintaining LEAPS models for every major ship class in the U.S. Navy to enhance lifecycle support and incident response. A future goal is for NAVSEA to maintain a LEAPS model for every ship in the fleet.

5. Because ship design and analysis tools are applicable across multiple ship programs, and because tool development must often occur before ship programs are adequately funded, it is impractical to develop and maintain tools on an ad hoc basis with each Program office. Therefore, Annual Execution Agreements for programs should include general resources for design and analysis tool development and transition.

Subj: SHIP DESIGN AND ANALYSIS TOOL GOALS

6. My point of contact for assessing how well currently available tools meet the needs specified herein and in reference (a), and for coordinating efforts to develop a Memorandum of Understanding (MOU) among stakeholders to alleviate shortfalls is Seth Cooper, SEA 05T1T. Seth Cooper can be reached at (202) 781-3139 or [seth.cooper@navy.mil](mailto:seth.cooper@navy.mil).

*T. J. Eccles*  
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