Harmonizing Model-Based Standards for Shipbuilding

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Presenters:
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Ryan Bounds, Design Engineer
Model-Based Engineering

- AAS in Mechanical Engineering Technology
- BA in History from Texas A&M University
- Model-Based Definition lead developing the model-based standards strategy for NNS’s digital evolution
- 10+ years in shipbuilding
  - Manufacturing
  - Instructor (GD&T Evangelist & MBD practices)
  - Design Engineering
  - Manufacturing Engineering
  - Model-Based Engineering
- GDPT-2009 Senior Level
Presentation Topics

• HII-Newport News Shipbuilding (NNS) Overview
• Problem Description and Objective
• Lines of Effort
• Discussion/Conclusion
HII SHIPBUILDING DIVISIONS

NEWPORT NEWS SHIPBUILDING
- **Ford-Class** Aircraft Carrier Programs
- **Aircraft Carrier Refuelings** (RCOH) & Inactivation
- **Submarine Programs** New Construction
- **Submarine Onsite and CVN Offsite Fleet Support Programs**
- **Engineering and Planning Yard** Programs
- **Kenneth A. Kesselring** Site Operations

INGALLS SHIPBUILDING
- **America-class** Large Deck Amphibious Assault Ships
- **San Antonio-class** Amphibious Transport Dock Ships
- **Arleigh Burke-class** Aegis Guided Missile Destroyers
- **Legend-class** National Security Cutters

MISSION TECHNOLOGIES
- **Cyber & Electronic Warfare**
- **Live, Virtual, Constructive Solutions**
- **Fleet Sustainment**
- **Nuclear & Environmental Services**
- **Intelligence, Surveillance & Reconnaissance**
- **Unmanned Systems**
About Newport News Shipbuilding

• **Sole designer, builder and refueler** of U.S. Navy aircraft carriers

• **One of only two U.S. shipyards** capable of designing and building nuclear-powered submarines

• **Designs, builds, maintains and inactivates** the most advanced ships in the world using expertise in nuclear propulsion, naval design and manufacturing

• **Largest industrial employer** in Virginia
Why Go Digital?
Manufacturing Demands

Standards Contribution

- Repeatable solutions
- 1st time quality/accuracy
- Data exchange and efficiency
- Outsourcing interoperability (6 million man-hours per year)
- Digital thread sustainment (Navy)
- MBSE Requirements management
  - Traceability
  - Certification
  - Early validation
- Drawingless Products
- Clear end-user interpretation/understanding

“Manufacturing Need for Technology Efficiency at Scale”—Matt Needy (NNS VP, ShipTech 2024)
Current standards that address digital needs are limited and legacy data-based.

Define and perform work for activities that will ensure efficient data development, management, and exchange for engineering and manufacturing operation activities for a new digitally designed Naval program.
Model-Based Standards

Define standards that support the way ships are designed, built, and maintained.

Shipbuilding Model-Based Standards must support:

- Assembly configurations for design & build
- Data exchange between partners and customers
- Integration between internal PLM and ERP Systems
- Integration with external Systems (Navy)
- Automation of derivative products for build / test & inspect processes
- Advanced simulation & predictive models (Digital Twins)
- Data that will persist for the lifecycle (30-50 years)
Lines of Effort

- Author 3D Technical Data that represent real-world designs and are digitally ready for:
  - Manufacturing
  - Quality
  - Sustainment
- Produce native and neutral formats to be tested against the Standards and Tools by the Qualification Team

- Review existing standards
- Identify gaps
- Write new standards
- Continuously manage standards, iterate and update over time

- People-focused use of 3D Technical Data including:
  - OCM guidance & expertise
  - Workforce transformation
  - Workforce communications
  - Workforce training
  - Facilitation guidance to teams

- Maintains Mission and Vision
- Provides operating guardrails for teams to work within
- Provides guidance when teams stall

- Evaluate software tools for: Interoperability, Data Exchange, Security
- Review software tools: Available, Emerging, Posit future state technology needs

- Evaluate 3D Technical Data Examples for digital-readiness using:
  - Software Tools
  - Standards
  - Examples
  - Report results
HII-NNS Planned Digital Environment

Each software tool is mapped to the Data Creation Steps

*Engineering Model = Validation CAE of Design Model

CAE and Analysis is not in the scope for now, but we will leave in the block to show it is future work

OUT OF CURRENT SCOPE
Use Cases

**Design**
1. Design Review
   a. Part
   b. Assembly
   c. System*
2. Engineering Changes
   a. Part
   b. Assembly
   c. System*

**Planning**
1. Ship Plan
   a. Part
   b. Assembly
   c. System*
   d. Modules**
2. Shop Plan
   a. Part
   b. Assembly
   c. System*

3. Manufacturing Model
   a. Part
   b. Assembly
   c. System*

**Build & Test**
1. Fab Work Package – Part and Components
2. Install Work Package – Assembly
3. Inspection Work Package
   a. Part
   b. Assembly
   c. System*
4. Test Work Package

**Supply Chain**
1. Build to Print
2. Build to Spec
3. Inspection Work Package
4. Receipt Inspection

*System: Refers to a specific functional area (e.g., structural, electrical, piping)
**Modules: Refers to a strategic boundary within the ship that includes many systems

This list is not exhaustive. New use cases will arise as the project develops.
Standards

**Design**
- ASME Y14
- LOTAR
- QIF (Quality Information Framework)
- ISO 10303 (STEP & PLCS)
- SAE EIA-649-1 (Configuration Management)
- MIL-HDBK61A (Configuration Management)

**Planning**
- ISO 14306, 14739-1 (3D Viewables)
- SAE EIA-649-1 (Configuration Management)
- MIL-HDBK-61A (Configuration Management)
- ISO 10303 (STEP)

**Build & Test**
- MIL-STD 881F (Work Breakdown Structure)
  - MIL-STD 31000B
  - DoDI 5000.97
  - MIL-HDBK-539
  - Dev/Sec/Ops?

**Supply Chain**
- NAVSEA 9090-700E (SCLIS)
- S-Series
- MTConnect
  - ASME, ASTM (Process Standards)
  - ISO 16949 (IATF AIAG Quality Management System)
    - ASME Y14, B46, B89
    - SAE AS9000, AS9102
  - QIF (Quality Information Framework)
Cohorts

Supply chain vendors have personas in each cohort that match the HII-NNS personas

Authors

Authors 3D Data
- Creates standardized Data and Refers to Standards
  - Repair Officer/Lead, USN
  - Design Engineers
  - Quality Engineers
  - Manufacturing Engineers
  - Tooling and Fixturing
  - CAD Administrator

Analysts

Reads and Manipulates 3D Data
- Uses Standardized Data and Refer to Standards
  - Specialist, USN
  - Quality Assurance, USN
  - CNC Programmers
  - CMM Programmers
  - Machinists
  - Procurement Specialist

Consumers

Reads 2D Drawings
- Today, Needs to Read and use 3D data
- Uses Standardized Data
  - Supply, USN
  - Operator, USN
  - Inspectors
  - Assembly Teams
  - Technical Writer
  - Area Planner

Command

Needs to Know the Value of 3D Data
- Refers to Standards
  - Command, USN
  - Executives
  - Management
  - Sales
  - Document Control
  - Supply Chain Manager

Supply chain vendors have personas in each cohort that match the HII-NNS personas.
Develop & Implement a Standards Strategy

**Governance**
- Maintains Mission and Vision
- Provides operating guardrails for teams to work within
- Provides guidance when teams stall

**Adoption**
- People-focused use of 3D Technical Data including:
  - OCM guidance & expertise
  - Workforce transformation
  - Workforce communications
  - Workforce training
  - Facilitation guidance to teams

**Examples**
- Author 3D Technical Data that represent real-world designs and are digitally ready for:
  - Manufacturing
  - Quality
  - Sustainment
- Produce native and neutral formats to be tested against the Standards and Tools by the Qualification Team

**Tools**
- Evaluate software tools for: Interoperability, Data Exchange, Security
- Review software tools: Available, Emerging, Posit future state technology needs

**Standards Harmonization**
- Review existing standards
- Identify gaps
- Write new standards
- Continuously manage standards, iterate and update over time

**Qualification**
- Evaluate 3D Technical Data Examples for digital-readiness using:
  - Software Tools
  - Standards
  - Examples
  - Report results

Work Performed in Collaboration with Action Engineering
Thank You for your Attention...

Model Based Design – Efficient & Effective Design/Build Information
Technology for Integrated Digital Shipbuilding (IDS)

Our Workforce is Thinking Digital

Visual Work Instructions (VWI’s)
- Provides step by step digital work instructions
- Exposes all Technical information required for a given installation
- Excludes non-installation specific information