1) Potential for Applying Artificial Intelligence (AI) in Shipyards Processes

2) Building "Failure Data & Prediction Models" for Ship Construction & Sustainment Support

NSRP Sustainment Panel Meeting
September 24,2025

Presenters:
Subrat Nanda; ABS
Karen Cassidy: HII-Ingalls Shipbuilding
Alaysha Shearn; HII-Newport News Shipbuilding
Mark Debbink; HII-Newport News Shipbuilding

NSRP NATIONAL SHIPBUILDING RESEARCH PROGRAM™ Taking Shipbuilding and Repair to the Next Level

ABS

HII

NSRP Panel Project 2018-455-041

Potential for Applying Artificial Intelligence (AI) in Shipyards Processes

NSRP Sustainment Panel Meeting on September 24, 2025
San Diego, CA

Presenters:
Alaysha Shearn; HII-Newport News Shipbuilding
Mark Debbink; HII-Newport News Shipbuilding

Project Overview

- NSRP Panel Project 2018-455-041
- NSRP Investment: $200K
- Prime/Lead:
  - Newport News Shipbuilding (HII-NNS)
  - Leads: Alaysha Shearn & Mark Debbink
- Team Members:
  - HII-Ingalls Shipbuilding: Ken Kenjale
  - HII-Mission Technologies – Uncrewed Systems: Amanda Costa
  - Old Dominion University: Krzysztof Rechowicz & Thomas Irwin
- Observers
  - Fincantieri Marinette Marine
  - Pacific Shipyards International
- Duration
  - 9 months with ECD 11/2025

Problem Statement

- AI is being increasingly integrated into defense industry processes and has proven to drive efficiency at lower costs.
- The Shipbuilding industry lags in the assessment of opportunities for AI integration to reduce costs, streamline processes, and provide competitive advantages.

Project Objectives

- Business Objectives:
  - To facilitate the planning and implementation of projects that drive the integration of artificial intelligence and machine learning in applicable use cases
  - To promote collaboration across the business at all levels
  - To identify and leverage defense AI projects and apply to shipbuilding processes
- Technology Objectives:
  - To increase the efficiency of technical processes
  - To increase knowledge of available artificial intelligence software and application
  - To leverage on premise systems and databases for data analytics

Artificial Intelligence (AI) Industry Review - Categorization

The below categories are AI application areas within Manufacturing. The industry review will determine how these applications are leveraged in shipbuilding.

Smart Design & Engineering

- Generative Design & Optimization AI
- Digital Twins & Simulation AI
- Additive Manufacturing with AI
- Expert Systems / Rule-Based AI

Intelligent Shipyard Automation

- Computer Vision
- Machine Learning for Process Optimization
- Reinforcement Learning & Robotics
- Sensor Fusion AI

Connected Ship Lifecycle & Digital Operations

- Predictive Analytics / Machine Learning
- Anomaly Detection Algorithms
- Natural Language Processing (NLP)
- AI in the Metaverse / AR/V

AI Pilot Overview

ODU CME: Defense Manufacturing Readiness Level

- An advanced interactive decision support system designed for strategic planning in defense manufacturing.
- Integrates Systems Dynamic Modeling, Data Analytics, and Mission Engineering
- Benefit: Assesses the readiness of defense manufacturing processes and evaluates the capability to develop, produce, deploy, and sustain systems of systems (SoS) for defense missions

HII-Ingalls: LLMs for Data Harmonization

- Leverages a large language model (LLM) to identify and harmonize disparate data labels that refer to the same variable
- Aims to detect semantically similar labels across datasets – such as bill of material – which often represent the same underlying variable but are inconsistently named.
- Benefit: Streamlines data integration and analysis

HII-Mission Technologies: Predictive Maintenance

- Uncrewed Systems is in the process of developing a tool used for predictive maintenance on surface vessels
- Pilot will leverage AI/ML capabilities to identify maintenance events and predict when new events will occur
- Benefit: Increases longevity and optimizes sustainment activities

Building “Failure Data & Prediction Models” for Ship Construction & Sustainment Support

Presenter:
Subrat Nanda; ABS

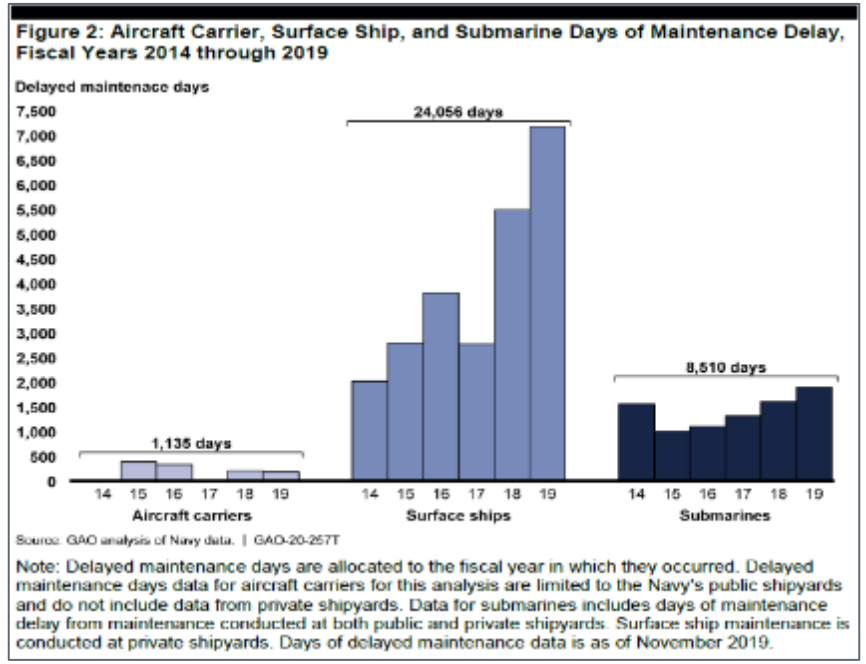
Contributors:
Karen Cassidy: HII-Ingalls Shipbuilding
Alaysha Shearn; HII-Newport News Shipbuilding
Mark Debbink; HII-Newport News Shipbuilding

Project Overview

- NSRP RA Project 2024-01
- NSRP Investment: $411K + Industry Investment: $400K
- Prime/Lead:
  - American Bureau of Shipping (ABS) Subrat Nanda
- Team Members:
  - Newport News Shipbuilding (HII-NNS) Mark Debbink & Alaysha Shearn
  - Ingalls Shipbuilding (HII-Ingalls) Karen Cassidy
- Government Participants:
  - NAVSEA 05Z with NSWC Philadelphia & USCG Surface Forces Logistics Center
  - NOAA, MSC
- Duration
  - 18 months

Problem Statement

- Sustainment costs for ships continue to be a large and difficult to manage cost for the Navy and other services
- Considerable effort is being spent on sensing and measurement of parameters that may help identify and predict failures
- Opportunities remain to extract much more value from the amount of data already being collected



Project Objectives

- Demonstrate the ability to build useful failure data and prediction models from ship condition data sets for use with advanced data analytics methods/tools
- This work will focus on critical systems that contribute to the biggest issues for government fleet owner/operators and shipyards that build and support fleets
- The desired outcome is a process and guidelines that can be used for making failure data models to provide greater insight into the condition of ship systems
- This business intelligence can support key decisions related to ship sustainment (especially yard availability planning) and new construction of future ships

Expected Outcomes

- **Provide a failure data readiness/quality assessment and develop a roadmap for government fleet owner/operators and shipyards to:**

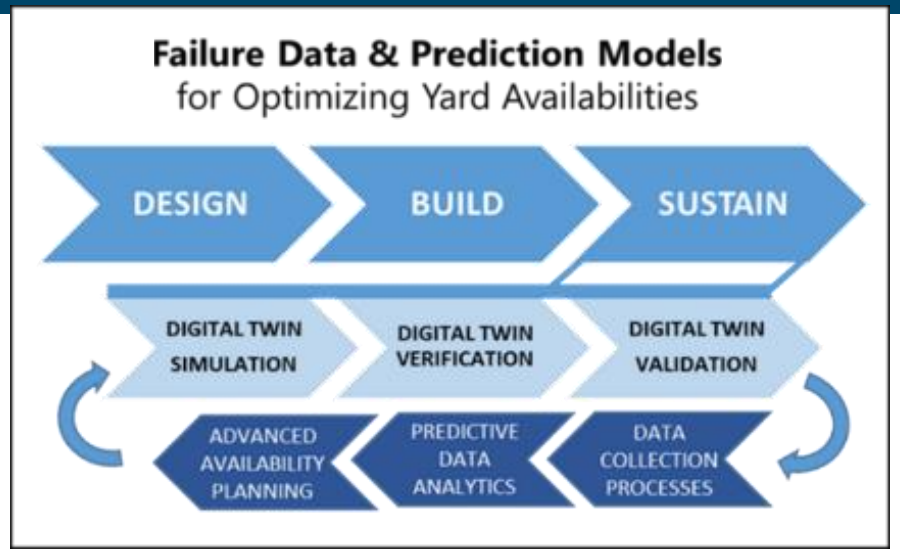
  (1) Optimize yard availabilities

  (2) Provide feedback to follow-on vessels using advanced data analytics of available ship condition

- **Lay the foundation for increased use of advanced data analytics that:**

  (1) Reduce the cost and improve the predictability of scheduling for yard availability periods for ships

  (2) Reduce the total cost of ownership of ships produced and sustained by yards, especially due to unrecognized vulnerabilities and material conditions that lead to failures



What Do Artificial Intelligence-Based Machinery Analytics Provide?

Anomaly Detection

Insights to make data-driven operational & maintenance decisions *(active and pro-active)*

- Detect incipient issues (prior to potential failure) > reduce unplanned failures
- Identify target areas for closer monitoring
- Augment upcoming planned maintenance > condition based
- Plan for corrective action (when failures confirmed) > flexibility

Disposition

- Provide most likely and actionable IP
- Continuous program improvement
- Identify additional components or failure modes

RAMS (Reliability, Availability, Maintainability and Safety)

Insights for Planning & Optimization

- Understanding system reliability & trends
- Identify bad actors and/or systemic FMs
- Detect emergent reliability-related risks
- Perform vessel-to-vessel benchmarking
- Insights for ABS surveyors: inputs to PCM; targeted & focused
- Identify data quality issues
- Potential insights using CMMS data:
  - Parts and spares
  - Maintenance cycles
  - Vessel operations

Salient Features

- Data-driven tools to augment customer's decision-making
- Insights to assist with planning, maintenance scoping and operational inputs
- Customer-ABS current processes undergo ***no*** change…only data-driven insights to support decision-making
- Perform continuous improvement in algorithms and data quality processes

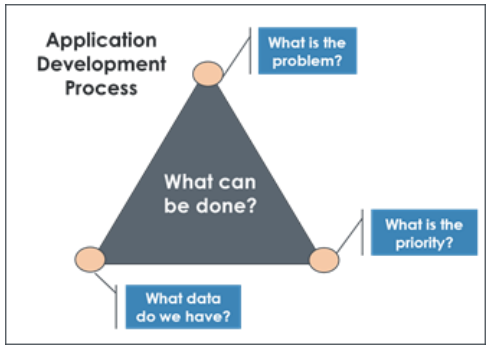
Program Roadmap

Identify Problem (Develop Use-Cases) → **Identify & Gather Data** → **Generating Value** (Ops, Maintenance, etc.) → **Key Insights** (Feedback to detail design and construction process) → **Decision Making & Creating Value**

Application Development

What can be done?

- What is the problem?
- What is the priority?
- What data do we have?



- **Configuration Information**
- **Operational Data** (SCADA sensors data)
- **Equipment, Yard Data** (DCACA data)
- **Maintenance Logs** (OARS)

- **Data Prep & Pre-Processing**
- **Build models**
- **Train/Validate Models**
- **Test Models**
- **Post-Processing**

1. Parts & System
2. Systemic issues affecting vessels to incorporate into present & future yard activities
3. Major damage types & damage descriptors affecting equipment in fleet vs specific vessels
4. Estimated reliability vs. expected reliability for major systems
5. Identify training needs: yard labor
6. Evaluate data types, sensors & process improvements to be planned for future construction
7. Improvements in maintenance (CMMS) systems to answer critical questions
8. Areas for potential process improvement

1. Incipient failure detection
2. Reliability benchmarking across fleet
3. Emergent risks for critical systems
4. Bad-actors: Unavailability risk

Final values to be determined during implementation

Expected Benefits

1. Inputs for yard availability planning
2. Informs processes for parts & design selection, affecting supply chain management
3. Potential inputs for operational decision-making

Key Lessons Learned

AI-based data analysis & reporting is for YOUR assistance only!

What will I do and get?
Why should I trust?

DATA ACQUISITION

- Resolution
- Connectivity

DATA QUALITY

- Fleet Variation
- Instrumentation
- Context-based

CHOICE OF AI METHOD

- Data Types
- Bias vs. Variance
- Complexity
- Maintainability
- Explainability – trust!

CBM PLATFORM CHOICE

- Orchestration
- Consumption
- HMI & UX for PHM

CBM ADOPTION

- User Training
- Shelf-life of an Analytic
- Drive Credibility
- Fatigue
- Feedback

Thank You for your participation.

Discussion…