NSRP Panel Project 2018-455-041

Potential for Applying Artificial Intelligence (AI) in Shipyards Processes

NSRP BT & SDMT Panel Meeting on August 5-6, 2025
Brunswick, ME

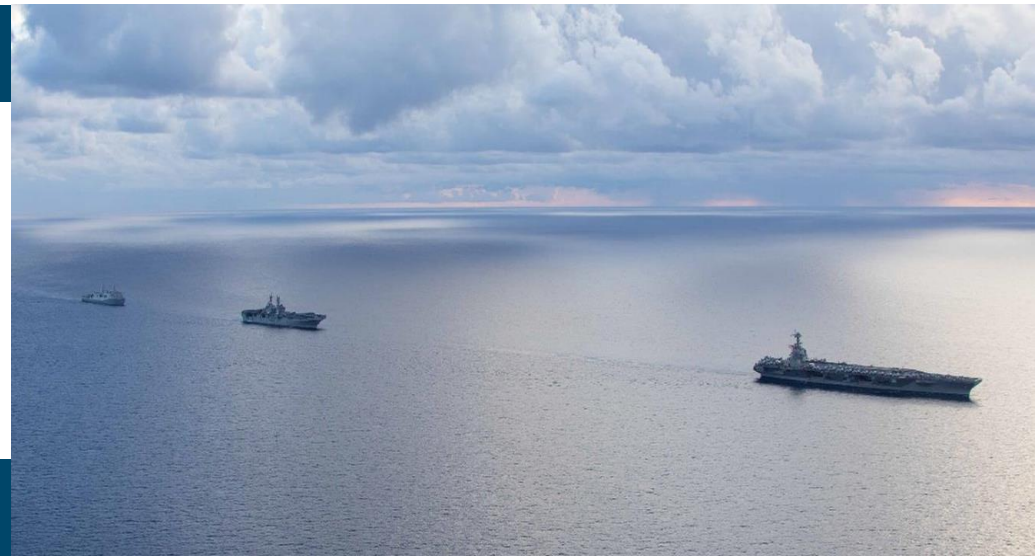
Presenters:
Alaysha Shearn; HII-Newport News Shipbuilding
Thomas Irwin; Old Dominion University Center for Mission Engineering

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
  - NSRP PP 2018-455-041 Potential for Applying AI in Shipyards Processes

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

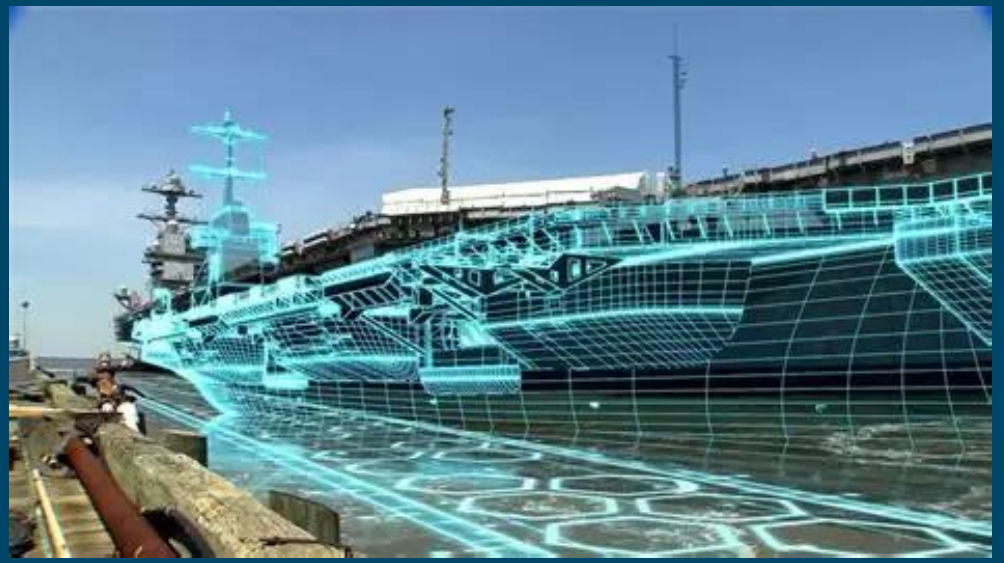
Expected Outcomes:

- Awareness of the opportunities AI can provide Shipbuilders.
- Results from AI pilot projects that can be extended to production use.
- Identified opportunities to drive efficiency throughout:
  - The engineering and design organization in the areas of communications, calculations, research gathering, evaluations, documentation, presentation, and digital twin applicability
  - Digital products for manufacturing data
  - Management of in-service data and sustainment products
  - Mission Readiness for the Navy
- Results that can have common use across Navy programs with minimal impact on software/hardware configurations.

Project Deliverables:

The tangible output of this project will be in the form of white papers describing:

- Categorization of AI use-cases applicability to shipbuilding
- Evaluation results of specific AI pilots/testing, implementation plans
- Follow-on Large-scale AI RA project options



Tactical Pilot Overview

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

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

Artificial Intelligence (AI) Industry Review – Manufacturing/Shipbuilding Application

Comprehensive Research/ Literature Review

Leverages online information, industry partner publications and use cases, academic publications, and more to provide an overview of AI application in shipbuilding.

AI Manufacturing and SCADA Technology (AIMST) Conference and Exhibition

(August 25-27, 2025 – Pittsburgh, PA)

- Three Tech Tracks
  - AI Manufacturing
  - Industrial AI 101 for SMEs
  - SCADA Technology
- Discussion Topics of Interest
  - Industrial AI Strategy & Implementation
  - Manufacturing & Processing Technology
  - Legacy System Integration
  - Data Quality & Availability
  - Digital Transformation

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

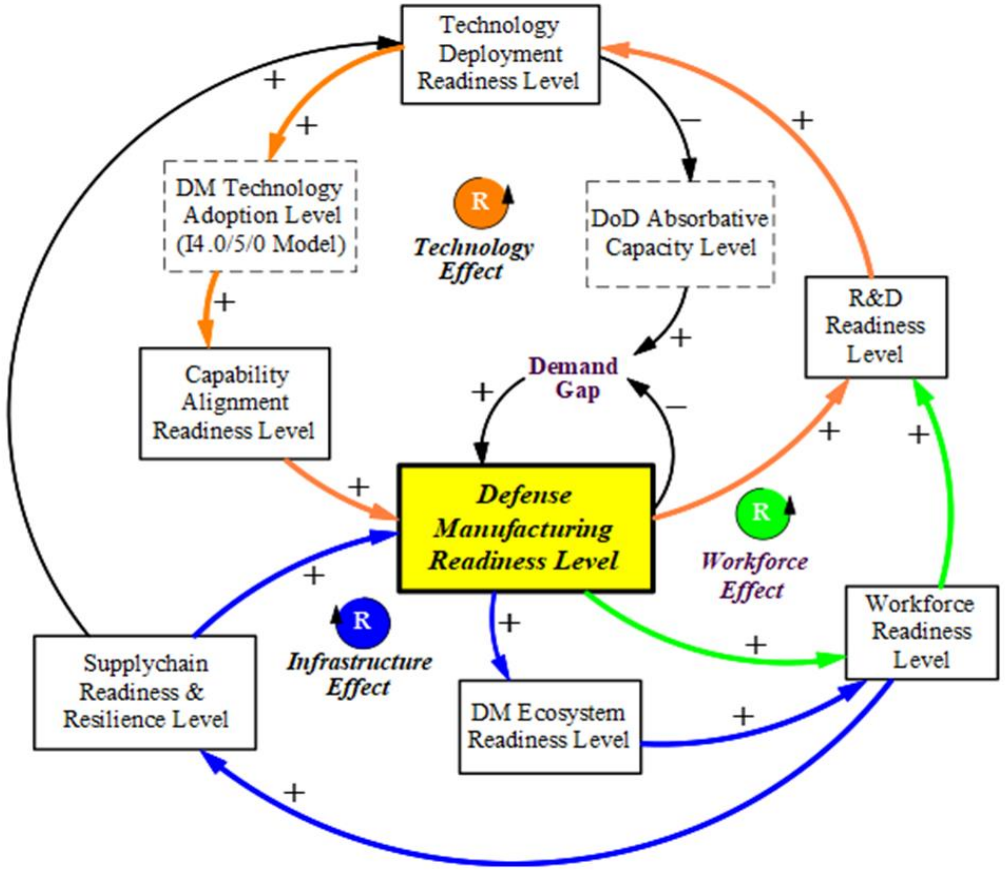
- Computer Vision
- Machine Learning for Process Optimization
- Reinforcement Learning & Robotics
- Sensor Fusion AI

Connected Ship Lifecycle & Digital Operations

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

Background: ODU CME's Defense Manufacturing Readiness Level

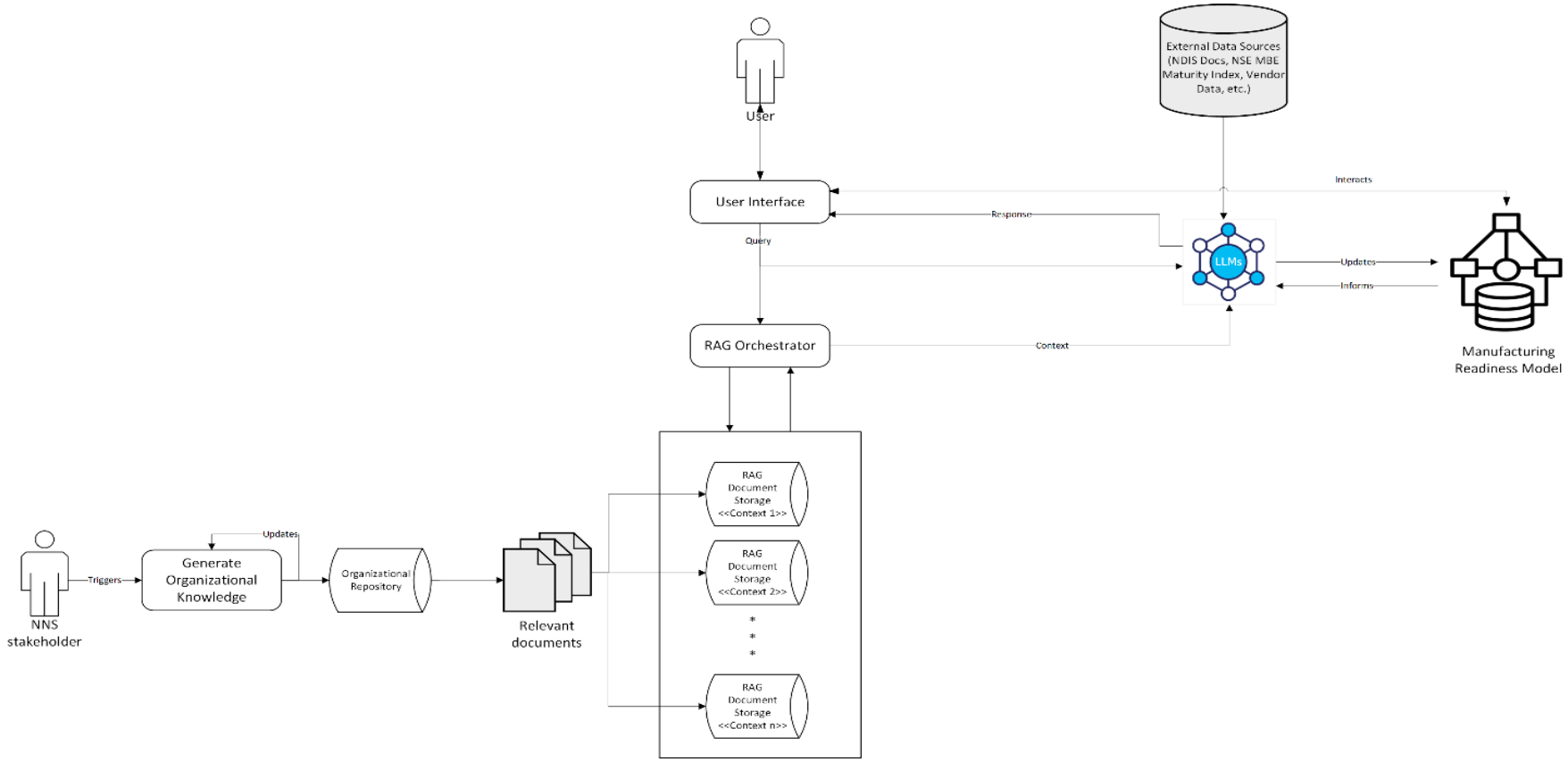
- An advanced interactive decision support system designed for strategic planning in defense manufacturing.
- Integrates Systems Dynamic Modeling, Data Analytics, and Mission Engineering to assess the readiness of defense manufacturing processes and evaluate the capability to develop, produce, deploy, and sustain systems of systems (SoS) for defense missions.
- Grounded in research from:
  - National Defense Industrial Strategy (NDIS)
  - National Strategy for Advanced Manufacturing
  - DoD ManTech Strategy
- Incorporating feedbacks from DoD stakeholders.
- Offers a robust framework for readiness assessment where users can configure variables within the tool to simulate various defense manufacturing strategies, enabling the generation of actionable insights for informed decision-making.



Readiness framework driving the decision-support tool. ODU-CME

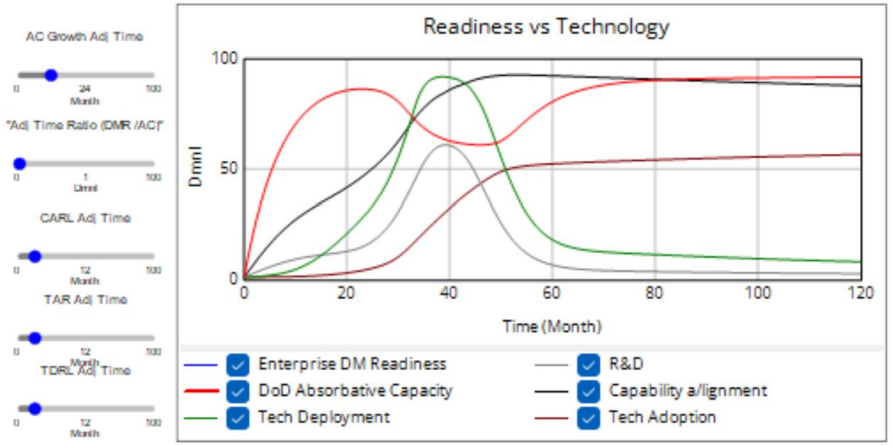
Architecture Overview

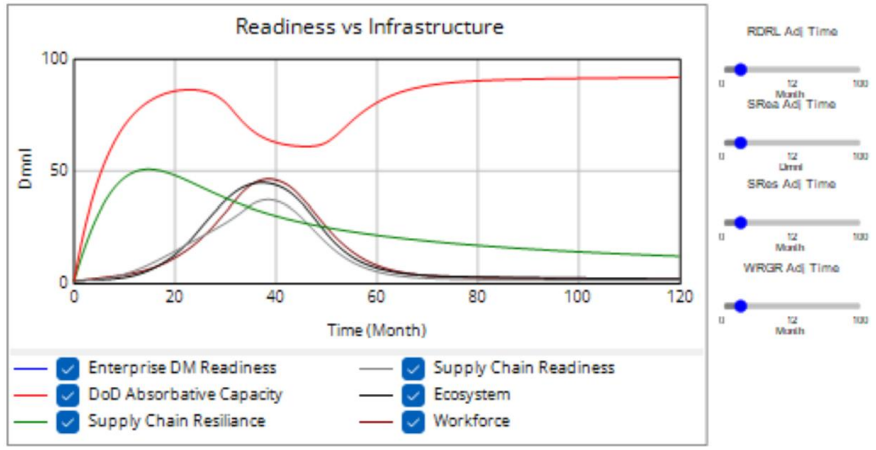
The high-level architecture of information and process flow in the RAG+LLM system, database connections and the resulting manufacturing readiness model.



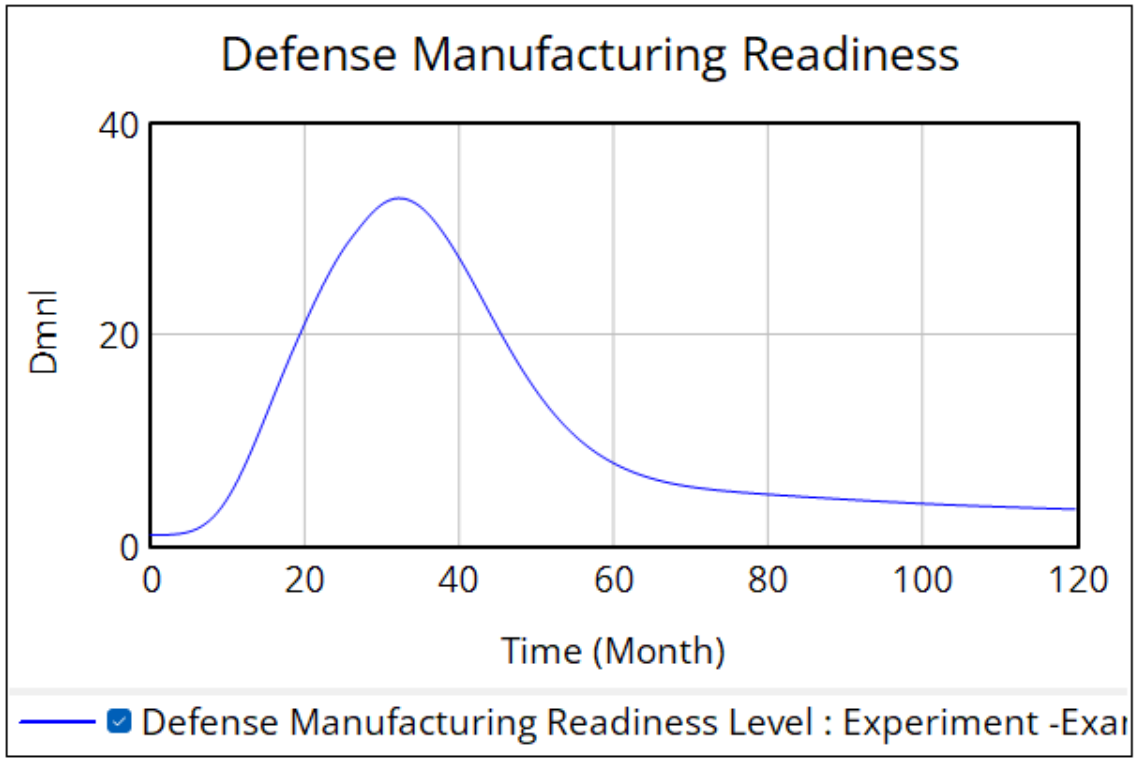
Mission Readiness Key Systems of SoS

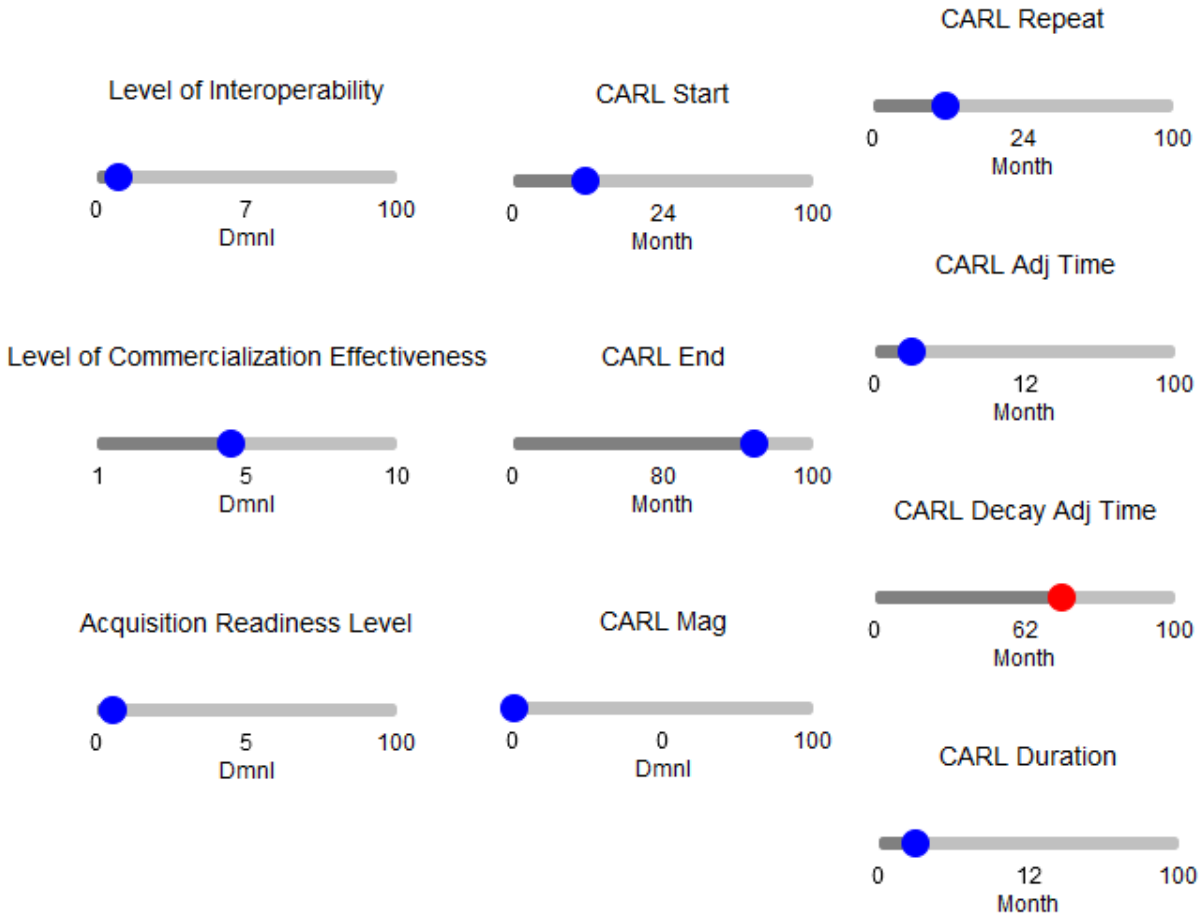
- Research & Development (R&D)
- Technology Deployment
- Technology Adoption
- Capability Alignment
- Supply Chain
- Workforce
- Ecosystem





Dashboard Example





Infusing Digital Integration

We will collect user stories in the following format:

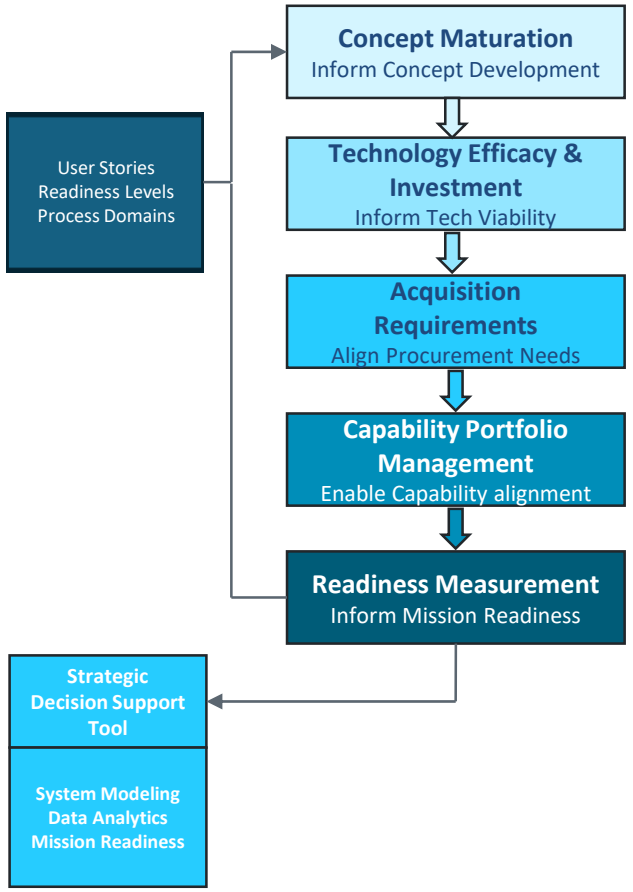
As a manufacturing planner:
I want to know when part lead times threaten build schedules,
So that I can achieve proactive planning and reduce schedule risks.

As a data analyst
I want clean routing histories to understand process variability
So that I can achieve more accurate quality and throughput analysis.

User stories will:

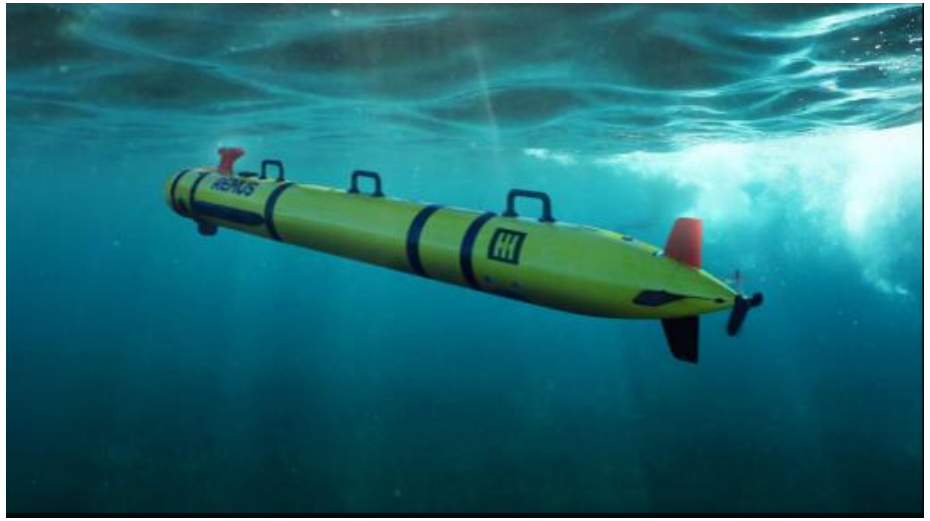
- Anchor the model variables to human workflows
- Support traceability in readiness simulation
- Align maturity diagnostics with end user behaviors

A Human Centered Data Driven Pathway



Upcoming Activities

- Industry review conference: AIMST
- NNS-ODU DRML Whitepaper
- Ingalls Pilot
- Mission Technologies Pilot
- Technology Transfer:
  - Present to SNAME (Society of Naval Architects & Marine Engineers) in Norfolk Oct. 29-31 2025



SNAME 2025 MARITIME CONVENTION

Summary

- Strategically focused efforts involve:
  - AI Mission Readiness Model use-case review and development with Old Dominion University (ODU) to provide an initial assessment and prototyping of the model that will be used to analyze NNS's defense manufacturing base.
  - AI industry review
- Tactical focused efforts involve pilot evaluation of:
  - Ingalls - large language model (LLM) solutions for disparate material data labels
  - Mission Technologies - AI/ML capabilities for identifying & predicting maintenance events.
- We will present the successful results of our AI research and piloting as they apply to shipyards processes related to:
  - Categorization of AI use-cases applicability to shipbuilding
  - Data evaluation results and implementation plans for detection of readiness gaps in current defense manufacturing (DM) base allowing development of strategy and resource allocation
  - Technical solutions for identifying and harmonizing disparate data to streamline data integration and analysis
  - Demonstration of AI use in predictive maintenance

Thank you for your participation.

Discussion

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