Advanced Knowledge Provisioning Using Artificial Intelligence (AI) & Augmented Reality (AR) for Ship Repair Project

SDMT and BT Joint Panel Meeting

Alameda, CA

September 15, 2021
Project Overview - Team

• Pacific Shipyards
• Conrad Shipyards
• Fincantieri Marine Systems, N.A.
• Auros Knowledge Systems
• D’Angelo Technologies
• Hepinstall Consulting Group
• NSRP Technical Manager
  • Jim House, ATI
• NSRP Project Technical Rep
  • Shawn Wilkerson, HII-Ingalls
“We don’t have enough (ship repair) capacity for peacetime,” let alone to repair combat-damaged ships during wartime.

First, Rear Adm. Eric Ver Hage
Commander of Navy Regional Maintenance Center (CNRMC) and Director of Surface Ship Maintenance and Modernization

Automate the provisioning of critical knowledge directly into the ship repair workflows using Artificial Intelligence (AI) and Augmented Reality (AR)
Knowledge Operating System Vision

Knowledge Ecosystem

- Flow-In: Assisted Capture
- Flow-Down: Controlled Crowd-Sourced Knowledge
- Flow-Up: Customer Requirements
- Flow-Back: Assisted Learning

Unified Stream of Knowledge (Readied for re-use)

External Standards (MIL STDs, ABS, IMO, etc)

AI Assisted Delivery

CAD

Eng. Office

SIM

PLM

Planning

Shipyard Facility

Ship Construction

CAD

AR

Onboard

Maintenance

Training

AR

AR

AR
Why the Focus on Ship Repair

How can we use AI, AR, and Knowledge Provisioning technologies to reduce Maintenance Availability Lead Times and Cycle Times to INCREASE CRITICAL SHIP REPAIR CAPACITY

- **AI**
  - Navy Std Items
  - Mil-Stds

- **AI, AR, KP**
  - Estimating Standard Processes
  - Work Package Auto Parsing
  - Ship Check Remote Assistance
  - Make/Buy Decisions
  - RFP Process

- **KP**
  - Project Mgmt Standard Processes
  - Transition Processes
  - LLTM

- **AI, AR, KP**
  - TIP Development
  - Visual Work Instructions

- **AI, AR, KP**
  - Readiness Assessment Controls
  - VR Training – Shipyard Processes
  - WAFs

- **AR, KP**
  - Compartment Closeouts
  - Remote Assistance
  - Work Completions
  - Quality OQE
  - Visual Instructions

- **KP**
  - Delivery Assessment Controls
Applying AI and AR to Ship Repair

Project Knowledge Sources

Document Ingestor

Knowledge Packets

Auto-Classified Items

Provisioned Knowledge

AI

AR
Artificial Intelligence Capabilities – Phase 1

• Development of core functionality
  1. Document parser

• Design and prototype implementation of Machine Learning model

• Proof Of Concept Results

Doc Ingestor Core Functionality
Artificial Intelligence Capabilities – Phase 2

• Develop User Interface for Document Ingestor

• Develop User Interface for AI Based K-PAC Classification Tool

AUROS AI Software Capabilities Released in IQ8 – August 2021
Augmented Reality Features

- Allows for information to be linked to specific ship compartments
- Scanning
  - iPad cameras make a model of the physical compartment
  - Model becomes point of reference for virtual content placement
  - Scanning facilitates automatic and accurate placement of virtual content
- Designation Nodes
  - Saved in association with the ship compartment
  - Stores text relating to any physical objects nearby
  - Stored information is dynamic
- Doorways
  - Simplify transitioning between virtual content
  - Facilitate offline Navigation
Augmented Reality Features

• Navigation
  • Turn-by-turn directional system
  • Provides directions from current Compartment to any other scanned Compartment
  • Does not require internet, Bluetooth, or Location Services/GPS
  • Virtual arrow points user toward the entrance to the next compartment

• Remote Assistance
  • Supports more effective assistance for workers from off-site SMEs
    • Direct, peer-to-peer connection
    • Real-time communication
  • Companion web client for use by SME
    • Video feed of iPad screen visible for SME
    • Two-way audio communication
    • Drawing feature

Split view of web client and iPad screen
Augmented Reality Features

• **Auros Connector**
  - Gives worker access to provisioned knowledge and reference materials
  - Live adjustment to work item conformance states
  - Built-in file viewer
  - Compartment-specific content
  - Data preload feature allows Auros Connector to function with poor network connection

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**Phase 2 Improvements**

Improved user interface and experience
Optimized, Enhanced, Simplified
Shipyard Pilots
Shipyard Pilots - PSI

Estimating  Planning  Project Management  Production  Quality
• Navy MACMO level estimating process and standard work captured
• Shared workflow with roles and responsibilities clearly identified
• Provisioned knowledge is utilized and evaluated resulting in effective knowledge transfer and visibility of project health
• Project Submittal Tracking Dashboard / Assessment
Maintenance and Repair Procedures

Maintenance Procedures - High Level Process Summary

1. Technical Documentation

2. Technical documentation converted into Knowledge Packets

3. Procedure level Assessment Controls created to track status

4. Procedure level Assessment Controls delivered at point of need
FMSNA Use Case – Service Job Execution

**BASELINE**
- Many manually derived documents in various locations
- Mechanics burdened to know all information
- Knowledge gaps within workflow
- Difficult change control

**AUROS**
- All job information in one system
- Integral work-flow
- Easy to use graphical interface
- Easy to monitor progress and compliance
- Information & data available on-demand
- Databased / easy change control
Preventative Maintenance Procedures
Shipyard Pilots – Conrad Shipyard

Specification
Compliance
Legacy Specification Compliance Process

Specifying Compliance

CONSTRUCTION SPECIFICATION
INLAND TANK BARGE | 297.5’x54’x12’ FT | 30,000 BIBLS

PREPARED FOR
Conrad Hull CXXX and HXXX

Specification Documentation

Manually created XLS files to track compliance
1. Specification Documentation

2. Auros Document Ingestor with AI capabilities to Automatically Parse and categorize specifications

3. Specification Documentation converted into Knowledge Packets

4. Assessment Controls to track compliance across deliverables
Final Steps

• Finish Implementation Pilots at Shipyards and Collect Data (June 2021 – September 2021)
  • Shipyard Implementation Report

• Measure Effectiveness of Shipyard Pilots (Aug – Sept 2021)
  • Implementation Evaluation Summary Report

• Conduct Final Project Workshop (Oct 2021)
  • Final Project Workshop Report

• Deliver Final Project Report (Oct 2021)
  • Final Project Report

WORKSHOP DATE: TBD
Stay tuned!
AI/AR Knowledge Provisioning

Questions