### NSRP National Shipbuilding Research Program

# Laser Scan to CAD Analysis

Cody Griffith, HII-NNS

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### Laser Scan to CAD Analysis - Agenda

- HII-Newport News Shipbuilding Overview
- □ Target Ship for Implementation (*FORD*-Class)
- Next Generation of Shipbuilders and Operators
- □ The Shipbuilding Digital Thread
- □ "Laser Scan to CAD Analysis" Project Description:
  - Goals & Objectives
  - Saving & Benefits
  - Team Members & Schedule
  - Technical Approach
- Validation
- Auto Segmentation
- Text Recognition
- Discussion



Visit the nsrp.org site for more information.



## Newport News Shipbuilding







Nuclear Power



 Largest industrial employer in Virginia, employing about 25,000 people, many of whom are third-and fourth-generation shipbuilders



- Only company capable of designing, building, refueling, overhauling and inactivating nuclear aircraft carriers for U.S. Navy
- One of only two companies capable of designing and building nuclear submarines for U.S. Navy

 Transforming our 130+ year company's paper-based processes to the Digital Age



- Eliminating drawings and moving toward a Model-Based Enterprise (MBE)
- Adopting technologies like laser scanning, digital twin, mobile computing and augmented reality



### Reinvention – The Next Generation of Shipbuilders

### **Tech-savvy**

Constant access to information

Expect speed and agility

Desire meaningful work – leave their mark



## Reinvention - Utilizing the Digital Thread



## Digital Thread – Advancing Data Management Through Ship's Lifecycle



The "Digital Thread" bridges the virtual and physical components of the "Digital Twin"



### Aircraft Carrier USS GERALD R. FORD The Big Picture

10+ Year Build Cycle







~55 Million Man-Hours of Navy Investment



**Shipboard** Over 50,000 Ship Work Packages 9 Million Feet of Cable 4 Million Feet of Fiber **Lifecycle** 50-Year Life Obsolescence Management Continuous Modernization Throughout



Our Challenge is Managing Complexity While Implementing Disruptive Technologies

### Laser Scan to CAD Analysis: Problem & Objective

**PROBLEM TO BE ADDRESSED:** The success of an in-service digital environment is predicated on a continued synchronization methodology between the most current ship's configuration and the 3D product model. There are two legacy processes that do not configuration manage unauthorized changes that will have to be changed to maintain accurate ship configuration.

- Changes preceding ship delivery that are documented on inspection reports (IRs) in lieu of 3D product model updates.
- During in-service operation, changes made by Ship's Force, executing yards or participating acquisition resource managers (PARMs) and alteration installation teams.

#### **PROJECT OBJECTIVE:**

- Develop capabilities to capture and maintain the current ship configuration through the use of laser scan data overlay on the 3D product model.
- Manage configuration deviations between the ship laser scan and FORD Class Hull Planning Yard (HPY) 3D product model by visual display, enabling the HPY to investigate the deviations and communicate with the organization that made the change.
- Provide an opportunity to educate organizations on the process and demonstrate TOC reduction benefit of preserving ship configuration management for in-service applications.



### Laser Scan to CAD Analysis: Lifecycle Sustainment





### Laser Scan to CAD Analysis: Savings & Benefits

This project addresses synchronization of the digital 3D product model & in-service ship configuration. This provides near-real-time ship configuration to the FORD Class Hull Planning Yard (HPY) and maintenance and repair teams for lifecycle-planning activities. This project :

- □ Strengthens ship's configuration HPY product model synchronization
- Acts as a tool to communicate and educate organizations that implement a change without HPY approval
- Helps with the process of changing the culture from 2D legacy to configuration-managed 3D environment
- Automates manual process to identify and capture unauthorized changes and deviations to the base-ship configuration
- **□** Efficiently captures and displays geometric change documented on inspection reports (IRs)
- Provides real-time configuration status thus reducing schedule time and resources required for shipboard ship checks
- □ Improves quality and timeliness to deliver logistics information directly to the Navy
- □ Significantly reduces the need for non-Ship's Force ship accessibility
- Allows for continued ship configuration control and management regardless of ship's geographic location





### Laser Scan to CAD Analysis: Participants & Schedule







### Laser Scan to CAD Analysis: Technical Approach

Technology related to laser scanning and 3D product model configuration-management processes have advanced significantly and have positioned the shipbuilding industry to move the "Capturing In-Service Ship Configuration" project to deliver production-ready capabilities.

- Utilize and integrate digital data from the FORD Class Digital Data Environment (FCDE) along with on-board ship laser scan information to provide needed 3D product-model ship-sustainment information in an environment where 2D drawings do not exist.
- Concentrate on data at the ship compartment level. Typically, ship scans are conducted and configuration-managed at the compartment level. This compartment scan data will match 3D product model partitions that are at the compartment level for in-service use. Thus a direct comparison of the current configuration and the baseline FORD Class Hull Planning Yard (HPY) 3D product model can be made.
- Leverage Elysium's state-of-the art technical capabilities for software development and integration. Elysium has vast experience and knowledge of the NNS 3D product-model environment and was responsible for the migration and validation code development when NNS transitioned for CATIA to a NX 3D CAD environment.





#### InfiPoints Capabilities:

- Point cloud processing
- Visualization & modeling
- Validation: Comparison of component and assemblylevel comparison with detailed statistical reporting for users to evaluate
- Identifies highly mathematical information and reports in a user-friendly way
- Collision detection
- Digital measurement
- ID recognition: Alpha-numeric interpretation

### Laser Scan to CAD Analysis: Test Data







### Laser Scan to CAD Analysis: Example Overlay







### Laser Scan to CAD Analysis: Validation (Current technology)



**Initial Deviation Check** 



#### Deviation Check (Rev. B)



### Laser Scan to CAD Analysis: Automatic Segmentation



Expected process

- □ Auto Segmentation
- Associate segmented point cloud to CAD components
- Perform comparison
- □ Issue report where the identified differences can be verified by the user



### Laser Scan to CAD Analysis: Text Recognition



Elysium Headquarters



### Laser Scan to CAD Analysis: Text Recognition



**Elysium Text Extraction** 



### Laser Scan to CAD Analysis: Text Recognition REV A



**Elysium Text Extraction** 



### Laser Scan to CAD Analysis: Text Recognition REV B

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**Elysium Text Extraction** 



### Laser Scan to CAD Analysis - Summary

### Today we are:

- □ Continuing improvement of automatic text recognition and label plate extraction
- □ Continuing improvement of automatic segmentation
- Developing and implementing an efficient method for comparing the point cloud against the CAD model
- □ Testing/validating the current processes and capabilities of InfiPoints



## Thank You

