S2699 – Digital Data for Next Generation Measurement / Locating Tools Project POP APR 19 – JUL 21

Process Change - Under Cognizance of Industry

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NSRP All Panel Conference
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Issue Description / Project Objective

- **Issue Description**

  Location identification can account for up to 10% of labor costs with regards to shooting studs and no paint mark-up areas. GDEB and GDBIW use current projection technologies developed years ago, which offer limited options for production due to a narrow scope of work.

- **Project Objectives**

- The Digital Data project will improve the processes used to locate and install paint masking and hanger stud positions by:
  1) Enhancing the Total Station System (EB)
  2) Developing a Mobile Optical Projection (MOP) device (BIW/ EB)

- The These objectives will be met by:
  - ✓ Automatic queries of the CAD model and planning databases for location and work sequencing data needed to drive the projectors
  - ✓ Develop and produce a mobile optical projection device (MOP) and supporting software to receive and process CAD and product data
  - ✓ Integration of paint masking data with the MOP
  - ✓ Integration of stud location data with the Total Station system (EB Specific)

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Total Station system enhancements

Specific Technical Goals:

- Update Plate Marking software to accommodate stud weld information
- Extract information on frame location and web/flange stud placement (forward/aft, inboard/ outboard)
- Adjust projected location if view is obscured
- Produce IP file for consumption by Spatial Analyzer (total station software) to integrate stud location data with the Total Station system

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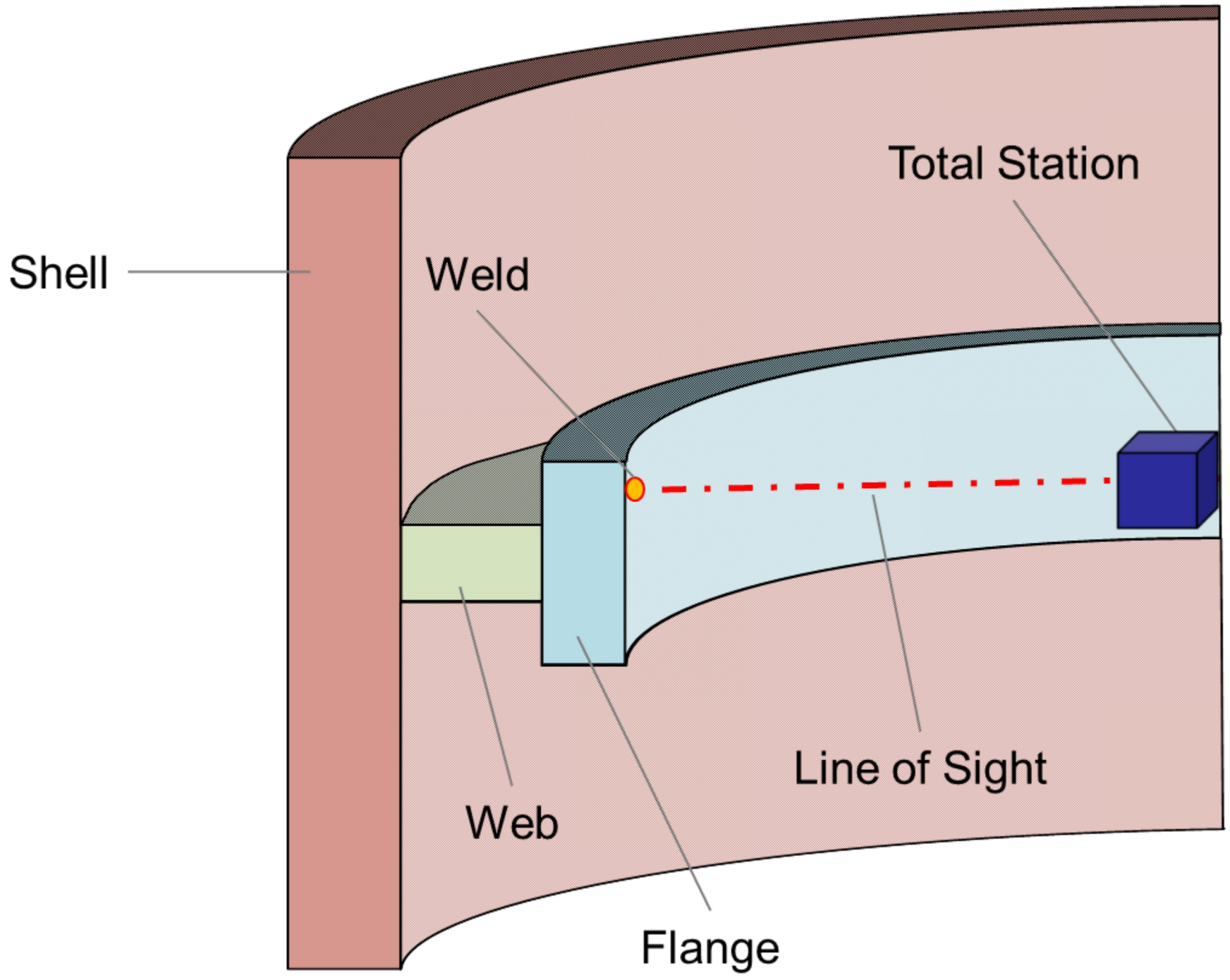
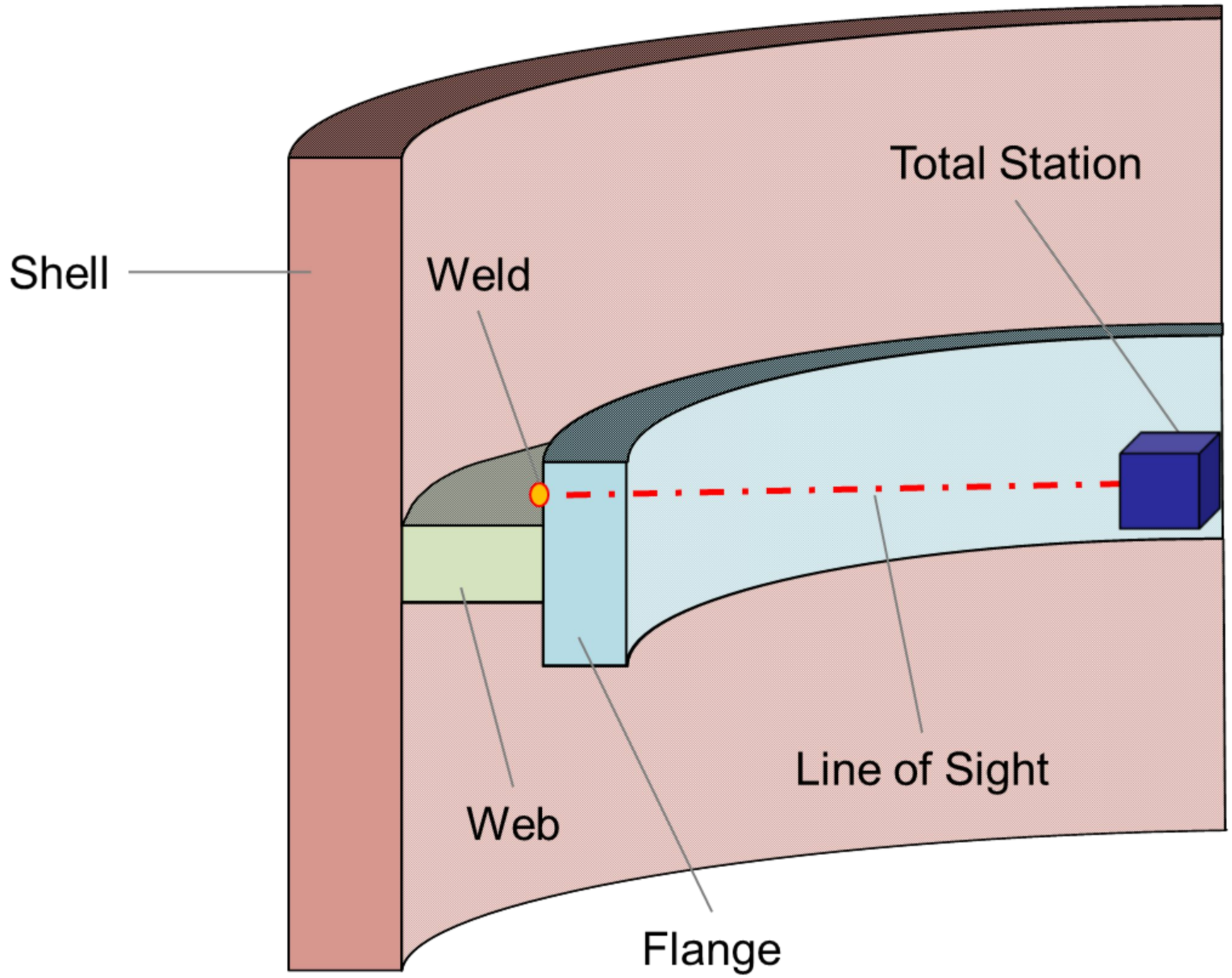
Example of Frame, Flange and Web



Example of Frame, Flange and Web



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Paint Masking:

- Step 1: Identify component requiring paint masking
- Step 2: Find all surrounding components
- Step 3: Automatically filter components
- Step 4: Manually select components to be protected

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Specific Technical Goals

- Develop shipbuilder end use software that automatically queries the CAD model and planning databases for location and work sequencing data needed to drive the projectors

- Design and produce a mobile optical projection (MOP) device and supporting software to receive and process CAD and related product data
  - ➢ Adapt Delta Sigma specialized 3D Projection technology for accurate location CAD projection in shipyard environment

- Integration of paint masking data with the mobile optical projection and stud location data with the Total Station system to validate the accuracy and repeatability of the improved process

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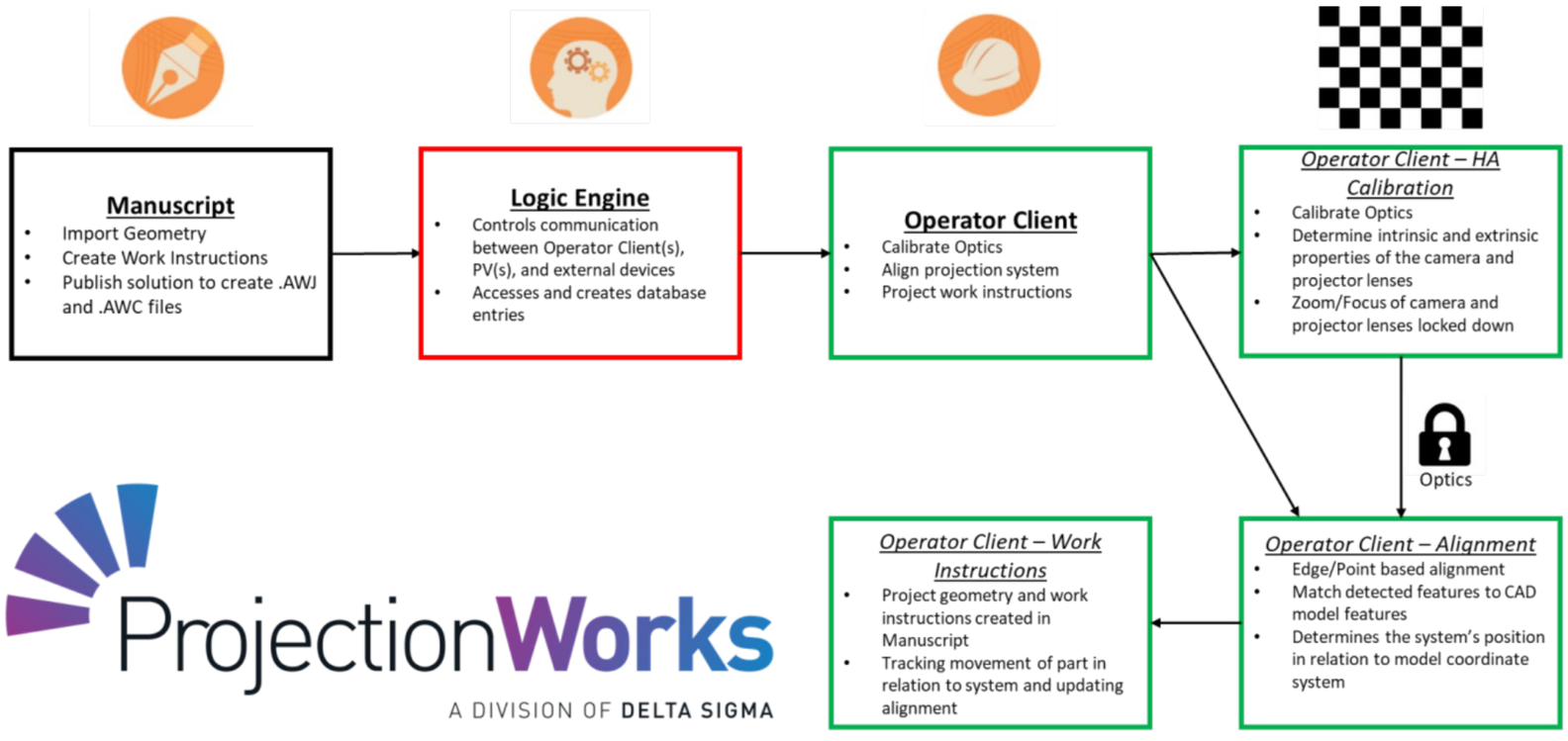
Specific Technical Goals

Prototype Rig



High Level Process Flow – Projection Execution

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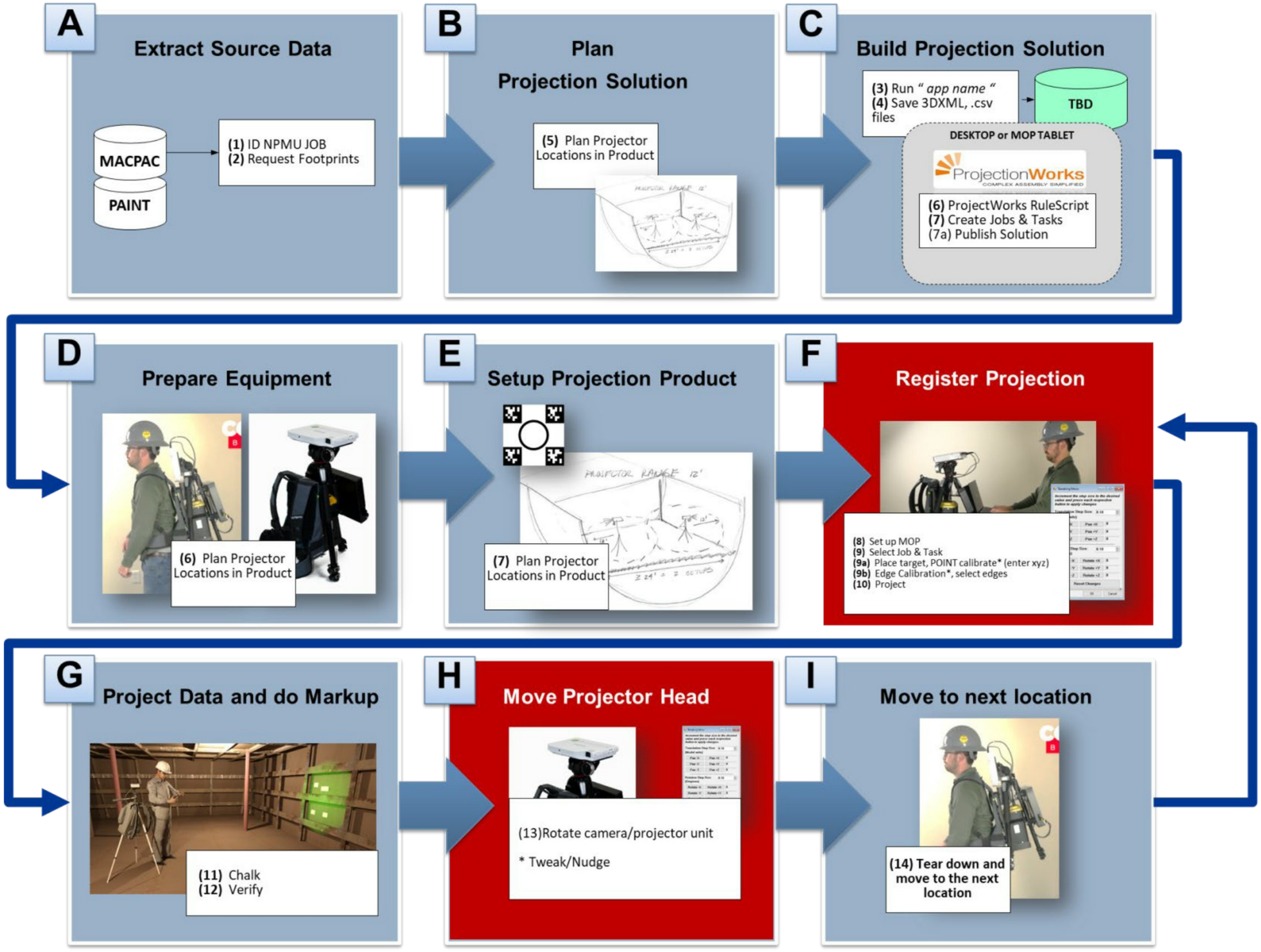
Process Map



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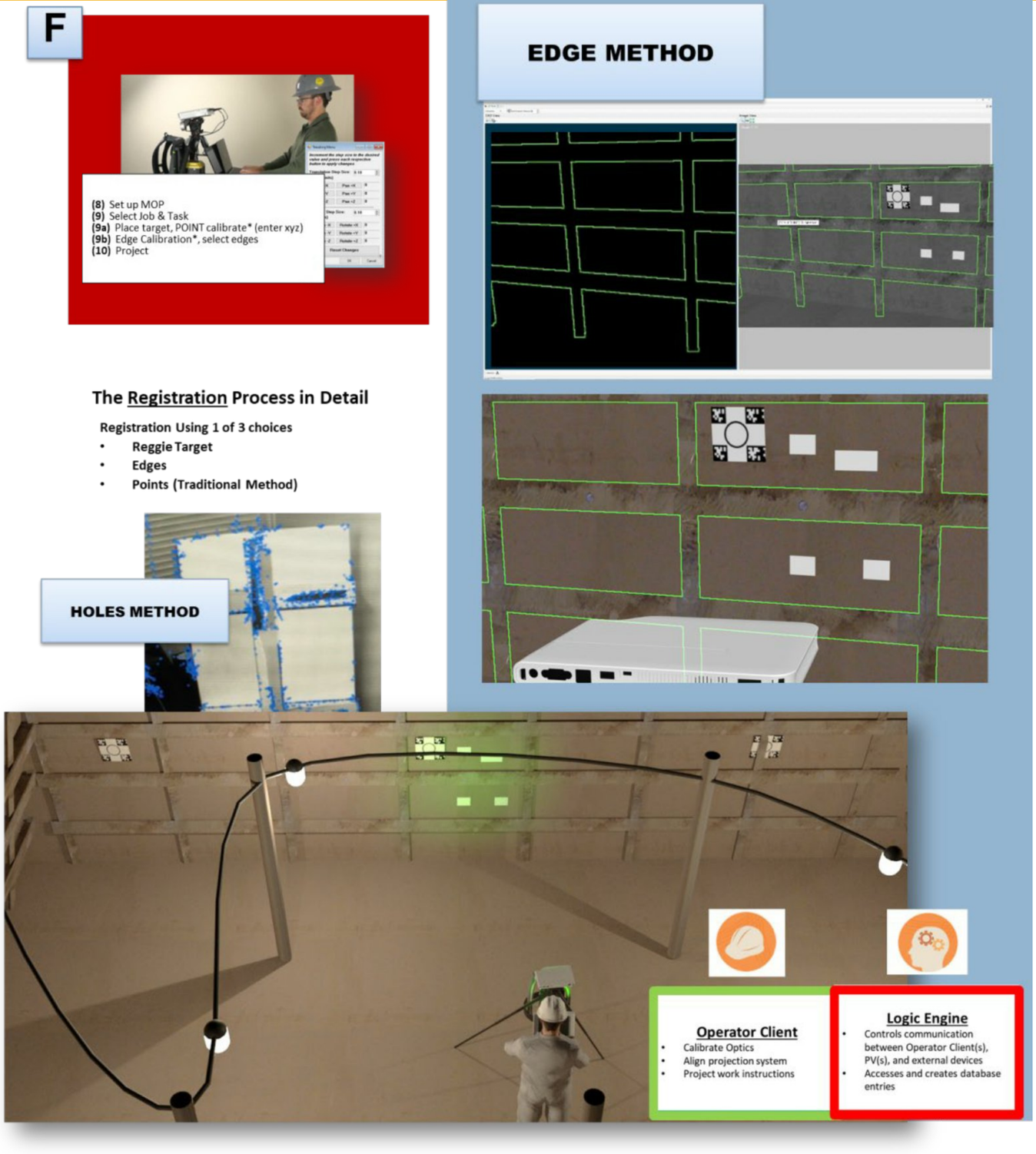
Register Projection



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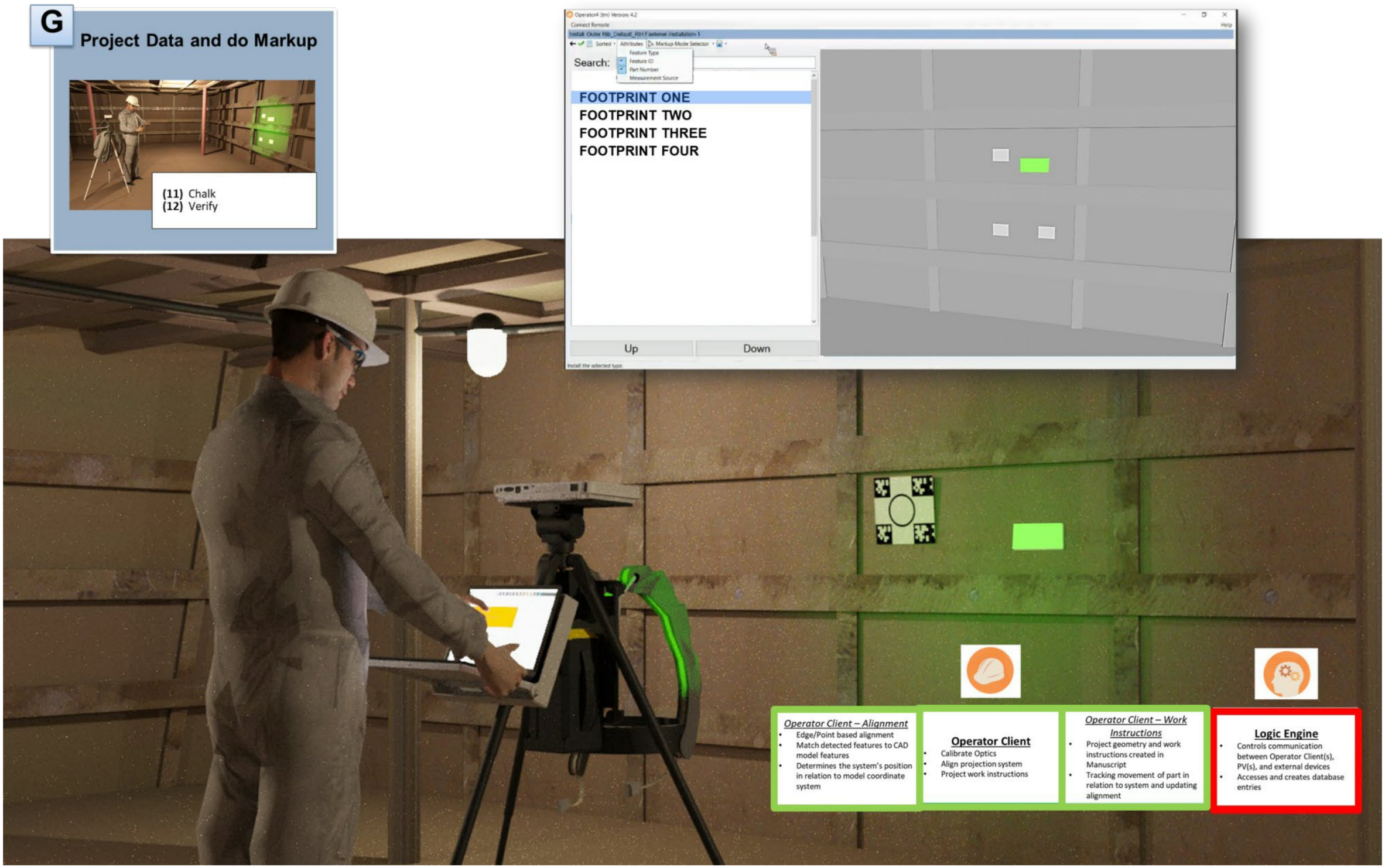
Project Data and Do Markup



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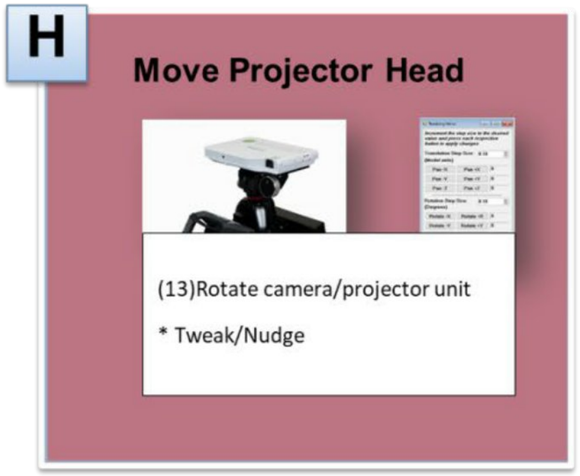
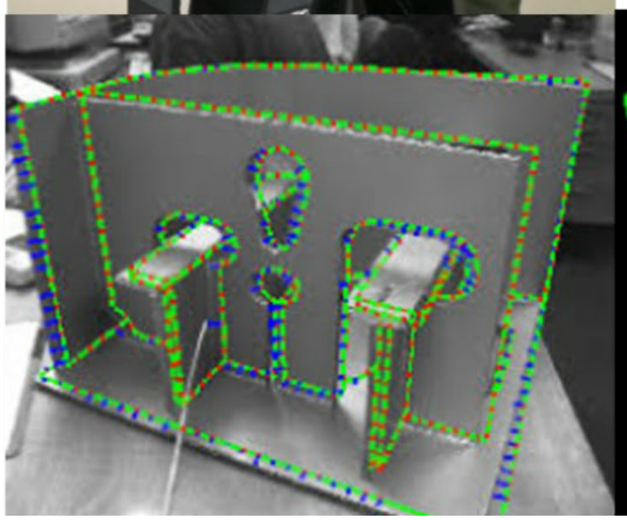
Move Projector Head – Edge Tracking

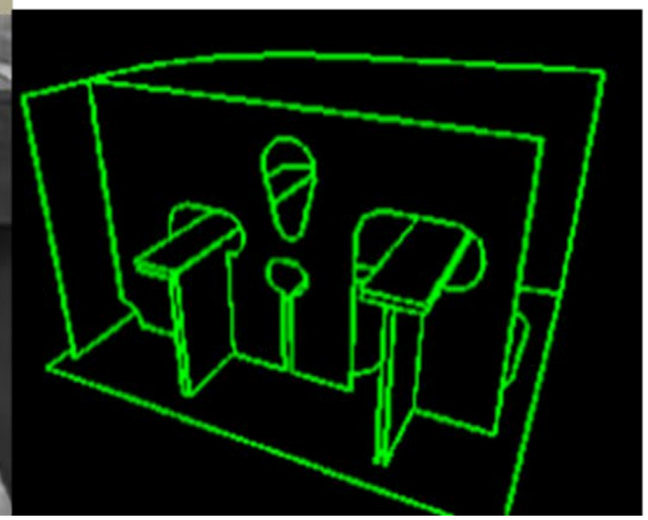


Tracking - Moving the Projector

Tracking using

- **Edge Tracking**





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BIW Partial Implementation

- Without edge tracking to enable the projector to maintain pose alignment while in motion, the business case for MOP is too low to implement as is

- Methods developed during this project to identify hotwork and generate hotwork “footprints” with CAD data is being leveraged for display via other technologies/devices under a “3D No Paint Mark Up (NPMU) Project”
  - Reduced cost/schedule & improved quality of NPMU design products
  - Reduced cost/schedule & improved quality of NPMU paint products

- 3D NPMU Project anticipated to start production pilot end of 2023 – after MOP software integration and development completes Q3 2023

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Conclusions

- **Highlights**
  - Successfully enhanced electrical hanger and tile stud location data using Total Station
  - Achieved success in extracting ‘footprints’ from CAD models (NX, CATIA)
  - Successfully developed mobile hardware prototype
  - Achieved 89% functional requirements for MOP
    - Anticipate realizing the remaining 11% during implementation

- **Challenges**
  - Target must be at physical 0,0,0 and directly in front of camera which is not always feasible with odd ship surfaces

- **Takeaway**
  - Once implemented, this technology will improve the outfitting processes in both shipyards.

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Backup

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Technical Approach

Phase I Accomplishment Summary

Task 1: Data Extraction of Electrical Hanger and Tile Stud Locations (GDEB)

- Requirements analysis & detailed design for extraction of data from model
- Implemented analysis & labeling on the electrical hanger studs
- Implemented compatibility with Spatial Analyzer
- User testing & demo Requirements Document

Task 2: Data Creation and Management for Paint Masking (GDBIW)

- Requirements analysis & detailed design for No Paint Mark Up (NPMU) data extraction from model
- Produced graphical footprints of hotwork attachments
- Explored alternative methods for creating footprints with Applied Physical Sciences for hotwork items shown on drawings but not in the CATIA model
- Unit & user testing

Task 3: Data Creation and Management for Paint Masking (GDEB)

- Requirements analysis & detailed design for extraction of paint masking data from model
- Enhanced Mobile Computing project's Build Plan Editor successfully enhanced to support paint masking views
- Bounding box query & down-select capability to select paint masking components
- Created Paint Masking work orders with storage and viewing ability in EB's Interactive Work Instruction
- Extracted treatment tile holograms
- Able to create treatment tile work orders, incl. center cross-hairs
- Unit & user testing

Task 4: Analysis and Design of Mobile Optical Projector (GDBIW)

- Requirements analysis & definition for the MOP system
- Concept and detail design of the MOP
- Attended Air Force ManTech presentation of Digital Flashlight in December 2019 at Wright Patterson AFB
- Leased and set up a projector for testing footprint projection at BIW and provided demo at Phase I Review

Task 5: Phase I Reporting

- Updated business cases, determined 'Go' to Phase II, Phase I Report

Technical Approach

Phase II Accomplishments Summary

Task 6: Development of Mobile Optical Projector

Hardware:

- Designed and assembled 2 prototype rigs
- Shipped rigs to EB & BIW

Software:

- Delta Sigma updated ProjectionWorks to v5
- Team developed MOP test plan
- Install software to shipyard laptops via temporary admin rights

Task 7: Integration of Data and MOP

- Tested and verified ProjectionWorks software
- Conducted lab assessments of MOP system
- Developed methods for repeatable registration
- Completed integration of paint masking data from CAD systems at EB & BIW with MOP
- Conducted user assessment at BIW

Task 8: Final Prototype and Demonstration

- Created storyboard to describe primary activities and sub-steps
- Conducted live demo at BIW Orion Trade Training Center

Project Team (Organization Chart)

Paul Huang - COR / Program Officer

Marty Ryan – Director
George Caramico -Technical Director Robert Mashburn –Deputy Director Scott Truitt– Project Manager
Dick Tiano- PTR (retired)

Ross Baker
VIRGINIA Construction Deputy
(PMS450C2)

Dave Hart

Steve Fuqua- PAPM for Affordability – PMS 397D
Larry Becker

Todd Hellman– PMS 400D4

GENERAL DYNAMICS
Electric Boat

Tom Rando (retired) – Technical Lead (retired)
Heidi Preston– Co-Technical Lead
John Iraci – ManTech Program Manager
Andy Faiss (retired) – ManTech Project Manager/ Coordinator
John Lovezzola – ManTech Project Manager

GENERAL DYNAMICS
Bath Iron Works

David Heath (retired) – Subject Matter Expert (retired)
Carrie Callalhan (retired) – ManTech Project Manager (retired)
Scott Record – ManTech Program Manager
Kyle Green – ManTech Project Manager

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