S2926: Improved Lead Bay Packing

NSRP All Panel Meeting 2025

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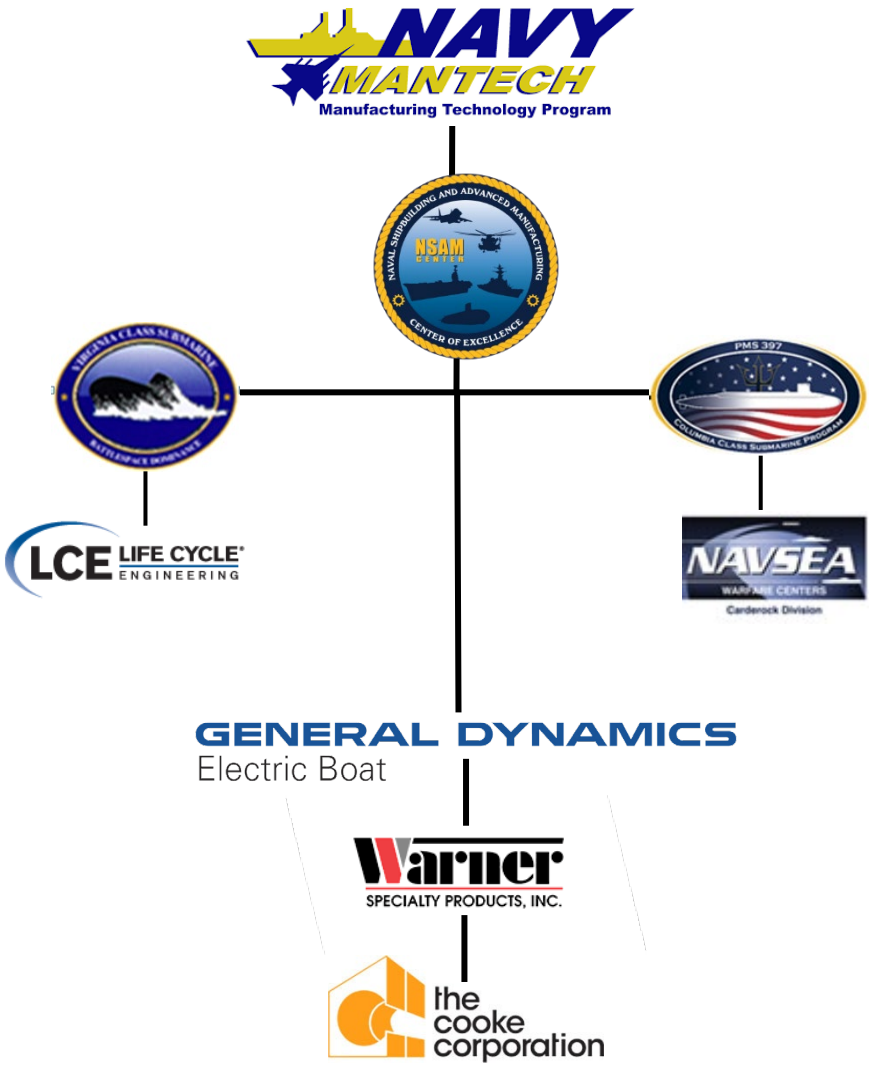
Agenda

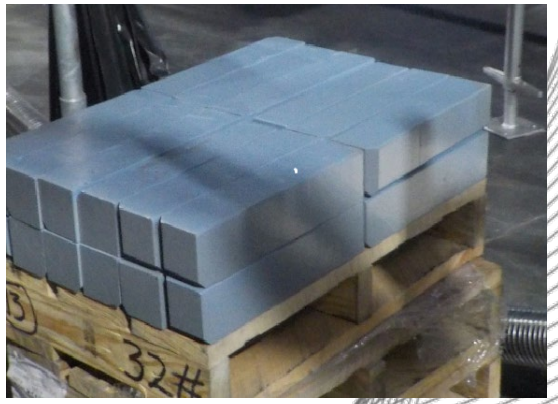
1. Project Team
2. Platform/Issue Description
3. Objective
4. Technical Goals
5. Benefits/Pay Off
6. Project Schedule
7. Technical Approach
8. Technical Content and Status
9. Transition/Implementation Plan
10. Next Steps
11. Q & A

Project Organizational Structure



Project Overview/Objectives

- Issue Description:
  - The current process for lead bay packing is time consuming and physically demanding. Lead is used as a fixed ballast to establish design equilibrium and stability, zero trim and zero list.
  - Painted lead bricks ranging in weight from 0.5 to 56 lbs are delivered to the shop floor to transported using an overhead crane to the hull section. The bricks are then manually transported to the appropriate bin within the hull section.



- Project Objective(s):
  - The objective of this effort is to develop a new process for delivering the lead bricks to the appropriate location on the hull section.
  - Other objectives are to reduce the exposure to the lead and the repetitive physical strain on the employee

Lead Ballast Installation (By the numbers)

Number of Handoffs

77,000 times

Approximate Weight of Lead Packed (Platform 1)

>100,000 lbs

Lead Brick Weight

56 pounds

Approximate Weight of Lead Packed (Platform 2)

>500,000 lbs

Average # of times handled (per brick)

6-7 times

# of pieces installed

>10,000 pieces

Project Goals

Goal 1: Transportation Time	**Goal 2:** Time loading into hull

- fewer handoffs
- improved ergonomics

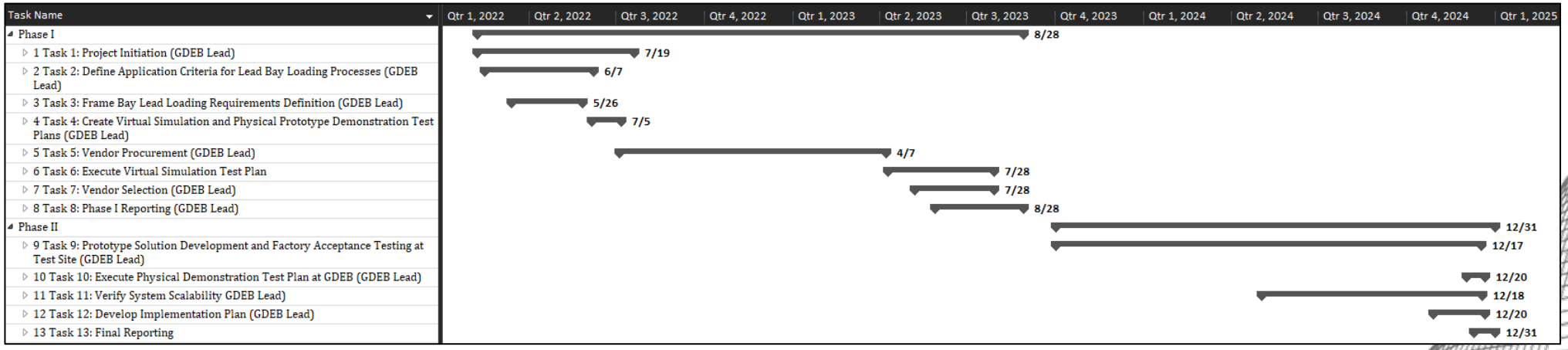
89%

reduction in lifting time

Expected ROI: 5.57

Project Schedule

- Recently Completed
  - ONR Period of Performance: 11 February 2022 through 31 December 2024



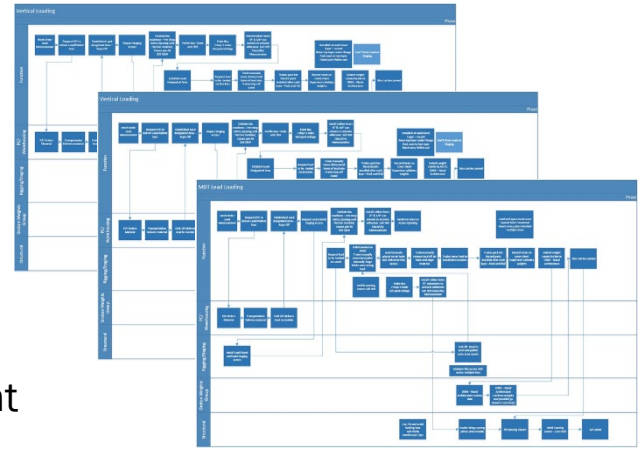
Define Current/Future State

Current stern loading process

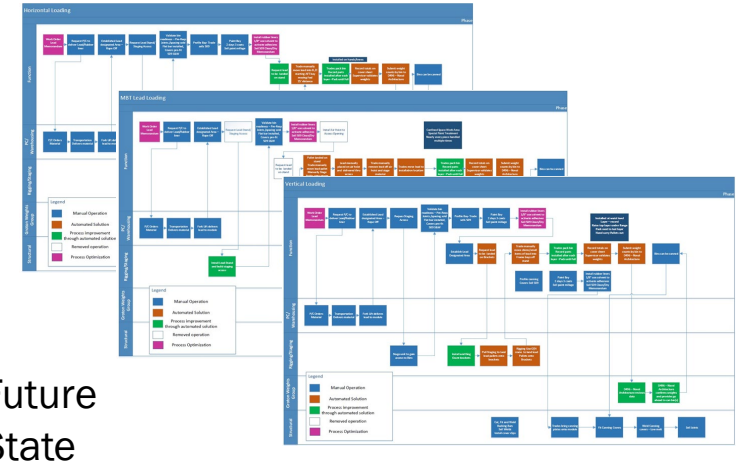
1. Lead pallets next to module after delivery
2. Lead stand assembled next to module for loading. Forklift lifts lead pallet.
3. Pallet jack to transportation from lead to stand to access opening
4. **Lift table to lift lead parts into module. (12 ft, 150 lb max load)**
5. Lead packed into a bin. Shimmed and tight, blue marks indicate the parts have been counted.
6. Lead covers for installation.
7. Lead cover welded in place.

Selected areas of improvement include:

1. Work Order Memorandum
2. Installing Rubber Liners
3. Submit Weight Count
4. **Stern loading lead transfer from pallet to access opening**
5. Vertical and Horizontal loading - trades pack bins



Current State



Future State

Market Survey

LIFT TABLES

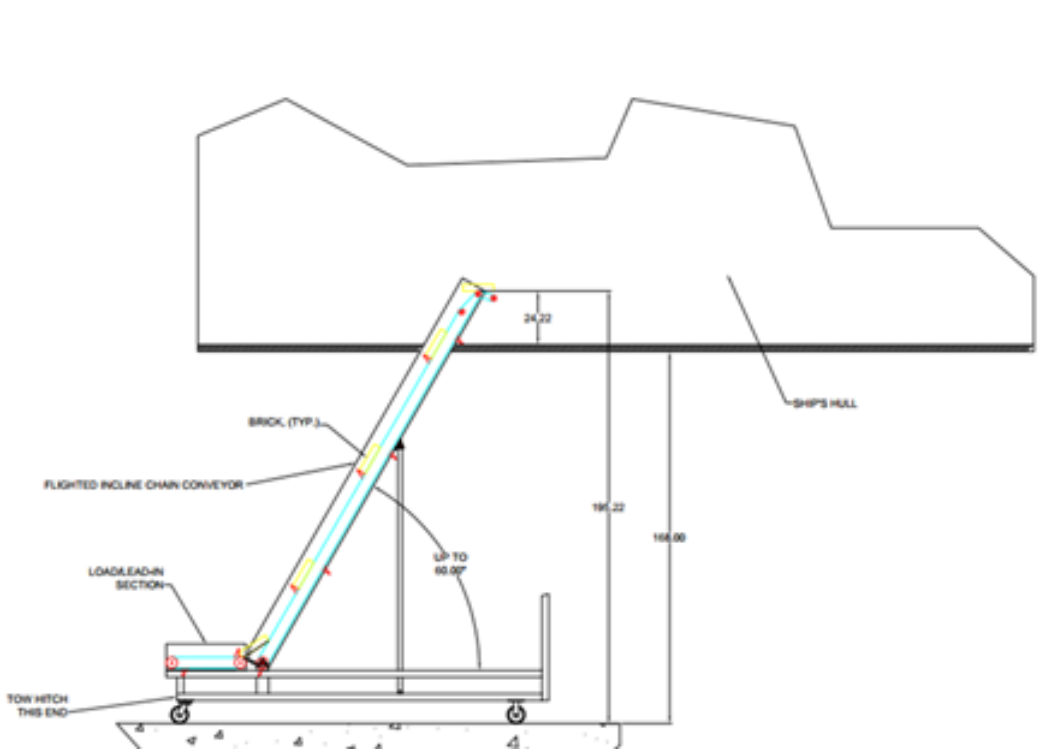
CONVEYORS

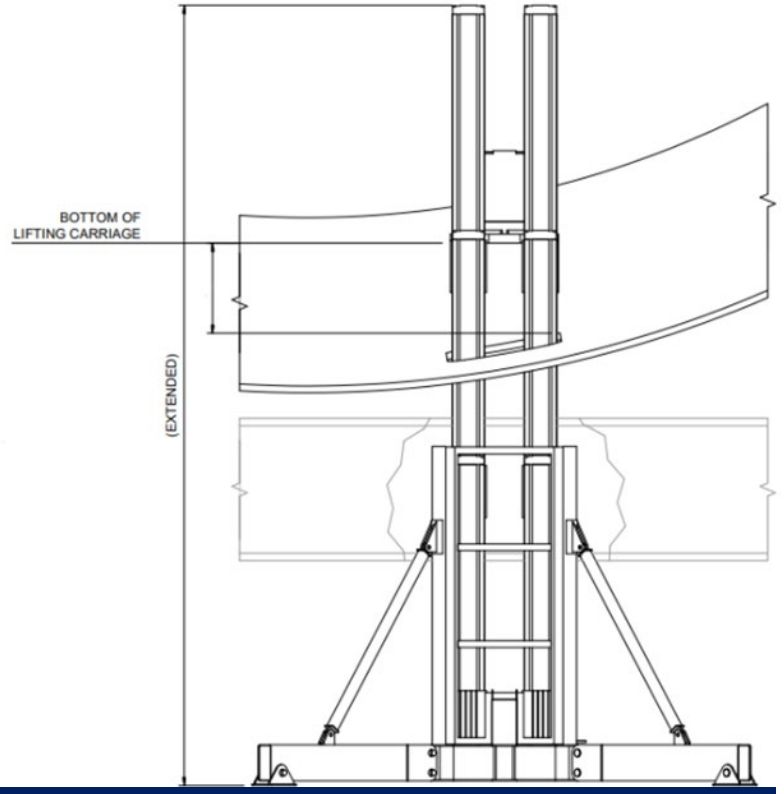
EXOSKELTONS

COBOTS

Increasing level of automation

Execute Virtual Simulation Test Plan





Model-based design enabled efficient down-selection and iteration

Vendor Down Selection

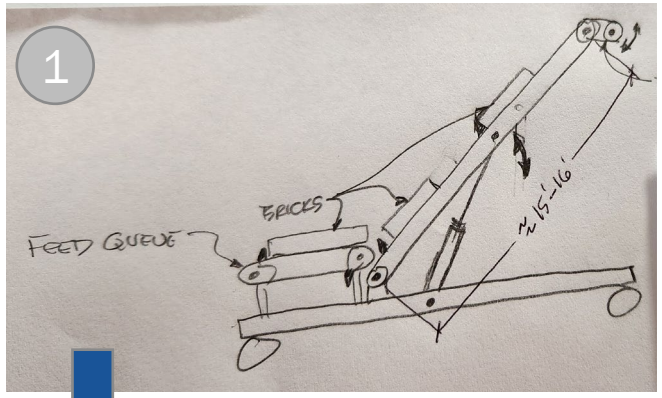
13 criteria were approved & scored

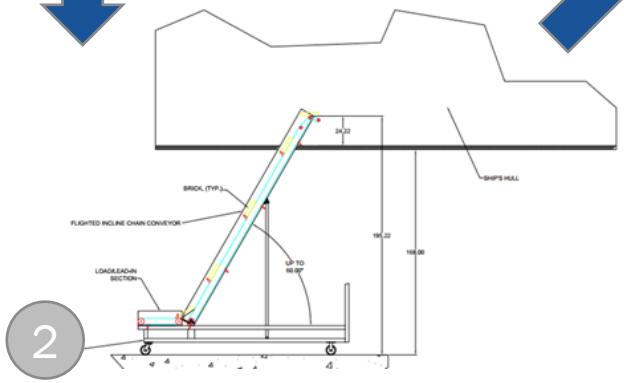
- Key Benefits:
  - Cycle time reductions
  - Flexible design
  - Lower costs
  - Substantial shorter lead times

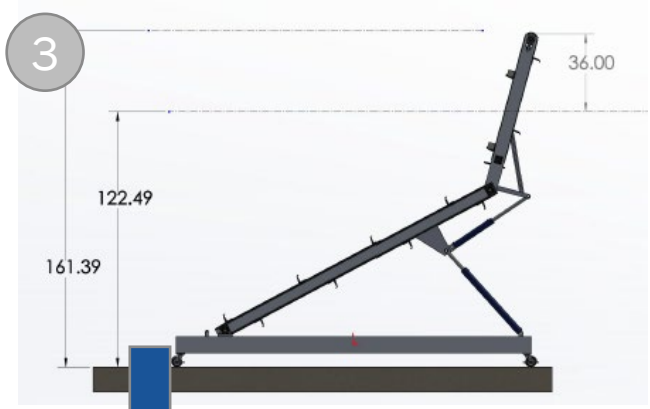
Recommendation: The Cooke Corporation

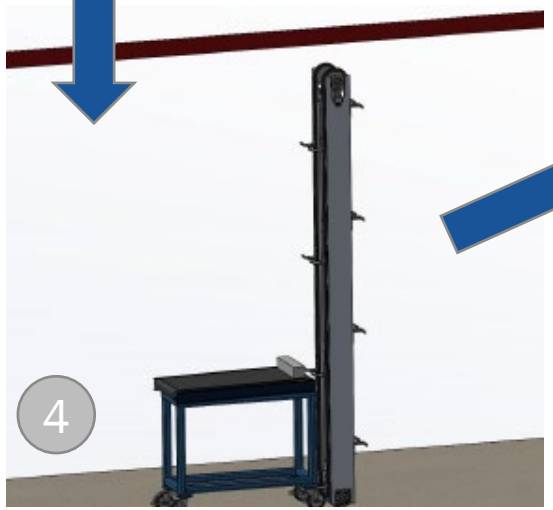
Decision Matrix					
Criteria	Weighting	Baseline Manual		Engineered Rigging	Cooke Corp.
		Score	Total	Total	Total
Reduction in Cycle Time	2.0	1.0	2.0	18.7	20.0
Reduction in Transportation	1.0	1.0	1.0	5.7	7.7
Feasibility of Success	3.0	10.0	30.0	20.0	24.0
Applicability to Other Loadings	1.0	10.0	10.0	6.0	9.0
Implementation Costs (1 - Expensive, 10 - Cheap)	1.5	10.0	15.0	2.0	11.5
Access Limitations (1 - Highly confined space, 10 - Low limitations)	1.0	10.0	10.0	3.7	5.7
Lead Quantity	1.0	1.0	1.0	9.7	6.7
Footprint - Amount of Space Occupied	1.0	9.0	9.0	9.7	8.0
Requires Process Change (1 - Drastic Change, 10 - No Change)	1.0	10.0	10.0	4.0	6.0
Ease of Operation	1.0	2.0	2.0	7.3	8.0
Safety Factors Considered	1.5	1.0	1.5	10.5	10.5
Off-the-shelf vs Customized Parts (10 - Off-the-shelf, 1 - Custom)	1	10.0	10.0	7.7	8.3
Lead Time	1.0	10.0	10.0	1.0	7.3
Total (Larger score is better)			111.5	105.8	132.7

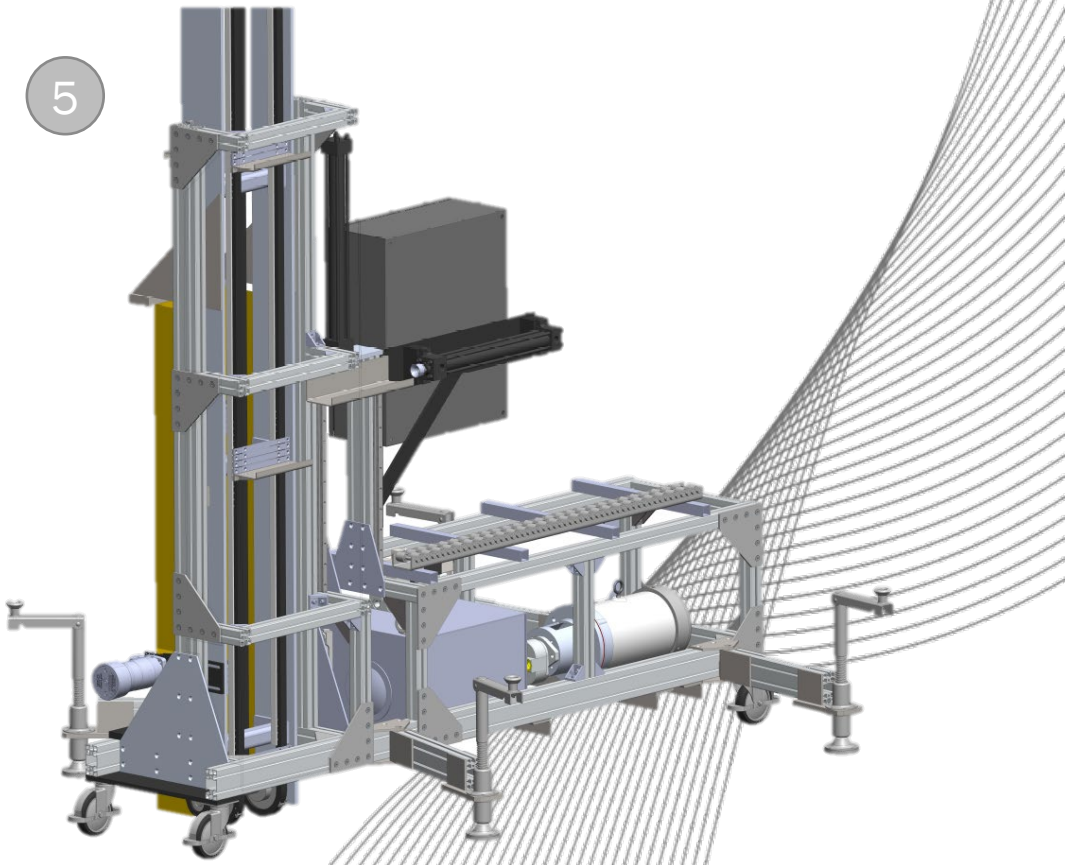
Iterative Design



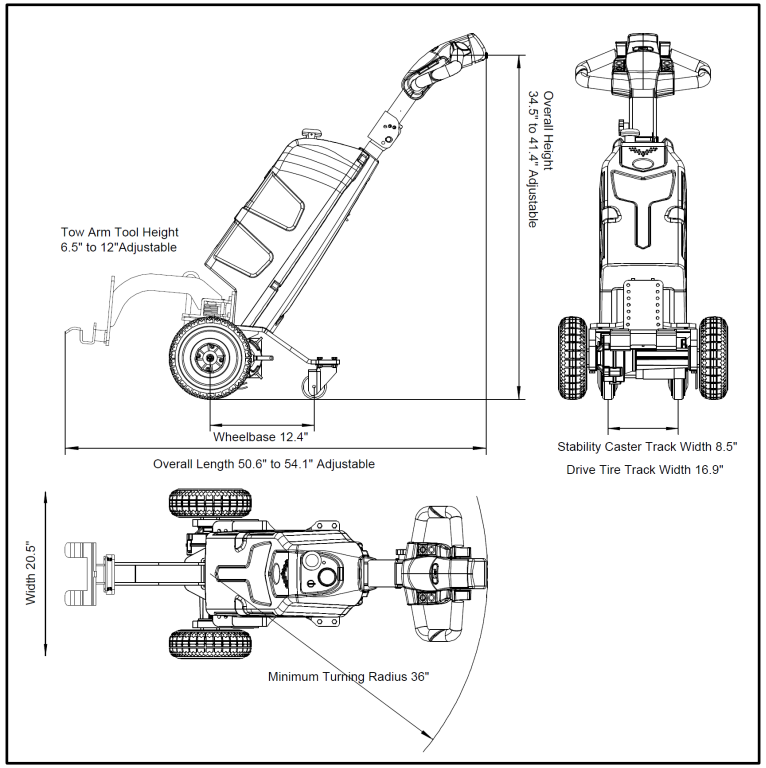


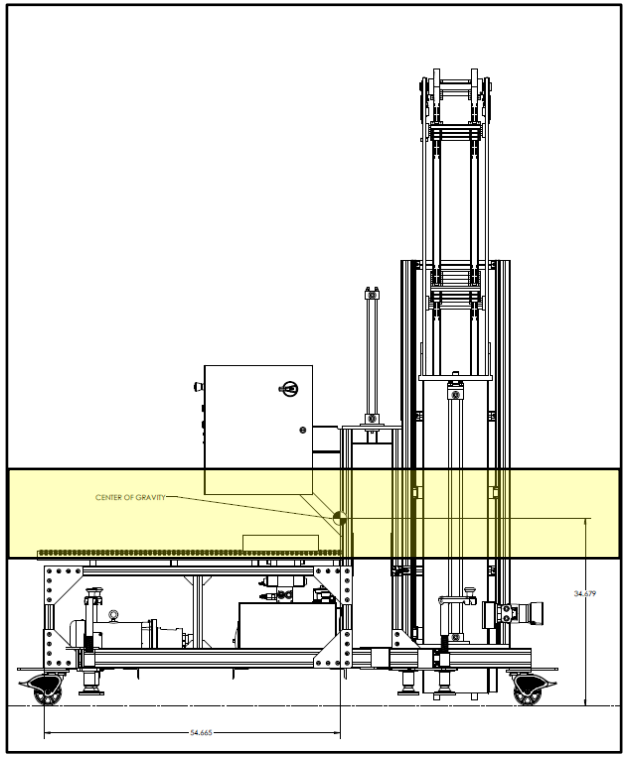


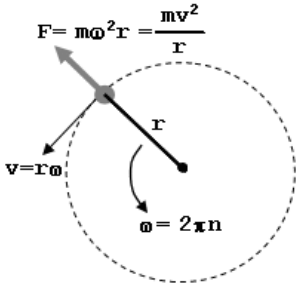




Risk Reduction - Prototype Safety Calculations

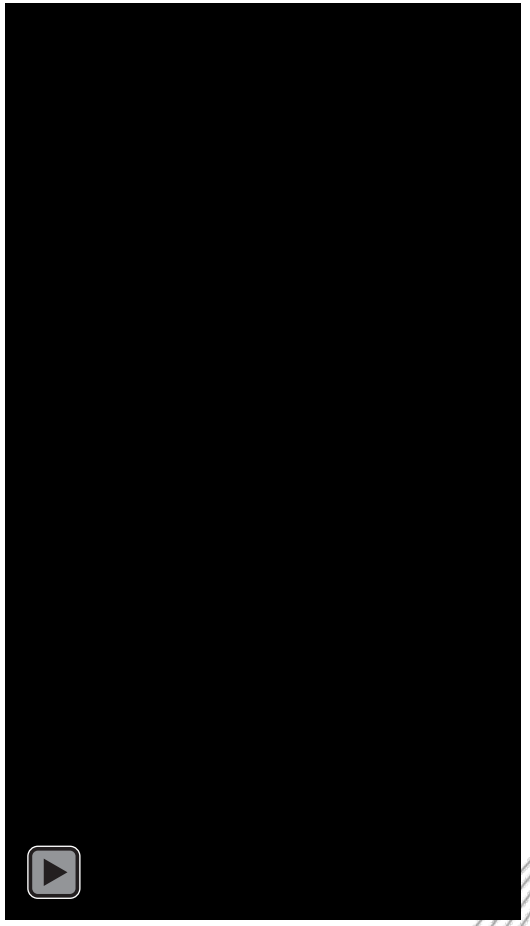




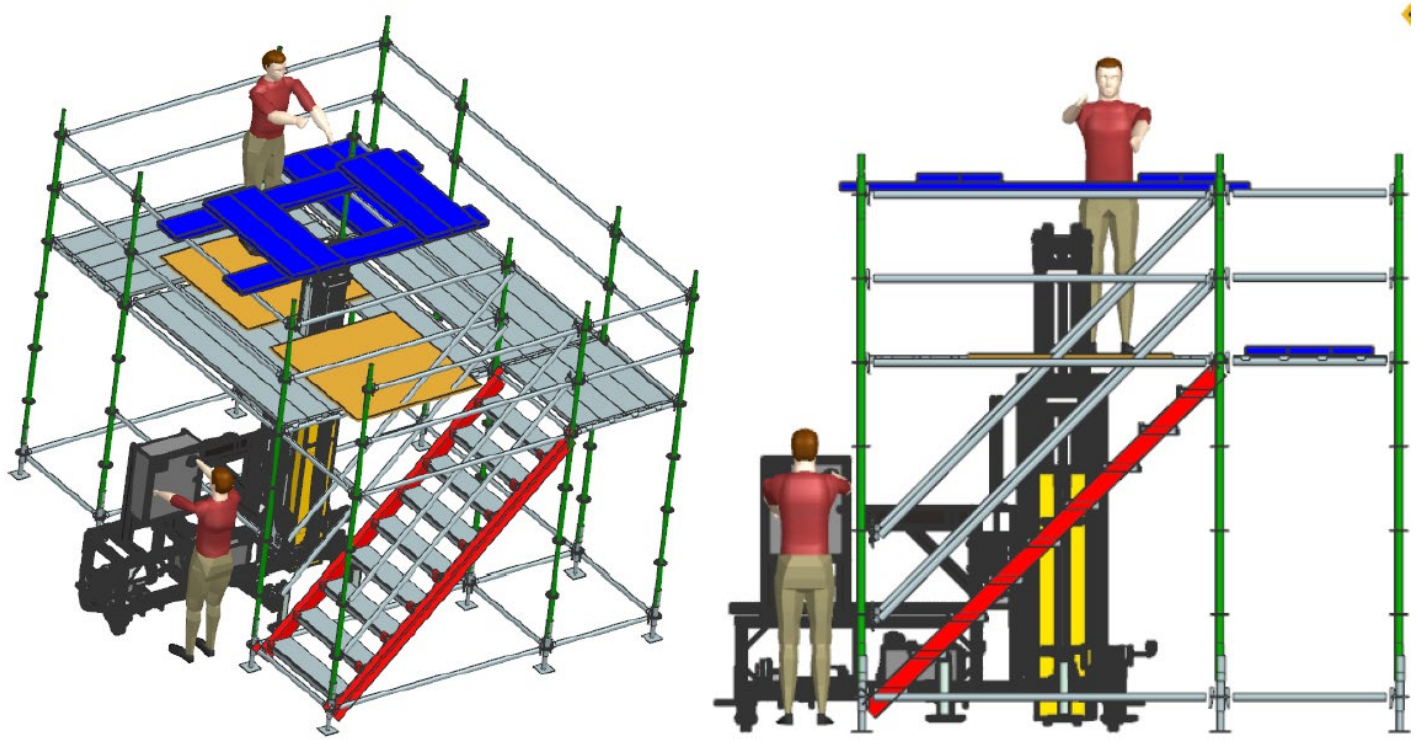


Dynamic calculations were reviewed to ensure safe operations in the shipyard

Final Design



Physical Demonstration Test



A physical mockup of the representative loading area was built to test and provide a training location

Transition/Implementation

- Technology Transition Plan Status: Approved, (under annual review control)
- Transition Event: Successful completion of trial runs and formal acceptance of new process and training by safety and union representatives
- Stakeholder Implementation Commitment: None at this time.
  - Target: General Dynamics Electric Boat QP
- Opportunities to Leverage:
  - Handling of heavy equipment similar in size/weight
  - Transportation of other equipment and material for install

Lessons Learned

- Human Subject Testing for exoskeletons
  - Navy Submarine Medical Research Laboratory (NSMRL) Internal Review Board (IRB) completed
- Iterative Design
  - Utilizing subject matter experts in design helped prevent challenges early
  - SMEs identified tight tolerances of hole opening would prevent challenges in using more complex, multi-conveyor solution
- Importance of Factory Acceptance Testing to mirror real-world application
  - Engaging end-users at Factory Acceptance Test at EBQP provided instant buy-in / training
  - Utilizing Lead Bricks during Factory Acceptance Test to verify systems lifting capability

Questions?