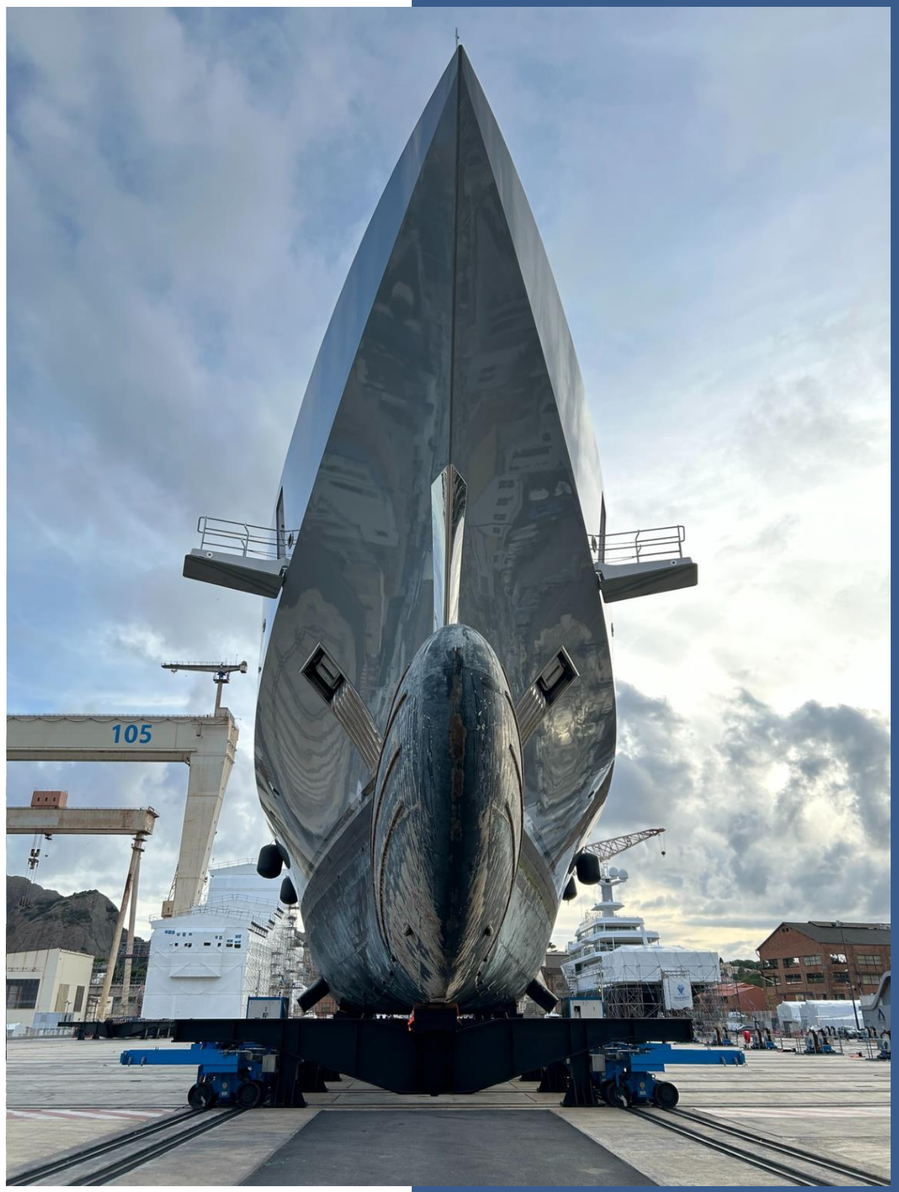
BARDEX CORPORATION

Royal United Services Institute of Nova Scotia

Drydocking Technology

Bardex

- Marine Engineering and Manufacturing
- Deep Water Mooring Systems
- Vertical Shiplift Systems
- Ship Transfer Systems
- Active on 6 Continents
- Offshore Mooring Systems Deployed Globally
- Defense, Commercial, Offshore Energy, and Leisure Maritime Sectors



Robert Taylor PE

- Principal Engineer – Shipyard Solutions
- Licensed Structural Engineer with 35 years of Experience
- 15 years Planning, Designing, Installing, and Operation of Vertical Shiplift and Transfer Systems Globally

Global Focus on Maritime Infrastructure

- National Security
  - New Vessel Construction
  - Fleet Sustainment
- Renewable Energy Transition
- Offshore Energy Production/Expansion
- Aquaculture
- Commercial – Transportation, Tugs, Fishing,
- Leisure – Small Cruise Ships, Yachts

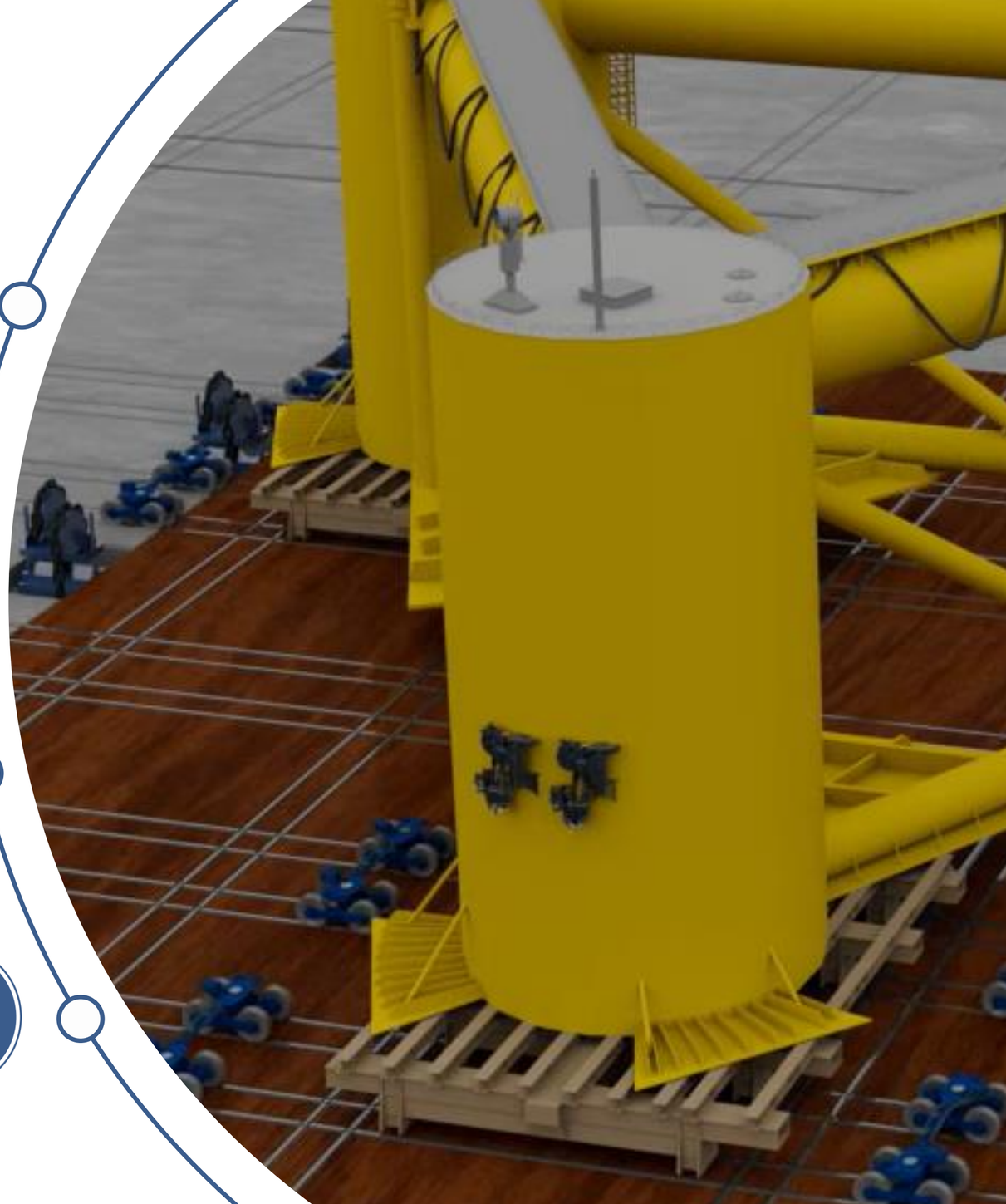
Common Types of Infrastructure (Tools)

01 Slipways

02 Drydocks

03 Floating Drydocks

04 Vertical Shiplift Systems



Slipways

Slipways or Marine Railways are used for both new construction and refit

Slipways can be parallel with or transverse to the vessel center line

This technology is scalable and was used extensively in the 20th century, both the Titanic and Goliath were built and launched on a slipway

Modern systems use mechanically driven chain or wire rope to in haul and launch vessels

These systems are still in use, however, construction of new systems is rare

Drydocks

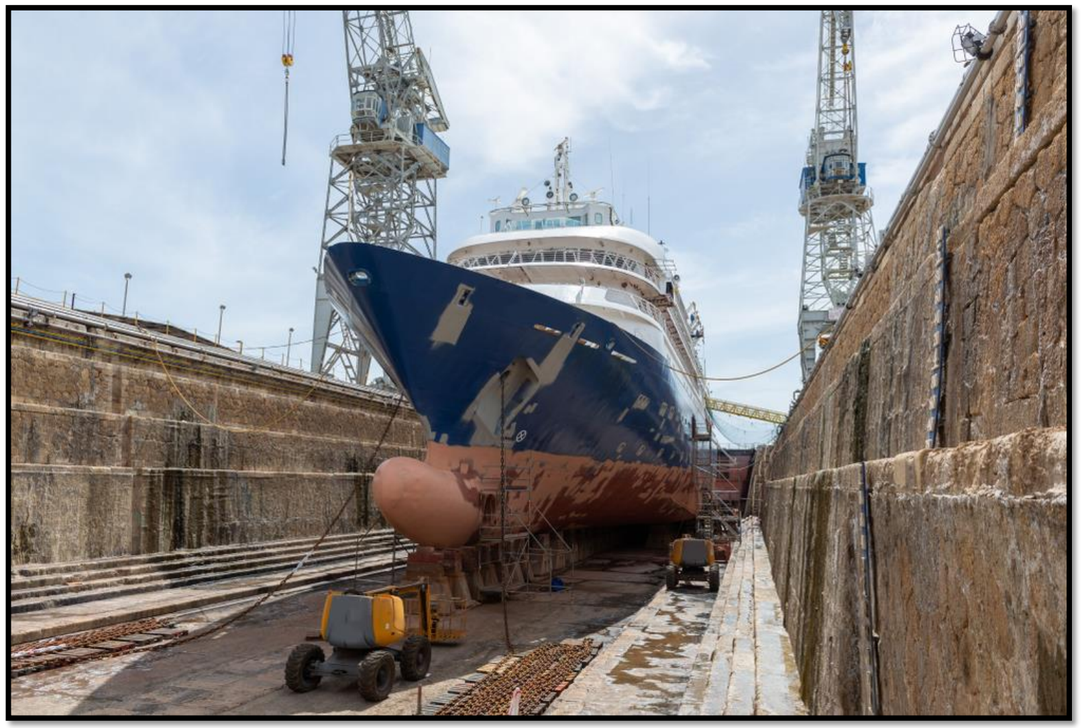
Drydocks are well known maritime sustainment infrastructure.

Drydocks typically serve larger vessels at low throughput

Economic viability is a challenge, especially for older drydocks

Drydocks are tide independent, weather can affect schedule of evolutions

CAPEX and OPEX costs are high, construction of new commercial drydocks is very rare.



Floating Drydocks

Floating Drydocks (FDD) are the most common tool used for vessel sustainment

FDD systems range in capacity from 2000 to over 40000 tons

FDD’s are expensive to design, construct, operate because these are classed vessels requiring regular inspection and maintenance

FDD’s are tide independent provided sufficient water depth is available for operation

Weather can affect schedule of evolutions

Vertical Shiplift and Transfer Systems

Vertical Shiplift and Transfer systems provide **high volume** ship handling at a lower CAPEX and OPEX than traditional Drydocks

Vertical Shiplift systems range in capacity from 1500 to over 27000 tons

Chain based vertical lift systems have acheived perfect safety record over the 58 years of operation

Vertical Shiplifts are tide independent and can operate in wide range of weather conditions

OPEX costs are typically lower than Drydocks and FDD's. Chain based systems have the lower OPEX and higher "up time" than wire rope-based systems

Market Activity Snapshot

01 SIOP Drydock Upgrades

02 FDD Replacements

03 New Shiplift Systems

04 Reactivation of Legacy Drydocks

05

06

Contextual Shiplift System Design

01 Geology and Bathymetry

02 Site Geometry

03 Target Vessel Market Data Analytics

04 Operational Objectives

05 EPC Planning

06 Financing and Grant Applications

OPERATIONAL INTELLIGENCE

We use Clarksons Data and our data analysis applications to assess your target market and ensure you are maximizing your assets to the fullest potential

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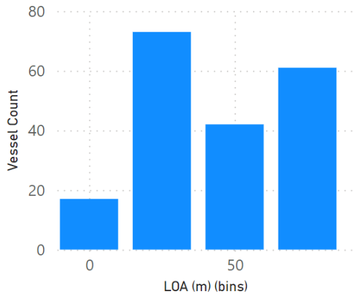
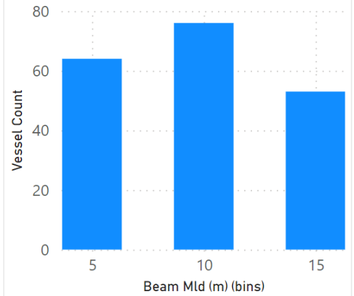
Shiplift Sizing-Market Capture Tool

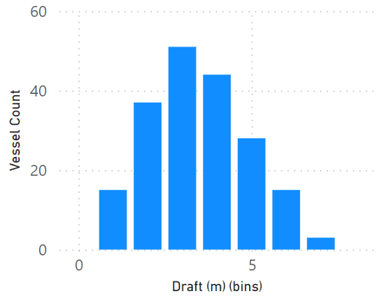
LOA (m)



Beam Mld (m)



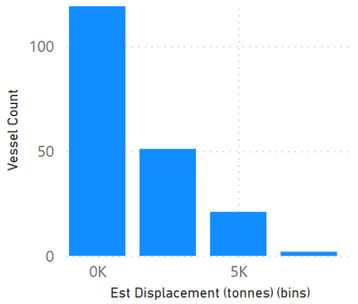
Draft (m)



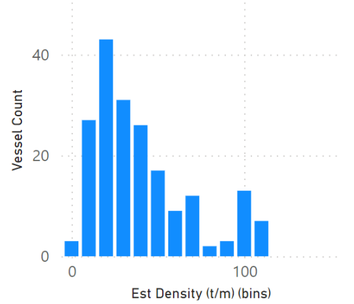
Est Displacement (tonnes)

133.88 9,825.00

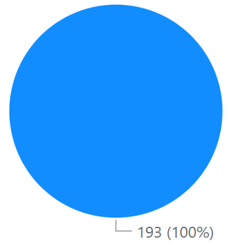
Est Docking Displacement (tonnes)



Est Density (tonnes/m)



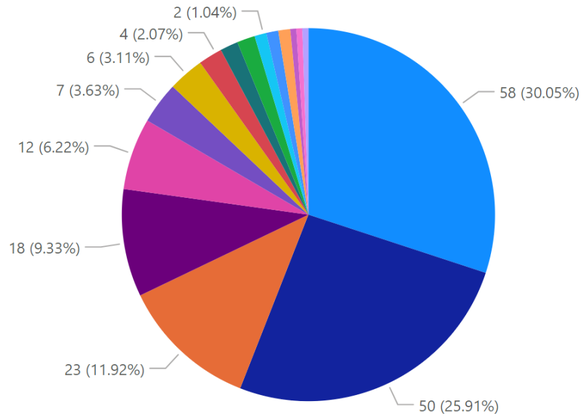
Vessel Count



Total Vessel Count

283

Vessel Count by Fleet Type



Fleet Type
- Offshore
- Tugs
- General Cargo
- Ferries
- Product Tankers
- MPP
- Oth Non Cargo
- Dredgers
- LPG
- Small Tugs
- Chemical Tankers
- Rigs and Other
- Small Workboats

Fleet Type	Type	LOA (m)	Beam Mld (m)	Draft (m)	Est Displacement (tonnes)	Est Density (t/m)	East Coast S America Deployment (Time in Last 12 Months, %)
Offshore	PSV/Supply 3-4,000 DWT	83.28	18.00	6.72	7,227.86	115.72	12.22
Offshore	AHTS >16,000 BHP	76.50	17.50	6.90	6,627.82	115.52	3.40
Offshore	AHTS >16,000 BHP	76.50	17.50	6.90	6,627.82	115.52	32.97
Offshore	PSV/Supply 4,000 DWT+	85.70	18.00	6.50	7,194.30	111.93	93.28
Offshore	PSV/Supply 4,000 DWT+	85.70	18.00	6.50	7,194.30	111.93	96.52
Offshore	PSV/Supply 3-4,000 DWT	94.86	18.28	6.36	7,912.95	111.22	94.60
Offshore	PSV/Supply 4,000 DWT+	91.16	18.29	6.25	7,478.02	109.38	64.71
Offshore	PSV/Supply 4,000 DWT+	91.44	18.29	6.20	7,440.65	108.50	79.57

Stakeholder Engagement

01 Owner / Operator

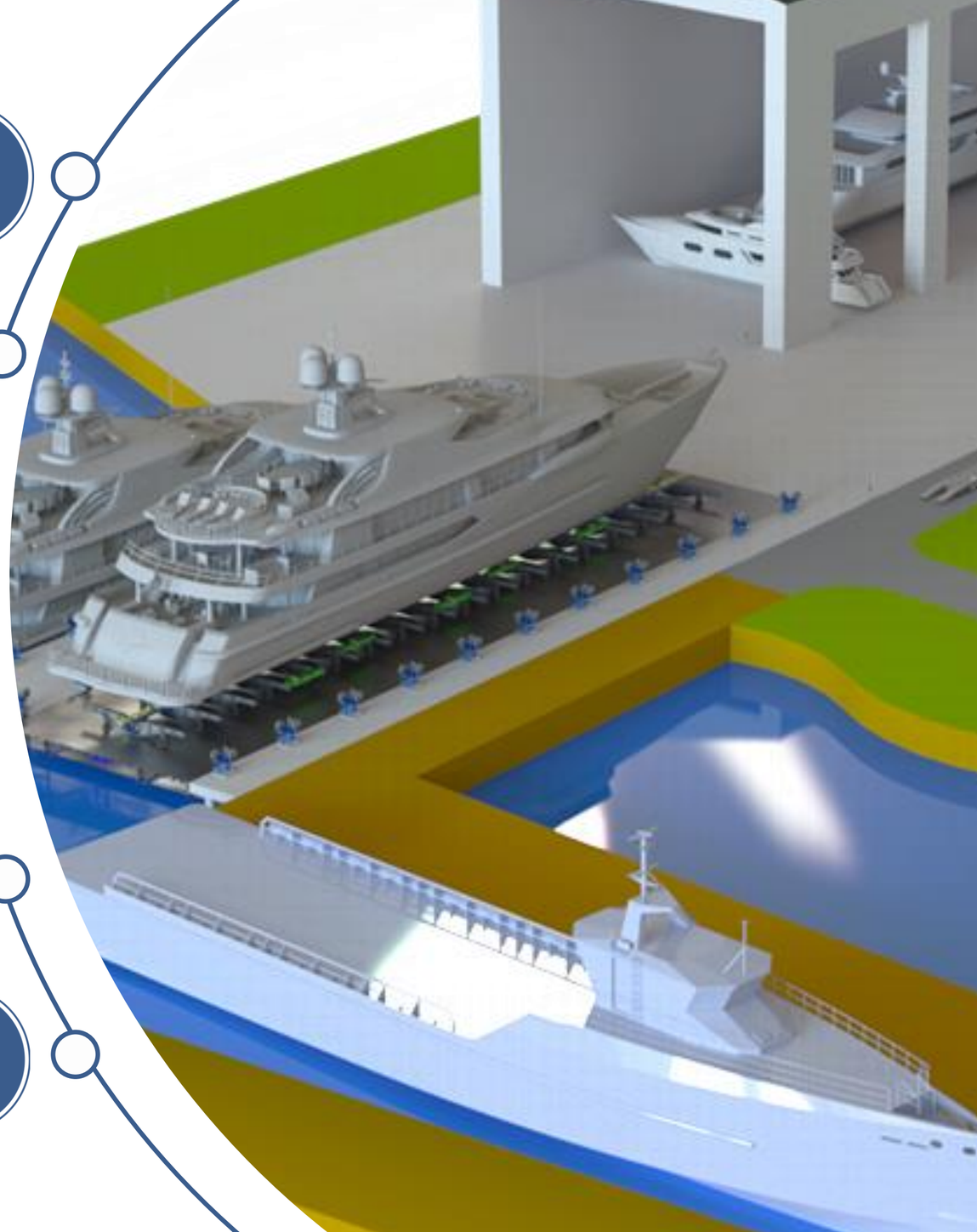
02 Facility Management

03 Civil Designer

04 Vessel Designers

05 Construction Team

06 Local Businesses Capable of Supporting Installation and Operation of System



The Irving Shipbuilding Project

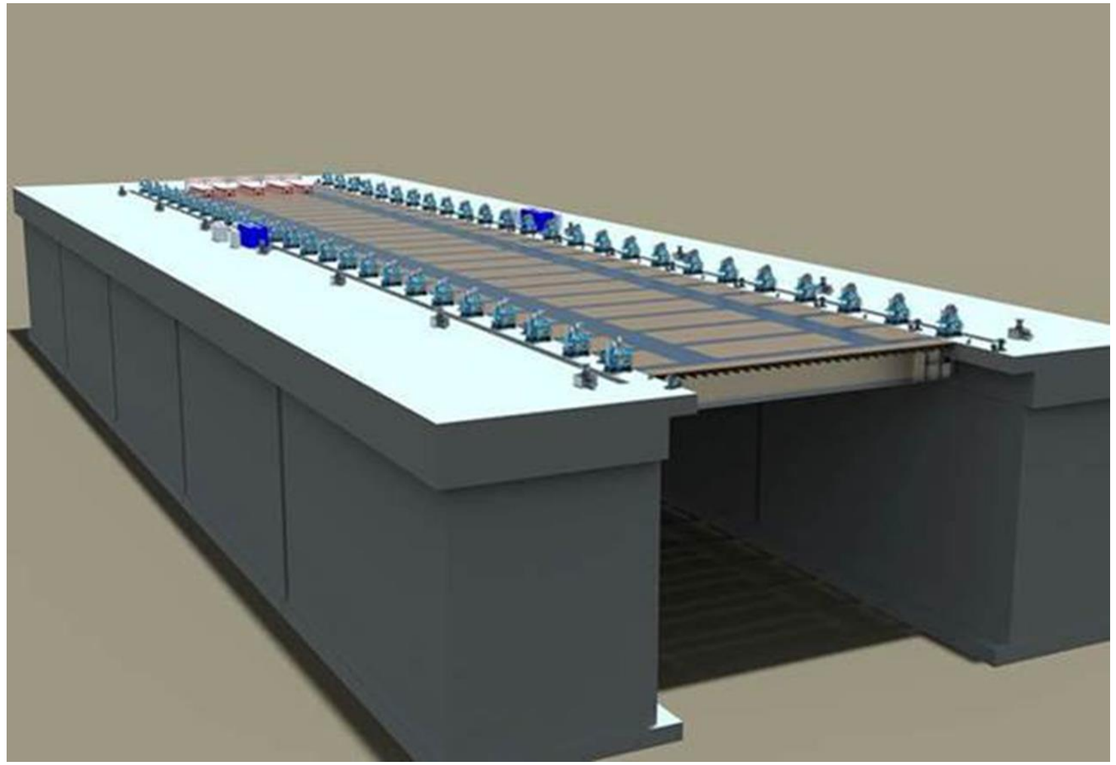
IRVING SHIPLIFT

- Irving Shipbuilding Inc. in Halifax, Nova Scotia – Atlantic Canada

- **Project Start Date**: July 2024
- **Commission Target Date:** July 2028

The Irving Shiplift System

- **Maximum Distributed Load (MDL):** 164.7 tonne/m
- **Maximum Lift Capacity (MLC):** 27,470 tonne
- **Transfer System:** SPMT
- **Chain Jack Lift Station Count:** 56
- **Capacity:** 575 tonne (per lift station)
- **Chain:** 95mm Studlink Grade R4S
- **Platform Dimensions:** 30m width x 165m length



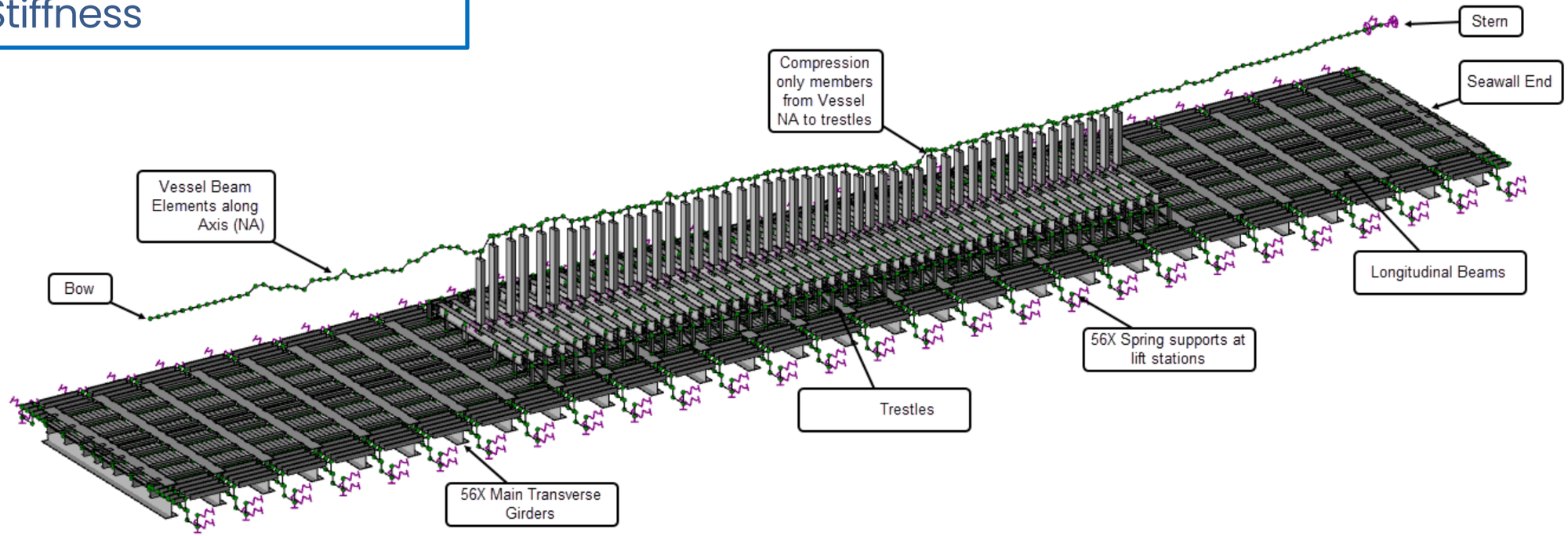
Advanced Finite Element Analysis of Vessel on Platform

Information In

- Blocking Plan
- Vessel Density
- Hull Stiffness
- Hull Neutral Axis
- Vessel Support Structure
- Shiplift Platform Structure
- Lift Chain Stiffness

Predictive Analysis

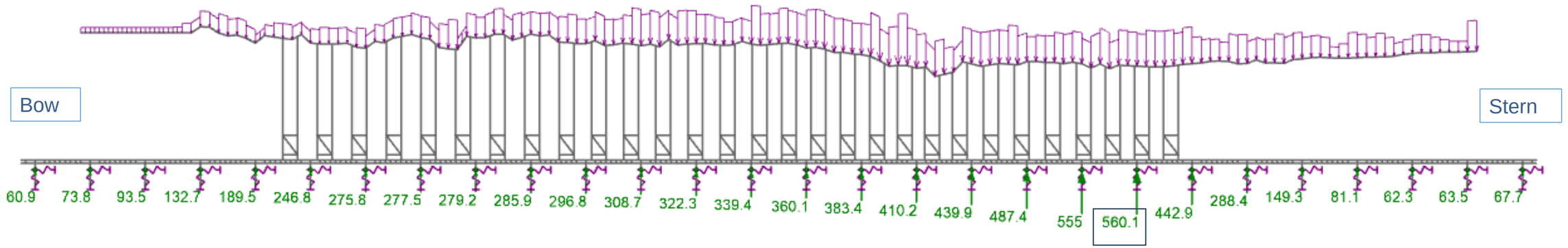
- Blocking Loads
- Structural System Utilization
- Lift Station Loads



Predictive Analysis For Every Vessel Lift

Bardex Works with Vessel Designers and Dockmasters to Reduce Risk and Ensure Outcomes

- Vessel Weight = 8080 tons.
- Effective Blocking Length = 95m
- Trestle Arrangement Weight = 1653 Te
- Maximum Lift Station Reaction = 560 Te



BARDEX CORPORATION

THANK YOU!

Robert Taylor, PE

Principal Engineer-Shipyard Solutions

rtaylor@bardex.com

www.bardex.com

Bardex Corporate Headquarters
6338 Lindmar Drive
Goleta, California 93117 USA

Houston Office
Daniel Toerner
dtoerner@bardex.com
12121 Wickchester Ln. Suite 200
Houston TX, 77079 USA

Canada
Dave Smith
dsmith@coil.ca

Europe, Middle East, Africa
Ian Finch
ifinch@bardex.com

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Project Profile

Navy II (Shipyard Upgrade)

Pyoengtaek, ROK

Navy Vessels
Shiplift & Transfer System
Commission Date: 2020

Design Vessel Data	Operating Criteria	Shiplift Design Data	Transfer System Design
Lightship Weight: 3,900 Te	Nominal Lift Capacity (NLC): 4,970 Te	Platform Type: Semi-Articulated 140m long (80/60m split type) 22m wide	Transfer System Type: Split Level Pit Type
Vessel Length (LOA): 135.5 m	Max Lift Capacity (MLC): 7,419 Te	Chain Jacks: 32 units 300 Te stall capacity 275 Te lift capacity	Lateral Transfer Carriage: 121.9m long 12.3m wide
Vessel EDL: 85% LOA (Effective Docking Length)	Max Distributed Load (MDL): 40-73 Te/m	Transfer Direction: End Transfer from Platform Side Transfer in Pit	Longitudinal Cradles: Modular Type Designed for Individual Vessels
Vessel MDL: 71 Te/m	Shiplift Operating Speed: 25 cm/min	Shiplift Power Supply: Hydraulic Power Units: 6x 160kW	Carriage and Cradles moved on rails by dozers in yard
Number of Berths: 3 (140m length) (Future expansion planned)	Transfer System Operating Speed: 10 m/min	Platform Weight: 1019 Te (Including wood deck and rails)	Lateral Transfer Carriage Weight: 251.6 Te

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Project Profile

Atlas 1

La Ciotat, France

Mega-Yacht
Shiplift & Transfer System

Commission Date: 2022

Design Vessel Data	Operating Criteria	Shiplift Design Data	Transfer System Design
Lightship Weight: 4300 Te	Nominal Lift Capacity (NLC): 4,300 Te	Platform Type: Rigid Platform Length: 100 m Platform Width: 20 m	Single Level Transfer System using modular cradles moved by bogies on rails
Vessel Length (LOA): 105 m	Max Lift Capacity (MLC): 5,185 Te	Chain Jacks: 20 units 415 Te Stall Capacity 375 Te Lift Capacity	Bogies : 36 units 180 Te Lift Capacity each
Vessel EDL: 85% LOA (Effective Docking Length)	Maximum Distributed Load (MDL): 64 Te/m	Transfer Direction: Longitudinal and Transverse From Platform	Modular Cradles: Up to 9 units per vessel Meters between Cradles: 10.1 m
Vessel MDL: 59 Te/m (Maximum Distributed Load)	Shiplift Operating Speed: 30cm/min unloaded 20cm/min loaded	Shiplift Power Supply: Hydraulic Power Unit, 3x 200kW	Transfer System Power Supply: 2x Diesel powered mobile HPUs (self driven units)
Number of Berths: up to 7 (100m length)	Transfer System Operating Speed: 4.4 m/min unloaded 2.2 m/min loaded	Platform Weight: 970 Te (Including wood decking & rails)	Trestles/Cradles Weight: 232 Te

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Project Profile

DSME Shiplift Upgrade

Okpo, Korea

Navy Special Vessel Shiplift System

Commission Date: 2019

Design Vessel Data	Operating Criteria	Shiplift Design Data	Transfer System Design
Lightship Weight: 3,800 Te	Nominal Lift Capacity (NLC): 7,370 Te	Platform Type: Rigid Platform Length: 96.4 m Platform Width: 14 m	Transfer System: Self Propelled Modular Transporter (SPMT by Others)
Vessel Length (LOA): 83.5 m	Max Lift Capacity (MLC): 8,880 Te	Chain Jacks: 32 units 400 Te Stall Capacity 375 Te Lift Capacity	
Vessel EDL: 85% LOA (Effective Docking Length)	Maximum Distributed Load (MDL): 110 Te/m	Transfer Direction: Longitudinal (End Transfer)	
Vessel MDL: 85 Te/m	Shiplift Operating Speed: 10cm/min Future Upgrade possible: 20cm/min	Shiplift Power Supply: Hydraulic Power Unit, 3x 160kW	
Vessel Beam: 9.6 m	Shiplift Travel: 16m	Platform Weight: 1159 Te (Including steel deck covering)	

Hanwha Ocean (formerly DSME) submarine shiplift in operation from 1990 operating continuously in its original specification until the system capacity upgrade in December 2019.