



Digital Toolbox for Efficient Port Design / Development

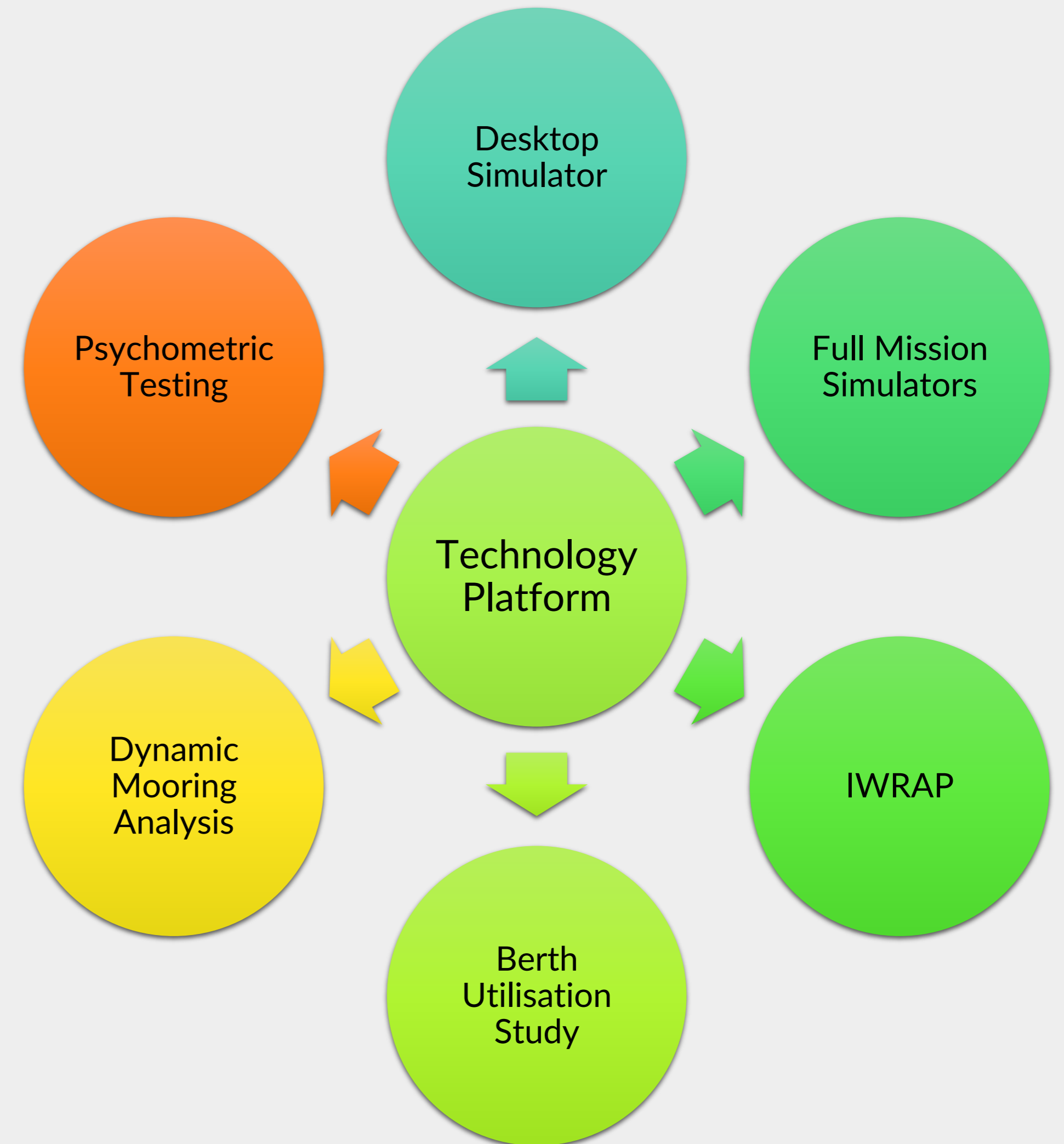
Benjamin Nair
KASI Group



Introduction

Port requirements have become more complex and expensive, and some existing port infrastructure are ageing. Coupled with increasingly larger ships with tighter schedules – safe and efficient port design has become paramount as an error could result in significant losses (economic / human life / environment).

In an effort to achieve this, it is recommended that designers utilise the latest available ‘tools’. Each component is useful on its own, but when combined, these tools allow designers to find quicker, safer and cost-effective design solutions.



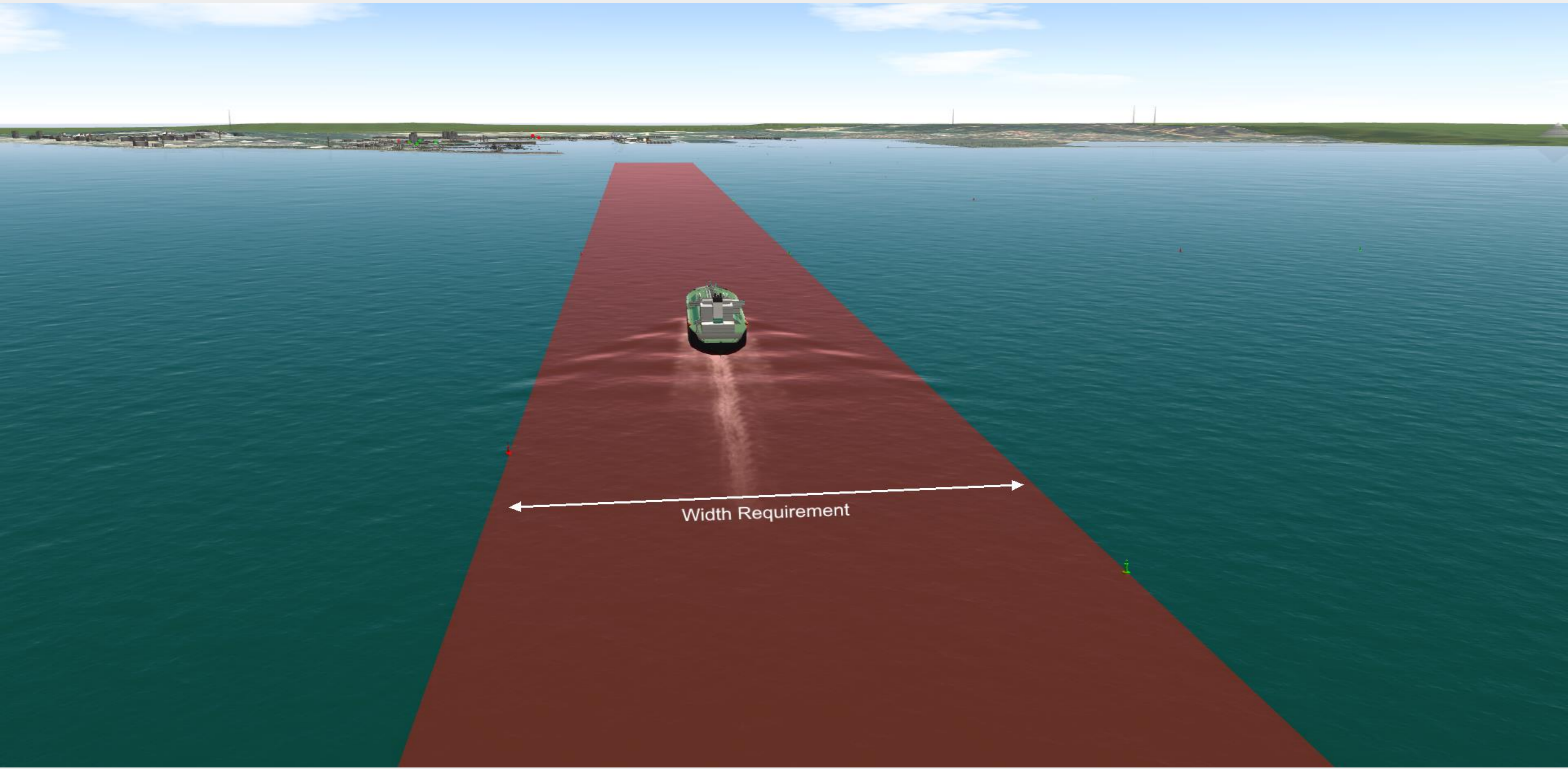
Port Design Process

The design of port and/or an approach channel encompasses a number of disciplines including ship handling and port engineering in order to design waterways to a desired level of navigability and safety, requiring assessment of the following key elements:

- Vessel size and behaviour
- Effects of the physical environment
- Human factors in ship handling

Designing the port's waterways involves designing the layout and dimensions of a port's main water area with reference to:

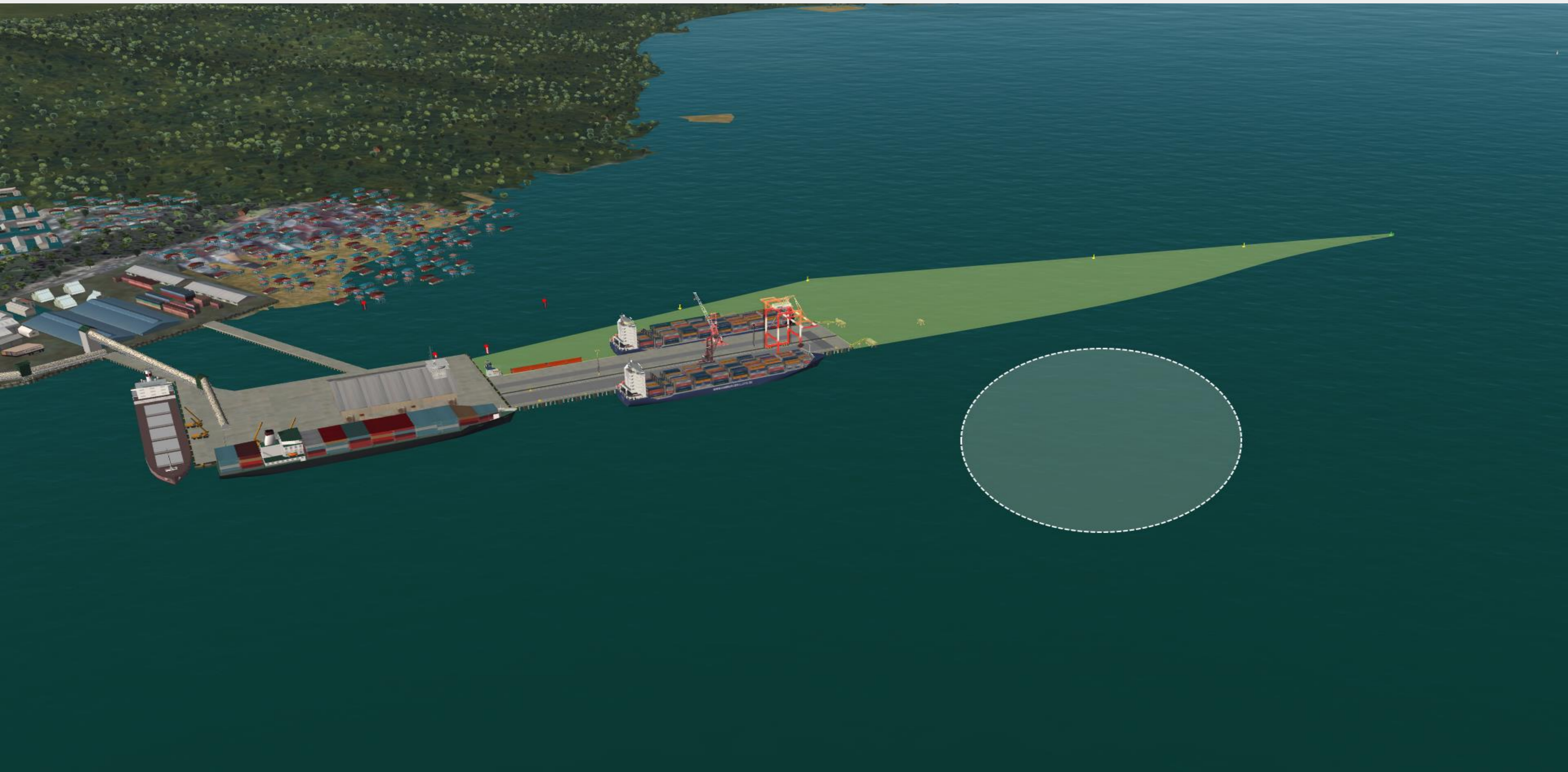
Alignment and Width of Approach Channels



Water Depth Requirements



Manoeuvring Spaces



Port Design

By using our desktop simulator and/or full mission simulators, KASI can assess and validate the concept design based on safety criteria with regard to international standards.

In addition to the layout of the port, other elements of port design can be assessed using specialised software. We've assisted Clients identify and mitigate potential navigational risks, determine the best number of berths and recommend suitable mooring and fender systems.

Key Benefits of Digital Tools in Port Design

Optimisation of port design in terms of safety, operational efficiency and cost

Establishment of operational procedures, including operating limits and tugboat requirements

Determination of infrastructure requirements

Desktop Simulator

Desktop Simulation often precede Full Mission Simulation as multiple simulation runs can be conducted in a short amount of time to get a quantitative assessment of the navigability of the port layout. This type of simulation is usually utilised during the **Conceptual Design Stage**.



Full Mission Simulator



Full Mission Simulation is necessary to include human factors in the study, normally deployed during the **Detailed Design Stage**. Human factors can be visual factors, communication with tugs, etc.

Full Mission Shiphandling Simulation (FMSS)

Full Mission Shiphandling Simulation provides quantitative performance data characterizing the design and operational alternatives being considered including data on the entire navigational system and variability of the shiphandler. This method provides subjective evaluations as well as quantitative assessments that can be used to guide the selection process and acceptance of a proposed design.



Conduct of an FMSS Run



Each scenario is planned by the simulation committee, taking into account the type of operation, environmental conditions and time of day.

At the end of each simulation run, the simulation bridge team and committee will replay and review the run. All aspects of a simulation run, down to helm and rudder orders as well as tugboat utilisation levels, are recorded and can be used to form conclusions or recommendations for improvement of navigational safety.

In-House Area Modelling

Simulation models are created based on photographs and videos of the area, and are spatially correct (calibrated using GPS coordinates taken from the site). Existing aids to navigation, prominent structures (landmarks) and even bathymetric data of the area are incorporated.

Lumut Iron Ore Terminal, Perak



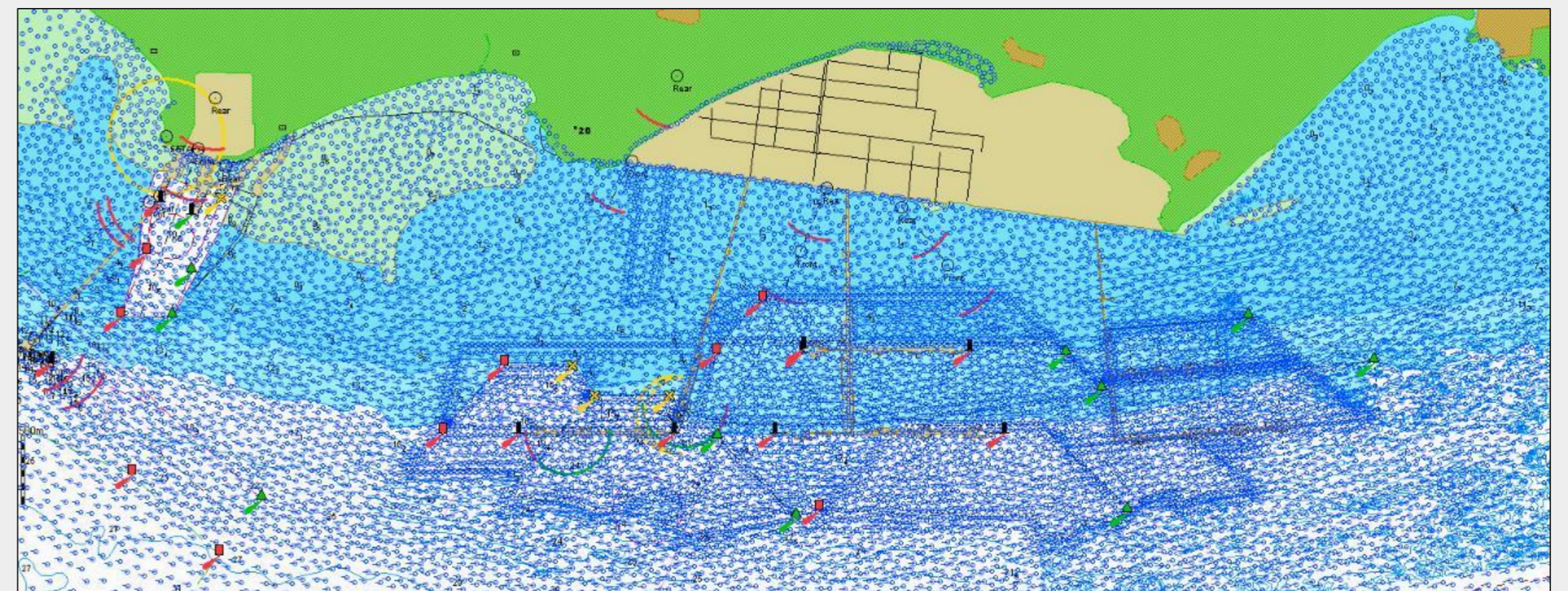
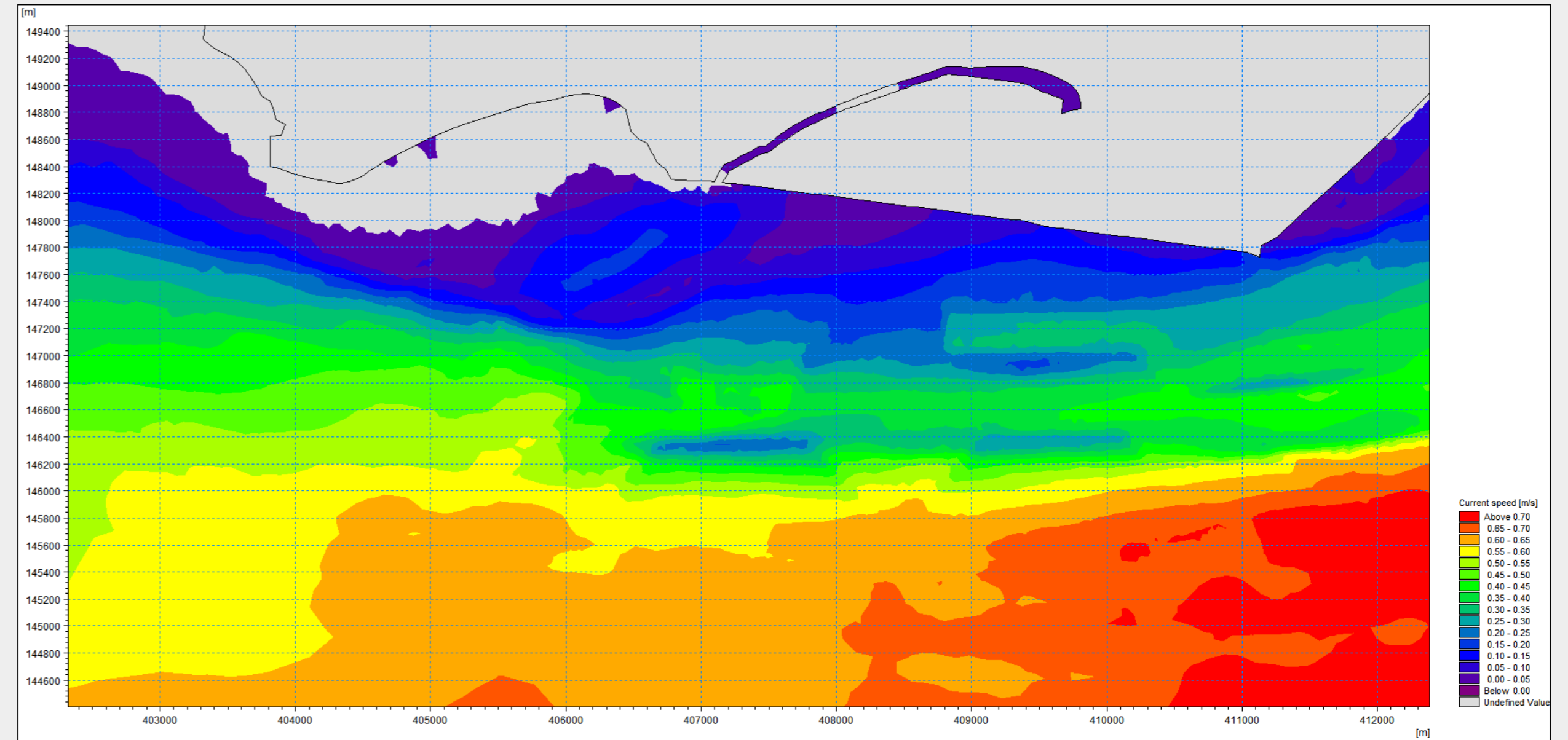
Simulation Area Model



Data Collection Methods

Simulation is only as accurate as the input parameters.

- Drone Image / Video Capture
- Engineering Drawings
- Direct Integration of Metocean Data:
 - Wind / Wave Data
 - Current Profiles
 - Bathymetric Survey Information



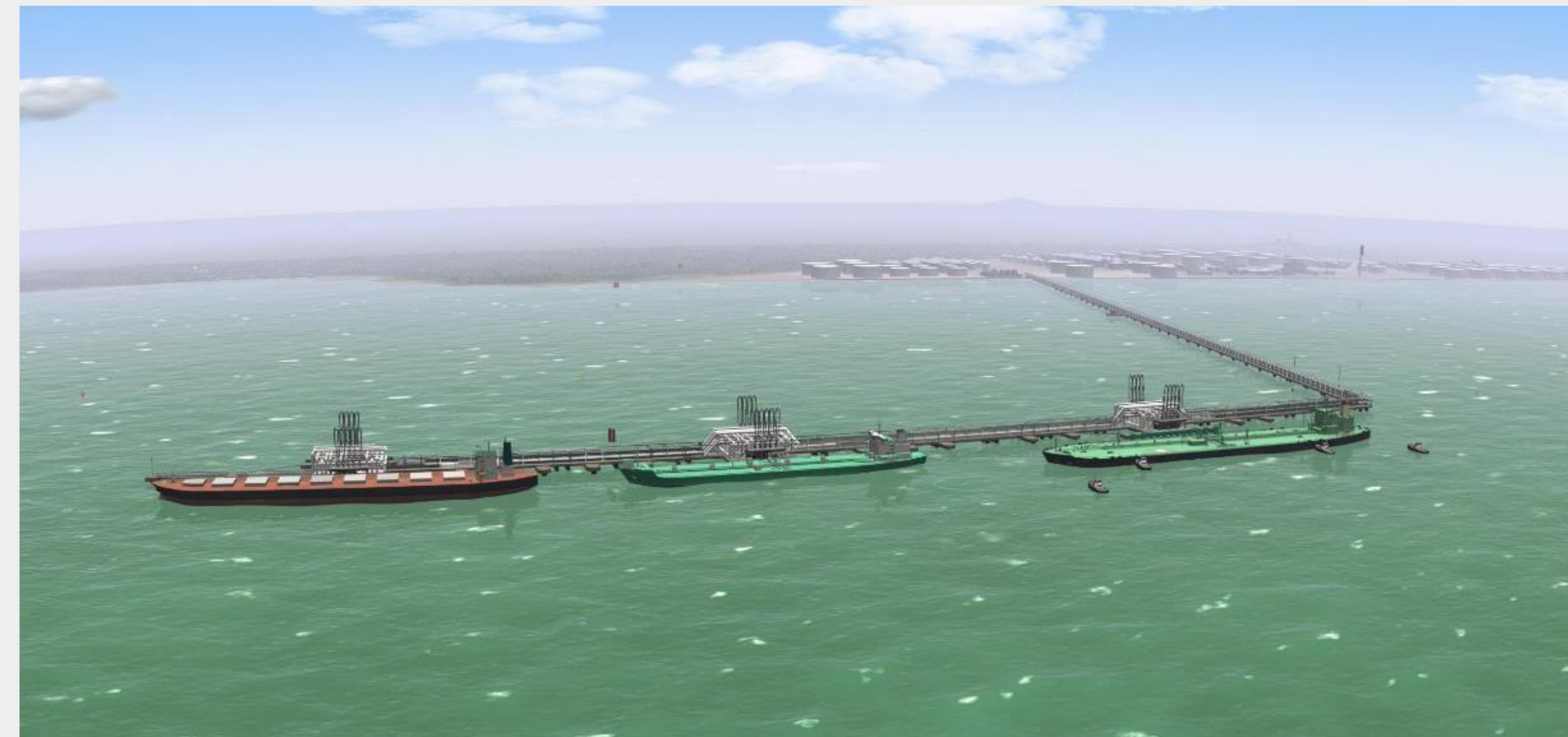
Case Study: FMSS for Petroleum Terminal Design

Project Optimisation

- Validation of navigation through approach channel and berthing / unberthing
- Identification of appropriate Pilot Boarding Grounds
- Optimisation of dredging layout, resulting in savings of up to RM 40 million
- Optimisation of efficiency of movements, reducing vessel berthing operation time from 4 hours to 1.5 hours
- Optimisation of tugboat configuration (sizing and numbers)

Project Highlights

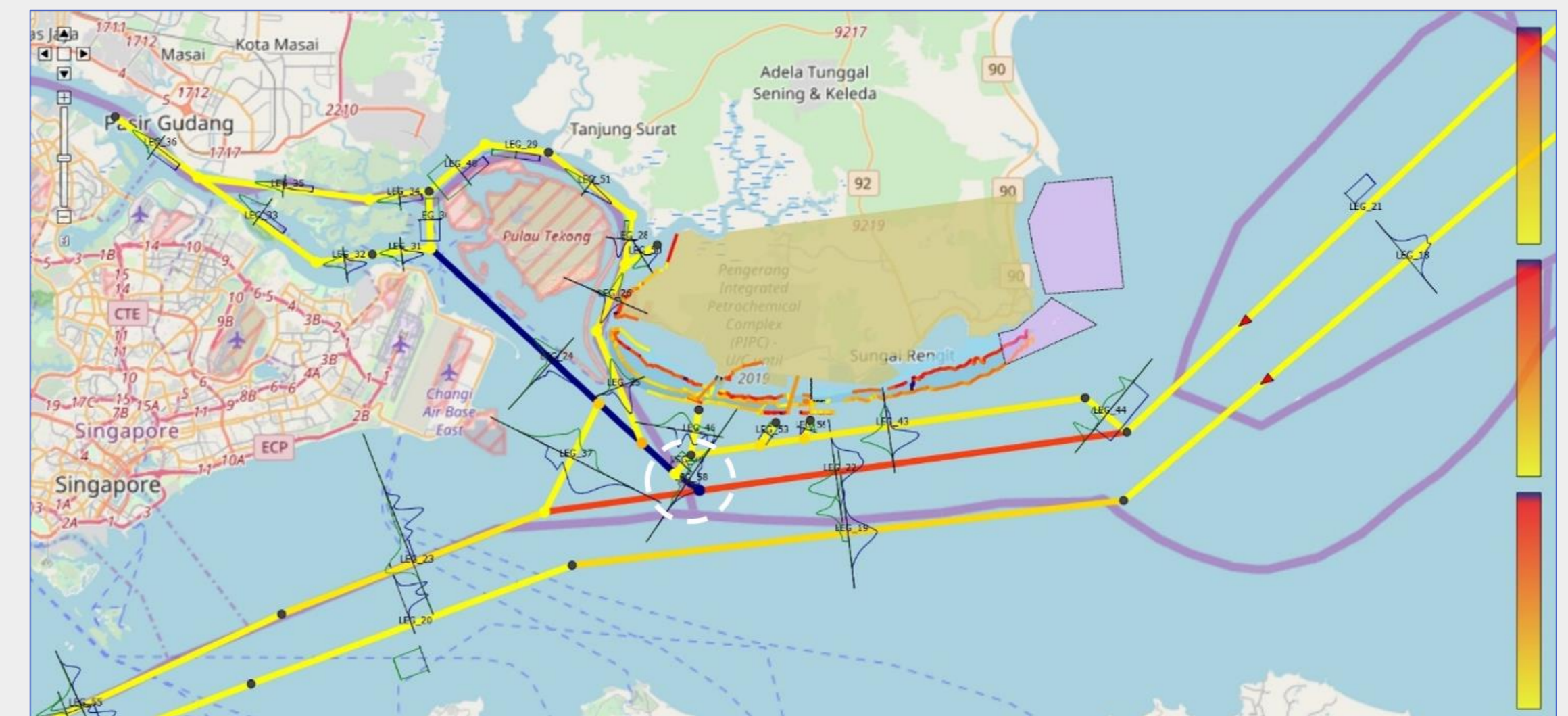
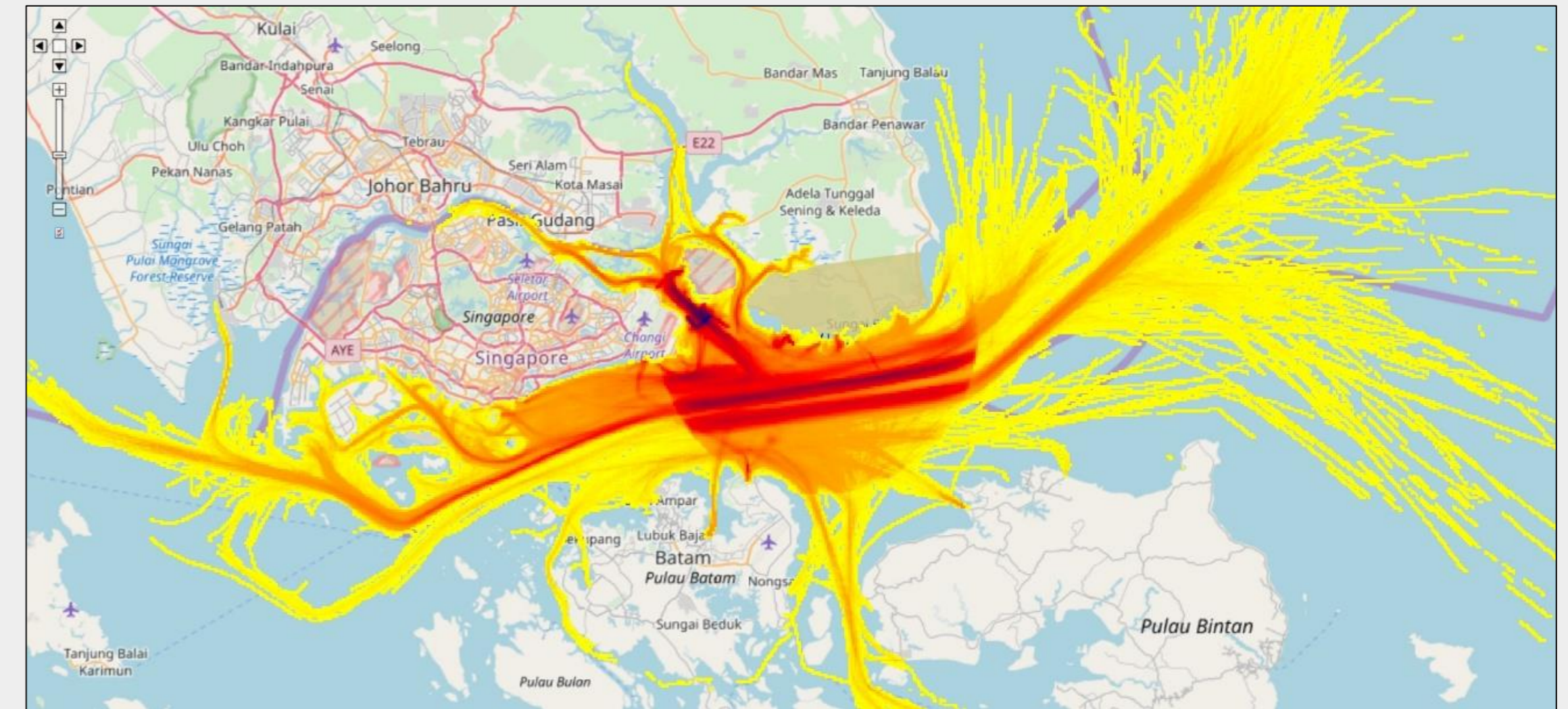
- Mixture of multiple types of vessels berthing at 27 berths
- Requirement for vessels to cross a Traffic Separation Scheme (TSS)
- More than 100 FMSS runs conducted by local pilots over the course of one month, with Client's senior management in attendance



Risk Identification

Introducing new (and larger) traffic into a waterway will create risks. Today, an accident could result in massive economic / life losses.

IALA's software, IWRAP Mk2 is an internationally recognized tool, capable of estimating the number of collisions, groundings and allisions that may occur within a waterway on the basis of a specified traffic intensity and composition. Instead of 'guesstimating' traffic patterns in an area, IWRAP is able to directly import historical AIS data from nearby traffic control centres.



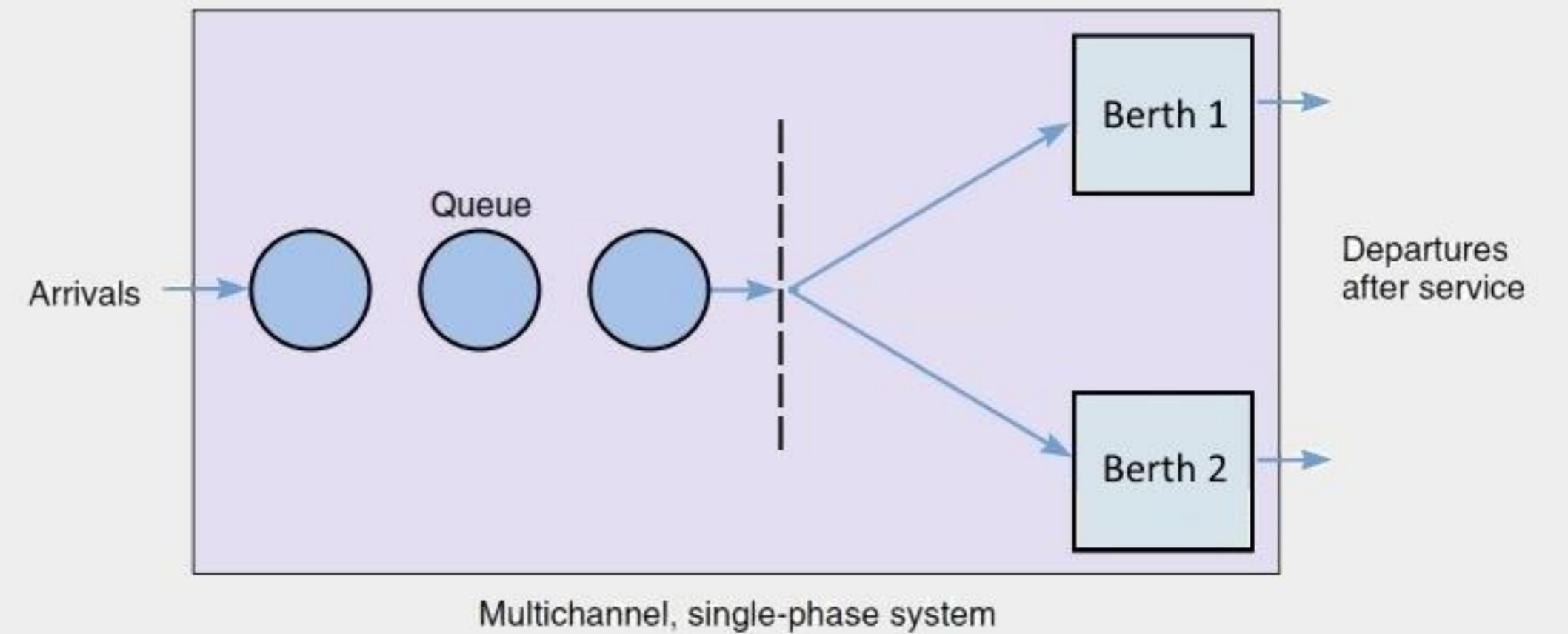
Berth Utilisation Study

There are multiple ways to achieve a desired port cargo throughput.

“Which would be more cost effective, upgrading existing cargo handling equipment or adding a new berth?”

Factors Considered

- Number of berths
- Cargo handling rates
- Uncertainty factors for berth downtime
 - Weather
 - Technical failure
 - Delayed arrival of vessels



IAPH
International Association
of Ports and Harbors

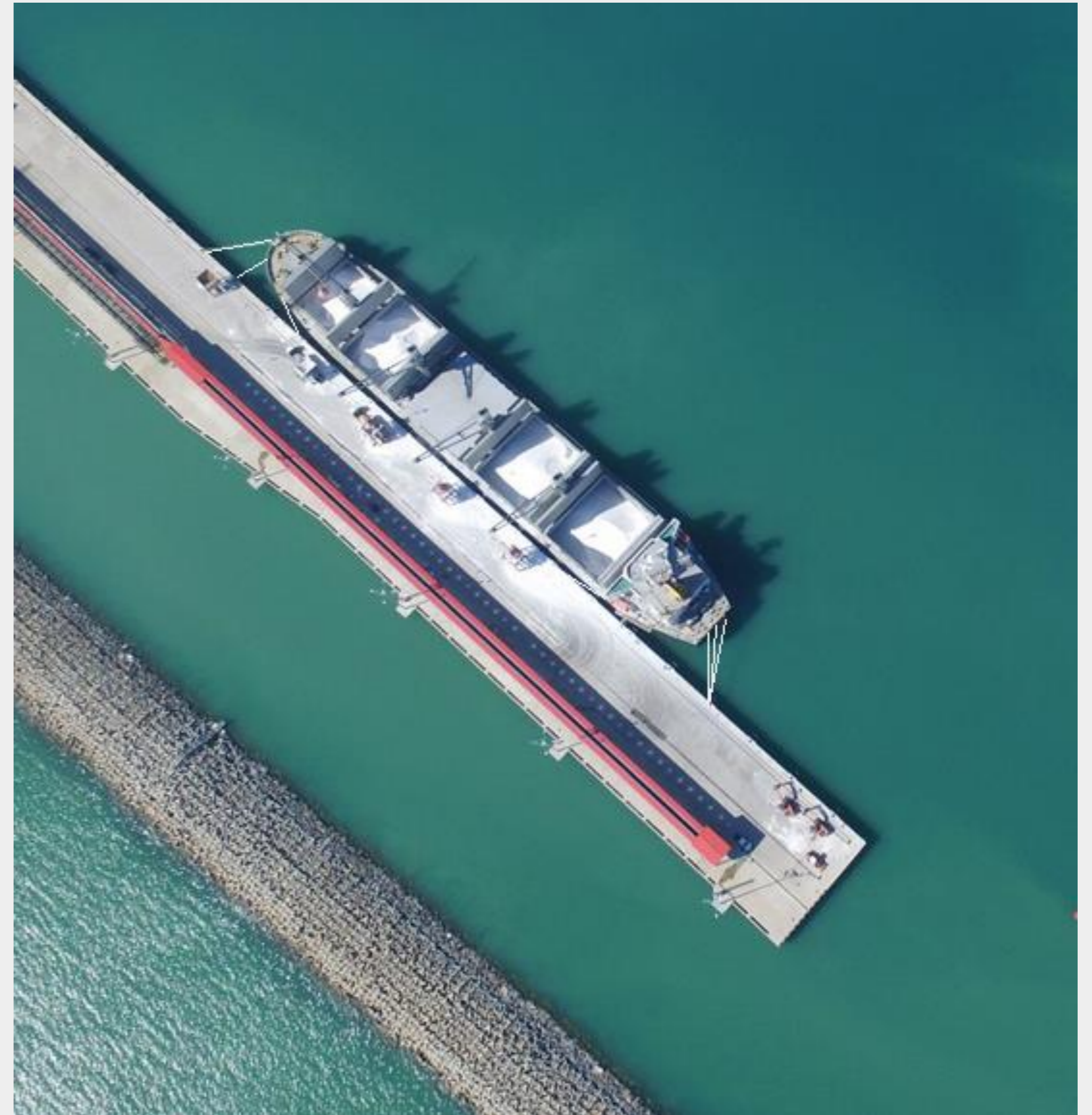


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Dynamic Mooring Analysis

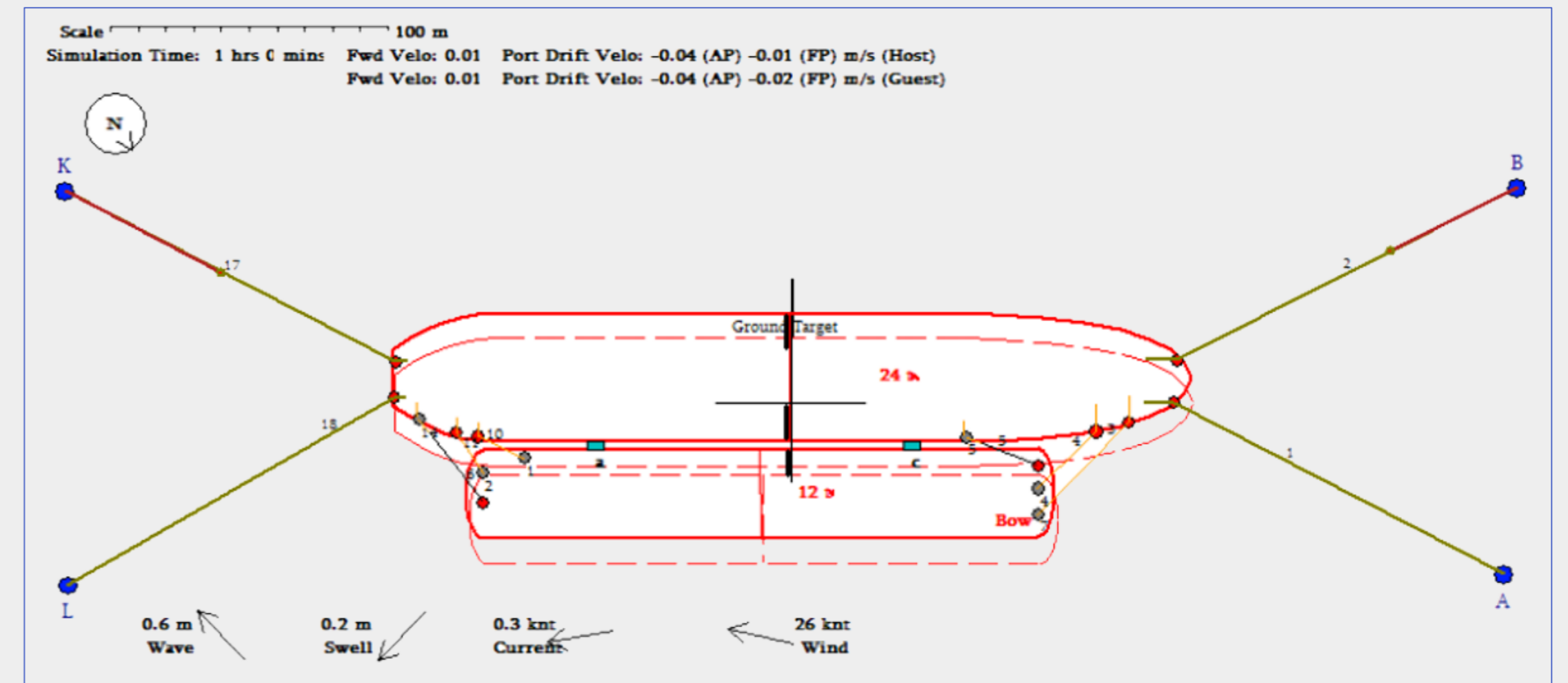
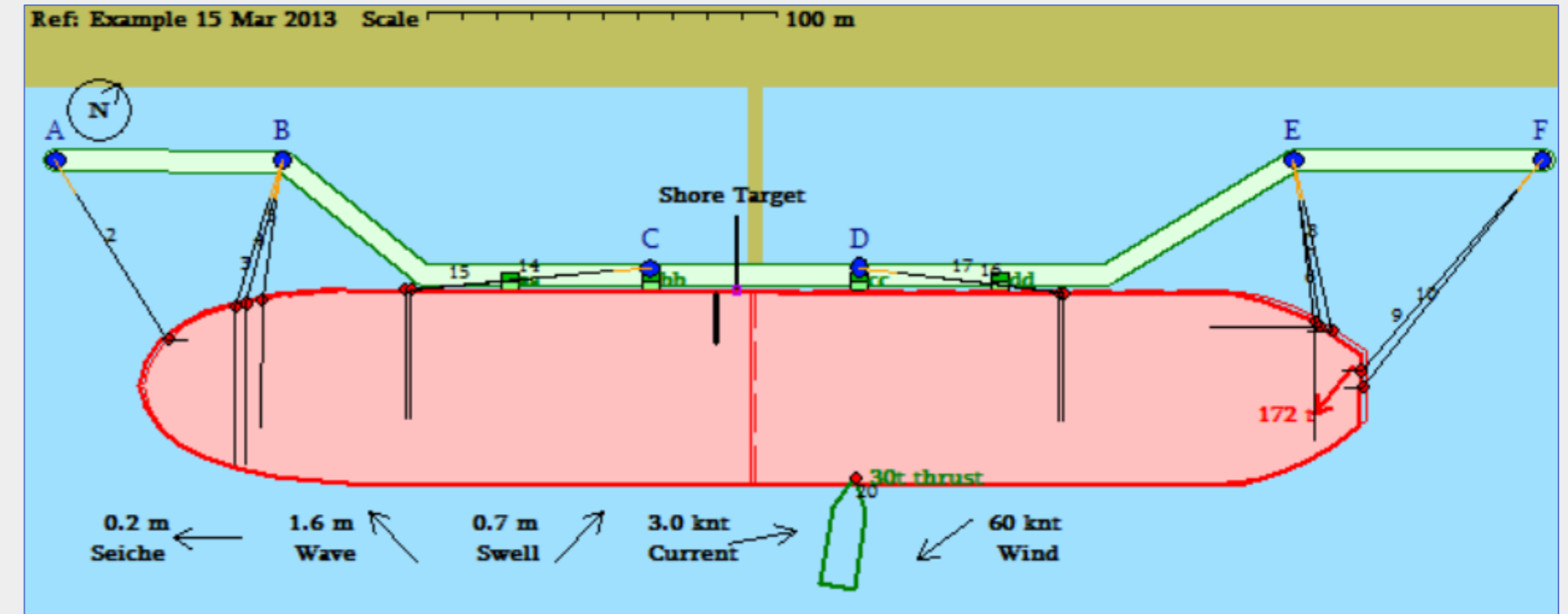
International Guidelines such as BS 6349 exist. These are too simplistic and conservative for precise use. They only apply to horizontal loads for moored vessels. By using dedicated software such as OPTIMOOR, multiple factors can be accounted for, such as:

- Mixed mooring line types
- Significant time-variations of wind, waves, currents, etc.
- Passing ship effects
- Different ship types (cruise ships, tankers, container ships, RoRo vessels, etc.)



OPTIMOOR

- Single vessel or ship-to-ship (STS) operations;
- Shore berth, or open-sea berths;
- Load-Out, Spread Anchor, CBM, SPM, CALM, Turret Mooring;
- Analysis over time, including wind spectra, wave response and passing ship effects.

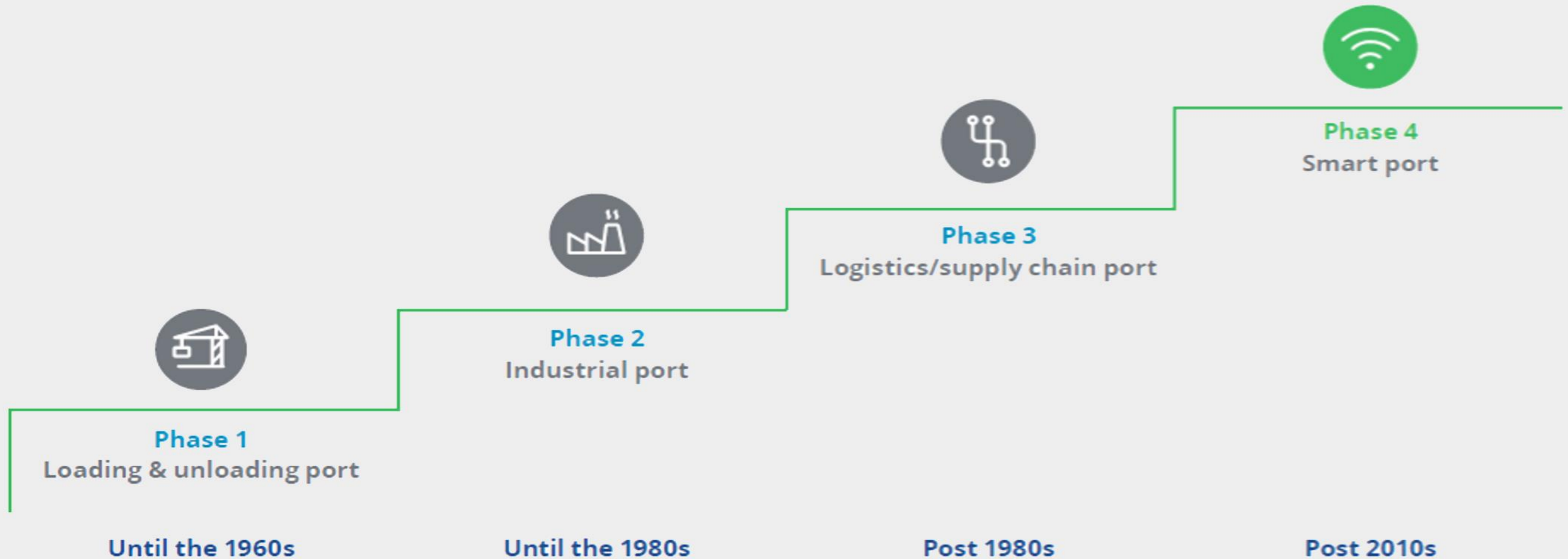


Port Operations

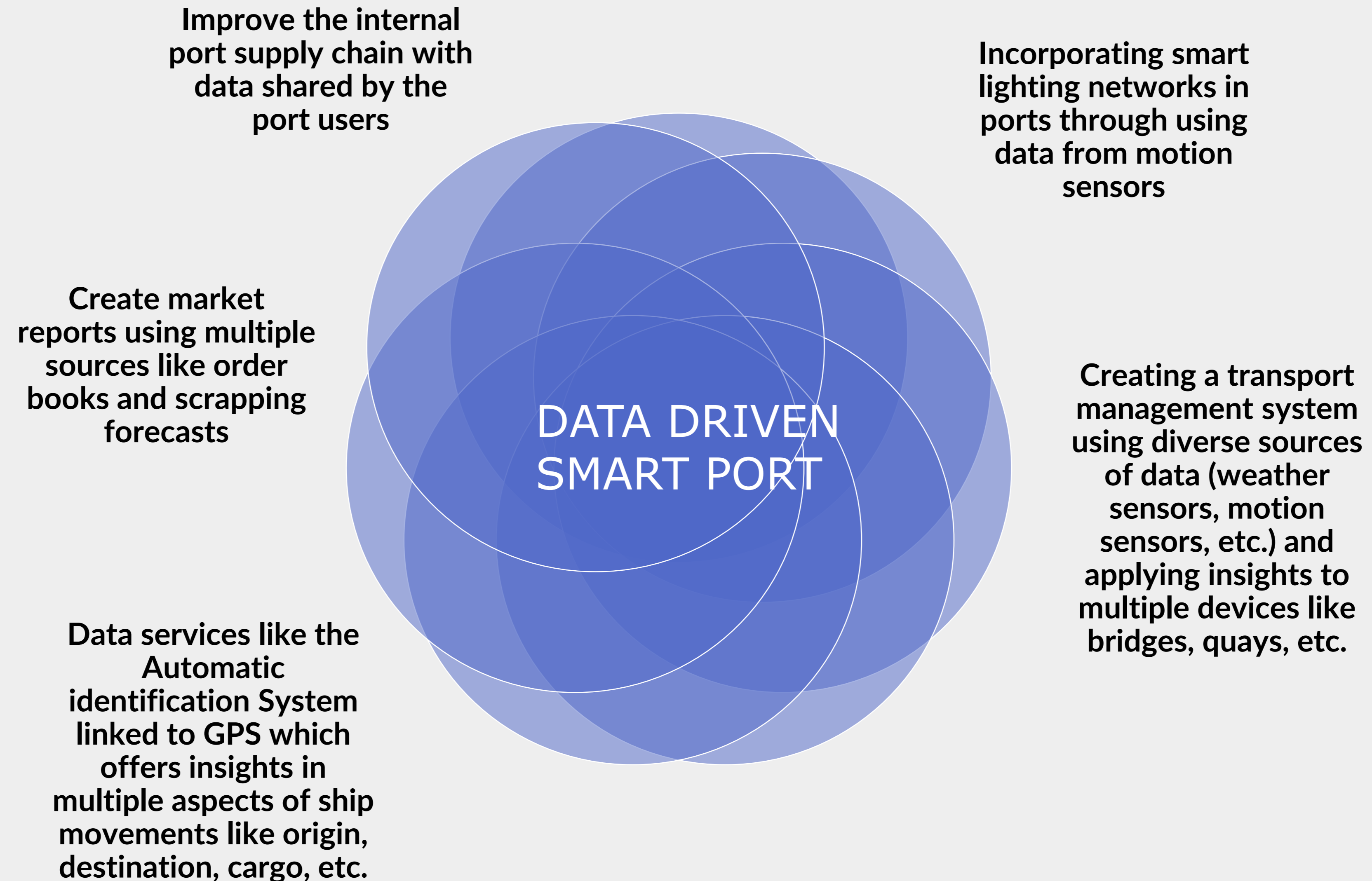
Digital tools are also key components for safe and efficient port operations and development, covering multiple aspects from personnel selection / training to management of port operations.

Smart Ports

The 4th Port Revolution is the introduction of the 'Smart Port', which was driven by new industry challenges.



Smart Ports – Internet of Things (IoT)



Port Tracking / Management Systems (1 of 2)



Operator Station



Radar



CCTV

Port Tracking / Management Systems (2 of 2)

View Filter Shapes Events Events Admin Report Port Settings
Total: 124261 Visible: 12 Overlay Server 2 Username: pba

Track List My Ports

Selected Port: **Felixstowe Port**
United Kingdom GBFXT

Zoom Ship Add Track Remove Track Add Waypoint Delete Waypoint AIS ETA → ERP

Help

GateHouse

Chart Type

Active Filter

Legend

0.5 nm

15 May 2018 08:20:02 UTC

Felixstowe Port - Arrivals list - Last update: 15 May 2018 10:20

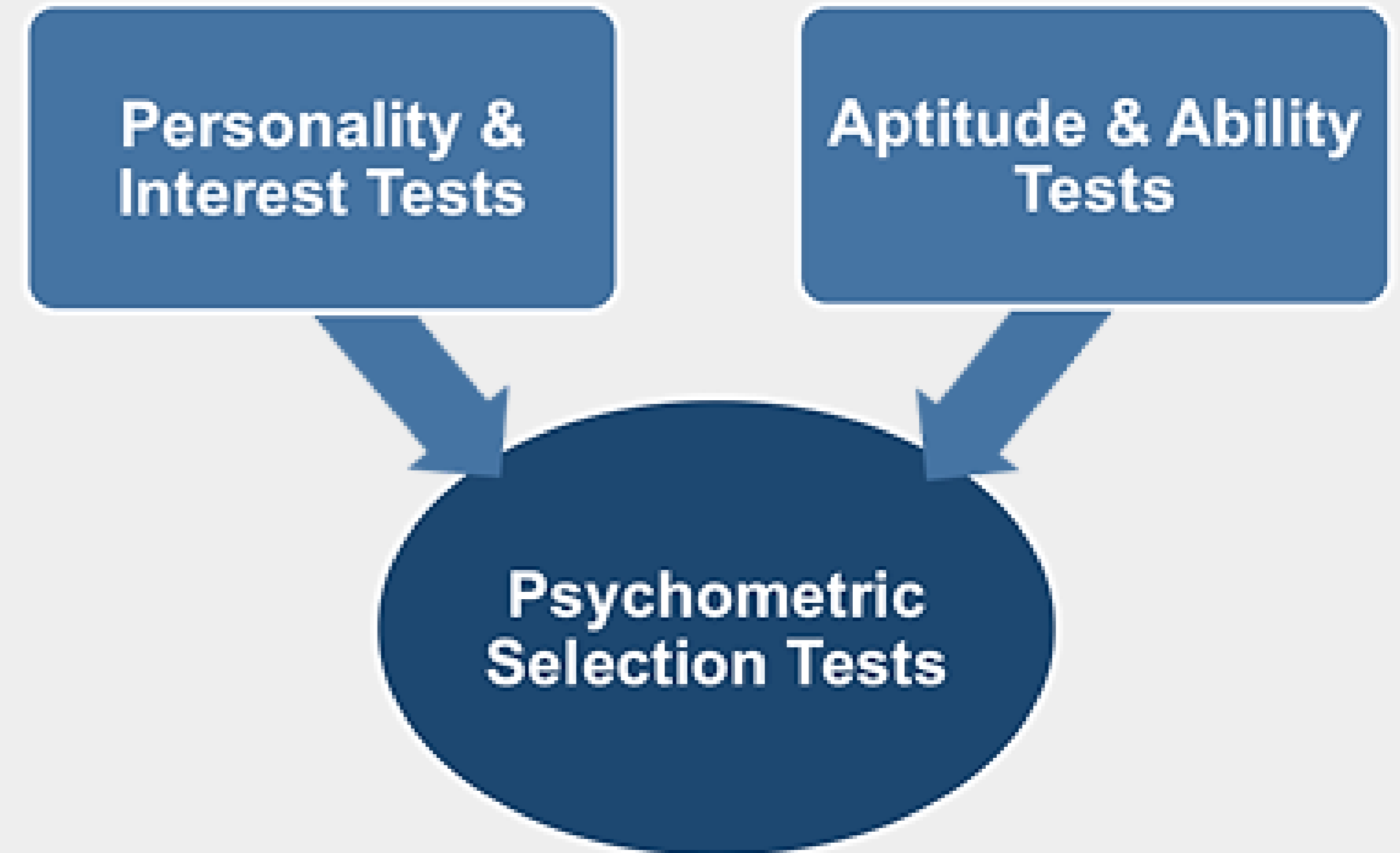
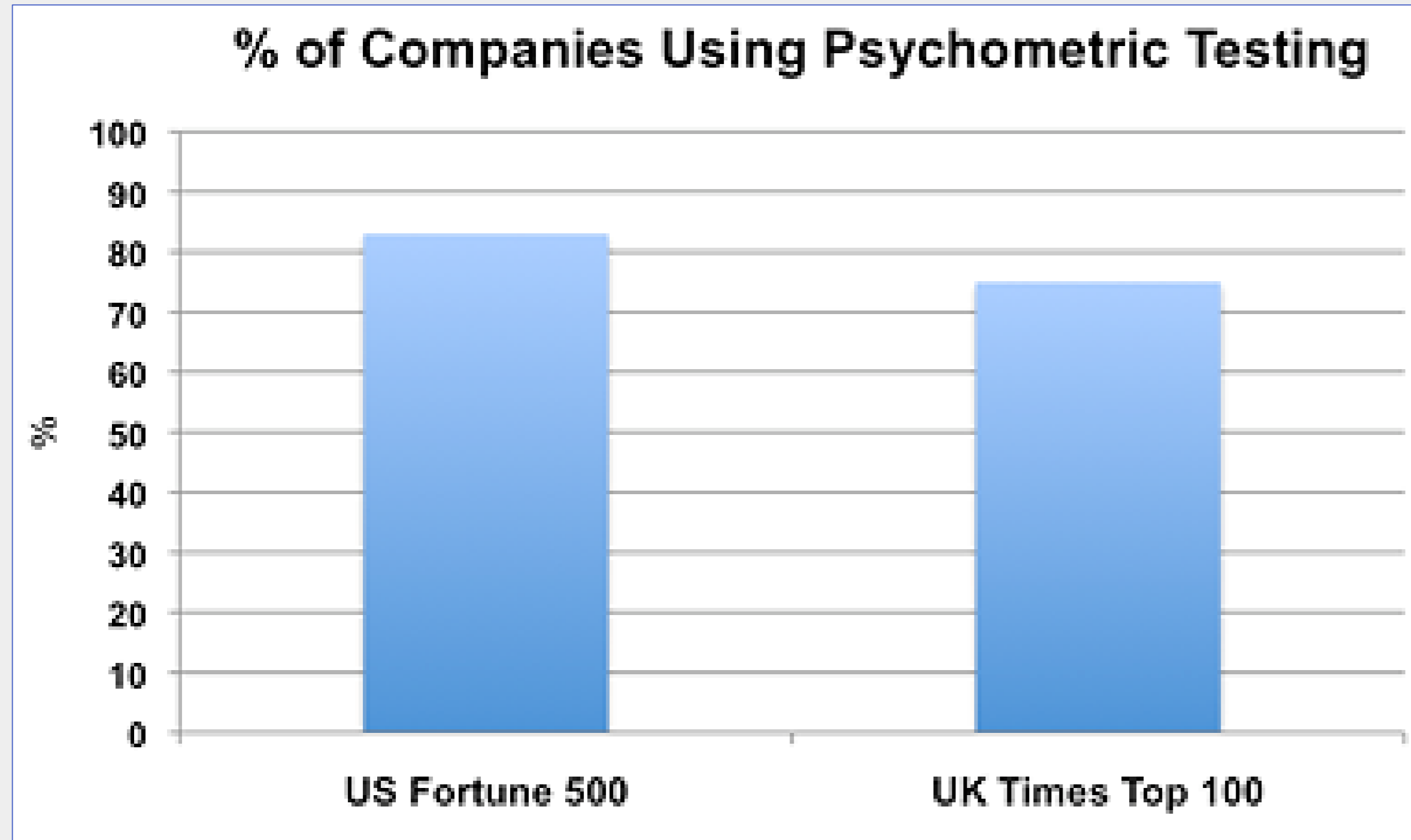
MSI	IMO	Callsign	Flag	ETA (Calculated)	ETA (erp)	Quay (erp)	Waypoints
6092836	9285689	D5Q16		16 May 2018 05:15	16 May 2018 04:00	B6	0
7712800	9695133	VRNV5		16 May 2018 19:30	16 May 2018 23:00	B3	0
6018320	9181675	D5PE8		16 May 2018 22:15	17 May 2018 05:00	B6	0
4645000	9708681	3ESP7		17 May 2018 08:15	17 May 2018 13:00	B3	0
3050300	9348091	9V8092		17 May 2018 15:15	17 May 2018 16:00	-	0
6380000	9725706	HPZK		18 May 2018 01:15	18 May 2018 04:00	B4 - B3	0

ERP Data - MSC SVEVA

Color	ETA	ETD	Quay	Starboard	Note
	17 May 2018 13:00		B3	Undefined	

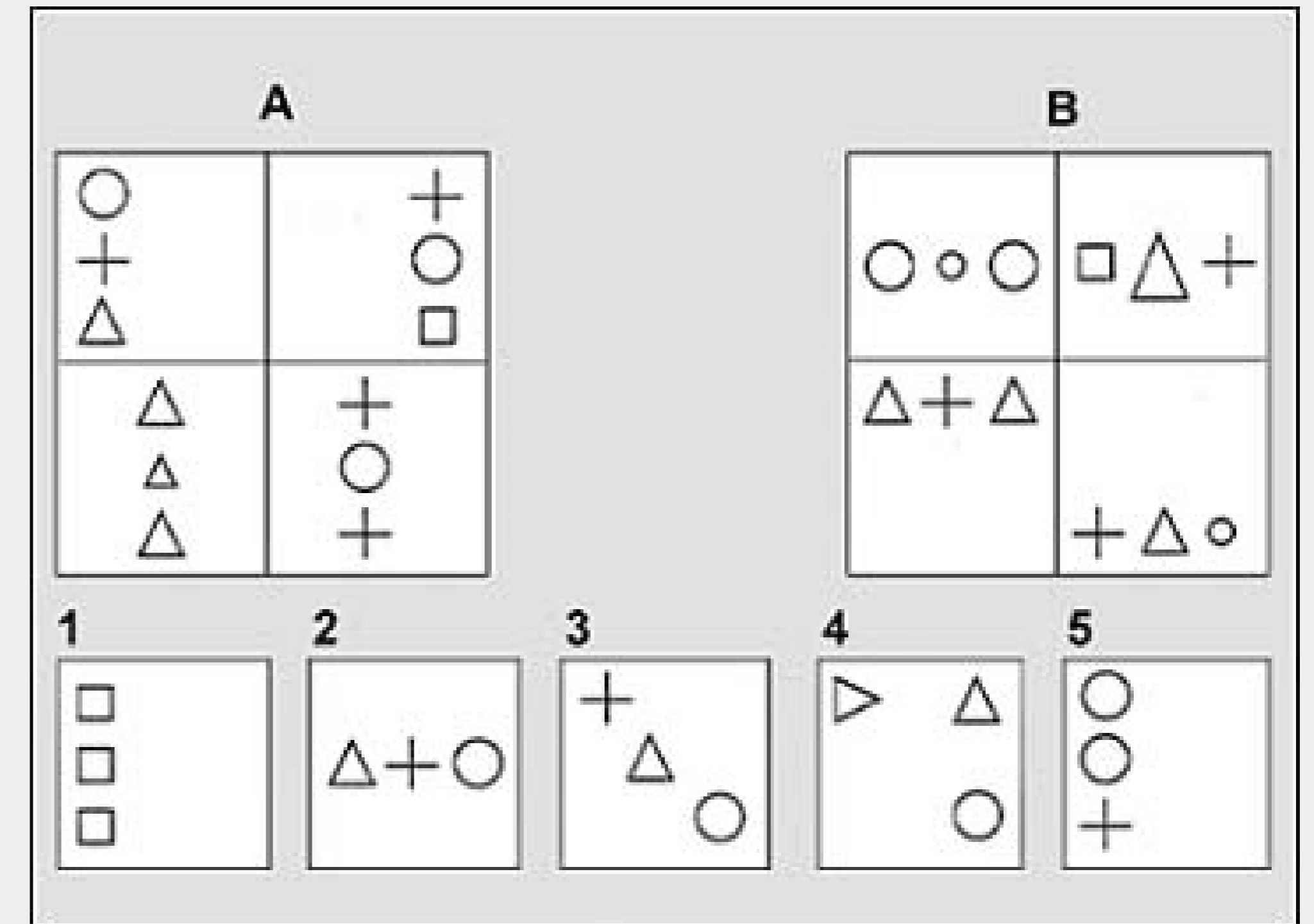
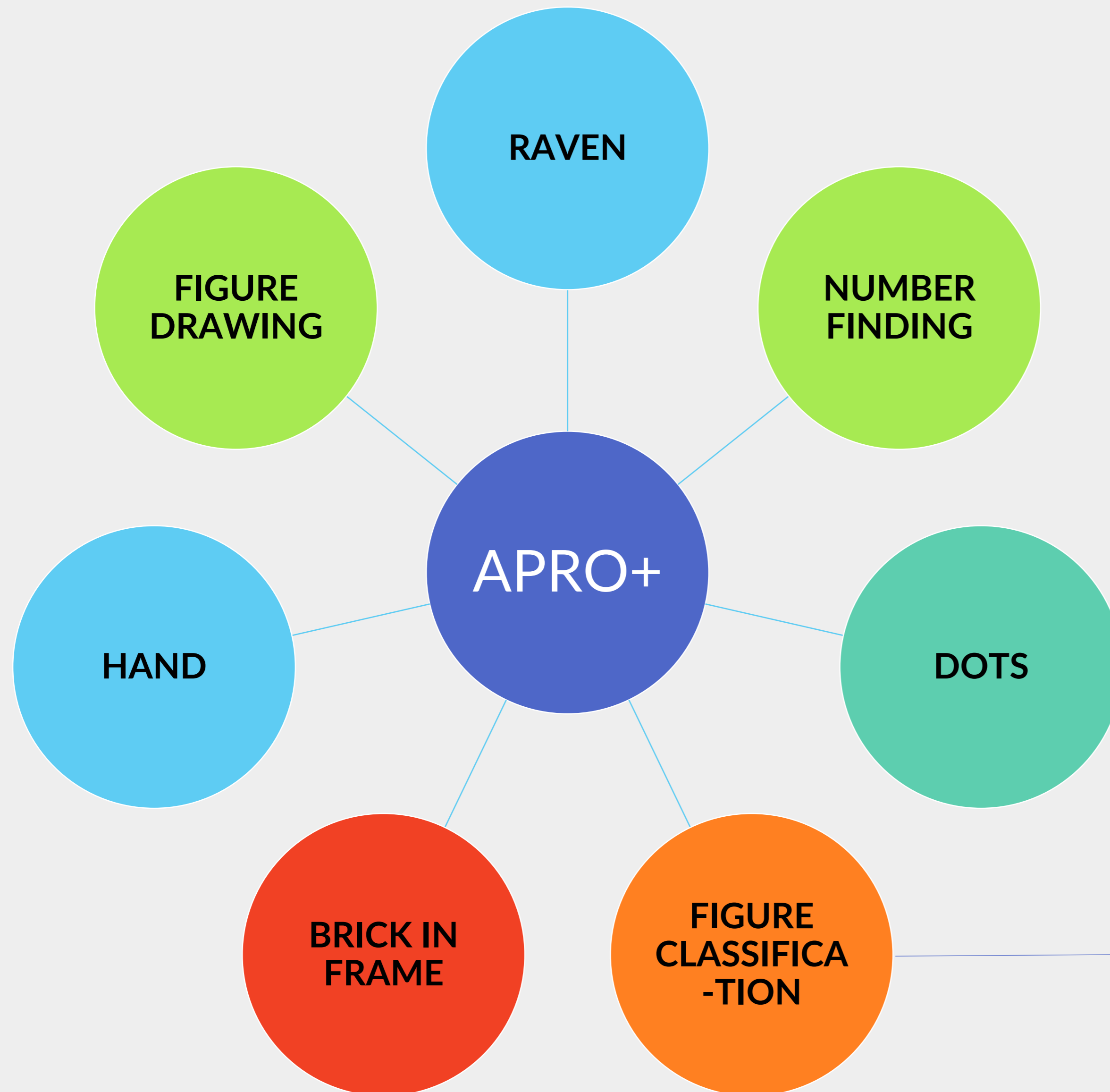
Attributes

Psychometric Testing



E.g. Pilots, Captains, Tugmasters, VTS Operators, etc.

Ability Profile Testing



Ability to find visual rules and principles. Measure ability to perceive and reason based on logical principles with the main weight on the reasoning.

Pilot Familiarisation Training

Pilot familiarisation training can be essential in cases such as:

- Expansion of an existing port
- Different alignment of berths from existing berths
- “Greenfield” port

Pilots may require training to understand:

- The impact of environmental conditions such as wind, wave and current
- The manoeuvrability / performance characteristics of different vessel types



Tugmaster Training

New ports / upgrading of existing ports to cater for larger vessel sizes and higher call volumes will require sophisticated tugboats. Tugmasters will need to undergo training to upgrade their capabilities and skillset.

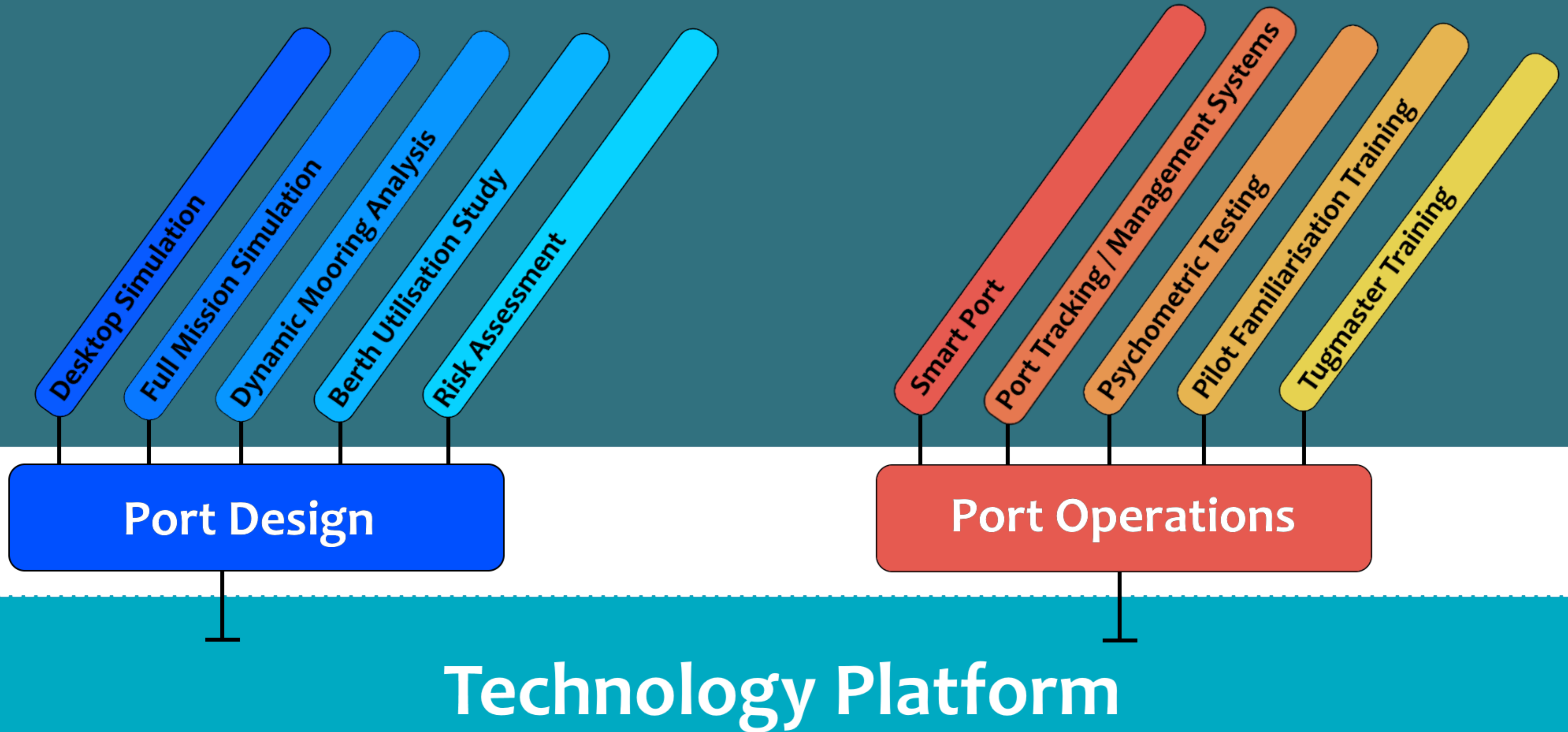
- Familiarisation in a safe environment
- Optimisation of SOPs and Emergency Procedures
- Tugmaster training (ASD-ATD, VSP, RoTo Tug, Conventional)
 - Port Towage
 - Active Escort and Ship Assist



ClassNK



KASI's Digital Toolbox





KEEP IN TOUCH WITH US

FOR FURTHER INFORMATION



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