Session Five – North Queensland Bulk Ports – ISPO Training, Technology and Passage Planning

Welcome Cal Callahan, from North Queensland Bulk Ports

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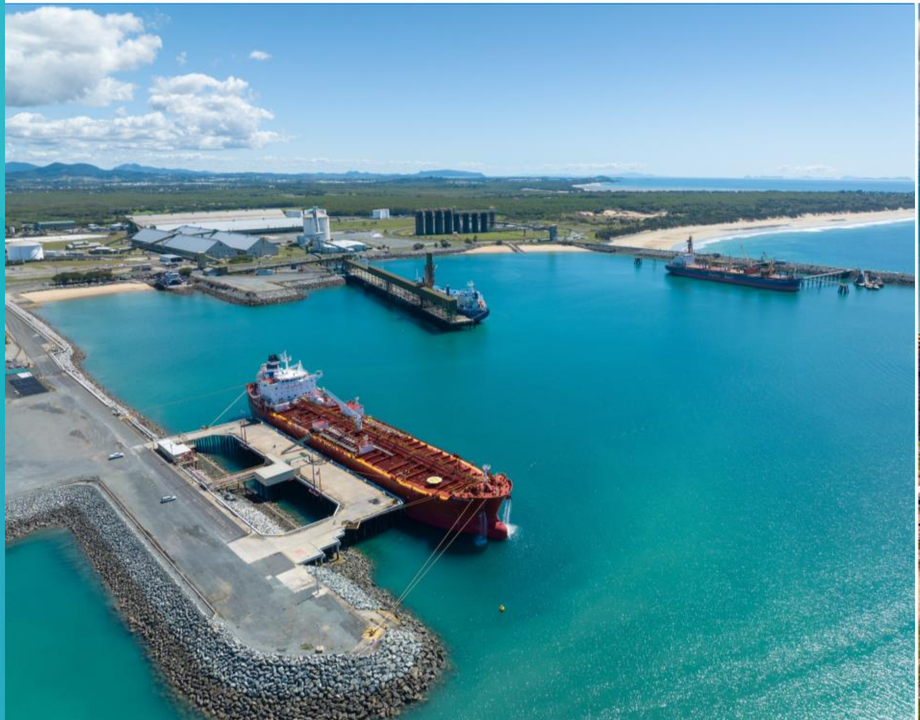
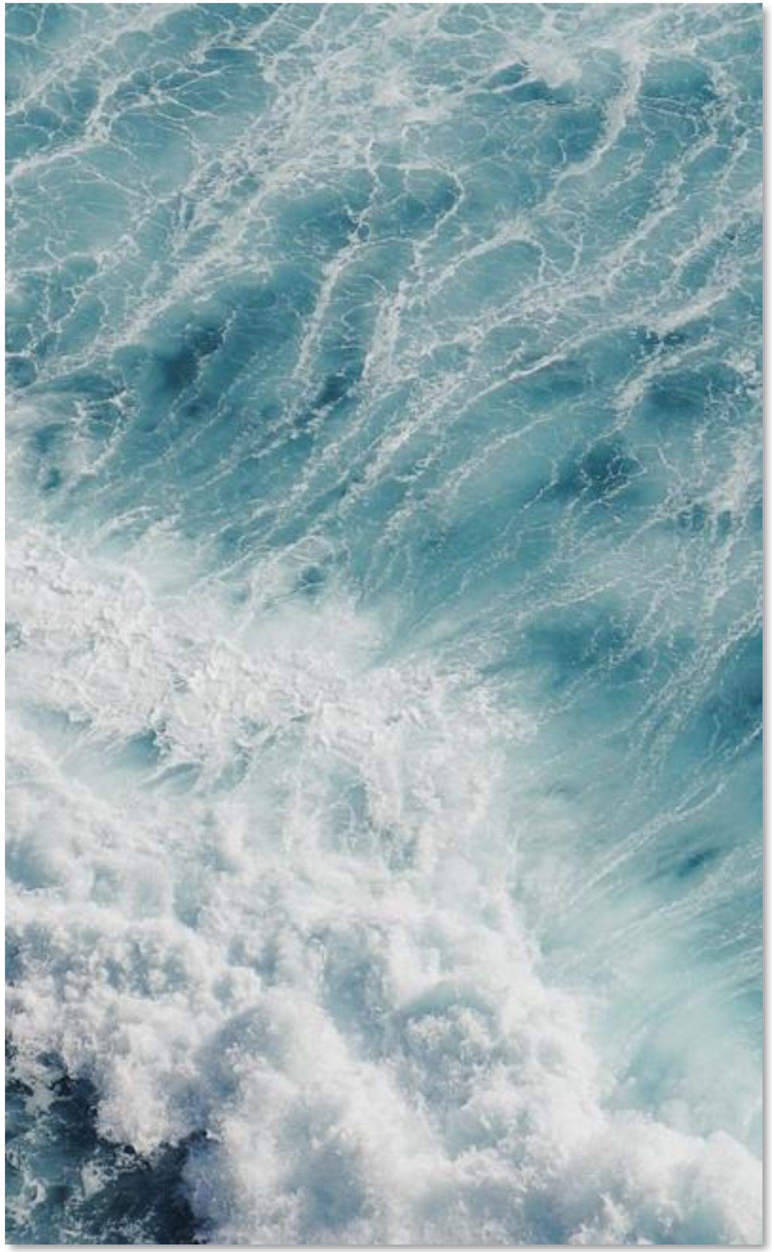
Marine Pilotage and Technology

With humans at the helm

Marine Pilot Cal Callahan

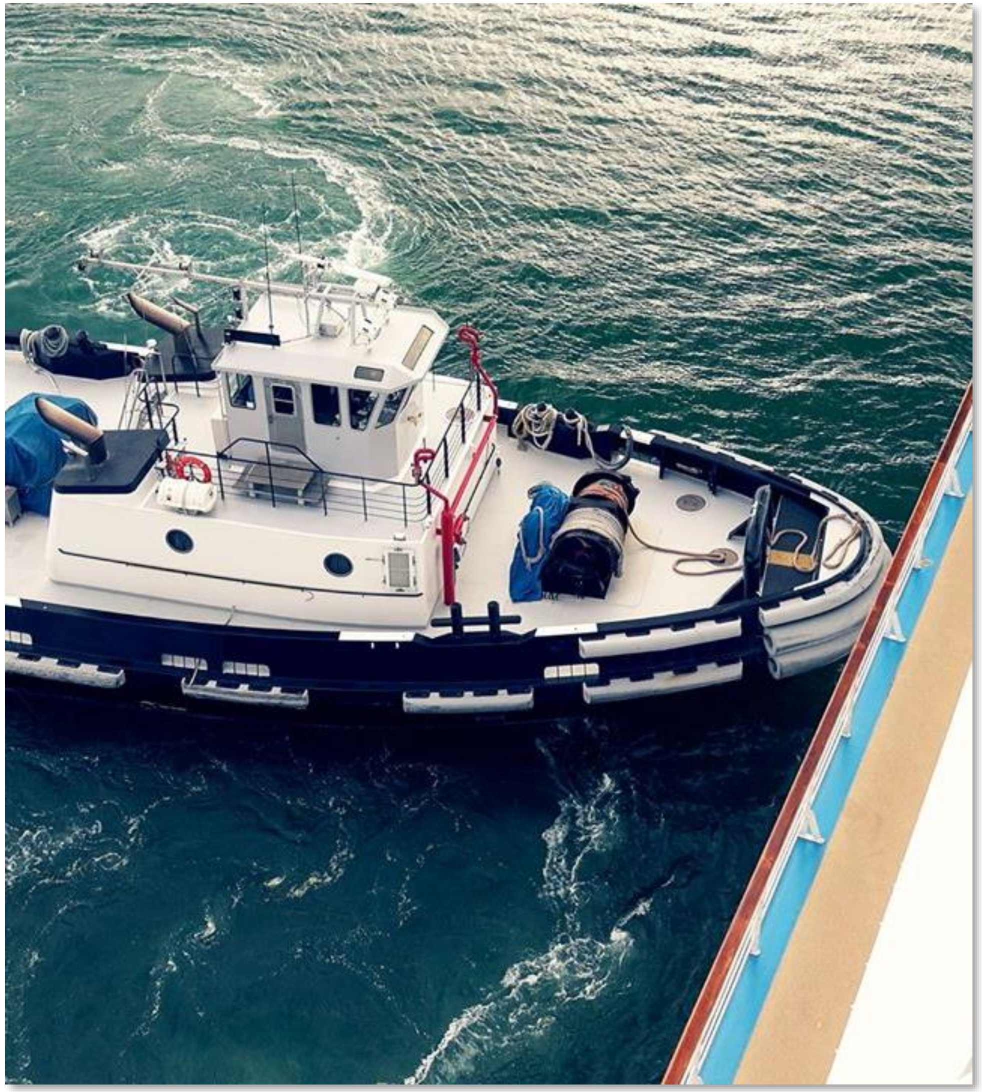
NORTH QUEENSLAND BULK PORTS CORPORATION





Today, we'll explore the evolving role of technology in marine pilotage and focus on the critical human element required to ensure that technology aligns with real-world conditions.

The role of technology in modern pilotage



- Relies heavily on advanced navigation instruments and software.
- Regulators mandating the use of these technologies.
- Organisations like ISPO advocate for their integration on every vessel movement.
- It is crucial that pilots ensure the technology accurately reflects the vessel's real position and environmental conditions.

Traditional approach to modern pilotage

VESSEL NAVIGATIONAL ASSISTANCE

Marine pilots board vessels to provide local navigational expertise and support safe passage through waterways, harbors, and channels.

ROUTE PLANNING AND GUIDANCE

Pilots use their in-depth knowledge of the local waters to plan the most efficient and safest routes for the vessel to follow.

SITUATIONAL AWARENESS AND RISK MANAGEMENT

Pilots maintain constant vigilance, monitoring the vessel's position, speed, and surrounding conditions to identify and mitigate potential risks.

COLLABORATION WITH BRIDGE CREW

Pilots work closely with the vessel's bridge crew to ensure clear communication, coordinate maneuvers, and make informed decisions.

THE TRADITIONAL APPROACH TO MARINE PILOTAGE EMPHASISES A SHARED MENTAL MODEL, WHICH HELPS PILOTS NAVIGATE SHIPS EVEN WHEN TECHNOLOGY FAILS OR PROVIDES INCORRECT DATA. VISUAL PILOTAGE REMAINS A VITAL SKILL THAT BACKS UP AND VERIFIES THE DATA PROVIDED BY MODERN TECHNOLOGY.

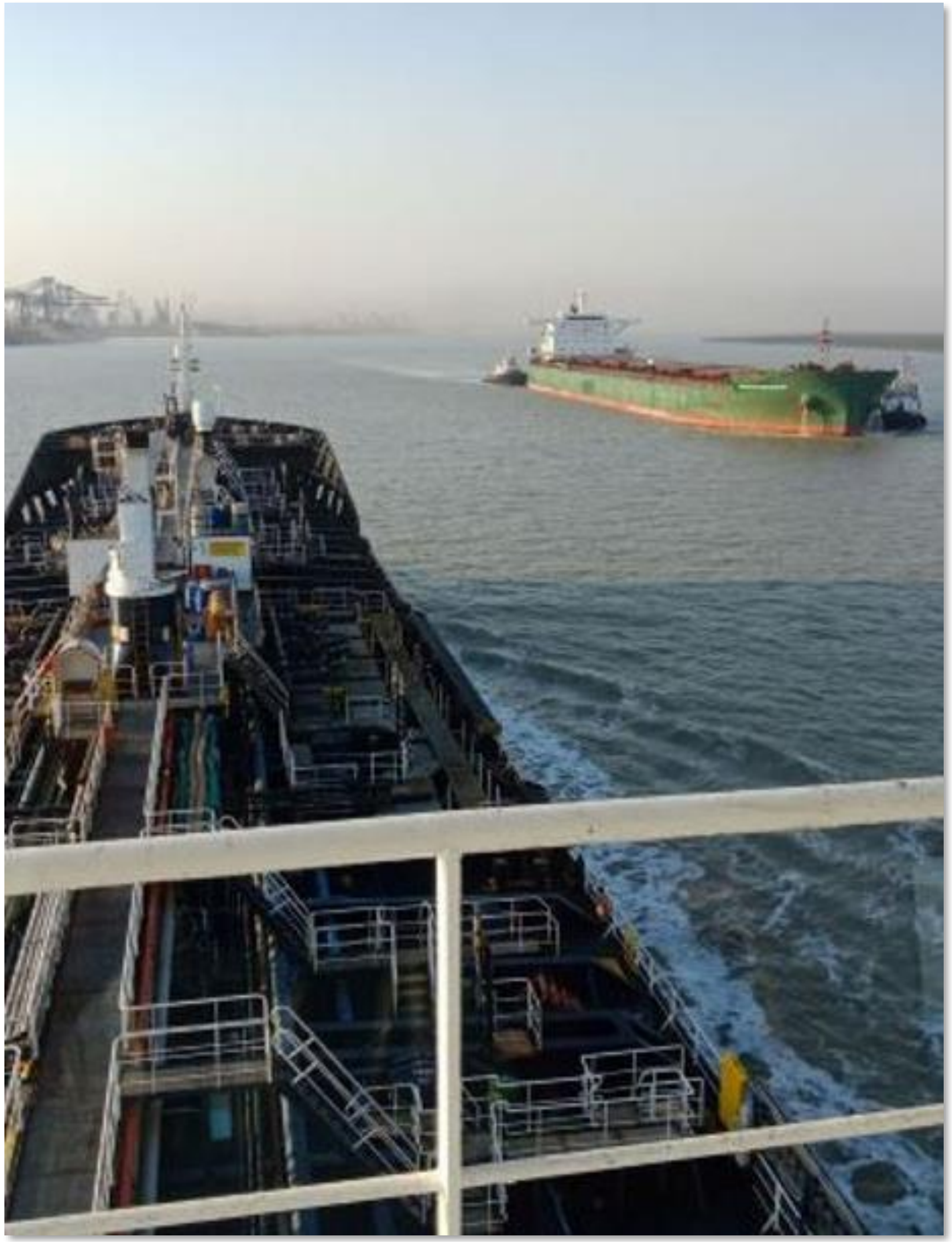
Modern ship handling

Using all available means

Today's ship handlers are trained to use "all available means," blending visual skills with modern technology.

Tools like portable pilotage units (PPUs) and real-time navigational aids are helpful.

However, they should complement—not replace—the pilot's ability to visually assess the environment and the ship's actual position.



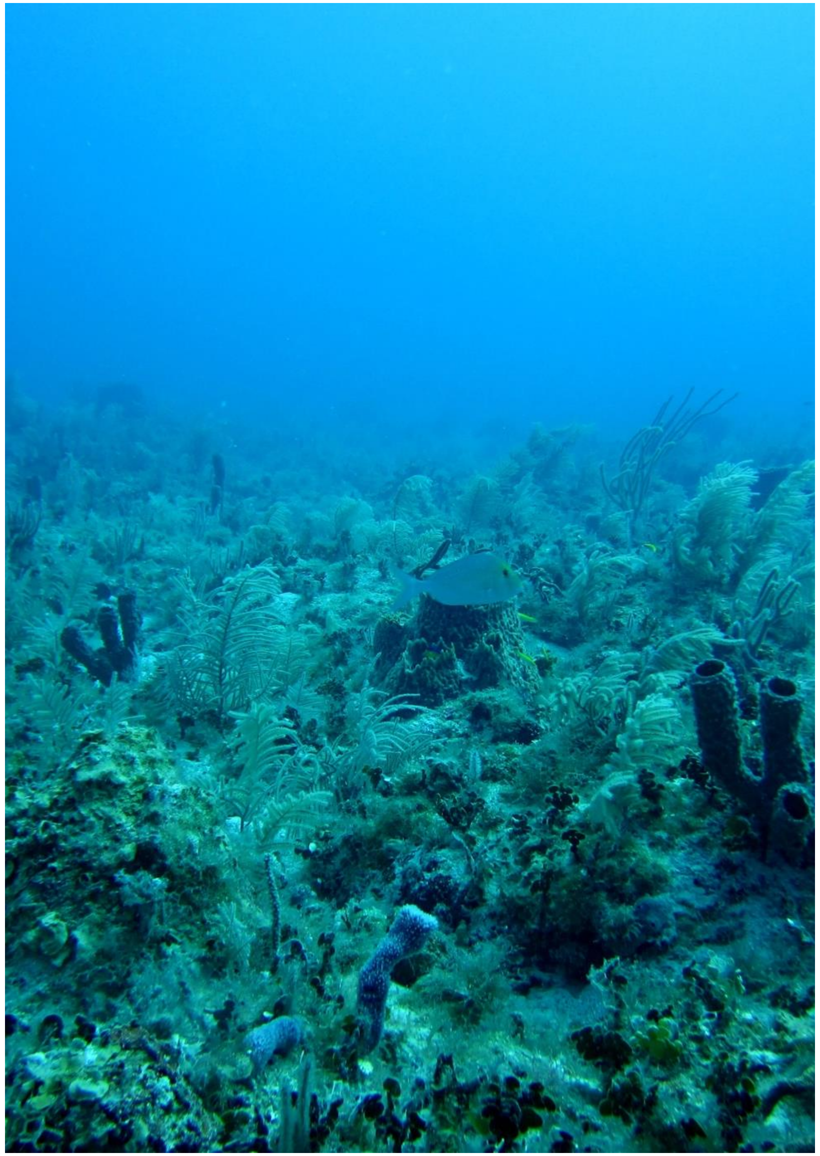
The importance of cross-verification

Technology, while helpful, can fail or provide inaccurate data, especially in marine environments.

Mariners are trained to cross-check technology with visual observations.

Pilots must ensure that sensor data, PPUs, current meters and digital imagery aligns with real-world conditions. Without verification, pilots risk relying on flawed data.

The impact of errors



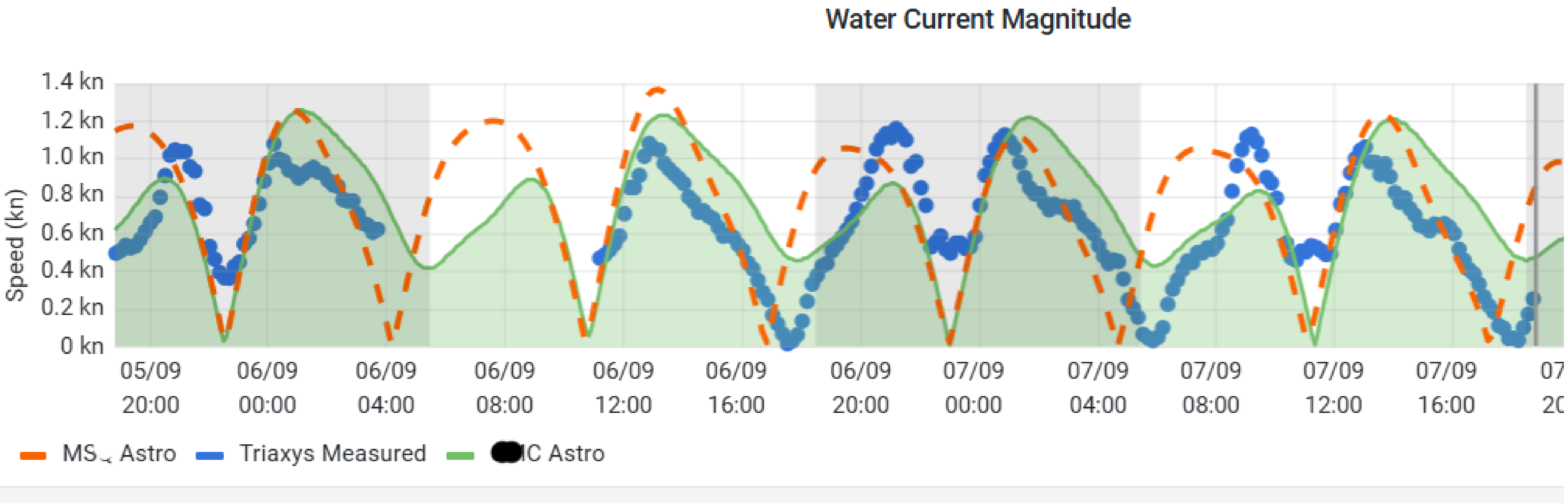
Marine environments are particularly tough on sensors like tide gauges and current meters, which are susceptible to drift, debris, or maintenance issues.

Studies show that while human error is responsible for most maritime incidents, technological failures play a role.

Technological failures can exacerbate human errors, further stressing the need for constant vigilance.

Consequence of over reliance on technology

When pilots rely too much on technology, they may overlook discrepancies between what instruments show and what they observe visually.



The inevitability of human error

The maritime industry operates in environments where the margin for error is razor-thin, with pilots relying on complex systems and technology to navigate.

However, human error accounts for 75-96% of maritime incidents, often due to the limitations and vulnerabilities inherent in these systems.

Pilotage, technology and human error

POOR DECISION-MAKING

Incorrect or misinterpreted data can lead to poor decision-making, increasing the risk of incidents.

COMMUNICATION CHALLENGES

Inadequate communication between crew members or shore personnel can contribute to human errors.

FATIGUE AND REDUCED SITUATIONAL AWARENESS

Fatigue and reduced situational awareness can compromise the ability of maritime operators to make informed decisions and respond effectively to emergencies.

OVER-RELIANCE ON AUTOMATION

Over-reliance on automation and sensors without cross-verification can lead to a failure to identify and address issues in a timely manner.

INADEQUATE TRAINING

Inadequate training in equipment can increase the likelihood of human errors.

SENSOR FAILURE

Failure to identify faulty sensor readings can result in incorrect adjustments and contribute to maritime safety incidents.

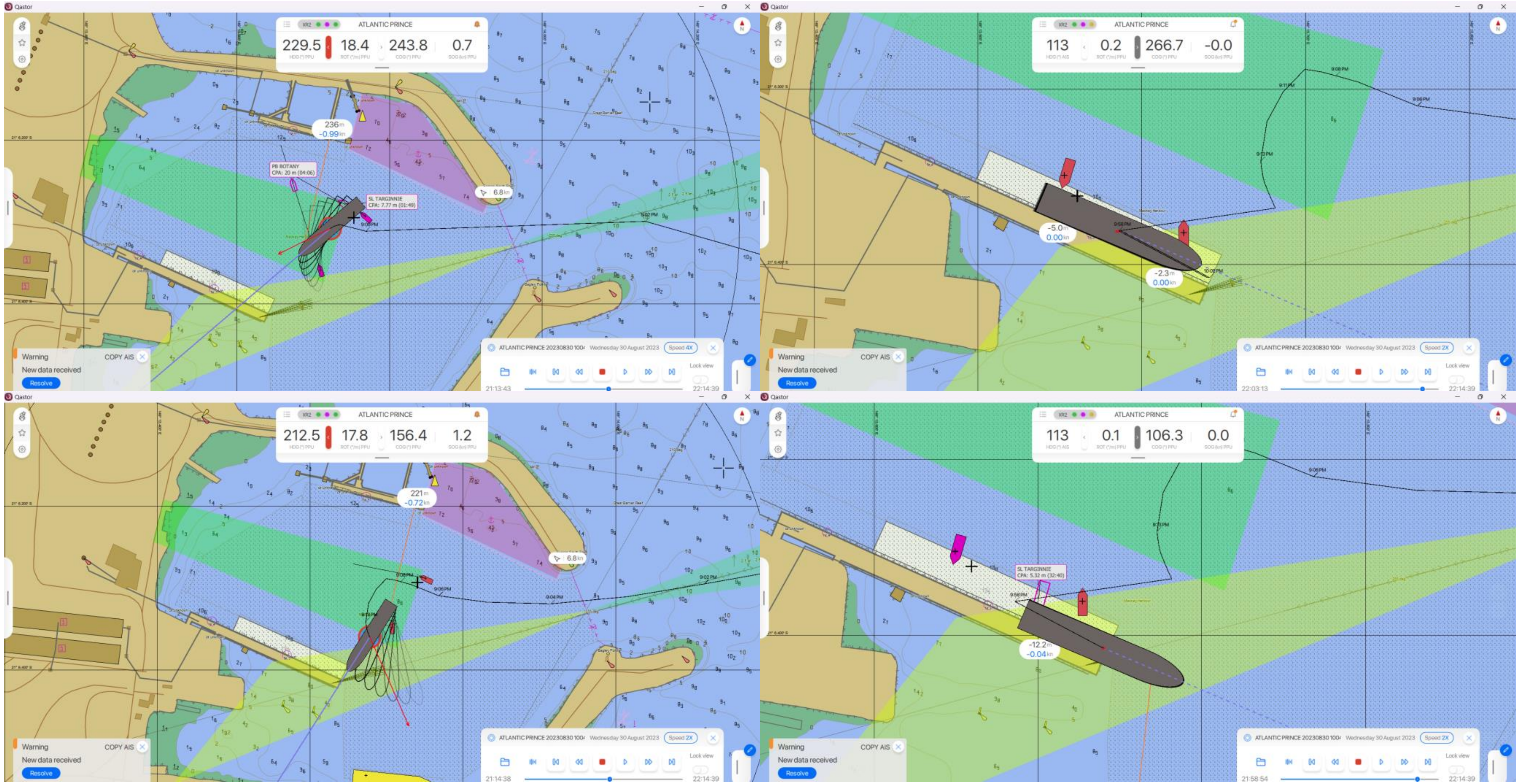
LACK OF CROSS-CHECKING

Failure to cross-check visual cues with technology-based data can lead to a false sense of security and complacency.

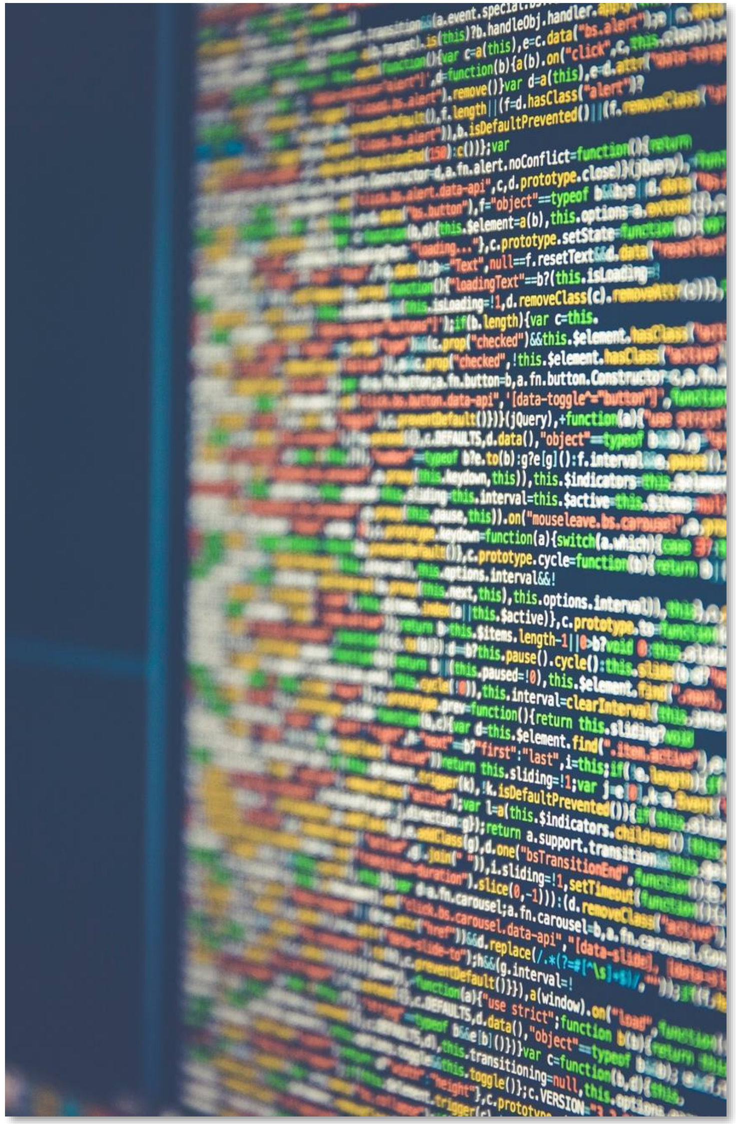
COMPLACENCY

Assuming that technology and automation will prevent all issues can lead to complacency and a failure to identify and address potential risks.

Personal experiences with human errors



The human element

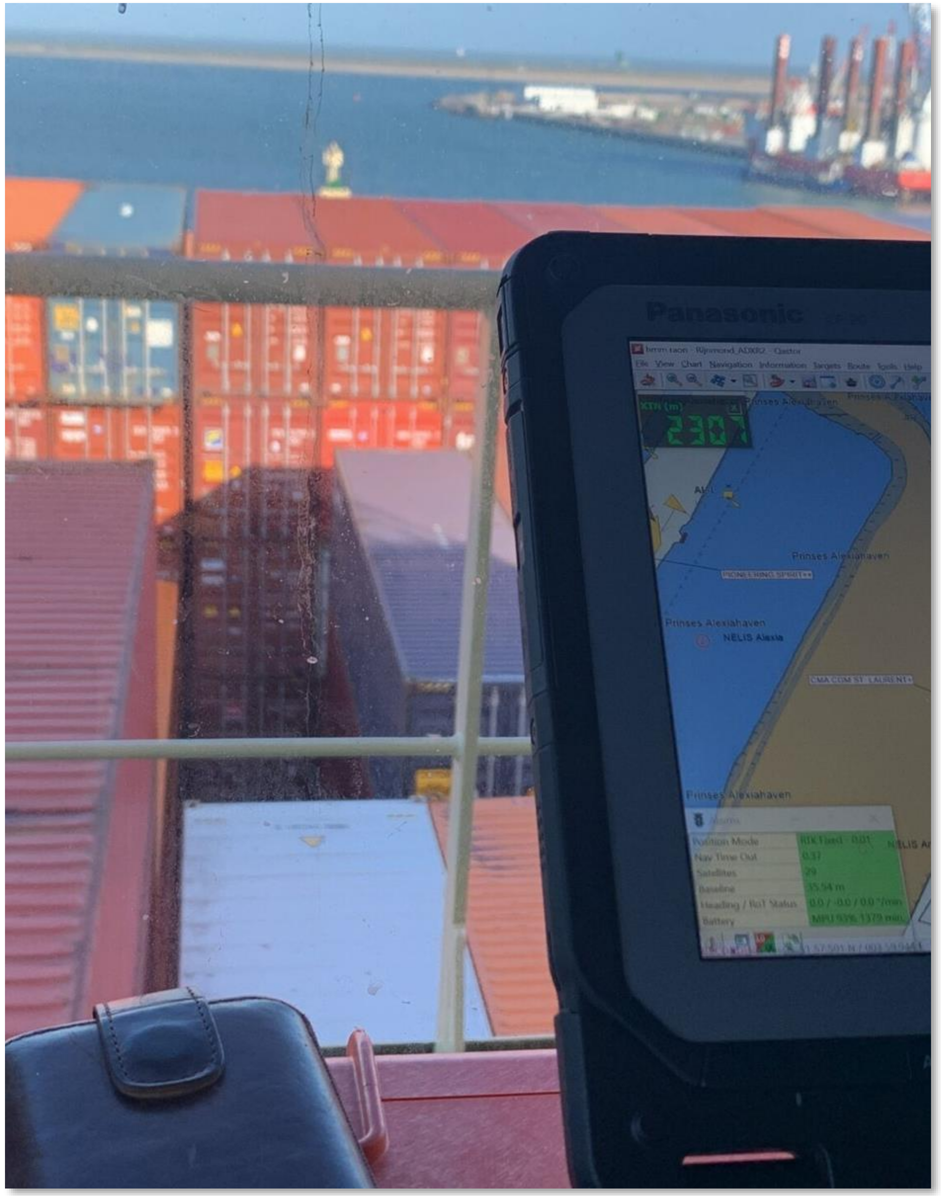


In modern pilotage, where the margin for error is minimal, the human element remains irreplaceable.

Pilots must actively cross-verify the data from their technology with their own visual observations, relying on their sharp spatial awareness and strong ability to read environmental conditions.

Without this vigilance, pilots risk overlooking critical discrepancies that technology alone cannot detect.

Overconfidence in technology



A growing concern is the overconfidence in technology, especially among less qualified and experienced mariners.

This generation may accept data from sensors and instruments without question. However, marine environments are unpredictable, and sensors can fail.

Pilots must be trained to challenge the data, using their judgment and visual skills to confirm the accuracy of the information provided by their technology.

Case Study

Australian Government
Australian Transport Safety Bureau

Over-reliance on GPS and failure to apply visual navigation checks played a key role

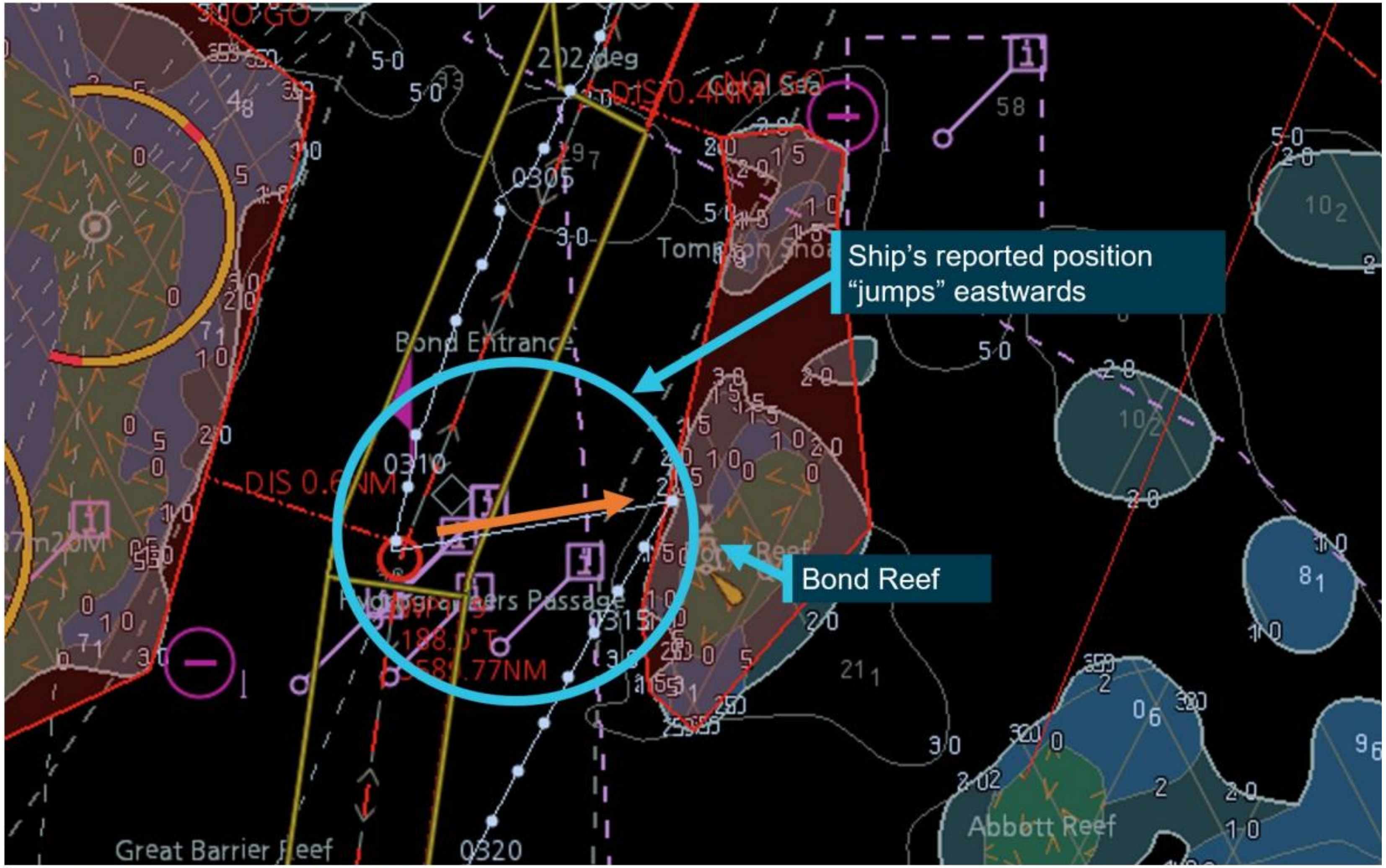
This incident reinforces the importance of visual pilotage and ensuring that pilots are properly trained to interpret data alongside real-world conditions.

It’s a reminder that technology should aid, not replace, critical human judgement.

Near grounding of *Rosco Poplar*

Bond Reef, Hydrographers Passage, Queensland on 4 May 2022

ROSCO POPLAR



Source: RP ECDIS, annotated by ATSB

Technology pushing boundaries

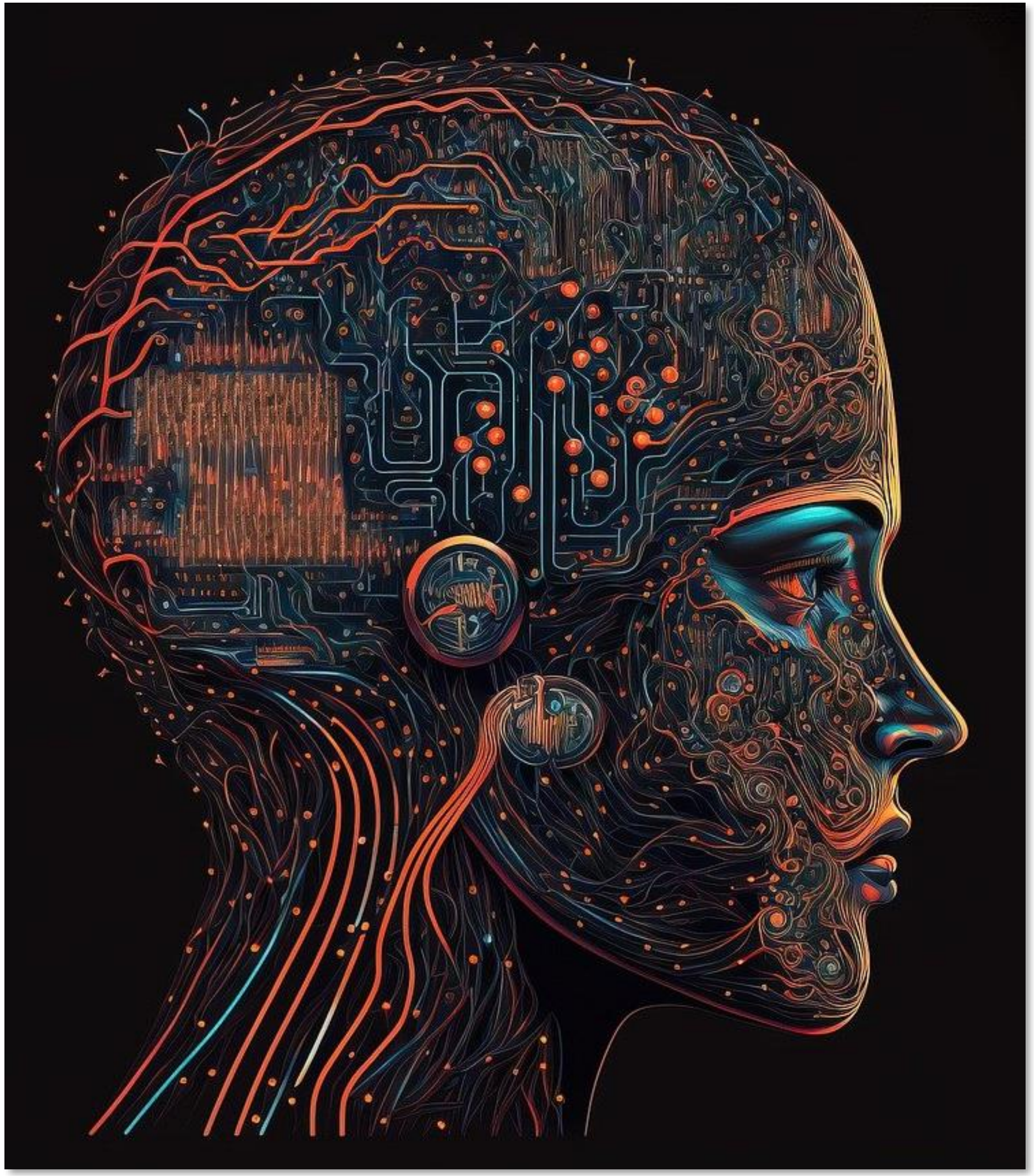
Wa News,News Wa,News Perth

News,WA News

Balancing technology with spatial awareness and traditional pilotage skills is essential to manage risks effectively.

Blending for the future

The future of pilotage depends on a delicate balance between technological advancements and the preservation of critical visual and spatial awareness skills.



Pilotage, technology and the human element

TECHNOLOGY IS HERE TO STAY

Marine pilotage will continue to rely on technological advancements, but the human element remains irreplaceable.

ALIGNING TECHNOLOGY WITH REAL-WORLD CONDITIONS

Ensuring that the data provided by modern instruments and systems accurately reflects real-world navigational conditions is critical for safe vessel handling.

BLENDING INSTRUMENTS AND VISUAL SKILLS

Pilots must seamlessly integrate the use of advanced instruments and systems with their traditional visual pilotage skills to create a comprehensive, reliable approach to vessel handling.

THE IRREPLACEABLE HUMAN ELEMENT

The expertise and decision-making capabilities of human pilots remain essential in navigating vessels safely, even as technology continues to evolve.

Session Five – North Queensland Bulk Ports – ISPO Training, Technology and Passage Planning

Welcome Bernardo Obando, from North Queensland Bulk Ports

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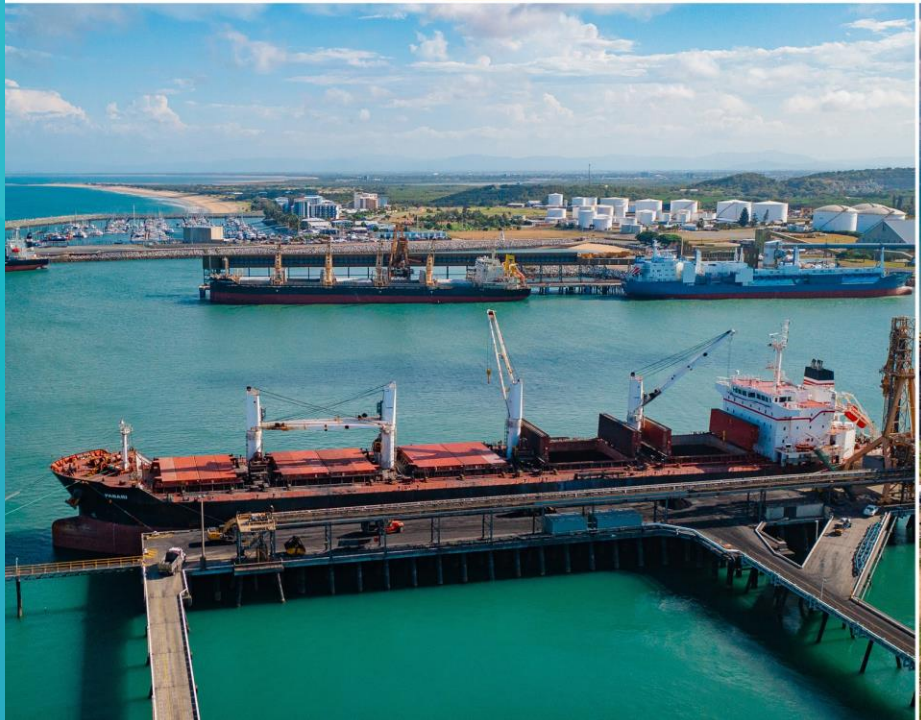
Passage planning in the electronic era:
Is it ISPO ready?

Captain Bernardo Obando
Marine Pilot

NORTH QUEENSLAND BULK PORTS CORPORATION



Evolution of Passage planning

Passage Planning: why?

Essential for appraising, planning, monitoring and executing a navigational passage (ie act of pilotage)

- Build and share a mental model
- Adhere to safety margins
- Test existing safety parameters
- Determine reserve areas/no go areas
- Take account of manouevering characteristics

Information Management

Information management (IM) and passage planning:

Information management is the collection and management of information from one or more sources and the distribution of that information to one or more audiences. This sometimes involves those who have a stake in or a right to that information. Management means the organization of and control over the structure, processing, and delivery of information.

(Association for Intelligent Information Management)

Information (mis)Management

Accidents happen because one person makes the sort of mistake to which all human beings are prone in a situation where there is no navigational regime constantly in use which might enable the mistake to be detected before an accident occurs.

Research into recent accidents occurring to ships has shown that by far the most important contributory cause of accidents is human error, and in many cases **information which could have prevented the accident was available to those responsible for the navigation of the ship concerned**

MSN M.854 (UK DoT)

Passage planning

Regulatory framework

- International regulations (TSS, PSSA)
- National legislation
- Port procedures (one way traffic, speeds, heading, underwater obstructions, maneuvering description)

Port navigation and geography

- Navigable waters
- Channels (length, width, restrictions)
- Navigational marks (buoys/ leads)
- Under Keel Clearance
- Swing basins
- Meteorological data (prevailing winds, seasons, precipitation, visibility)
- Tides and tidal streams

Pilotage and maneuvering requirements

- Boarding grounds and restrictions (heading, compulsory pilot limit, vessel sizes)
- Communications
- Contingencies
- Tugs (positioning, bollard pull, escort tug)
- Swinging and berthing

Bridge Procedures Guide (6th ed.) International Chamber of Shipping

The passage plan contains information related to navigation in pilotage waters.

The master should be prepared to accept any **necessary amendments** to the passage plan when the pilot boards, after and appropriate discussion. Any agreed changes to the passage plan should also be communicated to the OOW.

The appraisal and planning process is not a substitute for a full Master/ pilot information exchange covering the **most up-to-date information** when the pilot embarks.

Passage Planning: ISPO requirements

ISPO requirements: Passage Planning

7.3 Passage Planning

7.3.1 The pilot organization establishes procedures for the preparation, planning and execution of the pilotage passage with due consideration to local, national and international requirements and local best practice.

7.3.2 Information exchange between the maritime pilot organization and the maritime pilot should be conducted in such a way that sufficient preparation and planning of the pilotage passage can be established before commencing the act of pilotage.

7.3.3 Before commencing the act of pilotage, a detailed information exchange should take place between the master and/or bridge team and the maritime pilot.

7.3.4 During the execution of the pilotage passage, the pilotage passage plan should be reviewed and updated and the master and/or bridge team and all other parties involved should be informed accordingly.

7.3.5 The maritime pilot organization must instruct the maritime pilot that any hand-over procedure between maritime pilots during the pilotage passage takes place on the bridge of the vessel concerned and that this procedure must be clearly defined and unambiguous. The above hand-over procedure does not apply when the ship is safely moored, for example in a lock or alongside a berth.

7.3.6 The maritime pilot organization must establish procedures between the maritime pilot and any supporting maritime pilot as to define responsibility, authority, tasks and aspects of communication. It must always be clear to the master which pilot is the maritime pilot and which is the supporting maritime pilot.

Passage Planning: ISPO requirements

7.3.1 The procedures for the preparation and planning of the pilotage passage should include, but not be restricted to the following items:

- Pre-arrival or pre-departure checklist
- Embarking and disembarking procedures
- Maritime pilot card
- Communication procedures
- Use of ship's crew and shipboard systems
- Navigational aspects of port and or fairway
- Hydrographic and meteorological aspects
- Boatmen support and consigned mooring plan arrangements and requirements
- Berthing or unberthing procedures
- Tugboat support and consigned towing line arrangements
- Navigational warnings and notices to mariners with respect to the designated area
- Berths, quays, dry-docks and or lock characteristics
- Calibration and updates of navigational information and data of the maritime pilot specific positioning system, if in use
- Rules and regulations by national administrations and local best practice

Procedures for preparation, planning and execution

Passage planning: ISPO requirements

7.3.4 The planning of the pilotage passage should be agreed between the master and the maritime pilot before the maritime pilot starts assisting the master and/or bridge team in the navigation of the vessel and the execution of the pilotage passage commences.

Understood and agreed

7.3.5 During the execution of the pilotage passage it is appropriate to review and update the pilotage passage plan and inform the master and/or the bridge team accordingly.

Reviewed and updated

7.3.6 Depending on national and local regulations and local best practice the master may delegate the conduct of the navigation to the maritime pilot who directs the navigation of the ship in close cooperation with the master and or the bridge team.

7.3.7 It is important at all times that during the execution of the pilotage passage the responsibilities of the maritime pilot, the master and the bridge team are agreed and clearly understood. The presence of the maritime pilot does not relieve the master and or the bridge team of their duties and obligations regarding the safety of the ship.

Agreed responsibilities

7.3.8 The maritime pilot organization should instruct the maritime pilot that any hand-over procedure between maritime pilots during the pilotage passage takes place on the bridge of the vessel and that this procedure is clearly defined and unambiguous.

Handover procedures

7.3.9 The maritime pilot organization should establish procedures between the maritime pilot and any supporting maritime pilot as to define responsibility, authority, tasks and communications aspects. It must always be clear to the master which pilot is the maritime pilot and which is the supporting maritime pilot.

Multipilot acts

7.3.10 The maritime pilot organization should instruct the maritime pilot that all procedures derived from the passage planning are communicated effectively to the bridge team members, allied services, and port/fairway authority.

communication

Passage planning: ISPO requirements

7.3.2 The maritime pilot organization should ensure that the passage planning is in compliance with all applicable guidelines, standards and procedures recommended by IMPA, as so as to reduce the risk of miscommunication and misunderstanding between:

- The maritime pilot and the bridge team
- The maritime pilot and supporting maritime pilot
- The piloted vessel and shore services (e.g. VTS)
- The piloted vessel and other maritime traffic in the designated area

Compliant with regulations

7.3.3 The planning of the pilotage passage should be discussed between the master and the maritime pilot after the embarking procedure. Any amendments to the pilotage passage plan should be agreed on by the maritime pilot and the bridge team.

Conducive to building a Shared mental model

Evolution of information management in Passage Planning

Mental passage planning

Paper passage planning

(‘Disjointed’ Decision Support System -DSS)

Computer based passage planning

(Computer based DSS – analysis of big data)

Artificial Intelligence (AI) passage planning

Passage plan

TRADITIONAL	ELECTRONIC ERA
Appraisal and planning compiled from different sources (publications, printed notices, instrument readings, procedures, local knowledge, etc) No integration with external information systems	Appraisal and planning done electronically with seamless system integration for data gathering and analysis Tailored and real time integration with external information systems Easily update variations to plan
Printed plan(s) presented to master and bridge team on boarding Often not enough time to engage bridge team – put waypoints in ECDIS	Electronic plan sent in advance to vessel for bridge team to familiarise and evaluate Time to build a shared mental model
Berth to berth passage (ECDIS or paper) may (and in most cases will) differ from pilot's passage Vessel unseaworthy? Shared mental model?	Routes and waypoints sent in advance so ECDIS route mirrors pilot's plan (PPU) Regulatory compliance
Limited consideration to route optimisation UKC – static	Route optimization DUKC Environmental considerations

Paper passage planning – 1960s to 2023

Pilotage act information

UKC

Tides

Checklists

Tugs

Mooring plan

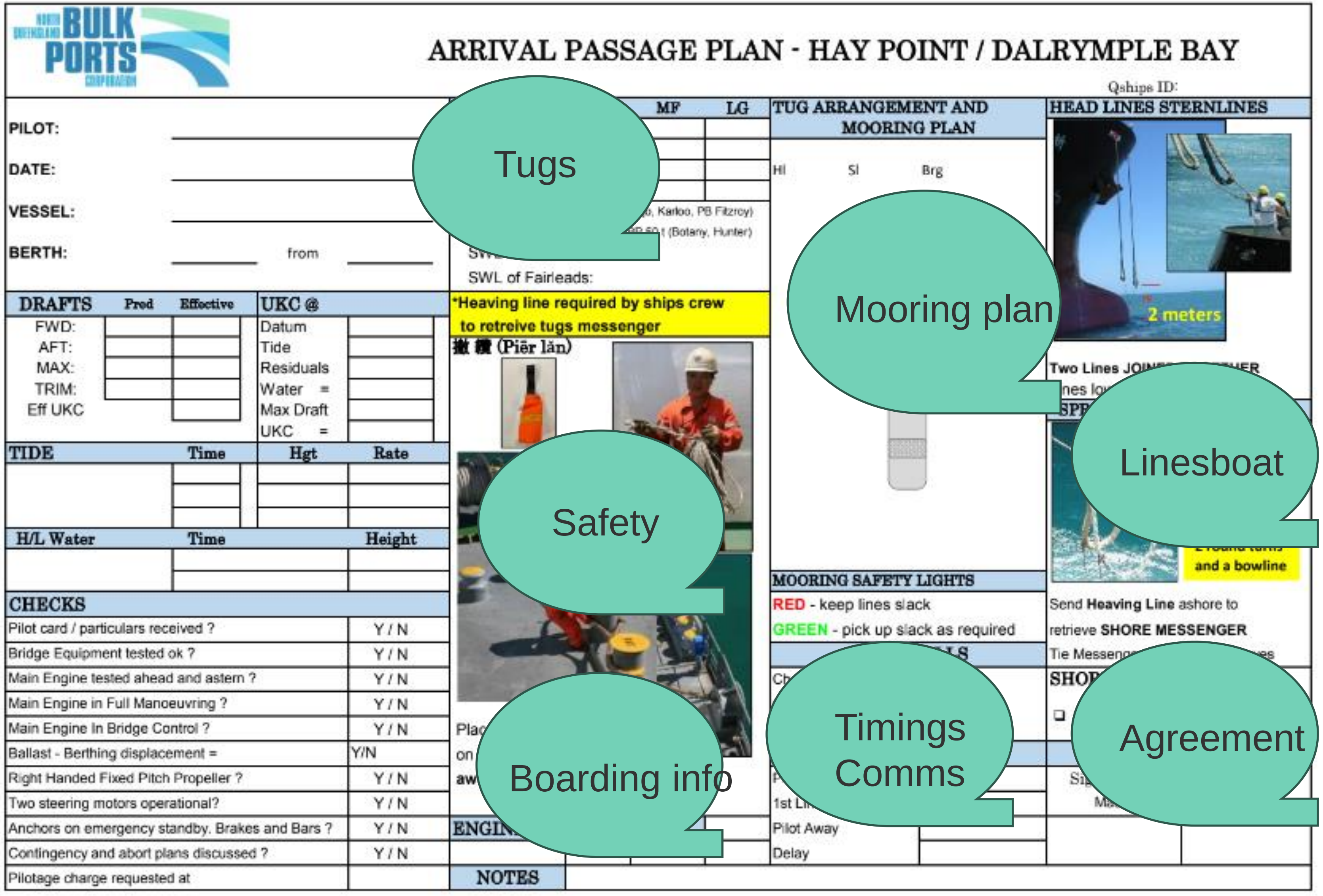
Linesboat

Safety

Boarding info

Timings Comms

Agreement



ARRIVAL PASSAGE PLAN - HAY POINT / DALRYMPLE BAY

Qships ID:

PILOT:

DATE:

VESSEL:

BERTH: from

MF LG

SWL of Fairleads:

*Heaving line required by ships crew to retreive tugs messenger

撇 纜 (Piĕr lăn)

TUG ARRANGEMENT AND MOORING PLAN

Hl Sl Brg

HEAD LINES STERNLINES

2 meters

Two Lines JOIN

and a bowline

DRAFTS	Prod	Effective	UKC @	
FWD:			Datum	
AFT:			Tide	
MAX:			Residuals	
TRIM:			Water =	
Eff UKC			Max Draft	
			UKC =	

TIDE	Time	Hgt	Rate

H/L Water	Time	Height

CHECKS	
Pilot card / particulars received ?	Y / N
Bridge Equipment tested ok ?	Y / N
Main Engine tested ahead and astern ?	Y / N
Main Engine in Full Manoeuvring ?	Y / N
Main Engine In Bridge Control ?	Y / N
Ballast - Berthing displacement =	Y/N
Right Handed Fixed Pitch Propeller ?	Y / N
Two steering motors operational?	Y / N
Anchors on emergency standby. Brakes and Bars ?	Y / N
Contingency and abort plans discussed ?	Y / N
Pilotage charge requested at	

MOORING SAFETY LIGHTS

RED - keep lines slack

GREEN - pick up slack as required

Send Heaving Line ashore to retrieve SHORE MESSENGER

Tie Messeng

1st Li

Pilot Away

Delay

NOTES

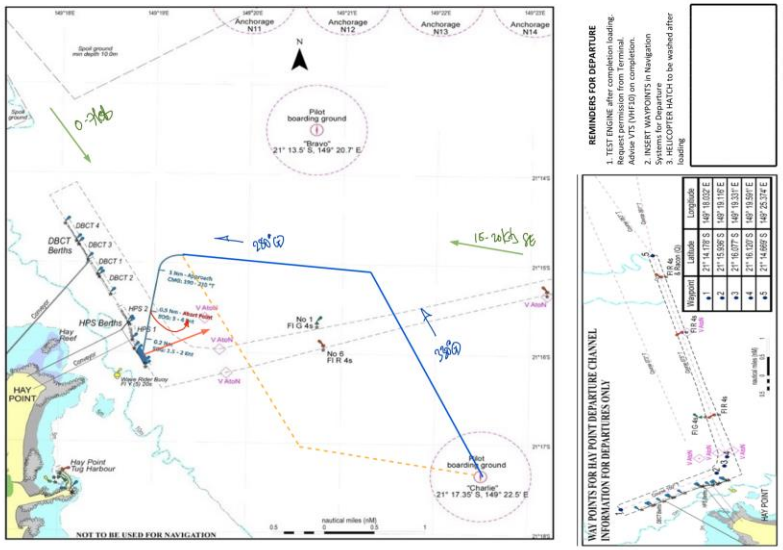
Document Set ID: 6708

Version: 3. Version Date: 28/09/2023

Paper passage planning – 1960s to 2023

Chartlets for passage

(waypoints, RoT, headings, speeds, contingencies, rendezvous points tugs/ traffic, wind, tide)



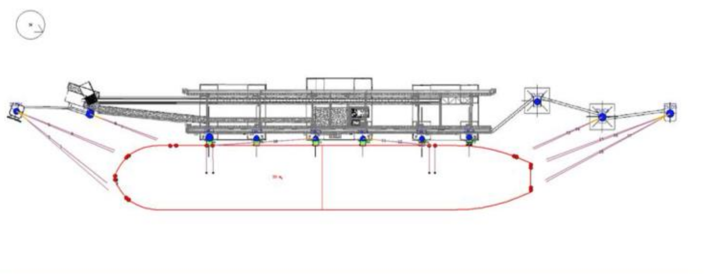
Berthing Chartlets

Approaches to berth
Berthing plans

Plan 2/Xa - 16 Winch Starboard Side

Four winches on forecastle – springs between 1 and 2

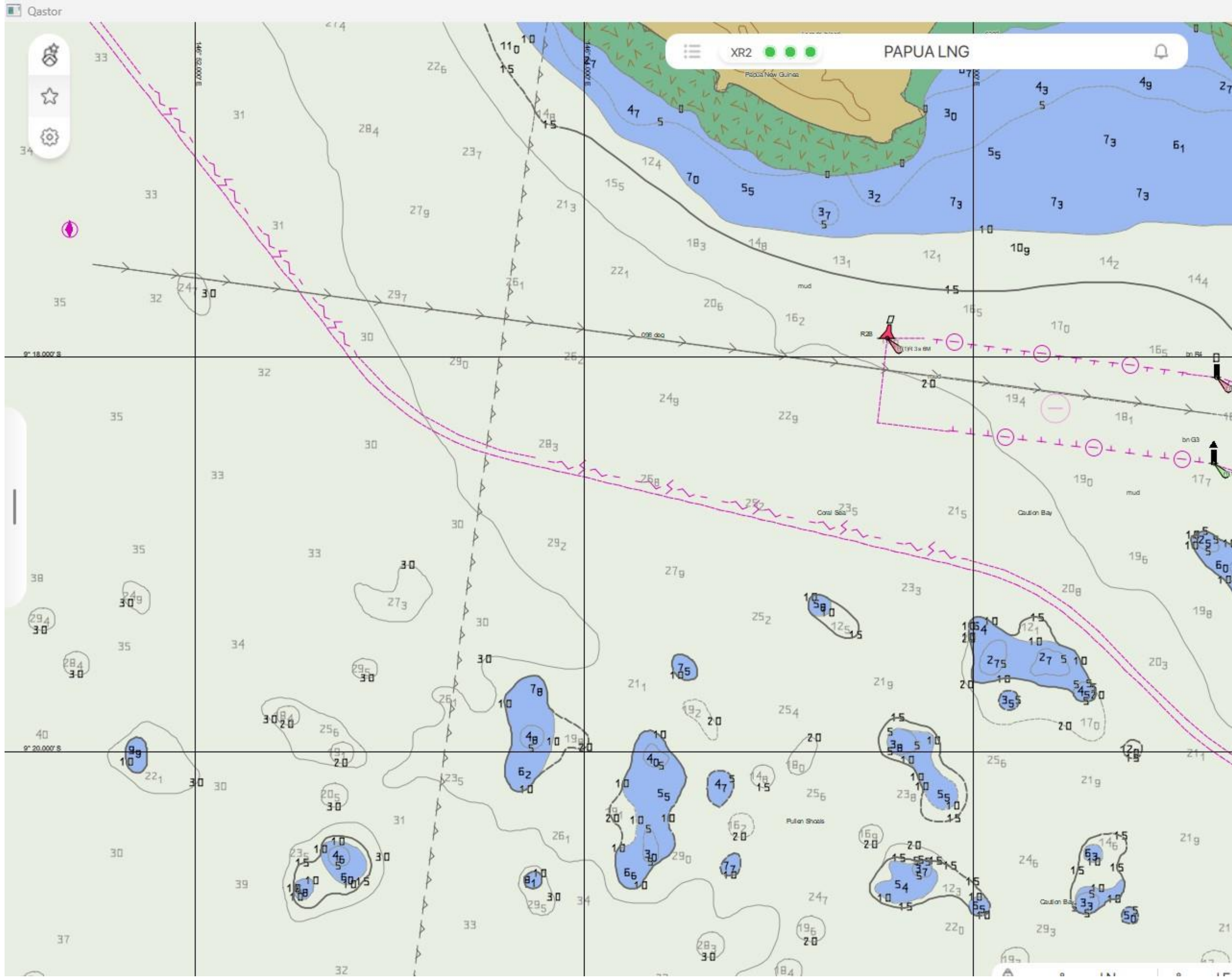
Vessel on bridge marker – Load hatch 9 position



MD1	MC2	BC1	BC2	BC3	BC4	BC5	BC6	MC3	MC4	MD5
4	2			2	2				2	4

Electronic Passage planning:
PPU Passage Planning (2014 – to date)

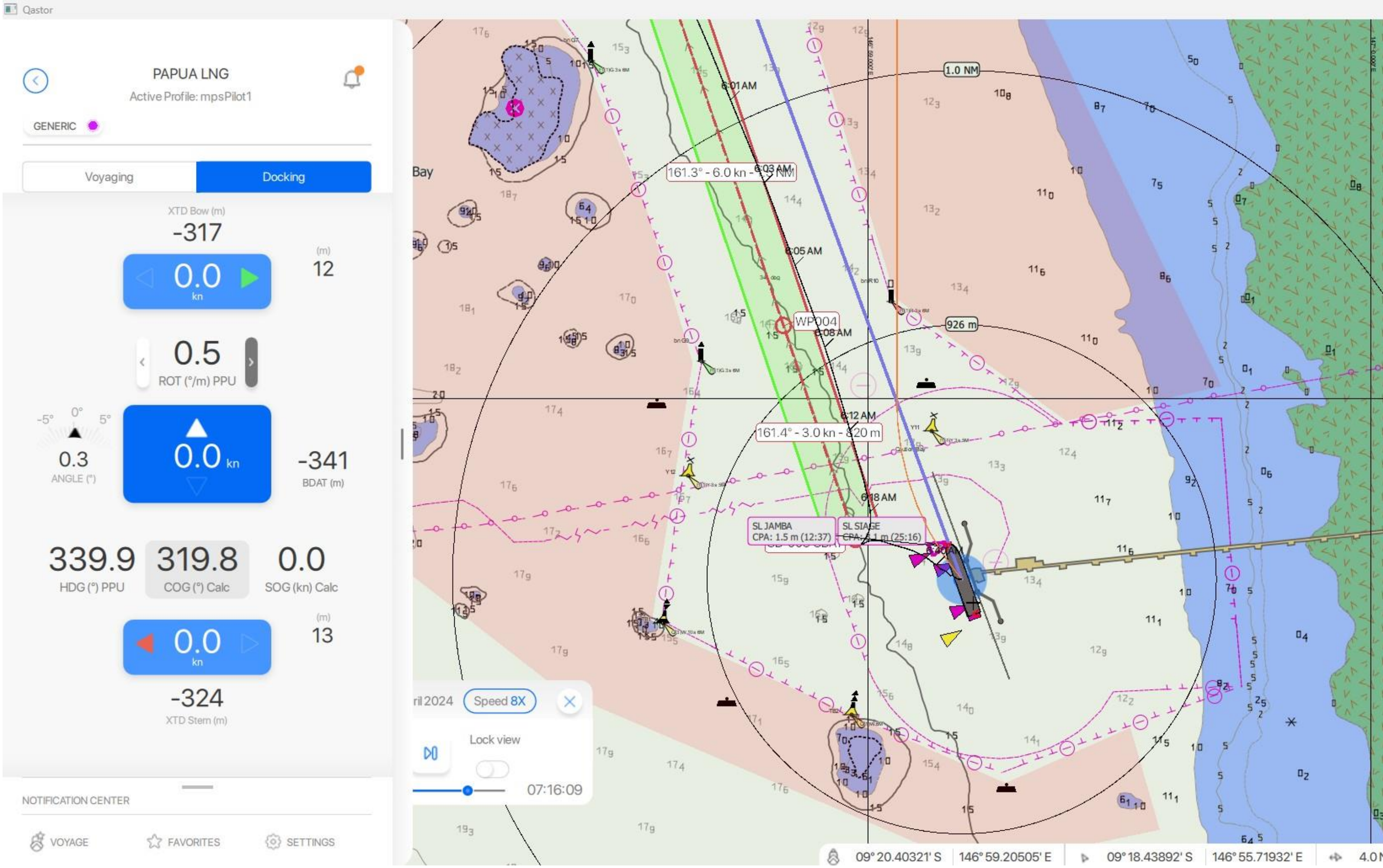
- Annotations
- Routes
- Docking lines



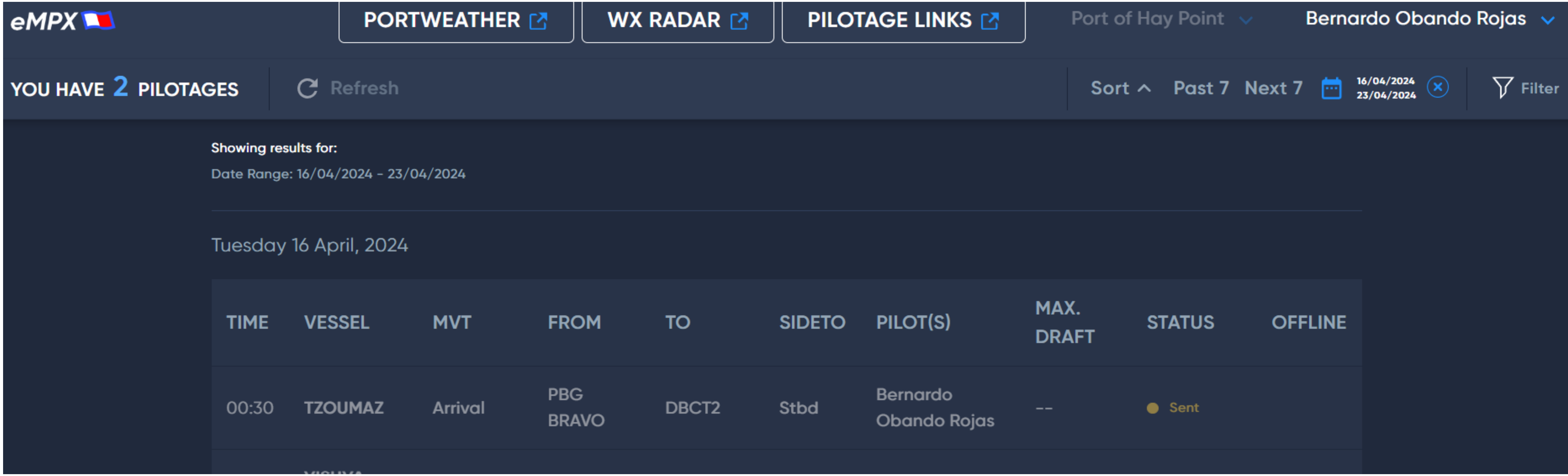
PPU Passage Planning (2014 to date)

Docking module

- Swing circles / distances off
- Berthing – bow and stern distances / lateral speeds



Electronic passage planning: eMPX as a tool (2023 -)



eMPX

eMPX MPX DOCUMENT - PORT OF CAUTION BAY NOT FOR NAVIGATION

North Queensland Bulk Ports Corporation

Pilotage

DATE	15 Jun 2024
TIME	08:00
TIMEZONE	UTC+10:00
MVT	Arrival
FROM	Pilot Boarding Station
TO	LNG Jetty
ROUTE	Arrival to Caution Bay LNG Jetty
SIDE TO	Starboard
MAX. DRAFT	-- m
FREEBOARD	-- m
FWD. DRAFT	-- m
AFT DRAFT	-- m
DISPLACEMENT	-- t
AGENT	ISS
PILOTAGE MODE	Direct
TRANSFER METHOD	Pilot Launch

PRIMARY PILOT Joji Takape

Vessel

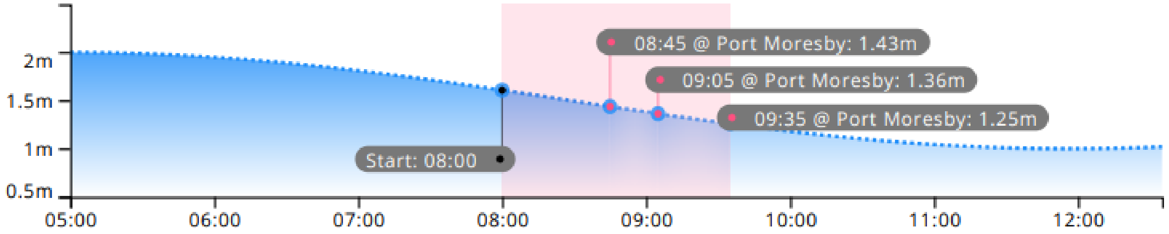
NAME	Kool Husky
IMO	9626039
MMSI	538004983
LOA	280.60 m
BEAM	43.40 m
HOA	-- m
S. TO BRIDGE	56.60 m
B. TO BRIDGE	224.00 m
GROSS TONNAGE	102100.00 t
CPP/FIXED	Fixed
ROTATION	Right
THR. FWD	-- kW
THR. AFT	-- kW
MAIN ENGINE	-- kW
BITTS (SWL) FWD.	-- t
BITTS (SWL) AFT	-- t

Risk Assessment

	CHANNEL Type: Tide_UKC	SWING BASIN Type: Tide_UKC	LNG JETTY Type: Tide_UKC
TIME	08:45	09:05	09:35
AVAILABLE DEPTH	-- m	-- m	-- m
REQUIRED DEPTH	-- m	-- m	-- m
STATIC UKC	-- m	-- m	-- m
REMAINING UKC	-- m	-- m	-- m

Predicted Conditions

Tidal conditions predicted for beginning of pilotage **08:00**



Port Moresby Range 0.99 m

▲	15 Jun	04:58	1.99m
▼	15 Jun	11:56	1m
▲	15 Jun	18:29	1.75m
▼	15 Jun	23:43	1.36m

Weather Information

Sourced from Weatherzone Forecast for **08:00** on **15 Jun 2024** at **Port of Caution Bay**

CONDITIONS	Mostly clear	TEMPERATURE	25 °C	WIND DIR.	S	WIND SPEED	9 kn	GUST	14 kn

eMPX + PPU

Pass/Caution Checklist

MASTER/PILOT EXCHANGE

1. Post-boarding Checks

- Confirm Draught
- Confirm Berth and Side To
- Confirm Planned Traffic Passes
- Course & Speed
- Bridge Equipment & Status
- Berth parameters and Cut-off limits
- Defects Noted and Reported
- Confirm Towage
- VHF Channels Checked
- Tugs Rendezvous location
- Secured Anchors

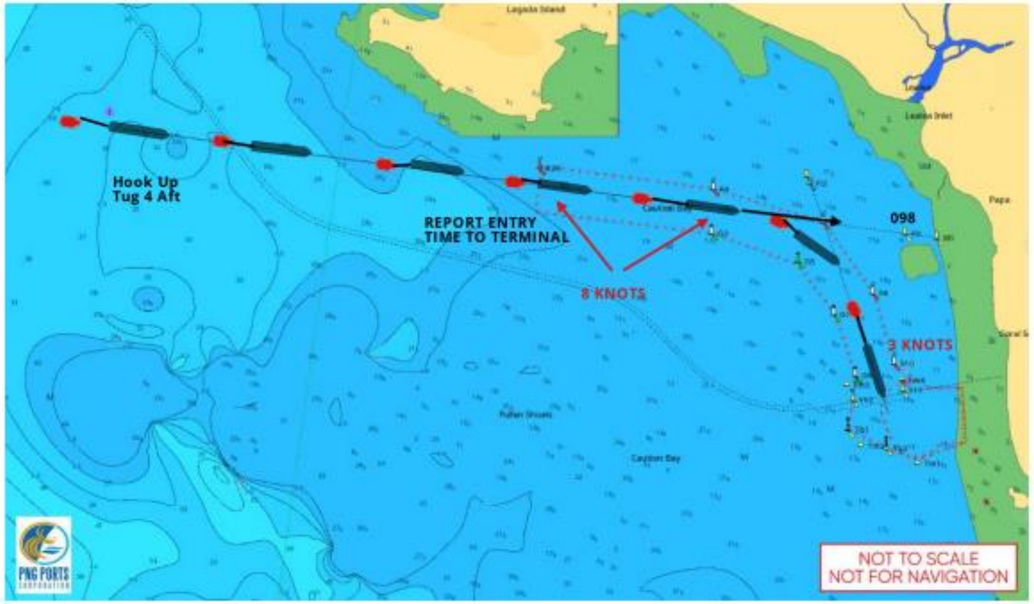
2. Passage Plan Discussion

- Vessel Pilot Card Sighted
- Contingencies and Abort Points Discussed
- Ship Handling Characteristics & Limitations Discussed
- Passage Speed
- Passage Plan Discussed
- Weather & Tidal Strength/Direction Discussed
- Radio reporting points

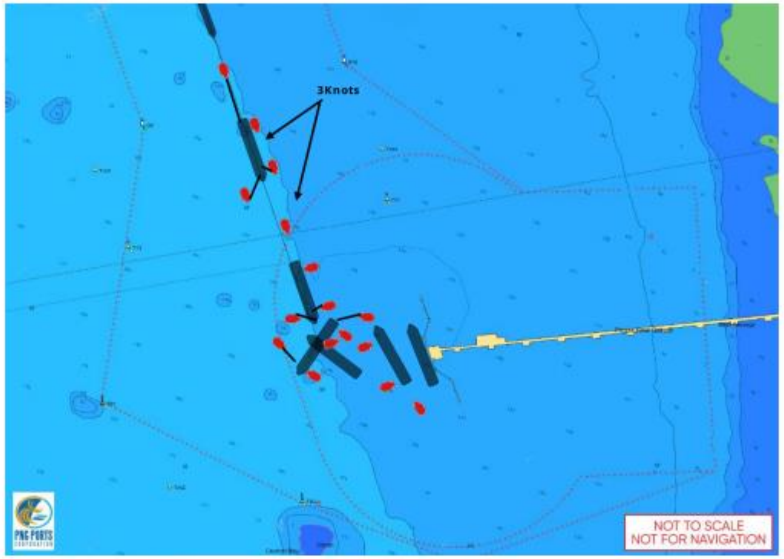
3. Manoeuvre and Mooring Discussion

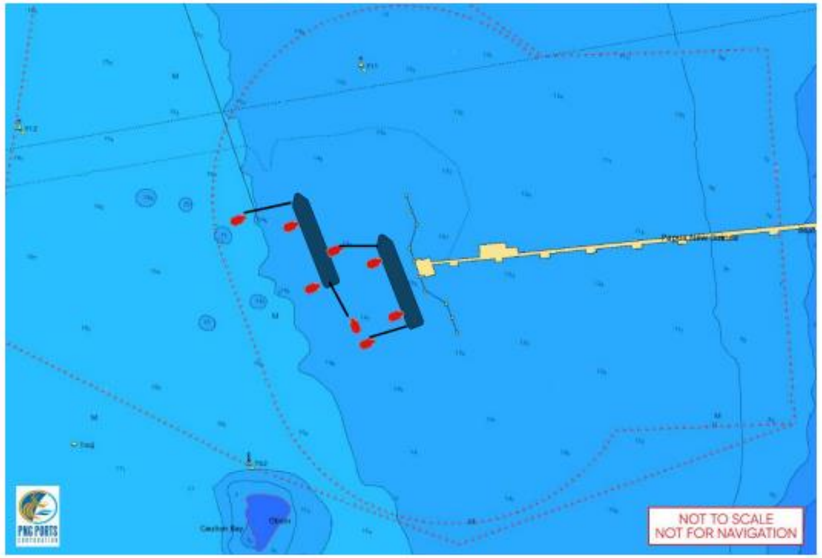
- Use of Towage Discussed, SWL Bitts Noted
- Use Of Weighted Heaving Lines Discussed
- Turn basin approach & speed
- Spoting the ship
- Manoeuvre & Mooring Plan Discussed
- Number of Tugs & securing sequence
- Fender Approach & Landing Speed
- Disembarking Arrangement

Passage Plan



eMPX + PPU





ort Guidelines

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Despite the duties and obligations of a pilot, the pilot's present on board does not relieve the Master or Office in charge should watch from the duties and obligations for the safety of the vessel. The bridge team heavy duty to support the pilot and ensure that his or her actions are monitored at all times.

MPX Acceptance Signed MPX with the Master and Pilots acceptance.

PILOT SIGN-OFF	MASTER SIGN-OFF
Accept and agree	Accept and agree
NAME Joji Takape	NAME Capt Arsen Frlan

Next generation:
Passage Planning and AI

Decision Support Systems – amalgamate and analyse data:

- Under Keel Clearance
- Portable Pilotage Units
- eMPX tools
- Collision avoidance
- Weather routing

Artificial Intelligence – machine learning

- Image recognition applications
- Passage planning

Automation

- Maritime Autonomous Surface Ships (MASS) – remote pilotage
  - Ships with automated processes and decision support
  - Remotely controlled ships with seafarers on board
  - Remotely controlled ships with no seafarers on board
  - Fully autonomous ships

(The Navigator June 2020 – David Patraiko/ Andy Norris)

Next generation: Passage Planning and AI

Demand for automation of passage planning is increasing due to advent of autonomous surface ships

Use of evolutionary algorithms on digital devices to plot optimal tracks. These algorithms have the ability to evolve and optimize.

Navigational knowledge and experience can be automated producing similar results (grid maps + transit analysis)

Change in passage planning as we know it and its associated information management

Is AI generated passage planning in use now?

Port of Mackay:
Channel definition
Based on AIS analysis and Grid map

Outcome:
Channel definition

Further evolution:
Route optimization - according to traffic, wind and tidal conditions

ISPO and AI passage planning

Passage planning requirements (7.3)

- **Underlying principles of passage planning continue to apply**
  - **Compliant with regulations**
  - **Understood and agreed information**
  - **Information exchange among stakeholders**
  - **Shared mental model**

Opportunities:

- Continuous development – Autonomous ships and AI
- Less human intervention but plan still to be reviewed by pilot/ master
- Integration of information systems
- Environmental and safety optimization of plans
- Creation of a ‘maritime cloud’ – information management

Challenges

- Algorithms (development and use)
- User preferences (delays, deliberate violations, changes based on judgement)
- Can experience and mariner’s judgement be replaced in the foreseeable future

Thank you!

Questions & Answers

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