

NATIONAL
ACADEMIES

Sciences
Engineering
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TRB TRANSPORTATION RESEARCH BOARD

TRB Webinar: Maritime Work in the Industrial Revolution 5.0

March 21, 2025

11:00 AM – 12:30 PM



PDH Certification Information

1.5 Professional Development Hours (PDH) – see follow-up email

You must attend the entire webinar.

Questions? Contact Andie Pitchford at TRBwebinar@nas.edu

The Transportation Research Board has met the standards and requirements of the Registered Continuing Education Program. Credit earned on completion of this program will be reported to RCEP at RCEP.net. A certificate of completion will be issued to each participant. As such, it does not include content that may be deemed or construed to be an approval or endorsement by the RCEP.



AICP Credit Information

1.5 American Institute of Certified Planners Certification Maintenance Credits

You must attend the entire webinar

Log into the American Planning Association website to claim your credits

Contact AICP, not TRB, with questions

Purpose Statement

This webinar will explore how these advancements are shaping future maritime workforce training and development. Presenters will discuss the impact of technology and the evolving role of soft skills, such as communication, teamwork, and leadership, in modern maritime operations.

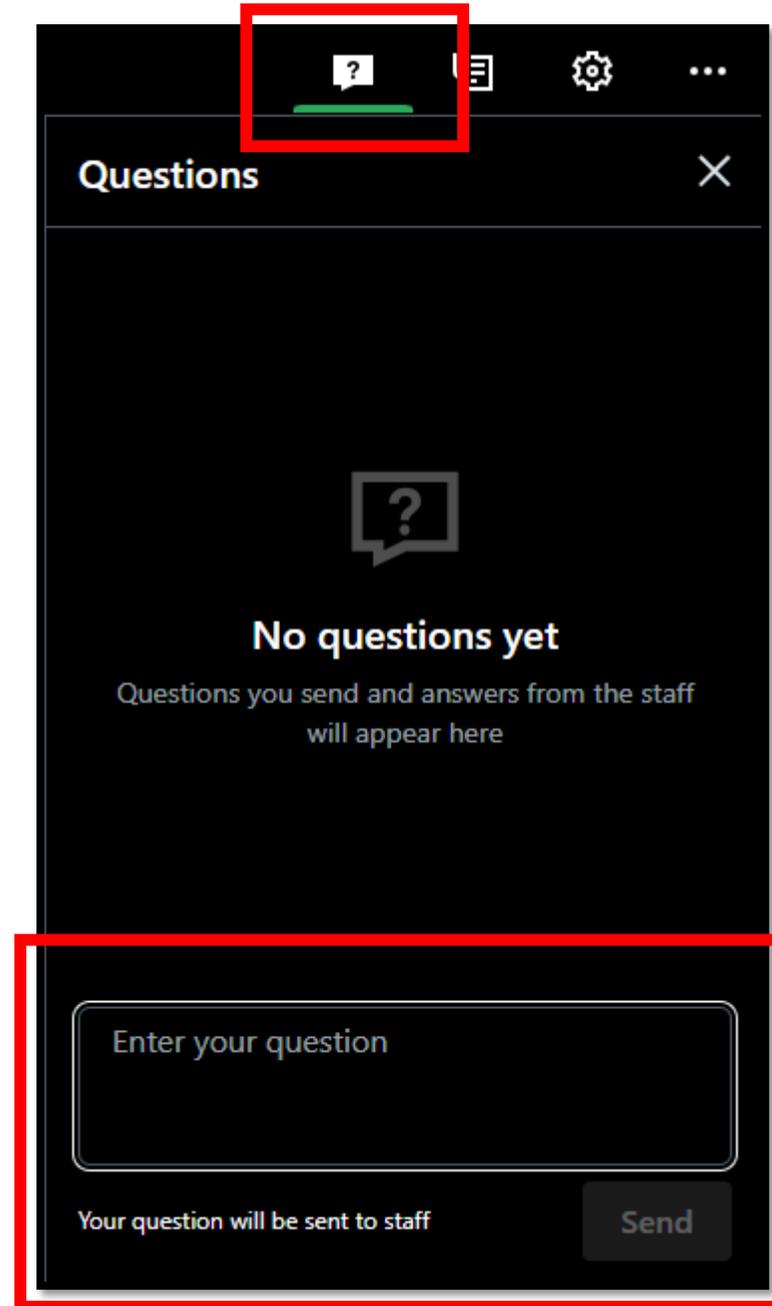
Learning Objectives

At the end of this webinar, you will be able to:

- (1) Understand how technological advancements are reshaping the skills required for future maritime workforce
- (2) Adjust competency-based training programs to better align with international standards the evolving needs
- (3) Prepare employees for both the technical and soft skills needed for the dynamic and collaborative nature of modern maritime operations

Questions and Answers

- Please type your questions into your webinar control panel
- We will read your questions out loud, and answer as many as time allows



Today's presenters



Dr. Cassia Bommer-Galvao
galvaoc@tamug.edu



Paul Szwed
pszwed@maritime.edu



Tracey Mayhew
tmayhew@seafarers.org



Dr. Srđan Vujičić
srdjan.vujicic@unidu.hr



**NATIONAL
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TRB Webinar: Maritime Work 5.0

Friday 21 March 2025

US training institution perspective on
meeting workforce training needs

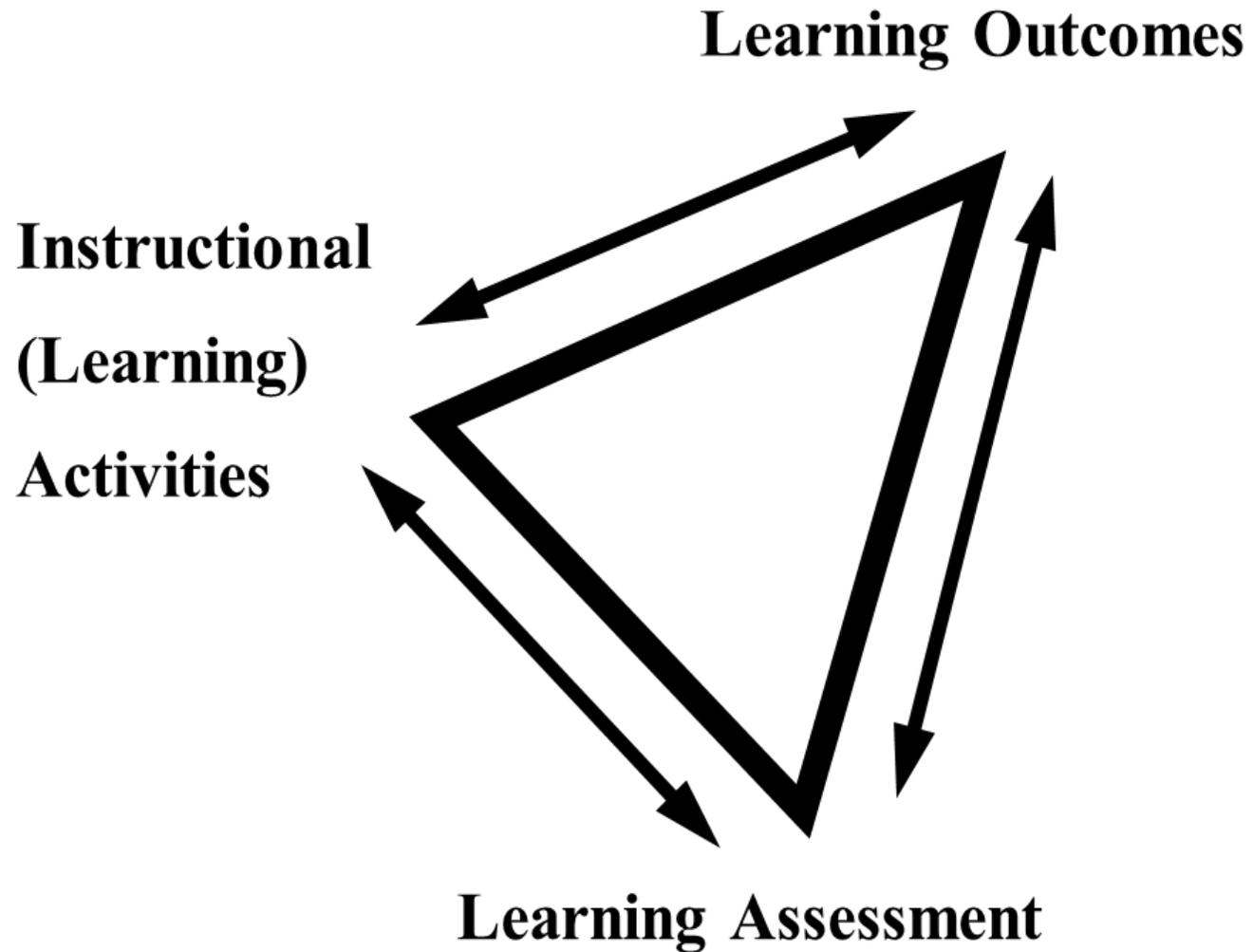
*Paul S. Szwed, DSc, PMP
Massachusetts Maritime Academy*

Current State

California | Great Lakes | Maine
Massachusetts | New York | Texas
+ United States



Current State





Marine Transportation Curriculum

2023 and beyond

MMA Program

STCW Tables
NVIC Tasks
Faculty
Definitions

Deck

Curriculum
Courses
Assessments
Tasks

Engineering

Curriculum
Courses
Assessments
Tasks

Common

Courses
Assessments
Tasks

Semester 1

EN-1112 Engineering Systems & Safety
HU-1111 English Composition
SM-1111 Precalculus w/ Trigonometry
SM-1131 Chemistry I
MT-1111 Vessel Familiarization & BST

Semester 2

HU-1222 Writing About Literature
SM-1214 Applied Calculus or Calculus I
SM-2121 College Physics I
SS-1211 Western Civilization
MT-1221 Coastal Navigation

Intersession

ST-0999 Sea Term I

Semester 3

SM-2119 Applied Mathematics for Deck Officers
SM-2222 College Physics II
MT-2121 Deep Sea Navigation
MT-2141 Ship Construction
MT-2161 Rules of the Road

Semester 4

SS-2121 American Government
GESS-3 Social Science Group I
MT-2231 Basic Seamanship
MT-2225 Integrated Navigation
MT-3221 Electronic Navigation

Intersession

MT-2371 Sea Term II: MT

Semester 5

Semester 6



MMA Course MT-2222

Celestial Navigation

MMA Program

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Course Description

This course covers the requirements of the 1978 STCW Convention as amended in 1995 and 2010. The course covers the theory and practice of navigation necessary for the effective and safe navigation of a vessel, including the use of charts, position fixing by celestial observations and the extraction of information from relevant navigational publications. It introduces and focuses on the theory and practice of the use of observations of celestial bodies for determining lines of position and checking compass errors. [Lab time required]

This course consists of three 1-hour lectures and one 2-hour lab per week for a semester with practical assessments and a comprehensive final examination.

Entrance Requirements

Successful completion of **MT-2121 Deep Sea Navigation**.

This course serves as a pre-requisite for **MT-3371 Sea Term III** / **MT-2372 Commercial Sea Term**.

STCW Objectives

Demonstrate knowledge and understanding of the following STCW elements:

- **OICNW-A1.01** Use celestial bodies to determine the ship's position
- **OICNW-A1.07** Ability to determine errors of the magnetic and gyro-compasses, using celestial means



STCW Table A-II/1

officer in charge of a navigation watch

MMA Program

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Function: Navigation at the operational level

Competence	Knowledge, Understanding & Proficiency	Location(s)
Plan and conduct a passage and determine position	<i>A1.01 Celestial Navigation</i> Ability to use celestial bodies to determine the ship's position	MT-2222 MT-4371
	<i>A1.02 Terrestrial and coastal navigation</i> Ability to determine the ship's position by use of: 1. landmarks 2. aids to navigation, including lighthouses, beacons and buoys 3. dead reckoning, taking into account winds, tides, currents and estimated speed	MT-1221 MT-2121 MT-2225
	<i>A1.03</i> Thorough knowledge of and ability to use nautical charts, and publications, such as sailing directions, tide tables, notices to mariners, radio navigational warnings and ships' routeing information	MT-2121 MT-4371
	<i>A1.04 Electronic system of position fixing and navigation</i> Ability to determine the ship's position by use of electronic navigational aids	MT-3221 MT-4371
	<i>A1.05 Echo Sounders</i> Ability to operate the equipment and apply the information correctly	MT-2121 MT-4371
	<i>A1.06 Compass - magnetic and gyro</i> Knowledge of the principles of magnetic and gyro-compasses	MT-1221 MT-4133
	<i>A1.07</i> Ability to determine errors of the magnetic and gyro-compasses,	MT-2121



MMA Assessments (MTRA)

for all marine transportation students

MMA Program

[STCW Tables](#)
[NVIC Tasks](#)
[Faculty](#)
[Definitions](#)

Deck

[Curriculum](#)
[Courses](#)
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[Tasks](#)

Engineering

[Curriculum](#)
[Courses](#)
[Assessments](#)
[Tasks](#)

Common

[Courses](#)
[Assessments](#)
[Tasks](#)

No.	Assessment	Description	Location	Status
1.	ABD-4J11A	Trace out and describe a piping system	MT-3151	moved
2.	ABD-4J7A	Demonstrate rigging and unrigging a bosun's chair	MT-2231	
3.	ABD-4J9A1	Marlinspike seamanship - knots I	MT-1111	
4.	ABD-4J9A2	Marlinspike seamanship - knots II	MT-2231	
5.	ABD-4J9A3	Marlinspike seamanship - splicing	MT-2231	
6.	ABD-4J9A4	Marlinspike seamanship - line handling	MT-2231	
7.	ABD-5J10B	Demonstrate use of a safety harness	ST-0999D	
8.	OICNW-1-1A	Adjust a sextant	MT-4371	
9.	OICNW-1-1B	Measure the altitude of the sun	MT-4371	
10.	OICNW-1-1C	Obtain a celestial fix	MT-4371	
11.	OICNW-1-1D	Measure the altitude of the sun at meridian passage (local apparent noon)	MT-4371	
12.	OICNW-1-1E	Celestial running fix	MT-4371	
13.	OICNW-1-1F	Star Fix	MT-4371	
14.	OICNW-1-1G	Measure the altitude of at least 3 stars	MT-4371	
15.	OICNW-1-2A	Fix by two bearings	MT-2225	moved
16.	OICNW-1-2B	Fix by two ranges	MT-2225	moved
17.	OICNW-1-2C	Fix by tangent bearings of two identified objects	MT-2225	moved
18.	OICNW-1-2D	Plot the ship's DR position	MT-2121	



MMA Assessment OICNW-1-1C

Obtain a celestial fix

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Condition

Aboard a ship at sea, given a standard marine sextant, a clear horizon, a clear or partly cloudy sky, and an accurate time, during a single twilight.

Performance requirement

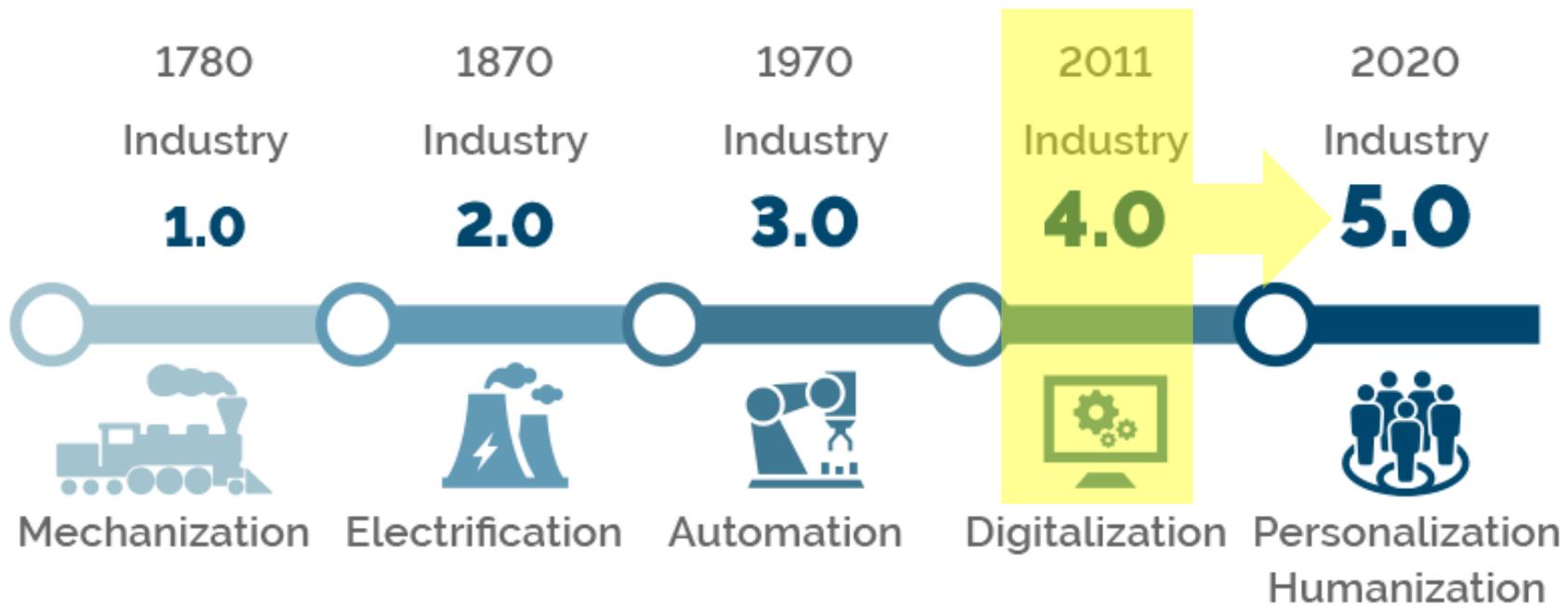
Behavior	Standard
<i>The student will:</i>	<i>During assessment, the student shall, at a minimum:</i>
Measure the altitude of three stars and accurately record the times of the observation of each star.	<ul style="list-style-type: none">Determine altitudes within ± 2 minutes of arc, after correction for index error, as compared with the altitude measured by the assessor at the same time;Record an observation time which is within ± 2 seconds of UTC of the time of observation as determined by the assessor.
Plot three lines of position and advance them to a common time.	Plot the resultant position of the star fix within 1.5 nm of the ship's GPS position at the corresponding time, or within 3 nm of the assessor's solution taken during the same time.

Location

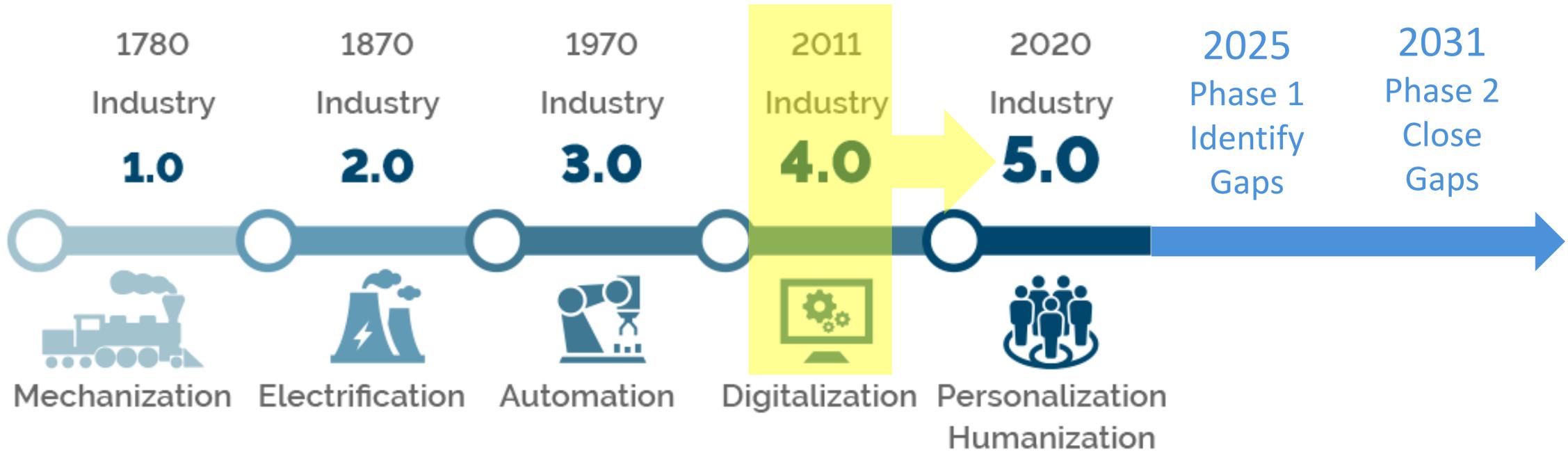
Assessed in MT-4371 Sea Term IV: Marine Transportation.

References

1. Table A-II/1 OICNW-A1.01

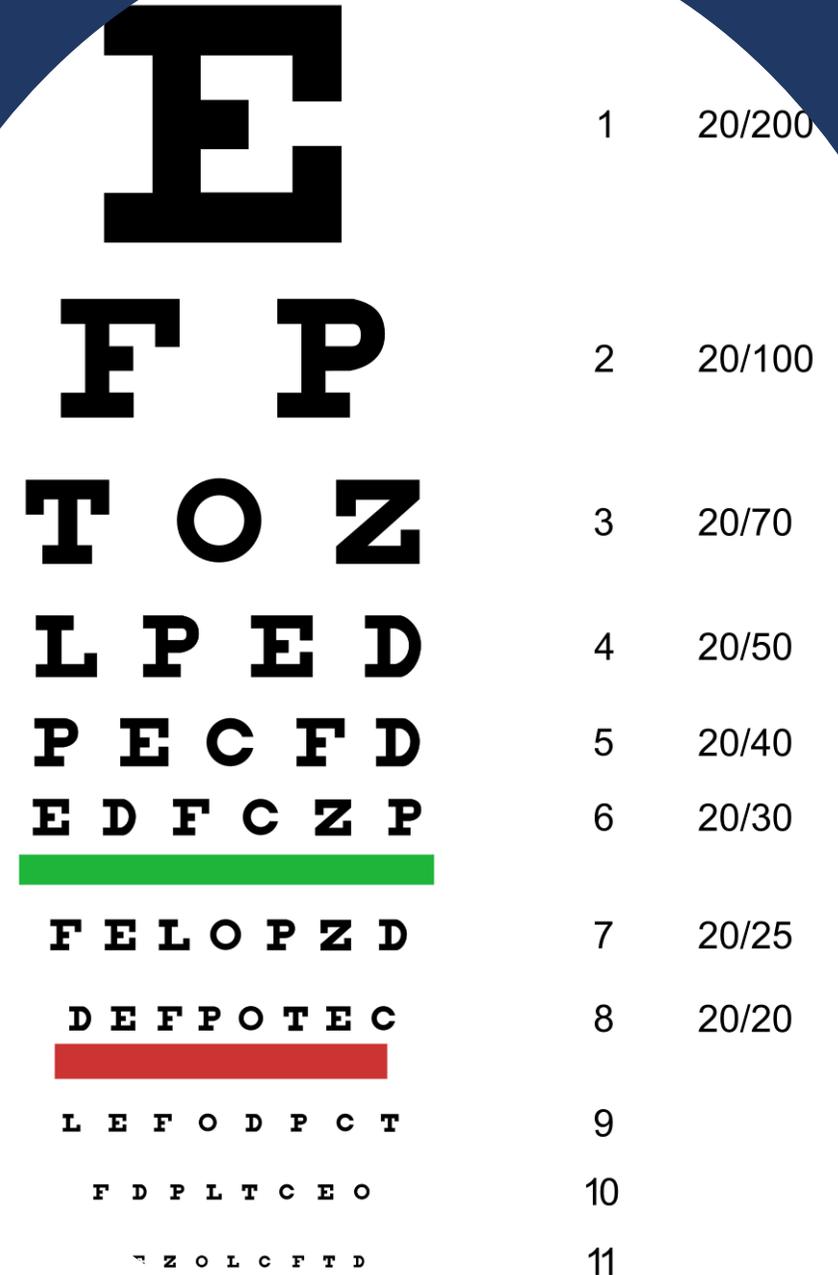


STCW Review & Revision



Conclusion

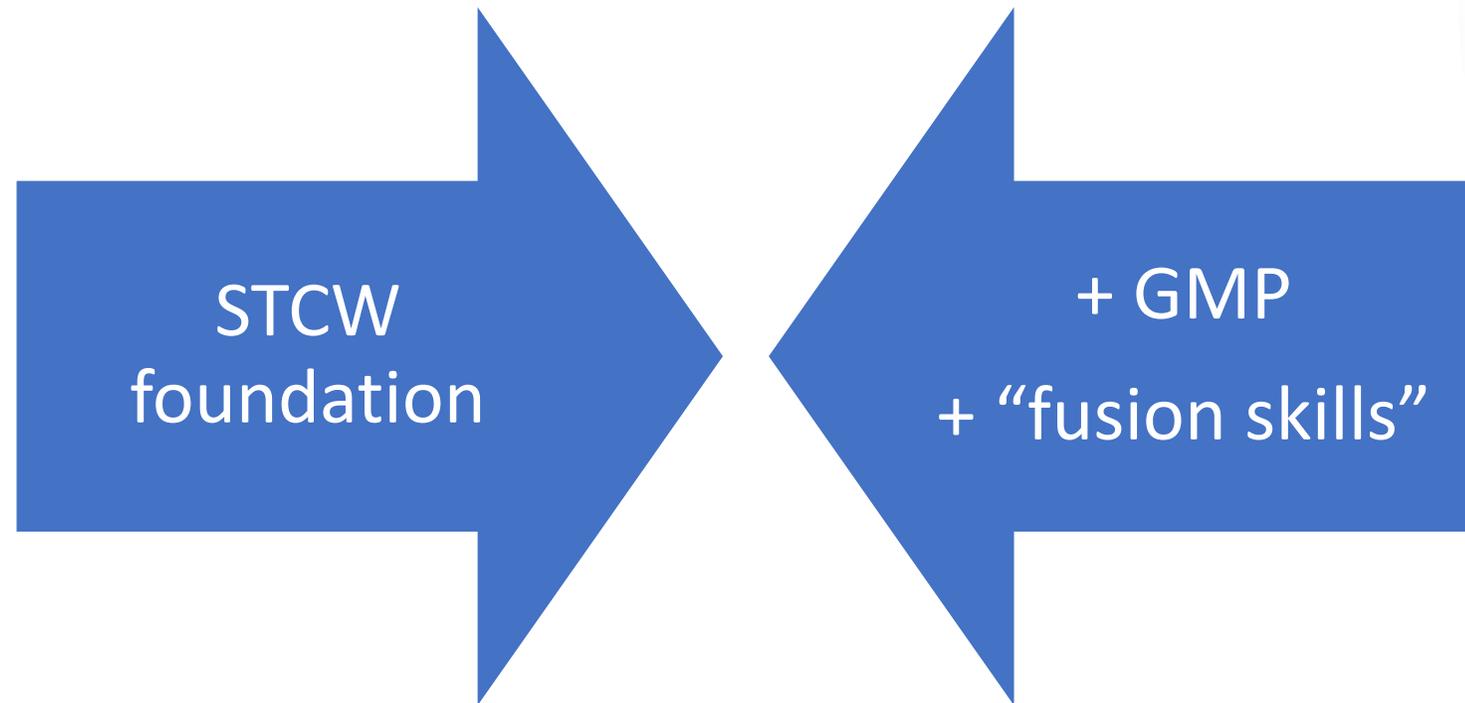
We need to figure out how to help our seafarers, “see fairer.”



A Snellen chart with 11 rows of letters. The letters are arranged in a grid. The first row has a single large letter 'E'. The second row has two letters 'F' and 'P'. The third row has three letters 'T', 'O', and 'Z'. The fourth row has four letters 'L', 'P', 'E', and 'D'. The fifth row has five letters 'P', 'E', 'C', 'F', and 'D'. The sixth row has six letters 'E', 'D', 'F', 'C', 'Z', and 'P'. The seventh row has seven letters 'F', 'E', 'L', 'O', 'P', 'Z', and 'D'. The eighth row has eight letters 'D', 'E', 'F', 'P', 'O', 'T', 'E', and 'C'. The ninth row has nine letters 'L', 'E', 'F', 'O', 'D', 'P', 'C', 'T'. The tenth row has ten letters 'F', 'D', 'P', 'L', 'T', 'C', 'E', 'O'. The eleventh row has eleven letters 'F', 'Z', 'O', 'L', 'C', 'F', 'T', 'D'. To the right of each row is a number and a fraction representing visual acuity. A green horizontal bar is under the sixth row, and a red horizontal bar is under the eighth row.

E	1	20/200
F P	2	20/100
T O Z	3	20/70
L P E D	4	20/50
P E C F D	5	20/40
E D F C Z P	6	20/30
F E L O P Z D	7	20/25
D E F P O T E C	8	20/20
L E F O D P C T	9	
F D P L T C E O	10	
F Z O L C F T D	11	

Future State



Global Maritime Professional



- 24 competencies
 - Foundational
 - Technical (including STCW, digital literacy)
 - Interpersonal (including leadership)
 - Strategic
- 5 year look-ahead (*focused mostly on Maritime 4.0*)

Maritime 5.0 “fusion skills”

- Rehumanizing time
- Responsible normalizing
- Judgment integration
- Intelligent interrogation
- Bot-based empowerment
- Holistic melding
- Reciprocal apprenticing
- Relentless reimagining



Call to Action

1. Call for an agile regulatory revision process
2. Engage in pedagogical research devoted to helping operators become ready for Maritime 5.0
3. Create a cross-modal TRB sub-committee devoted to operators – perhaps pilot with a webinar



TRB Webinar: Maritime Work 5.0

Labor Perspective

Tracey Mayhew, BSc

Seafarers International Union

International Transport Workers Federation



Maritime 5.0

Opportunity

Maritime 5.0



Learn from past
systemic failures



Opportunity

Maritime 5.0

Don't exacerbate
past mistakes

Opportunity

Maritime 5.0

Learn from
past systemic
failures

Don't
exacerbate
past mistakes

Opportunity to correct mistakes
of the past

Topics

- Regulatory Developments
 - Fair Treatment
 - Abandonment
 - Crewing & Fatigue
- Flag of Convenience
- Maritime Just Transition
 - STCW Review
 - Safety

Regulatory Development

Fair Treatment

Abandonment

Crewing & Fatigue

Flag of Convenience

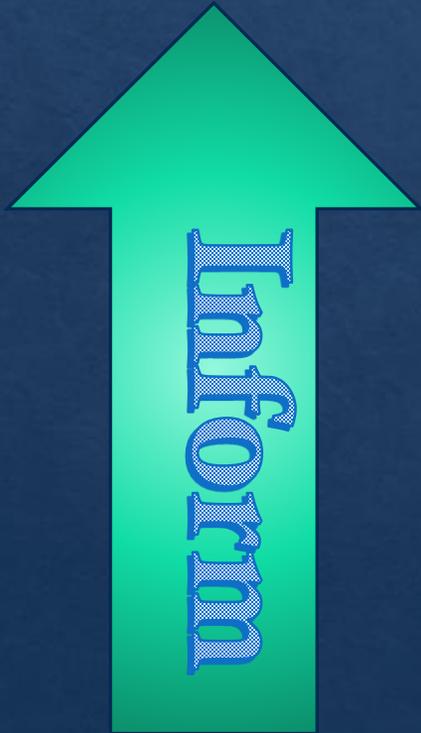
Maritime Just Transition

STCW

Safety



Regulatory Developments



Fair Treatment

Abandonment

Crewing & Fatigue

Flag of Convenience

Maritime Just Transition

STCW

Safety

Fair Treatment aka Criminalization

- Criminalisation of seafarers: criminal charges as a result of an incident or accident involving their vessel or someone onboard.
- MLC not being enforced and seafarers being unfairly treated during detainment
- More and more legislation being enacted that can lead to seafarer criminalization
 - ILO/IMO Joint Working Group recently developed new guidelines but these are meaningless if not followed or enforced.

Fair Treatment aka Criminalization

- 90% of seafarers fear criminalization and 70% said it impacts their feelings of working at sea. (Nautilus Federation, 2019)

Abandonment

Abandoned seafarers can experience:

months of unpaid wages

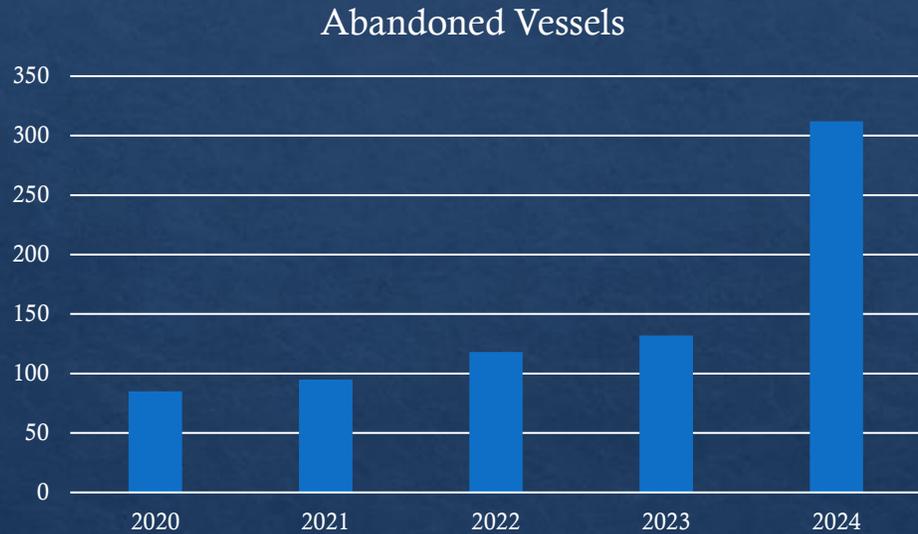
extremely poor on-board conditions

inadequate food and clean drinking water

long periods of work without proper rest.

In some cases, they are left completely stranded for months – even years – on end.

Abandonment



Abandoned Seafarers

2023 1,676

2024 3,133

136% increase

90% of abandoned vessels in 2024 sailed on a Flag of Convenience (FOC)

25 vessels were abandoned 2 times in 2024

3 vessels abandoned 3 times in 2024

Flags of Convenience

A 'flag of convenience' vessel is one that flies the flag of a country other than the country of ownership, at the same time adopting the regulations set down by that flag.

The United Nations (UN) Convention on the Law of the Sea states that there must be a "genuine link" between the ship and the flag state. In reality, 'genuine links' between ships and flags often fail to exist.

Crewing & Fatigue

- Minimum safe crewing levels continue to decline with the approval of the flag state.
- Reduction in crewing intensifies stress, fatigue and mental health challenges which directly affects the safety of personnel, ships and the environment.
- 87.6% of seafarers say there is an imbalance between work demand and crewing levels.
- When reported to company only 22.4% of cases did companies respond by providing additional crewing.

Maritime Just Transition

Maritime Just Transition
Task Force established
during COP26 in
November 2021

The Task Force has the
aim of supporting a just
and human-centered
decarbonization of the
shipping industry.



Mapping a Maritime Just Transition for Seafarers

Position paper | November 2022



Findings

A lot of Seafarers need a lot of training in a short amount of time!

- Significant updates to training and competences of seafarers.
- Current estimate is that up to 800,000 seafarers may need additional training by the mid-2030s.
- Enhanced safety measures and equipment: energy specific safety measures, advanced mitigation strategies and enhanced personal protective equipment including specialized breathing apparatus and gas detectors.
- Additional training in operation and maintenance of fuel supply systems and management of risk (flammable vapors, toxic exposure and corrosion).

STCW Review & Revision

Overarching concerns

Cumulative Impact of training on seafarers

No degradation of competencies

STCW Review & Revision

How's it going?

- Over 500 gaps identified in the review
 - Mostly adding, not taking away
 - Trying to maintain the Hawsepipe
- Training costs, especially for alternative fuels

Safety

- Transcends everything
- Proper Personal Protective Equipment
- Effective training
- Protection of Seafarer's Rights
- Effective Reporting and Response

Thank You!

Tracey Mayhew

Seafarers International Union

tmayhew@seafarers.org

International Transport Workers Federation

Mayhew_Tracey@itf.org.uk



STCW and NON STCW COURSES INDUSTRY 4.0 and 5.0 – CRUISE INDUSTRY

Integrated Navigation System (INS)

- (RADAR+ARPA+AIS+PREDICTOR+RADAR-CHART OVERLAY+SENSOR&ALARM MANAGEMENT+TRACK
PILOT+"ONE OCEAN")

BRM ELEMENTS

VOYAGE PLANNING (ONE OCEAN)

LEARNING FROM INCIDENTS

SHIP HANDLING (POLAR CODE)

REGULATIONS and COMPLIANCE

ELECTRICAL PROPULSION

LNG MANAGEMENT COURSES

ENVIROMENTAL COURSES

Webinars:

-TECHNICAL WEBINARS (NAUTICAL)

- **ENVIROMENTAL**

- **CYBER SECURITY**

- **GREEN CRUISING**

- ARROW SOFTWARE

- RAAS MARITIME

- NAPA

- **SUSTAINABILITY**



STCW and NON STCW COURSES INDUSTRY 4.0 and 5.0 – BULK SECTOR



- **TECHNICAL COURSES** (STS operation, Near Miss, Lock out, Working at height, IMSBC code, hatch cover, oil record book, commob bulk cargoes, use of PPE, hot work, fuel oil bunkering, garbage and waste management, pilot ladders, engine room emergencies, mooring and safe practice)
 - CYBER SECURITY
 - ENVIROMENTAL AND SAFETY
- RISK ASSESSMENT AND MANAGEMENT
 - LOW SULPHUR FUEL
 - MARITIME ENGLISH
- RESILIENCE, POSITIVITY PERSPECTIVE AND CONFIDENCE
 - MENTAL HEALTH AND WELLBEING

ALTERNATIVE MARINE FUELS IN SHIPPING

According to Shipbuilding News from Feb 28, 2025:

- In Shanghai the most powerful methanol dual-fuel marine engine launched
- First Methanol – Diesel Hybrid Vessel
- First container ship with SAVER Wind technology
- LNG dual fuel Container ship
- Carbon – free Ship propulsion system
- AI Based Route Optimization Solution on shipping vessel (**OceanWise**)
- First dual fuel ammonia powered vessel (MAN started to test)

According to DNV Alternative Fuels Insight (AFI platform)

the number of :

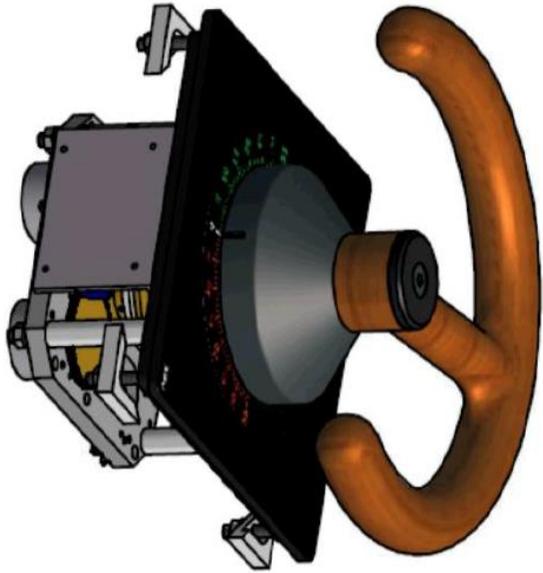
LNG vessels 1200 ships. This fleet includes about 452 - container, 242 – tanker, 208 – car carrier, 73 bulk carrier, 49 cruise ships. All those in addition to 751 LNG carriers.

On Ammonia only 3 vessels (offshore supply, tugboats)



BNWAS – Bridge Navigational Watch Alarm System –

The bridge navigational watch alarm system (BNWAS) monitors bridge activity and detects operator disability.

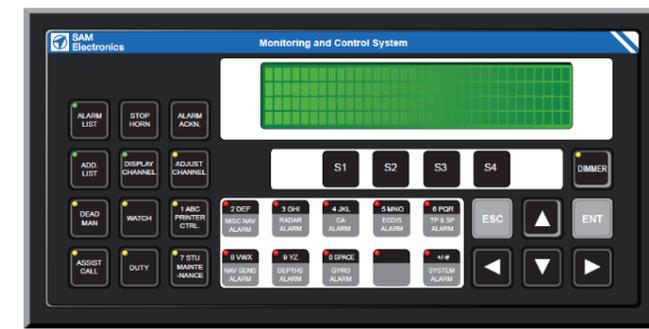


TRACK PILOT and TRACK PILOT SETTINGS

HEADING Mode switches the track pilot to the Heading Mode. The track pilot is keeping the ship on selected set heading and does not take into account the drift.

COURSE Mode: switches the track pilot to the Course Mode. The track pilot is keeping the ship on selected set course over ground (taking into consideration the drift).

TRACK Mode: switches the Track Pilot to Track Mode. The track pilot is keeping the ship on the system track. When approaching a waypoint, the TP WPT APPROCHING alarm will appear. 30 seconds before wheel over point is reached the TP WOP EXECUTION alarm will appear. Press "Execute" to acknowledge the alarm..



AIO – Admiralty Information Overlay–

AIO is a service from the United Kingdom Hydrographic Office (UKHO) and provides temporarily and Preliminary Notices to Mariners, and additional reported navigational hazards, as a separate overlay on top of the Admiralty Vector Charts.

AIS – Automatic Identification System –



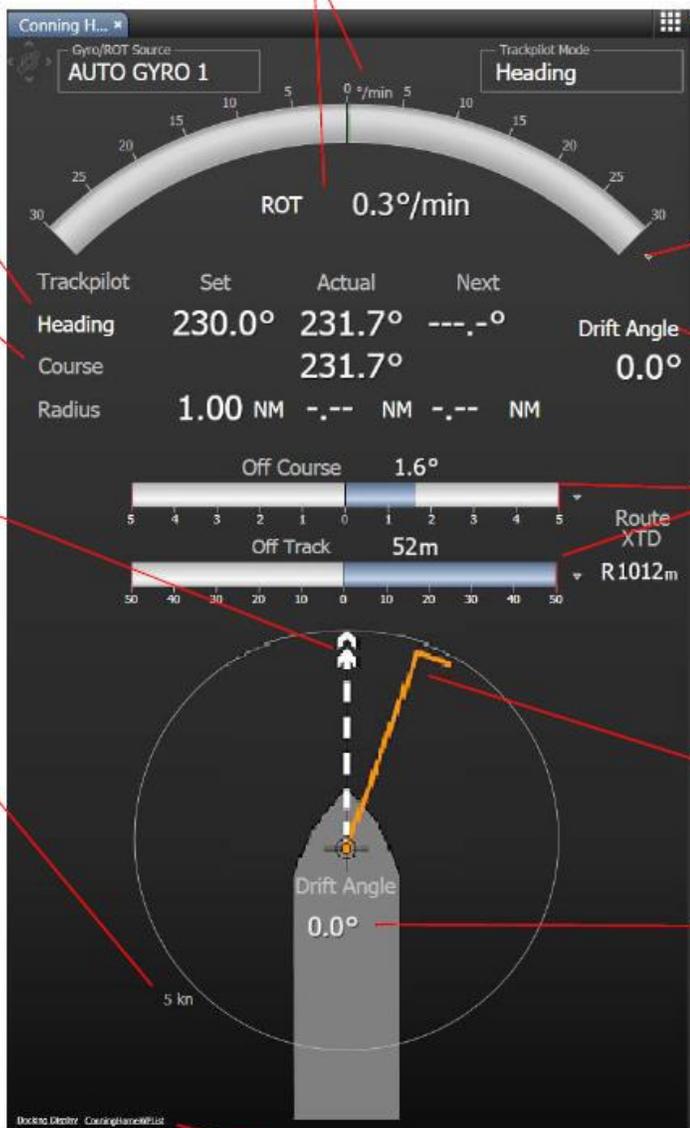
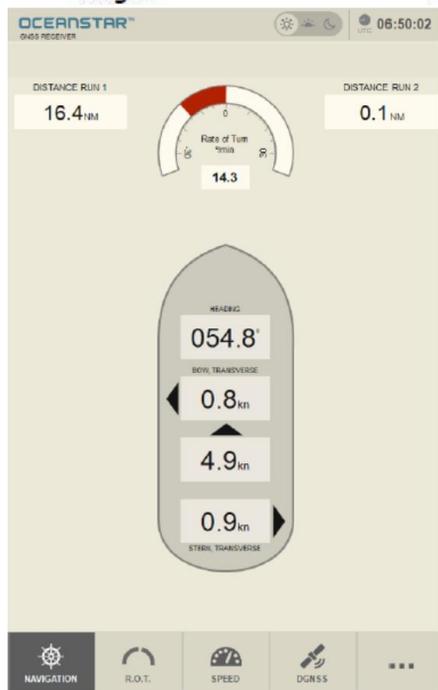
Look–Ahead Sector

Red bar to the left: Ship is turning to port.
Green bar to the right: Ship is turning to starboard.

TRACKPILOT operating mode

Heading indication with the Set, Actual and Next values used by the TRACKPILOT in Heading mode.

Speed vector with drift angle



Click to open another Conning page, i.e. with waypoint or docking

Click to the small triangle to change the scaling

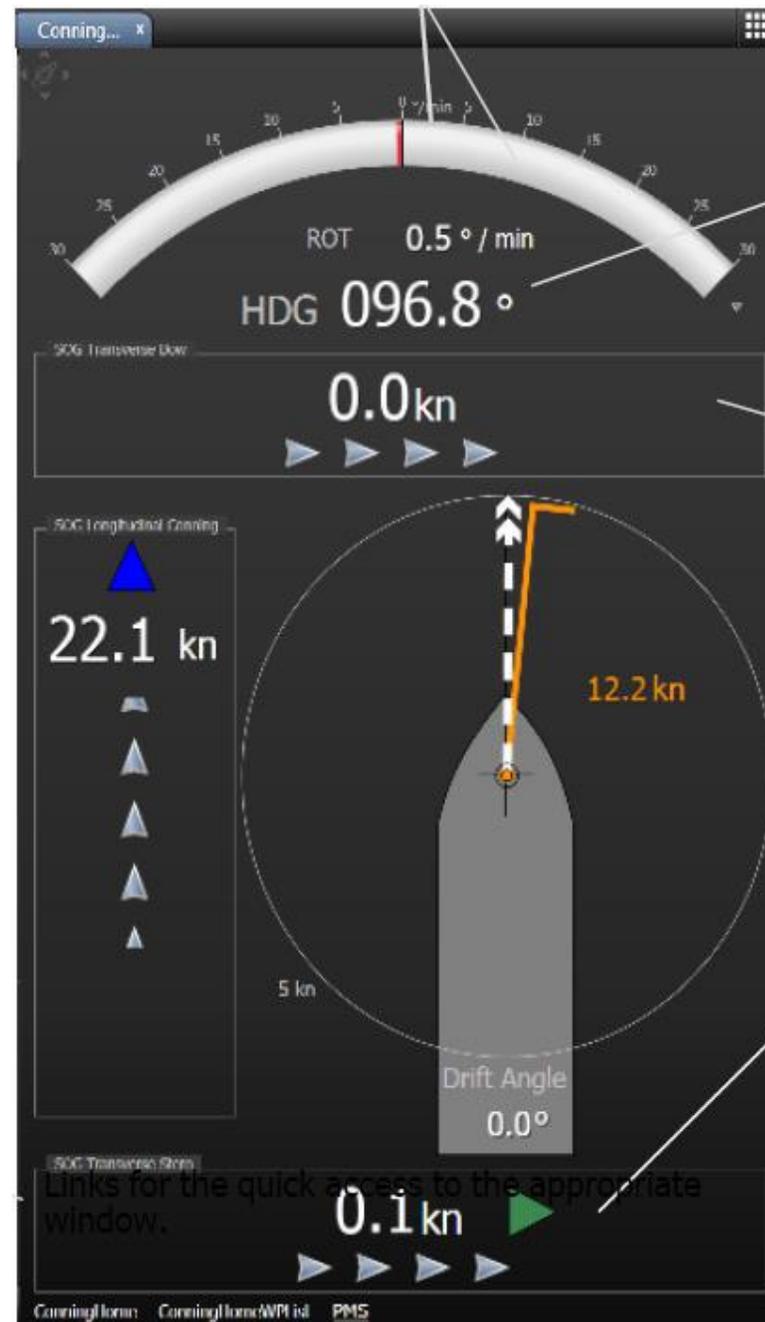
Drift angle value calculated by TRACKPILOT

Off Course/ Off Track numerical value and trend indicator, click to the small triangles to change the scaling

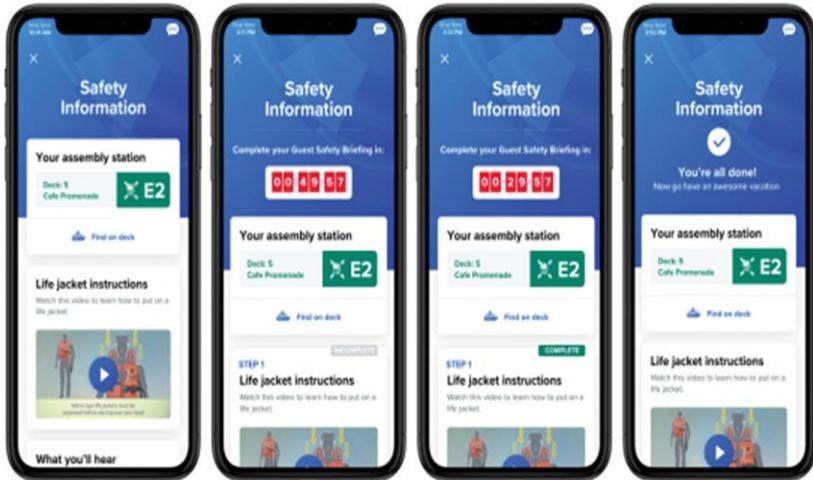
Wind direction and speed indication

Drift angle value calculated by MFD (later SW version) or TRACKPILOT (earlier SW version)

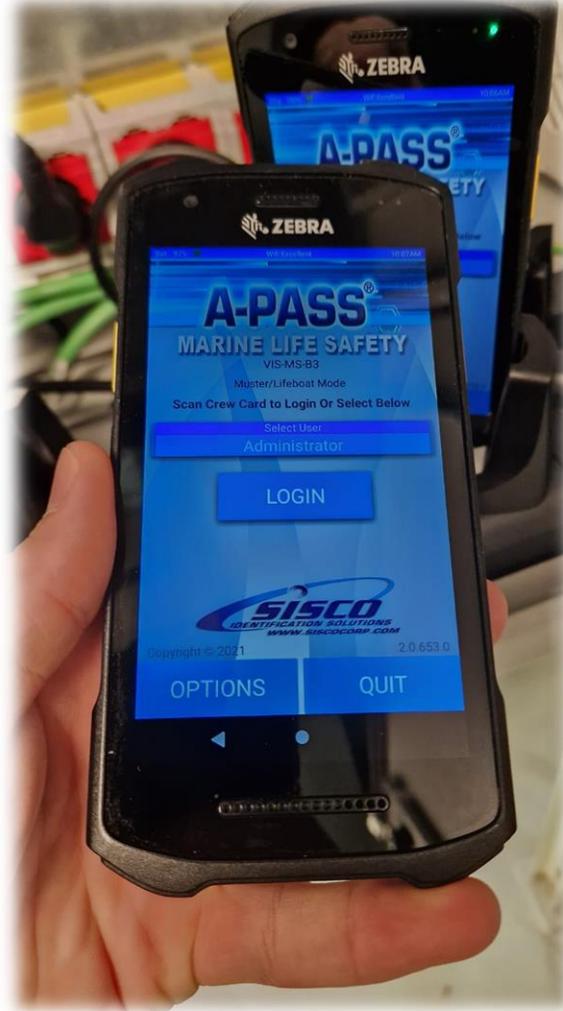
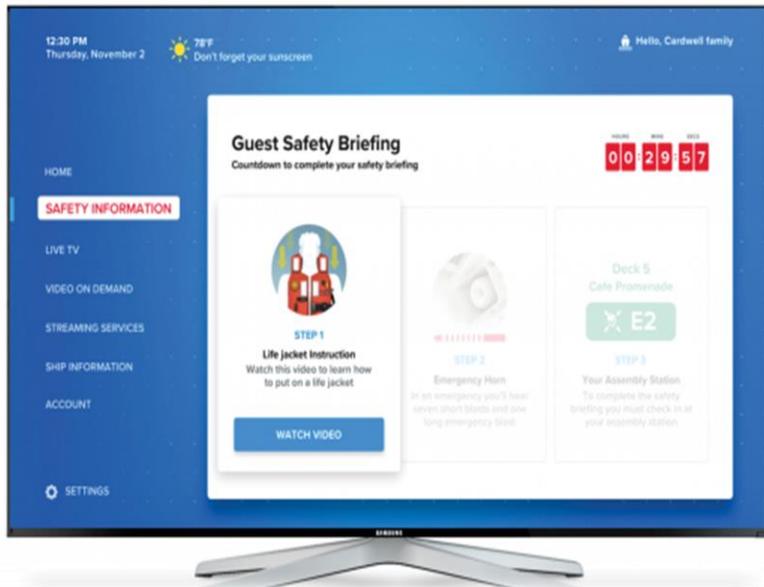
Links for the quick access to the other windows



MOBILE APP



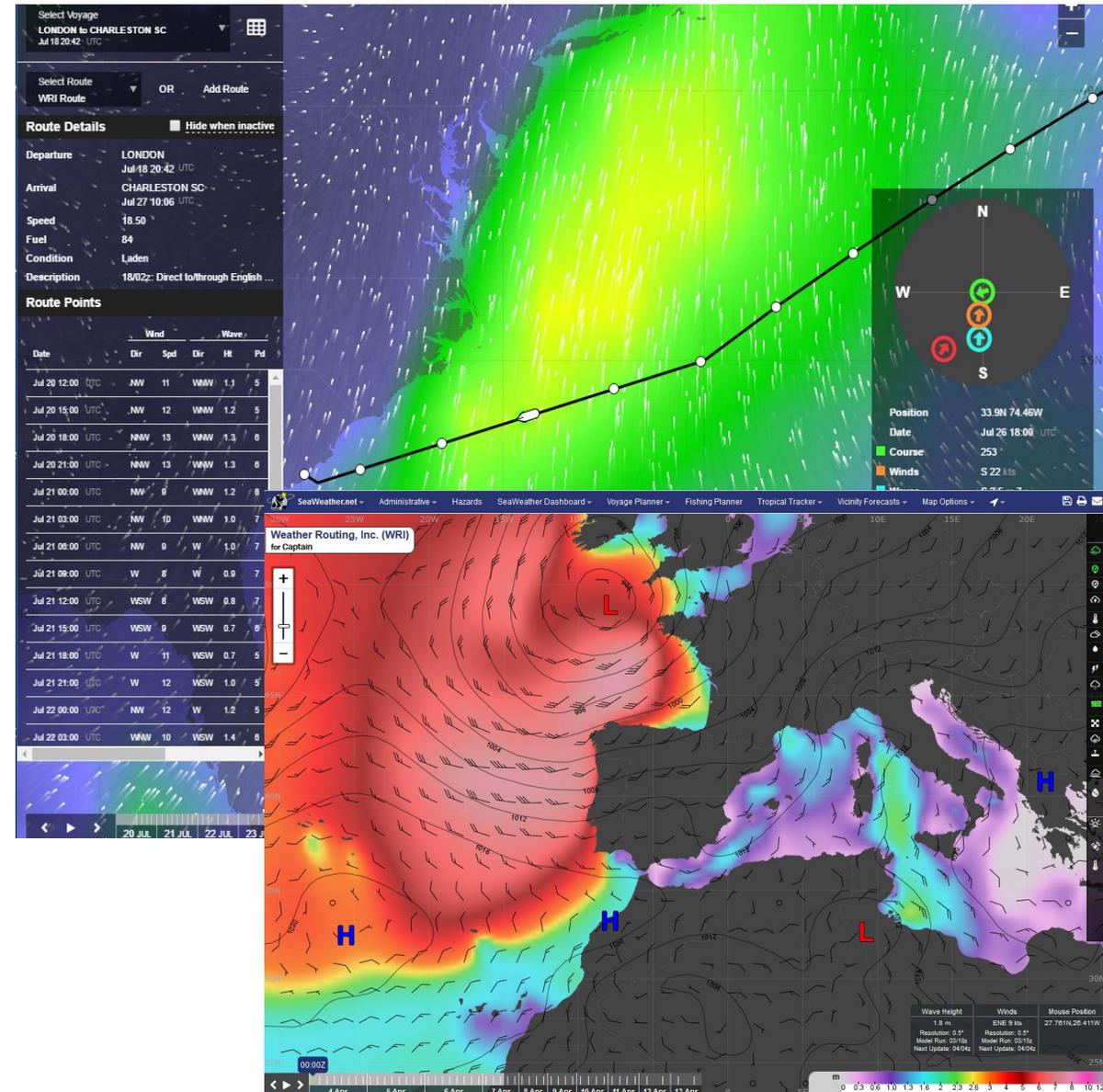
INTERACTIVE STATEROOM TV

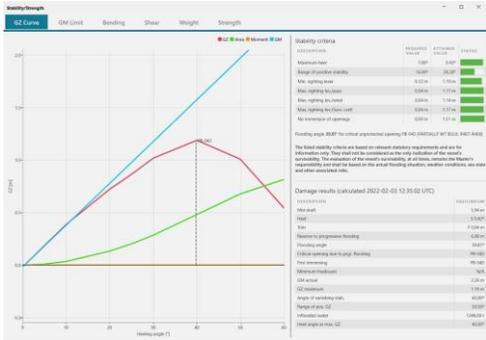


Weather Routing Inc. (WRI) - since 1961

24/7

- Weather monitoring for the vessels in next seven days
- Wind gust (underway 60m and port 10m)
- Significant wave height
- Visibility
- Squall Threat Index
- Daily port Forecast (daily to all vessels – next port of call)
- Weight height at sea buoys
- Tender and visibility reports
- Full routing on request or vessel or land based staff
- Tropical surveillance (prediction for tropical development)
- T-Storm tracking and lighting alerts
- Weather reporting
- Direct Consultation 24/7





NAPA Fleet Intelligence Voyage optimization

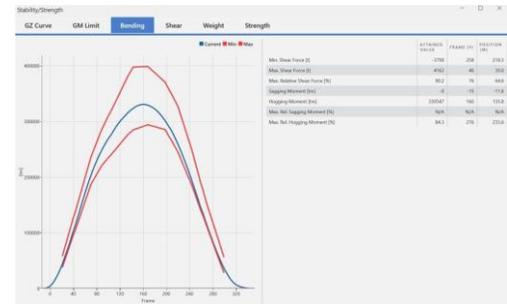
NAPA TANKER

VOYAGE OPTION Draft: 9.5m

PLANNING

ALTERNATIVES

HEEL GM LIMIT CURVE CHECK NOT VALID DUE TO HEELING ANGLE DISMISS



Departure Time
2019-01-29 00:00+00:00

Rpm
90

Houston

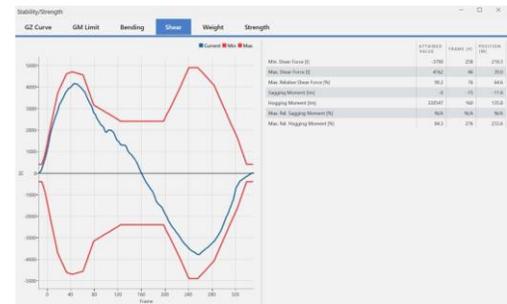
Estimated Arrival Time
2019-02-12 02:10+00:00

Avg. speed	Duration
15.1kn	14d 2h
Distance	Consumption
5263nm	617mt

NAPA Stability Loading summary Page 1 of 4

LOADING CONDITION: LIVE CONDITIONS
Loading condition calculated: 2021-03-20 09:22:31

CRITERIA STABILITY CRITERIA NOT MET DISMISS



B SHORTEST

ETA: 2019-02-12 21:38 +00:00

693mt **5052nm**

C TYPICAL

ETA: 2019-02-13 02:05 +00:00

690mt **5351nm**

Thu 31.01.2019 **13:28:00** +00:00

Heading **240 deg** Wind **8.0 m/s** Waves **3.1 m** Swell **1.0 m** Cur **0.0**

Fleet operation center (FOC) use a tracking and data analysis platform built on Microsoft's cloud technologies enables real-time information sharing between ships and onshore teams.

The system helps Shipping Company to optimize ship safety, efficiency, environmental sustainability and overall fleet performance.

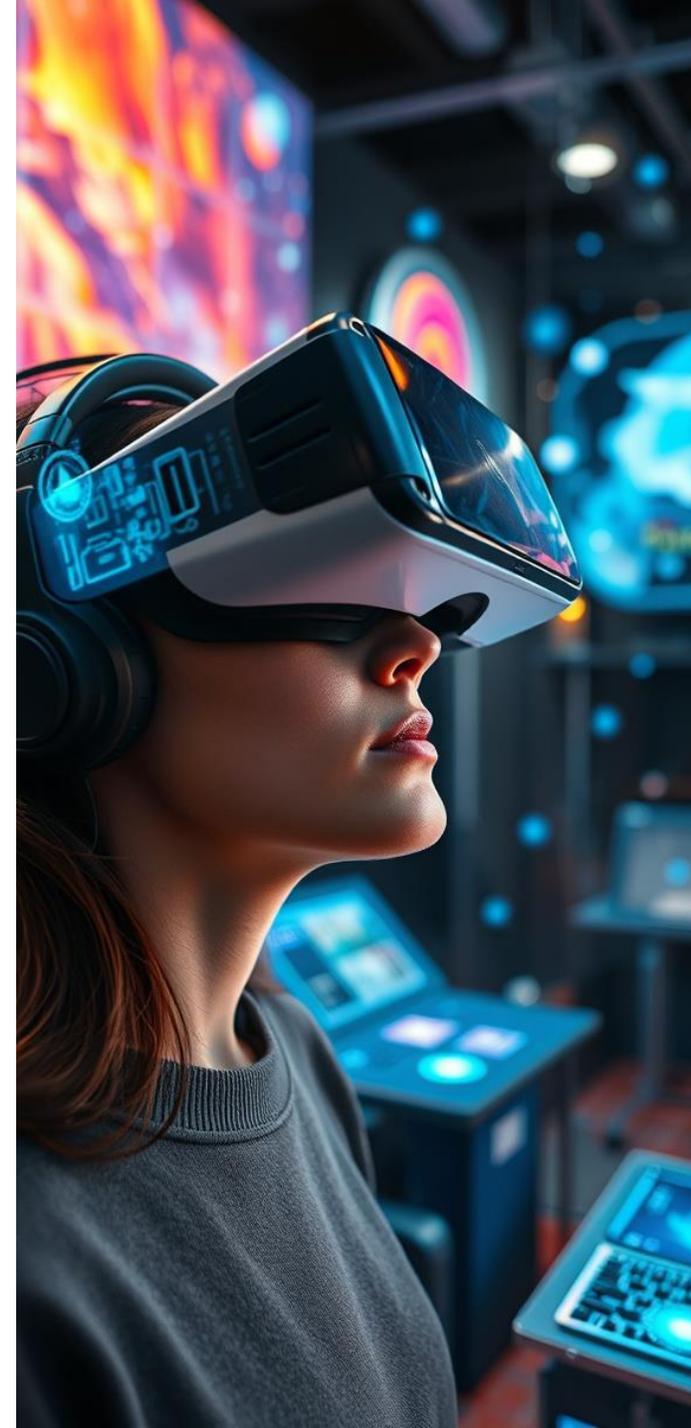
- Nautical Operations & Safety – including the capability to see real-time radar visuals, stability conditions, automation, the Safety Management and Command System, and webcams from each ship, along with GPS location, routing, ship conditions and weather data.
- Procedural Optimization & Efficiency – including speeds, navigational data and engine conditions.
- Sustainability – including fuel and energy usage, emissions levels, water and waste management



Digital, technical, sustainability and green skills, decarbonisation, human centric automation, circular economy, carbon neutral, AI optimization, cloud based system, ...

- Virtual Reality (VR) and Augmented Reality (AR) – ship navigation and familiarisation
- AI powered learning platforms (customizes courses based on individuals)
- Microlearning training (Short lessons for quick skills – life long learning)
- Collaborative learning (E-learning platforms, discussion, virtual classrooms)
- Green maritime education (Scenario based training – ECO Simulator)
- Data analytics
- Blended learning (traditional and face to face training)
- CBT training
- Simulators

**CHALLENGES
for
MET**



Thank you for your attention
„Hvala”



Today's presenters



Dr. Cassia Bommer-Galvao
galvaoc@tamug.edu



Paul Szwed
pszwed@maritime.edu



Tracey Mayhew
tmayhew@seafarers.org



Dr. Srđan Vujičić
srdjan.vujicic@unidu.hr



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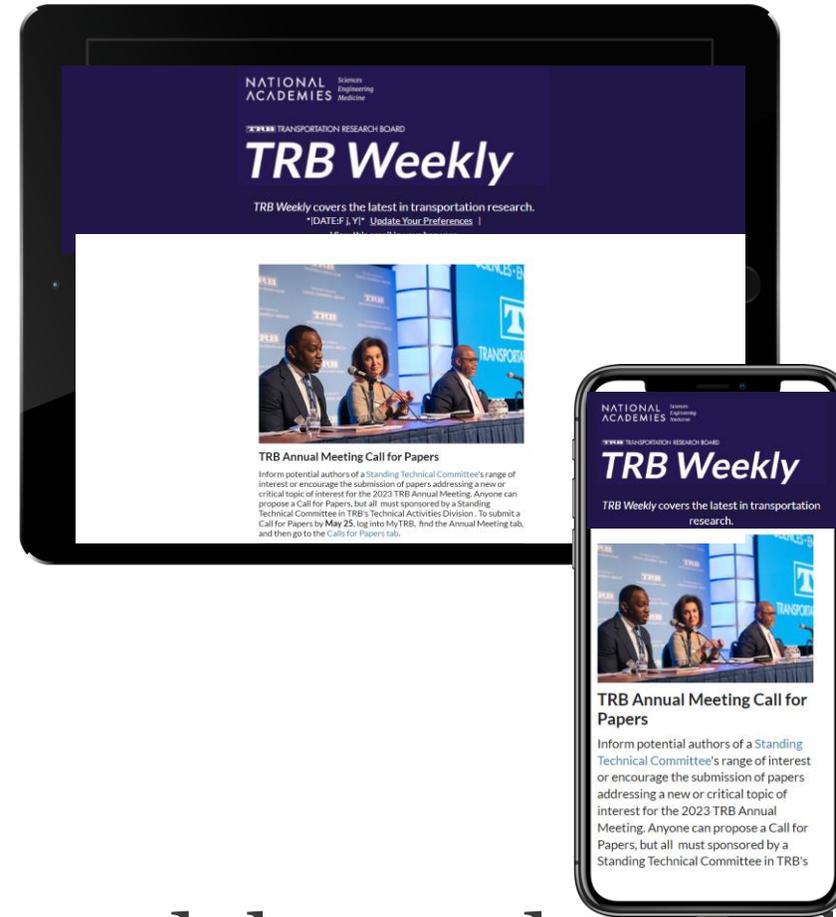


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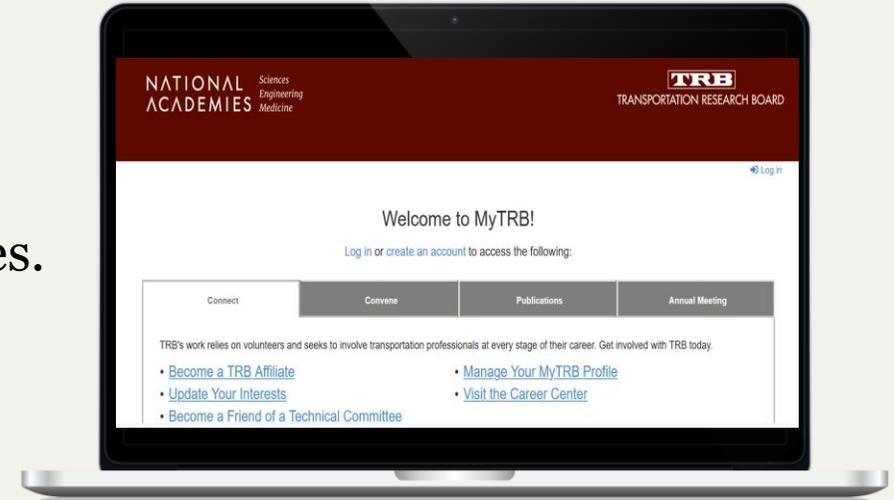


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