European Maritime Safety Agency

# Navigating Hazards: Technology Solutions for Ship Safety

## CESMA 2025

Department 2: Safety, Security & Surveillance /

**Unit 2.1 Safety and Security**

16th May 2025

EMSA

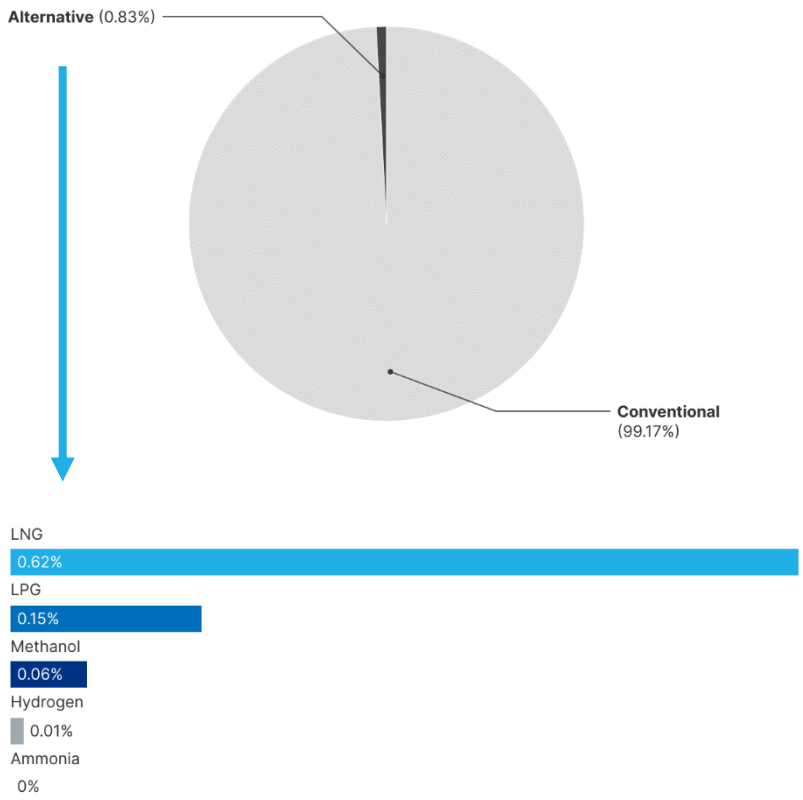
# Summary

- Alternative energy carriers
- Maritime Autonomous Surface Ships (MASS)

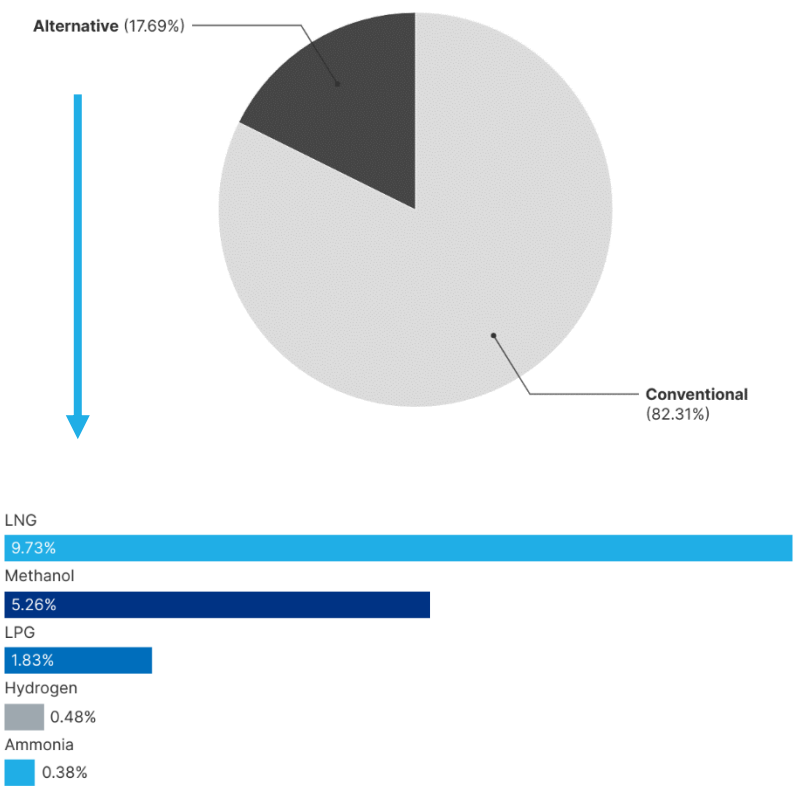
# Alternative fuels uptake – World Fleet

## World fleet – all ship types

In operation




On order for delivery until 2033



# Alternative fuels uptake – World Fleet

## Ammonia

No commercially operating vessel

25 vessels orderbook for delivery until 2027

Fortescue Green **Pioneer**

## Methanol

43 ships in operation

300 additional vessels are expected for delivery until 2028 - ≈ 60% are containerships

From 2019 to 2023 – double the no. of ships methanol-ready

## Hydrogen

3 ships in operation using hydrogen in the mix

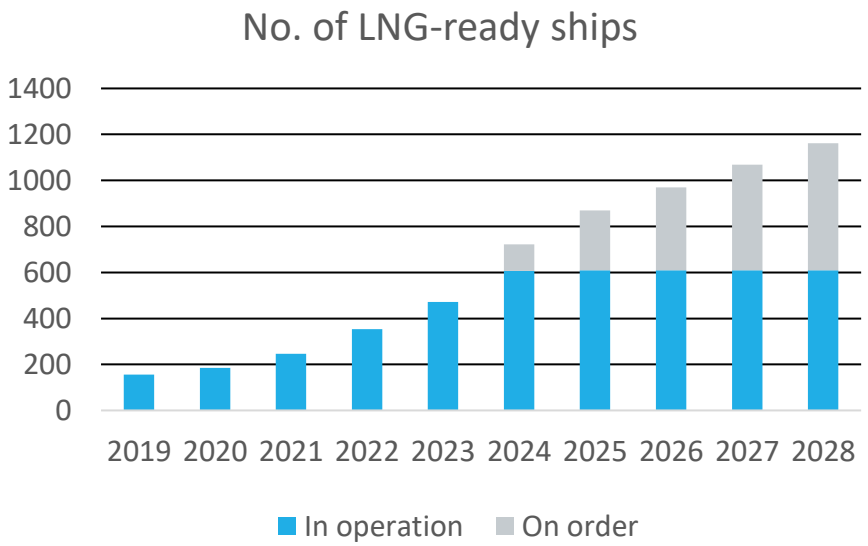
9 ships in orderbooks for delivery until 2026

## LNG-ready vessels

3x more ships operating in 2023 compared with 2019

Containerships: 20%

Crude oil tankers: 13%




**Source:** Alternative Fuels Insight. Extracted on 01-10-2024.

# Alternative fuels uptake – World Fleet

## LPG

Used in gas tankers – LPG cargo as fuel

No evidence of other ship types, operating or on order

## Fuel cells

5 ships in operation

1 under testing

20 on order for delivery until 2029

## Batteries

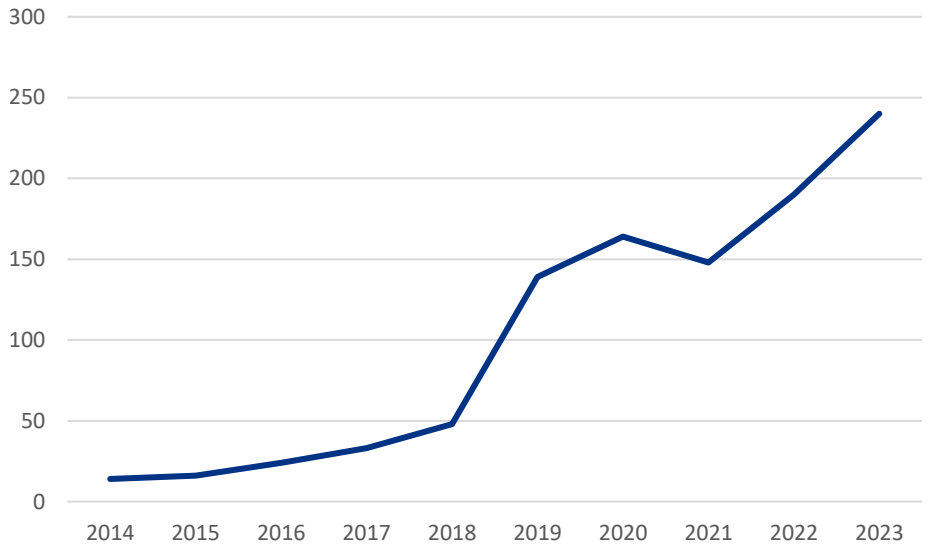
+900 battery ships in operation

3x more than five years ago

Additional 451 on order for delivery until 2027

Lithium-ion cell technology is the most common

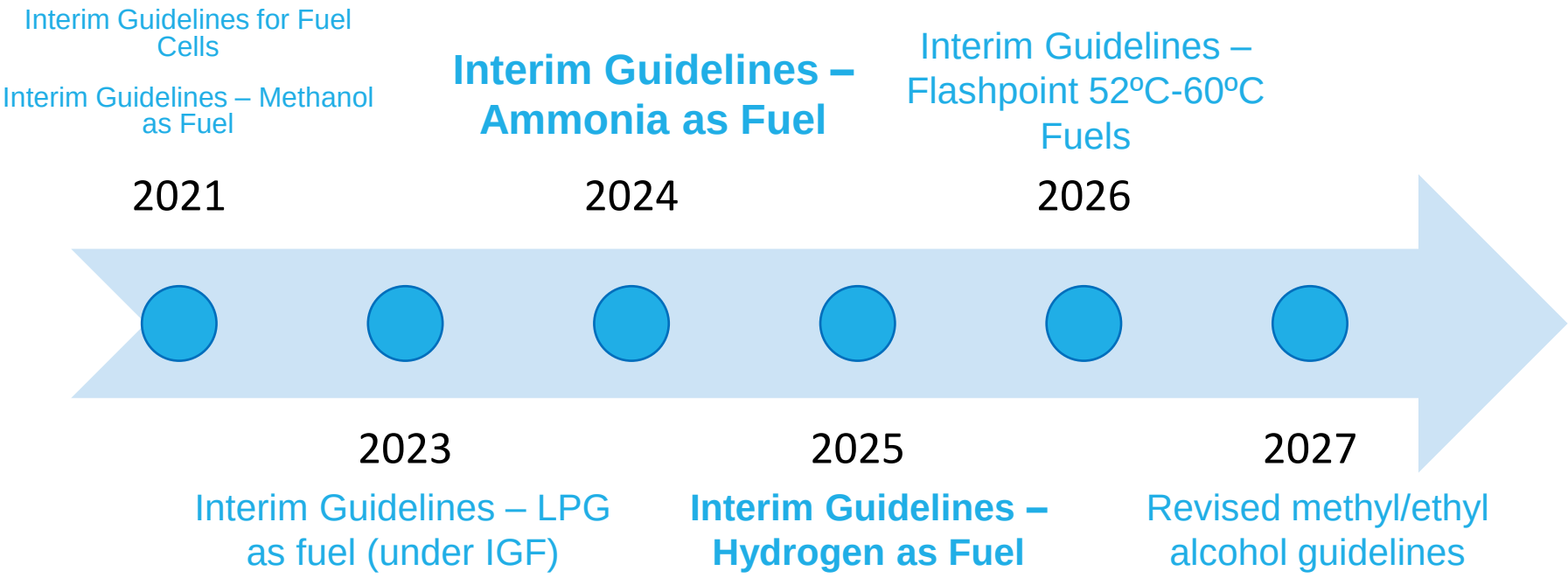
### No. of batteries installed onboard each year




**Source:** Alternative Fuels Insight. Extracted on 21-03-2025.

# International context

## IMO – Work on Safety of Alternative Sources of Power



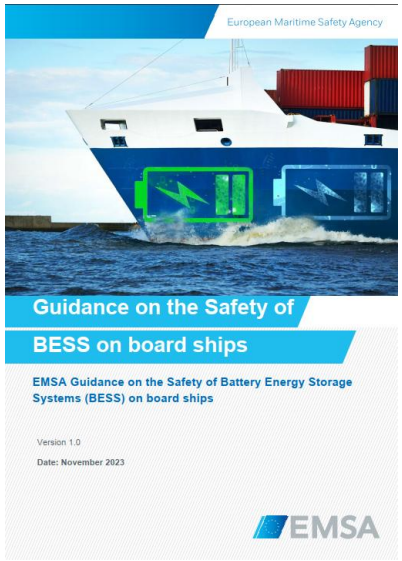
# EMSA Guidance - Electrification

Carriage of vehicles using Alternative Fuels/Batteries


## AFVs Guidance

May 2022

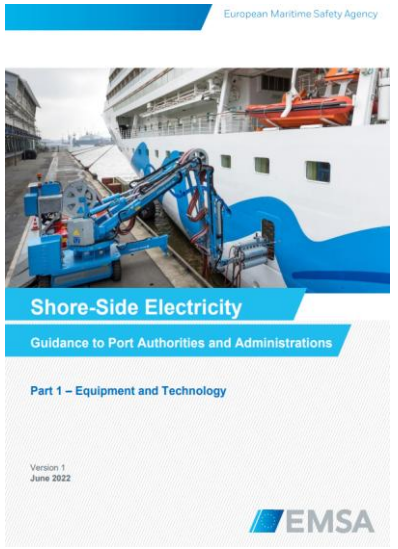
Batteries for ship's services




## BESS Safety Guidance

Nov. 2023

Shore-Side Electricity




## SSE Guidance

for Port Authorities and Administrations

June 2022

# Studies – Alternative fuels

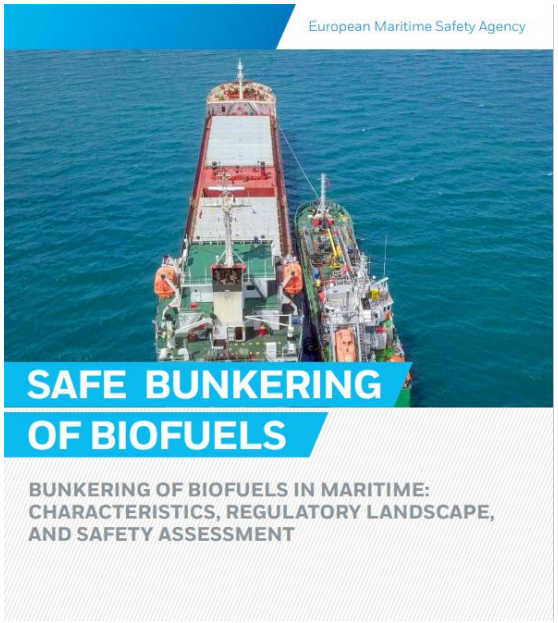

Toxic
20 ppm (8h) EU-EOL
IDLH 300 ppm

Corrosive to metals and skin

Flammability limit
15-28%
**Narrow**
**Medium concentration**

Contracted to **ABS Hellenic SM LLC, Fundacion Valenciaport and NTUA**

Start date: 18/09/2023 -
End date: Q4 2025




Contracted to **DNV AS**

Start date: 19/09/2023 -
End date: Q4 2024


Flammability limit
4-77%
**Extremely wide**
**Low concentration**

Liquefied gas - cryogenic
Compressed at 350-700 bar
Asphyxiant

BLEVE
Rapid phase transition
High flame velocity (>7x more than LNG)

Contracted to **DNV AS**

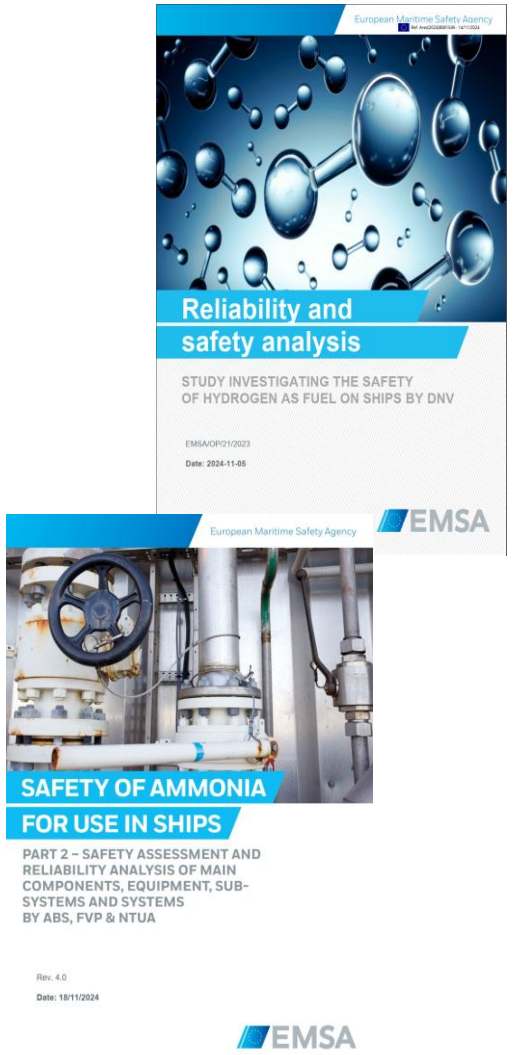
Start date: 6/05/2024 -
End date: Q1 2026

# Studies – Alternative fuels – Reliability analysis challenges

Assessment of databases – Identifying failure data that are most applicable and has the highest quality

- Leak frequency data (mechanical and rotating equipment)
- Failure-on-demand data (safety and control equipment)

High degree of uncertainty in leak frequency analysis in QRAs for hydrogen-fuelled ships



# Studies – Alternative fuels - Ammonia

Link to Biofuels Study / Guidance:

Publications - Study on Safe Bunkering of Biofuels - EMSA - European Maritime Safety Agency

Link to Hydrogen Safety Study:

Publications - Study investigating the safety of hydrogen as fuel on ships - EMSA - European Maritime Safety Agency

Link to Ammonia Safety Study:

Publications - Study investigating the safety of ammonia as fuel on ships - EMSA - European Maritime Safety Agency

# Risk Based Assessment Tool for MASS


## RISK METHODOLOGIES

Failure Mode Effects Analysis (FMEA)

HAZOP

Bow Tie

1940 1950 1960 1970 1980 1990 2000

Fault Tree Analysis (FTA)

Software

- New automation systems
- Increased interdependency between systems.
- Changes in the Human Machine Interface and the Role of the user.

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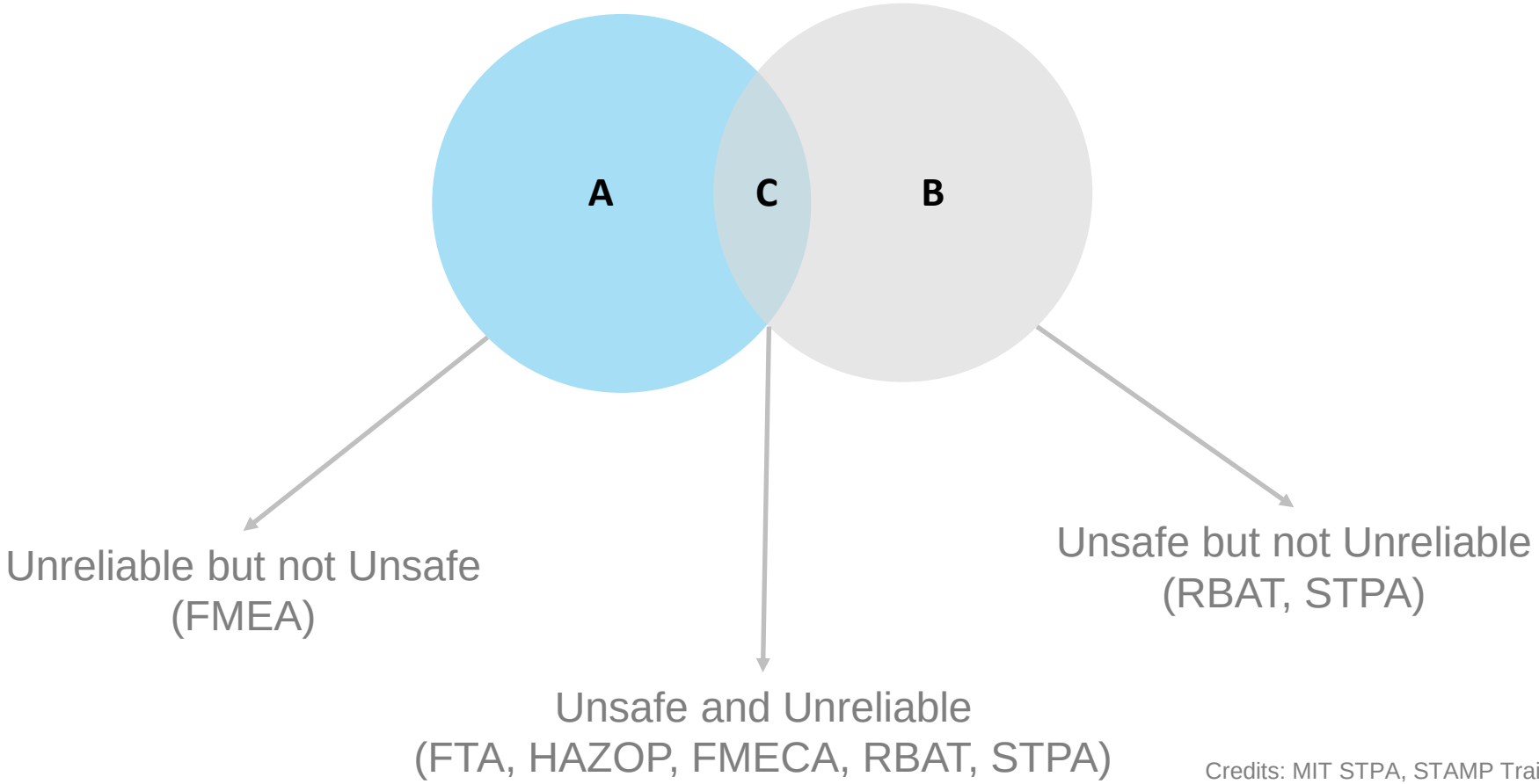
# Risk Based Assessment Tool for MASS

Going beyond component and functional failures




Credits: MIT STPA, STAMP Trainings

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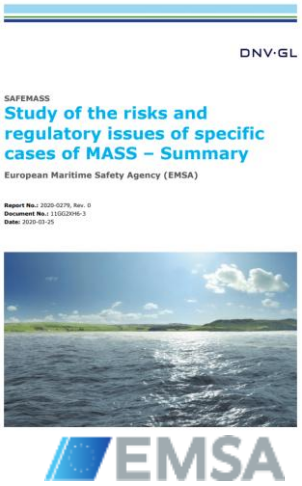
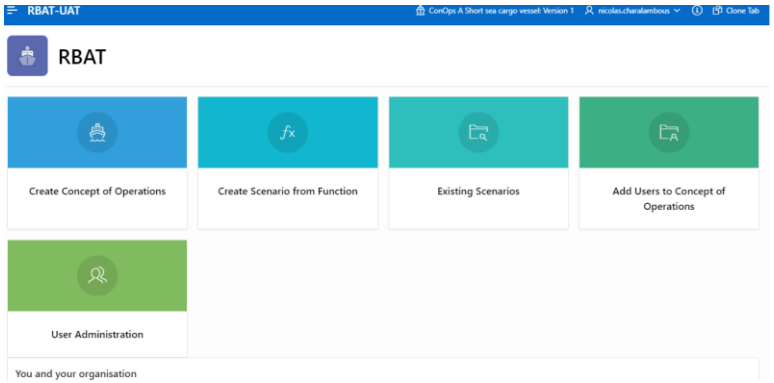
# Risk Based Assessment Tool for MASS

- Developed for autonomous and remotely operated vessels.
- Functions being automated or remotely controlled.
- Addresses risks from transferring control.

**What is RBAT?**

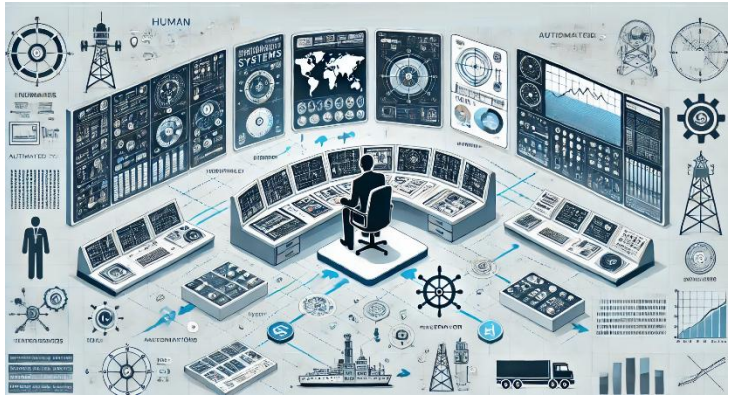
- Function-based and flexible.
- Adaptable to different technology stages.
- Focus on systematic failures and human errors.

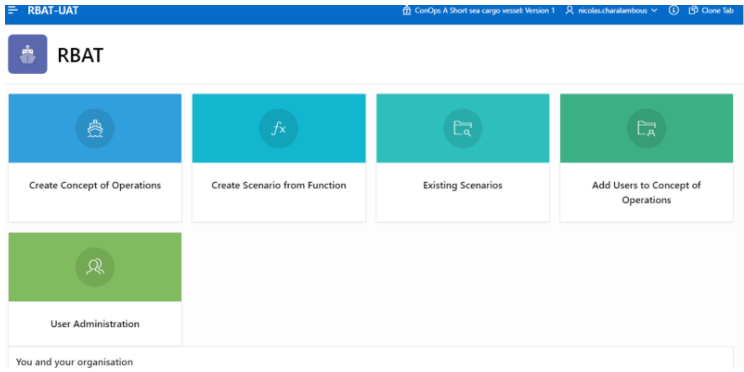



# Risk Based Assessment Tool for MASS

- Function-Based Approach;
- Novelty in Risk Management;
- Hazard Cause Analysis;
- Human Integration;
- Lack of Historical Data;
- Fallback Functions/States Identification;
- Mitigation Evaluation;
- Critical System Identification;
- Project Alignment;
- Transparency and Traceability;
- RBAT awareness sessions (first quarter of 2025)




# Thank you!

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