MARIN

BETTER SHIPS, BLUE OCEANS

SH2IPDRIVE – Crew interaction for an LH2 fueled vessel

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7 April 2026

Wie zijn MARIN?

https://www.marin.nl/nl

Rijksdienst voor Ondernemend
Nederland

2022-2025

24 M€

Projectplan
R&D Mobiliteitssectoren regeling

Projecttitel:

SH2IPDRIVE - Sustainable Hydrogen Integrated Propulsion Drives

Doel SH2IPDRIVE

Onderzoek Toepassingsmogelijkheden Maritiem:

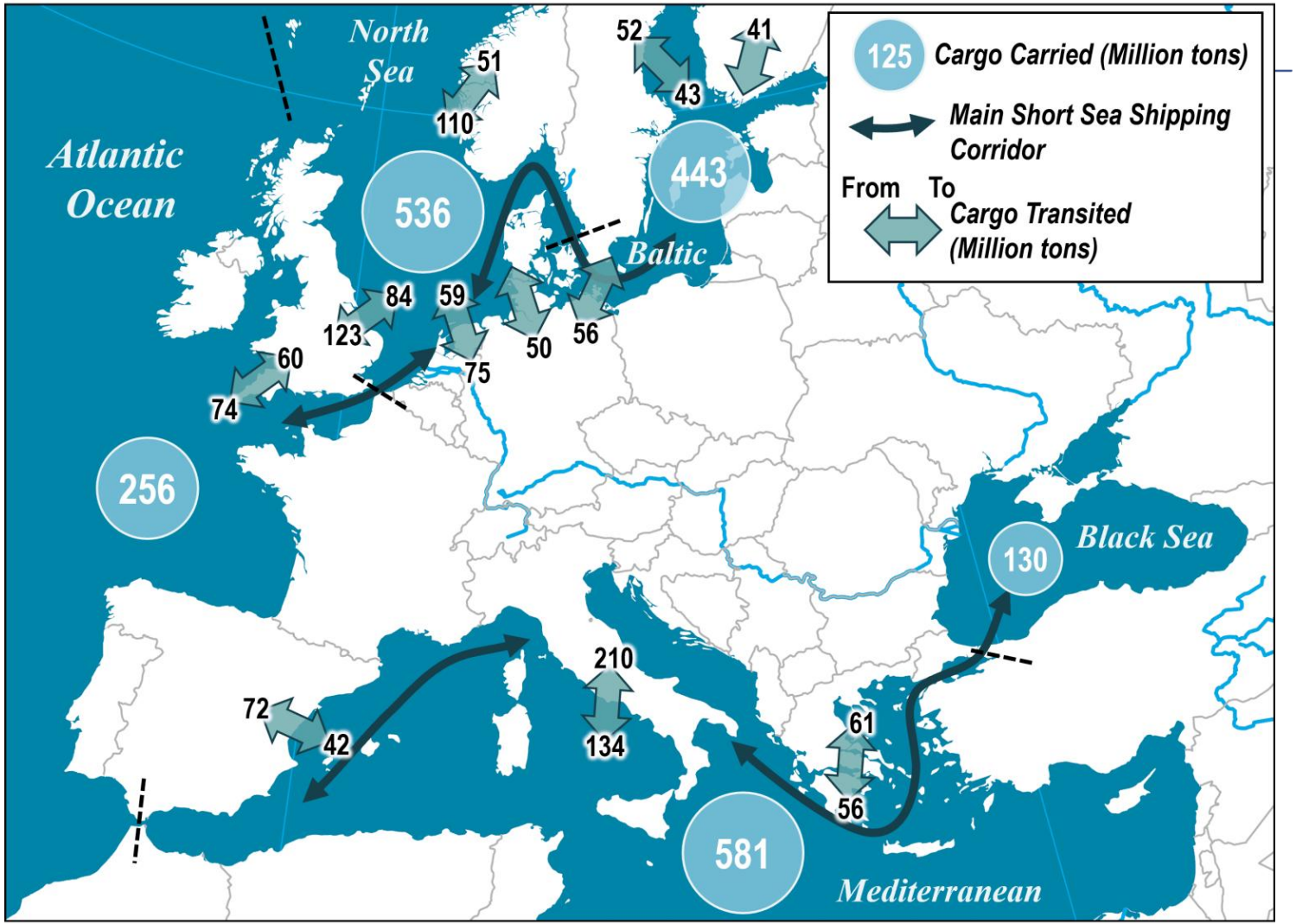
- (1) Gecomprimeerd waterstofgas (CH2)
- (2) Vloeibare waterstof (LH2)
- (3) Waterstof gebonden aan Liquid Organic Hydrogen Carriers (LOHC)
- (4) Waterstof gebonden aan BoorHydrides (BH)

Use Case - Short Sea Transport Vessel

Nett Volume LH2 = 200 m^3

MAIN PARTICULARS

Length over all	abt. 98.00 m
Length between perpendiculars	95.20 m
Breadth moulded	13.40 m
Depth moulded to maindeck	8.40 m
Design draught	6.45 m
Cargo Deadweight	5000 t

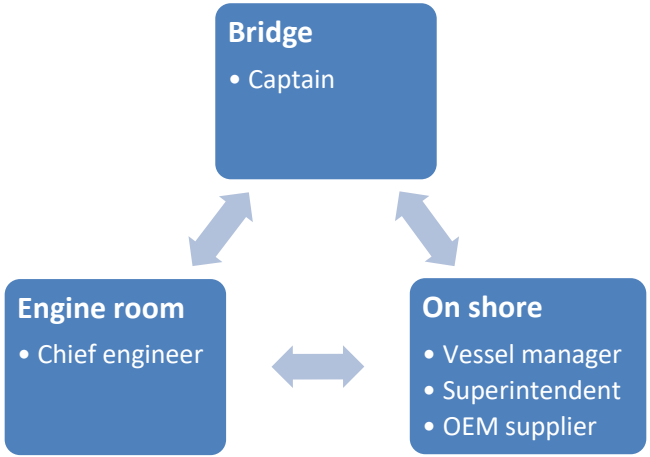

North Sea
Atlantic Ocean
Baltic
Black Sea
Mediterranean
125 Cargo Carried (Million tons)
Main Short Sea Shipping Corridor
From To
Cargo Transited (Million tons)
536
443
256
130
581
52
41
43
51
110
84
59
123
50
56
60
75
74
210
72
42
134
61
56

Research questions

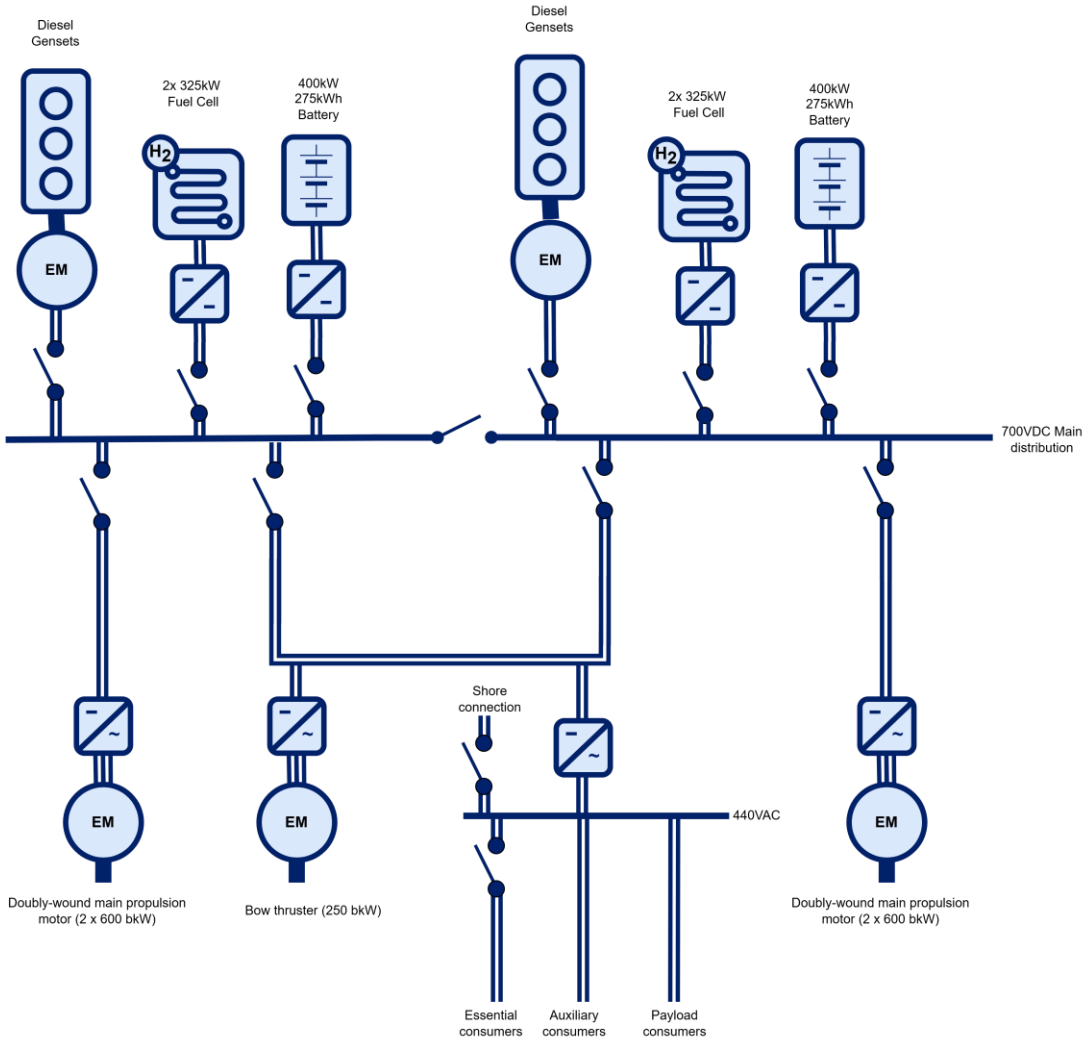
How can the crew be supported in performing their operational tasks on board of a hydrogen fueled ship?

The following research questions were posed in the research proposal:

- Which actions are required to be taken by the crew?
- What level of automation is optimal?
- How does it affect the team task distribution between crew members (bridge and engine room for example)?
- How is the shipping company office part of the operation on board?
- How is this translated into system requirements for the on-board system?

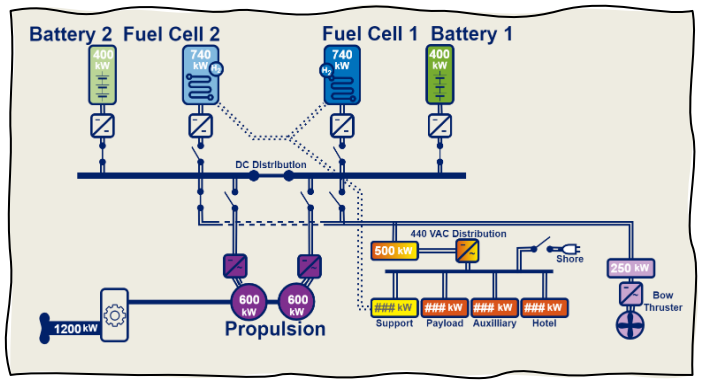


Designed Power and Propulsion System architecture



Use Case description – Full Scale

- Vessel concept design from SH2IPDRIVE – Short Sea Steel carrier
  - Liquid hydrogen
  - Evaporator
  - 2 Fuel cell sets (2x2)
  - 2 Battery strings
  - Electric propulsion motor

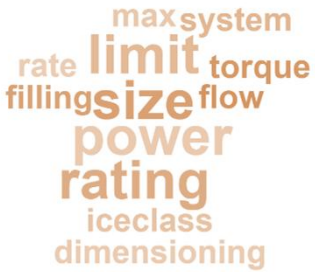


Scaled Test Set up in MARIN Zero Emission Lab

System	Qty	Specification	Use
Hydrogen PEM fuel cell	1x	40 kWe End of Life	Main electric power source
Variable speed diesel genset	1x	50 kWe	Main electric power source
Generic converter	2x	60 kWe	Emulation of (grouped) systems Sources / loads
Super capacitors	2x	500 Wh Max 100 kW	Energy Storage System Peak shaving / Ramp support
Electric shaft machine (ESM)	1x	63 kWe	Propulsion motor Shaft generator
Grid converter	2x	43 kVA	Feed power into secondary AC grid
Main DC distribution grid	2x	100 kW 700 V DC	Including fast bus coupler (SSCB)
Secondary AC distribution grid	2x	43 kVA 400 V AC	Support / auxiliary / payload power supply
24V DC distribution grid	2x	2 kW 24 V DC	Automation and control power supply

Geschaalde systeem testen – Focus Human Centred Design

Key success factors in innovative PPE system implementation



Technical Capability

Usability

Robustness

Acceptance

Operational success

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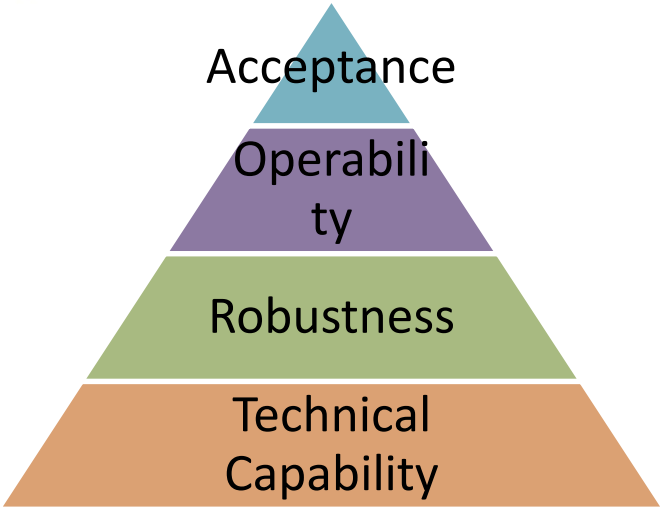
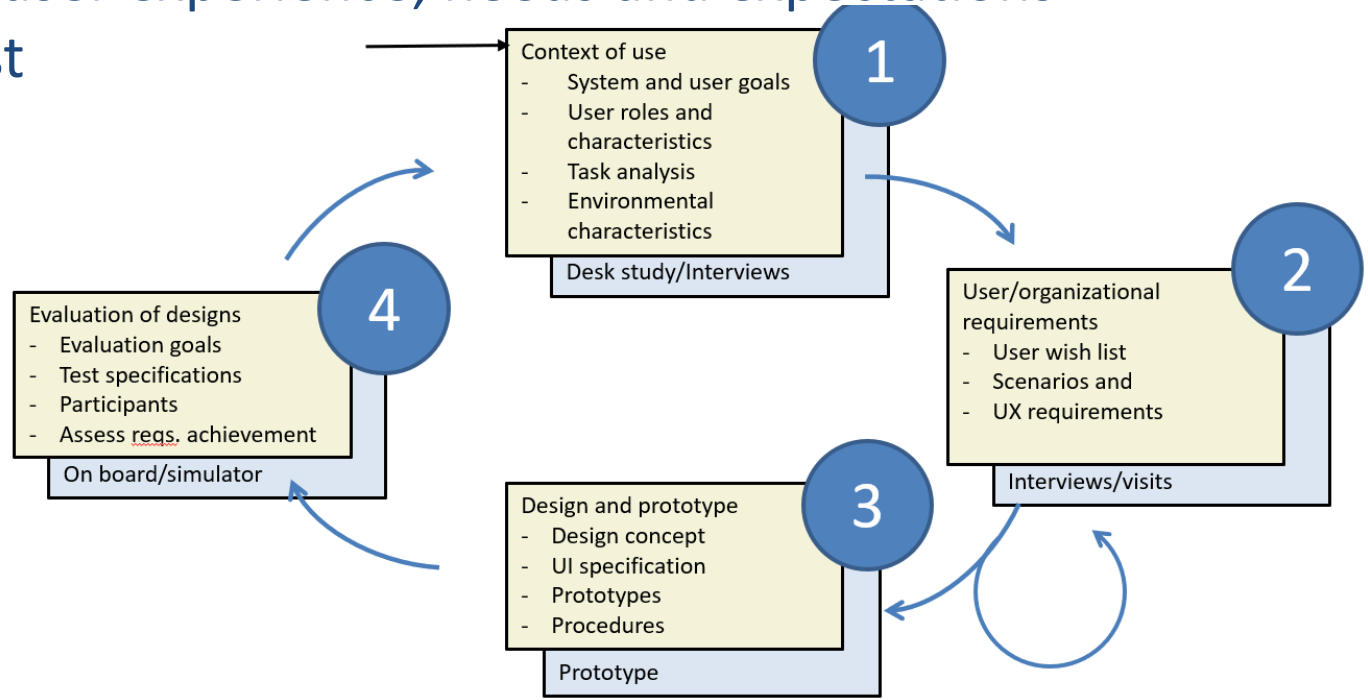
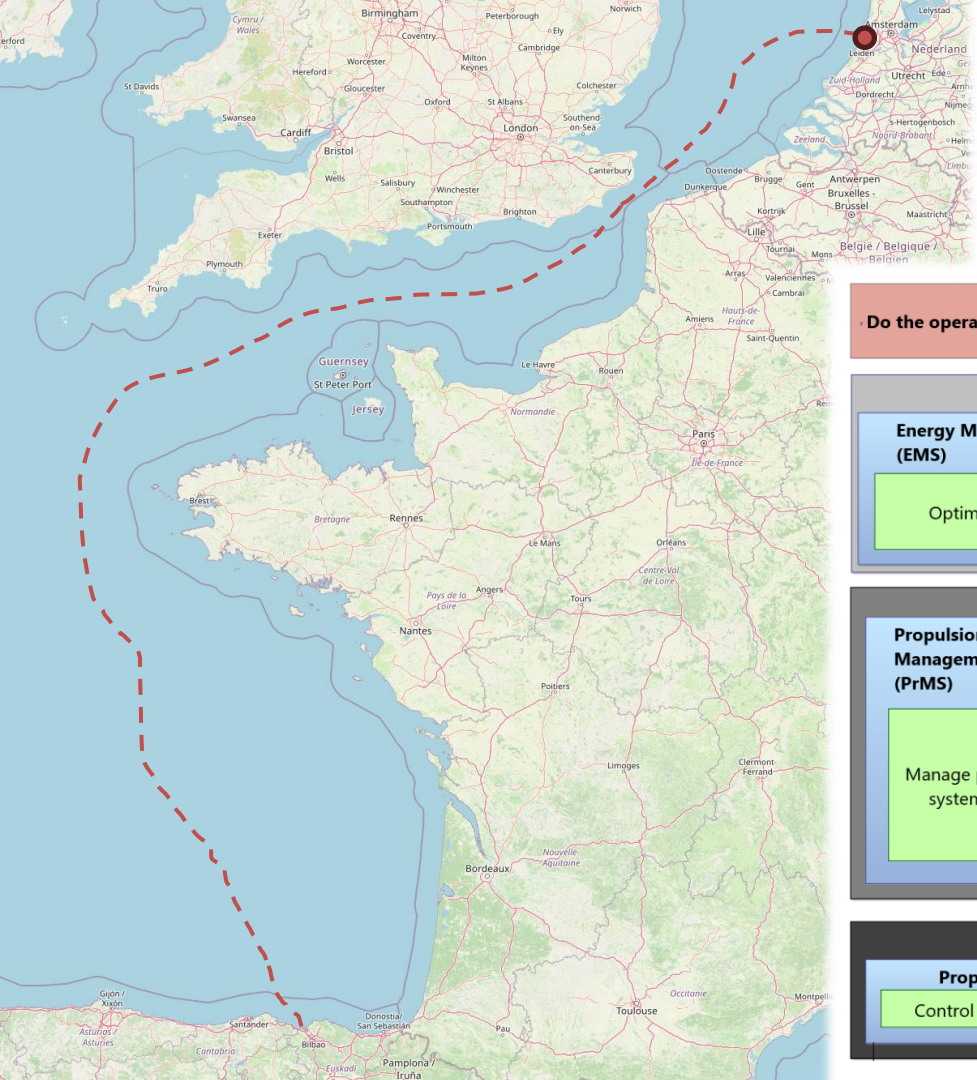
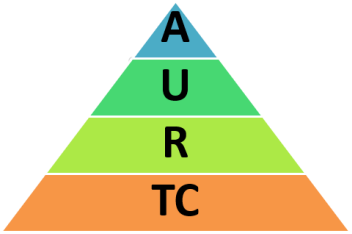


Human Centered Design method

- Goal: Solutions tailored to real operational contexts
- Early and continuous user involvement
- Aligning with user experience, needs and expectations
- Improves trust







Design Question:
Do the operational modes, developed during the design process, ensure that the system behaves in line with operator expectations for ship performance across all operational conditions?

4130 - Tertiary Control

Energy Management System (EMS)	Platform Management	Mission Management
Optimise use of energy	Align Ship systems with operational modes	Prepare the Ship for future operations

Human Interface

- Visualise system operation
- Select operational mode

4120 - Secondary Control

Propulsion Management System (PrMS)	Power Management System (PMS)	
	Operational Power Management	Power Control
Manage propulsion system modes	Ensure operation with sufficient available power	Manage load & supply balance

Design Philosophy: PMS Ensures a reliable power supply

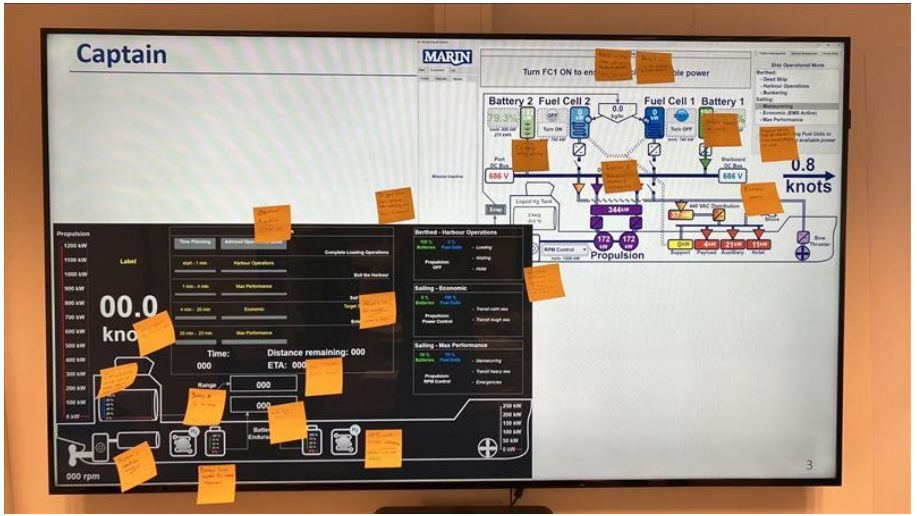
Primary Control

Propulsion Control	Local System Power Control
Control propulsion system	Control sub-second load & Supply balance

Design Philosophy: Voltage Droop to enable dynamic automatic control on individual system power and load sharing.

Research methodology – workshops

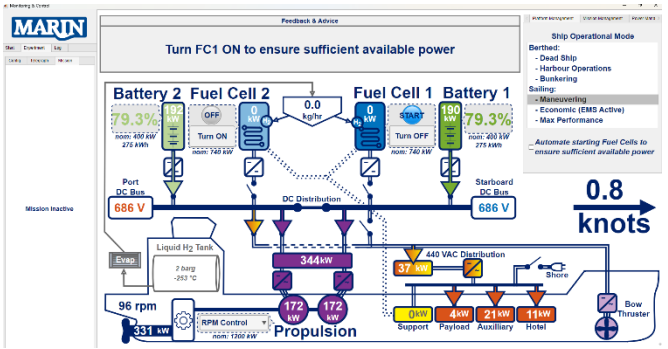
Interactive session on simulator



Gathering feedback

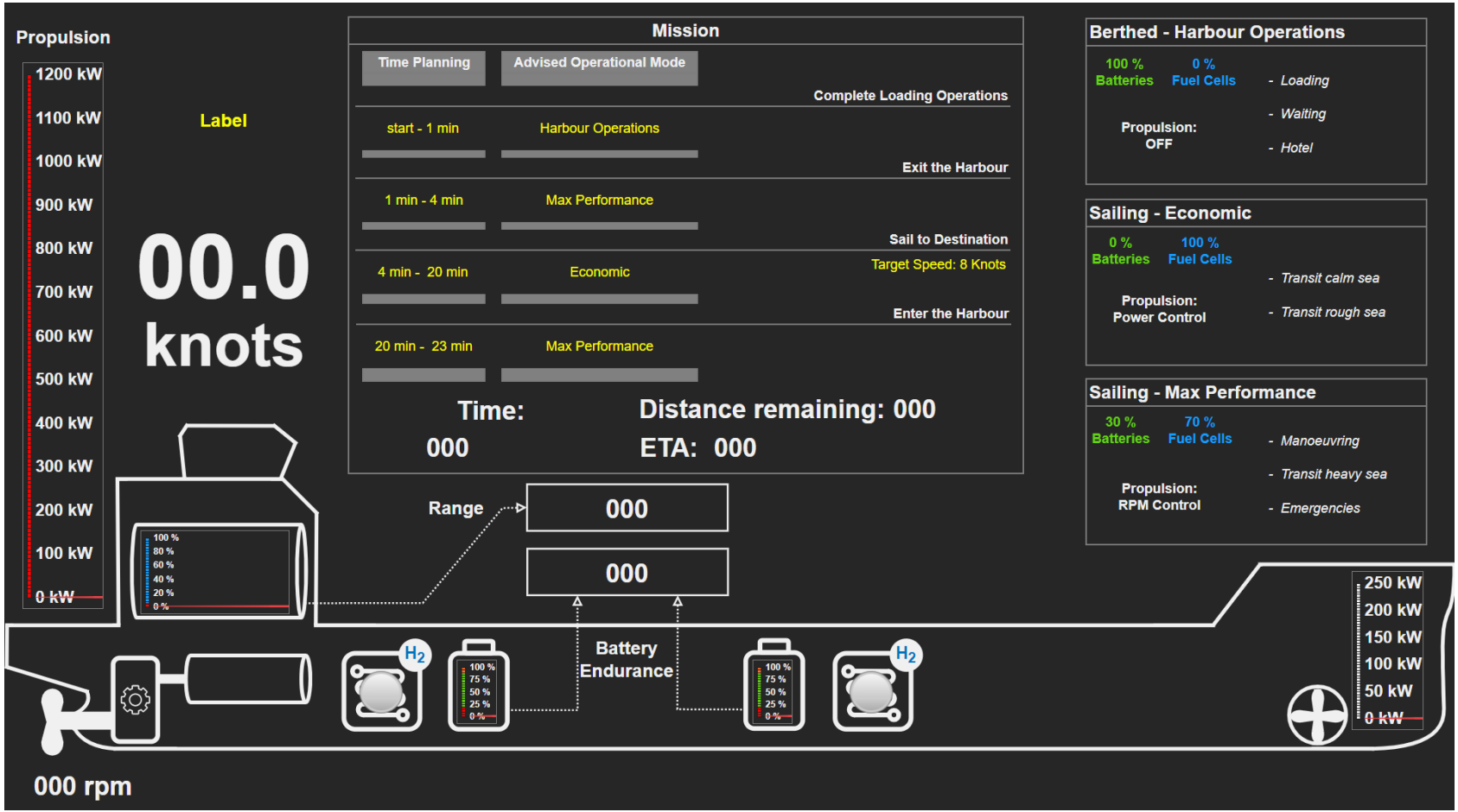
Main results

- 4 internal and 3 external workshops
- 3 design iterations for Captain HMI
- Proof of design concept



- Results vary upon:
  - Operator role
  - Operator experience
  - Owners' preferences
  - Segment standards

Results – Workshop HMI Iterations



Conclusions

- Iterative approach proved a good way to improve design and gather a lot of input
- Virtual prototyping provides a platform for assessing novel system design
- Crew interactions can be effectively studied in an early design phase with the virtual prototype
- Findings from human factor investigations can be effectively captured using a Capella MBSE model.

Nabrander

16th of December 2025, the TU Delft Hydro Motion Team Presented the design of their brand-new foiling liquid hydrogen-powered boat 2026

This year, the team is focusing on two major innovations:

- **integration of a liquid hydrogen storage system**
- change to a so called “pi” foil.

  Connecting the front foils to make one large wing, called a “pi” foil.

Liquid hydrogen as the fuel of choice for Hydro Motion Team