Discussion on MOSES innovations focusing on autonomous and automated systems

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01 The MOSES concept

02 MOSES innovations (autonomous/automated systems)

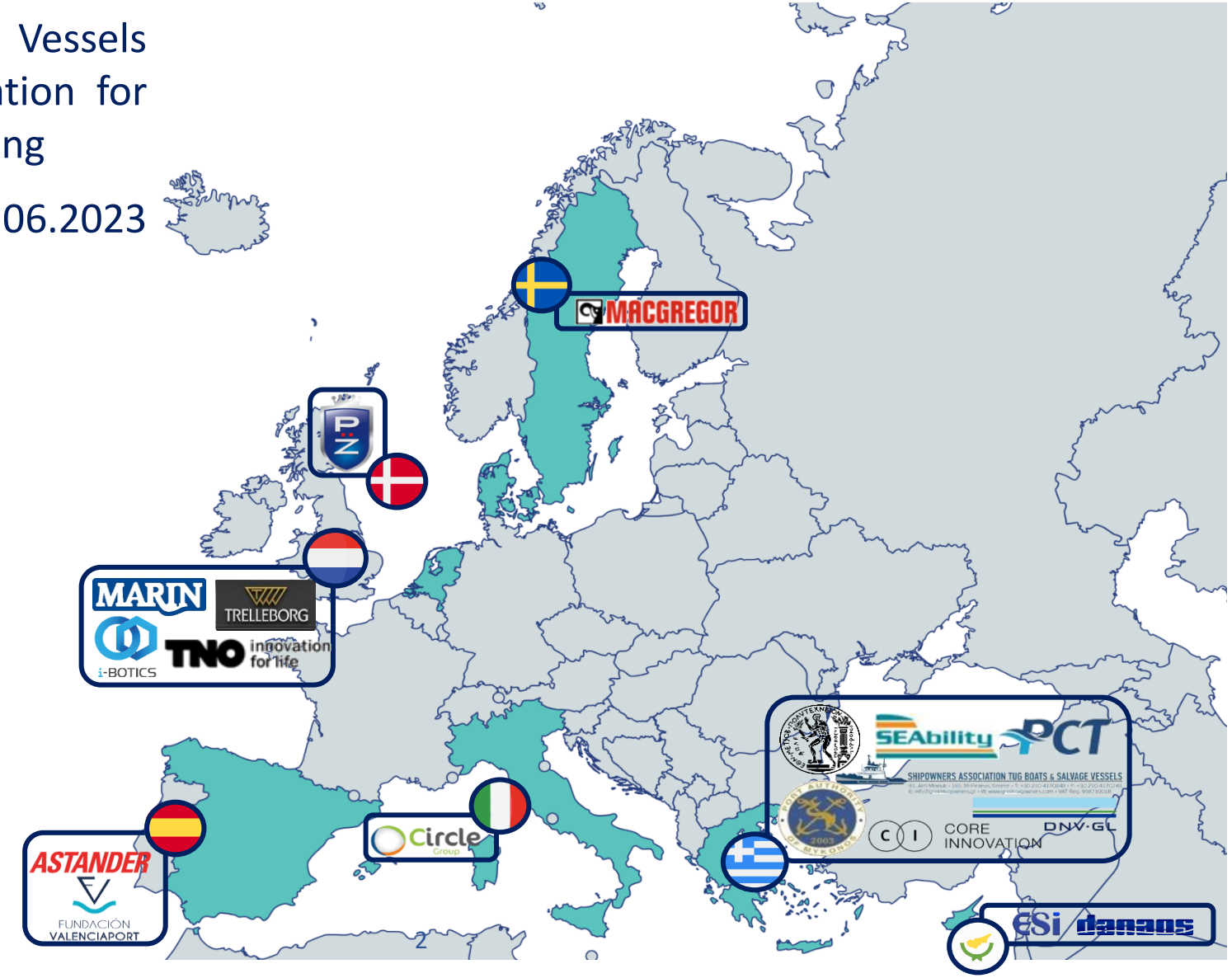
- Autonomous tugboat
- Innovative Feeder Vessel
- Robotic container-handling system

03 Impact and benefits from automation

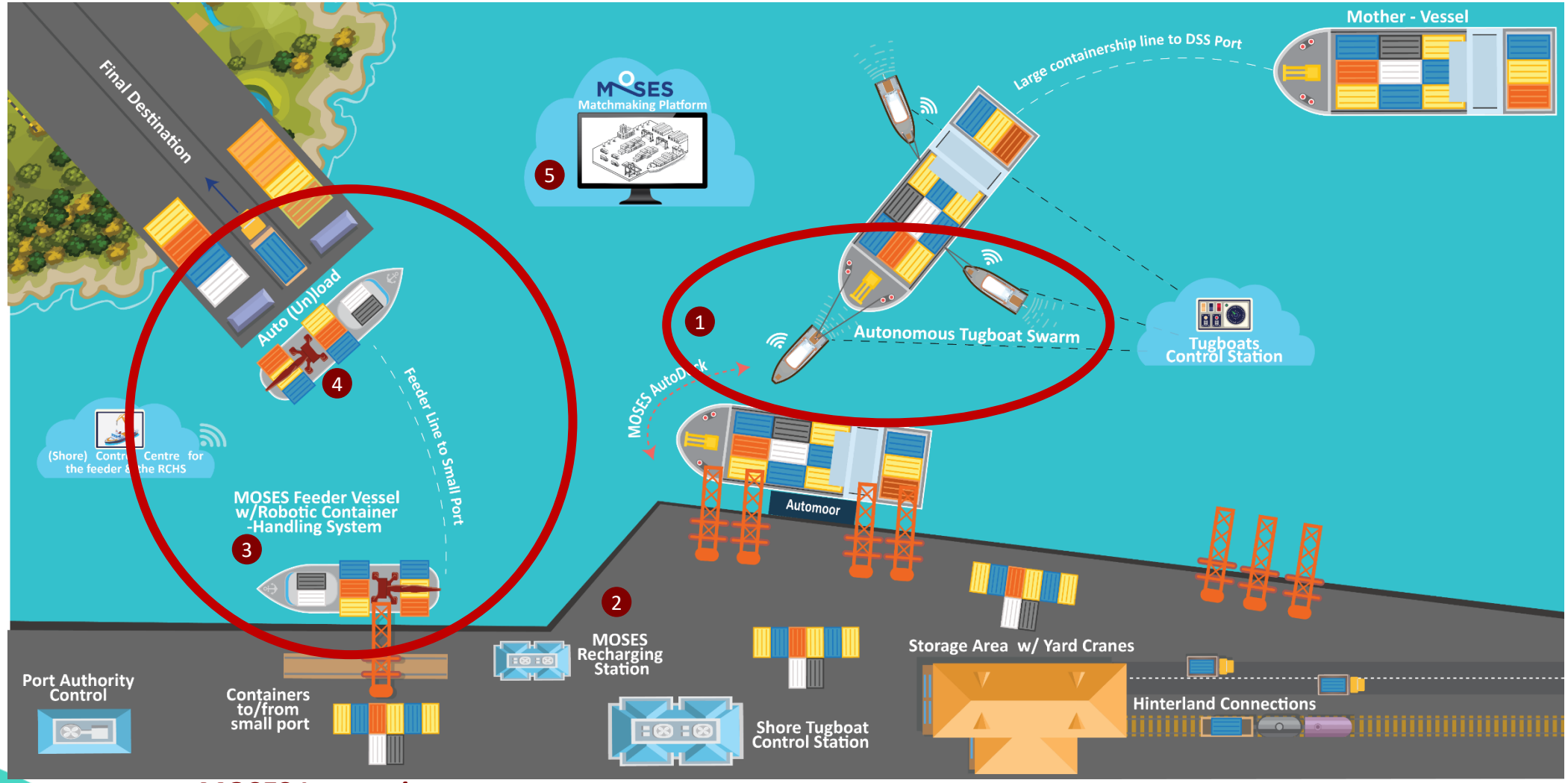
Developing solutions towards the future of the EU Short Sea Shipping

MOSES Facts

- **Project Title:** AutoMated Vessels and Supply Chain Optimisation for Sustainable Short SEa Shipping
- **Duration:** 01.07.2020 - 30.06.2023 (36 months)
- **Budget:** 8 million €
- **Consortium:** 17 Partners



MOSES Concept

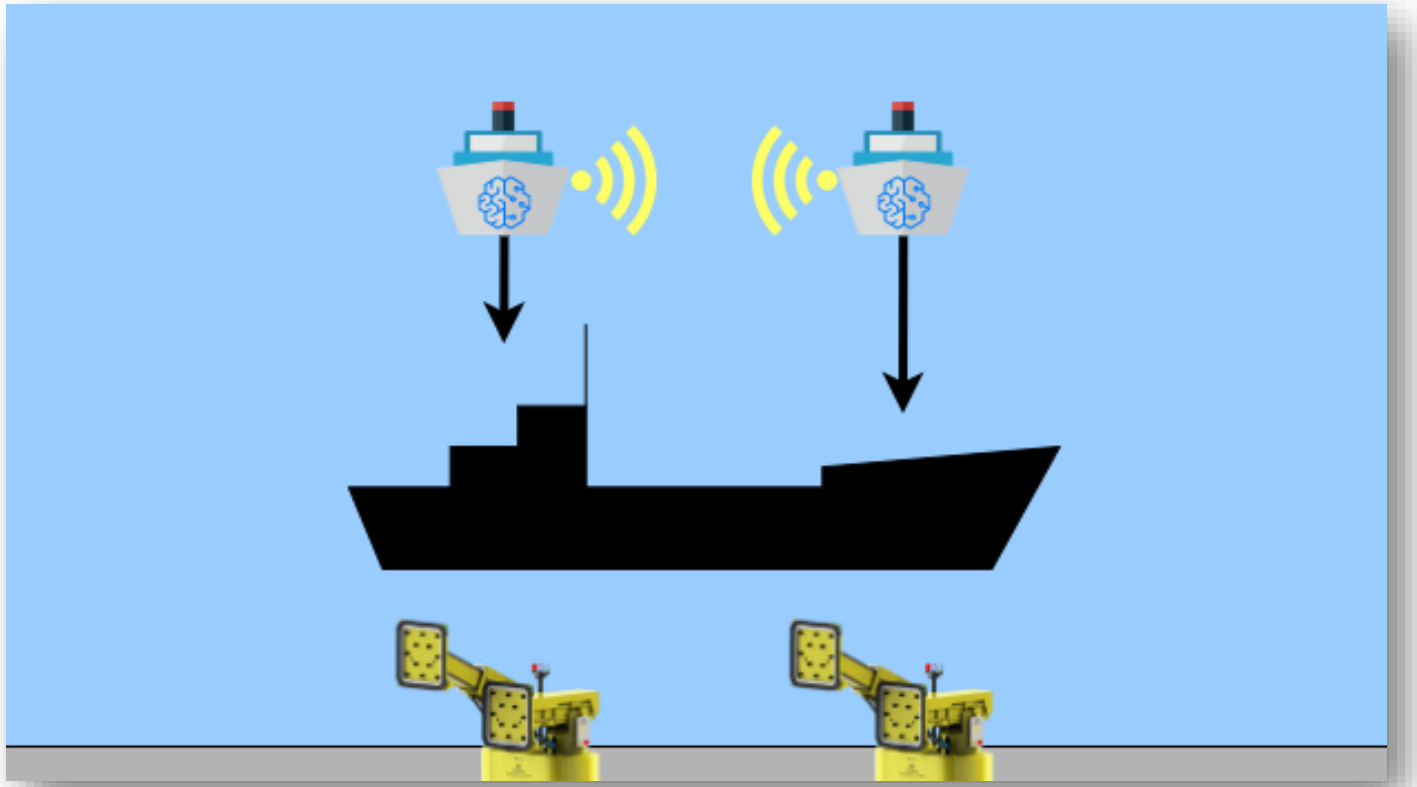


MOSES Innovations:

1. MOSES AutoDock (MOSES Autonomous tugboats + AutoMoor)
2. MOSES Recharging Station
3. Innovative Feeder Vessel
4. Robotic container-handling system
5. MOSES matchmaking platform

Autonomous Tugboats

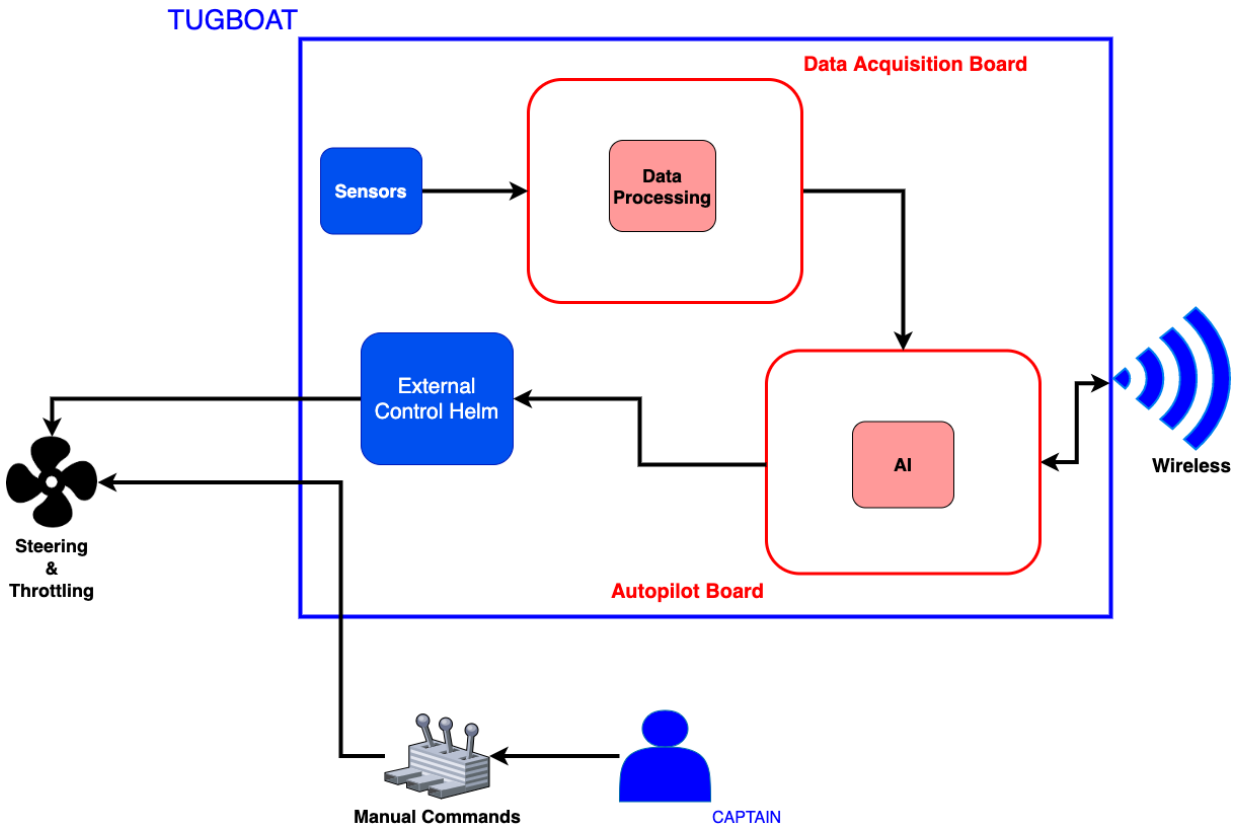
Swarm of AI-controlled tugboats to automate mooring and docking of large vessels



Goals

- Reduce time spent on maneuvering
- Reduce docking time
- Reduce human errors

Autonomous Tugboats

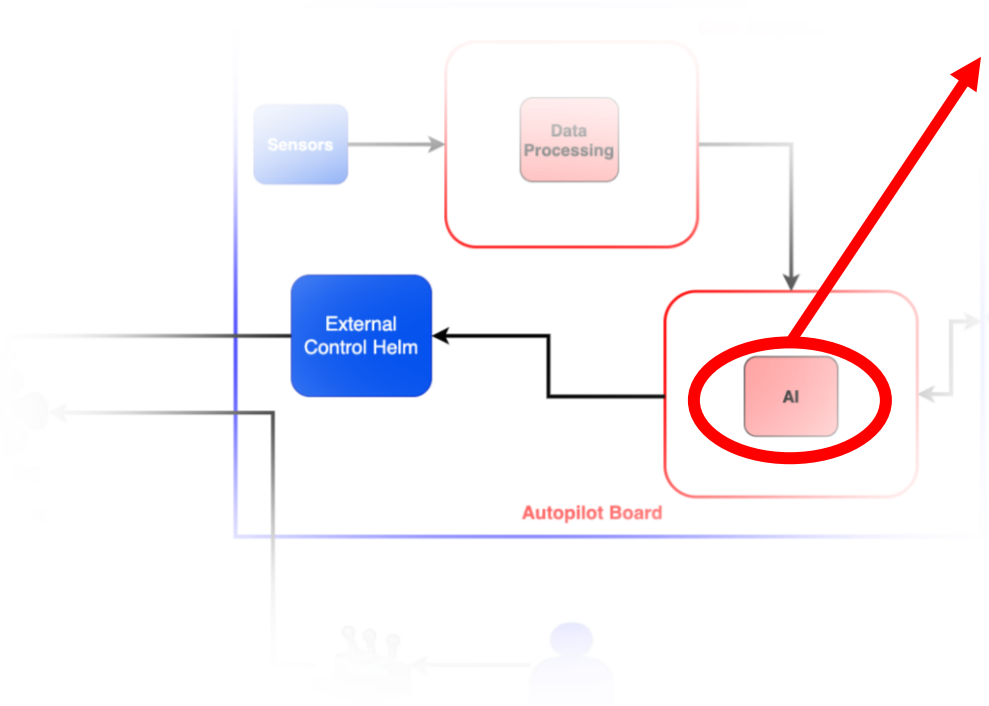


Sensors and hardware modules will be used to retrofit tugboats and transform them into **autonomous tugboats**

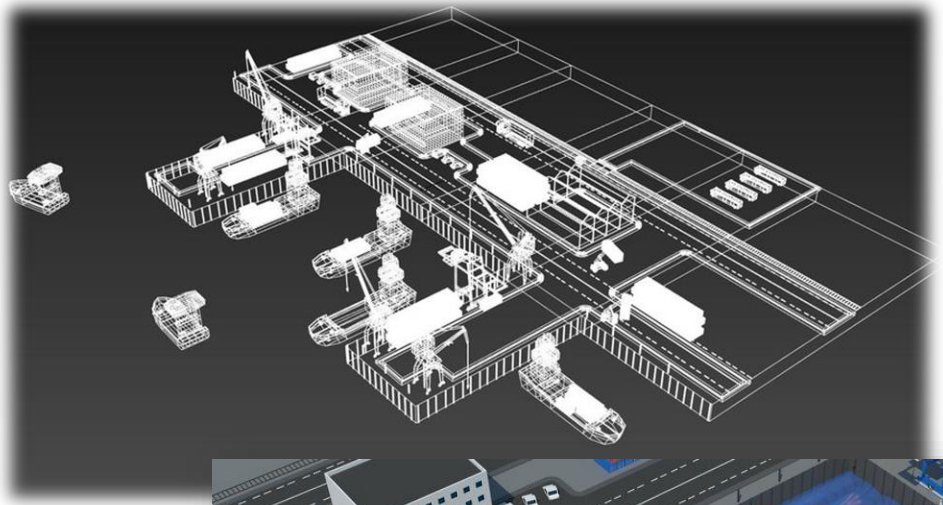
Wireless modules will ensure communication with Shore Control Station, AutoMoor, and other tugboats within the swarm

External Control Helm to convert AI commands into real steering & throttling

Autonomous Tugboats



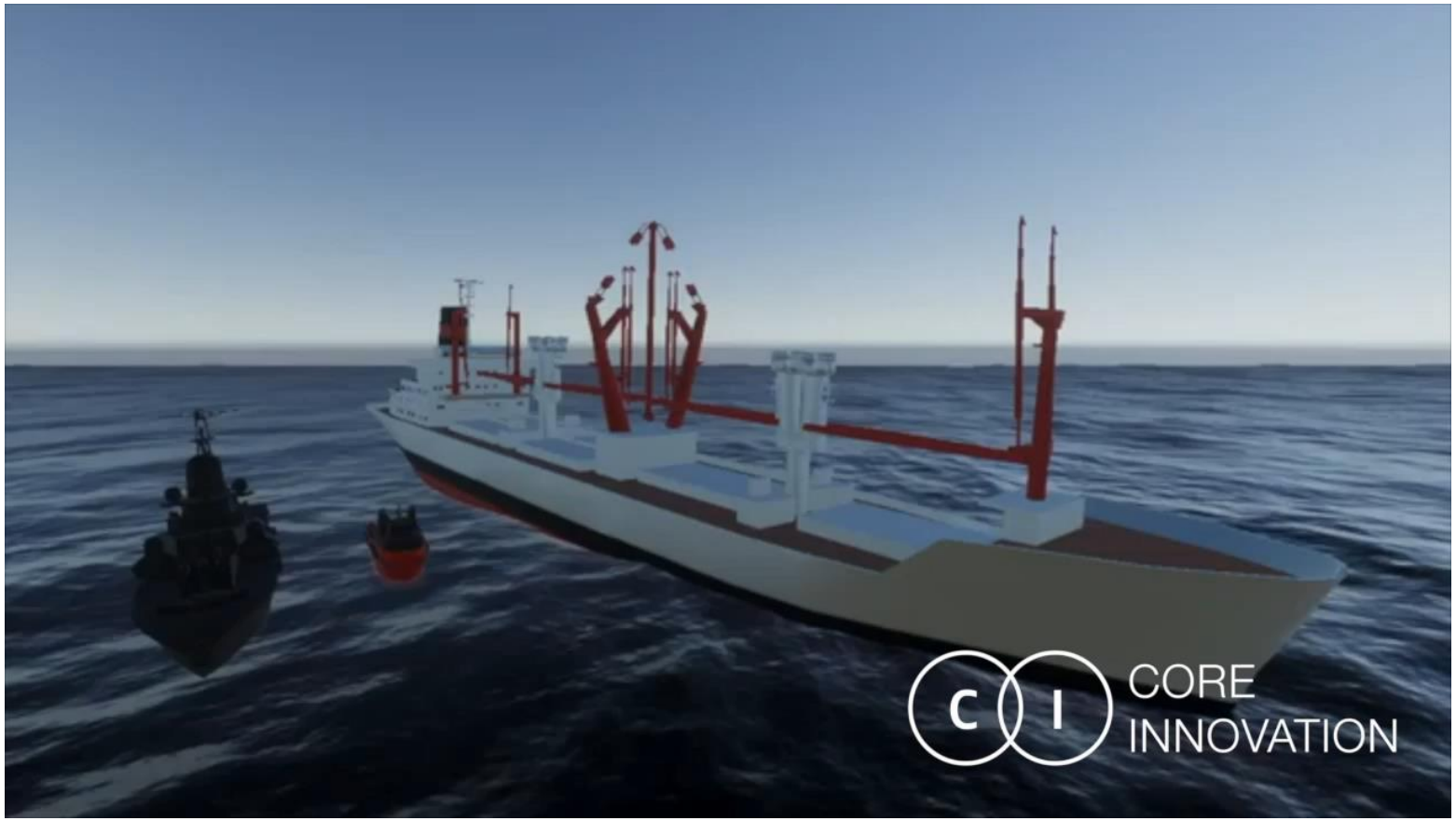
State-of-the-art swarm AI Algorithms will be **trained and tested in a 3D environment, based on real scenarios** before being installed on the system



Real port layouts will be replicated in the 3D environment, using sophisticated **physics simulation (waves, weather, kinematics, stresses)** tools

Autonomous Tugboats

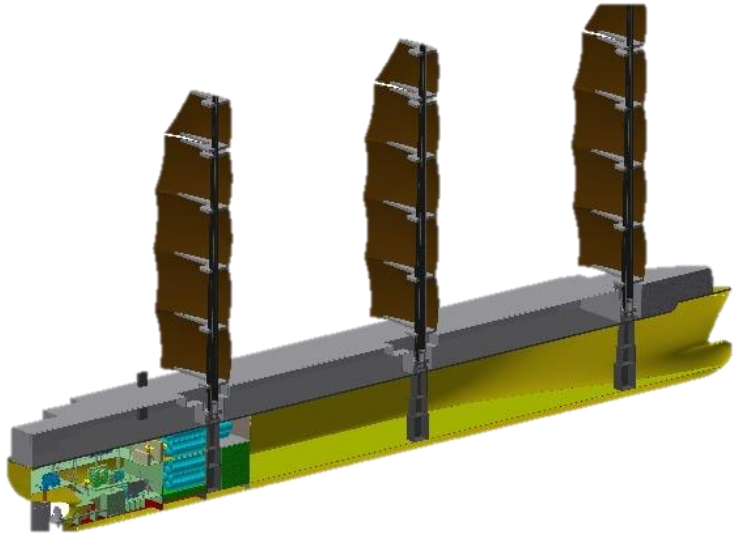
Virtual environment and swell effect on various vessel sizes (example)



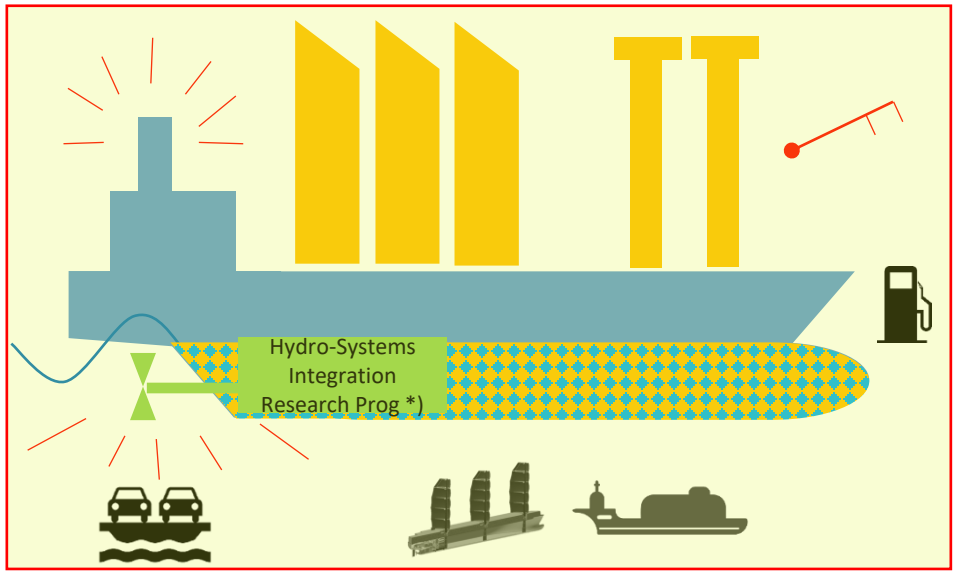
Innovative Feeder Vessel Design

Design alternatives

- Early innovative concepts/ideas for 3 different vessels
- Wind assisted alternative for 1 feeder design concept
- Basic hull form development for 3 feeder design concepts

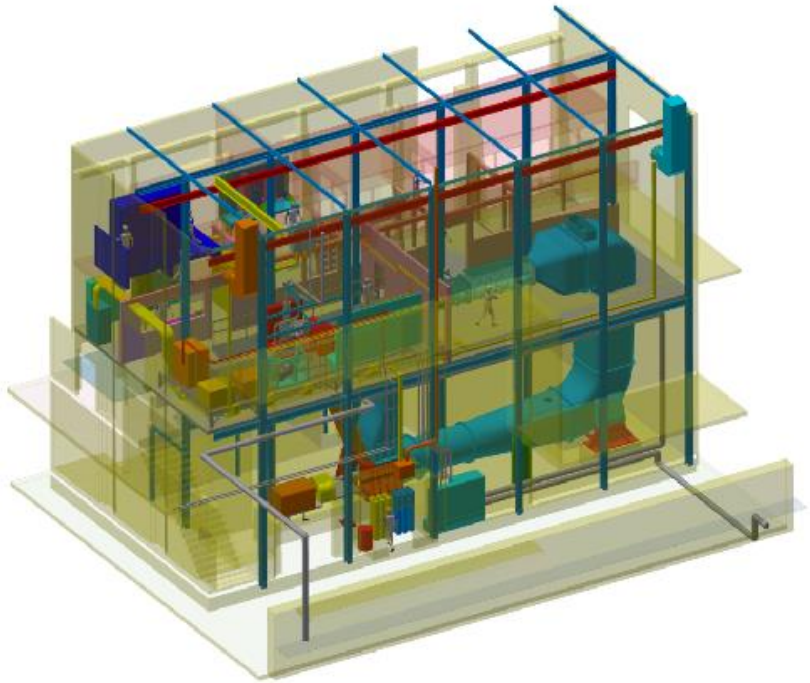


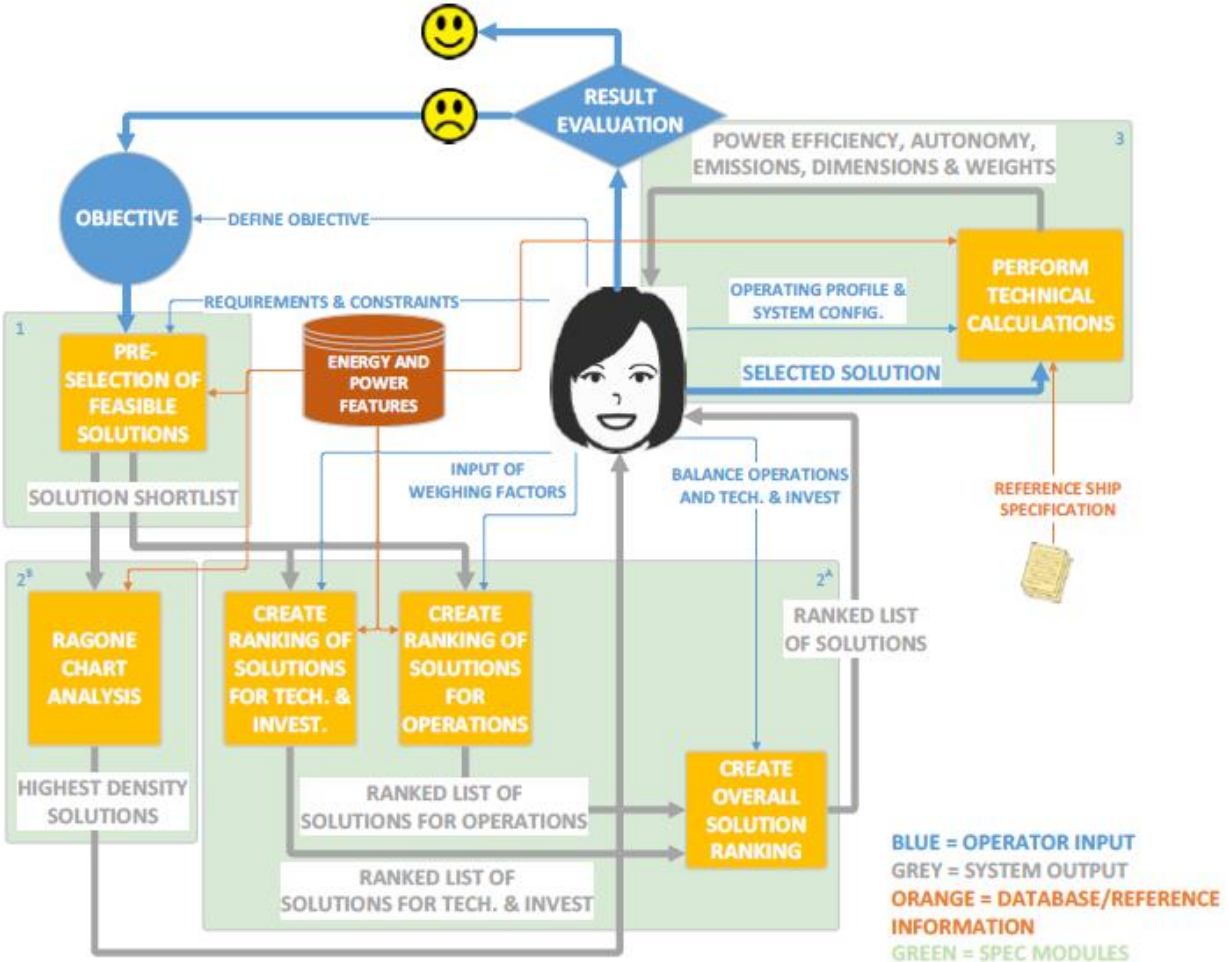
Example of WA-design - Ecoliner from DNA



Evaluation of Feeder design concept

Zero-emission investigation, including wind assisted propulsion

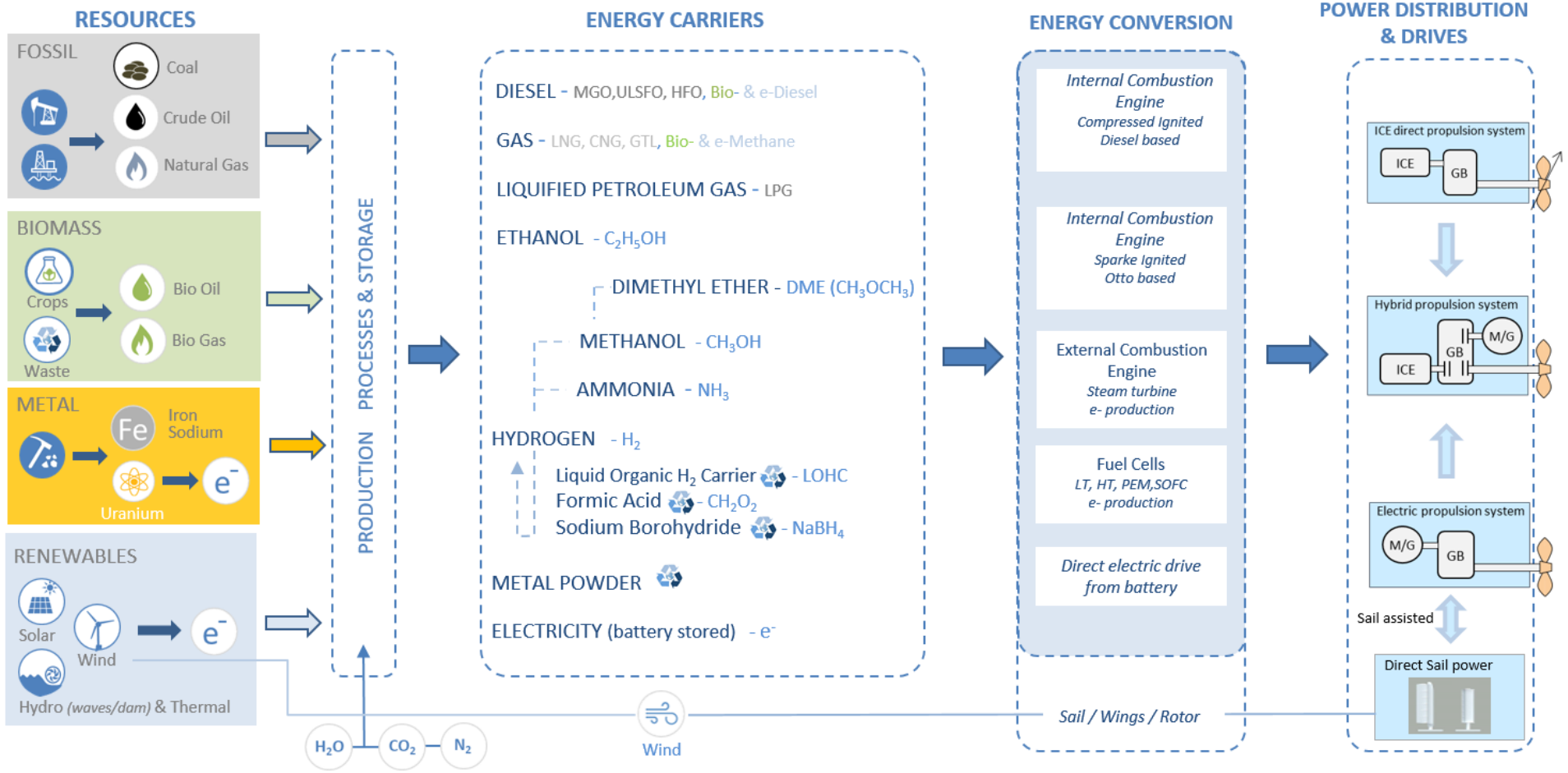




Alternative solutions will be ranked based on **operations** and **technical investments**

Evaluation of Feeder design concept

Well-to-wake for alternative fuels – Global solution, not local optimum

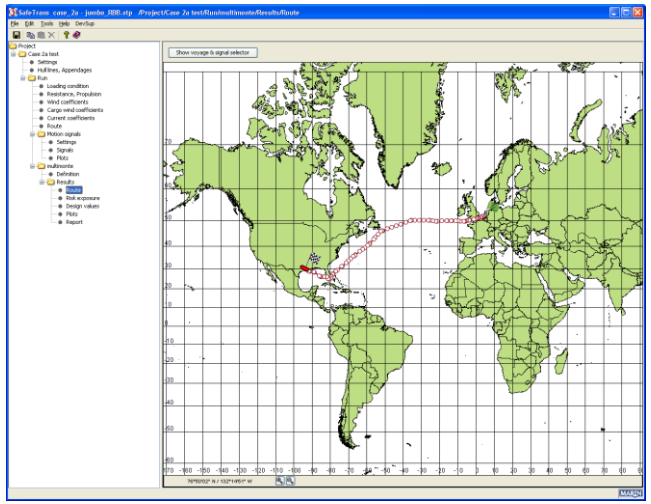


https://sustainablepower.application.marin.nl/

European Sustainable Shipping Forum
Sustainable Alternative Power for Shipping

Evaluation of feeder design concept

Voyage simulation for hull form, powering system



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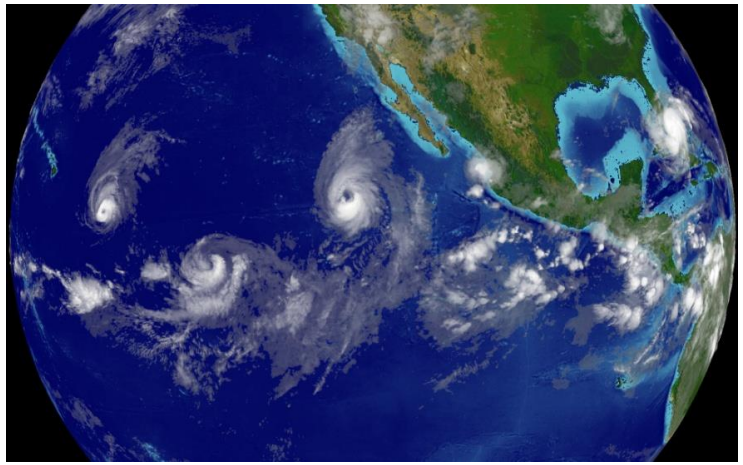
Hindcast weather database (5 year period)



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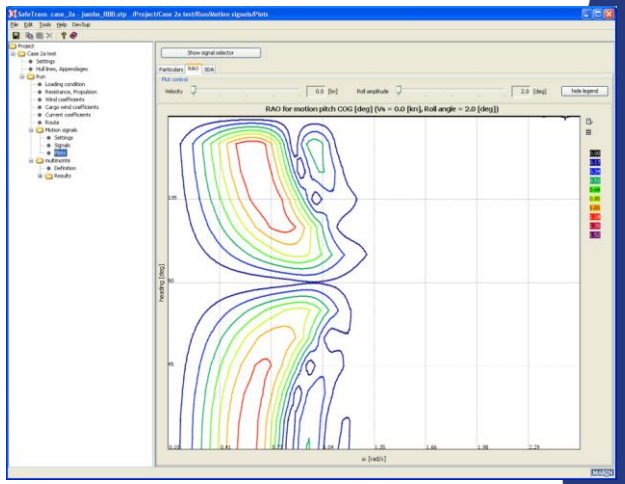
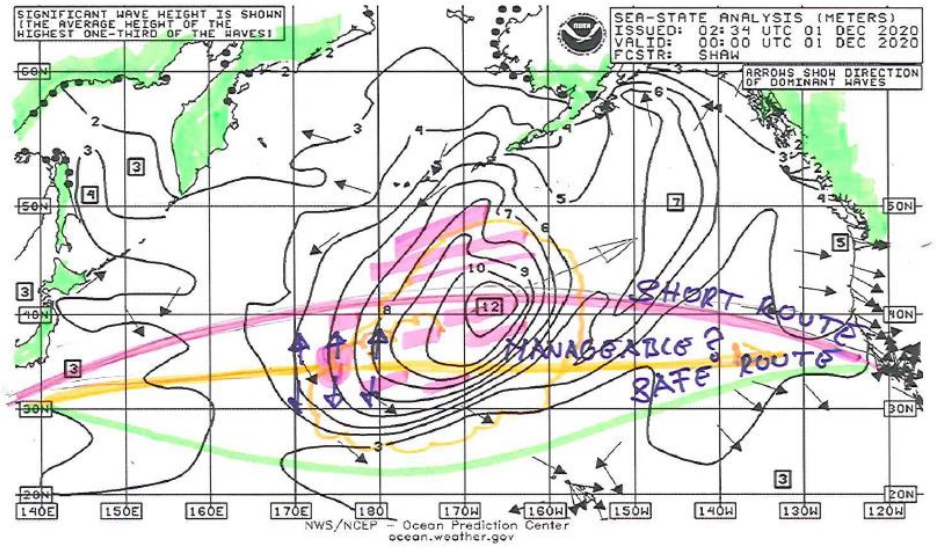
Ship Response Amplitude Operator (RAO)



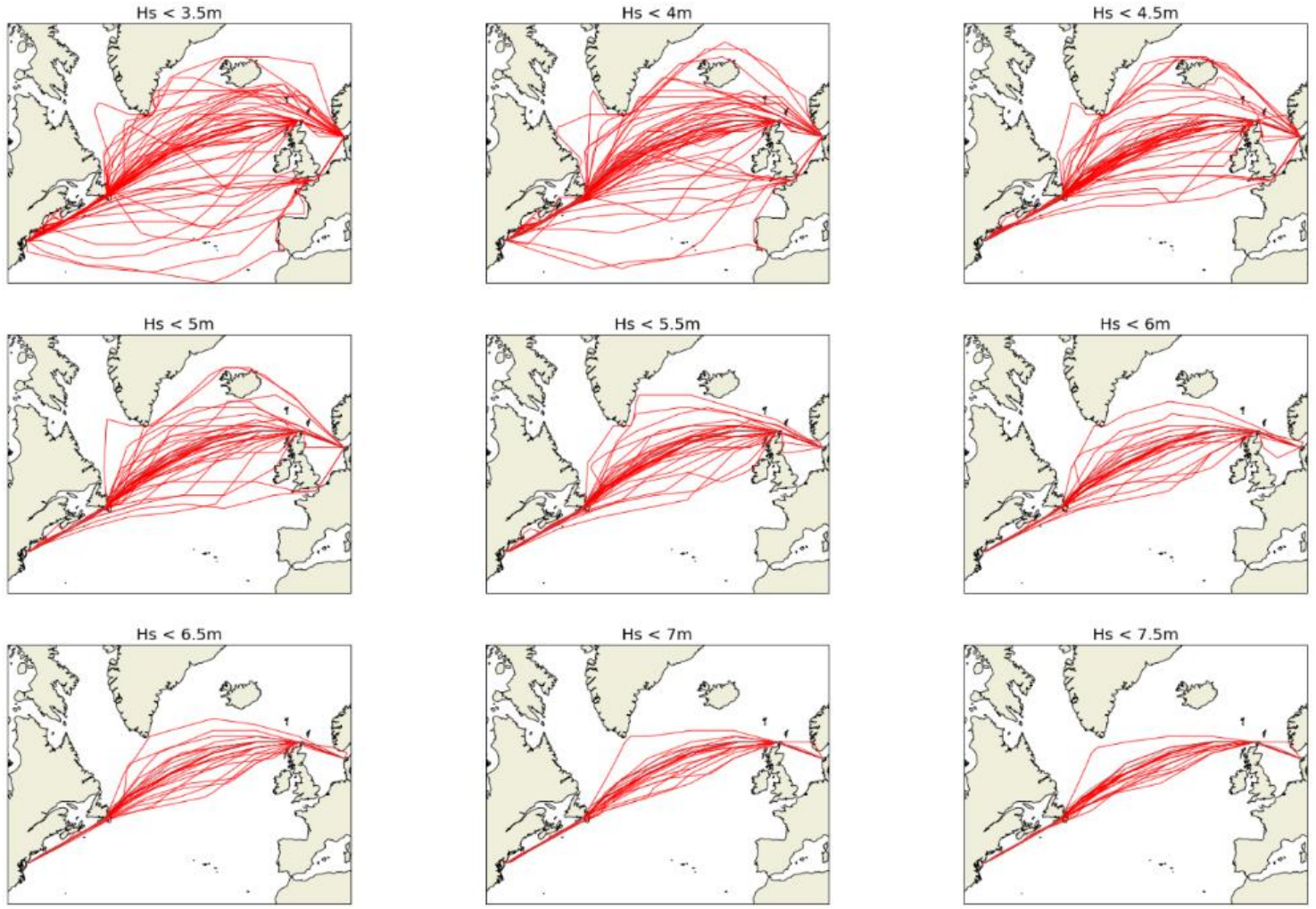
Safety assessment:
Simulation for determining rerouting requirements



Evaluation of feeder design concept

Voyage simulations used for:

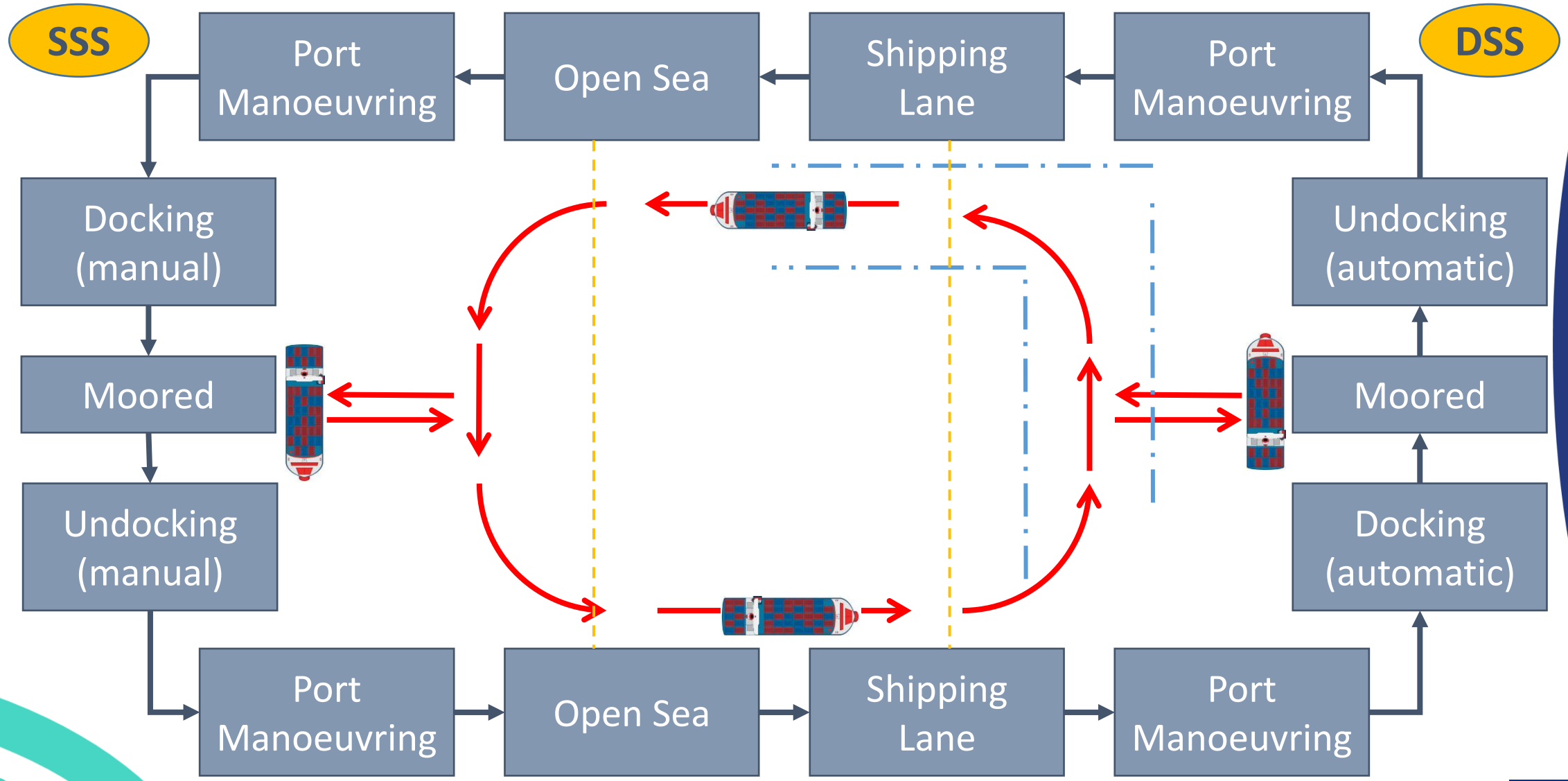
- Determination of sea margin
- Port manoeuvring
- Incident analysis
- Comfort analysis
- Rerouting potential
- Wind assistance potential



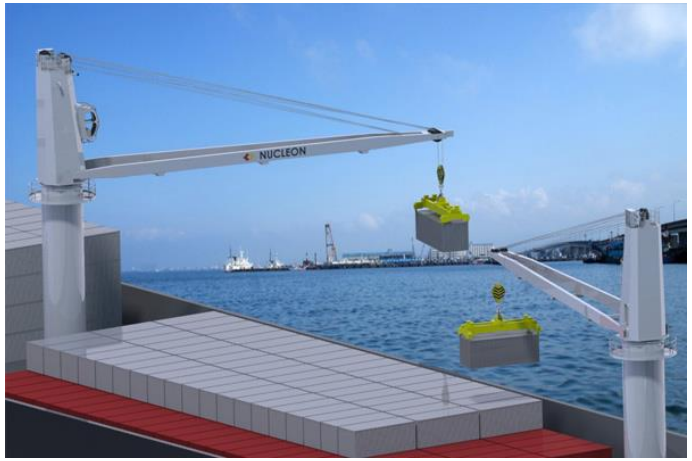
Evaluation of feeder design concept – Pilot demo

- **Free sailing model** of selected Feeder Vessel design
  - Propulsion
  - Seakeeping and added resistance
  - Autonomous operation
- **Demonstration Day** for Visitors

Autonomous Mission Execution – Scenario Development

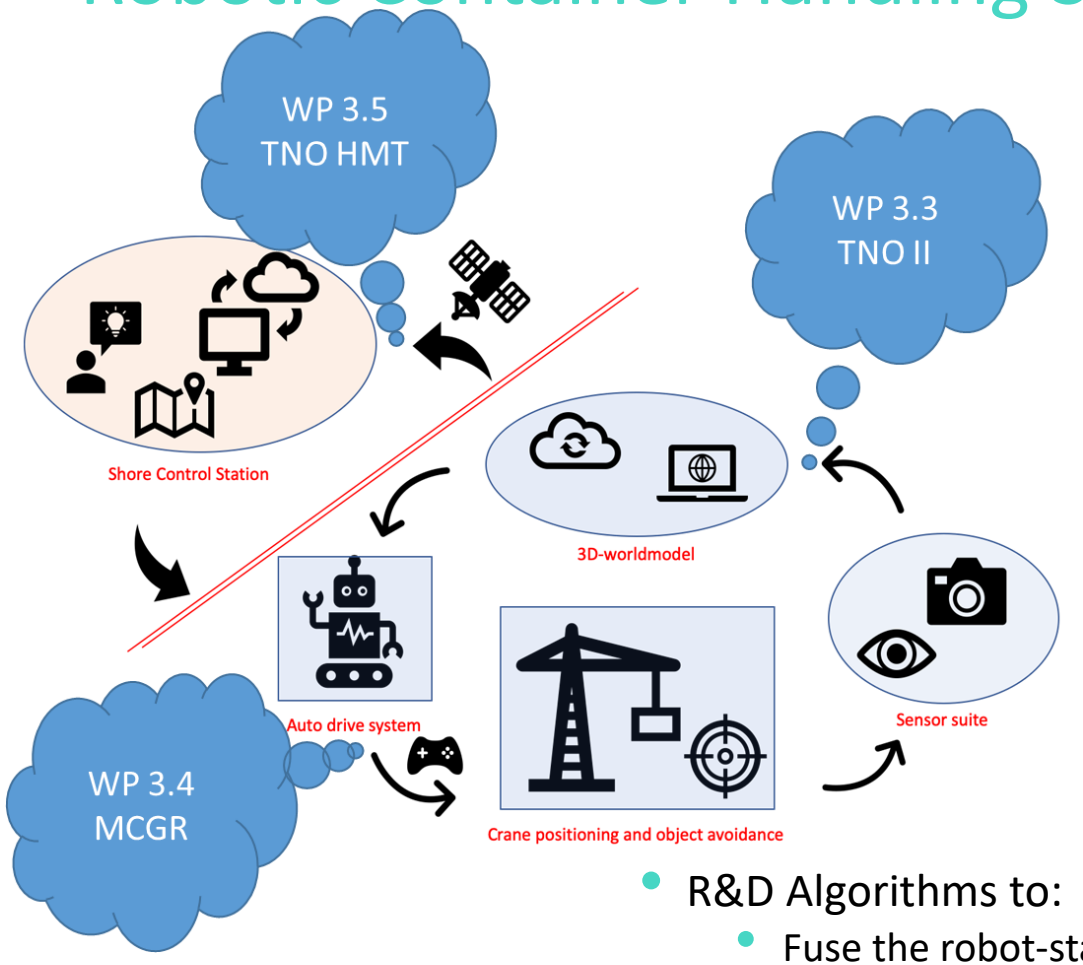


Robotic Container Handling System



Enabling cost effective short sea transport of containers to small local harbours without own port based container loading and offloading facilities

Robotic Container Handling System



- Create **3D world model**
  - **SA for the crane**; live obstacle map, safeguarding of humans/cars
  - **SA for the remote operator** (no direct visuals, only VR-mediated); a blended VR model with crane + states and some visual content
- Develop with MacGregor
  - **A live sensor suite for the crane** that can be used in the pilot demo at the test-site
  - **A virtual sensor suite in Unity** to support the validity in a harbour scenario

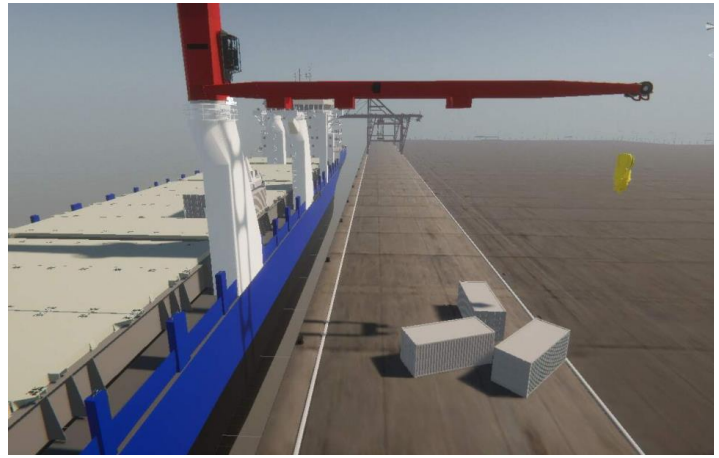
- R&D Algorithms to:
  - Fuse the robot-states, the live 3D data, and the (old) static 3D map into an obstacle map
  - Verify the location of containers (and/or detection)
  - Apply existing car/person detectors, and use stereo-calibration to add them as 3D red-alerts
  - Data selection & transmission from crane to remote-operator
  - 3D renderings into Blended-VR
- TRL5 demonstrator, H2020 publication(s)…

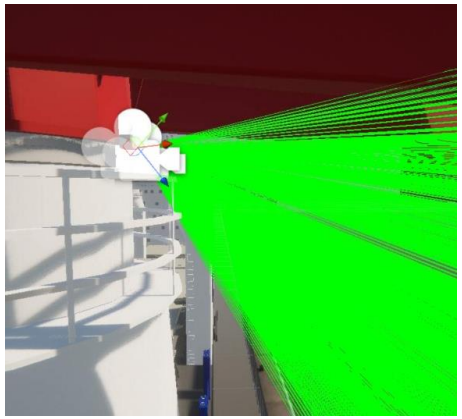
Robotic Container Handling System

- **Autonomously pick-up and move containers** from the quay side surface to the ship and vice versa
- **Integration of existing equipment** into a single robotic container handling system that is able to operate (semi)autonomously
- **Integrate the sensor suite with the crane control unit** for safety and operational visibility
- **Vessel movement will be compensated** by adding reference point from quay side
- **Emulation of system components** by C-HOW software (VR)
- **Creating API** for surrounding systems to co-operate

Sensor Suite Development

- **VR models from MacGregor & Bromma**
  - Ship, crane, spreader, docks, containers
  - (later) Live connection to the sensor-suite PC in the cabin
- **TNO sensor suite simulation in Unity-VR**
  - Good position on the crane
  - Stereo camera design with correct FOV
  - VLP16 assets
  - Simulated capture, streaming, and rendering…

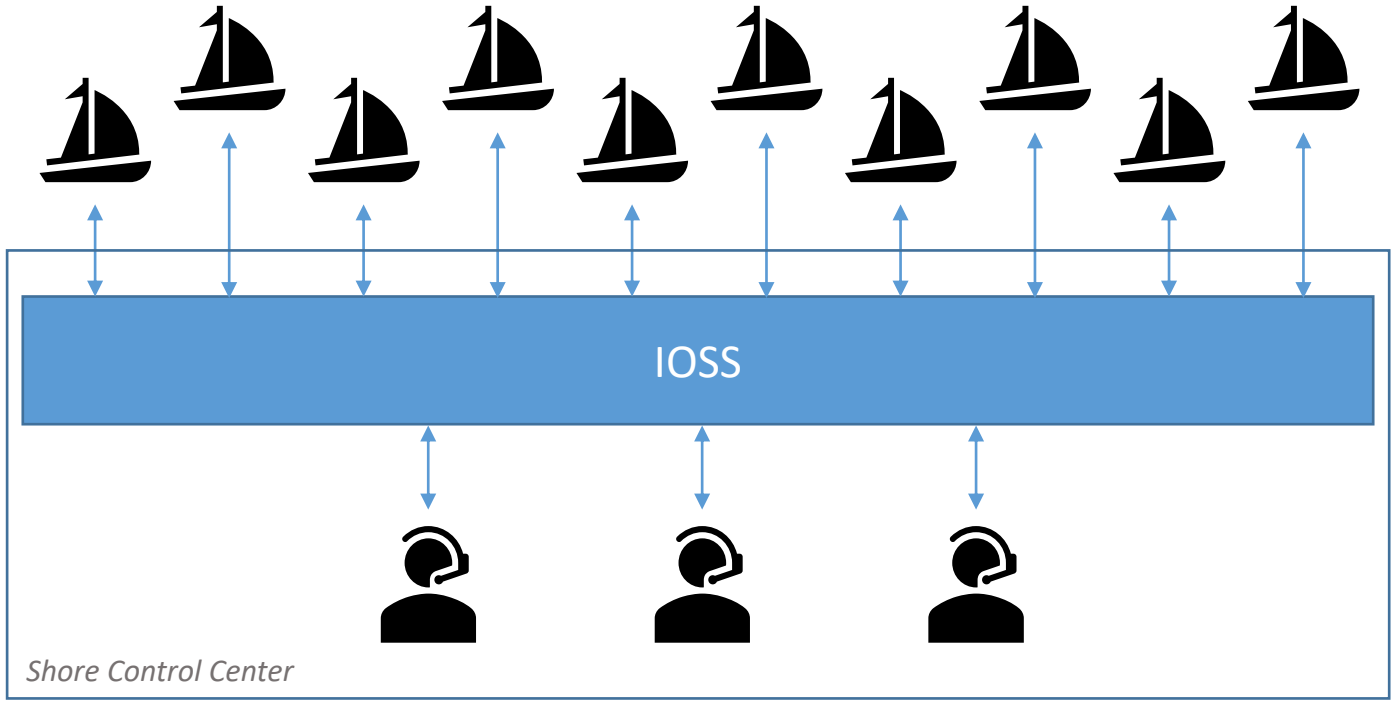




Shore Control Station and Intelligent operator support

IOSS: Intelligent Operator Support System

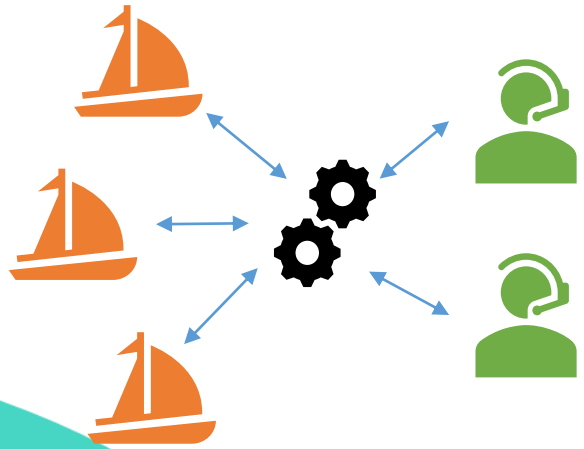
"A system that supports remote operators in their supervision and control of autonomous cranes loading and offloading containers in parallel."



IOSS Functions

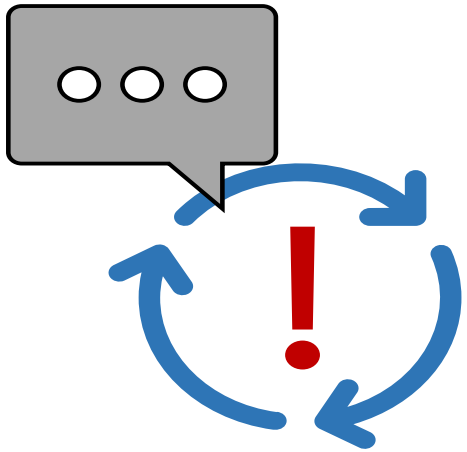
Dynamic Task Allocation

Allocating tasks over time to operators based on operator and task profiles, with real-time adjustments based on these changing profiles.

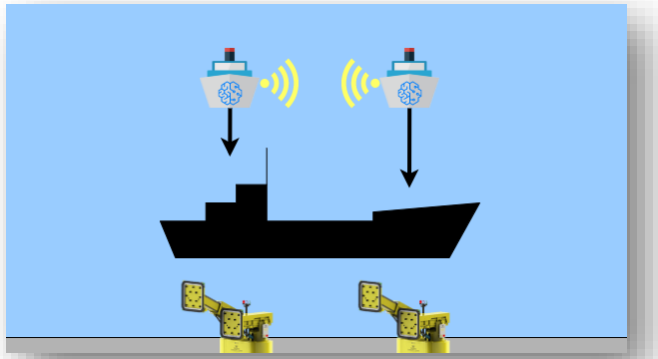


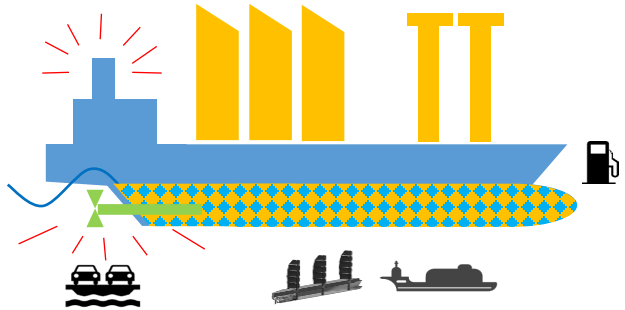
Situational awareness

Proactively bringing the operator into the loop with all relevant information for just-in-time awareness as well as a progressive disclosure paradigm for a fleet, vessel and immersive perspective.



MOSES Impact on sustainable SSS





Safety

- Minimize human error in towing
- Reduce accident during berthing

Automated functionalities (cargo handling and navigation).

Minimize risk in cargo handling.

Efficiency

- Reduced time to berth
- More reliable towing services
- Increase service availability

- Improvement of maritime logistics chains.
- Make SSS a competitive alternative to land transport cargo delivery in smaller ports.
- Benefit local communities with infrequent RoPax connections (passengers' accommodation).

- Enable Lo-Lo container services to small ports that have limited or no loading and offloading infrastructure.
- Impact on the local logistic infrastructure to transport Lo-Lo delivered containers to the final destination of the end-costumer.
- Impact on the receiving port logistic infrastructure and port control organisation.

Paving the way towards the future of Short Sea Shipping

- The problem addressed by MOSES does not have an obvious solution!
- The expected benefits will strengthen the **presence of SSS within the EU supply chain by taking advantage of the benefits of autonomous shipping.**

MOSES – Towards the future of SSS

Automated technologies/processes
Autonomous operation

Safety + Efficiency

Sustainable SSS feeder services to small (and remote) ports without infrastructure

www. moses-h2020.eu

MOSES project2020

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MOSES Project

Thank you very much for your attention!

If you have any questions or require further information, please contact us:

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