



# MOSES

## Introduction: H2020 Project MOSES

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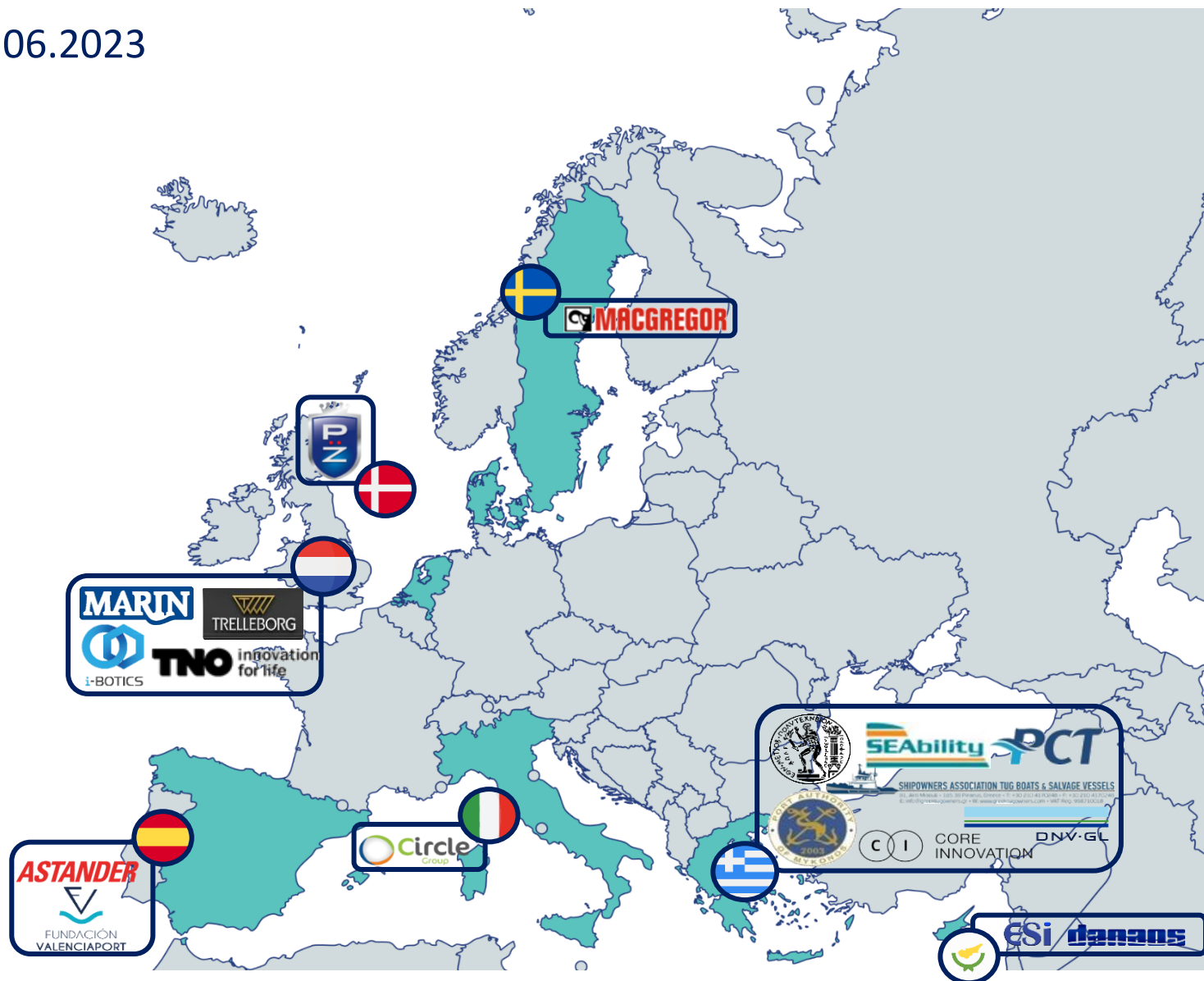
Associate Professor  
School of Naval Architecture & Marine Engineering  
National Technical University of Athens





# Facts about the MOSES project

- **Duration:** 01.07.2020 - 30.06.2023  
(36 months) – *extension*  
31.12.2023 (42 months)
- **Budget:** 8 million €
- **Consortium:** 17 Partners
- **Coordinator:** NTUA







# MOSES aims to...



Containerised cargo



Create sustainable feeder services from large container terminals to small ports with no infrastructure to replace trucks on Ro-Ro ships

# Is modal shift relevant?



Trucks are becoming electrically-driven!

But there will still be problems, such as congestion...



*Illustration of ASKO's zero emission shuttle  
Source: ASKO Maritime*



*MV Yara Birkeland  
Source: Yara International*

Modal shift to maritime transport will be meaningful if we start to **think differently...**

# The MOSES concept





# The MOSES Use Cases



Northern Case

**MOSES**  
**Open Call**  
Submit by 31-Aug-2023 (05:00:00 PM CEST)

[SUBMIT HERE](#)

## Western MED-Spain

Decongest truck transport traffic in Valencia port and connect it to Sagunto and Gandia satellite ports



## Eastern MED-Greece

Decongest Piraeus container terminal and integrate small Greek ports into the container supply chain





# “Eastern MED-Greece” use case

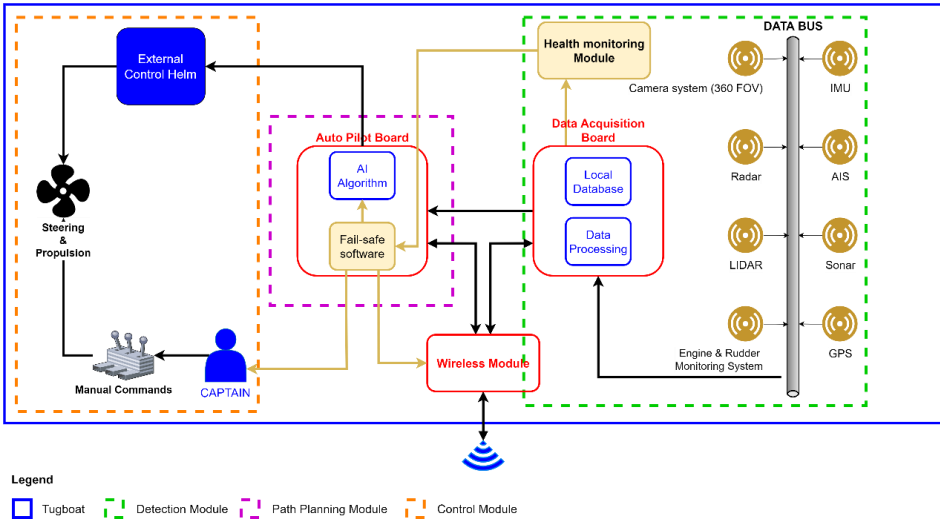


For achieving **-3.5% cost / cargo unit** compared to the Ro-Ro transport chain, the feeder must call on each port **at least twice a week** and capture **at least 40% of the estimated demand**.

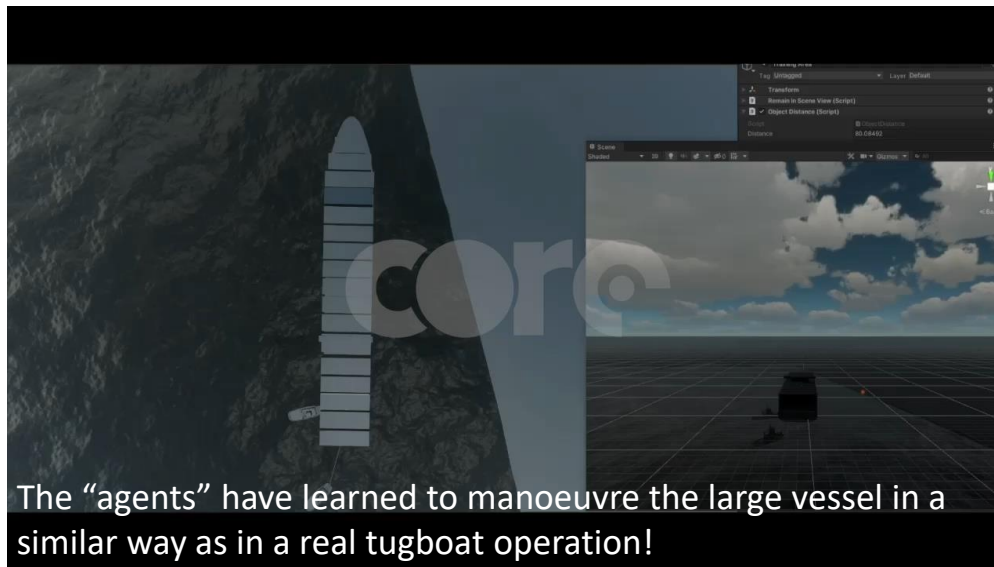
# MOSES AutoDock System



## Architecture



## Artificial Intelligence



## Automated Mooring



## Prototype innovations:

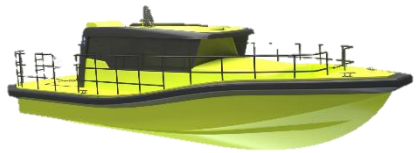
- Small-scale
- Surge motion control
- Energy harvesting
- Communication with tugboats



# MOSES AutoDock System – Demonstration



TUCO Pro:Zero Workboats



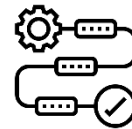
Trelleborg AutoMoor system for automated mooring adapted for small vessels



3<sup>rd</sup> week of October 2023



Showcase the automated maneuvering, docking, and mooring scheme for large ports



- Two workboats will simulate a swarm of autonomous tugboats
- They will guide a floating vessel towards a berthing spot
- The re-engineered AutoMoor prototype will safely moor and secure the floating vessel at berth



Denmark

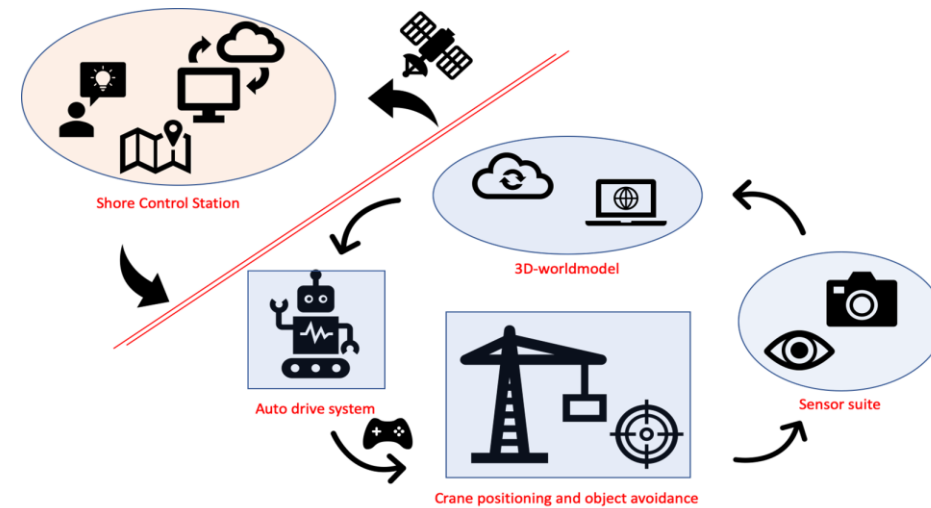
# MOSES Robotic Cargo Handling System



## Automated Crane

- Compensation of pendulation (ship motions, weather conditions)
- Identification of container to load

## Intelligent Operator Support System (IOSS)



- Enabling local situation awareness – anomaly detection
- Robot self awareness in problem detection
- Control Intelligence
- Dynamic task allocation (One-to-many)
- Risk assessment for problem solving



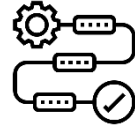
# MOSES Robotic Cargo Handling System – Demonstration



September 28, 2023



Demonstrate the **automated operation for (un)loading containers** from the MOSES Innovative Feeder with the Robotic Container-Handling System



- A **full-scale crane** (*located at MacGregor's test site*) will be outfitted with a sensor package and control systems to enable remotely controlled and autonomous operation
- A remote operator (*located at TNO's facilities*) will monitor the operation through the **Intelligent Operator Support System (IOSS)**



Sweden and the Netherlands

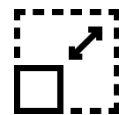
# MOSES Innovative Feeder Vessel – Demonstration



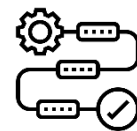
## Today's pilot demonstration



Demonstrate **port-to-port autonomous operation** of the MOSES Innovative Feeder vessel in a Seakeeping and Manoeuvring Basin (SMB)



Free sailing, **1:17 scale ship model** of Greek II concept design



Round-trip between two ports, including autonomous docking and undocking



# Innovative Container Feeders



Innovative feeders must be:

- Environmentally friendly
- Cost-effective for carrying relatively small amounts of cargo
- Able to approach relatively small ports



ASKO



Yara Birkeland



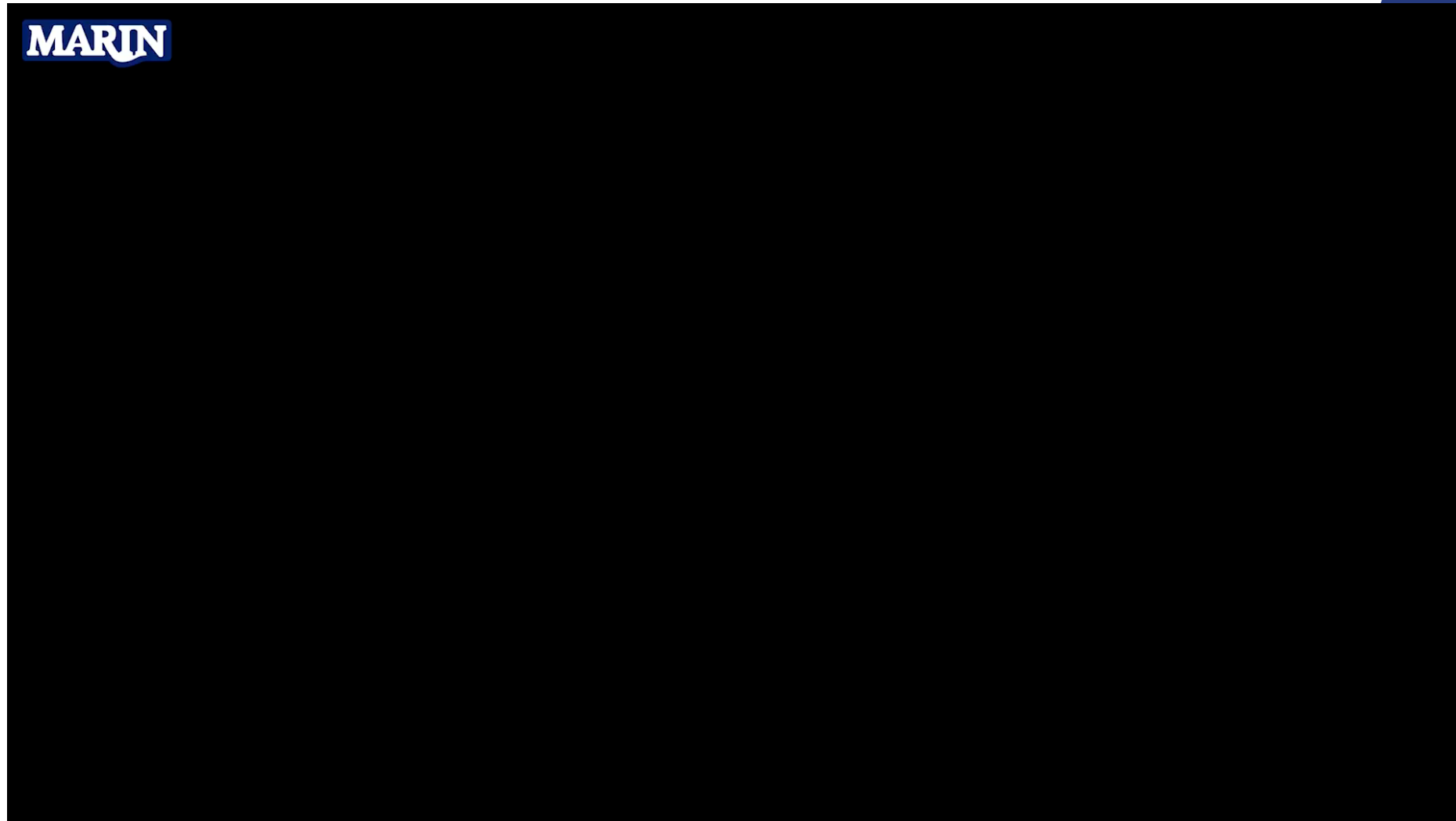
Samskip Seashuttle

Vessels that carry up to 300 containers and are operating with zero emissions (batteries, hydrogen fuel cells) are already being developed!



# Added value of the MOSES Innovative Feeder

- Does not depend on:
  - port infrastructure (geared, (un)load directly from/to trucks)
  - the availability of port services (stevedoring, tug assistance)
- Environmentally sustainable propulsion



Simulation of fully automated vessel control at the port of Mykonos

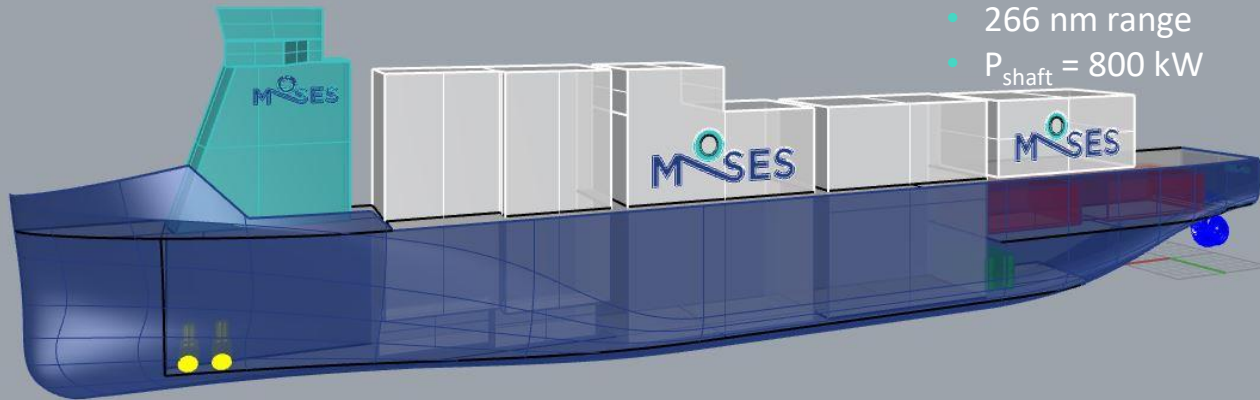


# The feeder's technical characteristics



## Greek concept I

- $L_{BP} = 80$  m
- 180 TEU
- 10 kn service speed
- 266 nm range
- $P_{shaft} = 800$  kW



Assumption: 80% of estimated demand captured

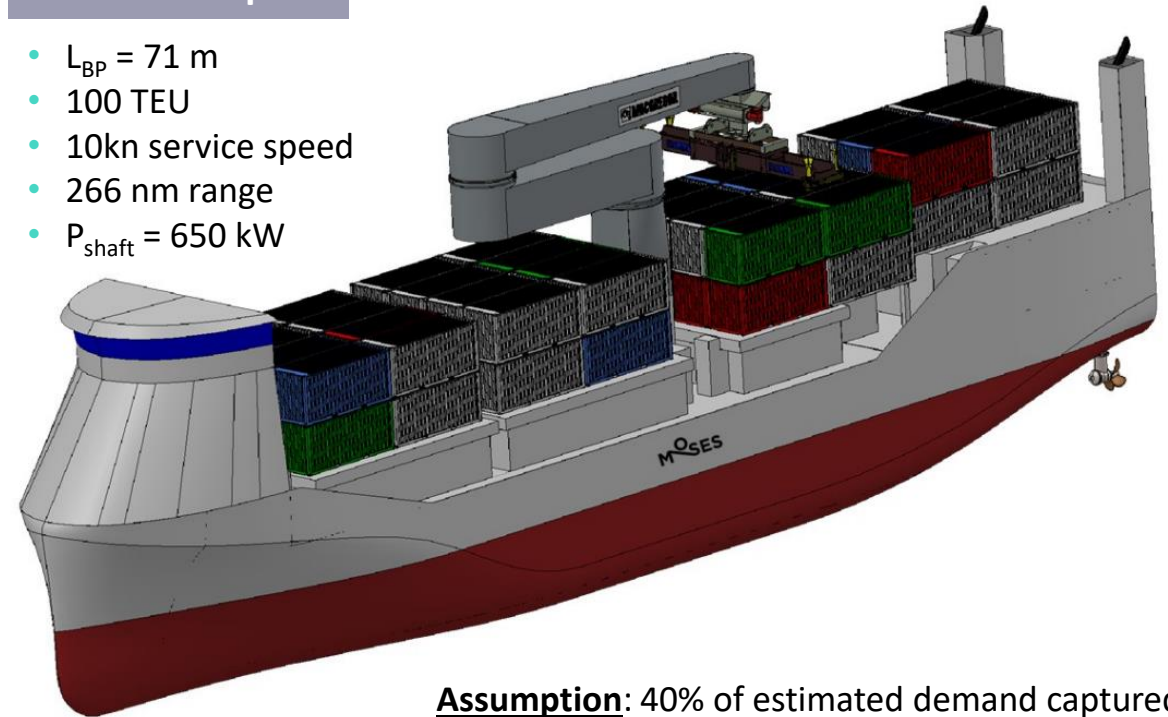
## Innovations:

- Sustainable propulsion (Hybrid – methanol ICE + batteries, Full electric)
- Azimuth thrusters for enhanced manoeuvrability
- Automated cargo-handling, *as first step towards higher autonomy*

Available power for safe navigation in adverse weather conditions was **verified through simulations** (based on 2011 – 2016 weather data)

## Greek concept II

- $L_{BP} = 71$  m
- 100 TEU
- 10kn service speed
- 266 nm range
- $P_{shaft} = 650$  kW



Assumption: 40% of estimated demand captured

# MOSES Recharging Station – Feasibility study

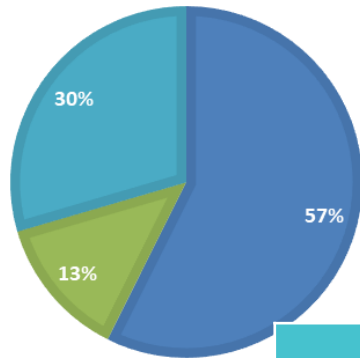


## Criteria:

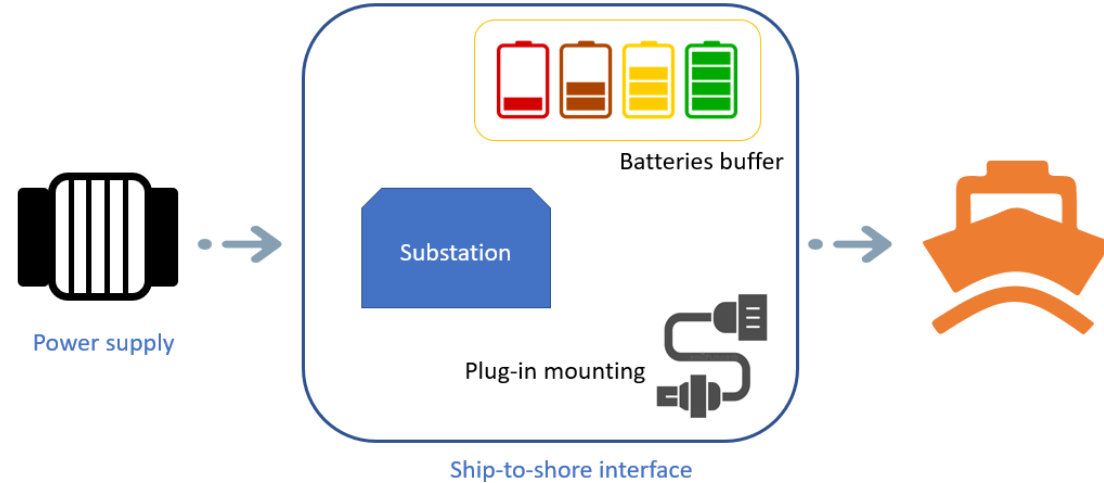
- Recharging should not disrupt operation
- The grid should provide the required power
- Port real-estate needs to be available for the station

## Feeder operational profile:

■ Sailing ■ Manoeuvring ■ Loading/ Unloading



Port	Time for charging (h)
Piraeus	2,72
Mykonos	7,09



## Preliminary Scenario:

Feeder recharges at Piraeus and Mykonos to avoid draining the batteries below 20%

- Need to install batteries buffer at Mykonos port to allow constant supply without the risk of port black-out
- Recharging at Mykonos *does not seem promising* given the current state of the grid and the recharging technology

**Feasibility study result:**  
Feeder recharges only at Piraeus

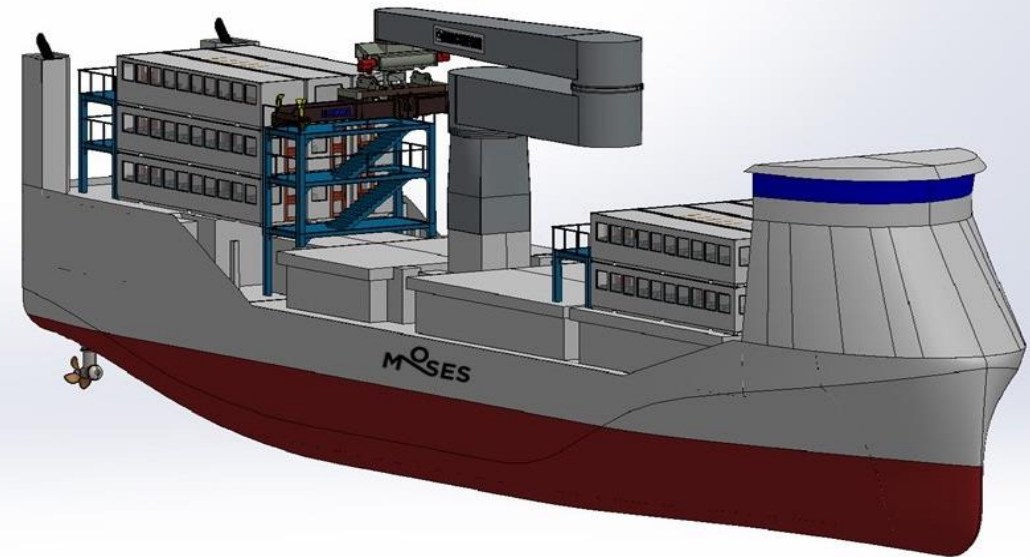


# The innovative feeder's additional functionality

- A **feasibility study** was conducted to identify if waiting time could be exploited for other uses.
- **10 waiting hours per trip (based on trip simulations)** for pax transportation to nearby islands.



## Modular concept design for pax transport



**This feature will not be demonstrated**



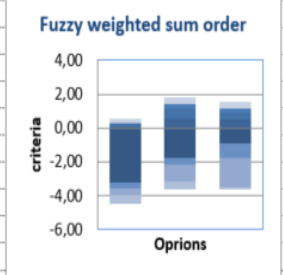
# Pilot Demonstration results

- The pilot demonstration results will provide input to the **detailed sustainability framework** developed by MOSES
- The objective is to evaluate the **sustainability and added value to SSS of the MOSES Innovations**, based on specific criteria (incl. cost, environment, safety etc.)



Attributes		# Experts		4 # Alternative		2 # Attributes		8		MULTI-ATTRIBUTE DANAOS SOLVER		MULTI-ASSESS DrC  Sofia Archontaki - Takis Varelas		ORDER PREFERENCE		x1	x2	x3					
Code	Description	Asses	Type	BAU	MOSES	BAU	MOSES	BAU	MOSES	BAU	MOSES	E1	E2	E3	E4	wi	x1	x2	x3				
A1	COST	O	cost	900	500	900	500	900	500	900	500	1	9	9	9	0,381	-0,333	-0,185	-0,090	0,056	0,944	0,000	Fuzzy
A2	ENVIRONMENT	LS	Benefit	VL	VH	VL	M	VL	M	VL	VH	1	1	1	1	0,381	-0,204	-0,243	-0,090	0,120	0,880	0,648	Crisp
A3	SAFETY	LS	Benefit	VL	VH	VL	L	VL	M	VL	VH	1	1	1	1	0,039	0,021	0,032	0,026				
A4	COMPLIANCE	LS	Benefit	L	H	VL	M	VL	M	L	H	1	1	1	1	0,039	0,021	0,033	0,024				
A5	REGULATION	LS	cost	L	M	VL	M	L	L	M	L	1	1	1	1	0,097	-0,080	-0,056	-0,085				
A6	HEALTH	LS	cost	M	M	VL	M	VL	M	L	M	4	4	4	4	0,206	-0,142	-0,150	-0,174				
A7	SOCIAL VALUE	LS	cost	M	VH	H	M	H	M	VH	M	1	1	1	1	0,070	-0,047	-0,052	-0,015				
A8	BUSINESS VALUE	LS	Benefit	M	VH	VL	M	L	M	VH	H	1	1	1	1	0,061	0,044	0,042	0,042				
												10	8	7	4	0,061	0,038	0,048	0,041				

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Microsoft Excel  
and the winner is X2 And the FUZZY winner is x2

# MOSES making waves...



**MOSES** was *awarded* by the Institute of Logistics Management of Greece (ILME) with the Logistics Excellence Award "**Alexander the Great – Project of the Year 2022**"

6<sup>TH</sup> INTERNATIONAL LOGISTICS FORUM

COLLABORATION  
TECHNOLOGY  
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01.06.2023 \ 14.00-20.00

ΚΕΝΤΡΙΚΟ ΑΜΦΙΘΕΑΤΡΟ ΧΑΡΟΚΟΠΕΙΟΥ ΠΑΝΕΠΙΣΤΗΜΙΟΥ

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# One more thing...an interesting event



*November 7, 2023*



Brussels



**M<sup>o</sup>SES**



**AUTOSHIP**  
Autonomous Shipping Initiative for European Waters



# MOSES

## Thank you for your attention!

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

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*(niven@deslab.ntua.gr)*

**National and Technical University of Athens - NTUA**

 [www.moses-h2020.eu](http://www.moses-h2020.eu)

 MOSES project2020

 @mosesproject20

 MOSES Project



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