



AutoMated Vessels and Supply Chain Optimisation for Sustainable Short SEa Shipping

D.3.1: Concept designs for one RoCoPax and two SSS small feeder vessels

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Contributors	NTUA, DNV, AST, SEAB, MCGR, CIRCLE, MHM, VPF	Lead Author	Gerco Hagesteijn (MARIN)
		Reviewers	George Pedakakis (PCT) Mirjam Huis in 't Veld (TNO)



Document Information

List of Contributors		
First Name	Last Name	Partner
Alex	Grasman	MARIN
Chara	Georgopoulou	DNV
Christos	Pollalis	NTUA
David	Laguera Zabala	ASTANDER
Erik	Rotteveel	MARIN
Elena	Krikigianni	SEAB
Gerco	Hagesteijn	MARIN
Konstantinos	Louzis	NTUA
Lefteris	Tryfonopoulos	NTUA
Nikolaos	Themelis	NTUA
Nikolaos	Ventikos	NTUA
Rolinka	Los-Elsenbroek	MARIN

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List of Acronyms

Abbreviation / acronym	Description
B	Maximum breadth moulded at or below still waterline
B/T	Breadth-Draught ratio
CAPEX	CAPital EXpenditure
C _b	Block coefficient
CI-ICE	Compression Ignition Internal Combustion Engine
CNG	Compressed Natural Gas
ConOps	Concept of Operations
D	Propeller diameter
D1.1	Deliverable number 1 belonging to WP 1
DAC	Direct Air Capture
DESP	DEsign Ship Powering
DF-CI-ICE	Dual Fuel Compression Ignition Internal Combustion Engine
DISM	Displacement mass in seawater
DISV	Displacement volume moulded
DOC	Diesel Oxidation Catalyst
EC	European Commission
ECHA	European Chemicals Agency
EGR	Exhaust Gas Recirculation
ETA-D	Propulsive efficiency
ETA-H	Hull efficiency
ETA-O	Propeller efficiency in open water
E&S	Equilibrium and Speed
FB	LCB position fwd of 1/2FP
FEU	Forty-foot Equivalent Unit
FI	Frequency index
FN	Froude number
GT	Gross Tonnage
HFO	Heavy Fuel Oil

Abbreviation / acronym	Description
ICE	Internal Combustion Engine
IMO	International Maritime Organization
LNG	Liquid Natural Gas
LPP	Length between perpendiculars
Lpp/B	Length-Breadth ratio
LWL	Length on still waterline
N	Rate of revolution
NOx	Nitro Oxides
OPEX	Operational EXpense
PE	Effective power
PHA	Preliminary Hazard Analysis
PM	Particulate Matter
PS	Shaft power
R	Resistance in general
RI	Risk index
S	Wetted surface area hull
SCR	Selective Catalytic Reduction
SDS	Safety Data Sheets
SI	Severity index
SI-ICE	Spark Ignition Internal Combustion Engine
SOLAS	International Convention for the Safety of Life at Sea
SOx	Sulphur Oxides
SPEC	Ship Power Energy Concepts
SWL	Safe Working Load
TA	Moulded draught at aft perpendicular
TEU	Twenty-foot Equivalent Unit
TF	Moulded draught at forward perpendicular
THDF	Thrust deduction fraction
V	Speed of ship
W	Effective wake fraction on thrust identity

Abbreviation / acronym	Description
WP	Work Package

Executive Summary

The MOSES project has expressed the ambition to design innovative feeder vessels. The innovations for the vessels are concentrated on two different directions, in which the innovations for the maritime industry are being developed and demanded by society. The first one is the ambition to reduce or eliminate harmful emissions by designing environmentally friendly vessels. The second one is the ambition to design a highly autonomous feeder vessel, that is able to sail large part of its route without human intervention. Main drive here is to reduce the number of accidents due to human errors followed by a reduction in cost.

The design of both zero emission and autonomous vessels of this size is beyond the current state of the art of technology. Especially for seagoing vessels the steps that are made in this field are very small. Up to now most zero emission and/or autonomous vessels are operated in a small and coastal area or at inland waters. The design of larger seagoing vessels with a capacity of 100 or more than 600 TEU (Twenty-foot Equivalent Unit) and an increased autonomy range, has not been done before.

In addition, the vessels will be equipped with an autonomous robotic crane, which will be developed in T3.3, T3.4 and T3.5. Finally, the vessels should be able to facilitate the transport of passengers in selected legs of their round trip, which is worked out in T3.6.

Concept designs were made using information from a Greek and Spanish business case (D2.3) in combination with the concept of operation and requirements that were drafted up in D2.4.

In the design of the vessels, partly autonomous operation of the vessels has been considered. This was done in the selection of the equipment but also considering the effects autonomous operations might have on the potential safety of the vessel. The autonomous operation of the feeder vessel concepts described in D3.1 will be further explored within T3.2.

With the first ship parameters, the route and cargo volumes, a so called “trip simulation” was done. In this simulation, the sailing and logistic operations are calculated for a period of two years. From the results of these simulations, it was concluded that the presented logistic ambitions could be fulfilled with a smaller vessel, which lead to the introduction of a second Greek case for which the design process was repeated. The design studies for the Greek case showed that it is technically possible to design a hybrid powered solution, consisting of a methanol fuelled ICE in combination with a battery, which enables partly zero emission operation of the feeder vessel. The operational cost of the hybrid methanol solution is found to be

about 15% more than those for a conventional feeder vessel. This is attributed to the higher price of the selected energy carriers for the innovative feeders.

For the Spanish case both a methanol hybrid powered solution and a battery electric solution were found to be feasible from a technical and operational point of view. The operational cost of the methanol hybrid solution is about 10% lower than those of a conventional design. The cost reduction is derived via the increased autonomy and manoeuvrability of the vessel, which results into lower cost for pilotage and tug assistance.

The preliminary hazard analysis (PHA) for the innovative feeder concepts has resulted in a non-exhaustive list of twelve (12) hazards that are the sources of specific hazardous events. The identified events relate to the following system components, focusing on innovative aspects of the feeder: propulsion machinery, fuel/energy/storage system, cargo space, superstructures and hull.

The main result of the analysis is the identification of five (5) high-risk events, from the total twelve (12), from which further design requirements and risk analysis have been derived. These five events have the following hazards as their source: system complexity, extreme weather conditions, the operation of the on-board crane, and situation awareness with respect to monitoring the cargo space.

Summarizing, the designs of the innovative feeder vessels prove in concept the feasibility for a zero emission and autonomous operational feeder vessel for routes that are not or occasionally being served at this moment. The concepts are in this way not only new, but the various evaluations that were done for the selected hybrid concepts, which are beyond current design practice, show that the realisation of these concepts is possible.

Finally, it must be noted that the future costs of the innovative vessels will be lower in than those of the conventional ones, once a tax related with CO₂ emissions is introduced.