SEAMLESS

SAFE, EFFICIENT AND AUTONOMOUS:
MULTIMODAL LIBRARY OF EUROPEAN SHORTSEA
AND INLAND SOLUTIONS

Publications collected since the start of the project

From the first conceptual steps to the cutting-edge advancements achieved by November 2025, the SEAMLESS project has been steadily charting the course toward a smarter, safer, and more sustainable future for autonomous and smart shipping.

Throughout these years, SEAMLESS partners have combined scientific excellence with technological innovation, producing a wide range of publications that capture the project's progress - from cost efficiency analyses and sensor fault diagnostics to risk mitigation methods, business model evaluations, and novel performance assessment tools.

Each contribution reflects the collective expertise and interdisciplinary collaboration that drive SEAMLESS forward, turning research into tangible pathways for the next generation of autonomous Short Sea Shipping and Inland Waterway Transport.

And this is only the beginning: the consortium is already working on new scientific and technical papers that will further expand SEAMLESS's impact. These upcoming publications, expected throughout 2026, will continue to shape the dialogue on automation, digitalization, and sustainability in the maritime and logistics sectors.

Stay tuned - the SEAMLESS journey toward fully autonomous waterborne logistics is just gaining momentum.

From vision to evidence: SEAMLESS research outputs

Navigating the Future: SEAMLESS and the Next Autonomous and Smart Shipping Frontier, published by PNO Innovation Italia in the summer 2023 edition of European Energy Innovation, explores how SEAMLESS aims to develop and adapt missing technology building blocks and key enabling technologies into a fully automated, economically viable, cost-effective, and resilient waterborne freight feeder service for Short Sea Shipping (SSS) and Inland Waterway Transport (IWT).

Cost Efficiency Of Autonomous And Conventional Ships On The Route Novi Sad – Constanţa, written by Anita Abođi, Vladislav Maraš, Danijela Pjevčević, Aleksandar Radonjić (University of Belgrade, Faculty of Transport and Traffic Engineering), presents the outcomes of a cost calculation and comparison between a conventional and an autonomous ship navigating the route between the Port of Novi Sad and the Port of Constanţa. The aim was to determine the potential of utilizing autonomous ships on the Danube from an economic perspective. The analysis includes the determination of capital, operational, and voyage costs incurred during the navigation of both conventional and autonomous ships. For the purpose of calculating the costs of autonomous ships, electricity costs, Remote Control Centre costs, and Automated Facility Services costs were taken into account.

A Multiple Sensor Fault Diagnosis Scheme for Autonomous Surface Vessels, realized by Abhishek Dhyani, Rudy R. Negenborn, Vasso Reppa (Department of Maritime and Transport Technology, Delft University of Technology), presents a model-based fault diagnosis scheme for ASVs affected by multiple sensor faults. Various monitoring modules comprising nonlinear observers are employed to detect faults occurring in the vessels' navigational sensors.

Active Thruster Fault Diagnosis for an Overactuated Autonomous Surface Vessel, written by Anastasios Tsolakis, Laura Ferranti, Vasso Reppa Reppa (Department of Maritime and Transport Technology, Delft University of Technology), presents a scheme for detecting and isolating actuator faults within ASVs to ensure uninterrupted and safe operation. The method primarily addresses the loss of thruster effectiveness as a specific actuator fault. For fault detection, the proposed approach leverages residuals generated by nonlinear observers, coupled with adaptive thresholds, thereby enhancing fault detection accuracy.

A POMDP model-based online risk mitigation method for autonomous inland vessels, realized by Abhishek Dhyani, Yunjia Wang, Mathias Verbeke, Davy Pissoort, Vasso Reppa (Department of Maritime and Transport Technology, Delft University of Technology; ESAT-WaveCoRe, M-Group, KU Leuven; Declarative Languages and Artificial Intelligence (DTAI), M-Group, KU Leuven), proposes a new method based on a partially observable Markov decision process (POMDP) model for the online risk mitigation of autonomous inland vessels. The POMDP-based method utilizes situational awareness information to assist the vessel's planning and control system in real-time decision-making during hazardous situations, thereby ensuring that the vessel remains in a minimum-risk condition.

A novel method for evaluating ship concept performance in transport systems, co-written by H. Nordahl, E. J. Tangstad, P. Specht, V. C. Podimatas, J.S. Dæhlen, L. A. L. Wennersberg (SINTEF Ocean AS; Laboratory for Maritime Transport, School of Naval Architecture & Marine Engineering, National Technical University of Athens; Institute of Shipping Economics and Logistics), addresses the need for more empirical analyses of innovative waterborne transport performance by presenting a novel method for evaluating ship concept performance in transport systems.

Hazard analysis of autonomous vessel operation during the interaction and execution between remote operation centre controller and onboard controllers, realized by Mir Md Ashfaque Sumon1, Hyungju Kim and Børge Rokseth (Norwegian University of Science and Technology (NTNU)), examines a use case of an autonomous ship with a control hierarchy spanning human operators at the shore side and onboard systems such as the Ship Motion Controller, Power Management System, and Battery Management System. Using the System-Theoretic Process Analysis (STPA) method, the research identifies 127 unsafe control actions that could potentially result in hazards. These findings are classified by hazard severity and operational mode, highlighting where particular attention is required to ensure safe operations. The results provide a structured foundation for prioritizing safety–critical control actions in battery-powered autonomous ships, supporting designers, operators, and regulators in developing more effective risk mitigation strategies. This publication is part of Task 4.3 of the SEAMLESS project and marks another important step toward advancing safe, sustainable, and efficient autonomous inland waterway transport.

Autonomous Ships in Optimized Logistics Ecosystems: Strategic Models and Survey Insights, written by Jorge M. Lara López and Aida Mora Ayuso (Innovation & Port Cluster Development Department, Fundacion Valenciaport), addresses the challenge of integrating autonomous ships into existing logistics chains - a complex task, particularly in terms of developing viable business models. The study analyzes current and emerging business models through a comprehensive survey and a series of expert interviews conducted within the SEAMLESS project. It identifies key drivers and barriers to adoption, evaluates cost–benefit assumptions, and explores interactions with ports and inland waterways.

Evaluating Business Models in Autonomous Shipping: A Systematic Literature Review, authored by Aida Mora Ayuso, Jorge Miguel Lara López, Vladislav Maraš, Angeliki Stouraiti, Antonis Strongylos, Cyril Alias and Amparo Costa Celda (Innovation & Port Cluster Development Department, Fundacion Valenciaport; Department for Waterborne Transportation, University of Belgrade, Faculty of Transport and Traffic Engineering; School of Naval Architecture and Marine Engineering, National Technical University of Athens; Dept. of Logistics & Transportation, DST - Development Centre for Ship Technology and Transport Systems; Documentation Area, Fundacion Valenciaport), presents a systematic literature review of academic contributions related to business models for Maritime Autonomous Surface Ships (MASS). A total of 43 peer-reviewed publications, spanning from 2016 to 2025, were analyzed using a structured coding and segmentation approach. This review provides a foundation for understanding how MASS can evolve from technological concept to commercially scalable solutions within modern maritime ecosystems. Further research should focus on testing these models in real-world conditions.

Operational Safety and Cybersecurity in Autonomous Vessel Mooring and Cargo Handling: A Cascading Effects Approach, written by Anastasia Danopoulou, Nikolaos P.Ventikos, Vassilis Podimatas, Panagiotis Georgantopoulos, Panagiotis Siokouros; National and Technical University of Athens, presents an examination of risk assessment methodologies for autonomous maritime operations. The paper addresses the intersection of operational safety and cybersecurity in the context of mooring and cargo handling systems, focusing on framework development within the SEAMLESS project. Through analysis of cyber vulnerabilities and their potential cascading effects on safety-critical operations, a structured approach to identify, evaluate and mitigate both cybersecurity risks and hazardous scenarios is proposed. This work emphasized the importance of designing autonomous systems that account for critical component interdependencies, ensuring that maritime operations are both safe and secure by design.

Other publications are:

- **The SEAMLESS Approach to Enabling Fully Automated Waterborne Freight Feeder Loop Services**, Nikolaos P. Ventikos, Konstantinos Louzis, Vassilis Podimatas, Angeliki Stouraiti, Odd Erik Mørkrid, Håvard Nordahl.
- **Key Performance Indicators for an Autonomous Short Sea Shipping and Inland Waterway Transport System in Europe: THE "SEAMLESS" PROJECT,** Vasileios Podimatas, Angeliki Stouraiti, Konstantinos Louzis, Nikolaos P. Ventikos, Harilaos N. Psaraftis, Håvard Nordahl.
- **L'engin automatisé circulant sur mer : un navire comme les autres?**, Iolande Vingiano-Viricel.
- **Set- Membership Estimation for Fault Diagnosis of Nonlinear Systems**, Anastasios Tsolakis, Laura Ferranti, Vasso Reppa.

Consortium

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