

NAVIGATING CYBER RISKS ON AUTONOMOUS SHIPS

A Policy and Regulation Perspective

Dr. Fatima Ozcan



Executive Summary

Maritime Autonomous Surface Ships (MASS) have become a reality in the 21st century, with Yara Birkeland leading the way since 2021. The maritime industry has experienced substantial transformation due to rapid technological advancements, resulting in increased dependence on interconnected digital systems. This technological evolution has introduced novel security vulnerabilities, particularly cyber risks, which are not typically encountered by conventional vessels. Current marine insurance policies and regulatory frameworks inadequately address these cyber risks. Standard insurance clauses generally do not cover cyber incidents, and the existing regulations related to these risks are fragmented and insufficient. Therefore, there is a clear need to establish a tailored approach to address cyber risks associated with MASS.

The findings reveal that current forms of these perils fail to explicitly cover cyber incidents, leaving autonomous ships predominantly uninsured against cyber risks. We recommend two main approaches to enhance cyber insurance coverage for MASS: (1) modifying the existing marine and war risk insurance policies to explicitly include coverage for cyber-related incidents; and (2) the development of specialised cyber insurance policies tailored to the unique needs of MASS.

Background

The world's first fully electric, fully autonomous, and zero-emission ship, Yara Birkeland, launched in 2020 in Norway. [1] It successfully completed its maiden journey without any crew onboard, from Horten to Oslo on 18 November 2021. [2] What distinguishes Yara from its counterparts is not only its full autonomy but also its zero emissions, making it environmentally friendly for a cleaner and more sustainable future in shipping. [3]

Another groundbreaking vessel is the Mayflower Autonomous Ship (MAS), designed and constructed as fully autonomous, which became the first autonomous ship ever to cross the Atlantic Ocean. [4] It was launched in Plymouth on 16 September 2020. After a failed attempt in 2021, MAS accomplished its historic transatlantic journey from Plymouth, UK, to North America in 2022. [5] The importance of MAS lies in its ability to cross the Atlantic for the first time and draw its power from the sun.

Another notable achievement is the completion of the world's first commercial autonomous voyage aboard Suzaku, a 749 gross-ton container ship, in the congested waters off Japan's east coast, operating autonomously 99% of the time. [6] This 40-hour journey included 107 collision avoidance manoeuvres, marking a significant step for commercial autonomous shipping. These pioneering examples illustrate how quickly maritime autonomy is advancing and the significant changes it could bring to the industry. However, as these technologies progress, they also bring new challenges and vulnerabilities such as cyber risks that must be carefully managed, highlighting the importance for policymakers to create robust regulatory frameworks to keep maritime operations safe and secure.

About the research

In our research, we critically analysed existing regulations and marine insurance policies to assess how effectively they address cyber risks. We used case law and comparative analysis to evaluate the efficacy of current marine and war risk policies, identifying limitations and gaps that require attention. Our findings led us to propose new strategies specifically designed to address the unique challenges presented by autonomous ships.



Key Findings

Findings on MASS Regulation:

- Autonomous ships are now widely recognised as ships in the maritime industries, with the International Maritime Organisation (IMO) categorising them into four levels of autonomy, ranging from basic automation (Degree 1) to fully autonomous ships (Degree 4). Degrees 2 and 3, which involve remote control- Degree 2 with limited seafarers on board and Degree 3 without any crew- are anticipated to become operational in the near future. [7]
- Cyber risks for MASS are regulated through a combination of international and national frameworks. However, the fragmented nature of these regulations highlights the need for a unified approach. Various IMO committees conducted the Regulatory Scoping Exercise (RSE) to assess how existing maritime conventions address the safe, secure, and environmentally friendly operation of MASS. Although cyber security was identified as a major concern, it was only acknowledged as a gap, without specific recommendations for mitigation.
- The Regulatory Scoping Exercise outcomes emphasise the need for a comprehensive goal-based MASS Code [8], which is planned to be non-mandatory by 2026 and mandatory by 2032. [9] However, the slow pace and lack of coherence in regulatory updates highlight the need for proactive and overarching measures.

Findings on Cyber Risk Framework

- Current guidelines on maritime cyber risk management, though effective in raising awareness, lack enforceable measures and fail to address the specific needs of autonomous ships, leaving a gap in comprehensive cyber risk solutions.
- Cyber risks in maritime operations are classified across legal, insurability, and physical/virtual impact dimensions, with distinctions between malicious cyber attacks and broader cyber risks that include unintentional and accidental incidents. The lack of standardised definitions across industries complicates the categorisation and management of these risks.

Findings on Marine Insurance Policies

- Traditional marine and war risk policies, designed for fully manned vessels facing physical threats, do not adequately address the digital vulnerabilities of autonomous ships, which are particularly vulnerable to cyber attacks that may compromise navigation, communication, and operations.
- Cyber risks intersect with traditional marine and war perils—such as perils of the sea, fire, theft, piracy, capture and seizure, malicious acts, terrorist acts, and hostile acts. Although some aspects of cyber risks resemble these traditional perils, they are not explicitly covered by standard marine insurance policies. The complexity and variability of cyber risks—from targeted attacks to random disruptions—create challenges for integration into the existing marine insurance framework, which predates the emergence of cyber risks. As a result, despite certain overlaps, fully incorporating cyber risks into current definitions of marine and war perils remains challenging.

Findings on the Cyber Insurance Market

- The cyber insurance market has grown significantly in recent years due to the rising frequency and severity of cyberattacks. However, despite this growth, the market remains underdeveloped with challenges such as a lack of standardisation, pricing difficulties, and the complex nature of cyber risks. Standalone and add-on policies offer various coverages; but challenges such as high premiums, unclear policy terms, and a lack of historical data make it difficult for both insurers and businesses to operate successfully in the market.
- Silent cyber risks, where traditional policies unintentionally cover cyber incidents due to a lack of explicit exclusions, pose potential liabilities for insurers. Key cyber exclusion clauses, such as CL 380, LMA 5402, and LMA 5403, aim to clarify coverage boundaries and mitigate these uncertainties, though they have not yet been extensively tested in court.
- If regulatory and insurance frameworks fail to evolve appropriately, not only could this undermine industry confidence in MASS, but it may also disincentivise operators from investing in essential cyber safeguards—potentially increasing the likelihood of catastrophic attacks that disrupt global trade and stall the wider adoption of autonomous technology in shipping.



Proposed Recommendations

Insurance Industry Recommendations:

- **We propose two potential solutions for insuring MASS.** The first solution involves modifying existing policies to better address the risks associated with autonomous ships. It includes adapting existing marine and war risk policies to include cyber risks, either by revising the definitions of traditional perils or by adopting hybrid coverage models that integrate both physical and digital loss protections. The second proposal calls for developing new, standalone policies specifically designed for MASS, across all degrees of automation. These policies are envisioned to be flexible, comprehensive, and capable of adapting to emerging risks.
- **Hybrid models align with current frameworks and offer cost-effective, integrated coverage, but may lack clarity, especially in linking cyber and physical damage.** Standalone cyber policies provide clearer, more tailored protection for evolving digital threats to MASS, yet they are costlier, less standardised, and face challenges due to limited market readiness.
- **While hybrid insurance models combining physical and digital risk coverage have been proposed, their implementation faces unresolved challenges.** This includes impacts on premium structures, risk assessment, and claims management, as well as tailoring these models to different degrees of MASS automation.
- **The economic implications of insuring MASS against cyber risks are significant, impacting costs and market access.** Unquantified factors involve readiness for tailored insurance products designed specifically for MASS, as well as strategies to promote the uptake of comprehensive cyber insurance policies.

Policy Recommendations:

- **The current regulatory environment for autonomous ships is fragmented and lags behind technological advancements.** Harmonised international regulations are needed to address cybersecurity challenges specific to these vessels, with future research focusing on adaptive frameworks that evolve alongside technology and support ongoing updates.
- **The lack of standardised definitions for cyber risks remains a major challenge in both regulatory and insurance contexts.** A universally accepted framework for identifying cyber risks specific to the maritime industry, particularly addressing the unique vulnerabilities of MASS, needs to be developed. Standardisation would not only facilitate clearer communication among stakeholders but also ensure consistency in insurance coverage and regulatory enforcement across jurisdictions.
- **Given the interdisciplinary challenges associated with MASS, future policy reforms should incorporate perspectives from marine insurance law, cybersecurity, and autonomous technology.** Collaboration among these stakeholders will enable the sharing of knowledge, resources, and best practices, thereby enhancing the overall cybersecurity resilience of MASS within the maritime industry.

Contributions and Acknowledgements

This policy brief was developed with support from Public Policy | Southampton's (PPS) 'The New Things Fund' award. The insights and recommendations are based on findings from the author's PhD thesis titled 'Cyber Cover of Autonomous Ships in the Context of Marine Insurance Law', funded by the Republic of Türkiye Ministry of National Education.

Email: f.ozcan@soton.ac.uk

About author

Dr. Fatima Ozcan

Fatima is a Postgraduate researcher and Part-time lecturer at Southampton Law School, University of Southampton. She also works as a senior policy associate at Public Policy Southampton. Her research interests are Marine Insurance law, Cyber Insurance law, and Maritime Law.

This report should be cited as: Ozcan, F. (2025) Navigating Cyber Risks on Autonomous Ships: A Policy and Regulation Perspective. Policy Brief. Public Policy Southampton. University of Southampton. DOI: [10.5258/SOTON/PP0078](https://doi.org/10.5258/SOTON/PP0078)



Relevant Sustainable Development Goals:

SDG 9 Industry, Innovation, and Infrastructure

Bibliography

- [1] Asle Skredderberget, 'The First Ever Zero Emission Autonomous Ship' (YARA) <https://www.yara.com/knowledge-grows/game-changer-for-the-environment/> accessed 20 January 2024
- [2] Naida Hakirevic Prevljak, 'Yara Birkeland, World's 1st Zero-Emission Containership, Completes Maiden Voyage' (Offshore Energy, 2021) <https://www.offshore-energy.biz/worlds-first-zero-emission-containership-completes-maiden-voyage/> accessed 20 January 2024
- [3] Frankie Youd, 'Crewless Cargo: The World's First Autonomous Electric Cargo Ship' (Ship Technology, 2022) <https://www.ship-technology.com/features/crewless-cargo-the-worlds-first-autonomous-electric-cargo-ship/?cf-view&cf-closed> accessed 20 January 2024
- [4] 'Mayflower Autonomous Ship' (Mayflower 400) <https://www.mayflower400uk.org/mayflower-autonomous-ship/> accessed 20 January 2025
- [5] Rob High, 'The Mayflower Autonomous Ship Has Reached North America: Why This Pioneering Transatlantic Voyage Matters for the Advancement of AI and Automation Technology Across Every Industry' (IBM, 2022) <https://newsroom.ibm.com/The-Mayflower-Autonomous-Ship-Has-Reached-North-America?lnk=ushpv18nfi> accessed 20 January 2024
- [6] 'Autonomous Box Ship Trial Concluded in Japan' (Ship Technology, 2022) <https://www.ship-technology.com/news/autonomous-boxship-trial-concluded-japan/?cf-view> accessed 20 January 2024
- [7] 'Autonomous Ships: regulatory scoping exercise completed' (IMO, 2021) <https://www.imo.org/en/MediaCentre/PressBriefings/pages/MASSRSE2021.aspx> accessed 20 January 2024
- [8] 'The Outcome of the Regulatory Scoping Exercise for the Use of Maritime Autonomous Surface Ships (MASS), MSC.1/Circ.1638' (2021)
- [9] 'Autonomous Shipping' (IMO, 2024) <https://www.imo.org/en/MediaCentre/HotTopics/Pages/Autonomous-shipping.aspx> accessed 20 January 2024

<https://doi.org/10.5258/SOTON/PP0124>