



Turning the volume down

by Jukka Suvanto, Senior Sales Manager, Elomatic

For the maritime industry, environmental accountability represents one of the most important factors in shipowners' and operators' decision-making, the impact of which will resonate for decades to come. Beyond reducing greenhouse gas emissions, shipbuilders, owners, and operators are under increasing pressure to address the environmental impact of their operations, both above and below the waterline. One of the most significant yet under-regulated challenges is underwater radiated noise (URN): persistent, low-frequency noise caused primarily by propellers, engines, and on-board machinery. Studies suggest that 91% of Europe's oceans are exposed to continuous noise from commercial shipping, making it one of the most widespread human-induced impacts on marine ecosystems.

For marine species, sound is a life-line, particularly for mammals that rely on it for communication, navigation, hunting, and mating. The result of continuous low-frequency noise disrupts these vital behaviours, where prolonged exposure can trigger disorientation, stress, and even long-term population impacts.

Aside from a ship's propellers and engines, URN is also generated by sonar, seismic surveys, and offshore construction activities such as piling and dredging.

Uneven

Despite growing awareness of the effects of URN, most of the global fleet continues to operate without significant mitigation measures. While the International Maritime Organization (IMO) updated its Guidelines for the Reduction of URN in 2023, they remain non-mandatory, leaving owners-operators with little incentive to take proactive steps to reduce URN emissions. However, the EU's Marine Strategy Framework Directive sets regional limits, establishing that no more than 20% of a marine area can be exposed to continuous underwater noise.

Local incentive schemes also highlight what can be achieved in order to help mitigate URN. For instance, the Port of Vancouver rewards vessels that meet specific noise-reduction criteria through port fee reductions, worth up to CA\$4,000 (€2,700) per call for large container ships. More recently, in June 2025, following the 3rd UN Ocean Conference, 35 countries launched the High Ambition Coalition for a Quiet Ocean, the first global political alliance dedicated to tackling URN. However, without binding international regulations, the pace of progress remains uneven.

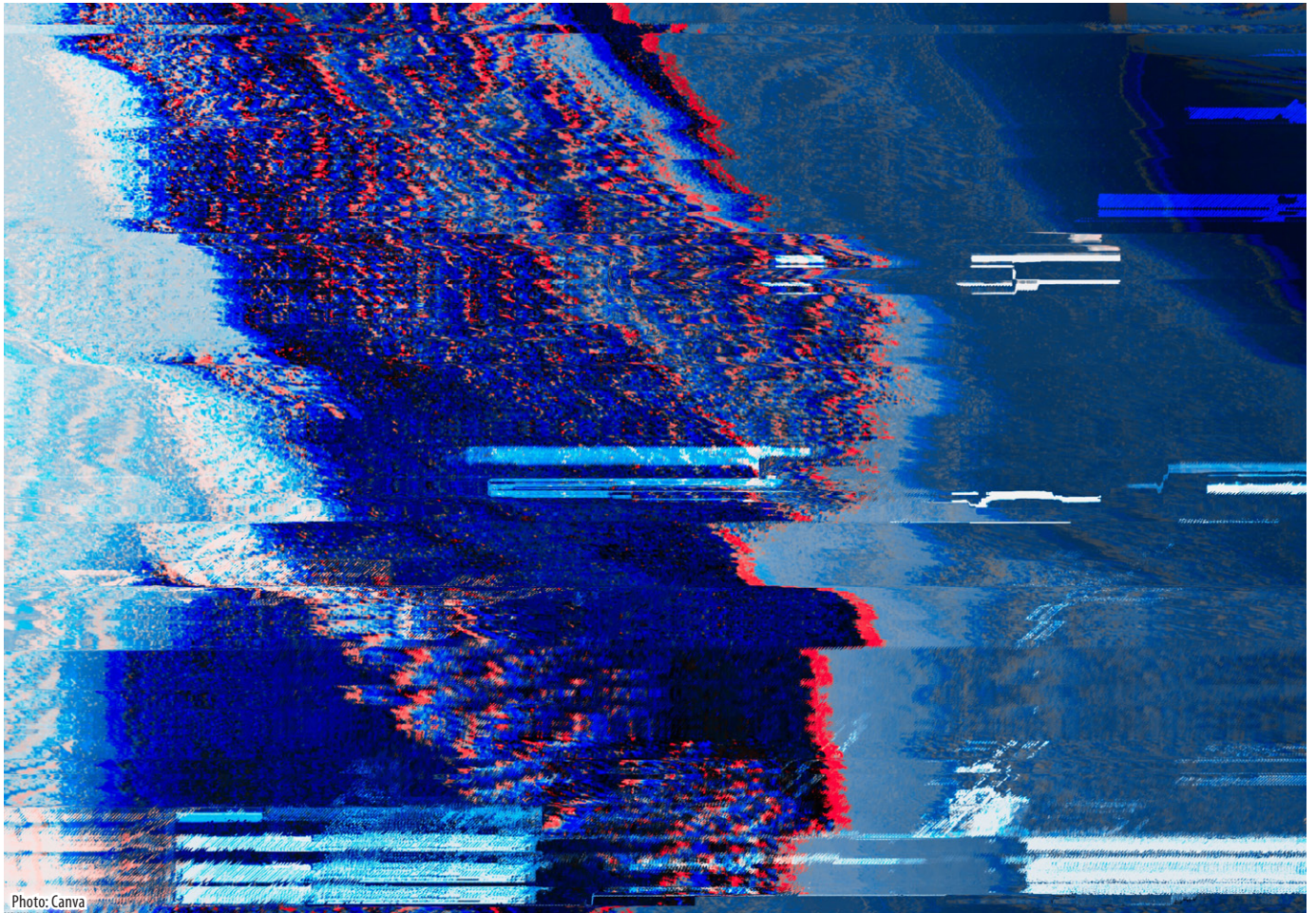
Innovation by design

As regulatory provisions continue to develop, the industry has taken the initiative by developing effective ways to reduce URN within newbuild projects, as well as retrofits, through the use of smarter approaches to design. As part of this effort, Elomatic has partnered with Aalto University to develop a predictive simulation framework capable of estimating a vessel's noise emissions during the design phase. By anticipating the acoustic impact before a single plate is cut, naval architects can optimise hull forms, propeller

geometry, and machinery placement to minimise cavitation and vibration.

Elomatic's approach to advanced marine modelling integrates several highly advanced techniques to provide extremely accurate predictions of fluid dynamics, cavitation, and noise. For turbulence, we employ detached eddy simulation (DES), a hybrid computational fluid dynamics (CFD) model that combines the strengths of Reynolds-averaged Navier-Stokes (RANS) equations and large eddy simulation. DES is particularly effective for simulating complex, turbulent flows around hulls and appendages because it resolves large-scale vortices while numerically modelling small-scale eddies, offering a balance between accuracy and computational efficiency that surpasses RANS-only approaches.

For cavitation, we use the Schnerr-Sauer model, a numerical method based on a simplified Rayleigh-Plesset equation. This model captures the dynamics of vapor bubbles and mass transfer rates, allowing precise calculation of vapor fractions within propellers, pumps, or other marine equipment. By simulating cavitation in detail, it enables engineers to predict potential performance losses and erosion



risks, leading to better-informed design and operational decisions.

To assess underwater noise, Elomatic applies the Williams-Hawkings (W-H) equation, a widely used tool in both aerospace and marine acoustics. The W-H approach calculates far-field noise, generated by moving or vibrating bodies, based on near-field pressure fluctuations. This makes it essential for analysing and mitigating noise emissions from propellers, rotors, and other machinery, ensuring compliance with regulatory requirements, as well as minimising environmental impact.

By combining DES for turbulence, the Schnerr-Sauer model for cavitation, and the W-H equation for acoustic emissions, Elomatic provides an integrated, highly accurate simulation framework. This allows ship designers and operators to improve the performance of their vessels, reduce the risk of cavitation damage, and proactively manage the advent of URN from the ship's operations.

Together, these tools provide detailed insight into likely URN emissions, enabling data-driven decision-making that can inform more targeted vessel design,

alongside integrating energy-saving systems. CFD analysis can also be applied to existing vessels to assess where necessary changes can be incorporated to reduce noise emissions, which can then be integrated as part of a retrofit project.

Along with CFD, mitigating the impacts of URN can be achieved through clean technologies as well as improvements in operational efficiency. Energy efficiency measures (such as slow steaming, wind-assisted propulsion, and air lubrication systems) can reduce both fuel consumption and underwater noise. According to BIMCO, these measures could contribute up to 32% of the industry's decarbonisation effort by 2050, while delivering 5-10dB reductions in URN.

Beyond hull and propeller design, Elomatic also models noise from mechanical

and piping systems, covering pumps, overboarding jets, propulsion train alignment, and pipe geometries. The goal is to reduce acoustic impact in ways that also support performance, fuel efficiency, and life cycle cost optimisation.

Longer delay = costlier compliance

The combination of regulation, voluntary frameworks, and incentive programmes is building momentum towards global standards. But the longer shipowners delay addressing URN, the more costly compliance will become. By embracing innovation at the design phase, owners-operators can future-proof their fleets, access incentives, and safeguard marine ecosystems from one of shipping's most widespread, yet at the same time, solvable environmental impacts. □



Elomatic is an international consulting and engineering company that provides top-level expert services, products and turnkey solutions to process, machinery, marine, energy and pharmaceutical industries. We are focused on continuous improvement and sustainable development, and we are committed to design solutions that increase the wellbeing of people and the environment. Established in 1970, Elomatic employs 1,300 professionals, and has customers in more than 80 countries across the globe. Go to [elomatic.com](https://www.elomatic.com) to discover more.