

Charting a smarter course: redefining offshore wind vessel operations



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Offshore wind's next chapter is being written by intelligent, autonomous vessels that navigate further, safer and cleaner than ever before. With AI-powered systems like Robosys Automation's VOYAGER AI, the industry is redefining what's possible at sea.

The offshore wind sector is advancing rapidly into more challenging territories: larger sites, often further from shore, and increasingly demanding weather conditions due to climate change.

These challenges bring higher demands and expectations for safety, cost reduction, and limiting environmental impacts. At the heart of these operations are crew transfer vessels (CTVs), support and survey boats, whose roles are both mission-critical and cost-intensive. In response to mounting pressures, the industry is embracing artificial intelligence (AI) and autonomy to transform



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vessel operations into uncrewed operations through the adoption of Uncrewed Surface Vessels (USVs)

Here we examine how AI and autonomy are reshaping offshore wind vessel operations, the technical and operational trends involved, and the pivotal role played by Robosys Automation.

Why autonomy matters in offshore wind vessel operations

Understanding the surge in autonomy adoption requires a look at the major issues facing vessel operators in offshore wind:

Transferring crews to turbines amidst rough seas is fraught with danger. Navigational hazards, unpredictable weather, poor visibility, and collision risks with debris or other vessels are ever-present challenges.

Conventional crewed vessel operations are expensive, factoring in fuel, crew wages, maintenance, downtime, and delays from waiting for suitable weather. Optimising routes, maximising uptime, and reducing idle periods are key to cost savings.

There is growing scrutiny over sustainability, emissions, and fuel choices, with inefficient

vessel operations becoming increasingly unacceptable.

As wind farms multiply and expand further offshore, the need for continuous monitoring, maintenance, and logistics grows. Operators demand reliable, affordable vessel support and more predictable operations.

AI and autonomy present solutions to these challenges by enabling smarter navigation, remote or lean-crewed operations, predictive maintenance, and empowering vessels to accomplish more with fewer risks and lower costs.

Key technological trends in autonomous vessel operations

Several technological advancements are driving the evolution of vessel autonomy:

Autonomous and Semi-Autonomous Navigation & Obstacle Avoidance are available with integration AIS, radar, ARPA, LiDAR, sonar and AI-based Computer Vision (CV) systems ie, Perception System, together with decision-making systems facilitating dynamic obstacle detection, collision avoidance, and compliance with maritime regulations.

Remote Operations Centre (ROCs), whether from onshore or from a mothership, can now supervise and control USVs, reducing personnel exposure to risk and enabling operations in hazardous conditions.

Autonomy can be implemented at varying levels, from decision support for human operators to fully autonomous operations, allowing phased adoption and risk mitigation due to its scalable nature.

AI can optimise speed, heading, and route to save fuel and reduce emissions, with integration of electric, hybrid, or hydrogen propulsion further lowering environmental impact.

Offshore autonomy systems must handle communication loss, sensor failure, and severe weather, employing strategies such as return-to-base or manual fallback protocols.

Vessels generate substantial data; therefore, strategies for onboard and off-board data processing must be considered, plus the addition of AI-driven predictive maintenance minimises downtime and prevents failures.

Authorities and classification societies are developing frameworks and standards to ensure safety, liability, and environmental compliance as autonomy increases.

Breaking the mould

Robosys Automation is a leader in AI-powered marine autonomy, vessel control systems, and remote vessel operations. Its VOYAGER AI software platform exemplifies real-world deployment, retrofit capability, and aligns with offshore wind sector needs.

VOYAGER AI's flexible software platform enables autonomy and remote operation for both crewed and uncrewed vessels. Its key features include:

- **Modularity and scalability:** offers a spectrum of autonomy, from decision support to fully autonomous navigation.
- **Sensor & system integration:** open interfaces for integration with existing onboard systems; autopilots, ship controls, thrusters, and supports electronic navigation charts (ECDIS), route planning, replanning, and validation.
- **Collision avoidance & regulatory compliance:** adheres to international maritime rules (COLREGs), integrating multiple sensor inputs for obstacle detection and avoidance.
- **Fail-safe protocols:** automatically invokes safe behaviour, such as return-to-base, if communication is lost or sensors fail.
- **Platform & payload monitoring:** integrates platform controls, sensor alarms, and payloads for survey and environmental monitoring.

These attributes make VOYAGER AI an attractive option for vessels supporting offshore wind operations.

Projects & deployments

In October 2025, Robosys announced the retrofit of a 26-metre Damen 2610 CTV with VOYAGER AI, incorporating remote control,

autonomous navigation, route planning, and collision avoidance. The vessel, operated under Lloyd's Register, demonstrates seamless integration with existing hardware and addresses real mission requirements such as crew transfer and logistics.

Robosys also collaborates with hydrogen-powered USV manufacturer, ACUA Ocean, to integrate VOYAGER AI into hydrogen/electric 14m uncrewed surface vessels designed for long-endurance ocean monitoring and offshore energy site support and intervention. This partnership highlights the merging of clean propulsion with advanced autonomy.

VOYAGER AI is also utilised across smaller survey USVs, such as Uncrewed Survey Solutions (USS) 7m Accession Class USV, to support remote and autonomous control for various survey missions, showcasing the system's versatility across vessel sizes and mission profiles.

Lessons for offshore wind

Several key themes emerge from Robosys' projects and similar initiatives:

Through the upgrading of existing vessels with autonomous capability, as demonstrated by the Damen 2610 CTV, the benefits were broad, including a reduction in capital expenditure, retention of known vessel

performance, and speed deployment; thus, enabling smarter and more efficient operations without the need for new builds.

VOYAGER AI supports a variety of tasks across mixed mission and hybrid environments, such as crew transfer, support, survey, monitoring, and environmental protection, adapting its levels of autonomy and sensor configurations to suit different missions and sea conditions.

Integration with hydrogen-powered USVs and craft powered by electric propulsion reflects a strong commitment to reducing the carbon footprint of vessel operations. VOYAGER AI's compatibility with alternative propulsion systems makes it a forward-thinking choice for operators focused on sustainability

Prioritising safety and trust plus supporting regulatory pathways, VOYAGER AI's features, such as advanced collision avoidance and COLREGs compliance, are regarded as crucial for building confidence among regulators, insurers, and operators. Real-world deployments are generating valuable data and lessons for certification and standardisation.

In addition, the ability to operate and oversee vessels remotely, including robust fail-safe measures, is increasingly vital as wind farms expand further offshore and operate in more hazardous conditions.



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Technology such as AI and autonomy is being realised today, delivering numerous benefits, as demonstrated by Robosys Automation's VOYAGER AI.

Challenges and barriers to widespread autonomy

Despite significant progress, several hurdles must be overcome before autonomy becomes routine:

There are regulatory and classification hurdles to overcome as maritime authorities, flag states, and insurers are still adapting frameworks for certifying autonomous operations and defining liability, standards, and safety requirements. Robosys has experience of achieving certification for IMO Degree 4 Autonomy.

Offshore wind farms face extreme weather, heavy seas, and challenging conditions; therefore, autonomous systems require resilient sensors and hardware.

Remote operations are dependent upon reliable and secure communications; therefore, issues such as latency, bandwidth, and cyber risks must be addressed with robust encryption and redundancy.

The initial costs of sensors, software integration, and retrofits are high, so operators require tangible savings and efficiency improvements to justify this investment.

The successful adoption of this depends on crew and operators trusting the technology, understanding system behaviours, and being able to intervene when necessary.

As autonomous systems proliferate, the need for standardised data formats, control interfaces, and protocols grows; ensuring data integrity and security is essential.

The near future: trends and expectations

Looking ahead over the next few years, several developments are expected to emerge.

As retrofitted vessel operators increase and, in turn, demonstrate positive outcomes, more existing vessel fleets will adopt AI-based decision support, autonomy and remote control to extend their own operational lifespan and enhance safety.

Combining clean propulsion with autonomy will become standard, especially for survey, inspection, and low-speed crew transfer missions.

Long-endurance USVs will support continuous monitoring, inspection, and potentially logistics, often managed from globally dispersed remote operations centres (ROCs)

using seamless and robust transfers of control protocols.

Data-driven AI will be used for scheduling, forecasting, routing, predictive maintenance, and resource optimisation across entire fleets.

As authorities and insurers further establish standards, confidence in autonomous and remote-controlled operations will grow.

Pressure to deliver on net-zero commitments will accelerate the adoption of autonomy and clean propulsion, with greater attention to the full lifecycle impact of vessel operations.

VOYAGER AI's role in the broader shift

Robosys Automation and VOYAGER AI embody the sector's evolution across both onboard and shore-based operations.

Retrofitting operational CTVs demonstrates that autonomy is moving beyond the experimental phase and into mainstream vessel use.

Supporting distributed ROCs with multiple levels of autonomy enables operators to match technology to mission risk and operational need.

By integrating with electric and hydrogen-powered USVs and through the use of these smaller craft, VOYAGER AI helps to mitigate an operator's environmental impact.

Setting Industry Standards: Practical deployments generate data and lessons that encourage regulators and classification societies to formalise effective practices.

Considerations for fleet operators

Operators exploring autonomy and remote operations should bear in mind the following:

- Target high-benefit mission segments first, as repetitive, hazardous, or costly tasks such as crew transfer and inspections are ideal for early adoption.
- Assess retrofit versus newbuild strategies, as upgrading existing vessels can deliver returns more quickly than commissioning new builds.
- Invest in resilient sensor suites and hardware capable of enduring harsh offshore conditions, with adequate redundancy.
- Plan communications infrastructure and remote operations centres carefully,



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ensuring robust connectivity, failover / backup systems, and clearly defined fallback protocols.

- Engage proactively with regulatory and classification bodies to streamline compliance and shape realistic standards.
- Integrate sustainability metrics into planning, considering autonomy, propulsion, energy use, and emissions together.

Conclusion

The offshore wind sector is undergoing a profound transformation. Vessels such as CTVs are evolving from traditional workhorses to intelligent, autonomous platforms that deliver greater efficiency, safety, and sustainability. Technology such as AI and autonomy is being realised today, delivering numerous benefits, as demonstrated by Robosys Automation's VOYAGER AI.

Through retrofits, integration with clean propulsion, adaptable and scalable autonomy levels, and a focus on safety and operational excellence, the industry is forging a smarter path forward.

As these technologies become more widespread, the benefits encompassing lower costs, improved safety, reduced environmental impact, and greater reliability will help offshore wind to achieve its potential as a leading source of clean, scalable energy.

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