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The Rise of Automation in Maritime Transport

As the global shipping industry continues its transition toward greater efficiency, safety and environmental performance, automation is emerging as a key instrument for operational transformation capable of setting the industry on a course for long-term prosperity and sustainability.

Developments including semi-autonomous systems that enhance navigational accuracy, fully crewless vessels operating under remote supervision and self-driving vehicles capable of advanced cargo management are all reshaping onshore and offshore maritime operations to ensure the sector remains competitive and well-positioned to keep pace with the rapidly evolving commercial demands of global transportation.

While automation presents considerable benefits, these are accompanied by complex technical, legal and operational challenges the various stakeholders will need to meet. For insurers, the transition introduces a paradigm shift in risk profiling, underwriting and claims assessment, requiring a re-evaluation of traditional approaches and the development of new, specialised solutions.

Innovative Technologies

Maritime automation encompasses a spectrum of innovations and operational models that span a myriad of technologies to help with everything from onboard decision-support systems and collision-avoidance software to fully autonomous cranes at ports.

A number of factors are converging to drive automation within the shipping industry. Primary among these are economic pressures, particularly the need to improve operating expenses through better fuel efficiency and reducing crewing costs. Closely linked are environmental considerations that encourage route optimisation and speed control. Human error remains responsible for over 75% of maritime accidents, so automation that improves safety across all maritime operations is another area of focus.

The integration of sensors, artificial intelligence (AI) and real-time data analysis marks an evolution in digitalisation that seeks to leverage the vast amounts of data generated within the industry to inform the development of further automation.

The International Maritime Organisation (IMO) completed a scoping exercise that categorises four degrees of autonomy for Maritime Autonomous Surface ships (MASS):

- Degree 1 – Ship with automated processes and decision support
- Degree 2 – Remotely controlled ship with seafarers on board
- Degree 3 – Remotely controlled ship without seafarers on board
- Degree 4 – Fully autonomous ship capable of making decisions and acting independently

The increased prevalence of automation in commercial shipping requires robust and effective regulations to ensure the safety of maritime crew, cargo and assets. The IMO seeks to integrate advancing technology within its regulatory framework to develop a MASS code that balances technology adoption with continually evolving safety and security concerns.

Leading international shipping companies, technology firms and classification societies are investing heavily in pilot projects to secure greater efficiencies and support decarbonisation. The Norwegian vessel *Yara Birkeland*, for example, was the world's first fully electric and autonomous container ship designed to be a proof of concept by Yara International in collaboration with the Kongsberg Group and specialised shipbuilder VARD.
Japan's *Suzaku* travelled 790 km totally unmanned, demonstrating that a container ship could sail and dock itself without a human crew onboard and serving as another early example of autonomous shipping concepts moving from theory into commercial testing.

Benefits of Automation

Automated systems can deliver continuous data analysis using radar, GPS, AIS (Automatic Identification Systems), Light Detection and Ranging (LiDAR), sonar and weather sensors to provide enhanced navigational accuracy and support better decisions. AI and machine learning are pivotal in developing collision-avoidance systems that can process variables faster than humans and help anticipate and prevent incidents. However, watchkeepers and other users must be well-trained and understand how to interpret and leverage data from such systems.

Reducing the dependence on human oversight can also help mitigate fatigue, distraction and errors in judgement. The collision between the container ship *Solong* and the oil/chemical tanker *Stena Immaculate* in UK waters in March 2025 illustrates what can happen when some of these factors are in play.

Automated vessels can optimise speed, routing and fuel consumption in real-time and crewless ships also eliminate the need for life-support infrastructure, which potentially releases additional space for cargo and reduces overall vessel weight. Over sustained periods, diminished crew requirements and lower fuel consumption may result in substantial cost savings. Maintenance can also be streamlined with predictive diagnostics and real-time monitoring, representing further potential savings.

Onshore, the use of automated vehicles and robotic cranes in ports can have dramatic effects on cargo loading, making turnaround times faster and lowering operating costs. Streamlined processes related to inventory management, order fulfilment and communications are further enhanced through automation and contribute to greater time and cost efficiencies.

Challenges and Limitations

Despite its undoubted potential to transform the global shipping industry, automation faces several technical, regulatory and operational obstacles to its widespread adoption. The reliability of the complex ecosystem of software, hardware and connectivity on which it relies is key to maintaining safety, particularly in unexpected situations. System failures, cyber vulnerabilities and sensor malfunctions can introduce new risks, meaning solutions must be designed with redundancy and fail-safe mechanisms to ensure the availability and continuity of critical systems.

While semi-autonomous systems enable vessels to operate specific tasks independently, they still require skilled operators capable of making critical decisions or intervening in complex scenarios. Transitioning to hybrid models requires extensive training and clear operational protocols, as an overreliance on automation can lead to reduced situational awareness or deskilling of crews.

Maritime law, including international conventions such as SOLAS (Safety of Life at Sea) and COLREGs (Collision Regulations), is predicated on the presence of crew. In the absence of humans, questions around liability, accountability and compliance remain unresolved and require existing legislation to evolve. Additionally, increased connectivity introduces vulnerabilities to hacking, data breaches or malicious interference. Cybersecurity standards and incident response plans are therefore essential onboard and at shore-based operations.

The perceptions of automation are central to its development, adoption and effectiveness, with positive assessments leading to increased trust and utilisation. Concerns around job displacement, safety and trust in AI systems can all slow the pace of implementation and investment. System errors can also have significant impacts on navigation and safety-critical operations, which can create scepticism among seafarers, unions and the public.

Operational Impacts

Advanced tools capable of real-time hazard detection and route optimisation can deliver significant navigation, safety and efficiency benefits. However, integration with legacy systems and ensuring interoperability among different vessel types and port systems remain a challenge. Ships must also operate safely in mixed environments alongside conventional vessels, where certain assumptions of behaviour may differ if automation is present.

Safety management improvements are available where automation is engaged for the continuous monitoring of critical systems, such as fire suppression, bilge water levels, structural integrity and engine performance. However, the absence of onboard crew may complicate the response in case of emergencies, so remote decision-making and control systems must be designed with built-in redundancies and manual override capabilities.

An area of considerable promise for automation is predictive maintenance, with real-time data enabling ships to predict component failure and initiate action to optimise resources and reduce downtime. This requires close oversight of data quality and system integrity but has undoubted potential to positively impact costs across maritime operations.

Implications for the Insurance Sector

As automation becomes more embedded in maritime operations, insurers must confront a shifting risk landscape and ensure their products, pricing and claims management evolve to ensure continued alignment. Traditional marine insurance lines, such as hull and machinery, protection and indemnity (P&I), cargo, and liability, must adapt to the introduction of automation and the associated changing risk profiles it brings. Insurers must understand how automation affects the frequency, severity and nature of potential claims and change accordingly.

Underwriting must account for variables such as the level of automation employed, the reliability of the systems, crew training and vendor assurances. In addition, risk assessments should include system testing, compliance with class and flag state requirements, contingency plans and cybersecurity protocols. As is often the case with technology integration, early adopters may face higher premiums or more stringent policy conditions while insurers establish a sufficient claims history.

Determining liability in the event of an incident involving an autonomous vessel presents new challenges. Identifying who is responsible for a collision or how the absence of a human crew affects the apportionment of blame are legitimate areas of contention. Insurers and reinsurers will therefore need to anticipate litigation, potentially involving multiple stakeholders, when determining levels of coverage for large vessels where the potential for greater claims exists.

Greater automation also increases the exposure to cyber risks, ransomware attacks and data integrity breaches. Marine insurers will therefore need the close involvement of cyber risk specialists to offer standalone or integrated cover, leveraging the vast amounts of operational data generated by automated vessels for risk scoring, premium calculation and loss prevention.

Collaborative relationships with shipowners can help gain access to such data, which may facilitate more dynamic, usage-based insurance models. However, governance, privacy and verification issues must be addressed to ensure the viability and veracity of the data used.

Difficulties in responding to salvage and pollution incidents are a further unique challenge created by the increased use of crewless ships. Following an incident, remote coordination with onsite emergency services, risk of system failure and vessels adrift without a crew are all issues that raise questions impacting liability and claims complexity. Insurers must reflect such scenarios and their associated risks in updated policy wordings to mitigate exposure.

The Strategic Role of Insurers

The gains in safety, efficiency and environmental stewardship available with automation have the capacity to revolutionise the shipping industry, but the unprecedented challenges it introduces must be carefully managed.

The insurance sector needs to adapt underwriting models, refine policy wordings and deepen technical expertise to facilitate the industry's digital transformation and help steer it towards a safer and smarter future. It has a vital role in supporting the responsible adoption of maritime automation and, through engagement with stakeholders, can help shape standards, develop best practices and ensure that risk transfer keeps pace with innovation.