



ISSUE

02

CRUISE CONNECT

**The Smart Ship Revolution:
Embracing Technology for Cruise Experiences**

Explore how cutting-edge technologies like AI, IoT and automation are transforming cruise operations and enhancing passenger journeys.

A LETTER FROM LEADERSHIP

The cruise industry is undergoing significant change, driven by tighter regulatory scrutiny, evolving environmental performance goals and rising guest expectations. Digitalization and data driven systems are playing an increasingly important role in how cruise ships are designed, operated and maintained.

This edition of *Cruise Connect* highlights how smart technologies, condition-based class, and intelligent systems verification can support better decisions, from design through operation. The articles explore real-world applications that can contribute to improved vessel performance and stronger compliance, while also helping protect the guest experience and reduce the risk of operational disruption.

As cruise fleets continue to grow in size and complexity, aligning innovation with safety, regulatory compliance and long term operational value is essential. ABS continues to work alongside cruise operators to support the safer and more effective application of new technologies.



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THE SMART SHIP REVOLUTION

—> **Lead Author:** *Eric VanDerHorn, Technology Director, ABS*

A New Era of Cruise Ship Innovation

The cruise industry is entering a decisive new phase. Advanced digital technologies, rising regulatory pressures and growing guest expectations are converging to reshape how fleets are designed, operated and experienced. This smart ship revolution places data, connectivity and intelligent decision support at the center of cruise operations. Operators that embrace this shift will be best positioned to deliver cleaner, more efficient voyages and seamless, guest-centric journeys.

Understanding Cruise Industry Challenges and Opportunities

As ships grow larger, itineraries become more complex, and regulatory demands increase, cruise operators face a decisive moment: either turn data into a strategic asset, or see cost, risk and guest expectations outpace current operating models. Addressing these forces holistically is no longer optional. It is fundamental to long-term competitiveness and resilience. For cruise leaders, this is not only a technological trend, but also a balance-sheet issue. Smart, data-driven ships protect itineraries and revenue, reduce fuel and maintenance costs, de-risk compliance, and strengthen the brand promise to guests and investors.



1

Regulatory Compliance

The industry faces intensifying pressure to improve environmental performance and show a credible path toward regulatory compliance. With cruise ships typically operating for decades, decisions made today on fuels, systems and monitoring will shape compliance, capital allocation and competitiveness for years to come. At the same time, investors are linking capital access and stock value to transparent, data-backed emissions strategies, while passengers increasingly expect operators to disclose how they manage emissions, waste and energy. Meeting these expectations demands integrated, data-driven approaches to energy management, waste reduction, and emissions control that support both profitability and long-term compliance.

2

Operational Efficiency Gaps

Operationally, cruise ships are floating cities. Propulsion, power, hotel and safety systems must work in harmony across complex itineraries. Many fleets still rely on fragmented data from siloed systems and have limited real-time visibility into equipment health and performance. Manual and calendar-based processes struggle to keep pace with operational variability and regulatory complexity, making it difficult to assess risk accurately, forecast degradation and prioritize maintenance investments. For a global fleet, even modest reductions in unplanned downtime, fuel consumption or schedule disruption can add up to tens of millions of dollars annually. To stay competitive, operators need smart ship capabilities that unify vessel data, enable predictive insights and support evidence-based decisions. These capabilities reduce cost volatility and unplanned downtime while aligning maintenance and energy spend with what matters most: safety, reliability, itinerary fidelity and guest satisfaction.

3

Passenger-Centric Innovation

The guest experience is undergoing its own digital transformation. Today's passengers expect a continuous, personalized journey from booking through disembarkation. Digital check-in can streamline arrival and reduce wait times, while wearable devices can be used for keyless cabin access, location-aware services where appropriate and cashless payments. Internet of Things (IoT)-enabled platforms support real-time restaurant reservations, lower-friction service interactions, and tailored recommendations, while digital muster solutions modernize safety procedures and reduce congestion. These digitally enabled experiences don't just delight guests, they can increase onboard spending, improve excursion uptake and drive repeat bookings when supported by reliable operations and resilient information technology (IT) and operational technology (OT) systems. Delivering these capabilities requires balancing innovation with safety, privacy, cyber resilience and operational practicality. The cruise industry has the potential to advance effectively when fleets improve environmental performance, operate more intelligently and deliver a seamless digital guest experience.



Lessons from the Commercial Marine and Offshore Industries

To move forward with confidence, cruise operators can draw on proven lessons from the commercial shipping and offshore energy industries. ABS has long been a leader in evaluating and certifying smart technologies for demanding environments characterized by remote operations, harsh weather and high-stakes decisions. The ABS Guide for Smart Functions for Marine Vessels and Offshore Units provides a framework for evaluating and certifying smart technologies that deliver real-time insights and reduce reliance on scarce human subject-matter expertise. Using this framework, ABS works with solution providers and asset operators to qualify systems such as predictive maintenance tools and digital twins, helping ensure they are fit for purpose and align with goal-based objectives. Predictive maintenance solutions certified under this approach continuously monitor critical equipment, allowing operators to anticipate and address potential failures before they escalate into costly disruptions.

Digital twins, which are virtual replicas of actual vessels, systems or components updated with live and historical data, are especially powerful for the cruise sector. They can model complex systems such as propulsion, power generation, HVAC and hotel loads, helping to enable operators to simulate “what-if” scenarios without affecting the actual ship. These simulations help explore vessel-specific trade-offs among fuel consumption, emissions, comfort and risk, supporting proactive asset management and operational optimization aligned with sustainability goals. In offshore energy, where production units operate far from shore with tight uptime and safety requirements, experience shows that combining digital twins with disciplined condition monitoring and alarm management reduces unplanned downtime and improves operator clarity. Applied to cruise ships, this approach uses real-time equipment health and energy signals to generate explainable recommendations. It also keeps alarms prioritized and correlated so crews focus on what matters, while enabling safety and evacuation modeling to refine routes, muster plans and communications. This can help crews make faster, more consistent decisions that help keep itineraries on track and protect guest comfort and safety.

Smart Solutions for the Cruise Ship Industry

Smart technologies offer a powerful tool kit for addressing growing efficiency and passenger needs. In sustainability and energy management, smart data frameworks transform environmental performance from a reporting obligation into a continuous optimization process. Real-time visibility into emissions, fuel consumption and energy flows gives operators

a clearer basis for benchmarking and optimizing propulsion and hotel loads. It can also inform planning for alternative energy sources and hybrid solutions such as liquefied natural gas, methanol, fuel cells and batteries. These efforts can support compliance with evolving regulations and provide auditable, data-driven reporting to regulators, investors and passengers.

Operational agility is enhanced by real-time condition monitoring and digital twins. Operators can track equipment health continuously, anticipate maintenance needs and adjust voyage plans based on weather, sea state and port conditions. For example, HVAC systems can be monitored and optimized to reduce energy consumption and downtime while maintaining passenger comfort. Predictive analytics for hard-to-access or critical machinery, such as azimuth thrusters, can detect emerging issues early and help avoid costly delays.

The passenger experience improves when these capabilities are paired with intelligent, guest-facing technologies. Smart cabins can adapt lighting, temperature and air quality to individual preferences, while real-time apps allow guests to manage dining, entertainment and excursions on demand. Safety and operational systems function in the background so that that greater personalization does not come at the expense of preparedness or security.

As ships become more connected, cybersecurity is foundational. For cruise operators, cyber incidents can simultaneously disrupt ship operations, impact guest-facing systems and expose sensitive personal and payment data. ABS applies maritime-specific cyber standards and risk-based approaches to onboard digital and control systems, helping operators strengthen protections around safety-critical and guest-facing systems. A disciplined, standards-based approach helps operators stay ahead of evolving regulations and threats, reinforcing trust in digital services and smart systems.

Chartering a Smarter Course Together

At the heart of the smart ship revolution is decision support. Larger ships, leaner crews and growing passenger numbers demand systems that turn complex, cross-domain data into clear, actionable guidance. The goal is simple: systems carry the data burden and generate insights, and crews command the decisions. A unified operational view can bring bridge, engineering and hotel systems into a single, role-aware picture. Together with stronger alarm handling and more reliable performance baselines, it can support safer, more efficient operations and better-informed long-term planning. The smart ship revolution is changing what cruise operators can see, anticipate and act on across the vessel.



*ABS works with solution providers and asset operators to qualify systems... helping ensure they are **fit for purpose** and **align with goal-based objectives**.*

BUILDING TRUST IN INTELLIGENT MARITIME TECHNOLOGIES

→ **Lead Author:** Donghan Woo, Managing Principal Engineer, ABS

Strategically located at the heart of one of the world's premier shipbuilding regions, the Intelligent Systems Technology Center (ISTC) in Korea is dedicated to advancing the trustworthiness, safety and reliability of intelligent maritime technologies. Working with shipyards and technology developers, the ISTC evaluates emerging technologies such as autonomy and AI for use in the maritime industry, focusing on safety, reliability and efficiency. These evaluations are guided by ABS standards, requirements and frameworks for the verification and validation of intelligent systems.

The center has spearheaded key projects that apply these frameworks to the operational assessment of intelligent technologies. These efforts support practical solutions for the cruise industry to tackle complex operational challenges, such as safer navigation, optimized energy use and reducing environmental impact.

Safe navigation is a top priority, and the ISTC has been involved in several key initiatives, including collision avoidance, remote operations and semi-autonomous systems. In one example, the ISTC led the review of an AI system designed to enhance situational awareness. By integrating multiple data from multiple sources, this system helps mitigate blind spots and improve navigation in congested waterways, narrow channels and busy ports. For cruise operators, where safe and precise navigation is critical, this technology can help reduce collision risk.

In another example, a remote operation system allows onshore teams to monitor and support ship operations in real time via communication networks. By providing enhanced oversight from shore, the system can reduce demands on shipboard crews, supports operational continuity and improve overall reliability. Authority remains on the bridge, while shore teams can help improve visibility and support faster decision-making. Such advancements are especially relevant for the cruise industry, where operators must constantly balance uninterrupted operations with passenger safety.

The ISTC has also supported the review of a semi-autonomous optimization system that dynamically adjusts power distribution and engine performance based on real-time operational data, supporting more informed decisions on machinery management. By continuously monitoring and responding to changing conditions, these systems can identify efficient operating parameters at a given moment, reducing the complexity of decision-making for the bridge and engine room. This helps address key industry challenges such as high fuel consumption and evolving regulatory demands, helping to enable cruise operators to reduce operational costs while supporting compliance goals without compromising vessel performance.

In another application, the ISTC has completed energy-saving evaluations for commercial vessels, demonstrating how AI-applied navigation systems can help reduce fuel consumption while improving operational efficiency. These systems provide operators with suggested route and speed data and, with

operator approval, can automatically adjust steering and engine performance to support route tracking, collision avoidance and fuel savings while keeping the operator in supervisory control.

Drawing on its experience in autonomous and remote operations, as well as smart technologies, the ISTC serves as a trusted third-party bridge between technology developers and vessel owners, supporting the independent verification and validation of these systems against international standards. As fuel remains one of the cruise industry's largest operating costs, the ISTC's findings offer practical insight into the integration of energy-saving solutions. These advancements help align economic and environmental priorities, supporting improved profitability alongside broader sustainability goals.

Finally, in collaboration with global partners, the ISTC is developing a virtual testing framework for autonomous navigation systems. This framework could be used to evaluate collision detection and avoidance technologies under realistic maritime conditions, helping cruise operators assess advanced navigation assistance tools. By utilizing virtual testing, intelligent technologies can be assessed under complex traffic and environmental scenarios before deployment.

With its portfolio of projects and experience across intelligent maritime technologies, the ISTC is well positioned to support the safer implementation of smart technologies in the cruise industry.



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THE FUTURE OF CLASSIFICATION IS DIGITAL, SMART AND CONDITION-BASED

→ **Lead Author:** Ryan Salamati, Operations Senior Manager, ABS

As the cruise industry accelerates its journey toward greater digitalization, efficiency and passenger experience, the role of classification is evolving. ABS is leading the way with condition-based class, a shift from traditional calendar-based surveys to a more dynamic, data-driven system that can support a smarter, safer and more efficient operating environment.

From Calendar to Condition: The PMP Framework

At the foundation of this shift are the preventative maintenance program for maintenance systems (PMP-MS) and PMP for digital (PMP-DG) [BC3.1] notations, designed to align class with the realities of modern fleet maintenance and data governance.

The PMP-MS notation applies to vessels where all machinery is covered under a planned maintenance system. Instead of rigid survey due dates, vessels undergo flexible, annual audit-based surveys. For cruise operators, this means major benefits in turnaround efficiency, less disruption to embarkation schedules, more predictable dockside maintenance and reduced port delays. Various systems can be verified under a structured audit program rather than sequential surveys, freeing up time for both crew and technical staff.

The PMP-DG notation takes this a step further by connecting a company's computerized maintenance management system (CMMS) directly with the ABS digital infrastructure through a secure application programming interface (API). This allows for digital audits, either remotely or at the operator's premises,

and provides visibility across an entire fleet. For cruise lines managing complex itineraries and global schedules, PMP-DG supports seamless class engagement without interrupting guest operations, enabling faster data validation, fewer onboard disruptions and reduced administrative workload.

Smart Monitoring for Passenger-Critical Systems

Beyond maintenance, digitalization now extends into real-time condition awareness. The SMART (MHM) notation for machinery health monitoring and the SMART (SHM) notation for structural health monitoring support the delivery of continuous insights into asset condition.

The SMART (MHM) notation leverages vibration, oil and temperature analytics to anticipate machinery issues before they affect service. For cruise ships, this has direct relevance to azimuth thrusters, where vibration and bearing performance directly influence passenger comfort and itinerary reliability. The SMART (SHM) notation is for assets that use onboard sensors to measure stress, strain and fatigue in critical areas, correlating structural response with sea state and operational parameters. This supports targeted inspection planning and proactive management of vibration-related comfort issues.

These systems are not theoretical. They can be applied to support propulsion reliability, comfort management and drydock planning, helping operators move from reactive to predictive decision-making.



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Cruise Reliability and Passenger Perception

Cruise operations face unique reliability expectations. Incidents involving propulsion issues, delays or technical failures can rapidly become public and erode passenger trust. Condition-based class provides a more transparent and evidence-driven pathway for verifying system health, showing regulators, operators and guests alike that reliability is being managed proactively and scientifically.

Similarly, for Safe Return to Port requirements, data-driven readiness checks help demonstrate not just compliance, but real-world reliability under operational conditions, a growing area of focus for both flag authorities and operators.

Collaborating with Equipment Manufacturers for Smarter Class

ABS continues to expand digital pathways through collaboration with original equipment manufacturers (OEMs). Co-innovation projects with global technology leaders integrate processed equipment health data and raw sensor feeds directly via secure APIs. By evaluating pressure, load and vibration data from key systems such as engines, propulsion units and auxiliaries, ABS helps validate machinery condition and, where supported by evidence, may grant survey credit without physical opening. This improves efficiency and grounds digital verification in engineering rigor and full regulatory alignment.

From Events to Evidence: A Class Pathway to Propulsion and Comfort Reliability

The cruise sector has experienced several high-profile propulsion and vibration challenges, ranging from service disruptions to emergency repairs. These highlight a shared industry priority: avoiding passenger-impacting events through better foresight and control. Condition-based class turns this intent into action. This model creates a bridge between operational reliability and regulatory assurance, helping operators minimize disruptions while maintaining transparency and safety.

Global Digital Survey Infrastructure

Supporting these digital pathways are the ABS Operations Centers in Houston, Singapore and Athens. Wherever and whenever your fleet operates, ABS can support faster, more informed decision-making.

Digital tools are now part of everyday class activity, not a future concept. Through condition-based class, SMART monitoring and OEM collaboration, ABS is helping cruise operators transform data into reliability, reduce passenger disruptions and build evidence-based trust in the age of smart shipping. This is not just a reimagining of class, it is the foundation of a connected, intelligent and passenger-focused maritime ecosystem.



OPEN DECK

We want to hear from you. Share your thoughts with ABS, so that we can better assist in supporting your fleet.



Scan Here ↗

- What's your experience with smart technologies on board?
- Have you encountered any challenges with new technology on your cruise ships?
- What innovations would you like to see in the future?

WHAT'S COMING UP NEXT

Prepare to explore critical advancements in passenger safety with the next edition of *Cruise Connect!* This issue will delve into how innovative technologies like passenger evacuation modeling (PEM), human factors engineering and digital twins are revolutionizing evacuation strategies by optimizing routes and simulating crowd dynamics. It will also spotlight the ABS Singapore Innovation Research Center (SIRC) and its role in advancing this work. From ergonomic life-saving equipment and intuitive communication systems to accessible muster stations, the next edition will examine how technology and human-centered design are raising the bar for emergency preparedness in the cruise industry. Don't miss this essential issue that could redefine your approach to safety at sea!

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