*An innovator in marine operations risk research*

# The United States Maritime Resource Center

The United States Maritime Resource Center (USMRC) is an independent, nonprofit marine operations and maritime risk research centre. USMRC's programs focus on navigation safety, risk mitigation, human capital development, raising awareness of international shipping and maritime trade, and contributing to environmental stewardship. USMRC employs various maritime simulation technologies in support of these programs as a tool for both traditional and emerging applications.

USMRC's marine operations and maritime risk research integrates industry practitioner expertise and analysis with modelling and simulation tools for risk assessment and proof of concept R&D work. The findings of its research support the development of risk mitigation strategies and best practices as well as serve as the foundation for specialized maritime education and training programs.

Traditional use of navigation simulation software and technologies in marine operations research covers a wide range of applications including terminal design evaluation and proof of operational concepts, new ship design trials, navigation safety assessments, port and waterway design studies, human factors, dredging plan validations, etc. Outcomes from this research have been used to inform and drive maritime education and training activities such as advanced shiphandling and navigation training, bridge resource management and mariner assessments.

USMRC employs both a unique, proprietary navigation simulation system as well as a leading, commercial off-the-shelf system. It has found, through several decades of conducting marine operations and maritime risk research, that real-time, mariner-in-the-loop, full mission bridge simulations tend to yield the most realistic, reliable and practical results. For certain research applications with more limited scope, USMRC has also incorporated the use of desktop simulation workstations into the project with great success.

The key for any maritime research centre and its ability to produce high quality outcomes is having a well-defined and thoroughly tested process in place, combined with the technical expertise to employ both simulation tools and research participants in a manner that optimizes the final outcomes. This includes critical process components such as clearly articulating the problem set, research objectives and assumptions; a robust data collection effort that forms the basis of the precision hydrodynamic and visual modelling work; a comprehensive internal verification and external validation of the vessel(s) and port area models by experienced in-house staff experts and outside marine professionals; fully understanding the capabilities and limitations of the modelling and simulation technologies; and post simulation processing and technical analysis of simulation output data.

**Innovative Use of Simulation Technology**
In addition to employing maritime simulation technology in a wide range of traditional applications in marine operations research, USMRC's emphasis in the coming years will be on expanding its utilization of simulation technologies to conduct innovative, high-end research that addresses emerging maritime risks such as maritime cybersecurity and the mariner-machine interface, implementation of e-navigation, demonstrating new operating concepts for transferring alternative marine fuels and conveying supply chain risks.

Simulation technology also has proven to be a useful tool in exercising the potential impacts

of a cyber disruption on board a ship. Yet, this is only one aspect of what can be examined through simulation with regard to the increased reliance on technology and access to data that the mariner encounters. As the role of the mariner continues to evolve as a result of the seemingly ever-increasing volume of data they are exposed to at sea, the impacts to the mariner profession have yet to be fully understood. Training in dynamic simulation environments allows mariners to reconcile the use of big data, e-navigation and advances in the mariner-machine interface.

As USMRC has demonstrated with the use of simulation to examine cyber threats and the impact of big data on the mariner profession, simulation technology can be used in applications beyond just shiphandling. One such manner is simulating bunker operations for emerging alternative marine fuels, specifically liquefied natural gas (LNG). By employing a fuel transfer simulator created by

an industry leader for LNG-fueled engines, it is able to walk students through the transfer process for LNG prior to students having conducted a live LNG fuel transfer operation.

Beyond educating the mariner, USMRC has found that simulation can be leveraged to advance discussions at the highest levels of the maritime industry. For example, it is using simulation as a means of augmenting an executive level discussion with the shipping industry's leaders and senior government officials on the impacts of human migration on maritime trade and supply chain security.

USMRC continues to pioneer innovative means of leveraging simulation in marine operations research and training to provide solutions to the most complex and demanding challenges facing safe maritime operations.

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