

Priority Issue

Autonomous Ships, Vehicles, and Shipping

Key Facts

- Emerging technology and economic factors are causing the maritime community to consider autonomous ships and vehicles
- Europe currently leads in the research and development of autonomous commercial ships and marine vehicles, for example
 - Project MUNIN – (Maritime Unmanned Navigation through Intelligence in Networks) – EC funded
 - Finnish government and Rolls Royce – Oskar Levander
 - Danish Maritime Authority and Technical University of Denmark
 - Norwegian Forum for Autonomous Ships – 39 companies & organizations, Trondheim fjord autonomous vessel test site
- U.S. has no such integrated strategy or plan for commercial applications of autonomous vessels that includes all stakeholders
- Offshore oil and gas industry has deployed ROVs and unmanned vehicles (surface and underwater) and activities with autonomous vehicles ongoing

Key Facts

- US Navy and DARPA have autonomous vehicle developments related to military applications
 - DARPA developed and testing Anti-Submarine Warfare (ASW) Continuous Trail Unmanned Vessel (ACTUV) for tracking submarines
- Department of Defense also focusing on autonomy and how it can exploit ongoing advances in technology developments that can benefit DOD missions
- National Science Foundation – new research program on Smart & Autonomous Systems leading to long-term autonomy requiring minimal or no human operator intervention
- International Classification Societies have initiated efforts to provide a framework for accepting vessels with varying levels of autonomy



Key Facts

- Need for national efforts to focus on maritime research that can help the U.S. gain a leading role with respect to innovation in autonomous ships and vehicles. Lessons can be learned from other industries which face similar challenges and risks, but in different environments with different characteristics:
 - Auto industry – driverless cars
 - NHTSA has issued Best Practice Guidance for the safe design, development and testing of Highly Automated Vehicles prior to commercial sale or operation on public roads
 - Aircraft industry – unmanned aircraft (drones)
 - FAA has issued operational rules for routine commercial use of small (<55 lbs) unmanned aircraft

Key Issues

- Commonly stated requirement for autonomous unmanned vessels to be acceptable for commercial use, they must be “at least as safe as conventional vessels currently in use for similar purpose.”
- With driverless cars and unmanned aircraft for commercial applications the technology for these autonomous vehicles is maturing faster than the development of sufficient safety standards. To prevent this from happening with marine autonomous ships and vehicles, actions in this regard should be taken sooner rather than later.
- While technological advances and solutions are being developed to enhance the deployment of marine autonomous ships and vehicles there remains a number of technical, operational, regulatory, legal, marine insurance, security, navigation and positional assurance, traffic management, and human factors concerns that need to be addressed.

Key Issues

Concerns:

- Technical – reliability of safety critical equipment and systems, capable sensor technology for situational awareness, and artificial intelligence.
- Operational – autonomous vessel operations should be at least as safe as manned vessel. Levels of autonomy are needed to safely operate unmanned vessel to address items such as docking/undocking, autonomous navigation, interaction between manned and unmanned vessels, and emergency response.
- Regulatory – there is need for a regulatory framework in which design and operation of autonomous vessels can be assessed. Existing conventions and regulations must be updated for autonomous vessels, such as Regulations for Preventing Collisions at Sea (COLREGS), Law of the Sea (UNCLOS), SOLAS, STCW, and national regulations, all of which presupposes a Master and crew.
- Legal – legal implications for unmanned vessels without Master and crew. Questions on liability need to be clarified (e.g., what parties are liable for unmanned vessel operations?).
- Marine insurance – changes are necessary to traditional rules of maritime liability and insurance to include new types of risk such as product liability due to defective products and systems. Transferring risk from Master/crew to products/systems
- Security – security from cyber attacks and from pirates.

Key Issues

Concerns:

- Navigation and Positional Assurance – precision geolocation, time-keeping, and synchronization--Global Positioning System (GPS)--integrity
- Traffic Management – integration of, and operation and communication with, autonomous and manned systems
- Human factors – integration of human elements and the technology system that can function in complex and unpredictable environment. Human element issues include for example:
 - Diminished ship sense
 - Information overload
 - Mishaps during changeovers and handoffs (this problem has occurred in unmanned aircraft system)
 - Boredom and vigilance maintenance

Possible Marine Board Role and Approaches

- Marine Board can hold a focus session with industry, society, and public authority participants from the maritime industry addressing autonomy research and development initiatives and state-of-the-art. Bring attention to the issues and foster a dialogue regarding the adequacy of current programs, plans, and resources.
- Marine Board can focus attention on autonomy as a priority for public and private entities. At the informational stage, the Marine Board can work with potential sponsors to develop a list of maritime priorities in autonomy in the technical, operational, regulatory, legal, marine insurance, security, navigation and positional assurance, traffic management, and human factors areas. The Marine Board can then serve as a liaison with public and private entities performing related assessments delivering relevant products to help promote and implement these priorities.
- Marine Board can host a workshop with broad participation by the maritime and offshore industry, government agencies, and academia to identify current research and development programs, to discuss their contribution to the larger autonomy effort, and identify where there are gaps or needs particularly relevant to the maritime community, and address how such needs can be achieved. Public and private entities can be better informed through such a workshop facilitated by a rapporteur providing a summary of discussions and the posting of all briefings.

Potential Agency Sponsors

Maritime Administration (MARAD)

U.S. Coast Guard (USCG)

Bureau of Safety and Environmental Enforcement (BSEE)

U.S. Navy (USN)

National Oceanic and Atmospheric Administration (NOAA)

U.S. Army Corps of Engineers (USACE)

Society of Naval Architects and Marine Engineers (SNAME)

Society of Petroleum Engineers (SPE)

Offshore Operators Committee (OOC)