



Unmanned & Autonomous Systems: New Opportunities, New Challenges in Ocean Law & Policy

Maritime Law Association of
the United States
- Fall 2021 Meeting -
Boston



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TECHNOLOGICAL INNOVATION

THE 1ST INDUSTRIAL REVOLUTION USED WATER AND STEAM POWER TO MECHANIZE PRODUCTION. THE 2ND USED ELECTRIC POWER TO CREATE MASS PRODUCTION. THE 3RD USED ELECTRONICS AND INFORMATION TECHNOLOGY TO AUTOMATE PRODUCTION. THE 4TH HAS BEEN OCCURRING SINCE THE MIDDLE OF THE LAST CENTURY AND IS CHARACTERIZED BY A FUSION OF TECHNOLOGIES THAT IS BLURRING THE LINES BETWEEN THE PHYSICAL, DIGITAL, AND BIOLOGICAL SPHERES.

- KLAUS SCHWAB



TECHNOLOGICAL INNOVATION: AUTONOMY AT SEA



SpaceX Autonomous Spaceport
Drone Ship

Rolls-Royce/Finferries: First
Fully Autonomous Ferry *Falco*



DEGREES OF AUTONOMY

DEGREE ONE: SHIP WITH AUTOMATED PROCESSES AND DECISION SUPPORT

- Seafarers are on board to operate and control shipboard systems and functions. Some operations may be automated and at times be unsupervised but with seafarers on board ready to take control.

DEGREE TWO - REMOTELY CONTROLLED SHIP WITH SEAFARERS ON BOARD

- The ship is controlled and operated from another location. Seafarers are available on board to take control and to operate the shipboard systems and functions.

DEGREES OF AUTONOMY
Framework for the Regulatory
Scoping Exercise for the Use of Maritime
Autonomous Surface Ships (MASS)
MSC 100/20/Addendum 1, Annex 2

DEGREE FOUR – FULLY AUTONOMOUS SHIP

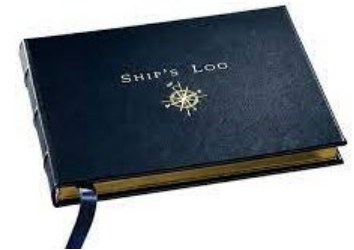
- The operating system of the ship is able to make decisions and determine actions by itself.

DEGREE THREE – REMOTELY CONTROLLED SHIP WITHOUT SEAFARERS ON BOARD

- The ship is controlled and operated from another location. There are no seafarers on board.

IMO Conventions: A “Seafarer”-Based Regime

- Conventions and IMO Regulations are premised/contemplated to have a human onboard
 - Making Notifications
 - Keeping Logs
 - Displaying lights/hoisting signals (day shapes)
 - Bridge-to-Bridge Communications
 - Maintaining proper bridge watch standing
 - Sufficient manning to ensure safety of life at sea
 - Effective crew performance in safety evolutions
 - Requirements to take a pilot onboard





USING AUTOMATION IN NAVAL OPERATIONS



U.S. Navy Unmanned Surface Vessel *Sea Hunter*
(*DARPA*)

USCG *29RDC*
(*USCG Research & Development Center*)





OPERATIONAL IMPACT OF AUTONOMY



MILITARY



LAW ENFORCEMENT



COUNTER
DRUG



SEARCH
AND RESCUE



FISHERIES
ENFORCEMENT



INTELLIGENCE

Counter-Drug: Pros/Cons of Autonomy



Seized drug contraband from
maritime interdiction
operations

Unmanned Aerial Vehicle
(UAV) Launched from
USCG National Security
Cutter



Counter-Drug: Pros/Cons of Autonomy



??????



Duty to Render Assistance

- Customary roots date back to antiquity
- Modern Codification
 - UNCLOS
 - Flag states “shall require **the master**” to “proceed with all possible speed” to render assistance, so long as doing so does not endanger the ship, crew, or passengers. UNCLOS 98(1)
 - Safety of Life At-Sea (SOLAS)
 - “The **master of a ship** at sea” in a position “to be able to provide assistance... is bound to proceed with all speed to their assistance” Chapter V, Reg 33





Duty of Naval Commanders

- Commander's Handbook on the Law of Naval Operations:
 - **3.2.1.2 Duty of Naval Commanders**
 - U.S. Navy Regulations, 1990, Article 0925, requires that, insofar as he can do so without serious danger to his ship or crew, **the commanding officer or senior officer present**, as appropriate, shall proceed with all possible speed to the rescue of persons in distress if informed of their need for assistance; render assistance to any person found at sea in danger of being lost; and, after a collision, render assistance to the other ship, its crew and passengers, and, where possible, inform the other ship of his identity. U.S. Coast Guard Regulations. Section 4-2-5, Assistance (COMDTINST M5000.3B), imposes a similar duty for the Coast Guard.

DUTY TO ASSIST? DEGREES OF AUTONOMY



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Vessel/Ship: What's in a name...

- **'Ship/Vessel' Defined Broadly under Domestic Law**
"Every description of watercraft or other artificial contrivance used, or capable of being used, as a means of transportation on water." 1 U.S.C. § 3
→ See *Lozman v. City of Riviera Beach* (SCOTUS, 2013): structure/watercraft does not fall within 1 U.S.C. § 3's definition of a "vessel" unless a "reasonable observer," looking to the structure or watercraft's physical characteristics and activities, would consider it ***designed to a practical degree for carrying people or things over water.***
- **No Specific Definition for 'Ship' under International Law.**
 - However, majority of scholarship finds that autonomous craft are "vessels" subject to the COLREGS and other international instruments.
- **COLREGS Rule 1(a):** COLREGS "apply to all **vessels** upon the high seas and in all waters connected therewith navigable by seagoing vessels."
- **Ships enjoy Rights (defined in UNCLOS)**
 - Freedom of the Seas/Innocent Passage/Straits Transit/Archipelagic Sea Lanes
- **But, have Responsibilities**
 - Flag State Registration/Jurisdiction
 - Must abide by flag state requirements for seamanship, lookouts, engineering, manning, and pollution control
 - COLREGs (seamanship, collision avoidance, lighting, signals)
 - Customary Duties
 - Render Assistance



PORT AND WATERWAYS SAFETY

THE SECRETARY MAY ORDER ANY **VESSEL**, IN ANY PORT OR PLACE SUBJECT TO THE JURISDICTION OF THE U.S. OR IN THE NAVIGABLE WATERS OF THE U.S., TO OPERATE OR ANCHOR IN A MANNER HE DIRECTS IF HE HAS REASONABLE CAUSE TO BELIEVE SUCH VESSEL DOES NOT COMPLY WITH ANY REGULATION ISSUED UNDER THIS CHAPTER OR ANY OTHER APPLICABLE LAW OR TREATY.

33 U.S.C. § 1223

COAST GUARD REGULATION OF VESSEL AUTONOMY



FLAG STATE AUTHORITY UNDER IMO INSTRUMENTS

- CONVENTION ON THE INTERNATIONAL REGULATIONS FOR PREVENTING COLLISIONS AT SEA, 1972 (COLREGS)
- CONVENTION FOR THE SAFETY OF LIFE AT SEA, 1974 (SOLAS)
- CONVENTION ON STANDARDS OF TRAINING, CERTIFICATION AND WATCHKEEPING FOR SEAFARERS (STCW)
- INTERNATIONAL SAFETY MANAGEMENT CODE (ISM CODE)

DOMESTIC REGULATIONS IN THE CODE OF FEDERAL REGULATIONS

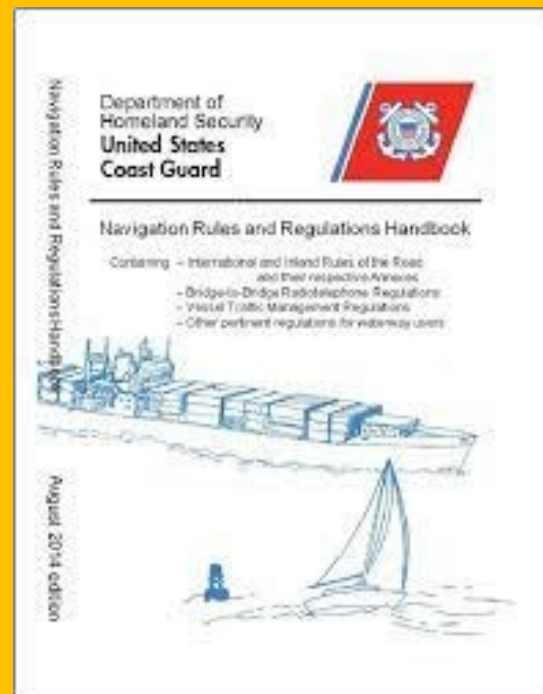
- UNINSPECTED VESSEL – 46 C.F.R. SUBCHAPTER C
- CARGO VESSEL – 46 C.F.R. SUBCHAPTER I
- PASSENGER VESSEL – 46 C.F.R. SUBCHAPTERS H, K, T
- RECREATIONAL VESSEL – 33 C.F.R. SUBCHAPTER S



COLREGS

Case Study

- Rule 2: Responsibility
- Rule 5: Lookout



Rule 5: Maintaining a Proper Lookout

- Every Vessel Shall at All Times **Maintain a Proper Lookout by Sight and Hearing** as well as by all available means appropriate to the prevailing circumstances and conditions so as to make a Full Appraisal of the Situation and Risk of Collision.
 - COLREGS, Rule 5
- Detailed requirements for what the “conning officer” should be able to see (2 ship lengths or 500 meters), bridge design (range of vision in degrees), window size and thickness (to permit sound and see), and height cargo can be stacked above the bridge of a ship.
 - SOLAS Reg 22

Could automated sensors, cameras and audio devices meet the requirements of a “proper lookout” and comply with SOLAS regs?

- SOLAS permits deviations and functional equivalents, e.g. “sound reception systems” are permitted to fulfill the requirement for bridges that are too insulated from outside sounds. (IMO V/19)
- **COLREGS, unlike SOLAS, offer no provisions for substitutions or functional equivalents.**
 - Onboard personnel maintain ability to exercise control
 - Prof Allen – Can a ‘Master’ be a program or a well tested system?



Rule 2: Responsibility

- Nothing in these rules shall exonerate any vessel, or owner, master, or crew thereof, from the consequences of any neglect to comply with these Rules or of the neglect of any precaution **which maybe required by the ordinary practice of seamen**, or by the special circumstances of the case.... This requires **due regard** to all dangers and to any special circumstances, **which may make a departure from these Rules necessary** to avoid immediate danger.
 - COLREGS, Rule 2
- So the rules require “due regard,” “ordinary practice of seamanship,” and “departure from the rules.”
- Technological Challenge:
 - Challenge 1: Programming to **follow rules**.
 - Challenge 2: Programming to know when **to break rules**.



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Questions?



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