E-NAVIGATION 2019

AUTONOMOUS SHIPS MEET THE COLREGS

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“Unmanned” and “Autonomous” Vehicles

The Blind Men and the Elephant Fable, Ancient Buddhist text *Udana* 6.4 (ca. 1,000 BCE).
THE EVOLUTION OF UMV

1. The manned ship operated from an e-Nav enabled bridge that provides information to a navigating OOW.

2. The manned ship operated from an e-Nav enabled bridge with a monitoring OOW who relies on automated decision support systems.

3. The manned ship operated from a virtual bridge (Rolls Royce concept).

4. The “unmanned ship” remotely operated from a shoreside control center manned by the shipowner or a fleet service provider.

5. The unmanned fully autonomous ship.

The IMO defines MASS and divides the term into 4 categories that vary by level of autonomy and whether manned or unmanned.
SHOULD UMV BE TREATED DIFFERENTLY?

• Unmanned vessels present unique safety, vulnerability, and security concerns; they might be safer than manned vessels in some applications, but pose greater risk in others.

• Uncertainty regarding reliability of control systems and their vulnerability to cyber, manipulation, exploitation, attack, or disruption.

• Human in the loop? There is no one on board to communicate with, to clarify vessel’s nationality, nature of operations, cargo, or intentions.

• Accountability, responsibility, and liability concerns.
SCOPING

• UNCLOS Issues.
• SOLAS/MARPOL/STCW Issues.
• COLREGS Issues:
  – Rule 2: Good Seamanship/Special Circumstances
  – Rule 3: Definitions
  – Rule 5: Look-out
  – Rule 7: Risk of Collision (undefined)
  – Rule 9: Narrow Channels (undefined)
  – Rule 10: Catalyst for Positive Shoreside Control?
  – Rule 11: Vessels “In Sight”: The key to B-II or B-III rules.
  – Rule 19: Restricted Visibility (rules on lights/sound signals)
IMO INTERIM GUIDANCE ON MASS TRIALS (2019)

• Maritime Autonomous Surface Ship (MASS) trials should be conducted in a manner that provides at least the same degree of safety, security and protection of the environment as provided by the relevant instruments.

• Risks associated with the trials should be appropriately identified and measures to reduce the risks, to as low as reasonably practicable and acceptable, should be put in place.
IMO’s Four MASS Degrees of Autonomy

• MASS: a vessel that is capable of being operated without a human on board in charge and which has alternative control arrangements available.

• The IMO divides MASS into 4 degrees of autonomy that vary by degree of autonomy and whether it is manned or unmanned.

  – An “unmanned” vessel is defined as one that is not operated or controlled by on-board “seafarers.”

  – On any given voyage, a MASS may operate in more than one of the four degrees.
THE IMO’S FOUR DEGREES OF AUTONOMY

1. Ship with automated processes and decision support; seafarers operate and control the vessel, but some may be automated.

2. Remotely controlled or operated, but with seafarers aboard, who can intervene if and when needed.

3. Remotely controlled [by licensed seafarers?] and without any seafarers aboard.

4. Fully autonomous ships. The ship’s operating system is able to make decisions, choose courses of action and execute them, without human intervention.
When WIG Craft emerged, COLREGS was amended (not merely re-interpreted) because 1972 Conference never considered them.
Unlike SOLAS, no “Equivalencies” can be substituted under COLREGS!

• *Machine Executable Collision Regulations for Marine Autonomous Systems*: two-year project to evaluate COLREGS (and good seamanship) compliance by autonomous ship navigation systems.

• Participants: Rolls Royce (project lead), Lloyd’s Register, Atlas Elektronik, Queen’s University Belfast, and Warsash University.

• Testing conducted: desktop, simulator (two-ship and multiple ship encounters using historical case studies), and on an USV.

  On-the-water COLREGS compliance testing also conducted with *Sea Hunter*.
**Other Possible Responses to UMV**

- Larger role for class societies (certifying the collision avoidance system/software).
- Safety (and security) minded states will likely insist on shoreside control over UMVs in their waters by increasingly automated VTS; that control will likely be extended to manned vessels (drawing on the Air Traffic Control model).
- Pilotage may also shift shoreside.
- UMV owner liability for collisions will be strict, not requiring proof of “operator” negligence.
- It is unlikely UMV owners will be able to meet the legal standard for limitation of liability.
THANK YOU

THE “DASHBOARD” OF THE 2019 GENERAL MOTORS CRUISE AV