



Unmanned ships and navigation: the regulatory framework

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Fundamental questions



- What are the regulatory obligations of unmanned craft and their operators?
- Can they and their operators comply with these obligations?
- Does the regulatory framework need to adapt?

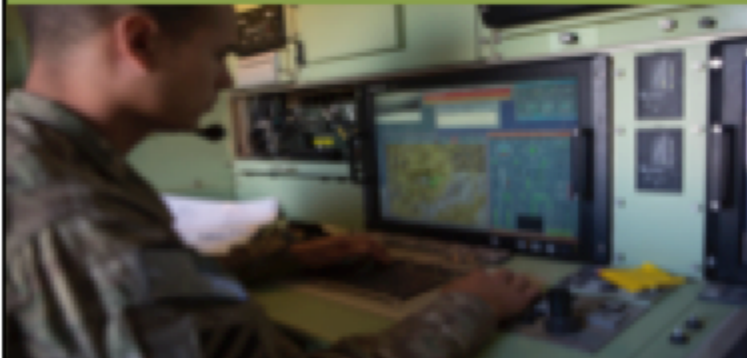
The technology



Unmanned control methods

Remote Control

- Human in loop
- Computer screen / joystick



- Line of sight
radiocommunication
- GPS (over the horizon)

Autonomous Operation

- Human **not** in loop
- **Pre-programmed** to set nautical course



- Sonar radar
- Control algorithms

Today



The (not so distant) future



The existing regulatory framework



- International law of the sea
 - UN Law of the Sea Convention 1982
- IMO Regulations
 - Convention on the Safety of Life at Sea 1974
 - Convention of Standards of Training, Certification and Watchkeeping
 - MARPOL
 - International Regulations to Prevent Collisions at Sea 1972
- Civil Liability Conventions
 - Salvage Convention 1989
 - Limitation of Liability for Maritime Claims Convention 1976
 - Nairobi Wreck Removal Convention
 - International Convention on Civil Liability for Oil Pollution Damage
- Domestic Shipping Legislation
 - Merchant Shipping Act 1995 (UK) etc.

Do “unmanned CRAFT” come within the existing framework?



Yes

No

Navigational rights
(innocent passage,
high seas)
Limitation of Liability
Uniform standards
Certification for port
access

No UNCLOS
freedoms and
protections?
Unlimited liability?
No uniform
standards
National regulatory
and safety systems

Do “unmanned CRAFT” come within the existing framework?



- Existing regulations generally applicable to “ships”
- Is an “unmanned craft” a “ship”?
- Can there be a “ship” without seafarers?
- Seemingly, **yes**:



- Merchant Shipping Act 1995, s.313 (England and Wales)
 - Code des Transports, Art L.5000-2 (France)
 - Burgerlijk Wetboek (BW) Boek 8 (Book 8), Art 194 (Netherlands)
 - Title 1, § 3 US Code - Rules of Construction Act (United States)
- **UNMANNED SHIP MUST COMPLY WITH EXISTING REGULATIONS!**

Regulatory compliance

1. Crewing requirements
2. Collision avoidance
3. Personnel training



Crewing requirements



- UN Law of the Sea Convention, Art 94
 - requires that:
 - “each ship [must be] in the *charge of a master* ...who possess appropriate qualifications, in particular in seamanship, navigation, communications and marine engineering, ...”

Crewing requirements

Remote controller of unmanned ship?



Crewing requirements

Pre-programmer of autonomous unmanned ship?



Crewing requirements



What is a “master”?



- S.313 Merchant Shipping Act 1995 (UK):
 - “every person (except a pilot) having *command or charge* of a ship”

International convention for the safety of life at sea (SOLAS)



- Technical requirements for ships
 - Chapter II (Structure)
 - Chapter III (Fire protection)
 - **Chapter V (Navigation)**



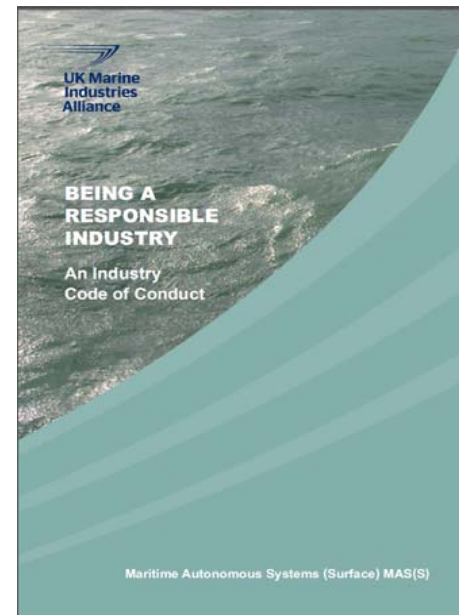
Regulation 14: Ships' manning

- “1. Contracting Governments undertake, each for its national ships to maintain / adopt measures to ensure that from the point of view of safety of life at sea, all ships shall be ***sufficiently and efficiently manned***.”
- “2. For every ship ... the Administration shall:
 - Establish appropriate minimum safe manning following a transparent procedure, taking into account the relevant guidance adopted by the Organization
 - Issue an appropriate **safe manning document** as evidence of the minimum safe manning considered necessary
- Development of industry standards and practices is *fundamental*

Industry standards and practices: the battle for hearts and minds



- **The burden of proof of safety is on the operator**
 - Voluntary codes of practice
 - Collaboration with the relevant maritime authorities
 - Codified reference document
 - **A checklist for authorities to rely on**
 - **Long-term process**



Collision Avoidance



Regulation 24 (SOLAS) : Use of heading / track control systems

- “In areas of high traffic density ... and in all other hazardous navigational situations where heading / track control systems are in use, it shall be possible to establish manual control of the ship’s steering immediately”
- “The officer in charge of the navigational watch shall have available without delay the service of a qualified helmsperson who shall be ready at all times to take over steering control”

Collision Avoidance



The International Regulations for Preventing Collisions at Sea (COLREGS), 1972

Overview

- Part A - General
- Part B – Steering and Sailing Rules
- Part C – Lights and Shapes
- Part D – Sounds and Light Signals
- Part E - Exemptions



Rule 2 (Responsibility)

- “(a) Nothing in [the] Rules shall exonerate any vessel or master...from the consequences of any neglect to comply with [the] Rules or ... any precaution required by the ordinary practice of seaman or by ... special circumstances...”
 - Overarching standards of seamanship
 1. Deviation from the rules mandatory
 2. Need for real-time human judgement

Rule 5 (Look-out)



- “Every vessel shall at all times maintain a *proper* lookout by *sight* as well as by *hearing*, as well as by all available means appropriate in the prevailing circumstances ... so as to make a full appraisal ... of the risk of collision”
 - Does it require people?
 - Requires human perception and judgment
 - Does it require *seafarers*?
 - Cameras and sound receptacles for shore streaming
 - An adequate substitute?
 - » Historic use of shore side support?
 - » Historic use of technological advances?
 - Is the lookout *proper*?

Rule 8 (Action to Avoid Collision)



“(a) Any action taken to avoid collision shall, if the circumstances of the case admit, be positive, made in ample time and with due regard to the observance of good seamanship”

- Can unmanned ship’s communications facilitate this?

Rule 18

(Responsibility between vessels)



- “(a) A power driven vessel underway shall keep out of the way of, among others, vessels not under command.”
 - Rule 3(f): “vessels not under command”
 - “vessel which, through some *exceptional circumstance* is unable to manoeuvre as required by the Rules and is therefore unable to keep out of the way of another vessel”.
 - “Exceptional circumstances”?
 - Engine failure
 - Unmanned operability?
 - Loss of communications?

Part C: Lights and Shapes



- Essential capability
 - Emission & detection
- Rule 27 (Vessels Not Under Command or Restricted in their Ability to Manoeuvre)
 - “(a) a vessel not under command shall exhibit (i) two all-round red lights in a vertical line where they can best be seen”.

Personnel training



- STCW *Convention* does NOT apply
 - Article 3: The Convention shall apply to “seafarers *serving on board* seagoing ships...”.
- Development of training standards and practices is **fundamental**
 - Nautical training
 - Technological training

The development of industry standards and practices



- Greater emphasis on manufacturer and product liability
 - Quality control and testing
 - Camera and microphone minimum capabilities
 - Communications
 - Cyber security
- A long-term process

Conclusions



- Autonomous technology is here *today*
- Unmanned ships fall within the existing regulatory framework
- Difficulties with autonomous operation
- Modest amendments required to make remote-controlled unmanned operation *legal*
- Long-term challenge is to develop practices in unmanned operations in order to make it *happen*



Thank you

For further information:

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