Autonomous and remotely controlled ships: new regulation; new liabilities?

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"Maritime Autonomous Surface Ships" (MASS)

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MASS: Fundamental questions

1. Can MASS and their operators comply with international (IMO) regulations?
2. How will *liability* be impacted by unmanned and autonomous operations?

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Terminology – what does it all mean?

- Manned : crew on board
- Unmanned : *no* crew on board
- Remote controlled : ship navigated by *persons* located *elsewhere*
- Autonomous : computer *decision-making* capability without human input
- "Autonomous" does *not* mean "unmanned"

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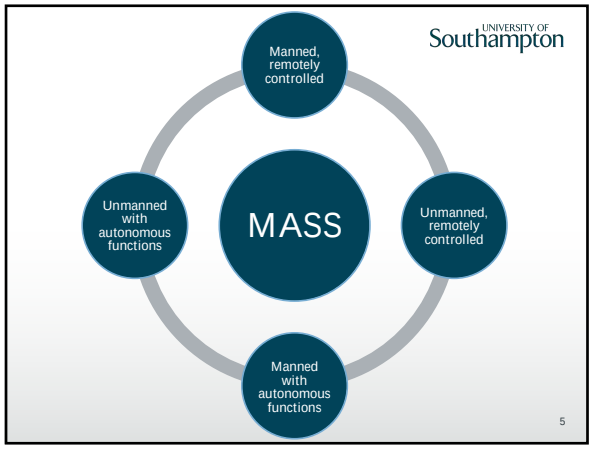

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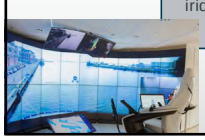
MASS control methods

Remote-control
- Human-in-loop
- Camera live-feed
- Radiocoms
- Satellite / iridium

Autonomous operation
- Spatial sensors
- RADAR / LIDAR
- Computer data processing
- Control algorithms



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The "existing regulatory framework"

- International law of the sea
  - UN Law of the Sea Convention 1982 (UNCLOS)
- IMO Regulations
  - Convention on the Safety of Life at Sea 1974 (SOLAS)
  - Convention of Standards of Training, Certification and Watchkeeping (STCW)
  - The International Convention for the Prevention of Pollution from Ships, 1973 (MARPOL)
  - International Regulations for Preventing Collisions at Sea 1972 (COLREG)
- Civil Liability Conventions
  - International Convention on Civil Liability for Oil Pollution Damage (CLC)
  - Nairobi Convention on the Removal of Wrecks 2007
  - International Convention on Salvage 1989
  - Limitation of Liability for Maritime Claims Convention 1976

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Regulatory compliance

Article 94(3) UNCLOS

(3) Every State shall take measures ... to ensure safety at sea with regard, ... to:

(a) the construction, equipment and seaworthiness of ships;

(b) the manning of ships and the training of crews...;

(c) the use of signals, the maintenance of communications and the prevention of collisions.

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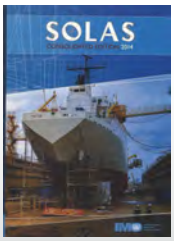
Construction and equipment

- International Convention for the Safety of Life at Sea (SOLAS)
  - Chapter II-1 (Construction – Subdivision and stability, machinery and electrical installations)
  - Chapter II-2 (Fire protection)
  - Chapter III (Life saving appliances)
  - Chapter IV (Radiocommunications)
  - Chapter V (Navigation)
  - ...



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Construction and equipment

- SOLAS Chapter V (Navigation)
  - Regulation 15 – *Principles relating to bridge design*
- All decisions are made for the purpose of applying the requirements of Regulations 19, 22, 24, 24, 25 and 28 and which effect bridge design – the design of the navigational systems and equipment on the bridge shall be taken with the aim of:
  1. Facilitating the tasks to be performed by the bridge team and the pilot in making a full appraisal of the situation and in navigating the ship safely under all operational conditions
  2. ...
  3. Enabling the bridge team and the pilot to have convenient and continued access to essential information which is presented in a clear and unambiguous manner, using standardized symbols and coding systems for controls and displays.

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Construction and equipment

- International Convention for the Safety of Life at Sea (SOLAS)
  - Chapter IV (Radiocommunications)
    - Reg 16:
      1. "Every ship shall *carry, personnel* qualified for distress and safety radiocommunication purposes to the satisfaction of the Administration." ...
  - See also the Part VIII STCW Code (Watchkeeping)

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Construction and equipment

- International Convention for the Safety of Life at Sea (SOLAS)
  - Bespoke regulation for autonomous systems?

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B) Crewing requirements

- UN Law of the Sea Convention, Art 94(4)
  - 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, …''

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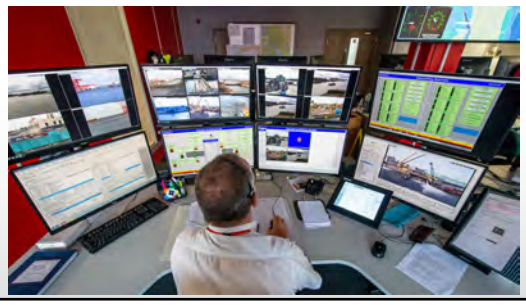
B) Crewing requirements

Remote controller of unmanned ship?



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B) Crewing requirements

Pre-programmer of autonomous unmanned ship?

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B) 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"
    - Autonomous ships do not comply if unsupervised

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Regulation V/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
- Resolution A.1047(27) Principles of Safe Manning

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C) Collision Avoidance

The International Regulations for Preventing Collisions at Sea (COLREG), 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

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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 standard of seamanship
    1. Deviation from the directions sometimes mandatory
    2. Need for real-time human judgement
  - Autonomous and unsupervised ships probably cannot comply
  - Remote controlled ships probably can

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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

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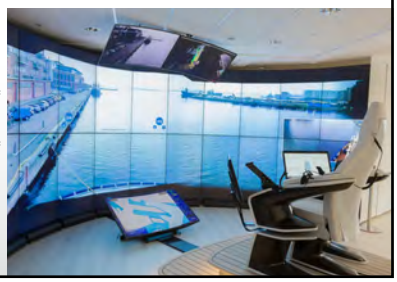
Rule 5 (Look-out)

- Does is 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*?



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Watchkeeping requirements

- STCW Code, Chapter VIII – Watchkeeping
  - Part 4, para 18 (Watch arrangements)
    - "when deciding the composition of the watch on the bridge … [a number of] factors shall be taken into account.." including one that "at no time shall the bridge be left unattended".
  - Part 4, para 24 (performing the navigational watch)
    - the "officer in charge of the navigational watch shall … in no circumstances leave the bridge until properly relieved".

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Personnel training : "the human element"

- International Convention on Standards for Training, Certification and Watchkeeping for Seafarers (STCW) Chapter VIII (Watchkeeping)
  - Article III
    - The Convention shall apply to "seafarers *serving on board* seagoing ships…".
    - Literally, the STCW Convention finds no application to shore-based personnel
- New regime needed for:
  - Remote controllers
  - Pre-programmers
  - Pilots

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Reforming the *regulatory* framework

- MASS control method effects regulatory compliance
- Clarifications and amendments needed to regulatory framework
- Integrated approach essential
- Goal—based standards?

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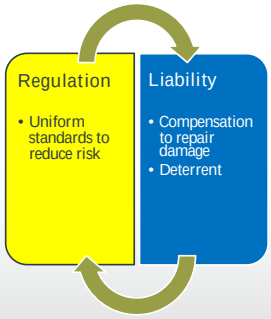
Ensuring safe and clean shipping



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The current *liability* framework

- Maritime liability regimes funnel third-party liability to *shipowner* (generally)

Art III(1) CLC
Except as provided in paragraphs 2 and 3 ..., the owner of a ship at the time of an incident, ... shall be liable for any pollution damage caused by the ship as a result of the incident.';

Art 3(1) Athens Convention
For the loss suffered as a result of the death of or personal injury to a passenger caused by a shipping incident, the carrier shall be liable to the extent

Art 10(1) WRC 2007
Subject to article 11, the registered owner shall be liable for the costs of locating, marking and removing the wreck under articles 7, 8 and 9, respectively, unless

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The current liability framework

- Maritime liability regimes funnel third-party liability to *shipowner* (generally)

Art 3, 1910 Collision Convention
If the collision is caused by the fault of one of the vessels, liability to make good the damages attaches to the one which has committed the fault.

The Merchant Prince [1892] P.129

- Doctrine of "inevitable accident" may be available to shipowners for collision caused by latent defects in ship
- High threshold; must show accident could not have been avoided

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The current liability framework

- Third-party liability funnelled to *shipowner*

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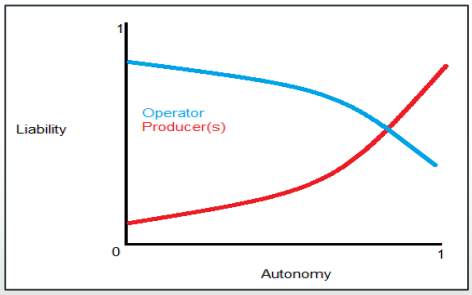
A shift in the liability trend?



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Autonomous technology

- Hardware (sensors)
- Software
- Algorithms
- Components thereof
- More than automation

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An increased role for product liability?

- Product liability: liability claims against manufacturers and designers of *products*
- Will the increased reliance on autonomy mean an increased number of product liability claims?

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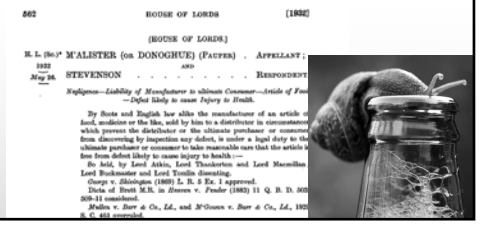
The tort of negligence

- Manufacturers owe duty of care to users of product and public at large
- Relevant to *all* sectors
- Applicable to all foreseeable personal and property damage


562 HOUSE OF LORDS [1932]

(HOUSE OF LORDS.)

M'ALISTER (or DONOGHUE) (PAUPER) . APPELLANT;

AND

STEVENSON . . . . . RESPONDENT.

Negligence—Liability of Manufacturer to ultimate Consumer—Article of Food —Defect likely to cause Injury to Health.

By Scots and English law alike the manufacturer of an article of food, medicine or the like, sold by him to a distributor in circumstances which prevent the distributor or the ultimate purchaser or consumer from discovering by inspection any defect, is under a legal duty to the ultimate purchaser or consumer to take reasonable care that the article is free from defect likely to cause injury to health:—

So held, by Lord Atkin, Lord Thankerton and Lord Macmillan, Lord Buckmaster and Lord Tomlin dissenting.

George v. Skivington (1869) L. R. 5 Ex. 1 approved.

Dicta of Brett M.R. in *Heaven* v. *Pender* (1883) 11 Q. B. D. 503, 509-11 considered.

Mullen v. *Barr & Co., Ltd.*, and *M'Gowan* v. *Barr & Co., Ltd.*, [1929] S. C. 461 overruled.

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The tort of negligence

- Lessons from aviation …
- *Lambson Aviation v Empresa Aeronautica* [2001] All ER (D) 152.
  - Crash after failure of Artificial Horizon gyroscope
    - Gyroscope manufacturers NOT negligent
  - Important factors:
    - Expectations of on-board crew
    - Compliance with CAA standards
      - "*considerable but not decisive weight*"

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"Reasonable" usage, operations and expectations of MASS

- What MASS usage is "reasonable"?
  - What kind of operations?
  - Relevance of manning?
  - *Degree* of autonomy?
- *Hindustan Steam Shipping Co Ltd v Siemens Bros & Co Ltd* [1955] 1 Lloyd's Rep. 167.
  - Expectation of human intervention often prevents liability in *automation* context
  - Same expectation for *autonomy*?

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MASS compliance with relevant standards

- Importance of effective standardisation
- Regulation and best practices still developing
  - Compliance is important but *not* conclusive evidence of due care (under tort *and* Directive 85/374)

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A new liability trend?

- Unclear whether general liability direction will change
- Public expectations and societal acceptance key factors in success of product suits
- Effective standardisation very important
- Producers *not* entitled to global limitation under LLMC
- Time to pause for reflection?

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