Autonomous Vessels
Legal Challenges and Opportunities

-by-

Michael G. Alexiou

Legal Director

DAC LISTED NYSE

Danaos Shipping CO. LTD

Industry Ahead of Regulation

- **Yara Birkeland**: Anticipated to launch in 2020 and commence unmanned operations by 2022. Yara, the fertiliser company that owns the Yara Birkeland will use the vessel to transport its products in Norway in order to replace 40,000 truck journeys per annum and reduce Yara's CO2 and NOx emissions.

- **ASKO Project:** Fully electric autonomous RoRo feeders for 16 trailers. It will cross the Oslo fjord and aims at replacing 1 million truck klms per annum.

- **Seashuttle Project**: Semi-autonomous container feeder running on hydrogen fuel cells. Trading between Oslo fjord, the Swedish west coast and Poland. Aims to develop emission free container vessels that also can compete on cost compared to existing truck-ferry options.

- **NYK:** Developing a manned autonomous ship. The ship shall have an advanced support system with additional functions to assist the human operator based on the existing navigation system. The vessel shall be autonomous but shall require approval of a human operator.

Yara Birkeland

A fully electric – autonomous 120 TEU feeder vessel

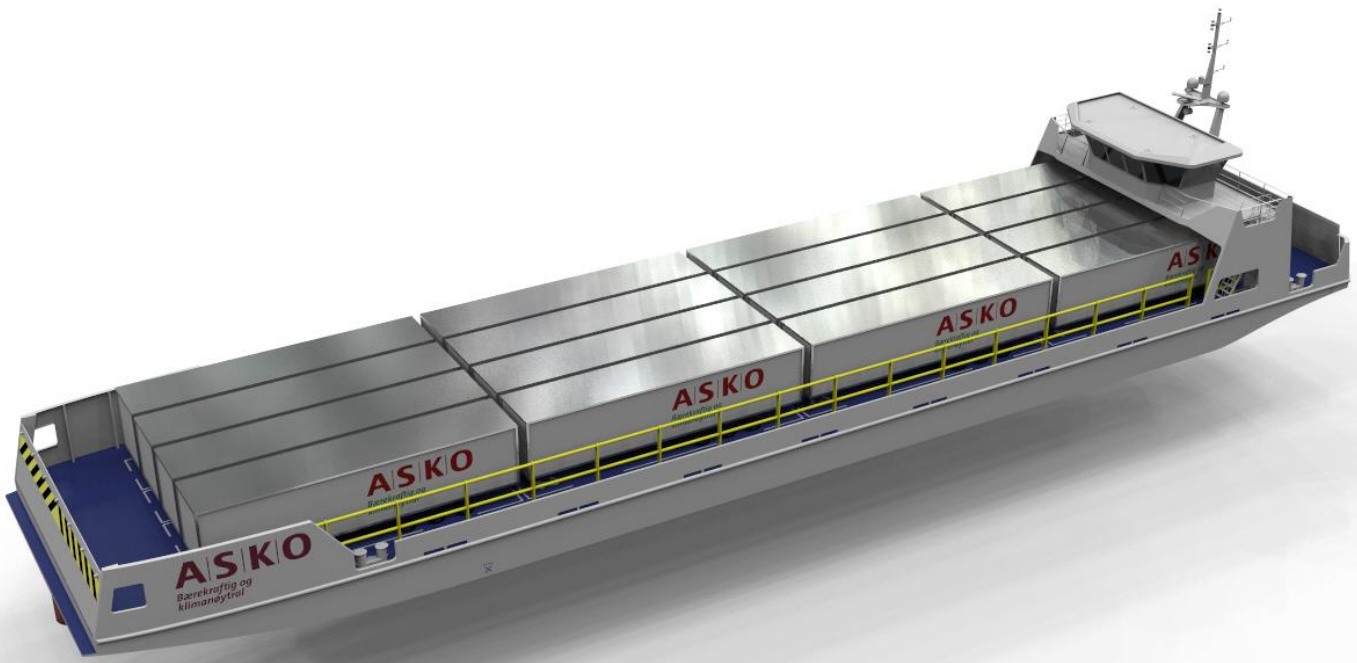
Sailing between Herøyaand Brevik/Larvik
Replacing 25K-40K truckloads/year

Length: 80 m
Width: 15 m
Dwt: 3,200 mt
Service speed: 8 knots
Battery capacity: 6 MWh
Delivery (VardBrevik):Q1 2020
Fully autonomous:2021/22

Source: Massterly

ASKO Project

Fully electric autonomous RoRo feeders for 16 trailers



Sailing between Moss, Holmestrand and Langøya (NOAH)

- Replacing 1 million truck-kms/year
- Length: 66 m
- Width: 15 m
- Service speed: 8 knots
- Battery capacity: 1,7 MWh
- Target delivery: 2020
- Fully autonomous:2021/22

Source: Massterly

Seashuttle Project:

Autonomous container vessel driven by hydrogen fuel cells -trading between Oslo fjord, Swedish west coast and Poland

Awarded €6 Million in support from Norwegian government (PILOT-E program)

- Project lead: Samskip –Europes largest multimodal operator
- Partners: Massterly, HYON (hydrogen integrator) and FlowChange (consultants)
- Aim to develop emission free container vessels that also can compete on cost compared to existing truck-ferry options

Source: Massterly

Benefits of Automation in Shipping

- Eliminate human error: According to the Shipowner's Club, on average 38% of all notified claims are caused by human error. Additionally, 42% of claims are categorised as personal injury claims.
- Reduce crewing costs.
- Reduce Fuel consumption (due to the reduction in weight and air resistance).
- More efficient use of space in ship design.
- A three-year research project by MUNIN (Maritime Unmanned Navigation through Intelligence in Networks) predicted a saving of over $7m over a 25-year period per autonomous vessel in fuel consumption and crew supplies and salaries.

Sources: The Standard Club and the Shipowner's Club

What is an Autonomous Ship?

- The IMO has defined Maritime Autonomous Surface Ships (MASS) as "*a ship which, to a varying degree can operate independently of human interaction*".

The IMO has defined four levels of autonomy:

1. **Ship with automated processes and decision support:** Seafarers are on board to operate and control shipboard systems and functions. Some operations may be automated.

2. **Remotely Controlled Ship with Seafarers on board:** This ship is controlled and operated from another location, but seafarers are on board.

3. **Remotely Controlled Ship without Seafarers on board:** The ship is controlled and operated from another location. There are no seafarers are on board.

4. **Fully Autonomous Ship:** The operating system of the ship is able to make decisions and determine actions by itself.

The IMO is currently conducting a two-step regulatory scoping exercise due in 2020

Step 1:

Assess whether any of the 27 IMO instruments selected are applicable to MASS
and/ or
whether they preclude MASS operations

Step 2:

Determination of the most appropriate ways of addressing MASS operations taking into account of the **human element**, **technology** and **operational factors**

Does Current Regulation Follow Suit?

- Human element is omnipresent in most IMO instruments.
- Current liability regimes target different actors (registered owner/ vessel/ crew).
- Regulation of Artificial Intelligence is not only a shipping problem.
- Can software developers be held liable for defects in their algorithms under IMO instruments (e.g. COLREGS)?
- Can an algorithm replace good seamanship?
- Is a fully autonomous vessel seaworthy?

Convention on the International Regulations for Preventing Collisions at Sea, 1972 (COLREGs)

- Primary International Instrument on the prevention of collisions at sea and on navigational rules.

- Vessel is defined as: "*every description of water craft, including non-displacement craft, wing-in-ground craft and seaplanes, used or capable of being used as a means of transportation on water*".

- COLREGs apply to "*all vessels upon the high seas and all waters connected to the high seas and navigable by seagoing vessels*".

Rule 2: Responsibility

(a) Nothing in these Rules shall exonerate any vessel, or the owner, **master or crew** thereof, from the consequences of neglect to comply with these Rules or of the neglect of any precaution which may be required by the **ordinary practice of seamen**, or by the special circumstances of the case.

(b) In construing and complying with these Rules due regard shall be had to all dangers of navigation and collision and to any special circumstances, including the limitations of the vessels involved, which may make a departure from these Rules necessary to avoid immediate danger.

SUBJECTIVE / HUMAN ELEMENT:

Rule (2)(a): You must follow both the Rules AND the ordinary practice of seamen, i.e. Common Sense

Rule (2) (b): Rule never a justification for not following the Rules. Departure is only justified in order to avoid immediate danger.

Source: NEPIA

Good Seamanship

- Owners, Masters or Crew must take the precautions required by the ordinary practice of seamen.
- Failure to comply with rules of the ordinary practice of seamen may bring about civil or criminal liability.
- There is no rigid test.
- Full adherence to the Rules is prima facie evidence of good seamanship, but Rules do not provide answers to all possible scenarios.

Chapter V/ Regulation 34 of the SOLAS (Safety of Life at Sea) Convention 1974

- This Regulation provides how to navigate safely and how to avoid dangerous situations.
- Regulation recognizes the Master’s exclusive right to make informed decisions on matters relating to safe navigation and protection of the environment.
- 34(3) provides that the owner, the charterer, or the company, as defined in regulation IX/1, operating the ship or any other person, shall not prevent or restrict the master of the ship from taking or executing any decision which, in the master's professional judgement, is necessary for safe navigation and protection of the marine environment.

The MAchine eXecutable Collision Regulations for Marine Autonomous Systems Project

- On 21st March 2018, Rolls Royce announced completion of the Project.
- Rolls Royce and its partners in the Project found that: "*Artificial Intelligence based navigation systems were able to enact the rules to avoid collisions effectively, even when approaching manned vessels were interpreting the rules differently.*"
- Tests were performed on simulator based scenarios and during sea trials.
- "*Trials showed that an unmanned vessel is capable of making a collision avoidance judgement call even when the give-way vessel isn't taking appropriate action.*"
- According to Rolls Royce and its partners, the project demonstrated that autonomous collision avoidance is indistinguishable from good seafarer behaviour.

Source: Rolls Royce

CONCLUSIONS

- By analogy current regulatory instruments can be applied to vessels controlled remotely by transferring the role of Master and Crew to the shore based operator.
- The same can not be said for fully Autonomous Vessels (AI Developer vs. Vessel Owner).
- Fully Automated Vessels can eliminate human element risks such as fatigue, intoxication, attention deficit, illness etc.
- It is not clear whether current satellite communication capacity allows vessels to be continuously remote controlled (at least in the high seas).
- Underwriting MASS will become challenging (Loss Record vs. Algorithm.)
- Council Directive 85/374/EEC of 25 July 1985 on the approximation of the laws, regulations and administrative provisions of the Member States concerning liability for defective products.

DAC
LISTED
NYSE

danaos