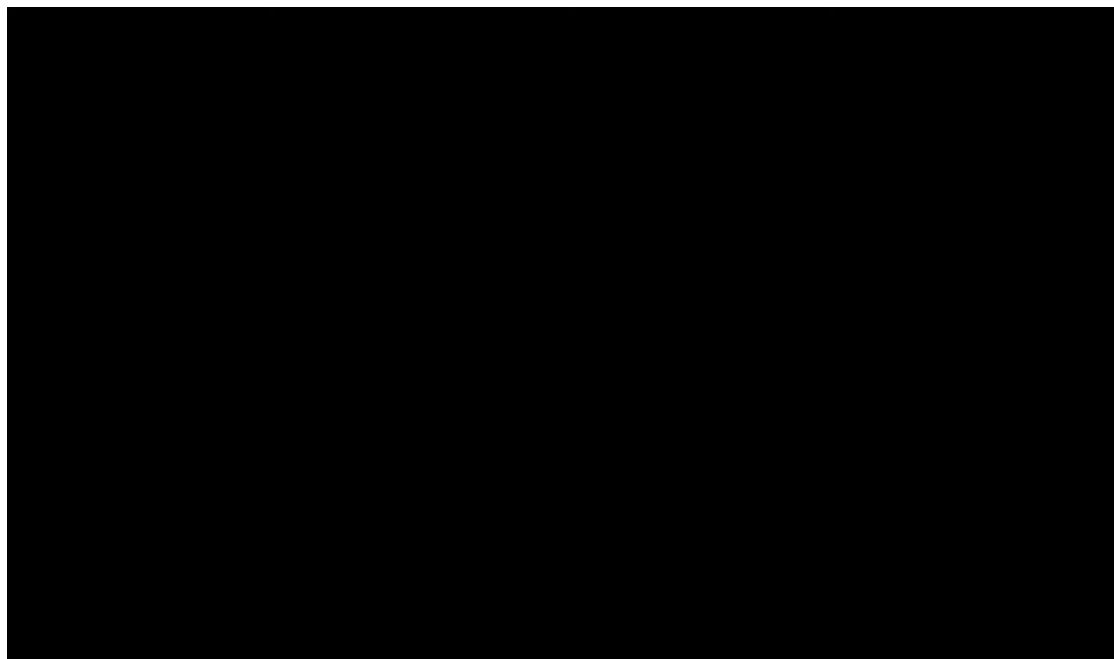


# The Unmanned/Autonomous Ship and Greener Shipping: From a Legal Perspective

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# “M.V. *Yara Birkeland*”: The first zero-emission autonomous ship



# UN Secretary-General: Shipping, aviation have failed to cut GHG emissions

by The Editorial Team — October 15, 2021 in Green Shipping



peaking during the Global Sustainable Transport conference, Mr. Guterres stated that:

“While [UN] member states have made some initial steps through the International Civil Aviation Organization and the International Maritime Organization to address emissions from shipping and aviation, current commitments are not aligned with the 1.5C goal of the Paris agreement. In fact, they are more consistent with warming way above 3C”

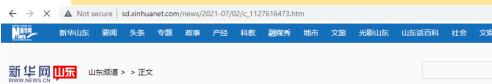
# Outline of my presentation

- I. Introduction: Unmanned/autonomous shipping and its development
- II. Legal status of an unmanned ship
- III. Unmanned ships & greener shipping
- IV. Conclusions

# I. Introduction: Unmanned shipping and its development



*BRINAV (智飞号)*  
Container ship  
Autonomous-control  
Length: 110m  
Capacity: 316 TEU  
Electric-powered



## 我国首艘无人驾驶集装箱船在青岛启航

2021年07月02日 09:16:51 来源: 青岛日报

6月29日,随着一声汽笛长鸣,我国首艘、全球规模最大的自主航行集装箱实验船“智飞”号,在船长的指挥下开青岛造船厂船坞,驶向位于青岛蓝谷附近海域的我国首个智能船舶测试场。

“智飞”号是国内首艘满足无人驾驶自主航行测试需要的沿海集装箱运输船。由交通运输部水运科学研究院作为牵头单位,青岛蓝谷智慧航海(青岛)科技有限公司负责投资建设。“智飞”号总排水量约8000吨,总长117.15米,17.32米,型深9.9米,设计航速12节,续航力4500海里。本船将实现国家重点研发计划项目“基于船岸协同的船舶行与控制关键技术”研发成果的示范应用。

Discover · Design · Deliver

物流及航海學系



*Yara Birkeland*  
Container ship  
Autonomous-control  
Length: 80m  
Capacity: 120 TEU  
Electric-powered

IMO aims to integrate new and advancing technologies in its regulatory framework - balancing the benefits derived from new and advancing technologies against safety and security concerns, the impact on the environment and on international trade facilitation, the potential costs to the industry, and their impact on personnel, both on board and ashore. IMO wants to ensure that the regulatory framework for Maritime Autonomous Surface Ships (MASS) keeps pace with technological developments that are rapidly evolving.

IMO has [recently completed a regulatory scoping exercise on Maritime Autonomous Surface Ships \(MASS\)](#) that was designed to assess existing IMO instruments to see how they might apply to ships with varying degrees of automation. The regulatory scoping exercise (RSE) for safety treaties was finalized at the [103rd Session of the MSC](#) in May 2021, and for treaties under the purview of the [Legal Committee](#), in July 2021.

The exercise involved assessing a substantial number of IMO treaty instruments under the remit of the MSC and identifying provisions which applied to MASS and prevented MASS operations; or applied to MASS and do not prevent MASS operations and require no actions; or applied to MASS and do not prevent MASS operations but may need to be amended or clarified, and/or may contain gaps; or have no

# Unmanned shipping and classification societies (CS)

- The technical guidance documents issued by the CS, e.g.:
  - China Classification Society (CCS) - Rules of Intelligent Ships 2020
  - Det Norske Veritas (DNV) - Class Guideline for Autonomous and Remotely Operated Ships
  - Lloyd's Register (LR) - Guidance Notes for Registration of Autonomous Ships

Classification Societies	China Classification Society (CCS)	Det Norske Veritas (DNV)	Lloyd's Register (LR)
<b>Automated Functions</b>	Navigation Hull Machinery Energy Efficiency Management Cargo Management Integration Platform	Navigation functions Vessel engineering functions Remote control centers Communication functions	Safety Maintenance Performance Security

# Levels of autonomous ship

CCS	DNV	LR
—	<b><u>M</u>: Manually operated function</b>	<b><u>AL0</u> - No cyber access</b>
<b><u>A1</u> – Autonomously operated from anchorage to anchorage; manually operated under other conditions</b>	<b><u>DS</u>: System decision supported function</b>	<b><u>AL1</u> - Cyber access for information only</b>
<b><u>A2</u> – Autonomously operated from anchorage to anchorage; remotely operated under other conditions by onshore controllers.</b>	<b><u>DSE</u>: System decision supported function with conditional system execution capabilities</b>	<b><u>AL2</u> - Cyber access for autonomous/remote monitoring</b>
<b><u>A3</u> – Autonomously operated from berth to berth; remotely operated only when necessary</b>	<b><u>SC</u>: Self-controlled function while human is able to override.</b>	<b><u>AL3</u> - Cyber access for autonomous/remote monitoring and control (onboard permission is required, onboard override is possible)</b>
	<b><u>A</u>: Autonomous function without human intervention</b>	<b><u>AL4</u> - Cyber access for autonomous/remote monitoring and control (onboard permission is not required, onboard override is possible)</b>

- The classification societies, representing the shipping industry from the technical and administrative point of view, accept the smart ships (including the unmanned/autonomous ships) **as a combination of “conventional merchant ships” and “subsidiary smart systems”**, rather than introducing a new concept of “ship”.
- There will be a **gradual progress** of the development of onboard autonomous systems. Throughout the progress, the degree of accessibility of human intervention in performing a task will gradually fade away.
- The ultimate outcome of the development is a ship without human participating in its operation.

\* Yiteng Li and Ling Zhu. “The Technical and Regulatory Aspects of Unmanned Merchant Ships Reconsidered”. *Journal of International Maritime Law*. Forthcoming.



### III. Legal status of an unmanned ship

Is unmanned ship a “ship” as defined in international conventions & domestic statutes?

- But first, what is a legally defined “ship”?
  - The legal definitions of “ship” and “vessel” differ greatly from one international maritime convention to another, because they are very much a function of the subject matter concerned.
  - The maritime laws of different countries include more details when defining a ship. But they may also take different approaches when giving the definitions.

# What is a “ship”?

In the domestic/national legislations: e.g.,

- **UK** - Section 313(1) of Merchant Shipping Act 1995:

*‘Unless the context otherwise requires ... “ship” includes every description of vessel used in navigation.’*

- **US** - Title 1 U.S. Code §3:

*‘The word “vessel” includes every description of watercraft or other artificial contrivance used, or capable of being used, as a means of transportation on water.’*

# What is a “ship”? (Cont’d)

- **Greece** - Article 1 of the Code of Private Maritime Law:

*“Vessel is any craft of at least **10 net registered tones** intended to **navigate at sea** by its **own means of propulsion**.”*

- **Mainland China** - Article 3 of Maritime Code of the PRC:

*“Ship” as referred to in this Code means **sea-going** ships and other mobile units, but does not include ships or craft to be used for military or public service purposes, nor small ships of less than **20 tons gross tonnage**.’*

- **Hong Kong** – Article 2(1) of Merchant Shipping Ordinance of HK

*“ship” means ... every description of vessel capable of **navigating in water** **not propelled by oars**, and includes any ship, boat or craft and an aircushion vehicle or similar craft used wholly or partly in navigation in water.’*

## In the international conventions, e.g.

- **United Nations Convention on Conditions for Registration of Ships**

“... any **self-propelled sea-going** vessel **used in international seaborne trade** for the transport of goods, passengers, or both with the exception of vessels of less than **500 gross registered tons**”.

- **International Convention for the Prevention of Pollution from Ships (MARPOL):**

“...a vessel of any type whatsoever **operating in the marine environment** and includes hydrofoil boats, air-cushion vehicles, submersibles, **floating** craft and **fixed or floating** platforms”.

- **International Regulations for Preventing Collisions at Sea**

“...the word vessel includes every description of watercraft, including **non-displacement** craft and seaplanes, used or capable of being used as a **means of transportation** on water.”

## The basic characters of a “ship” thus include:

- 1) **Floating/Sea-going/Waterborne:** A ship shall float upright on the surface of the water, rather than above or under the water.
- 2) **Self-propelled/Self-powered:** Some national/domestic laws and international conventions consider that being self-propelled is essential for a ship, while some others don't.
- 3) **Navigability:** A ship's navigability means that a ship is capable of moving and being manipulated by humans.
- 4) **Tonnage:** Some of the statutes explicitly stipulate a ship should be above a certain level of tonnage.
- 5) **Used for transportation:** Several legal instruments indicate that transportation is a principal function of a ship.

# What about an unmanned ship?

First, the physical attendance of crew is not considered as a crucial character of being a “ship”.

Second, the differences between unmanned and conventional ships would be the equipment of autonomous navigation systems and information transformation systems; **such improvement in technologies will in no way run contrary to any of the characters of being a “ship”.**

Therefore, unmanned merchant ships would meet no impediment in legally constituting a ship.

\* Xing, Wangwang and Zhu, Ling\* (2021). A Functional Approach to Assessing Legal Status of Ships and Ship-Shaped Structure. *Transport Policy*. Volume 106, June 2021, Pages 120-130.

## IV. What is “green shipping”?

*Green shipping refers to the use of resources and energy to transport people and goods by ship and specifically concerns the reduction in such resources and energy in order to preserve the global environment from GHGs and environmental pollutants generated by ships.*

Lee, Tachee & Nam, Hyunjeong. (2017). A Study on Green Shipping in Major Countries: In the View of Shipyards, Shipping Companies, Ports, and Policies. *The Asian Journal of Shipping and Logistics*. 33. 253-262.

*Green shipping practices can be broadly defined as “the handling and distribution of cargoes in an **environmentally sustainable way** with a view to **reducing waste creation and conserving resources** in performing shipping activities”*

Lai KH, Lun YHV, Wong CWY, Ngai EWT, Cheng TCE (2013) Measures for Evaluating Green Shipping Practice Implementation. *Int J Shipping Transp Logistics* 5(2):217–35

*Green shipping: efficient marine transport with minimal health and ecological damage*

Wan, Z., Zhu, M., Chen, S. *et al.* Pollution: Three Steps to a Green Shipping Industry. *Nature* **530**, 275–277 (2016).

# Pathway to green shipping



## About IMO

“IMO – the International Maritime Organization – is the United Nations specialized agency with responsibility for the safety and security of shipping and the prevention of marine and atmospheric pollution by ships. **IMO’s work supports the UN SDGs.**”

The measures adopted by the IMO “have been successful in reducing ship-sourced pollution and illustrate the commitment of the Organization and the shipping industry towards protecting the environment. Of the **51 treaty instruments for the regulation of international shipping** IMO has adopted so far, **21 are directly environment-related.**”



# IMO's environment-related regulations

e.g.:

- The Protocol on Preparedness, Response and Co-operation to Pollution Incidents by Hazardous and Noxious Substances
- The International Convention on the Control of Harmful Anti-fouling Systems on Ships
- The Ballast Water Management Convention
- The Ship Recycling Convention
- **The International Convention for the Prevention of Pollution from Ships (The MARPOL 73/78)**

- **The MARPOL 73/78 Annex VI Prevention of air pollution** from ships.
- The regulations of Annex VI initially seek to minimize airborne emissions from ships and their contribution to local and global air pollution and environmental problems; and ship-sourced air pollutants include SO<sub>x</sub>, NO<sub>x</sub>, ODS (Ozone Depleting Substance), VOC (Volatile Organic Compounds) shipboard incineration.
- In 2011, IMO adopted mandatory **technical** and **operational** energy efficiency measures (**Energy Efficiency Design Index-EEDI/Ship Energy Efficiency Management Plan-SEEMP**) which are expected to significantly reduce the amount of CO<sub>2</sub> emissions from international shipping.

# Control of GHG emissions

- In 2018, IMO adopts an **initial strategy on the reduction of greenhouse gas(GHG) emissions from ships**.
- In 2021, The IMO MEPC adopted amendments to Annex VI that will require ships to reduce their GHG emissions. The new measures will require all ships to calculate their **Energy Efficiency Existing Ship Index (EEXI)** following technical means to improve their energy efficiency and to establish their annual operational **carbon intensity indicator (CII)** and **CII rating**.

# Unmanned ships and greener shipping

*“...Vessel operations could also become more environmentally friendly, as new autonomous ships are designed to operate with alternate fuel sources, zero-emissions technologies and no ballast. In addition, given fewer or no crew on board, there would be less garbage and sewage to manage and treat.”*

- United Nations Conference on Trade and Development, “Review of Maritime Transport 2018”

*“One of the main purposes of autonomous ships is reduced environmental impact.”*

- Danish Maritime Authority Report (2017): “Analysis of Regulatory Barriers to the Use of Autonomous Ships”

# As for the unmanned ship...

*“It’s really only when you go fully unmanned that you can reduce all the systems. When we add this all together, the reduced electrical consumption when we take out systems, the lower weight of the vessel, the lower wind resistance, we talk about a 10 to 15% fuel savings, for a typical cargo vessel.”*

—— Oskar Levander, vice president of innovation at Rolls-Royce Marine



*Future autonomous ship will benefit from reduced construction costs and higher environmental sustainability due to the removal of superstructure, accommodation and deckhouses.*

——Bjørn Kjærland Haugland, EVP & Chief Sustainability Officer DNV GL



VS.



Annex IV Pollution by  
**sewage** from ships  
Annex V Pollution by  
**garbage** from ships

No crew, no domestic waste.  
No need for treatment  
plant/sewage tank.  
Less structures, more  
flexibility



- **New propulsion & fuel system: Less fuel oil consumption**  
**Clean energy-powered**



DNV-GL calculated in the *ReVolt* project that **the time elapsing between defects on considerable electrical propulsion components is considerably longer than on conventional machinery**, where they also proposed redundant propulsion machinery drives two propellers.

<https://www.dnv.com/technology-innovation/revolt/>  
[https://www.dma.dk/Documents/Publikationer/Autonomie%20skibe\\_DTU\\_rapport\\_UK.pdf](https://www.dma.dk/Documents/Publikationer/Autonomie%20skibe_DTU_rapport_UK.pdf)

# • Smarter energy control system

## • In classification society rules or guidelines:

	CCS	DNV	LR
<b>Automated Functions</b>	Navigation Hull Machinery Energy Efficiency Management Cargo Management Integration Platform	Navigation functions Vessel engineering functions Remote control centers Communication functions	Safety Maintenance Performance Security



## IV. Conclusions

- Unmanned ships would meet no barrier in legally constituting a ship under most of existing domestic and international law.
- The unmanned/autonomous ship can make its contribution to green or greener shipping, particularly following the pathway paved by the IMO.

# Acknowledgement

The research is supported by the following two grants:

1. Project title: “Reducing Greenhouse Gas Emissions from Shipping: Regulatory Challenges, Opportunities and Recommendations for Hong Kong”. Public Policy Research (PPR), Policy Innovation and Co-ordination Office (PICO), HKSAR, HK\$432,975.
2. Project title: “Unmanned/Autonomous Merchant Ships: Liability and Insurance Issues”. RGC, General Research Fund (GRF), HKSAR. HK\$558,000.

# Thank you!

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