



## AUTONOMOUS SHIPS: MASS FOR THE MASSES

Since our last bulletin in January 2022, further promising developments have taken place around the world in the field of autonomous shipping.<sup>1</sup> We have seen an increase in activity in this sector of the maritime industry as various Maritime Autonomous Surface Ships (MASS) projects continue to come online and are fast becoming more widely adopted into mainstream shipping. Competition among players in this field is becoming fierce, with new developments being reported on a nearly daily basis.

<sup>1</sup> <https://www.hfw.com/Autonomous-Ships-Known-Knowns-and-Known-Unknowns-Jan-2022>

A number of autonomous vessels have successfully carried out their first trials, with ships sailing from Norway, China and Japan. At the same time, a newly constructed tug which can be operated from an onshore Remote Operating Centre (ROC), was the first vessel globally to receive the Autonomous Notation from classification society ABS. New orders for survey and multi-purpose autonomous vessels have been placed, evidencing a future increase in the global autonomous vessel fleet.

The outlook for autonomous vessels is not limited to commercial operations. Research has been undertaken on autonomous maritime asset protection systems, for the purpose of detecting surface and subsurface threats. In addition, as evidenced from other ventures, unmanned vessels can be used to collect valuable ocean data and autonomous tenders can assist with recharging other ships from a vessel designed as a safe charging station.

Meanwhile, some progress is being made at a national and international level to identify the issues preventing and restricting MASS operations. According to the minutes of the most recent IMO Maritime Safety Committee meeting (MSC 105), the IMO is aiming to develop a non-mandatory goal-based MASS code which will be ready for adoption in the latter part of 2024.<sup>2</sup> The initial intention is for the non-mandatory code to only be applicable to cargo ships, with the IMO looking into the feasibility for the non-mandatory code's application to passenger vessels taking place at a later date.

Whilst the non-mandatory code will undoubtedly provide guidance for a large proportion of the shipping industry that may be considering adopting MASS, certain categories of vessels such as tugs, survey vessels and offshore vessels will not be catered for. As is evident from the update below, the owners and operators of these types of vessels are

adopting the technology far quicker than other sectors. It seems therefore that an international solution to the regulation of MASS will still have to wait until 2028.

Fortunately, however, it seems that the UK is keen to position itself as a front runner to be a jurisdiction open and willing to accommodate MASS in its waters. In parallel to this we have seen a number of other flag states becoming more accommodating to the registration of MASS. For example, France, Antigua & Barbuda, Australia and Luxembourg, have all indicated a willingness to permit owners to register MASS with them.

## Industry update

### *Yara Birkeland*<sup>3</sup>

Following the two-year hold up due to Covid-19, the 262 ft *Yara Birkeland* commenced its first regular voyage in April 2022 from Brevik Harbour, Norway. The world's first electric autonomous containership has been entered into a two-year trial service period to gain certification after the outfitting and testing of her systems in the last 6 months.<sup>4</sup>

HFW have followed the journey of the zero-emission, autonomous ship since the concept came into play back in 2017. After 5 years of Massterly's joint venture, the ship is now equipped with internal and external cameras, sensors, night-vision lenses, radar and Artificial Intelligence (AI) technology that enables the vessel to react to obstacles.<sup>5</sup>

Travelling at approximately 6-7 knots, the vessel is propelled by two Azipull 900 kW pods along with two 700 kW side thrusters. It has been estimated to replace over 40,000 diesel truck journeys per annum and will be placed on a seven nautical mile course transporting fertiliser from Yara's Porsgrunn plant to Brevik Port prior to domestic and international forwarding. By the end of the trial period, the vessel is set to

autonomously transport and load/unload cargo of up to 120 containers.

While there are currently crew members onboard the vessel, this will gradually change as the ultimate goal is for all jobs to be transferred onshore and for the crew accommodation to be removed once the vessel is satisfactorily operating autonomously. The vessel's robotic mooring arm, designed by MacGregor, is estimated to replace two people who normally carry out this job, and will be the first autonomous operation to be tested.. This will be followed by the move of the chief engineer and then of the two navigators from the vessel to onshore positions.<sup>6</sup>

The launch of the *Yara Birkeland* is an exciting development in the autonomous shipping journey and will no doubt be watched by a significant number of stakeholders in the shipping industry. Having conducted manned sea trials, the focus will now be on the unmanned operations where the owners will be looking to prove the reliability and safety of the ship and the efficiency that this brings to Yara's operation.

### *Zhi Fei*<sup>7</sup>

It is reported that the title of the world's first autonomous vessel in commercial service has been awarded to the Chinese owed *Zhi Fei*.<sup>8</sup> The 384 ft fully autonomous containership was launched onto its regular service route on 22 April 2022 after a substantial trial period commencing in June 2021. The marine technology company Bestway has worked closely with Jiahao Ship Design Institute and the Dalian Maritime University since 2019 to construct the tri-modal operated vessel which can be operated in manned, remote control and unmanned modes.

Travelling at a speed of 8-12 knots between Qingdao Port in Shandong Province and Dongjiakou, the BRINAV managed vessel showcases a

<sup>2</sup> <https://www.imo.org/en/MediaCentre/MeetingSummaries/Pages/MSC-105th-session.aspx>

<sup>3</sup> <https://www.maritime-executive.com/article/yara-birkeland-christened-and-begins-testing-for-autonomous-operations>

<sup>4</sup> <https://www.yara.com/corporate-releases/crown-prince-and-youths-christen-worlds-first-emission-free-container-ship/>

<sup>5</sup> Massterly is a Joint Venture between two established and strong, yet innovative and agile companies: Wilhelmsen and Kongsberg (<https://www.massterly.com/our-owners-1>)

<sup>6</sup> <https://www.tradewindnews.com/technology/yara-birkeland-crew-to-move-onshore-one-by-one-as-autonomous-trials-begin/2-1-1196658>

<sup>7</sup> <https://maritime-executive.com/article/china-reports-first-autonomous-containership-entered-service>

<sup>8</sup> <https://marineindustrynews.co.uk/china-launches-autonomous-container-ship-zhi-fei/>

# “The LNG carrier *Prism Courage* used autonomous navigation systems for half of its voyage from the Gulf of Mexico, US, to South Korea, claiming to have completed ‘the world’s first transoceanic voyage of a large merchant ship employing autonomous navigation technologies.’”

direct current (DC) electric propulsion system. It has been reported that the vessel has a pioneering integration of DC power systems and intelligent operations. The ship has 5G, satellites and a multi-network IT system deployed onboard with remotely controlled operations and capabilities including intelligence driven route planning, and collision detection / evasion.

## **Mayflower (MAS400)<sup>9</sup>**

MAS400, the first self-directed autonomous vessel, completed a historic transatlantic voyage from Plymouth to Halifax, US, despite mechanical failures necessitating two diversions during the voyage.<sup>10</sup> The voyage constituted the vessel's second attempt to cross the North Atlantic. The endeavour to sail from the UK to the US was initially halted by the pandemic and a subsequent mechanical fault back in June 2021. On her second attempt, MAS400 was first diverted to the Azores, Portugal, to troubleshoot a mechanical issue which apparently arose from an isolation switch issue causing power levels to diminish too quickly. The vessel resumed her journey on 20 May in better weather conditions. However, she subsequently suffered a further setback, due to “an issue with the charging circuit for the generator starter batteries”.<sup>11</sup> As a result, on 30

May, MAS400's backup navigation PC system had to be switched on and the vessel was forced to divert again and head to Halifax, where she arrived on 5 June. The vessel's ETA at the US capital (it's planned destination) has not yet been announced.

Fitted with six artificially intelligent cameras, the vessel's systems process over a million images to determine potential obstacles and assess conditions at sea. Satellite connections will allow the delivery of data from the vessel's thirty onboard sensors and fifteen edge devices to onshore control systems. The data has also been made available to the public via the 'Mayflower Autonomous Ship' website, through an interactive dashboard.<sup>12</sup>

The research joint venture has brought together industry stakeholders such as MSubs, IBM, University of Plymouth, and charity ProMare.

In subsequent exchanges with HFW's Paul Dean, the project director and founding board member of ProMare the non-profit maritime research organization that led the effort, Brett Phaneuf, confirmed that “*part of the Mayflower mission is to push on the legal and regulatory soft spots and also recalibrate the risk, widely overstated from my perspective.*”

## **New developments**

### **Avikus' *Prism Courage* completes world's first transoceanic autonomous voyage**

The LNG carrier *Prism Courage* used autonomous navigation systems for half of its voyage from the Gulf of Mexico, US, to South Korea, claiming to have completed “the world's first transoceanic voyage of a large merchant ship employing autonomous navigation technologies”.<sup>13</sup>

*Prism Courage* was built by Hyundai Heavy Industries for SK Shipping of South Korea and was delivered in 2021. Avikus, a subsidiary of HD Hyundai has developed the vessel's autonomous navigation system. This is the semi-autonomous HiNAS 2.0 navigational system, which generates “optimal routes and speeds based on Hyundai Global Service's Integrated Smartship Solution”.<sup>14</sup> Apart from steering the vessel, the system is also reported to have achieved the reduction of fuel consumption by 7% and greenhouse gas emissions by 5%.<sup>15</sup>

Following a 33-day voyage, the vessel passed through the Panama Canal and arrived on 2nd June at Boryeong LNG Terminal in South Korea. Her advanced navigation technologies enabled the ship to

9 <https://www.maritime-executive.com/article/mayflower-autonomous-ship-begins-second-attempt-at-atlantic-crossing>

10 <https://newsroom.ibm.com/The-Mayflower-Autonomous-Ship-Has-Reached-North-America?lnk=ushpvi8nfl>

11 <https://www.maritime-executive.com/article/mayflower-autonomous-ship-diverts-after-second-mechanical-failure>

12 <https://mas400.com/dashboard>

13 <https://www.maritime-executive.com/article/lng-carrier-completes-first-autonomous-ocean-crossing-by-large-vessel>

14 *ibid*

15 <https://www.bloomberg.com/press-releases/2022-06-02/hd-hyundai-s-avikus-successfully-conducts-the-world-s-first-transoceanic-voyage-of-a-large-merchant-ship-relying-on-autonomous>

avoid over 100 potential collisions, optimizing the journey. According to Avikus, *Prism Courage* “sailed half of roughly 20,000 kilometres in total distance with the autonomous navigation technology HiNAS 2.0”, while the vessel’s crew controlled the remaining part of the voyage.<sup>16</sup>

### **Singapore Maju 510<sup>17</sup>**

Keppel Offshore & Marine announced the completion of the *Maju 510* tug as the first joystick-controlled vessel from ashore. The vessel was the first in the world to be awarded the *ABS Remote Control Navigation Notation* in October 2021 utilising M1 designed ‘4.5G’ network to provide the communication systems with ultra-low latency facilitating complex manoeuvres from an onshore operating centre.<sup>18</sup>

The tugboat features ground-breaking technologies such as ABB Ability Marine Pilot Vision and Marine Pilot Control. The vessel is capable of automated navigational observations, processing multiple data sources, assessing risk, decision-making and vessel operation.

The vessel has also been put through extensive testing via / using situation simulation and assessment of vessel behaviour as a result of the outfit of innovative technologies, such as *Digital Twin*. This advanced technology has been developed and provided by KMDTech in collaboration with MPA and the Technology Centre for Offshore and Marine, Singapore (TCOMS).

### **Molten Salt Reactor by Ulstein<sup>19</sup>**

The marine enterprise, Ulstein, released in April 2022 the design for their *Thor* concept vessel powered by a thorium molten salt reactor (MSR).<sup>20</sup> The reactor generates clean electricity by dissolving Thorium, a naturally occurring radioactive metal,

into liquified salt to produce steam to drive a turbine. Thor is designed to be a safe charging station for a brand new line of electric cruise ships. The recharging process will be carried out by autonomous tender vessels which will charge up from Thor and then move around to charge the cruise ships.

Whilst the concept has been proven on land, the implementation into the marine space has yet to be proven but, if successful, the MSR could present an opportunity to reduce carbon emissions.

### **Van Oord's VO:X Metiri<sup>21</sup>**

Van Oord's survey team have recently contracted plans for a second unmanned survey vessel in collaboration with technology company Demcon, following the success of their first DUS V2500 deployment last year.

The new development is proposed to support the construction of maritime infrastructure and offshore wind farms, as well as assisting dredging operations. There are plans in place to improve the autonomous navigation throughout the year, adding to the companies' current “standardised and modular system”.<sup>22</sup>

Propelled using a fully electric system, the survey vessel will facilitate offshore activity in an autonomous, cost-effective fashion in an accurate and compact form.

### **MOL's successful sea trial of autonomous containership**

Mitsui O.S.K. Lines (MOL), together with its two group companies and consortium partners, succeeded in the completion of the world's first sea trial of an unmanned containership in Japanese waters. The trial took place on the 24th and 25th January 2022, in the context of the unmanned

ship project MEGURI2040 led by The Nippon Foundation. The vessel departed from the Tsuruga Port in Fukui Prefecture and completed its journey at Sakai Port in Tottori Prefecture. The sea trial was conducted with two types of vessels: a coastal containership and a coastal car ferry. The vessels employed the MES-S-developed autonomous ship operation control system for their autonomous navigation. Information on other ships and obstacles located on the vessels' routes was collected through the Furuno Electric-developed autonomous surrounding information integration system.<sup>23</sup>

### **DSTL trials of autonomous maritime asset protection system**

The Defence Science and Technology Laboratory (DSTL), in collaboration with the Royal Navy, industry partners and the US Naval Undersea Warfare Centre, carried out research, using autonomous systems alongside traditional ones, in order to enhance “detection, tracking, classification and defeat capabilities against surface and subsurface threats to high value assets and critical infrastructure”.<sup>24</sup> A two-week trial took place in Portland Harbour in October 2021, in which different levels of autonomy were tested. The Maritime Autonomy Surface Testbed vessel MAST-13 and DSTL's containerised system were successfully operated at the trial. A long-range acoustic device was remotely employed, and the “firing of a vessel arrestor system with the aim to stop a suspect craft” was demonstrated.

### **Ocean Infinity**

Ocean Infinity has contracted VARD for the design and construction of six, 85-meter, optionally crewed robotic vessels. The vessels will be built at Vard Vung Tau shipyard in Vietnam and their expected delivery

16 <https://www.digitaljournal.com/business/Ing-tanker-sets-new-record-with-a-semi-autonomous-ocean-journey/article>

17 <https://www.marinelink.com/news/maju-tug-singapores-first-autonomous-495637>

18 <https://www.keppcorp.com/en/media/media-releases-sgx-filings/keppel-to-develop-its-first-autonomous-vessel-for-operations-in-singapore-6564/>

19 <https://www.marinelog.com/technology/video-ulstein-offers-cruising-a-nuclear-option/#:~:text=Autonomous%20tender%20vessels%20would%20charge%20battery-powered%20cruise%20ships,a%20thorium%20molten%20salt%20reactor%20%E2%80%94%20or%20MSR>

20 <https://ulstein.com/news/ulstein-thor-zero-emission-concept#:~:text=Ulstein%20has%20launched%20%27ULSTEIN%20THOR,of%20battery%20driven%20cruise%20ships.>

21 <https://www.vanoord.com/en/updates/van-oord-acquires-second-autonomous-survey-vessel/>

22 <https://www.marinetechnews.com/news/orders-autonomous-offshore-vessel-618121#:~:text=The%20initial%20result%20was%20the%20VO%3A%20Metiri%20%28first,activities%20remotely%2C%20cost-efficiently%20and%20in%20an%20automated%20manner>

23 [https://www.offshore-energy.biz/mol-worlds-first-autonomous-seatrial-of-commercial-boxship-completed/#:~:text=MOL%3A%20World%27s%201st%20autonomous%20sea%20trial%20of%20commercial%20boxship%20completed,-Innovation&text=A%20Japanese%20consortium%20including%20shipping,led%20by%20The%20Nippon%20Foundation.](https://www.offshore-energy.biz/mol-worlds-first-autonomous-seatrial-of-commercial-boxship-completed/#:~:text=MOL%3A%20World%27s%201st%20autonomous%20sea%20trial%20of%20commercial%20boxship%20completed,-Innovation&text=A%20Japanese%20consortium%20including%20shipping,led%20by%20The%20Nippon%20Foundation.;); <https://www.mol.co.jp/en/pr/2022/22007.html>

24 <https://www.gov.uk/government/news/dstl-trials-autonomous-maritime-asset-protection-system-amaps>

is in 2025.<sup>25</sup> All six multi-purpose offshore vessels will be operated from shore and will increase Ocean Infinity's remote vessel fleet to 23 vessels, the largest globally. The vessels will eventually operate on green ammonia and, as stated by Richard Daltry, Technical Director – Surface Technology at Ocean Infinity “the new design continues to drive minimalised environmental impact with its integration of new fuel-cell and battery technology”.<sup>26</sup> The first vessel's full suite of new technology and equipment will be installed and integrated at one of VARD's shipyards in Norway, utilizing VARD's globally integrated value chain.<sup>27</sup>

### Jan De Nul's *Beluga 01*

In February 2022, Jan De Nul Group announced it had ordered an unmanned sea-going survey vessel, *Beluga 01*, from Norwegian Maritime Robotics.<sup>28</sup> The vessel is named after the Beluga whale and will sail under the Luxembourg flag. The group's aim is to utilise the vessel “for worldwide hydrographical and environmental surveys on marine and offshore construction projects”.<sup>29</sup> The order of this hybrid Unmanned Surface Vehicle (**USV**) will establish the group as the first dredging contractor to deploy a vessel of this type in marine and offshore conditions. The USV will have a fully redundant hybrid propulsion system, will be capable of operating autonomously for up to 50 hours and is expected to be a “user-friendly, cost-effective and low-risk platform for data acquisition at sea”.<sup>30</sup> *Beluga 01* will also promote Jan De Nul's efforts to reduce carbon emissions, as well as enhance safety and operational control during the group's survey activities.

25 <https://www.ship-technology.com/news/vard-ocean-infinity-ships/>

26 <https://www.worldpipelines.com/contracts-and-tenders/24022022/ocean-infinity-broadens-remote-fleet-plans/>

27 <https://www.vard.com/articles/ward-secures-contract-for-a-series-of-six-multi-purpose-offshore-vessels-for-ocean-infinity>

28 <https://www.jandenu.com/news/jan-de-nul-orders-seagoing-unmanned-survey-vessel-marine-and-offshore-construction>

29 <https://www.tradewindnews.com/shipyards/jan-de-nul-orders-first-unmanned-survey-vessel-for-offshore-operations/2-1-1162670>

30 <https://www.jandenu.com/news/jan-de-nul-orders-seagoing-unmanned-survey-vessel-marine-and-offshore-construction>

## Events

### Past events

#### 'MASS in the UK – Getting the Law Onboard' at UCL by Tom Walters

6 April 2022

HFW Partner, Tom Walters, recently delivered a presentation at UCL covering recent updates on some of the work that HFW has undertaken to assess the state of UK legislation and how MASS can best be accommodated in UK waters. The talk highlighted the importance of filling the gaps in the regulatory framework to prevent slowing innovation, as well as the opportunities it creates for maximising the commercial benefits of operating in UK waters.

#### Workshop: MASS – Regulating the operation of autonomous and remotely controlled vessels > 24m

30 May 2022

HFW has collaborated on an autonomous vessel project with the Maritime and Coastguard Agency (MCA). The project is the first large autonomous vessel review work commissioned by the MCA, marking a watershed moment for smart shipping in the UK.

A consortium made up of HFW, Robosys Automation and Houlder worked with the MCA to identify regulatory gaps and barriers to the development of safe, secure, and environmentally-friendly autonomous and remotely-operated vessels over 24m in length. The team reviewed existing UK primary and secondary legislation and international instruments to identify both regulatory and physical and cyber security issues. It also organised a workshop to explore key questions around MASS rendering assistance to persons in distress. The aim of the project was to explore how operations of these vessels might be addressed in the UK's primary and secondary legislation and the degree to which existing legislation may need to be amended to facilitate MASS operations.

Tom Walters and Henry Clack of HFW collaborated with Robosys, an advanced robotics technology company that specialises in the design and operation of autonomous systems for the maritime sector, and Houlder, who have a track-record of over 3,000 projects spanning newbuild design, retrofits, specialist vessels and conversions, and offshore wind operations, installation and mobilisation.

We hope that through this exercise, the UK waters will become a more commercially attractive jurisdiction to permit the operation of MASS for owners, operators and manufacturers alike.

### Forthcoming events

We hope to be attending, and look forward to seeing you at, the following events this year:

- **Autonomous Ship Expo:** 21-23 June 2022, Amsterdam, the Netherlands (<https://www.autonomousshipexpo.com/conference-program.php?day=all#programme>)
- **Electric & Hybrid Marine Expo:** 21-23 June 2022, Amsterdam, the Netherlands (<https://www.electricandhybridmarineworldexpo.com/en/>)
- **The Seawork Commercial Marine Conferences:** 22 & 23 June 2022, Southampton, UK (<https://di9mr54a05a64.cloudfront.net/api-mercatormedia.expoplatform.com/files/2022CMCConferenceProgrammeMay.pdf>)
- **Digital Ship Conference:** 19 October 2022, Athens, Greece (<https://www.athens.thedigitalship.com/>)

With so much happening in the sector in terms of new designs, improved technology and accommodation of MASS into various legal and regulatory regimes, MASS really are coming to the MASSes. We will continue to provide regular updates in due course, but if HFW can assist with any queries, please contact a member of the team for assistance.

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