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**DEVELOPMENT OF A GOAL-BASED INSTRUMENT FOR MARITIME AUTONOMOUS
SURFACE SHIPS (MASS)**

**United Kingdom developments on Maritime Autonomous Surface Ships:
research, legislation and industry projects**

Submitted by the United Kingdom

SUMMARY

Executive summary: This document provides a summary of the research and policy work that has, and is, taking place in the United Kingdom to support the development and introduction of MASS.

Strategic direction, if applicable: 2

Output: 2.23

Action to be taken: Paragraph 35

Related documents: None

Introduction

1 The development and introduction of MASS is happening. To ensure their safe and secure operation it is important that regulations are updated to keep pace with innovation. To support United Kingdom industry, that is at the forefront of this emerging technology, the United Kingdom has decided to update its domestic regulations. This document provides a summary of the research and policy work that has and is taking place in the United Kingdom.

The MASS industry in the United Kingdom

2 The United Kingdom has been a development ground for MASS for several years. Most vessels have been under 24m in Load Line-length and remotely operated (both within line of sight and over-the-horizon). More recently larger vessels, up to 85m, are being designed and constructed. These vessels are no longer just being developed as proof of concept but used for commercial purposes, for example the United Kingdom Government has employed MASS on the Civil Hydrography Programme to map the United Kingdom seabed. With the number of requests for use increasing it was important to consider how the United Kingdom regulatory framework could support these innovative vessels.

Maritime Autonomy Regulation Lab (MARLab)

3 In 2018, as the IMO Regulatory Scoping exercise commenced, the United Kingdom outlined the research needed to understand what domestic regulatory changes were required to allow the safe operation of United Kingdom MASS and MASS in United Kingdom waters.

4 From an industry perspective, regulatory barriers were seen to be stopping innovation. From a regulator's perspective the approach to autonomous shipping had been ad hoc. Therefore, an overarching view was needed of industry and technological advances.

5 Through United Kingdom government Regulator's Pioneer Fund, the Maritime and Coastguard Agency (MCA) established the Maritime Autonomy Regulation Lab (MARLab). MARLab created a single point of contact between government, academia and industry while promoting on-water testing and flagship projects and help the United Kingdom grow its presence in the global marketplace.

6 MARLab reviewed the United Kingdom's Merchant Shipping Act and four key statutory instruments relevant to the size of vessel being operated or proposed. Although, existing regulations had been written with the assumption that a person would always be on board, this detailed review discovered few fundamental barriers.

7 The key areas that needed to be addressed in the United Kingdom primary legislation included:

- .1 clarify that the "Master" of a MASS does not need to be on board;
- .2 clarify terms such as "crew", "seaman" and consider terminology for new roles;
- .3 clarify how manning for MASS can be assessed;
- .4 clarify implications for local Health and Safety laws for shore-based personnel;
- .5 ensure training requirements, equivalent to Master and Seafarers, include minimum standards of training similar to conventional vessels, and specialized training on MASS platforms;
- .6 clarify carriage of document requirements for MASS;
- .7 define the geographic boundaries for the operation of MASS; and
- .8 consider alternatives to the traditional means of law enforcement that may not be viable for MASS.

8 Importantly, MARLab confirmed there are mechanisms within current United Kingdom regulation to enable the development of innovation, and many of the barriers perceived by the industry were not actually present.

Current Approach: Guidance for Novel Technology

9 To date, the United Kingdom is treating each application for MASS operation on a case-by-case basis. For each vessel wanting to operate in United Kingdom waters, the operator must produce a safety case and obtain exemptions, exceptions, or equivalences from the MCA against national and international maritime safety requirements. The approach demonstrates the MASS is at least as safe as current shipping.

10 The United Kingdom approach has been published in *MGN 664 Certification Process for Vessels using Innovative Technology*.^{*} It is expected that where a vessel can meet the existing regulations it will do so, for example equipment like VHF radios fitted to the vessel should meet approved maritime standards. The approach has been aligned with the *Guidelines for the approval of alternatives and equivalents as provided for in various IMO instruments* (MSC.1/Circ.1455), including the documents companies should submit for the assessment of MASS such as:

- .1 Concepts of Operation;
- .2 Hazard Analysis – such as Functional Hazard Analysis;
- .3 Regulatory Gap Analysis; and
- .4 General drawings.

11 As part of the analysis, consideration is given to the risks and impacts on third parties and the environment and not just those directly engaged in the operation of the MASS.

12 While this approach has enabled MASS to operate, as the number of MASS increase it is expected to become unsustainable. Therefore, the United Kingdom has simultaneously been updating regulations.

Regulatory Developments: UK Workboat Code

13 Based on the regulatory review conducted by MARLab and the industry developments on vessels under 24m, the UK's *Workboat: The Safety of Small Workboats and Pilot Boats – A Code of Practice* is being updated to address gaps and provide clarification to allow for remote operation of under 24m vessels.

14 The Workboat Code applies to workboats that operate to sea, and to all dedicated pilot boats, carrying cargo and/or not more than 12 passengers. It applies to United Kingdom vessels wherever they may be, and to non-United Kingdom vessels in United Kingdom waters or operating from United Kingdom ports. The Workboat Code deals with matters such as construction, stability, safety equipment and manning.

15 A new Annex to the Code has been developed to provide all additional information needed for Remotely Operated Unmanned Vessels (ROUV) of under 24m Load Line Length operating as a Workboat. ROUVs are defined as vessels with no persons on board, that are operated from a location remote to the vessel. ROUVs will need to meet the requirements set out in the Annex in addition to the relevant sections of the main body of the Code.

16 It was decided that remotely operated unmanned sub-surface vessels would not be covered by the Code of Practice. A decision was also made to not include, at the current time, vessels that are fully autonomous or carry crew whilst being remotely operated. This reflects the current developments of the United Kingdom MASS industry, but these may be added in the future as additional experience develops.

* MGN 664 (M+F) Certification process for vessels using innovative technology, available at: <https://www.gov.uk/government/publications/mgn-664-mf-certification-process-for-vessels-using-innovative-technology>

- 17 As a high-level summary the key areas in the Annex include:
- .1 defining a Remote Operation Centre (ROC) to mean either a shore-based location which is permanent or mobile, or a manned vessel from which a Remotely Operated Unmanned Vessel is operated;
 - .2 defining "Remote Operator" as any person, including the Master, with recognized or certifiable experience who is engaged in the remote operation of a ROUV;
 - .3 defining "Remotely Operated Unmanned Vessel" as a vessel with no persons on board that is operated from a location remote to the vessel;
 - .4 allowing alternative options to watchkeeping, e.g., proper lookout provided by visual and auditory readouts from cameras and sensors which are replicated at the ROC;
 - .5 providing a new option to traditional anchors, e.g., the use of dynamic positioning systems; and
 - .6 expanding safety management system requirements, incorporating cyber security.

18 The publication of this annex will provide a significant number of the current United Kingdom MASS industry a clear route to certification and operation. Larger and more complex vessels will continue to be considered on a case-by-case basis.

Regulatory Developments: Primary Legislation

19 The United Kingdom is also working to update its primary legislation to establish the foundation for wider regulatory framework that will provide for the safe operation of MASS, including their Remote Operation Centres (ROCs). This work would also prepare the United Kingdom legal framework for future changes in international law and be to address future maritime innovation.

20 Consideration has been given to how existing powers can be used with minimal amendment, and the following assumptions have been used:

- .1 existing regulations that can be applied should remain applicable to MASS;
- .2 any new legislation will apply to vessels under the remit of the UK Merchant Shipping Act, in commercial operation, regardless of size; and
- .3 there should be no inadvertent changes to the existing requirements for non-MASS vessels as a result of new legislation.

21 The intention is that the primary legislation will give powers to regulate:

- .1 All sizes of MASS;
- .2 Remote Operation Centres (ROCs);
- .3 Software used for autonomy and remote operations; and
- .4 MASS operation in ports and harbours.

22 As the legislation is still being drafted it is not possible to provide examples of the specific provisions but the following areas are expected to be addressed to ensure the safe and secure operation of United Kingdom MASS, and MASS in United Kingdom waters:

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- .1 New definitions, including "MASS", "MASS Master", "Remote Operator" and "Remote Operation Centre". It will not include degrees of autonomy, as these continue to be developed and the regulations need to be developed in such a way that they are able to address requirements for all degrees of autonomy.
 - .2 With regards manning, qualifications, and training, powers will allow for:
 - .1 MASS to be safely manned, both in respect of the numbers of operators and their standards of competence;
 - .2 regulations specifying the training and certification requirements for Remote Operators and MASS Masters; and
 - .3 regulations to determine hours of watchkeeping and working conditions for Remote Operators and MASS Masters.
 - .3 Powers to ensure regulations can be made in relation to safety for both MASS and ROCs, which will allow for the survey and inspection of both equipment and vessel operation (e.g. safety management).
 - .4 Powers to ensure environmental protection regulations apply to MASS.
 - .5 Ensure that the enforcement powers in the Merchant Shipping Act are extended to cover MASS and ROCs, and that ROCs based outside the United Kingdom can be inspected and enforcement action taken.
 - .6 Ensure that any existing or new requirement for a MASS to carry documents can be met by electronic or other means and documents can be held (or available) at a ROC.
 - .7 Measures to ensure security, insurance and liability and pilotage regulations are suitable and can be applied to MASS.

23 The primary legislation will give the powers to develop regulations in all the above areas, with the detailed requirements in secondary legislation, such as statutory instruments.

24 Two important areas that will be clarified within this work is that for the United Kingdom:

- .1 Remote Operators will not be considered a seafarer. There are a number of reasons for this including: they are not on board a ship; they will require bespoke training and certification (which may cross over with seafarers' training); differences between maritime and on-shore employment, and health and safety requirements that will impact on hours of work; and implications for calculation and qualifying sea-time.
- .2 The location of a ROC operating a United Kingdom MASS or MASS in United Kingdom waters will be clarified from a legal perspective, i.e., how can jurisdictional issues regarding location of a ROC be resolved such as survey and inspection and enforcement of ROCs overseas. It will also ensure United Kingdom MASS are being operated to the required standard and employees not exploited.

25 A public consultation was held between September and November 2021, and details of the consultation can be viewed at [Future of transport regulatory review: maritime autonomy and remote operations - GOV.UK \(www.gov.uk\)](https://www.gov.uk/government/consultations/future-of-transport-regulatory-review-maritime-autonomy-and-remote-operations).

Further Research

26 For some of the areas, there is a need to undertake further research. These include the need to better understand how to regulate full autonomy, AI and machine learning, as well as human element implications for remote operators (screen fatigue, working patterns on shore, compared to working at sea). To address this need the United Kingdom Government is working collaboratively with universities and research centres, such as:

- .1 the Warsash Maritime Autonomous Surface Ships (MASS) Research Centre (WMRC) that is "pioneering research into maritime autonomy, from Smart Ships and Smart Ports, to the human elements of working in tandem with smart systems, and maritime teaching and consultancy."
- .2 the Trustworthy Autonomous Systems Hub whose objective is "To enable the development of socially beneficial autonomous systems that are both trustworthy in principle and trusted in practice by the public, government, and industry".

27 In addition to working with universities and commissioning research, the United Kingdom is also working with other administrations and companies, as with MASSPeople.

Further Research: MASSPeople

28 One critical area for the success of MASS will be the people, the training and skills of the current and future workforce in maritime. The shift from crew being on board a ship to a shoreside location will require a workforce with traditional skills alongside a set of different technological skills to prepare them for new diverse roles. This led to the creation of MASSPeople in early 2021.

29 The group's purpose is to develop internationally recognised industry competency and training standards for remote operators and other personnel involved in the operation of MASS. Through regular meetings, the group is establishing the timeline and milestones necessary to support this work and will establish a detailed set of requirements which can be used to influence IMO discussions.

30 The global industry enthusiasm for this initiative means that in just over a year, eight other flag States have now signed up, representing Belgium, Denmark, France, Italy, Netherlands, New Zealand, Norway and Poland and the expectation is that more will be interested to join in the future. This group is now well established and are currently preparing a stakeholder/survey questionnaire for dissemination amongst each international member state's national stakeholders to focus and explore key questions on the emerging operational setup/standards for the control, monitoring, support and recovery of MASS. Understanding each of these will then help develop and drive the creation of training competencies and standards.

31 Continuing the close working relationship between government, industry and academia, a National Correspondence Group (NCG) was established with various stakeholders to create a United Kingdom-centric forum to collaborate on training and skills to support this work while focusing on the development of MASS training nationally.

32 Our aim as part of MASSPeople nationally, will be to help establish and create MCA guidance for a Remote Operators training course. This will take the format of current MNTB (Merchant Navy Training Board) guidance and help to build best guidance and promote the standards of remote operator training across the United Kingdom.

Conclusion

33 By 2023 it is hoped the United Kingdom will have the start of a domestic regulatory framework to support United Kingdom MASS and MASS operating in United Kingdom waters. In primary legislation there will be powers to regulate MASS of all sizes, and in secondary legislation a Code of Practice with guidance for Remotely Operated Unmanned Vessels.

34 There are still many unanswered questions regarding fully autonomous vessels, and the use the AI and machine learning. These questions are not exclusive to the maritime environment but across all industries developing autonomous systems, therefore collaboration remains key. Research and collaboration will continue to ensure the regulations and guidance developed are evidence-based, and priority will be given to addressing the questions raised by the MASS registered in the United Kingdom and/or operating in United Kingdom waters. This legal framework, and support provided, means the United Kingdom has a maritime eco-system that supports and welcomes innovation in MASS.

Action requested of the Committee

35 The Committee is invited to note the information provided in further work on Maritime Autonomous Surface Ships.
