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~ The Forefront of Training Remote Operators for Maritime Autonomous Surface Ships (MASS) ~

1. Introduction

In previous reports on Maritime Autonomous Surface Ships (MASS), we have primarily presented research findings from a technical perspective, such as developments in AI and sensing technologies, and advances in communications infrastructure[1], and from a regulatory perspective, such as the formulation of the MASS Code by the IMO[2][3]. Alongside discussions at the international level, various countries are proceeding with initiatives such as demonstration trials within their own national regulatory frameworks.[4][5]

In light of these latest developments, this report focuses on education and training. We visited

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1 https://www.nikkaibo.or.jp/london/umi604ex

2 https://www.nikkaibo.or.jp/london/no-25-08%e3%80%8cicmass-2025%e5%8f%82%e5%8a%a0%e5%a0%b1%e5%91%8a%e3%80%8d

3 https://www.nikkaibo.or.jp/london/no-25-10%e3%80%8c%e6%b5%b7%e5%a4%96%e6%83%85%e5%a0%b1%e3%80%80mass-north-sea-mou-symposium%e5%8f%82%e5%8a%a0%e5%a0%b1%e5%91%8a%e3%80%8d

4 https://www.nikkaibo.or.jp/london/no-26-06%e3%80%8c%e7%89%b9%e9%9b%86%e3%80%80%e6%ac%a7%e5%b7%9e%e3%81%ae%e7%84%a1%e4%ba%ba%e9%81%8b%e8%88%aa%e8%88%b9%e7%ad%89%e5%b0%8e%e5%85%a5pt%e5%8b%95%e5%90%91%e2%91%a1%e3%80%8d

5 https://www.nikkaibo.or.jp/london/no-25-06%e3%80%8c%e7%89%b9%e9%9b%86%e3%80%80%e6%ac%a7%e5%b7%9e%e3%81%ae%e7%84%a1%e4%ba%ba%e9%81%8b%e8%88%aa%e8%88%b9%e7%ad%89-%e5%b0%8e%e5%85%a5%e3%83%97%e3%83%ad%e3%82%b8%e3%82%a7%e3%82%af%e3%83%88

SeaBot Maritime[6] (hereinafter 'SeaBot'), which is based at the National Oceanography Centre (NOC)[7] in Southampton. The company is the first in the world to have obtained Voluntary Recognition for remote operator training from MCA (Maritime and Coastguard Agency)[8]. Based on the insights gained from the facility visit and discussions, this report introduces initiatives for the practical training of ROC (Remote Operation Centre) personnel in the UK.

Exterior view of the NOC

2. Overview of the MASS Regulatory Framework in the UK

(1) The UK's Regulatory Approach to MASS

As outlined in the previous report[9], the MCA is addressing innovative technologies such as MASS by interpreting and applying existing laws and regulations. For matters not fully covered by existing rules, it adopts a flexible approach by applying guidance such as MGN 664[10] and granting exemptions from existing requirements where necessary.

A Remote Operation Centre (ROC) plays a vital role in the practical implementation of autonomous vessels within this framework. An ROC refers to a facility used to monitor, navigate, operate and control the systems of a vessel at sea from a remote location, such as onshore.

Currently, there is no single, detailed legal provision governing ROCs in the UK. Instead, safety is demonstrated on a case-by-case basis through a combination of ROC-related requirements under the Workboat Code Edition 3[11], guidance such as MGN 703[12], and industry codes of practice.

MGN 703 stipulates that operators working in ROCs must complete training in remote

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6 https://www.seabotmaritime.com/
7 https://noc.ac.uk/
8 https://www.gov.uk/government/organisations/maritime-and-coastguard-agency
9 https://www.nikkaibo.or.jp/london/no-26-05%e3%80%8c%e6%b5%b7%e5%a4%96%e6%83%85%e5%a0%b1%e3%80%80oceanology-international-2026-%e5%8f%82%e5%8a%a0%e5%a0%b1%e5%91%8a%e3%80%8d
10 https://www.gov.uk/government/publications/mgn-664-mf-amendment-1-certification-process-for-vessels-using-innovative-technology
11 https://www.gov.uk/government/publications/the-workboat-code-edition-3
12 https://www.gov.uk/government/publications/mgn-703-information-concerning-the-training-and-competence-of-remote-operators-working-with-remotely-operated-unmanned-vessels-rouvs-certified-und/mgn-703-information-concerning-the-training-and-competence-of-remote-operators-working-with-remotely-operated-unmanned-vessels-rouvs-certified-und

operation, GMDSS[13] and cyber security, amongst other areas, prior to commencing duties. Furthermore, Annex A sets out the skills required for remote operation, such as dealing with communication delays, situational awareness, incident response, and fatigue management.[14] SeaBot is one of the companies providing ROC training within this framework of training and competency requirements.

(2) Overview of SeaBot Maritime

SeaBot is a UK start-up founded in Portsmouth in 2017, with 12 employees. It also has a base at the NOC, where this visit took place. The NOC is one of the UK's leading marine research centres and operates two research vessels. In particular, the Innovation Hub[15], which we visited, is a facility designed to support marine technology and innovation.

The company's Chief Executive Officer (CEO), Gordon Meadow[16], is an expert in maritime education and training, having previously taught at the Warsash Maritime Academy[17], a leading maritime educational institution in the UK. In addition, he currently serves as a Fellow of the Institute of Marine Engineering, Science and Technology (IMarEST)[18]. The company's main activities are as follows:

・Provision of ROC training modules and AI-powered training systems

A meeting with SeaBot

Going beyond traditional classroom-based learning, the company offers modular training systems utilising digital twins, e-learning and detailed 3D models. Within the system, AI assumes the role of the "Officer of the Watch", supporting three tasks in accordance with the International Regulations for Preventing Collisions at Sea (COLREGs)[19]: (1) navigation and collision avoidance, (2) deployment and recovery of Autonomous Underwater Vehicles (AUVs), and (3) AUV tasking and control. Human operators are trained to act as the "Senior Officer of the Watch", overseeing the entire system from a supervisory position.

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13 https://www.gov.uk/maritime-safety-weather-and-navigation/the-global-maritime-distress-and-safety-system

14 https://www.gov.uk/government/publications/mgn-703-information-concerning-the-training-and-competence-of-remote-operators-working-with-remotely-operated-unmanned-vessels-rouvs-certified-und/mgn-703-information-concerning-the-training-and-competence-of-remote-operators-working-with-remotely-operated-unmanned-vessels-rouvs-certified-und

15 https://innovationcentre.noc.ac.uk/

16 https://www.linkedin.com/in/gordonmeadow/

17 https://maritime.solent.ac.uk/

18 https://www.imarest.org/

19 https://www.imo.org/en/ourwork/safety/pages/preventing-collisions.aspx

・Provision of MCA-recognised remote operation training

In October 2022, the company received the world's first Voluntary Recognition from the MCA for its MASS Remote Operator Training programme. Fugro, a marine-related company, has already undertaken this recognised training programme. Furthermore, representatives from AD Ports Group, an Abu Dhabi-based ports and logistics group, and the UAE's maritime authority also participated in this training, which was held in the Middle East.[20]

3. Programmes provided by SeaBot

(1) Overview of the Training Programme

SeaBot's practical training consists of a two-week course. The curriculum begins with theoretical instruction, followed by the acquisition of screen-based orientation and hardware operation skills on a simulator. Participants then deploy an Unmanned Surface Vehicle (USV)[21] into a real, congested port alongside a guard vessel to learn risk management whilst operating in close proximity to other vessels. It should be noted that in the UK, the use of a guard vessel is currently a regulatory requirement when operating USVs.

SeaBot has also developed cross-skilling programmes for companies such as Ocean Infinity. These programmes are designed to enable a single technician to handle tasks such as the operation, diagnostics and maintenance of ROVs (Remotely Operated Vehicles), and the company has independently developed 22 types of e-learning modules, each lasting between 15 and 30 minutes. The training content extends beyond basic vessel-handling skills to include knowledge necessary for understanding the entire system, such as basic knowledge of AI and cyber security. Furthermore, for SBM Offshore, SeaBot has constructed a digital twin model of the entire vessel, providing a training environment where participants can examine and familiarise themselves with each component in a 3D setting.

Training utilising such digital twins is also crucial for addressing the increasing sophistication and complexity of onboard systems in recent years. At the Annual Offshore Support Journal Conference (AOSJ), an international conference for the offshore support vessel industry that I attended in February this year, it was also discussed that virtual training environments are essential for enabling crew members to adapt to these technological changes. SeaBot's programme can be seen as a concrete example of this trend.

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[20] https://www.maritimeindustries.org/news/seabot-maritime-receives-uk-maritime-and-coastguard-agency-mca-voluntary-recognition-pioneering-mass-remote-operator-training

[21] https://oceanexplorer.noaa.gov/technology/usv/

(2) Simulator Training Demonstration

Scene from the demonstration

During the demonstration using a digital twin, we observed the operation of a 36-metre USV on screen. In this demonstration, a single operator simultaneously managed both the navigation of the USV and the deployment and recovery of the AUV. According to a development representative from SeaBot, the AI acts in a role similar to that of an Officer of the Watch. Furthermore, it was explained that this simulation is capable of reproducing various contingencies and malfunctions, including weather conditions such as fog and wind, changes in ocean currents, as well as camera malfunctions, communication failures, autonomous system failures and GPS spoofing.

(3) Other contributions to regulation and standardisation

(a) AI, Autonomy and Human-Centred Design

Gordon Meadow, the company's CEO, repeatedly emphasised 'human-centric' as the philosophy underpinning SeaBot's initiatives. The company views AI not as a replacement for humans, but as an extension of human capabilities ("Us plus us more"). Rather than treating AI as a mere automation tool, it treats it as an "agentic colleague" or an "AI Officer of the Watch", and is developing interfaces and training methods to enable humans and AI to collaborate as a team through human–machine teaming.

This human-centric philosophy is closely linked to the debate regarding the qualification and competency requirements for ROC operators. Nevertheless, the question of whether ROC operators should be subject to traditional seafarer qualification requirements remains under discussion within the IMO, and international consensus has yet to be established.[22] Meanwhile, within the UK, qualification requirements for ROC operators are beginning to take shape. The current framework indicates that, as a prerequisite, operators will be required either to meet the requirements set out in the Workboat Code Edition 3, to hold operational-level qualifications under the STCW Convention, 1978, as amended, such as STCW Regulation II/1 unrestricted, or to hold a Deck Officer Certificate of Competency (CoC Class 1 or 2).[23]

(b) Contributions to Regulation and Standardisation

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[22] https://www.imo.org/en/mediacentre/meetingsummaries/pages/joint-msc-leg-fal-working-group-on-mass.aspx

[23] https://assets.publishing.service.gov.uk/media/686299f73464d9c0ad609d30/03._RO_CERTIFICATION_FRAMEWORK.pdf

Mr Gordon Meadow has also established the working group 'MASSPeople' in collaboration with Fugro, whose members include maritime authorities from several countries, around eight according to publicly available information.[24][25] This group examines the development of competency standards for MASS and publishes its findings in the form of submissions to the IMO and public reports.[26] These activities can be regarded as contributing to international discussions and progress in standardisation regarding MASS.

4. Conclusion

SeaBot has placed a strong emphasis on 'human-AI collaboration' and has been actively developing practical training programmes for real-world operators. The visit highlighted that the practical deployment of ROCs requires not only technological development but also various other elements, such as educational frameworks and the establishment of social rules and governance frameworks.

In the UK, within the framework of support for industry–academia–government collaboration, the expertise of agile start-ups is actively drawn upon. The fact that SeaBot was the first company to obtain official recognition from the MCA serves as a prime example of this. Furthermore, it is particularly noteworthy that the company has chosen not to monopolise the competency standards it has developed, but has instead made them freely available worldwide. This suggests an approach that contributes to the wider industry while also helping SeaBot's own standards develop into "global standards". In the MASS sector, where momentum is building towards practical implementation, this practice, grounded in intellectual contribution, offers useful implications for the future implementation of MASS.

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[24] https://www.fugro.com/news/business-news/2021/fugro-launches-masspeople-international-working-group-for-remote-and-autonomous-training-standards

[25] https://www.imarest.org/resource/future-proofing-competency-standards-on-autonomous-surface-ships.html

[26] https://www.masspeople.org/imo-submission

Exterior view of the SeaCity Museum in Southampton

All photographs taken by the author