**HSSC16-05.9A**

## Report and Recommendations of the Maritime Autonomous Surface Ships (MASS) Navigation PT

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| ***Submitted by:*** | Mark Casey |
| ***Related Documents:*** | N/A |
| ***Related Projects:*** | S-100 |

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| *Chair:* | Mark Casey, United Kingdom |
| *Vice-Chair:* | Dongli Sun, China |
| *Secretary:* | Annie Biron, Canada |
| *Member States:* | Brazil, Canada, China, Denmark, Finland, France, Islamic Republic of Iran, Japan, Malta, Norway, Republic of Korea, Singapore, Sweden, United Kingdom, United States of America |
| *Expert Contributor Organisations:* | Korea Maritime and ocean University, MOKPO National Maritime University, Avikus, IALA, Robosys, BlkSail, Warsah MASS Research centre, H2i Consulting |
|  | *Annex A – Terms of reference**Annex B – 5 year plan* |

## Meetings Held During Reporting Period

One meeting held since HSSC 15. This meeting was held as a hybrid meeting with participants attending the IHO HQ in Monaco and the majority of MS and contributing organisations attending via VTC.

## Executive Summary and Recommended Actions

At HSSC 15, the Chair of the Project Team (PT) reported that the PT had achieved it’s 2 year remit ahead of time, however, due to various reasons outlined below, the Chair recommended that the MASS Project Team should become a permanent Working Group (WG). Reasons for the establishment of a permanent working group:-

* The MASS industry is still in its infancy and new requirements will emerge as it matures.
* A number of requirements currently fall outside the scope of the S-100 standards landscape.
* More regional representation is required from members states to address gaps from regional MASS activity.
* Closer MASS industry and academic collaboration is required to further develop standards as the MASS industry grows and matures.
* Complimentary work is required in adjacent bodies such as IALA and WMO to ensure interoperability and machine readability of the wider S-100 family standards.
* Data quality needs to be ensured from data providers to ensure fit for purpose data is provided for MASS.

As such the group would address the points above by ensuring the following activities occur:-

* It will pick up any outstanding issues/requirements for further analysis and make recommendations on how to address these gaps.
* It will add new member states to gain greater global coverage to ensure all regional activity is captured.
* It will invite representation from industry and academia into the group to keep gathering requirements as the industry develops.
* It will repeat the discovery and analysis exercise on an annual or biennial basis.
* It will work with the S-100 Working Groups and Project Teams alongside the Data Quality Working Group to ensure product specifications and data standards are aligned to MASS requirements and to provide appropriate challenge to groups and data providers in meeting the standards.
* It will work with complimentary organizations such as IALA and WMO to ensure their data will cater for MASS navigation and operations.

However, the Chair of HSSC suggested that the group continues as a PT until HSSC 16, at which point the chair of the MASS PT should submit Terms of Reference (ToRs) for the WG along with a plan of activities to allow HSSC to consider forming the MASS Navigation WG.

The MASS PT held a hybrid meeting in Monaco on the 27th – 28th February to formulate the ToRs for the group and to outline a 5 year plan with a breakdown of tasks to be accomplished by the WG. ToRs are art **Annex A**, 5 year plan and tasks at **Annex B**.

**5 Year plan and immediate tasks**

The PT has defined a number of related tasks that it will aim to carry out over a 5-year period in line with the ToRs at Annex A. As with all long-term strategic plans, the level of detail is understood more clearly in the initial years of a plan. As the timescale extends over the 5 year period, the detail is less clear and will evolve and the plan may change to accommodate new or emergent aspects of the MASS industry. A number of initiatives will be conducted by or supported by the WG in the first couple of years which are summarised below:-

* In 2024
  + Try again to recruit new Member States in areas of MASS activity
  + Recruit additional MASS industry experts, specifically from Japan and Norway if possible
  + With industry develop use-cases and test-scenarios around the use of navigation data
  + Continue to engage with IALA MASS Task Force
  + Engage academia in research and data trials
  + Conduct Seminars with industry on the value of S-100 for MASS
  + Make sample S-100 data sets available to MASS for trials
  + Engage with IMO specifically on the MASS Code
* In 2025
  + Engage and support sea trials of MASS using S-100
  + Repeat Discovery and Analysis process for new MASS requirements
  + Work with WMO on machine-readable data
* In 2026
  + Evaluate the interoperability of the S-1xx product specification in a MASS scenario
  + Consider standards and specifications for synthetic environments for the maritime domain (e.g. Digital Twin of the Navigable Waters).

**Additional Activity of the MASS Navigation PT**

Furthermore, since HSSC the Chair of the PT has recruited industry experts and academic institutions into the membership of the group to facilitate expert knowledge sharing surrounding the developments of MASS. The Chair also requested additional member states join the group via a Circular Letter from the IHO secretariat, though sadly only one further member state has elected to volunteer to join the group at this time (Republic of Korea - KHOA).

The Chair has also supported and taken part in IALA workshops and the IALA MASS Task Force and has contributed to the recently published IALA report on the Future of Maritime Autonomous Surface Ships. Furthermore, the PT has invited membership from IALA into the MASS PT.

The Chair has also contributed to discussions on the IMO’s new draft MASS Code. It is important that the IMO MASS code considers the future state of MASS and the need for official electronic and machine-readable data. In order to ensure that happens the Chair has suggested adding new terminology to the code, i.e. Electronic Navigational Data Services (ENDS) to the existing references of charts and publications (which will still be relevant for Degrees 1-3 of the IMO’s definitions of autonomy), which will also have the benefit of being consistent with the IMO’s Resolution ECDIS Performance Standard’s terminology. The Chair has been invited to write a paper to the IMO’s MASS ISWG in early Autumn to suggest the change formally, which is being supported by the UK’s MCA as a MS of the IMO and this notion has been socialised throughout the IMO’s MASS Navigation Splinter Group, and has been met with positivity.

The Chair has also represented the IHO and MASS PT showcasing the proactive work that the IHO is doing in terms of MASS at several international MASS conferences, including the UK, Netherlands, Japan and Singapore. This has demonstrated the leadership and forward-thinking approach that the IHO is taking to support the MASS industry and has been very much welcomed by industry around the globe.

## Leadership of the MASS Navigation Working Group

## If HSSC establishes a permanent WG, naturally it would be appropriate to formally vote for the Chair, Vice Chair and Secretary positions at that point. The current PT Chair will not stand for re-election as Chair of the Working Group, however, the UK is prepared to put forward a candidate to Chair the Working Group to provide continuity of the group and its activities. If the Working Group is established, the current PT Chair will arrange and Chair the first MASS WG meeting and oversee the voting process before stepping down and passing on the baton to the new Chair.

## Justification and Impacts

It is clear that the MASS industry is gaining momentum and moving to Degree 3 and 4 levels of autonomy. The IHO must keep pace and ensure S-100 is fit for safe navigation in manned and unmanned shipping situations. The need for an international Working Group to monitor the developments in the MASS industry and gather requirements for the relevant IHO Working Groups to implement, is clear and will complement the work of the existing Working Groups. Once the MASS Navigation WG is established, the plan at Annex B can be commenced.

## Action Required of HSSC

The HSSC is invited to:

1. Endorse the permanent formation of a MASS Navigation Working Group.
2. Endorse the ToRs for the WG
3. Endorse the 5 year work plan and detailed tasks

**Annexes**

**Annex A – Terms of Reference**

**Annex B – MASS WG 5 year plan**

**Annex A – Terms of Reference**

**HSSC - MASS NAVIGATION WORKING GROUP**

**Terms of Reference and Rules of Procedure**

1. **Objective**

To ensure the standards developed by IHO, and in particularly the S-100 suite of Product Specifications, meet the navigational needs of vessels operated under all degree of autonomy or high levels of automated navigation. It will do this by:

* Working with the S-100 WGs and PTs and other relevant IHO groups to ensure product specifications and data standards are aligned to MASS requirements.
* Inviting representation from industry and academia to the WG and engaging with all relevant stakeholders to ensure the requirements for navigational data in the context of MASS is properly understood and communicated to the relevant Product Specification WGs
* Liaise and work with other international bodies such as IMO, IALA and WMO to ensure coherence of developments, activity, and regulation across the autonomous domain.

1. **Authority**

The Working Group is a subsidiary of the Hydrographic Services and Standards Committee (HSSC). Its work is subject to HSSC approval.

1. **Composition**
2. The Project Team shall comprise representatives of IHO Member States (MS), Expert

Contributors (EC), observers from accredited NGIOs, and a representative from the IHO

Secretariat. A membership list shall be maintained and posted on the IHO website.

1. EC membership is open to entities and organizations that can provide a relevant and

constructive contribution to the work of the WG.

1. The Chair and Vice-Chair shall be a representative of a MS. The election of the Chair

and Vice-Chair shall be decided at the first meeting after each ordinary session of the Assembly and shall be determined by vote of the MS present and voting.

1. If a secretary is required it should normally be drawn from a member of the WG.
2. If the Chair is unable to carry out the duties of the office, the Vice-Chair shall act as the

Chair with the same powers and duties.

1. ECs shall seek approval of membership from the Chair.
2. EC membership may be withdrawn in the event that a majority of the MS represented in

the WG agrees that an EC's continued participation is irrelevant or unconstructive to the work of the WG.

1. All members shall inform the Chair in advance of their intention to attend meetings of

the WG.

1. In the event that a large number of EC members seek to attend a meeting, the Chair may

restrict attendance by inviting ECs to act through one or more collective representatives.

1. **Procedures**
2. The WG should work by a combination of correspondence, teleconferences, group

meetings, workshops or symposia. The WG should meet at least once a year. When meetings are scheduled, and in order to allow any WG submissions and reports to be submitted to the HSSC or on time, meetings should not normally occur later than nine weeks before a meeting of the HSSC.

1. Decisions should generally be made by consensus. If votes are required on issues or to

endorse proposals presented to the WG, only Members may cast a vote. Votes at meetings shall be on the basis of one vote per Member represented at the meeting. Votes by correspondence shall be on the basis of one vote per Member represented in the WG.

1. The WG should liaise with other IHO bodies, international Organizations and industry

representatives to ensure the relevance of its work and timely notice of changes to the standards.

1. The WG should report to the HSSC on its activities and submit a rolling two-year work plan,

including expected time frame.

**Annex B – MASS Navigation WG 5 year plan**

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| Work Item | Task Description | Status | Comments |
| **A1** | **Raise profile of MASS domain and promote MASS navigation issues within IHO community.** |  |  |
| A1.1 | Promulgate Circular Letter to members inviting participation in WG. | Planned for 2024 | Encourage broader engagement across member states. |
| A1.2 | Identify other opportunities to brief / present MASS-related developments to member states. | Planned for 2024 & on-going | Provide greater awareness across member states. |
| **A2** | **Engage with industry, academia and other MASS interest groups to raise awareness of issues for MASS navigation with conventional navigation products & services.** |  |  |
| A2.1 | Invite relevant industry participation in WG. | Planned for 2024 | Encourage broader engagement across MASS domain. |
| A2.2 | Engage with relevant academic institutions to inform and encourage research and trials. | Planned for 2024 & on-going | Encourage broader engagement across MASS domain. |
| A2.3 | Attend and present at relevant conferences, exhibitions and trade shows. | On-going | Provide greater awareness across MASS domain. |
| A2.4 | Provide advice and information around S-100 specifications and their applicability to autonomy. Disseminate via IHO portal and potentially hold seminar with industry. | Planned 2024/25 | Provide greater awareness across MASS domain. |
| **A3** | **Provide a focal point and coherence for MASS-related matters across the IHO domain.** |  |  |
| A3.1 | Monitor and review standards development across IHO WGs and PTs as industry requirements are raised. | On-going | Ensure MASS requirements are understood and met by emerging IHO standards. |
| A3.2  A3.3 | Undertake formal Discovery & Analysis phases, as conducted during 2-year PT remit, on a biennial basis.  Where gaps in navigation data standards are identified  Consider standards and specifications for MASS navigation | Planned 2025  Planned 2025 & On-going | Ensure MASS requirements are understood and met by emerging IHO standards. |
| **A4** | **Support and evaluate trials of MASS navigation to inform applicability and interoperability of IHO standards.** |  |  |
| A4.1 | Members to identify permissible areas and industry opportunities for autonomous trials. | Planned 2024/25 | Facilitate MASS trials. |
| A4.2 | Make available sample, test and/or trial data sets of S-1xx Product Specifications via a MASS ‘portal’ on IHO website. | Planned 2024 | Facilitate MASS trials. |
| A4.3 | Engage in sea trials of IHO standards, with a focus on S-101, S-102, S-104, S-111, S-124 across Degree 3 & 4 levels of autonomy. | Planned 2025 & On-going | Evaluate performance of IHO standards for MASS. |
| A4.4 | Support synthetic environment and simulation trials with industry. | Planned 2025 & On-going | Evaluate performance of IHO standards for MASS. |
| A4.5 | Where gaps in navigation data standards are identified, ensure these are understood by IHO Product Specification WGs or, if they fall outside of any current remit, propose new standards and specifications for MASS navigation | On-going | Address gaps in IHO standards for MASS. |
| A4.6 | Evaluate the interoperability of the S-1xx product specification in a MASS scenario. | Planned 2026 | Address gaps in S-98 documentation for MASS operations. |
| A4.7 | Compile and maintain a record of lessons identified during trials and publish on IHO portal. | Planned 2025 | Widen the knowledge base across the domain. |
| A4.8 | With industry develop use-cases and test-scenarios around the use of navigation products in an autonomous environment. | Planned 2024/2025 | Inform and support MASS trials. |
| **A5** | **Wider S-100 Interoperability** |  |  |
| A5.1 | Investigate the interoperability of S-100, S-200 & S-400 suite of standards. | Planned 2026 | Ensure coherence of MASS navigation products and support, in the wider maritime domain. |
| **A6** | **Liaise with other international bodies, in particular IALA, WMO, IMO on MASS related matters.** |  |  |
| A6.1 | Engage with IALA MASS Task Force. | On-going | Ensure coherence across maritime domain. |
| A6.2 | Work with WMO on machine-readable data. | Planned 2025 | Ensure coherence across maritime domain. |
| A6.3 | Engage with IMO, in particularly the MASS Correspondence Group, to be informed, and to inform, the MASS regulatory activity. | On-going | Ensure coherence across maritime domain and that the regulatory framework considers navigation data issues for MASS. |
| **A7** | **Synthetic Environments** |  |  |
| A7.1 | Consider standards and specifications for synthetic environments for the maritime domain (e.g. Digital Twin of the Navigable Waters). | Planned 2026/2027 | Provide coherence and efficiency in maritime synthetic environments. |
| **A8** | **Artificial Intelligence & Machine Learning** |  |  |
| A8.1 | Work with academia and industry on the development of artificial intelligence and/or machine learning models. | Planned 2024/2025 | Mitigate risk of text-rich products and services to MASS operations. |

**Graphic view of plan**

