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| DISCUSSION PAPER |

**IMPLICATIONS**

**of**

**MARITIME AUTONOMOUS SURFACE SHIPS**

**FROM A**

**VTS PERSPECTIVE**

DRAFT

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Revisions to this IALA Document are to be noted in the table prior to the issue of a revised document.

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# DOCUMENT PURPOSE

The purpose of the discussion paper is to assist the Committee achieve a common understanding of MASS and its implications on the provision of VTS by clearly and concisely identifying:

* + Trends and opportunities presented by MASS
  + Issues / challenges for the management of ship traffic in a VTS area.
  + Options, policies and strategies for VTS to embrace / influence MASS.
  + Implications for the regulatory and legal framework for VTS
  + Implications for IALA Standards relating to VTS

The document supports IALA’s *Strategic Vision* and *Current Drivers and Trends* by providing a means to:

* Monitor closely the advent of MASS and its associated implications for VTS.
* Strategically plan for MASS and determine new work programme tasks associated with the preparation of new/amended IALA guidance.
* Develop guidance to assist authorities ensure the safety and efficiency of vessel movements in the VTS area, recognising:
  + The advent of MASS and their interaction with conventional manned vessels within VTS areas.
  + The interaction process of autonomous vessels with conventional traffic.
  + The information flow between MASS and shore authorities; and
  + The related information exchange with conventional traffic.

Noting the advent of MASS will be ongoing for many years it is intended that this document will be reviewed and updated:

* Following each VTS Committee meeting, as appropriate; and
* Pending information/liaison with the Cross-Committee Task Force on the Impact of MASS on Marine AtoN (*PAP41-6.1.5.1 Impact of MASS on Marine AtoN*).

# EXECUTIVE SUMMARY

The advent of MASS is progressing rapidly with many ‘test beds’ being conducted world-wide and, particularly for smaller craft, autonomous vessels are already in operation.

MASS will have significant implications for how VTSs interact, both with conventional and autonomous ships, manages ship traffic and responds to situations developing in its area to mitigate the development of unsafe situations.

Balancing the benefits derived from new and advancing technologies against safety and security concerns will be a primary consideration for VTS as MASS transitions from ‘local’ trial environments to operational scenarios.

Key elements for consideration include:

*<text to follow>*

# DISCUSSION

IALA has prepared IALA’s *Current Drivers and Trends* document to serve as guidance as to how IALA can reach its strategic goals with a long-term horizon and perspective. Nine trends and developments have been identified to “*be monitored closely and when required, appropriate action should be taken such as an adjustment of the priorities and/or structure of the organization”*.

The “*Development of autonomous, automated and unmanned vessels*” is one of these nine trends and developments*.* Key aspects and implications identified with regards to MASS include:

* *“The further development of autonomous vessels could lead to increased safety and efficiency*
* *Today some vessels are to some extend semi-automated or semi-autonomous*
* *The development is expected to continue with unmanned vessels as the ultimate stage*
* *The trend will have an implication on the infrastructure and lead to fewer human errors*
* *It will also require reliable and resilient Position, Navigation and Timing (PNT) and connectivity in terms of integrated and corresponding systems and machine-readable signals in cases where no crew are present”*

Recognising VTS will have a key role in the advent of MASS this document has been prepared to collate opinions and ideas as a basis for informed discussion on the advent of MASS and achieve a common understanding of MASS and its implications for VTS.

## Overview

### IMO Regulatory Scoping Exercise

In 2017, following a proposal by a number of Member States, IMO's Maritime Safety Committee (MSC) agreed to include the issue of marine autonomous surface ships on its agenda. This was in the form of a scoping exercise to determine how the safe, secure and environmentally sound operation of Maritime Autonomous Surface Ships (MASS) may be introduced in IMO instruments.

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 application to MASS operations.

IMO completed the regulatory scoping at the 103rd Session of the MSC in May 2021.

The outcome highlights a number of high-priority issues, cutting across several instruments, that would need to be addressed at a policy level to determine future work.

These involve the development of MASS terminology and definitions, including an internationally agreed definition of MASS and clarifying the meaning of the term “master”, “crew” or “responsible person”, particularly in Degrees Three (remotely controlled ship) and Four (fully autonomous ship).

Other key issues include addressing the functional and operational requirements of the remote-control station/centre and the possible designation of a remote operator as seafarer.

Further common potential gaps and themes identified across several safety treaties related to provisions containing manual operations and alarms on the bridge; provisions related to actions by personnel (such as firefighting, cargoes stowage and securing and maintenance); watchkeeping; implications for search and rescue; and information required to be on board for safe operation.

The Committee noted that the best way forward to address MASS in the IMO regulatory framework could, preferably, be in a holistic manner through the development of a goal-based MASS instrument. Such an instrument could take the form of a “MASS Code”, with goal(s), functional requirements and corresponding regulations, suitable for all four degrees of autonomy, and addressing the various gaps and themes identified by the RSE.

The Committee has invited Member States to submit proposals on how to achieve the best way forward to a future session of the MSC.

### Expected Time frame

Source - Mitsui & Co. Global Strategic Studies Institute Monthly Report September 2019



## Opportunities

< Section to be coped further at VTS51>

Noting the trials being undertaken and the outcomes from the RSE there is an opportunity for IALA to strategically plan for integrating new and advancing technologies and practices relating to MASS in its Standards - balancing the benefits derived from new and advancing technologies against safety and security concerns and their impact on personnel, both on board and ashore, and the functional and operational requirements of existing services and those of emerging remote-control station/centre.

* *Opportunities associated with embracing MASS now and learning from MASS 1 and 2*
* *May fast track digital technology*
* *Changes to other key things such as Digital Comms and Automated data exchange.*

## Challenges for VTS

< establish a common understanding and consensus on assumptions associated with MASS and each degree of MASS>

### Overarching Assumptions

| **OVERARCHING ASSUMPTIONS** |
| --- |
| Consideration of the implications of MASS from a VTS perspective have been prepared based on the following assumptions:   * MASS will be required to participate in VTS. That is, the same: * regulatory reporting requirements, and * obligations with regards to the issue of advice, warnings and instructions as deemed necessary. * MASS will be subject to COLREG, as amended. * MASS will be required to Broadcast status as to who/what is in command at any time (Master/on-board DST, Remote Center?) |

### Degree of autonomy, Assumptions and Implications for VTS

Key assumptions and implications for VTS include[[1]](#footnote-1):

| **Degree of autonomy** | **Assumption/s** | **Implications for VTS** |
| --- | --- | --- |
| **Degree one**  Ship with automated processes and decision support.   * Seafarers are on board to operate and control shipboard systems and functions. * Some operations may be automated and at times be unsupervised but with seafarers on board ready to take control. | MASS of degree one is considered as a conventional ship with some additional functions to support human decision making on board.  The master and crew of the ship are in control of all ship operations at all times. | **Minimal**  There is a need to monitor advances in the automated process and decision support onboard |
| **Degree two**  Remotely controlled ship with seafarers on board:   * The ship is controlled and operated from another location. * Seafarers are available on board to take control and to operate the shipboard systems and functions. | MASS of degree two is controlled and operated from the RCC.   * Seafarers considered as a back-up should remote control experience problems/fail.   The RCC may release control and operation to the master/crew.  No matter if MASS can be operated from another location, seafarers on board are assumed to be able to meet all the operation and control requirements. | **High**   * Managing ship traffic comprising both MASS and conventional ships * Digital interaction with ships, RCCs and other stakeholders to:   + Exchange information   + Provide advice, warnings and instruction * Managing Interaction with multiple RCCs * Operational and procedural changes associated with the above * Provision of advice, warnings and instructions to the RCC with responsibility for the vessel. * Communications and interaction with participating ships (Voice / data exchange). This may include communications between ships (MASS and Traditional). |
| **Degree three**  Remotely controlled ship without seafarers on board:   * The ship is controlled and operated from another location. * There are no seafarers on board. | The ship is controlled and operated from the RCC with no seafarers on board. | **High**   * As above, plus: * Emerging situation where ship needs to be contained / controlled to mitigate incident (national gov’t, VTS, other agencies) |
| **Degree four**  Fully autonomous ship:   * The operating system of the ship is able to make decisions and determine actions by itself. * There are no seafarers on board. | The operating system of the ship is able to make decisions and determine actions by itself.  A remote control centre may exist for MASS 4 but will have minimal impact on voyages except to define destinations and a route plan  The remote control centre could take control of the MASS 4 if necessary and in such circumstances would change the vessel status to MASS 3. | **High**  As above, plus:   * Operational and procedural changes associated managing Degree four MASS * VTS should be able to request that the RCC retakes control of the MASS 4, changing its operational status to MASS 3 |

### VTS Operations

Major change to how VTS interacts with and manages ship traffic to ensure the safety and efficiency of ship movements by VTS. Key implications include:

* **VTS Operations**, that is:
  + How VTS receives, assimilates and processes data and information from MASS.
  + How does VTS interact with both conventional ships and MASS.
  + How does the VTS interact with the entity in control of the ship (Master/RCC/automated systems).
  + How VTS manages ship traffic, including:
    - A mix of conventional ships and MASS.
    - The means of providing warning, advice and instruction to achieve its purpose.
  + How VTS responds to the development of unsafe situations (conventional ships and MASS).
  + Knowing the degree of MASS for individual ships.
  + Managing interaction with multiple RCC’s.
  + Emerging situations where a ship needs to be contained / controlled to mitigate incident effects (national governments, VTS, other agencies).
* **Communications and interaction** 
  + Embracing digital communications.
  + Data and information exchange, including automated exchange.
  + Managing a mix of VHF voice, digital communications and automated data exchange.
  + The need for MASS to communicate their status.

The advent of MASS will invariable be associated with VTS managing ‘big data’, interacting with MASS using digital means, and possibly centralised, distributed and/or virtualised VTS ‘centres’ in the future.

### Options, policies and strategies for VTS to embrace influence MASS.

* IALA Strategy
* Trends doc
* This document

Options for future

* Regular review of this document
* Greater IALA engagement with MSC
* Greater IALA engagement with FAL

## Implications for the regulatory and legal framework for VTS

### IMO Regulatory Framework

IMO MSC 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 at the 103rd Session of the MSC in May 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 application to MASS operations.

The Committee noted that the best way forward to address MASS in the IMO regulatory framework could, preferably, be in a holistic manner through the development of a goal-based MASS instrument. Such an instrument could take the form of a “MASS Code”, with goal(s), functional requirements and corresponding regulations, suitable for all four degrees of autonomy, and addressing the various gaps and themes identified by the RSE.

Significantly, the RSE did not identify any issues associated with SOLAS regulation V/12 (Vessel Traffic Services) or the IMO resolution for VTS.

## Implications for IALA Standards relating to VTS

The implications of MASS for IALA Standards relating to VTS are significant.

### Existing Guidance

A preliminary review of existing Recommendations and Guidelines related to IALA *Standard 1040 – Vessel Traffic Services* has identified the following documents which will need to be reviewed.

| **Scope** | **Recommendation** | | **Associated Guideline/s** | |
| --- | --- | --- | --- | --- |
| **VTS**  **implementation** | R0119 | Establishment of VTS | G1071 | Establishment of a Vessel Traffic Service Beyond Territorial Seas |
| G1150 | Establishing, planning and implementing VTS |
| **VTS**  **operations** | R0127 | VTS Operations | G1089 | Provision of VTS (INS, TOS & NAS) |
| G1110 | Use of Decision Support Tools for VTS Personnel |
| G1141 | Operational Procedures for Vessel Traffic Services |
| **VTS data and information management** | R0125 | The use and presentation of symbology at a VTS center |  |  |
| R1014 | Portrayal of VTS information and data | 1105 | Shore side Portrayal ensuring harmonization with e-Navigation related information |
| **VTS**  **communications** | R1012 | VTS Communications | G1132 | VTS VHF Voice Communication |
| **VTS technologies** | R0128 | Operational and Technical Performance of VTS Systems | G1111 | Preparation of Operational and Technical Performance Requirements for VTS Systems |
| **VTS additional services** |  |  | G1102 | VTS Interaction with Allied or Other Services |
| G1130 | Technical Aspects of Information Exchange Between VTS and Allied or Other Services |

Significantly, it is considered that while relatively minor amendments would assist authorities in the short term many of these will require significant revision and updating with the advent of MASS as indicated in the expected timeframe above (Refer Section XX)

### New Guidance

Consensus is that new/additional guidance will be identified such as the need for guidance on VTS digital communications (*VTS51-X.X.X Proposed new task - Digital VTS Communications*)

### Ensuring VTS Guidance documents evolve with the advent of MASS

To ensure IALA Standards specifically related to the establishment and operation of VTS evolve with the advent of MASS and continue to provide an effective framework for achieving worldwide harmonisation of VTS a scoping exercise is being undertaken to:

* Identify guidance requiring updating/amendment (refer 3.5.1).
* Identify additional guidance required with the advent of MASS (refer 3.5.2)
* Provide a framework for planning the preparation of amended/new guidance that reflects the assumptions and implications described in the *Discussion Paper - Implications of MASS from a VTS Perspective*, as amended, particularly with regards to the assumptions, implications and expected timeframes.

The methodology and process for undertaking this work will be considered at VTS51 (*VTS51-X.X.X Proposed new task - MASS - Implications for IALA Guidance*).

# Acronyms

AIS Automatic Identification System

MASS Maritime Autonomous Surface Ships

RCC Remote Control Center

VDES VHF Data Exchange System

VTS Vessel Traffic Services

# references

1. China MSA. (2020). Scoping exercise on the implications of MASS on VTS documents (VTS48-8-2.6).
2. NL Paper on the impact of MASS on VTS (VTS49-3.1.2).
3. IALA. (2019d). VTS COMMITTEE TASK REGISTER FOR 2018 – 2022.
4. IALA Standards S1040
5. IALA Guideline 1141
6. IMO. (2021). MSC.1/Circ.1638
7. IMO. (2019). MSC.1/Circ.1604
8. IMO. (2018). MSC 100/20/add.1
9. IMO. (2017). MSC 98/20/2

1. Note – This table provides a high-level summary of a working table prepared to assist achieving a common view on the assumptions and implications for VTS based on the outcomes from the MASS workshop and subsequent scoping by TG-1.2.5. In addition to information specifically related to VTS the working table summarises thoughts and opinions related to the operation of MASS vessels and implications for other IALA Standards. It has been retained as a working table for further use (*TG1.2.5 - Working Table - Degrees of Autonomy, Assumptions, Considerations and Implications)* [↑](#footnote-ref-1)