

IHO MASS PT S100 Gap Analysis

Member State/Organization	Brazil – Directorate of Hydrography and Navigation (DHN)
S100 Standard Reviewed	S126
Maturity of Standard	It is on hold. No version published.
S100 Standard Chair	Evind Mong

Issue/Requirement (take from Spreadsheet)	Issue addressed?	More content?	Gap in standard?	Potential Solution/s	Ease to implement?
MASS will require fairways to be captured as polygons and features in their own right.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Not applicable to S126	Choose an item.
Mass will require canal locks to be captured with relevant attribution, such as width of lock.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Not applicable to S126	Choose an item.
MASS will require port areas/limits to be captured as polygons with relevant attribution.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Not applicable to S126	Choose an item.
MASS will require the ability to exchange route information between vessels.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Not applicable to S126	Choose an item.
MASS will require VTS areas to be captured as polygons with relevant attribution.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Not applicable to S126	Choose an item.

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MASS will require 3D applications or Digital Twins. 3D models or Digital Twin for rehearsal of Port entry both above and sub surface will be increasingly important for situation awareness in Degree 3 and 4. Digital Twins could be a useful 3D chart in the future that a MASS can use with computer vision sensors to compare the real world with the Digital Twin and triangulate its position.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Not applicable to S126	Choose an item.
MASS will require dynamic data on surface currents.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Not applicable to S126	Choose an item.
MASS will require Ice conditions and areas.	✓	✓	<input type="checkbox"/>		Choose an item.
MASS will require wind information.	<input type="checkbox"/>	<input type="checkbox"/>	✓	Average direction and intensity of winds should be part of S126, in percentage.	Moderately
MASS will require wave height information.	✓	✓	<input type="checkbox"/>		Choose an item.
MASS will require the natural language data in publications, charts (pick reports) and	<input type="checkbox"/>	<input type="checkbox"/>	✓	It should be considered as part of S126 the development of MASS common language.	Moderate

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MSI to be made machine readable and interpretable. Natural language is difficult for machines to read and interpret, we need to move to a feature and attribute model for all aspects of data for MASS. This will also need to cover meta data for the actual data.					ly
MASS will be required to perform spatial analysis (e.g., algorithm able to determine the best route using features of the ENC). The ENC data (S-57 or S-101 using ISO 8211) is not adequate for software based spatial analysis. Spatial indexation of ENC data, e.g., Hexagonal Hierarchical Spatial Index, could be a solution to foster spatial analysis.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Not applicable to S126	Choose an item.
MASS will require historic marine accident or incident layers for risk profiling a particular area.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Not applicable to S126	Choose an item.
MASS will require more frequent or real-time updates of the data contained in the S100 products, which should be pushed from official sources that the vessels can 'listen' out for and update their navigational database and products automatically irrespective of where they are in the world. Event driven data updates and near real	✓	<input type="checkbox"/>	<input type="checkbox"/>		Choose an item.

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time updates will be required for MASS as MASS will always need to be up to date.					
The communication infrastructure necessary to sustain data exchange is not reliable and affordable today. Thought needs to be given to data packets sizes for data and updates for MASS.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Not applicable to S126	Choose an item.
MASS will require historical traffic pictures, and if there are any anomalies in operations compared with historical traffic or adverse weather or unforeseeable events (e.g. freak wave) and behave differently, they can alert the human overwatch who can then revert to a Degree 3 control.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Not applicable to S126	Choose an item.
MASS will require ferry routes and the ferry route timetables. Ferry routes could be captured as polygons or lines with attribution in a machine-readable format that shows the ferry timetable.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Not applicable to S126	Choose an item.
MASS will require full bathymetric coverage datasets/DTM, gaps in data will pose a problem for MASS.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Not applicable to S126	Choose an item.
MASS will require a better standardization and accessibility to harbor infrastructure datasets.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Not applicable to S126	Choose an item.

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<p>To avoid large volumes of bathymetric data (i.e., S102 gridded data), there is a need for conspicuous seabed features to be highlighted (such as sea mounts, obstacle or trenches) for use with Inertial Navigation Systems in GNSS denied environments. Similar to land based visually conspicuous objects captured in ENC's today.</p>	✓	<input type="checkbox"/>	<input type="checkbox"/>		Choose an item.
<p>MASS will require certainty of seabed and associated features. High resolution data is great, but if it changes regularly, then that needs to be made clear and articulated in some way (example Humber estuary). Understanding when highly mobile seabed was last surveyed will also be important.</p>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Not applicable to S126	Choose an item.
<p>MASS will require an understanding of the reflective nature of the seabed, possibly associated with grab sample data for use in Inertial Navigation Systems.</p>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Not applicable to S126	Choose an item.
<p>MASS will require an understanding of the acoustic qualities of the water column for Inertial navigation Systems.</p>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Not applicable to S126	Choose an item.
<p>MASS has an issue with edge matching on charts. Often there is a discontinuation of data, particularly on depth contours.</p>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Not applicable to S126	Choose an item.

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Described as a "leap of faith" when transitioning from one chart to another.					
<p>MASS will require more visually, and radar conspicuous items required for alternate means of position fixing using computer vision techniques. Also, a measure of certainty of the features position would be required. Features to include could be (but not limited to)</p> <p>Coastal terrain</p> <p>Navigation marks</p> <p>Harbour Approaches</p> <p>Dock/quay walls</p> <p>Major buildings or landmarks</p> <p>Bridges and other man-made structures extending out over the water.</p>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Not applicable to S126	Choose an item.
<p>MASS will require shipping lanes to be made available and captured as polygons with suitable attribution.</p>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Not applicable to S126	Choose an item.
<p>MASS will require certainty of tidal heights and surface currents at a given point and time, particularly in congested water space and shallower waters. Bramble bank in UK was used as an example, being shoalier by</p>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Not applicable to S126	Choose an item.

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0.5m could lead to a grounding. Predicted and forecast tidal height and surface currents are essential but certainty factors surrounding the predictive nature is important for decision making and risk profiling a route for MASS.					
MASS will require more use of photographic imagery, specifically panoramic photographic imagery.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Not applicable to S126	Choose an item.
MASS will require more geographical polygons to describe areas (such as speed restriction and constraints), with suitable attribution for MASS to interrogate and act appropriately. This information is often captured in text boxes, Sailing Directions or Pick Reports in natural language with very little geographic descriptors, making it impossible for MASS to interrogate, read and act upon. These could be created as instructional layers which are geographically location based containing attribution such as name of feature, type of feature, unique number, reason for speed restriction or constraint etc. in a machine-readable format.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Not applicable to S126	Choose an item.
MASS will require areas defined by buoys	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Not applicable to S126	Choose an item.

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such as the edge of a channel captured as polygons. Humans can make the relationship between the buoys and a channel, machines cannot. This will allow MASS to plan paths and obey the rules.					se an item.
MASS will require communication zones to be captured as polygons with appropriate attributes. As an example, currently the rules for radio communications are within the Admiralty list of radio signals volumes 1-6, these volumes are particularly difficult for an autonomous vessel to understand.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Not applicable to S126	Choose an item.
MASS will require national infrastructure zones to identify areas of importance which could have security implications. For example, undersea pipes which transport oil and gas may be marked approximately on a chart, but the exact locations are not displayed as they supply an important service that could be maliciously targeted. For these areas a polygon larger than the infrastructure would be used to obscure the exact location of the resource, and thus protect it.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Not applicable to S126	Choose an item.
MASS will require unique identifiers for features which could be another means of	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Not applicable to S126	Choose an

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position fixing. As an example, charts may show an area of 'mooring posts' but not define how many or where, this information would overload a human readable chart. If, however they were identified with unique ID numbers and positions in a machine-readable format they would be a highly accurate method of the MASS in verifying its position, progress against goals and navigational status.					item.
MASS will require real time tidal data which is crucial in shallower waters.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Not applicable to S126	Choose an item.
MASS will need to know when restricted water space is active or inactive for example military exercise areas or firing ranges. When inactive it is perfectly safe to traverse these but not when active. Another example could be Fish farms and understanding when they need to be given a wider berth if it is breeding season etc.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Not applicable to S126	Choose an item.
MASS need to be aware of and go through Traffic Separation Schemes, but today there is no way for a degree 4 MASS to know that a TSS exists. A method of identifying TSS and then transitioning towards it and	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Not applicable to S126	Choose an item.

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through it safely will be crucial.					
MASS will need to know where reporting points or areas are geographically. As an example, knowing at what point to contact Falmouth Coastguard to say whether you were passing between UK mainland and the Isles of Scilly or not.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Not applicable to S126	Choose an item.
MASS will require polygons denoting what level or Degree of MASS operation is allowed. As an example, Degree 4 may not be allowed in a port. MASS and MASS operators will need to know what areas they can go into or not as they may need to move from Degree 4 to 3 when entering specific areas.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Not applicable to S126	Choose an item.
MASS requires more land based topographical data such as contours for visual reference.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Not applicable to S126	Choose an item.
Light sectors can sometimes be blocked by land mass or other features. MASS will need some method of determining line of sight, maybe having attribution that determines visibility in degrees.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Not applicable to S126	Choose an item.
MASS will need to understand the drift of Buoys, the length of chain and tidal range	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Not applicable to S126	Choose an

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can mean Buoys could be several meters out of position, humans can understand this MASS will need to know that a Buoy may have a tolerance of position if they are using them for navigation purposes.					item.
MASS will need the accurate fully resolution detail of wrecks. Today we generalize wreck features at certain scales, but MASS needs the rich detail, particularly in shallower waters. One of the main reasons given is that wrecks are often fishing locations and discarded nets are a hazard to smaller MASS. This raises the scaleless data question, scale is for human readers of data, machines don't care about scale or generalization.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Not applicable to S126	Choose an item.
MASS need to have richer detail on offshore infrastructure, for example is the feature still in use, is it being decommissioned, how high off the seabed is it etc. This requirement also exists for Wind Farms.	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Not applicable to S126	Choose an item.
MASS will require precise information regarding the interface between autonomous and human operation at points such as mooring operations, canal transit	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Not applicable to S126	Choose an item.

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Designated operating areas for MASS small craft? Geo-fencing	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Not applicable to S126	Choose an item.
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