

Meeting: 18th IMS Group User Consultation Meeting (UCM#18)

Place and date: Lisbon, 25 May 2022 (Hybrid)

Agenda item: 2 – Update on Automated Behaviour Monitoring and Advanced Analytics

Document number: IMS 18.2

Submitted by EMSA

Summary	This paper provides an update on the status of the Automated Behaviour Monitoring (ABM) tool within the Integrated Maritime Services (IMS) and the related developments.
Action to be taken	As per Section 10.
Related documents	[1] Automated Behaviour Monitoring and Advanced Analytics Workshops 1-7 Meetings' Minutes [2] HIGH LEVEL STEERING GROUP (9th Meeting) for Governance of the Digital Maritime System and Services, 8-9 December 2021 – Agenda Item 7 – Annexes B and D.

1. Background

Automated Behaviour Monitoring (ABM) algorithms provide Integrated Maritime Services' (IMS) users with services related to the detection of specific or anomalous ships' behaviours. They may reduce maritime surveillance operators' workload by automatic analysis of ships' positions and the related alerting.

The ABMs proved to be very useful for the maritime safety as they provide a better maritime situational awareness. In the context of VTMIS they may produce an early warning on potentially dangerous situations affecting safety or security of navigation. The VTMIS reporting obligations can be also verified with the usage of specific ABM algorithms.



Figure 1 – Illustration of the 'sudden change of heading' ABM detected alerts for a ship

2. ABMs capabilities

The ABMs are intensively used by EU Member States' authorities and EU Bodies executing various functions in the maritime domain. Scenarios related to the safety of marine traffic, environmental protection, fisheries control, border control and security can be effectively executed with their support.

They are also utilized to support risk identification and assessment in the maritime domain. Some ABMs provide input for advanced analysis or for automatized reporting. For instance, the ABMs are used in the IRD- 'Interoperability' project or provide inputs for the EMSA Maritime Analysis Tool- EMAT prototype.

The ABM implementation provides two types of capabilities:

1. 'Near real-time' algorithms (NRT- ABMs), detecting specific or anomalous behaviours and alerting users within around fifteen minutes.
2. 'Historical' ABMs (H-ABMs), where seven algorithms use archived position reports or form a database of specific, detected situations and events (e.g. detecting port calls globally).

Refer to Annex 1 for the complete list of algorithms.

The IMS users granted with specific ABM access rights, can configure required algorithms via the IMS graphical interface SEG, selecting ships in their areas of interest. The Historical ABMs are pending implementation in SEG but can be accessed via System-To-System (s2s) web interfaces or can be configured with EMSA's support.

3. 'Near real-time' (NRT) ABMs usage

EMSA monitors the level of usage of the ABMs. Based on the retrieved metrics it can be concluded that the number of ABM administrators as well as the overall use of the ABM algorithms has increased since the UCM#17 in October 2021.

- There are over 370 (+10) ABM admin accounts granted to 21 Member States, 1 candidate country, 5 EU Bodies and EMSA.
- As of May 2022, there are over 830 (+130) running, actively used ABM algorithms. More than 1,900 other ABMs were used over last year and are now either stopped or terminated. Additionally, 170 ABMs are set to start their operations in the future (with status 'pending').
- The NRT ABM-related alerts are distributed via over 340 (+40) distribution lists to more than 940 (+140) users. On average, daily over 10,000 alerts are provided to ABM users via: web services (System-to-System S2S), by email or to the graphical interfaces (SEG or the Mobile App).
- Over the last year, the top five most popular NRT ABM algorithm types, have been: 'In Area'; 'Speed Anomaly'; 'From Area to Area'; 'Drifting'; 'At Sea Encounter'.

4. ABM-related activities and developments

EMSA is currently validating the new version of the ABM technical module for the NRT ABMs. The updated software, apart from addressing a number of technical aspects, should also allow to use SSN Enrichment basic data as filter for vessels of interest (e.g. to select alerting for vessels with 'active' HAZMAT report). A new algorithm for the detection of a lack of position report messages should be also implemented.

The Historical (H) ABMs capabilities will be implemented in SEG at the end of 2022. Apart from the configuration by the ABM admins, all other SEG users will have a possibility to see the H-ABMs results for the 'detected' port calls. Consequently, it will be possible to quickly verify the declared ship calls.

As regards the training activities, the ABM related modules make part of the regular IMS training activities. The next IMS/SEG/ABM training is planned for June 2022. Member States can also request an ad-hoc, on-line information or awareness sessions. Additionally, the IMS team has recently updated the ABM user guide that is now available upon request by the active ABM users.

5. ABM and Advanced Analytics Workshop 7

EMSA held the 7th Workshop on Automated Behaviour Monitoring (ABM) and Advanced Analytics on 14 December 2021. Due to the 'COVID-19' situation and the related travel restrictions, the workshop took place via videoconference only. The outcome of the event can be summarized with the following points.

- Several Member States and EU Bodies provided feedback on ABM operational usage in the context of maritime safety, law-enforcement, traffic monitoring, pollution prevention, fisheries control, border control and cross-border crime. All the interventions included practical examples, outlined main challenges, and suggested changes in the ABM services.
- EMSA presented the status of ABM operations and the planned future developments. The evolution of the ABM services over the years was described together with the recently provided, new Historical ABM capabilities.
- Usage of the 'Cloud' and 'Big Data' new, technological solutions were described by EMSA based on High Performance Integrated Maritime Services (HP-IMS) platform experience.
- Previously identified Artificial Intelligence (AI) and Machine Learning (ML) business scenarios were discussed in the context of their VTMS supporting objectives, looking into practical aspects of their implementation, such as: the data, presentation aspects and the expected outcomes.
- The EMAT – EMSA Maritime Analytics Tool prototype status was presented, focusing on recently developed new dashboards for 'at sea encounters' and 'sudden change of heading' outside ports.
- ABM related training activities were also discussed with participants and a new version of the ABM User's Guide was distributed.

6. Artificial Intelligence (AI) and Machine Learning (ML) Advanced Analysis

Following the discussion on the potential Artificial Intelligence (AI) and Machine Learning (ML) scenarios in IMS, EMSA is currently conducting a study on the potential usage of the referred technologies in IMS. Several, voluntary MS users (NL, DE, DK, BE, HR, IE, NO) were interviewed in that context. The report prepared as an outcome of the study will contain feasibility analysis, summary of the AI and ML used in the maritime or other transport domains, clear business requirements and the potential evolution of the identified use cases. The document may be used in the future as a base for potential, operational implementation of the AI and ML solutions in IMS.

7. EMSA Maritime Analytics Tool prototype

As regards the EMSA Maritime Analytics Tool (EMAT) prototype, some of the ABM active users were granted with access to the software. New licences have been provided to the interested IMS/ ABM users. Additional two dashboards ('at sea encounters' and 'sudden change of heading' outside ports) were added to the tool. EMSA is planning to expand the tool in collaboration with MS, and consequently encourages IMS users to

further elaborate potential new use cases or dashboards based on the combination of various data sources. They can be provided by correspondence and further discussed during the next ABM and Advanced analytics workshop in December 2022.

8. ABM interfaces

The following interfaces are available for configuring and displaying the ABM related information (generated alerts or the ABM alerts).

Functionality	Configuration of the ABM algorithms	ABM related alerts	Configuration of the ABM alerts distribution
Interface	<p>S2S</p> <p><i>Separate APIs for NRT ABMs and H-ABMs</i></p> <p>SEG*</p> <p><i>* for the NRT ABMs. The H-ABM implementation in SEG is pending</i></p>	<p>S2S</p> <p><i>Separate APIs for NRT ABMs and H-ABMs</i></p> <p>SEG</p> <p>IMS Mobile App for the NRT ABMs only.</p> <p>E-Mail for the NRT ABMs only).</p>	EMSA Maritime Applications Portal (MAP) for the NRT ABMs only.

Table 1 – ABM interfaces

9. ABM admin tool

Access to the ABM administrative (configuration) tool can be requested by the IMS active users via an email to ims@emsa.europa.eu. Urgent requests for setting ABMs can be sent directly to the 24/7 EMSA's Maritime Support Services email: MaritimeSupportServices@emsa.europa.eu.

10. Action required

IMS Member States are requested to take note of the current ABM status, planned developments, analyse own operational needs for the related services and communicate them to EMSA.

- Annex 1 -- ABM algorithms ('near-real time' and 'historical').

Annex 1 — ABM algorithms ('near-real time' and 'historical'). 'Near Real-Time*' Automated Behaviour Monitoring (ABM) algorithms

* based on the incoming ship position reports

	ABM Type – which situations are automatically detected and alerted, based on the position reports	ABM name	Status
1	Vessel reports positions inside an area	InArea	Operational
2	Passage of a vessel close to the shore	DistanceToShore	Operational
3	Vessels entering or leaving ports, in an area of interest	AtPortAtSea	Operational <i>Note: limited to ports with declared UNECE LOCODE and coordinates.</i>
4	Detection of anchored vessels	Anchorage	Operational
5	Frequency of vessels' position reports higher than expected	OverReporting	Operational
6	Frequency of vessels' position reports lower than expected	UnderReporting	Operational
7	Vessels approaching one another closer than an indicated distance, with a speed below defined threshold	AtSeaEncounter	Operational
8	Change of heading higher than a threshold (e.g. more than 20 deg.)	SuddenChangeOfHeading	Operational
9	Sudden change of speed	SuddenChangeOfSpeed	Operational
10	Change of speed above or below a limit set	SpeedAnomallyOverPeriod	Operational
12	Passage of a vessel close to an area of interest	DistancetoArea	Operational
13	Vessels entering a closed area at a specific time	TimeAndPeriodOfDay	Operational
14	Vessel leaves Area of interest X and enters Area of Interest Y	FromAreaToArea	Operational

15	Vessel reports position outside an area	OutArea	Operational
16	Vessel is (potentially) switching off transponder	NotReporting	Operational
17	Port of Departure is X	DesignatedPortofDeparture	Operational <i>Note: limited to ports with declared UNECE locode and coordinates.</i>
18	Port of Arrival is X	DesignatedPortofArrival	Operational <i>Note: limited to ports with declared UNECE locode and coordinates.</i>
19	Vessel is drifting	Drifting	Operational <i>Note: may not be available for the Class B transponders</i>
20	Vessel departs from coastline	HeadingOffShore	Operational
21	Vessel heads towards coastline	HeadingtoShore	Operational
22	Potential spoofing- change of position/ out of range	SpoofingPositonInError	Operational <i>Note: based on measuring 'speed' and 'distance' parameters</i>
23	Change of speed above or below a limit set outside port	SpeedAnomallyOverPeriod Outside Port	Operational <i>Note: limited to ports with declared UNECE LOCODE and coordinates.</i>

24	Anchored vessels outside port	AnchorageOutsidePort	Operational <i>Note: limited to ports with declared UNECE LOCODE and coordinates.</i>
25	Detection of unidentified objects/ships i.e. Uncorrelated VDS (EO product Vessel Detection Service) in an area of interest	Uncorrelated in Area	Operational <i>Note: Detection depending on the availability of the VDS products and the EO acquired imageries</i>
26	Vessels entering and remaining in a zone around another, selected ship	ZoneAroundShip	Operational <i>Note: Defining zone around a vessel based on encounter/ rendezvous parameters</i>
27	Vessels entering a radius (bubble) around other, selected ship(s)	ZoneAroundShipEnhanced	Operational <i>Note: Defining zone using a radius parameter/value.</i> <i>Multiple vessels of interest can be selected in one ABM of 'Enhanced type'</i>
28	Vessel has specific navigational status in AIS transmission	NavigationalStatus	Operational
29	Vessel crosses a defined line (e.g. a reporting line)	LineCrossing	Operational

30	Vessel enters the area	AreaEntering	Operational
‘Historical’* Automated Behaviour Monitoring (ABM) algorithms <i>*based on the historical position reports in the Cloud-based HP-IMS</i>			
31	Vessel entered to an area	InArea	Pre-Operational <i>Note: Available via s2s interface.</i> <i>SEG (GI) integration still pending.</i>
32	Vessel was drifting	Drifting	Pre-Operational <i>Note: Available via s2s interface.</i> <i>SEG (GI) integration still pending.</i>
33	Vessels were approaching one another closer than an indicated distance, with a speed below defined threshold	AtSeaEncounter	Pre-Operational <i>Note: Available via s2s interface.</i> <i>SEG (GI) integration still pending.</i>
34	There was a change of speed above or below specific limits	SpeedAnomaly	Pre-Operational <i>Note: Available via s2s interface.</i> <i>SEG (GI) integration still pending.</i>
35	There was a gap in reporting of positions	NotReporting	Pre-Operational <i>Note: Available via s2s interface.</i> <i>SEG (GI) integration still pending.</i>

36	Vessels entered a radius (bubble) around other, selected ship(s)	ZoneAroundShip	<p>Pre-Operational</p> <p><i>Note: Available via s2s interface.</i></p> <p><i>SEG (GI) integration still pending.</i></p>
37	Detected port calls -per ship(s) /location(s)	Port Call(s)	<p>Pre-Operational</p> <p><i>Note: Available via s2s interface.</i></p> <p><i>SEG (GI) integration still pending.</i></p> <p><i>Limited to specific ports' polygons in EU and non-EU ports with declared UNECE LOCODE and valid coordinates.</i></p>