

Meeting: 16th IMS Group User Consultation Meeting (UCM#16)

Place and date: Lisbon, 26 May 2021

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

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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 8.
Related documents	[1] Automated Behaviour Monitoring and Advanced Analytics Workshops 1-6 Meetings' Minutes [2] HIGH LEVEL STEERING GROUP (8th Meeting) for Governance of the Digital Maritime System and Services, 15 December 2020 – Agenda Item 7 – Annexes B and D.

1. Background

The Automated Behaviour Monitoring algorithms are the Integrated Maritime Services' (IMS) tools analysing various position reports for the detection of specific or anomalous ships' behaviours. Their aim is to support the maritime surveillance operators and reduce their workload by providing an increased maritime situation awareness and automatized alerting. Although ABMs derived originally from the IMS for Member States, they are used across various services by EU Member States and EU Bodies executing functions in safety of marine traffic, environmental protection fisheries control, border control and security. ABMs may also support assessment of risks in the maritime domain and provide input for advanced analysis or automatized reporting (e.g. ABMs are used in the IRD- 'Interoperability' project).

2. Status and evolution of the ABMs - 'Near real-time' and 'Historical' capabilities

The ABM administrators, granted with additional access rights, can set their own ABMs via the SEG admin console, covering different ships in various areas of interest. Additionally, ABM administrators and other SEG users can take advantage of the access to the archived ABM alerts (via advanced search or area centric query) for supporting analysis of various maritime risks.

The ABM implementation so far aimed at providing 'near real-time' (NRT) capabilities, detecting specific or anomalous behaviours and alerting users within around fifteen minutes. The ABM users, consulted during the ABM and Advanced Workshops, requested expansion of these capabilities to historical data sets, for the purpose of 'no time- critical' applications.

Consequently, 'historical' ABMs, using Cloud infrastructure (so called High Performance 'HP-IMS'), were developed and are in 'pre-operational' status. In the future they will allow configuration of ABM seven algorithms (including detection of port calls worldwide) on the historical data sets, using the SEG interface (See Annex 1 for the list of 'near real-time' and 'historical' ABM algorithms).

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

The number of the ABM administrators, as well as the overall use of the ABM algorithms, has increased since the UCM#15.

- There are over 270 ABM admin accounts granted to 21 Member States, 1 candidate country, 5 EU Bodies and EMSA.
- As of April 2021, there are over 720 running (actively used) ABM algorithms. More than 1,300 other ABMs were used over last year and are now either stopped or terminated.
- The NRT ABM-related alerts are distributed via over 300 distribution lists to more than 400 users. Daily, over 7,000 alerts are provided to ABM users via: web services(s2s), by email or to the graphical interfaces (SEG or the Mobile App).
- Over the last year, the top five most popular ABM algorithm types, have been: 'In Area'; 'Speed Anomaly'; 'Drifting'; 'Not Reporting'; 'From Area to Area'.

4. New, ABM-related developments

The following developments have been completed since the IMS Group 15th User Consultation Meeting (UCM#15):

- The new ABM technical module was updated to the new version – STAR ABM 3.6. The new version included various bugs corrections and new algorithms (Navigational Status detection; Line Crossing; Area Entering, Enhanced Zone around the ship).
- The training activities in the area of ABMs were conducted solely online during 2020. There were 58 users from 6 MS and 3 EU Bodies trained during 12 dedicated webinars covering ABM topics.

As mentioned earlier, based on users' requirements, as recorded during the ABM and Advanced Analytics Workshops, EMSA developed new capabilities for detecting the following anomalous vessel behaviours or specific situations in the past, based on historical position reports ('Historical' ABMs):

- Entry to an area (In area);
- Drifting;
- At sea encounter;
- Speed anomaly;
- Not reporting;
- Zone around ship;
- Port Calls – on a global scale, based on defined port areas.

'Historical' ABMs were initially validated with a group of active ABM users from EU Bodies and Member States (BE, PL, IT, ES, HR, DE, DK, IE, NL).

5. Sixth (6th) ABM and Advanced Analytics Workshop

The ABM and Advanced Analytics Workshop 6, that took place on 14 December 2020 via videoconference, can be summarized with the following points.

- EMSA presented the current status of ABM operations and the planned future developments. The 'Cloud' related developments (HP-IMS) were put into context and examples of the 'Detected Port Calls' scenarios were demonstrated. The new pilot services were later validated with the active ABM end-users (see section 4).
- Some of MS and EU Bodies presented their feedback on the usage of the current ABMs, the EMAT tool and the scenarios for future expansion of the ABM services.
- AI and ML scenarios were reviewed and ranked. Based on the discussion, the following priority scenarios were identified:
 - Recognition of similar trading patterns;
 - Discrepancy destination vs. route taken;
 - Vessel not following recommended routes/ TSS-es;
 - Deviation from the usual route;
 - Detection of the non-viable economic activity;
 - Analysis/mapping of offshore activities;
 - Mapping of close quarter situations or density of anomalous behaviours;
 - New scenario/functionality allowing visualisation of tracks and the references to specific activities registered/detected;
 - A tool/functionality for the configuration and automatic assignment of the vessel risk, based on the static (e.g. GT, LOA) and dynamic data sets (tracks, events) associated to the ship(s).
- EMAT – EMSA Maritime Analytics Tool - prototype was discussed, as some of the users were already granted with access to the tool. An additional demonstration of the EMAT prototype was provided by EMSA. Requirements for relevant modifications of the existing scenarios were deliberated (e.g. timelines of the dashboards) as well as the new ideas for the dashboards.
- ABM related training activities were summarized. EMSA Capacity Building Unit's plans for the trainings support as well as the general approach to the training activities were also presented.

6. ABM interfaces

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

Functionality	ABM configuration	ABM- alerting mechanism	Configuration of the ABM alerts distribution
Interface	S2S SEG (new interface)	S2S; SEG (new interface) IMS Mobile App (with exemption of the Historical ABMs) E-Mail	EMSA Maritime Portal (new interface, with exception of the Historical ABMs)

Table 1 – ABM interfaces

7. ABM admin tool

Access to the NRT ABM administrative (configuration) tool can be requested to Lukasz.BIBIK@emsa.europa.eu with copy to ims@emsa.europa.eu. Urgent requests for setting ABMs via EMSA can be sent directly to the 24/7 EMSA's Maritime Support Services email: MaritimeSupportServices@emsa.europa.eu.

8. Action required

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

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

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** 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 imagery</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 <i>Note: Available via system-to-system (s2s) interface.</i> <i>SEG (GI) – awaiting version 1.11</i>

29	Vessel crosses a defined line (e.g. a reporting line)	LineCrossing	Operational <i>Note: Available vis s2s interface.</i> <i>SEG (GI) – awaiting version 1.11</i>
30	Vessel enters the area	AreaEntering	Operational <i>Note: Available vis s2s interface.</i> <i>SEG (GI) – awaiting version 1.11</i>
‘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 vis s2s interface.</i> <i>SEG (GI) integration stil pending.</i>
32	Vessel was drifting	Drifting	Pre-Operational <i>Note: Available vis 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	<p>Pre-Operational</p> <p><i>Note: Available vis s2s interface.</i></p> <p><i>SEG (GI) integration still pending.</i></p>
34	There was a change of speed above or below specific limits	SpeedAnomaly	<p>Pre-Operational</p> <p><i>Note: Available vis s2s interface.</i></p> <p><i>SEG (GI) integration still pending.</i></p>
35	There was a gap in reporting of positions	NotReporting	<p>Pre-Operational</p> <p><i>Note: Available vis s2s interface.</i></p> <p><i>SEG (GI) integration still pending.</i></p>
36	Vessels entered a radius (bubble) around other, selected ship(s)	ZoneAroundShip	<p>Pre-Operational</p> <p><i>Note: Available vis s2s interface.</i></p> <p><i>SEG (GI) integration still pending.</i></p>

37	Detected port calls -per ship(s) /location(s)	<p>Port Call(s)</p>	<p>Pre-Operational</p> <p><i>Note: Available vis 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>
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