EMSA
European Maritime Safety Agency

Meeting: 17th IMS Group User Consultation Meeting (UCM#17)

Place and date: Lisbon, 21 October 2021 (online)

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 10.
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 position reports for the detection of specific or anomalous ships' behaviours.

- They may be helpful in the VTMIS context, for the verification of the reporting obligations or for early warning on potentially dangerous situations affecting safety of navigation.
- They may also reduce workload of the maritime surveillance operators by providing better maritime situation awareness and automatized alerting (see Figure 1).
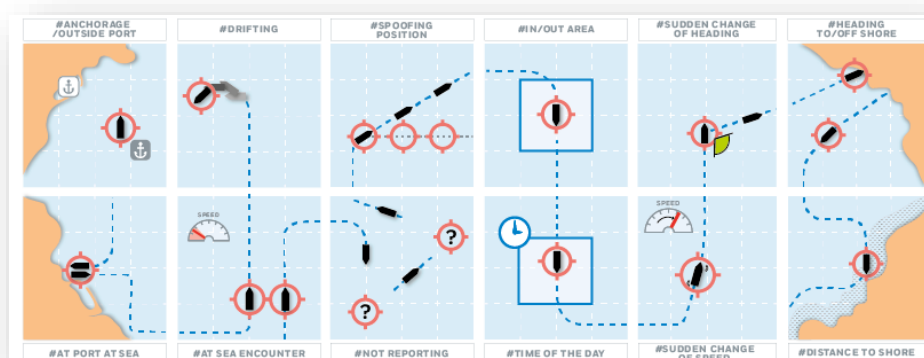

Figure 1 – Illustration of some situations that can be detected with ABM algorithms

ABMs are used by the EU Member States and EU Bodies executing functions in safety of marine traffic, environmental protection, fisheries control, border control and security. They are also utilized to support assessment of risks in the maritime domain, to provide input for advanced analysis or for 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 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 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 list of 'Near real-time' and 'Historical' ABM algorithms.

The ABM administrators, granted with specific access rights, can set their own NRT ABMs via the IMS graphical interface SEG, selecting different ships in their areas of interest. Additionally, the ABM administrators as well as the other IMS users can take advantage of the access to the archived ABM alerts via advanced search or area centric query. These functionalities can be useful for various analysis or for identifying maritime risks. The H-ABMs were developed responding to end- user requirements and are currently in 'pre-operational' status. They 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 using Business Intelligence (BI) tools and the ABM database queries. 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#16.

- There are over 360 ABM admin accounts granted to 21 Member States, 1 candidate country, 5 EU Bodies and EMSA.
- As of October 2021, there are over 700 running (actively used) ABM algorithms. More than 1,500 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 800 users. Daily, over 8,000 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 testing and validating the new version of the ABM technical module for NRT ABMs. The updated software should allow to change the content of the ABM alert email by adding the type of ship and dimensions. It will also address a couple of technical issues.

The Historical (H) ABMs capabilities should be implemented in SEG during 2022 and will allow ABM administrators to configure own historical algorithms via the existing ABM admin console. Additionally, all

users will have a possibility to see the results of the detected port calls from a selected ship or a selected port 'Command and Info' (C&I) panel. Thanks to this new functionality it will be possible, for instance, to quickly verify the declared ship calls without requesting historical tracks.

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 the 22 October. Member States may also request ad-hoc training activities (webinars) or ABM awareness sessions by contacting the IMS team. IMS team will also work on the available training materials, starting with the updates of the ABM quick start guide, as well as the complete ABM user guide.

5. ABM and Advanced Analytics Workshop 7

The next ABM and Advanced Analytics is provisionally planned for the 07 December. EMSA encourages the existing, active ABM administrators as well as new ABM users to participate in the event. Among many topics it will be possible to discuss ABM-related developments, future priorities, operational aspects and practices, and Artificial Intelligence (AI) and Machine Learning (ML) business scenarios.

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 in the process of tendering consultancy services supporting the definition of potential solutions in Integrated Maritime Services.

These solutions shall contribute in an economical, efficient, and sustainable way to the maritime safety, security, environment protection and the efficiency of the maritime traffic. The overall operational objective of the AI and ML in the context of IMS will be to reduce the workload of the maritime administrations, maritime traffic, or maritime surveillance operators by automatizing certain analysis. The related data shall be presented in a user-friendly and aggregated form, supporting ad-hoc analysis and potential alerting on events that may negatively impact maritime safety or security.

The expected outcome of the consultancy shall be a report containing 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 already identified use cases. In the future the report may be used as an input for the potential, practical future implementation of the AI and ML solutions using the existing or new IMS interfaces.

7. EMSA Maritime Analytics Tool prototype

As regards the EMSA Maritime Analytics Tool prototype, some of the ABM users were granted with access to the software. Additionally, based on the users' feedback new scenarios were deliberated, for instance, to verify VTMIS reporting obligations. EMSA encouraged MS to further elaborate potential new use cases based on the combination of the position data as well as the enrichment information from various sources. They can be presented and further discussed during the next ABM and Advanced analytics workshop in December 2021 (refer to section 5).

8. ABM interfaces

The following interfaces are available for configuring and displaying the ABM related information (generated alerts or results of the H-ABMs).

Functionality	ABM configuration	ABM- alerting or results notification mechanism	Configuration of the ABM alerts distribution
Interface	**S2S** (separate for NRT and H-ABMs) **SEG** (the H-ABM implementation in SEG is pending)	**S2S** (separate for NRT and H-ABMs) **SEG** **IMS Mobile App** (with exception of the Historical ABMs) **E-Mail** (with exception of the Historical ABMs)	EMSA Maritime Applications Portal (with exception of the Historical ABMs)

Table 1 – ABM interfaces

9. ABM admin tool

Access to the NRT ABM administrative (configuration) tool can be requested 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 .

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').'Near Real-Time*' Automated Behaviour Monitoring (ABM) algorithms

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 *Note: limited to ports with declared UNECE LOCODE and coordinates.*
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 *Note: limited to ports with declared UNECE locode and coordinates.*
18	Port of Arrival is X	**DesignatedPortofArrival**	Operational *Note: limited to ports with declared UNECE locode and coordinates.*
19	Vessel is drifting	**Drifting**	Operational *Note: may not be available for the Class B transponders*
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 *Note: based on measuring 'speed' and 'distance' parameters*
23	Change of speed above or below a limit set outside port	**SpeedAnomallyOverPeriod** ***Outside Port***	Operational *Note: limited to ports with declared UNECE LOCODE and coordinates.*

			Operational
24	Anchored vessels outside port	*AnchorageOutsidePort*	*Note: limited to ports with declared UNECE LOCODE and coordinates.*
25	Detection of unidentified objects/ships i.e. Uncorrelated VDS (EO product Vessel Detection Service) in an area of interest	**Uncorrelated in Area**	Operational *Note: Detection depending on the availability of the VDS products and the EO acquired imageries*
26	Vessels entering and remaining in a zone around another, selected ship	**ZoneAroundShip**	Operational *Note: Defining zone around a vessel based on encounter/ rendezvous parameters*
27	Vessels entering a radius (bubble) around other, selected ship(s)	**ZoneAroundShipEnhanced**	Operational *Note: Defining zone using a radius parameter/value.* *Multiple vessels of interest can be selected in one ABM of 'Enhanced type'*
28	Vessel has specific navigational status in AIS transmmission	**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			
based on the historical position reports in the Cloud-based HP-IMS			
31	Vessel entered to an area	**InArea**	Pre-Operational *Note: Available via s2s interface.* *SEG (GI) integration still pending.*
32	Vessel was drifting	**Drifting**	Pre-Operational *Note: Available via s2s interface.* *SEG (GI) integration still pending.*
33	Vessels were approaching one another closer than an indicated distance, with a speed below defined threshold	**AtSeaEncounter**	Pre-Operational *Note: Available via s2s interface.* *SEG (GI) integration still pending.*
34	There was a change of speed above or below specific limits	**SpeedAnomaly**	Pre-Operational *Note: Available via s2s interface.* *SEG (GI) integration still pending.*
35	There was a gap in reporting of positions	**NotReporting**	Pre-Operational *Note: Available via s2s interface.* *SEG (GI) integration still pending.*

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