Automated Behaviour Monitoring and Advanced Analytics - Workshop 6

Meeting Minutes

Held via Videoconference on 14 December 2020

Final Version
Date: 2 February 2021

EMSA

List of Abbreviations

AIS	Automatic Identification System
ABM	Automated Behaviour Monitoring
AOI	Area of Interest
CSD	Central Ship Database
EC	European Community
EFCA	European Fisheries Control Agency
EMSA	European Maritime Safety Agency
EBCGA	European Boarder and Coast Guard Agency (Frontex)
EU	European Union
IMS	Integrated Maritime Services
LRIT	Long Range Identification and Tracking (vessel position data based on telecommunication satellites)
IUU	Illegal Unreported and Unregulated Fishing
MAOC-N	Maritime Analysis and Operations Centre – Narcotics
MRS	Mandatory Reporting System
MSS	EMSA's Maritime Support Services
SADV	Statistical anomaly detection
SAT-AIS	Satellite Automatic Identification System (AIS data transmitted by satellite)
SSN-EIS	SafeSeaNet European Index Server
S2S	System-To-System
VDS	Vessel detection system (vessels detected on SAR satellite images)
VHF	Very high frequency (radio signals)
VMS	Vessel Monitoring System (tracking of commercial fishing vessels based on communications satellites)
VOI/ TOI	Vessel (Targets) of Interest
VTMIS	Vessel Traffic Monitoring and Information System

Background

Automated Behaviour Monitoring algorithms are the Integrated Maritime Services' (IMS) tools automatically 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, 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 active users have been meeting regularly since 2015, to discuss the usage of the tools and services. The European Maritime Safety Agency (EMSA) held the 6th Workshop on Automated Behaviour Monitoring (ABM) and Advanced Analytics on 14 December 2020. Due to the 'COVID-19 outbreak' and the related travel restrictions, the workshop took place via videoconference only.

Following the expansion of the ABM Workshop mandate in 2019, the data analytics and new technologies related topics and business scenarios have been put in the agenda of the event. All the related discussions are linked to the IMS User Consultations meeting with Member States as well as the cooperation on the European Coast Guard functions, embracing EU Bodies.

1. Opening and welcome

The 6th Workshop was chaired by Mr Lukša Čičovački, Head of Unit 3.1 Maritime Digital Services. The EU Member States (MS) and the EU Bodies actively using ABMs as well as the new ABM users were invited to the workshop. Delegations attended from: **Belgium, Bulgaria, Croatia, Denmark, Finland, France, Germany, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Poland, Portugal, Spain, Sweden, the Netherlands** as well as from the **European Commission (DG-MOVE), European Border and Coast Guard Agency** (**Frontex)**, **Maritime Analysis Operation Centre – Narcotics** (**MAOC-N**) and the **European Fisheries Control Agency (EFCA)**.

The Chair welcomed all participants and opened the event, outlining the topics and presentations and stressing the importance of developments in the area Artificial Intelligence (AI) and Machine Learning (ML) as well as the related Data Lake technology. The main objectives of the meeting were introduced, which were:

1) **To present and discuss ABM-related developments, reflecting on future priorities;**
2) **To share operational aspects and practices on the use ABMs by different communities, Member States and EU bodies;**
3) **To discuss feedback on the EMSA Advanced Maritime Analytics (EMAT) prototype tool;**
4) **To elaborate scenarios for the potential usage AI and Machine Learning ML.**

The agenda (see **Annex 1**) was adopted. The list of participants is presented in **Annex 2** and the Workshop's 6 action points in **Annex 3**. All the meeting presentations will be made available at: http://emsa.europa.eu/workshops-a-events/188-workshops.html.

2. Executive summary of the Workshop

The ABM and Advanced Analytics Workshop 6 meeting's outcome can be summarized with the following points.

- EMSA presented the current status of ABM operations and the planned future developments. The 'Cloud' related developments (so called HP-IMS) were put into context and examples of the 'Detected Port Calls' scenarios were demonstrated. The new pilot services should be validated with end-users. **(Action WS6.2)**
- Some of MS and EU Bodies presented their feedback on the usage of 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 priorities were identified **(Action WS6.1)**:
  - 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. In general, users provided positive feedback and would like to continue using and expanding the prototype tool. **(Action WS6.9)**
- **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.

3. Details of the WS discussions

Before the meeting, **EMSA** encouraged MS and EU Bodies to collect feedback from the active ABM users. This feedback was used as a basis for the discussion on the operational aspects and for exchanging experience and best-practices of different user communities. Additionally, a summary of the data sets that could be used for the advanced analytics were distributed, in order to initiate a discussion on the potential developments and their related priorities. The following topics were discussed as per the agenda points:

IMS ABM operations

EMSA presented the current status of ABMs, providing metrics on the usage of services and plans for further developments. MS and EU Bodies were requested to volunteer for the early business validation of the new 'near real-time' and 'Historical' ABMs and Port Calls services. It was underlined that access to PRE-PROD environment(s) for this purpose, required a fixed IP address on the MS/EU Bodies' side. An alternative approach for would be to provide scenarios for EMSA to execute, and then to validate the results. **(Action WS6.2)**

- EBCGA (Frontex) - provided feedback on the usage of ABMs in the context of cross-border monitoring. From EBCGA's perspective, the capability to combination ABMs is important. It was underlined that the overall long-term objective shall be an option for combining any types of algorithms. In the meantime, the presented plans for the 5 new combined scenarios were welcomed.
- EFCA - presented their perspective on the usage of ABMs for fisheries control/monitoring. It was important for EFCA to ensure 'stability' of the ABM related operations, avoiding backward compatibility issues or changes causing issues in the graphical interfaces. The usage of 'Favourites' (Areas of Interests and

Vessels) was given as an example of unstable functionality causing issues. EFCA also requested for a new ABM that would detect vessels' speed values within a certain range (opposite to the existing ABM- Speed Anomaly detecting speeds changes outside the defined thresholds). This use case should be further discussed in the context of EMSA-EFCA SLA, to ensure follow-up, assessment, decision and potential implementation plan.

EFCA supported remarks from EBCGA on the long-term goal for allowing the end-user to select combinations of algorithms. The remarks of EFCA regarding the needs for 'stabilizing' operations and developments were supported by EBCGA, FR[1] and DK. **(Action WS6.3)**

- MAOC-N – supported EFCA and EBCGA suggestions and concepts and recommended expanding the geographical coverage of the EMAT prototype to the North Atlantic. From MAOC-N's operational perspective, developments related to the combined ABMs and usage of VDS were the most important.

- DK requested additional information on the ABM s2s interfaces. EMSA outlined options and had provided technical documentation (STAR ABM Interface Control Document) prior to the meeting. PL shared their own experience on the s2s, where an interface was developed to the national system (SWIBZ) for the consumption of the ABM alerting, while the ABM configuration is made via EMSA's SEG interface. It was agreed that EMSA will share PL contacts with DK for the objective of organizing an experience-sharing session. **(Action WS6.4)** DK requested additional information on the 'Spoofing' algorithm.

- FR – spoke about an operational need for combining multiple parameters in the selection of Vessels of Interest (VOI), using new attributes (e.g. Gross Tonnage) and at the same time excluding other ones. An example for illustration was given: a selection of passenger ships, but not FR flagged, combined with chemical tankers of more than 300 GT, of all flags. **(Action WS 6.5)**

On-going issue of outdated ship identifiers was also raised by FR. EMSA confirmed an action plan for improving quality of the reference ship database and requested continuous reporting of the discrepancies to the 24/7 Point of Contact (PoC) – Maritime Support Services (MSS). These actions should ensure a quick reaction and update of the missing or mismatching data.

- IE – described the operational usage of ABMs covering mainly the 'Drifting' and 'Not Reporting' algorithms. From IE perspective, it was important to exclude fishing vessels from the analysis. It was also proposed to implement a SEG functionality for cleaning alerts from the screen once they are acknowledged/investigated. EMSA recommended the usage of the SEG's 'Timeline' functionality for displaying only recent alerts. IE suggested a new type of combination of the ABM algorithm for sudden course/heading change with the recent detection of potential pollution (by CleanSeaNet). The IE representative provided a feedback on the usage of the EMAT prototype and suggested new AI/ML scenarios for predicting a destination port, based on a ship's previously recorded activities. **(Actions WS6.2 and WS6.3)**

- FR, DK, EFCA- deliberated a possibility of aggregating the alerts and receiving a summary report, to avoid excessive alerting on every position. EMSA confirmed that such an option will be available via the Cloud-based historical ABMs.

ES – had provided a written feedback on the usage of ABMs by the Customs authorities, prior to the WS. The document highlighted operational needs for the vessel's attributes on ship size (LOA, Breadth), tonnage (GT) and age, as well as the combination of new attributes with the existing Flag and Types, for the selection of vessels of interest. **(Action WS6.3)**

Artificial Intelligence (AI) and Machine Learning (ML)

EMSA presented high priority business scenarios derived from the previous ABM and Advanced Analytics Workshop and discussed during the IMS User Consultation Meeting 15. Some examples of the combination of track and Met-ocean data were demonstrated. EMSA underlined that the objective of the AI and ML developments should focus on supporting and reducing workload, finding the right information for decision-making, automatizing labour-intensive processes and predicting specific situations.

- Participants were requested to review and indicate operational priorities, possible data sets and calculations needed for the following scenarios:

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[1] ISO 3166-2 country codes are used for indicating interventions by the representatives of EU Member States or EU Candidate countries. The EU Bodies are decoded with abbreviations.

1. Recognition of similar trading patterns.
2. Discrepancy/inconsistency between the destination declared and the one detected or predicted by the AI/ML.
3. Identification of economically viable activities.
4. Advanced Analysis of the TDMS - Global density maps; per flag; per type; per activity etc.
5. Close quarter situations detections - outside territorial waters/ VTS; Detecting near-miss situations with density mapping.
6. Analysis of the offshore activities- vessel behaviours per type - patterns of life.
7. Vessels not following recommended routes/TSS-es/common routes.
8. Density/frequent occurrences of specific anomalous behaviours.
9. Automatic assignments of risk associated to vessels – by combining specific data attributes' values and data products/calculations.
10. Flagging 'white'/positive examples of activities.

- In terms of priorities, the outcome of the discussions suggested that scenarios: 1,2,3,6,7,5,9 should be taken into consideration in the first place, as they were referred to by most participants in their responses and during the discussions. Additionally, business requirements and data sets and calculations are clearly identified for these business scenarios. **(Action WS6.1)**
- Potential new scenarios for AI and ML were also discussed. During the discussion a new approach was proposed, to allow the mapping of events over a simplified historical track of the ship (registry of events instead of individual positions).
- As regards the data sets and calculations for reference in the AI and ML scenarios, the following were noted:
  o Ships' cargo information -especially outside EU;
  o Crew nationality;
  o Metadata for ships – LOA, Breadth, Age, Gross Tonnage;
  o Calculation on the speed profile and distance profile per ship's type.
- IC – requested clarification on how open source data, e.g. from social media, could be used. EMSA provided examples of the situations were ship passengers' social media were the first source of information on the developing, potentially dangerous situations when a fire on board was detected or when a vessel was running into extreme weather conditions area.
- FR – suggested usage of the IMO GISIS data on the accidents/incidents for the purpose of early warning. The concept was supported by IT representatives. **(Action WS6.6)**
- DE – suggested exploring an option of analysing port arrival and departure draft information for the confirmation of cargo carried on board, especially in the context of non-EU port calls. **(Action WS6.1)**
- During the discussions it was also noted that:
  o Apart from the non-EU port calls information, the ABM end-users also required reliable information as whether cargo was taken on board. The overall objective would be to mark the port calls without an actual interface to port/shore-to-ship or ship-to-ship operations.
  o An evaluation on the best source for basic cargo data (from non-EU ports) should be undertaken by EMSA. Participants were also requested to share information on the suggested sources of this information. **(Action WS6.7)**
  o Port Calls data, as made available from the new Historical ABMs and Port Calls services, could be statistically aggregated and used as a reference for detecting non-economical activities.

EMSA's Maritime Analysis Tool (EMAT) prototype

EMSA provided a presentation on the Frontex sponsored EMAT prototype that covered the following four scenarios (previously identified as 'high priority' ones) around EU waters:

- o Black Flag Ships by Paris MoU;
- o Black Flag - Not reporting regularly;
- o Drifting ships around EU;
- o Ships Not Under Command.

Following the introduction on the existing statistics and demonstration by the EMSA/EBCGA team, the future evolution of the EMAT prototype was discussed. Some MS and EU Bodies provided feedback prior to the meeting; others outlined their needs during the Workshop. This session can be summarized with the following remarks:
- There is a general agreement on the added value that the tool represents.
- FR supported by ES, EBCGA and MAOC-N suggested the extension of the timelines for the existing dashboards to reach 12-60 months of data.
- Requirements for the new dashboards were provided, and they cover the following scenarios:
  - o Events of the 'sudden change of heading' and 'at sea encounters' with geographical expansion to the Atlantic and Caribbean (as supported by EBCGA and MAOC-N). Note: detection of the events can be based on running ABMs (the same as drifting in the current EMAT);
  - o Extension of the data coverage to minimum of 5 years of data for analytical purposes (as proposed by EBCGA- Frontex);
  - o Possibility to add anomalies on top of the pre-existing scenarios to improve filtering of the cases/vessels of interest (also suggested by EBCGA);
  - o Paris MoU, low performance companies' vessels around EU (as suggested by IT and confirmed with FR);
  - o Paris MoU - Banned vessels around EU (suggested by FR);
  - o Frequent changes of identifiers dashboard (based on MARINFO) – global service;
  - o First time visits - EU and South America;
  - o Crew nationality summary – vessels around EU;
  - o Late SSN notifications – Port+ with HAZMAT - EU;
  - o Lack of Port+ when vessels are located in the EEZ of a MS, or bound for a MS port based on AIS destination – EU;
  - o Discrepancy between Port+ and destination in AIS message 5 – globally;
  - o Dashboard on the vessels exceeding sulphur emissions' thresholds – EU.
- Due to the reference ship database quality issues described by FR, it was suggested for each of the dashboards mentioned above to track the changes in identifiers.
- FR evaluated the EMAT prototype. As regards the reporting functionality FR suggested changes so that the production of reports could be automatized/configured and include maps. It was also important to allow prepared reports to be automatically sent by email. For the graphical presentation of the data, FR uses mainly the 'Heat Map' visualisation and suggested making the calculated squares/sectors smaller.
- IE – stressed the importance of excluding fishing vessels from the statistics on drifting and focus on the cargo ships.
- DE, NL and IT volunteered to validate the tool further and requested additional credentials or sharing of the existing licences. **(Action WS6.8)**
- ES – suggested an inclusion of the new filtering in EMAT tool, allowing the aggregation of statistics per vessel size (LOA) and tonnage (GT).
- It was underlined that the outdated identifiers of vessels compromise the quality of the ABM and Advanced Analytics tools.
- NL – suggested the division of new dashboards reflecting the ship information, summary of the SSN related data (Port, Hazmat, Cargo) as well as the nationality of the crew, PSC related scenarios and notifications summary. **(Action WS6.9)**

ABM related training

The last session focused on the training activities related to ABMs. The Capacity Building Unit representative outlined the new approach to training activities. In 2020 EMSA has been working on schemes and qualification paths to support professional development and training for the staff of MS competent authorities. This new approach is called the 'EMSA Academy' and will implement ISO quality standards to certify all training services.

As regards the ABM related training, the expected and defined learning outcome is to: 'prepare the user to become an independent ABM administrator and to use ABM capabilities to enhance maritime domain awareness'.

An online training on EMSA's Integrated Maritime Services will be developed in 2021. Participants will begin with mandatory modules on SEG, followed by optional modules on tools such as ABMs.

- DK – suggested flexible approach to the online training and shortening the sessions in case of multi-day trainings. EMSA responded that this suggestion will be addressed by the responsible unit.
- FR – expressed doubts regarding the 'mandatory' modules in the online training. This was clarified by EMSA.

4. Closing remarks

Following the last session on ABM training activities, **EMSA** thanked all representatives for their contributions and closed the meeting.

Annexes

Annex 1 – Meeting Agenda

Annex 2 – Participants List

Annex 3 – Action points ABM WS6

Annex 1: Meeting Agenda

6th Automated Behaviour Monitoring and Advanced Analytics (ABM) Workshop – Agenda;

(via teleconference – Zoom, connection details in the invitation)

Monday, 14 December 2020

Time	Agenda Item	Speakers/Comments
08:45 – 09:00	Registration	
09:00 – 09:15	1. Welcome, opening, introduction	EMSA
09:15 – 10:00	2. IMS ABM operations ■ Status of the existing ABMs in IMS, future developments, reference data ■ Operational use of the ABMs by MS and EU Bodies	EMSA / MS / EU Bodies
10:00 – 11:30	3. Artificial Intelligence and Machine Learning ■ Foundations for the AI and ML – necessary data sets and calculations ■ Scenarios for the potential usage of AI and ML	EMSA / MS / EU Bodies
11:30 – 13:00	Lunch break	
13:00 - 14:30	4. Advanced Analytics Prototype Tool ■ Validation of the user scenarios, feedback from the users ■ Priorities and possible future scenarios	EMSA / MS / EU Bodies
14:30 – 15:00	5. ABM related trainings, support to the users	MS / EU Bodies / EMSA
15:00 – 15:15	6. Summary of the WS, conclusions AOB	EMSA

Annex 2: Participants List

Belgium	Vicky	Vangeel	Federal Police - Coordinator Maritime Information Centre
European Commission	Alexander	Hoffmann	European Commission MOVE
Bulgaria	Ivaylo	Nedelchev	Bulgarian Maritime Administration
Bulgaria	Petar	Petrov	BPI Co.
Croatia	Niko	Hrdalo	Ministry of the Sea, Transport and Infrastructure
Croatia	Alen	Alempijevic	Ministry of the Sea, Transport and Infrastructure
Denmark	Lise	Hoejriis	Royal Danish Navy Command
Finland	Toni	Pehkonen	Finnish Border Guard
France	Katell	Marcillaud	DAM/MAN5
Germany	Annika	Kauschmann	CCME
Germany	Torsten	Witt	Federal Police
Germany	Arne	Zilles	Waterways Police Coordination Centre
Germany	Moritz	Freerks	German Maritime Emergency Command
Hungary	Csaba	Bellyei	Ministry for Innovation and Technology
Iceland	Snorre	Greil	Icelandic Coast Guard
Iceland	Bjargulfur	Ingason	Icelandic Coast guard
Iceland	Birgir Hreiar	Bjarnsson	Icelandic Coast Guard
Ireland	Alan	Osborne	IRCG
Italy	Dario	Cau	Comando Generale Capitanerie Di Porto
Italy	Massimo	Marrazzo	Italian Coast Guard
Latvia	Deniss	Bickovs	ITDA
Lithuania	Edmundas	Tursys	Lithuanian Transport Safety Administration
Poland	Radoslaw	Hinca	Maritime Office Gdynia
MAOC (N)	Ana	Carreira	MAOC (N)
Portugal	Paulo	Lourenco	MRCC Delgada, Portuguese Navy
Portugal	Rui	Tavares	DGRM - General-Directorate of Maritime Resources
Portugal	Nelson	Marques	DGRM - General-Directorate of Maritime Resources
Portugal	Jeroen	Van Overloop	FOD Mobiliteit en Vervoer
Portugal	Carlos	Pimentel	GNR
Spain	Jose.	Maraver Romero	Salvamento Maritimo
EFCA	Sven	Tahon	EFCA
EBCGA - FRONTEX	David	Herrera Gonzalez	FRONTEX
EBCGA - FRONTEX	Emma	Casanova	FRONTEX
Spain	Carlos	Lopez Carrera	SPANISH CUSTOMS-DAVA
Spain	Pedro Alberto	Alonso	SPANISH CUSTOMS-DAVA
Spain	Jorge Luis	Bardaji	SPANISH CUSTOMS-DAVA
Sweden	Kristina	Holmqvist	Swedish Maritime Administration
The Netherlands	Bob	Van Den Hoek	Dutch Police
The Netherlands	Bastiaan	Maltha	NL Coastguard
The Netherlands	Nienke	Veldhuizen	Netherlands Coastguard
The Netherlands	Ageeth	Willems	Nederlandse Coastguard
The Netherlands	Rene	Dobbelaer	NL Coastguard
The Netherlands	Carien	Droppers	Rijkswaterstaat

The Netherlands	John	Kramer	NLD Coastguard
The Netherlands	Natasja	Jones	Kustwacht
The Netherlands	Cornelis Johannes	Kool	Rijkswaterstaat Water, Transport and Environment
The Netherlands	John	Dofferhoff	Rijkswaterstaat Water, Transport and Environment - Safety and Water
The Netherlands	Kees	Storm	Rijkswaterstaat
EMSA	Lorena	Amigo Lopez	EMSA
EMSA	Lukasz	Bibik	EMSA
EMSA	Luksa	Cicovacki	EMSA
EMSA	Anne-Marie	Hayes	EMSA
EMSA	Marc	Journel	EMSA
EMSA	Michael	Risley	EMSA
EMSA	Rui Miguel	Sequeira	EMSA

Annex 3 - Action points ABM WS6

No	Action	Responsible	Status/ Target date
WS6.1	Reflect identified scenarios in the future, potential AI and ML developments	EMSA	n.a.
WS6.2	MS to volunteer for the early validation of the new ABM-related scenarios, Historical ABMs and Port Call detection services	MS	January/ February 2020
WS6.3	Reflect identified scenarios in the 'near' real-time ABM developments	EMSA	During 2021 and further, as per contractual schedules for ABM services
WS6.4	Share the PL Point of Contact (PoC) with DK, for ABM system-to-system developments experience sharing	EMSA	Following the ABM and Advanced Analytics WS6
WS6.5	EMSA to analyse technical options for implementing multiple parameters selection	EMSA	During 2021. Outcome of the analysis to be presented during the next ABM and Advanced Analytics Workshop
WS6.6	EMSA, FR and IT – jointly investigate a possibility of using IMO GISIS accident information for the early warning scenarios on developing dangerous/distress situations	EMSA, FR, IT	During 2021. Outcome of the analysis to be presented during the next ABM and Advanced Analytics Workshop
WS6.7	EMSA and MS to evaluate the best source of information for the cargo data from non-EU ports	EMSA, MS	During 2021. Outcome of the analysis to be presented during the next ABM and Advanced Analytics Workshop
WS6.8	Provide new or share the existing licences for the EMAT prototype	EMSA	Following the ABM and Advanced Analytics WS6
WS6.9	Analyse new suggestions/scenarios, prioritize them with power users and reflect identified scenarios in the future developments of the EMAT prototype	EMSA	During 2021 and further as per contractual schedules for the EMAT prototype

EMSA