Automated Behaviour Monitoring and Advanced Analytics – Working Group, Workshop 5

Meeting Minutes

Held in Lisbon on

04 December 2019

Final Version

Date: 22 January 2020

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
EU	European Union
IMDatE	Integrated Maritime Data Environment
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
WG	Workgroup
WUP	Web User Portal, also referred to as web user interface

Background

On the 04 December 2019 the European Maritime Safety Agency (EMSA) hosted the 5th Operational Workshop on Automated Behaviour Monitoring (ABM) and Advanced Analytics.

ABMs are Integrated Maritime Services (IMS) tools automatically analysing various position reports for the detection of specific ships' behaviours. Their aim is to support the maritime surveillance operators by providing an increased maritime situation awareness and alerting. They are used by EU Member States and EU Bodies executing functions in safety of marine traffic, environmental protection fisheries control, border control and security.

The Automated Behaviour Monitoring (ABM) Working Group (WG), being an ad-hoc working group of the Integrated Maritime Services (IMS) Group, has been meeting regularly since 2015, to reflect on the ever-growing usage of the ABM-related tools and services. The IMS Group, at its 13th User Consultation Meeting (UCM), agreed to extend the scope of the ABM WG to include: Data Analytics and the use of new technologies (e.g. machine learning) topics, and hence renamed the working group to "Automated Behaviour Monitoring (ABM) and Advanced Analytics".

The data, information, related analytics products and tools are needed by Member State national authorities and EU Bodies to perform their maritime surveillance and risk assessment activities more effectively, both at strategic and tactical level. Following the expansion of the groups' mandate, specific data usage scenarios were elaborated. The related discussions were based on the data sets and initial data analytics products, as identified during the IMS User Consultations and the European Coastguard Functions Forum meetings.

1. Opening and welcome

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, Estonia, France, Germany, Ireland, Italy, Latvia, Luxemburg, Portugal, Romania, Spain, Sweden, the Netherlands** as well as from the **European Border and Coast Guard Agency** (**Frontex)**, **Maritime Analysis Operation Centre – Narcotics** (**MAOC-N**) and the **European Fisheries Control Agency (EFCA)**. The EU candidate country, and active IMS for MS user – **Montenegro,** was invited and participated in the event.

EMSA welcomed all participants and opened the event. Following the tour-de-table introduction **EMSA** announced the main objectives of the meeting, which were to:

1) **Present and discuss ABM-related developments, setting future priorities;**
2) **Share operational aspects and practices on the use ABMs by different communities, Member States and EU bodies;**
3) **Discuss scenarios for Advanced Analytics, Risk Assessment and the usage of new technologies (e.g. Machine Learning).**

The agenda (see **Annex 1**) was adopted without changes. The list of participants is presented in **Annex 2** and the Workshops 5 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 WG 5 meeting outcome can be summarized as follows:

- During the workshop **Member States and EU bodies** provided feedback on the operational use of ABM algorithms and expressed priorities for future developments. These will be analysed by **EMSA** (**Action WS5.1**).
- **EMSA** presented the current ABM status, moderated discussion on the priorities for the data analytics and made a demonstration of a new, prototype dashboarding tool (Qlik Analysis).
- Data analytics information sets and scenarios were discussed during the event. Feedback provided by the Member States and EU Bodies before the Workshop is summarized in **Annex 5.** All participants were encouraged to continue discussion on the scenarios with potential end-users and to provide further feedback (**Action WS5.5**). **EMSA** invited volunteers for the validation of the initial four data analytics scenarios (**Action WS5.6**) using the prototype dashboarding tool presented during the event.
- A discussion on the new ABM Mobile app was initiated. Member States and EU bodies participated in the identification of the ABM Mobile app use case scenarios. The outcome of the discussion is summarized in **Annex 6**. It is recommended that participants continue dialogue with the actual end-users at national level. If any new use case scenarios are identified, they should be communicated to EMSA for further analysis (**Action WS5.7**).
- Participants acknowledged information on the **IMS Group** decision on the planned phase-out of the old ABM admin interface – IMS WUP, following the introduction of the SEG version 1.10.
- **Member States and EU Bodies** received presentation on how ABM services are utilized in the context of 'interoperability' project and what are the new ABM-related, requirements stemming from it (**Action WS5.1**).
- **EBCGA (Frontex)** shared experience on the ABM s2s interface, used for the provision of 'anomaly detection' services to their users.
- As regards the presented Satellite AIS (Sat-AIS) new contract's data sets, participants were requested to analyse own needs for the usage of the 'data quality indicators' in the Sat-AIS position reports and their potential application for the ABMs (**Action WS5.3**).
- The following future developments were considered as high priority for the active users of the ABMs (**Action WS5.1**):
    o Inclusion of the Earth Observation (EO) product – Vessel Detection Service (VDS) in the ABM algorithms, for the detection of the uncorrelated (unidentified) targets in an area of interest;
    o Usage of the 'navigational status' indicator (with focus on the 'Not Under Command' status) in the ABM algorithms filtering.
- Participants underlined importance of the ABM algorithms combination capabilities (**Action WS5.4**).
- Additionally, participants were given a status report on the on-going works for the improvement of the reference databases (OVR and CSD).
- They also reflected on the ABM trainings and reviewed available training materials (**Action WS5.2**).

3. Discussions on the specific ABM related aspects and operational feedback

Before the WG meeting, **EMSA** encouraged MS and EU Bodies to collect feedback from the active ABM users. It was used as a base 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:

Belgium - shared operational experience, where ABMs, with the 'fishing vessel' type filtering, were used for the monitoring of the offshore windmill farms. **Belgium** users would be interested in the combination of filtering conditions, allowing, for instance: selection of specific vessel types and 'active' exclusion of other, identified ships.

Estonia – has a set of new IMS users, who may be potentially interested in the ABM tools. The new users joined IMS following a training provided by EMSA in September. **Estonia's** main objective for the WG was to learn about ABM developments and share the knowledge with other authorities at national level.

EFCA – represented fisheries control users' communities and has been promoting the usage of ABMs by the EU fisheries control authorities. Currently ABM's are mainly used for monitoring movements of specific fishing vessels during fisheries control campaigns and specific groups of target vessels, entering certain areas of interest. **EFCA** suggested **EMSA** to analyse a possibility of distributing ABM alerts also via other channels or communication platforms.

France – provided a presentation, illustrating operational experience in the ABMs and sharing best-practices. **France**, being one of the most active ABM users, demonstrated ABM-related organization at national level, showed evolution of the ABMs utilization and shared examples of the monitoring over large, complex areas. Examples of the application of certain algorithms was also provided and certain ABM operations-related challenges outlined. **France** confirmed that their ABM team had better understanding, experience and confidence in the usage of the ABM services.

EBCGA (Frontex) – spoke about the usage of ABMs in the 'anomaly detection' services and shared experience on the most popular algorithms, underlining a need for developing combinations of ABMs. An example of a potential combination was given: an entry to the area with subsequent anchoring, drifting or stopping behaviour (**Action WS5.4**). **Frontex** representative presented their perspective of the future developments priorities, which include: the usage of Earth Observation (EO) Vessel Detection Service (VDS) in ABMs.

Germany – have relatively new ABM users from the federal and border Police forces, working in the Maritime Emergency Centre (MZS Cuxhaven). Their users were evaluating the use of ABMs for detecting specific situations e.g. detection of tankers washing their tanks in special areas. **Germany** underlined a need for improvements in the alerting, so as not to overload the surveillance operators with unnecessary information (alerting). **Germany** have interest in improving the reference ship database, to correctly reflect on the ship types e.g. pleasure crafts which often code their 'types' incorrectly, in the AIS transmissions.

Ireland – shared their experience in monitoring Traffic Separation Schemes (TSS) and anchorages. **Ireland** underlined that their high priority functionality would be to get the ABM alerting on the detection of the 'navigational status' – Not Under command (NUC).

Italy – described the ABM usage in the context of security (ISPS, MARSEC). For **Italy** one of the future priorities for ABMs, would be a detection of the 'navigational status' – Not Under command (NUC). **Italy** requested clarification on the intended changes of some algorithms with the usage of COG (Course Over Ground). It was provided verbally by **EMSA**.

Latvia - confirmed that another training session for the IMS (and ABM) users may be desirable, at national level.

Luxemburg – discussed how the 'flag state' authorities used ABMs for regular monitoring of own (flag) fleet. Luxemburg will review the existing functionalities to evaluate if they could be used further.

MAOC-N – described the ABM usage in the context of the organization's work. The **MAOC-N** ABM users were particularly happy with the changes introduced to the SEG interface, allowing a display of bigger areas and an easier management of the areas of interest (AOI). It was suggested to **EMSA** to analyse a possibility of changing the approach to the 'clustering view', so that the SEG (and ABM) end-users could visualise vessels of interest (VOI) over larger areas. Additionally, **EMSA** should consider changing the ABM alerting message, by adding a link to the location in SEG interface rather than the existing, public web mapping service (Google Maps). **MAOC-N** considered the inclusion of the 'navigational status' – Not Under command (NUC), usage of EO VDS and possible combination of the ABM algorithms, as important future developments. As regards another potential, future development of a service for detection of port calls, **MAOC-N** believed, it would be important to allow users selecting a group of ports belonging to one country.

Montenegro – stated that their objective related to ABMs was to understand the services' capabilities and share the knowledge with other authorities at national level.

Portugal – explained ABM usage experience linked to the flag state obligations. Some authorities used IMS and ABM services for 'filling gaps' in the maritime situational awareness. **Portugal** intended to further promote the usage of ABMs among various national authorities. In that respect, additional training activities and materials could be useful.

Romania – joined the group of ABM administrators and users very recently. **Romania** had specific questions linked to the experience in the usage of ABMs and was going to liaise directly with **EMSA** to discuss them.

Spain - shared operational experience in ABMs, where they often use the list of vessels of interest (VOIs). **Spanish** authorities were interested in the detection of vessels drifting, having 'at sea encounters' in the areas of interest or violating 'innocent passage' rules.

Sweden – provided operational feedback on the usage of the combined 'Area to Area' ABM algorithm. It is used for the detection of ships arriving from specific directions for customs and border control operations. **Sweden** requested EMSA to analyse if and how the timelines for the provision of these alerts could be improved. National authorities were also interested in the combination of filtering conditions, allowing, for instance: selection of specific vessel types as well as others, specifically identified, vessels of interest. **Sweden** considered that the vessels of interest import functionality would be a very useful functionality for the ABMs.

The Netherlands - suggested splitting the data analytics scenarios into different groups, representing specific nautical risks. Priorities for the future developments, as consulted between various Dutch authorities, were the following: verification of the last 10 port calls (automatic service, based on position reports and port areas), detection of trends in declared port-call discrepancies / mismatches (ship types, flags, ports, owners, timing, etc.).

4. Closing remarks

Following the last session on the potential, new ABM Mobile App developments and the 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 WS5

Annex 4 – Action points ABM WS 1- 4 – summary/ status

Annex 5 – Outcome of the discussion on the priorities for the data analytics

Annex 6 - Outcome of the discussion on the future Mobile App use case scenarios

Annex 1: Meeting Agenda

Wednesday, 04 December 2019

Time	Agenda Item	Speakers/Comments
09:00 – 09:15	**Registration and coffee**	
09:15 – 09:30	**1. Welcome, opening, introduction**	EMSA
09:30 – 11:00	**2. IMS ABM operational aspects** ■ Status of the existing ABMs in IMS - most popular ABMs ■ Operational use of the ABMs by MS and EU Bodies – feedback, different communities' experience: Surveillance, Profiling, Risk Assessment ■ ABM use for interoperability project	EMSA Member States + EU Bodies EMSA
11:00 – 11:15	**Coffee break**	
11:15 – 12:10	**3. IMS ABM planned changes** ■ Information on phasing out old interface (WUP) and planned changes in SEG ■ Sat- AIS related developments - potential use in the ABM-related context ■ ABM planned developments - 2020 ■ Reference database of ships – status and further plans	EMSA, Member States + EU Bodies
12:10 – 12:30	**4. System-to-System Interface(s) – S2S** ■ S2S status and usage experience; sharing experience of different communities	Frontex – EBCGA
12:30 – 14:00	**Lunch break**	
14:00 - 15:15	**5. Advanced Analytics and new technologies (e.g. Machine Learning)** ■ Clarifications on definitions (Statistics, data analysis, big data, machine learning…) ■ Validation of the user scenarios/ use cases – data analysis ■ EMSA's, Member States' and EU bodies' experience and priorities ■ Pilot implementations of the data analysis use cases	EMSA, Member States + EU Bodies
15:15 – 15:45	**Coffee break**	
15:45 – 16:30	**6. ABMs – other potential developments** ■ ABM Mobile App – basic use case scenarios **7. ABM related training** ■ ABM user guide/ manual and ABM- related trainings	EMSA, Member States + EU Bodies
16:30 – 17:00	**8. Summary of the WS, conclusions, AOB**	EMSA, Member States + EU Bodies

Annex 2: Participants List

Belgium, Katrien Van Meerbeeck - Federal Public Service Mobility and Transport - DG Shipping

Estonia, Alar Siht - Estonian Maritime Administration

France, Katell Marcillaud - Direction des Affaires Maritimes/SDSI

Germany, Torsten Witt- Federal Police

Ireland, Gerry Keane - Irish Coast Guard

Italy, Dario Cau - MIT

Italy, Pantaleo Dell'Olio - Italian Coast Guard

Latvia, Deniss Bickovs - ITDA

Luxembourg, Victor Soeiro - Commissariat aux Affaires Maritimes

Montenegro, Agim Spuza - Maritime Safety Department of Montenegro

Portugal, Paulo Lourenço - Portuguese Navy

Portugal, Carlos Figueira - PRT NAVY - COMAR/MRCC Lisboa

Portugal, Rui Tavares - DGRM

Romania, Iulian Ichim - Romanian Naval Authority

Romania, Iulian Dobre - Romanian Naval Authority

Spain, Francisco Martinez Santiago - Ministry of Defence/ESP NAVY/COVAM

Sweden, Mats Kannerstal - SMA

Sweden, Emma Olofsson - Swedish Coast Guard

The Netherlands, Dimitri van der Heiden - Rijkswaterstaat

Sven Tahon, EFCA

Marcin Pempus, EBCGA (Frontex)

Ana Carreira, MAOC (N)

Lukasz Bibik, EMSA

Samuel Djavidnia, EMSA

Anne-Maire Hayes, EMSA

Konrad Kurpinski, EMSA

Yann Le Moan, EMSA

Joao Noronha, EMSA

Helena Ramon Jarraud, EMSA

Michael Risley, EMSA

Lukasz Ziolkowski, EMSA

Annex 3 - Action points ABM WS5

No	Action	Responsible	Status/ Target date
WS5.1	Analyse high priority requirements as well as new requirements stemming from the 'interoperability' project and user consultations. Reflect them in the future, ABM-related developments: - Use of the EO product - VDS ; - Line crossing detection; - SSN enrichment (e.g. HAZMAT) attribute in ABMs; - Detecting port calls, using position reports.	EMSA	Analysis – Q1 2020 Development - During 2020 depending on the resources available
WS5.2	Publish new ABM training materials.	EMSA	Q1 2020
WS5.3	Analyse own needs for the usage of the 'data quality indicators' in the Sat-AIS position reports. Provide feedback to EMSA.	MS and EU Bodies	Before next ABM WG meeting
WS5.4	Discuss the most popular combinations of the ABM algoritms.	EMSA- MS and EU Bodies	Q1-Q2 2020
WS5.5	Continue discussion on the data analytics scenarios with the potential end-users. Provide further feedback to EMSA.	MS and EU Bodies	Q1-Q3 2020
WS5.6	Volunteer for the validation of the data analytics scenarios in the prototype tool.	MS and EU Bodies	Q1 2020
WS5.7	Continue discussion ABM Mobile App use case scenarios, with the potential end-users. Provide further feedback to EMSA.	MS and EU Bodies	Q2 2020

Annex 4 – Action points ABM WS1-4 - – summary/ status

No	Action	Responsible	Status/ Target date
1	Involve volunteer MS and EU Bodies in the early validation of the new ABM-admin console in SEG	EMSA, MS, EU Bodies	Completed
2	New version of the ABM operational user manual to be drafted	EMSA	**Completed – Quick Star t Guide** **On-going – full user manual**
3	MS and EU Bodies interested in increasing the T-AIS messages frequency shall seek endorsement of the governance body (HLSG) and follow-up with relevant technical actions with regional servers and EMSA	MS and EU Bodies	**N.A.**
4	Work on the new developments – combination of ABMs, historical data, AIS coverage presentation, display of blocked ABMs, importing KML files.	EMSA	**Completed with exception of combination and historical data. Theoretical ranges mapping - pending availability of the source data from MS**
5	Analyse inclusion of new filtering criteria in the selection of ships: SSN data (HAZMAT), LOA, Age of the Ship.	EMSA	**During 2020**
6	Development of new ABMs using the AIS transmitted data (change of destination and navigational status).	EMSA	**During 2020**
7	Brief MS and EU Bodies on the outcome of the 'machine learning' / Deep Learning project.	EMSA	**Completed**
8	EMSA to provide S2S services documentations to interested MS and EU bodies.	MS and EU Bodies	**As per requests**
9	Analyse improvement of ABMs/ anomaly detection to work over larger areas.	EMSA	**Completed**
10	Request expansion of the mandate of the ABM Working Group to include data analytics and the use of new technologies (i.e. big data) for the assessment of risks in the maritime domain.	EMSA and MS	**Completed**
11	Analyse option of adding risk profiling tools in the ABMs	EMSA	**Completed – Pilot implementation presented at the ABM WS5**
12	Implement ABM admin console in the SEG interface	EMSA	**Completed**
13	Continue working on the improvement of the ship Reference Database	EMSA/MS	**On-going**

Annex 5 - Outcome of the discussion on the priorities for the data analytics

The tables below incorporate an overview of the discussions in the framework of:
- IMS UCM#13 and UCM#14 meetings (Parallel sessions on data analytics);
- Interagency Coast Guard cooperation (Technical Committee No.2 – Risk Assessment);
- European Coast Guard Function Forum.
- ABM WG WS 5

Data sets, derived products and their possible application

Data sets Overview of previous discussions	
Data set	**Proposed Priority**
Navigational Status	MEDIUM/HIGH
Flag information	MEDIUM/HIGH
Location of the offshore installations and navigational dangers	LOW/MEDIUM
Location of historical SAR operations, locations of distress calls (GMDSS)	MEDIUM/HIGH
Location of fisheries and leisure activities	MEDIUM/ HIGH
GPS cases of potential jamming or spoofing	LOW
Commercial routes per ship flag and per ship type	LOW/MEDIUM
Ship owner and changes of the ownership ISM Manager ISM Responsible	LOW/MEDIUM

Table 1 - Data sets and their priorities

Derived products Overview of previous discussions	
Derived product	**Proposed Priority**
Mapping of drifting, speed change, rendezvous at sea, spoofing and not reporting (based on ABMs). Filtering per vessel type and/or flag.	HIGH
Analysis based on historical ABM alerts	MEDIUM
Not reporting / dark activities areas	HIGH
Traffic density, per season, vessel type, vessel flag (Black Flags, Selected Flags)	MEDIUM/HIGH TDMS already available in SEG. Certain modifications may be required.

Oil Spills	MEDIUM/HIGH
Accidents/ incidents data (SSN or open source data)	MEDIUM/HIGH
Vessel Detection System – identification of non-cooperative targets (non-correlated vessels)	HIGH
Detection of the Port Calls globally, based on the position reports (with possible selection of a country)	MEDIUM/HIGH
Similar routes/ activity patterns – at global level	MEDIUM
SSN port call cancellations alert	LOW/MEDIUM

Table 2 - Derived products and their priorities

Scenarios for data analytics

Scenario	Details	Comment	Priority
'Black flag ships around EU'	Vessel is within EU and neighbourhood areas and The flag is 'Black' according to the latest PSC classification;	Launched as a pilot project	MEDIUM/HIGH
'Black flag ships not reporting regularly around EU'	Vessel is within EU and neighbourhood areas; and Flag is 'Black' according to the latest PSC classification; There is a gap of more than 8 hours in the positions reporting (position tables analysed)	Launched as a pilot project	MEDIUM/HIGH
'Drifting ships in key EU areas'	Vessel is within EU and neighbourhood areas and Vessel was drifting in the last week (reference made to a running ABM).	Launched as a pilot project	HIGH
'Not Under Command ships in key EU areas	Vessel had 'Not Under Command' navigational status reported in the last week; or Vessel was drifting in the last week (reference made to a running ABM).	Launched as a pilot project	HIGH
Now-casting and future casting – prediction of the ship movement	-	-	LOW/MEDIUM
Verification of the declared destination vs. route taken	-	-	LOW/MEDIUM
Dynamic search and automatic allocation of the user specific risk	-	-	MEDIUM

Detection of the non-viable economic activities	Based on commercial routes analysis.	-	LOW/MEDIUM

Table 3 - Scenarios for advanced analytics

Additional functionalities identified

Topic/ Data	Details	Comments	Priority
Vessels of Interest (VOI)	Important to have possibility to filter/Reflect VOI in the analysis - allow selection of specific analytical tools per VOIs defined by the users	-	MEDIUM
Near- miss situations mapping	Definition of the 'near-miss ' as well as the source of data identification is needed	-	TBC
Last 10 port calls	Verification of the declared information	-	TBC
Ship's draft	-	-	TBC

Table 4 -Additional data sets and functionalities

Annex 6 - Outcome of the discussion on the future Mobile App use case scenarios

Identified use case scenarios:

1. Configuration of the new ABMs
   - o For selected ABMs only
     - Zone around the ship;
     - In an area around the user location;
     - Selection of the area, ship, type of ship;
   - o Monitoring of the existing ABMs (those ABMs that user configured using SEG ABM admin)
     - Start/stop capability for all ABMs configured;
2. Data sets
   - o ABM alerts;
   - o ABM configuration areas;
   - o Ship positions;
   - o Ship tracks – up to 72 hours or 24 hours via the area centric query (ACQ);
3. ABM alerting
   - o With push notifications;
   - o With an overview of the all alerts delivered for the user in the last 24 hours;
   - o With the retrieval of the historical ABM alerts using ACQ;
4. Searching for alerts
5. Searching for ships
6. Alert panel
   - o Floating window; or
   - o A panel expanded form a bottom of the screen
   - o
7. Other scenarios
   - o No clustering is required