

# Results of **Research & Innovation** activities

2019  
**2020**  
2021



**FRONT****X**

 **EUROPEAN BORDER AND  
COAST GUARD AGENCY**

Results of  
**Research &  
Innovation**  
activities

**2020**



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This is a Frontex staff working document elaborated to inform Member States, the European Parliament and the European Commission on the results of Frontex research and innovation activities in 2020. Also, this report makes the information on research project budgets and partners public, as required by Regulation 2019/1896.

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# 1. Foreword

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*“Investing in research and innovation is investing in Europe’s future. It helps us to compete globally and preserve our unique social model. It improves the daily lives of millions of people here in Europe and around the world, helping to solve some of our biggest societal challenges.”<sup>1</sup>*

This statement, while applicable to research and innovation in the EU in general is also applicable to research and innovation for the future of borders, for the future of the European Border and Coast Guard. Since the very beginning – back in 2004 – the legal framework established research and development relevant for the control and surveillance of external EU borders as a core task for Frontex. More recently, the European Border and Coast Guard regulation expanded the mandate, tasking the agency to proactively monitor and contribute to research and innovation relevant for European integrated border management. The Agency was asked to develop and manage innovation activities including the use of advance surveillance technology, developing its own pilot projects, and to disseminate the results of those activities.

While information on Frontex research and innovation activities has been made available as part of the Agency’s regular reporting and through the Frontex website, recognizing the growing importance of research and innovation for the EU as a whole, and for the European Border and Coast Guard specifically, the Agency has sought to compile in one document the information on its activities in the field of research and technology innovation. I would like to highlight several considerations to keep in mind when reading this report.

Typically, research, technology innovation, and other related activities are multiannual, requiring lengthy preparations and implementation before conclusions can be drawn. Therefore, in this report you will also find information on research activities initiated before 2020, and whose results are relevant for 2020 and onwards.

Secondly, innovation and technology testing do not always bring results immediately. Often the results of research or technology tests lead to the need for follow-up activities in order to pursue further exploration and more in-depth research work. It may also occur that a technology test does not confirm the suitability of a research proposal or the cost efficiency required for its operational use.

Thirdly, the innovation of technologies alone is not sufficient in most cases for a successful introduction of new operational capabilities for Member States and for Frontex. Introducing innovation in our regular operations requires novel processes and procedures. Innovation is also about doing things differently, adopting new rules, and amending existing operating procedures. Moreover, innovation must be sustainable and persistent, making sure that the performance of capabilities and solutions is consistent over time. In this sense, technology performance assessment,

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<sup>1</sup> [Research & innovation | European Union \(europa.eu\)](https://european-council.europa.eu/media/en/press-communications/infographic/infographic-research-and-innovation-innovation-in-europe-2020.pdf)



training, technical assistance, issuing guidelines and standards is all essential part of the innovation process. The readers of this report will find several Frontex activities focusing on these important aspects.

Lastly, research and innovation is defined in the European Border and Coast Guard Regulation as a horizontal component in the implementation of European integrated border management. To plan for the new capabilities that Member States and the Agency require in order to respond to emerging operational needs, research must be tightly connected to national capability plans and to the capability roadmap of the European Border and Coast Guard. This aspect will be developed further in reports to come.

In ending, I want to underscore the importance of the ethical use and development of technologies for border control, and privacy. This unique and

undisputable way of approaching innovation with our community identifies the work of Frontex, making innovation the European way, the Frontex way, where the respect of Fundamental Rights is at the core.

I would like to thank all of those who contributed to the research and innovation activities included in the report. We, as the European Border and Coast Guard, will use these experiences and knowledge for consolidating our common and ever secure external borders of the EU.

I hope you will find this report informative and inspiring and that you will be looking forward to the next issue. I am wishing you a pleasant read!

**Fabrice Leggeri**  
Executive Director

## 2. List of acronyms

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<b>AI</b>	Artificial Intelligence
<b>AIS</b>	Automatic Identification System (an automatic tracking system for maritime traffic that uses transceivers on ships and boats)
<b>API</b>	Advance Passenger Information
<b>Athinai FIR</b>	International name for the Greek (Athens) Flight Information Region
<b>ATZ</b>	Aerodrome Traffic Zone: An airspace of defined dimensions established around an aerodrome for the protection of aerodrome traffic. (ICAO Annex 2 'Rules of the air' and Regulation (EU) No. 923/2012 Standardised European Rules of the Air (SERA))
<b>BLOS</b>	Beyond line of sight (international term – acronym used in relation to unmanned aerial traffic)
<b>Copernicus DA</b>	Copernicus Delegation Agreement
<b>COTS</b>	Commercial Off the Shelf
<b>EBCG</b>	European Border and Coast Guard
<b>EBCGA</b>	European Border and Coast Guard Agency (Frontex)
<b>EES</b>	Entry/Exit System
<b>EIBM</b>	European Integrated Border Management
<b>EO</b>	Earth Observation
<b>ICAO</b>	International Civil Aviation Organization
<b>ICBB</b>	International Conference on Biometrics for Borders
<b>IPA</b>	Instrument for Pre-accession Assistance
<b>LOS</b>	Line of sight (international term – acronym used in relation to unmanned aerial traffic)
<b>MALE RPAS</b>	Medium Altitude Long Endurance Remotely Piloted Aircraft Systems
<b>MMSS</b>	Maritime Mobile Surveillance System
<b>MTOW</b>	Maximum Take-Off Weight



<b>NOTAM</b>	In the context of aviation: Notice to Airmen
<b>PAM4DIS</b>	Performance Assessment Methodology for Document Inspection Systems
<b>PIU</b>	Passenger Information Unit
<b>PNR</b>	Passenger Name Record
<b>RPAS</b>	Remotely Piloted Aircraft Systems
<b>SAR</b>	Synthetic Aperture Radar
<b>TRL</b>	Technology Readiness Levels <sup>2</sup>

Where a topic description refers to a TRL, the following definitions apply, unless otherwise specified:

- TRL 1 – basic principles observed
- TRL 2 – technology concept formulated
- TRL 3 – experimental proof of concept
- TRL 4 – technology validated in lab
- TRL 5 – technology validated in relevant environment (industrially relevant environment in the case of key enabling technologies)
- TRL 6 – technology demonstrated in relevant environment (industrially relevant environment in the case of key enabling technologies)
- TRL 7 – system prototype demonstration in operational environment
- TRL 8 – system complete and qualified
- TRL 9 – actual system proven in operational environment (competitive manufacturing in the case of key enabling technologies; or in space)

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<sup>2</sup> Source: HORIZON 2020 – WORK PROGRAMME 2016-2017, available here: [https://ec.europa.eu/research/participants/data/ref/h2020/wp/2016\\_2017/main/h2020-wp1617-intro\\_en.pdf](https://ec.europa.eu/research/participants/data/ref/h2020/wp/2016_2017/main/h2020-wp1617-intro_en.pdf)

### 3. Executive Summary

Regulation 2019/1896 requires that Frontex inform Member States, the Commission and the European Parliament on the results of its research and innovation activities, and make public information on its research projects, including demonstration projects, the cooperation partners involved and the project budget. This report serves to complement and compile in one document the information already publicly available on research and innovation projects and activities whose results were implemented and later made available in the course of 2020.

The report is structured to present the results of Frontex activities obtained during the reporting period in the following clusters:

- i. research activities, to which a technical readiness level (TRL) of 1 to 5 is assigned (in a scale of 1 to 9 of technological maturity);
- ii. technology innovation activities, at the level of TRL 6 to 9, referring to the testing of new technologies for border checks and border surveillance;
- iii. activities ensuring interoperability and consistent performance.

For research activities, the results were:

- signature of Terms of Reference with DG Home regarding Frontex's role in the EU's Research & Innovation Programmes, Frontex activities stemming from this document and projects monitored;
- completion of a Frontex Research study on Artificial Intelligence-based capabilities for the European Border and Coast Guard.

For technology innovation activities, the results were:

- a pilot project on Maritime Analytical Tools testing the applicability of a maritime analytics system, specifically its artificial intelligence algorithms, to support Frontex's maritime risk analysis function;
- a pilot project testing the relevance of utilising a tethered aerostat for the purpose of maritime/coastal border surveillance for law enforcement purposes;
- pilot projects testing the usage of MALE RPAS and small MALE RPAS for the purposes of maritime/coastal border surveillance for law enforcement purposes;
- a pilot project testing the relevance of new earth observation services for border security, financed under the Copernicus Delegation Agreement;
- a pilot project testing the performance of mobile biometric solutions for border checks at airports.

In addition, in the reporting period Frontex continued to monitor new technologies relevant for border management available on the market, and coordinated the presentation of solutions selected by and for the European Border and Coast Guard community in the format of industry days.

To ensure interoperability and consistent performance, Frontex:

- initiated the development of technical standards for equipment for border management, in collaboration with Member States and the Commission;

- organised an International Conference on Biometrics for Borders in 2020, facilitating knowledge transfer on recent academic and practitioners' findings as well as enabling the presentation of existing biometric-relevant products and services for border management;
- provided technical assistance to the development of capabilities in relation to Advance Passenger Information in Member States and Western Balkan Countries in the form of study visits and contribution to the content and delivery of training on the topic.

In addition to the main projects and activities outlined above, research and innovation expertise was provided to support other activities and projects.<sup>3</sup>

The activities which were ongoing and whose final results were not yet available at the beginning of 2021 will be presented in the next iteration of the report, to be released by the end of 2022. In the meantime, regular updates on research and innovation activities will be shared via the Frontex website.

The total amount of Frontex budget spent for contracts relevant for the implementation of specific research and innovation projects presented in this report reaches almost EUR 7.5 Million EUR.<sup>4</sup> This amount does not include the cost of meeting logistics (other than the International Conference on Biometrics for Borders), reimbursement of participation of Member State experts, or Frontex staff missions.

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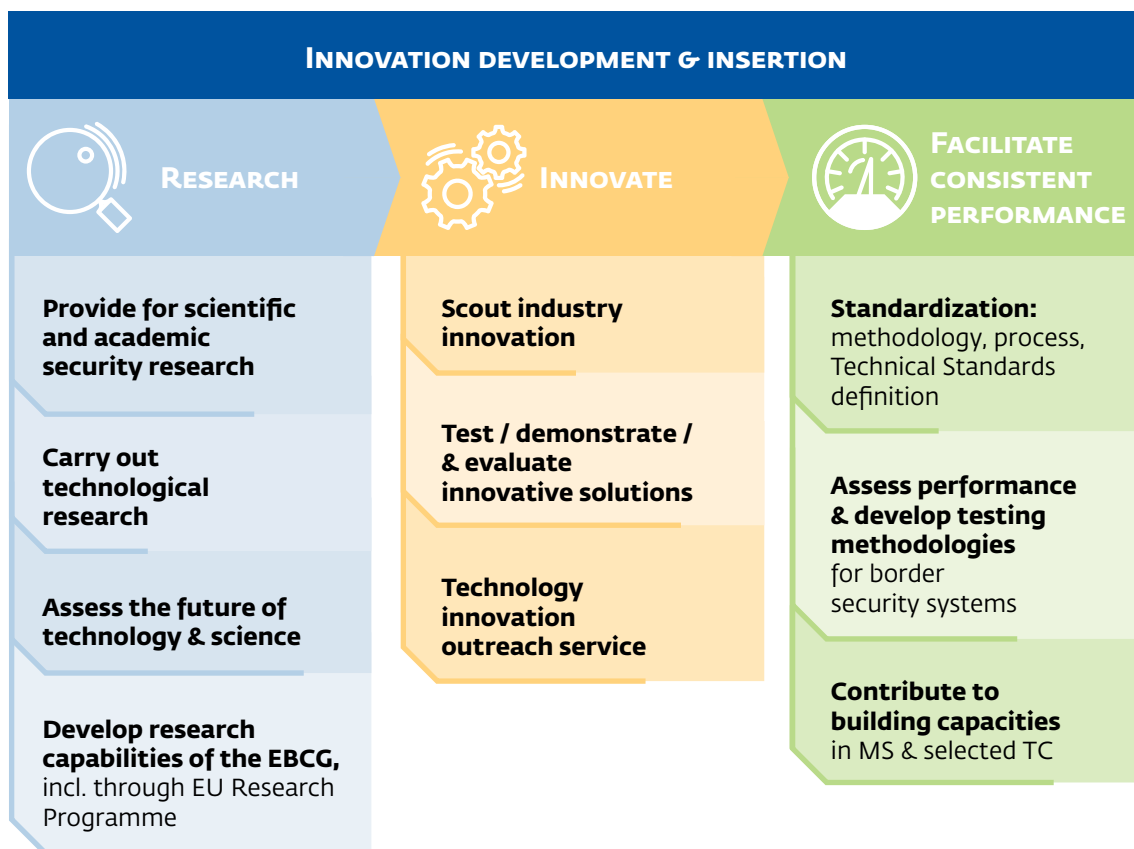
<sup>3</sup> More details available in Chapter 13.

<sup>4</sup> This amount does not correspond to the budget allocation for research and innovation in Frontex budgets 2019 or 2020, as some of the activities presented were committed earlier than 2019 and some of the activities with budget commitment in 2020 have not finalised to allow presentation of results by the end of 2020. Also, this amount refers to Frontex budget only and not to the budget for service development financed under the Copernicus Delegation Agreement.

## 4. Introduction – Note on report content and structure

In accordance with Article 66(1) of Regulation 2019/1896, Frontex “shall disseminate the results of ... research [and innovation activities relevant for border management] to the European Parliament, to the Member States and to the Commission.” Further, in accordance with Article 66(5), Frontex “shall make public information on its research projects, including demonstration projects, the cooperation partners involved and the project budget.”

This report focuses on presenting results obtained or completed in the year 2020. Thus, activities performed totally or partly during previous years that have led to a result in 2020 are also in scope. This approach reflects the complexity of research and innovation processes, whose preparation and implementation runs, in many cases, over several years. While information on specific and general activities contained herein has been shared with the public via



*Main research and innovation areas at Frontex*

news releases and publications available on websites<sup>5</sup>, or shared with experts through presentations in meetings and technical documents, this report offers a unique compilation. References to information available online are included where relevant.

In addition to the activities and projects whose results are included in the report, other activities, typically contributing to projects managed by other Frontex entities, are briefly mentioned. In a similar manner, activities ongoing or under preparation are listed in the final

chapter, even if not completed within the reporting period.

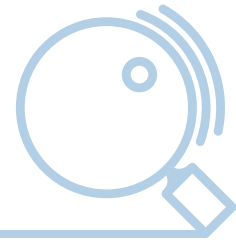
The Annexes include a list of key reports on topics relevant to research and innovation as well as the Annex on the budget and cooperation partners of the projects for the report timeframe.

The report structure reflects the components of Frontex research and innovation activities, following the Agency's mandate as expressed in Article 10(z) and Articles 64 and 66.

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5 For example: (i) Annual Implementation Report 2020: Annual Implementation Report (europa.eu); (ii) CAAR\_2020\_for\_publication.pdf (europa.eu), (iii) information on research and innovation activities on Frontex website [Announcements \(europa.eu\)](#); or (iv) information on tenders launched and tender results available on EU tendering website [Contracts awarded by EU Institutions – TED Tenders Electronic Daily \(europa.eu\)](#)

## 5. Supporting EU border security research



### EU Research & Innovation Programmes and Frontex Involvement

The European Union has a long history of investing in research and innovation. The most recent programmes are **FP7** (Seventh Framework Programme) and **Horizon 2020**. **FP7** lasted from 2007 to 2013, and following the programme's successful completion, **Horizon 2020** was initiated in 2014 to further ensure the EU's competitiveness worldwide by facilitating research and innovation. With a focus on novel technologies and discoveries, Horizon 2020 aimed to move innovations into the market, rather than keeping them in the lab, to contribute to the wider community. This core idea continues in the EU's new programme, **Horizon Europe**, which has initiated its 7 years duration in 2021.

The EU Framework for Research and Innovation Programmes Horizon 2020 (2014-2020) and Horizon Europe (2021-2027) provide funding for, inter alia, border security projects which address a wide spectrum of technological capabilities critical for the European Border and Coast Guard: unmanned platforms, document fraud detection, situational awareness, biometrics, command and control, artificial intelligence, robotics, augmented reality, integrated systems and identification of illicit drugs, to name a few. The EU investments in the Border Security Research domain

are of high importance to ensure that Frontex can fulfil its strategic objectives: reduce vulnerability of the external borders, guarantee safe, secure and well-functioning EU borders, and further enhance European Border and Coast Guard capabilities.

Frontex continuously seeks to engage with cross-sector partners responsible for the management, implementation and coordination of the projects so its research and innovation activities are able to transform operational requirements into innovative operational solutions. With this objective in mind, in February 2020 Frontex and the Commission's Directorate-General for Migration and Home Affairs (DG-Home) co-signed dedicated Terms of Reference<sup>6</sup> regarding Frontex's role in the EU's Research & Innovation Programmes, which laid the foundation for a close partnership and an enhanced Frontex contribution to maximising EU research as a joint goal-oriented effort.

Under these Terms of Reference, Frontex provides its assistance to DG-Home in relation to projects in the border security domain, namely in the areas of programming, monitoring and assimilation of project results. Frontex actively participates in a wide range of selected activities of border-security projects, such as tests, trials and demonstrations of technologies. These activities do not interfere with the roles of

6 [files\\_en \(europa.eu\)](https://files_en.europa.eu); [Frontex to provide border security expertise to European Commission's research projects \(europa.eu\)](https://files_en.europa.eu)

DG HOME and the Research Executive Agency, which continue carrying out their responsibilities linked to the overall design, implementation, and coordination of the security part of the EU Framework Programme for Research and Innovation.

In September-October 2020 Frontex operational staff participated in the evaluation of proposals for border security related research projects received by the European Commission in the framework of the last work package of Horizon 2020. Doing this, Frontex enriched the process with a unique view on operational border security aspects. Although challenging, this experience was also valuable to all participating Frontex staff, providing insight into new technologies under development and enabling the exchange of views with academia and researchers.

In summary, already since early 2019 and under the new Terms of Reference,

Frontex has been following a number of border security research projects under the EU Research Framework Programme and aims to share the outcomes of its engagement with the wider EBCG Community. To this end, a dedicated section of the Frontex website was set up with information on the Horizon projects followed and Frontex's main activities in relation to these projects.<sup>7</sup>

The impact of Frontex's involvement in these Horizon projects will be assessed towards the end of the projects' first life cycle. At that stage, it will be possible to evaluate their feasibility for integration into the operational environment and their possible acceptance by the EBCG community.

Since 2019 Frontex has been following the projects listed below, implemented under the EU Research Framework Programme.



**Project MIRROR** aims to develop an integrated platform, a set of tools, as well as a systematic methodology for the comprehensive intermedia analysis of the perception of Europe, the detection of discrepancies between perceptions and reality in Europe, and the creation of awareness for their impact and the resulting threats, including hybrid threats.



**Project PERCEPTIONS** strives to identify narratives, images and perceptions of Europe abroad; investigate how different narratives could lead to problems, false expectations, security threats or even radicalisation and in what way; create toolkits of creative and innovative measures to react to or even counteract them, considering social, societal and structural aspects.



**Project ARESIBO** aims at improving the efficiency of the border surveillance systems by providing the operational teams and the tactical command and control level with accurate and comprehensive information.



<sup>7</sup> <https://frontex.europa.eu/future-of-border-control/eu-research/introduction/>



**Project D4FLY** has the objective of augmenting the current capabilities and capacities of border authorities in countering emerging threats in document and identity verification at manual and highly automated border control points.



**Project BorderSens** will enable highly accurate selective detection of trace levels of illicit drugs and precursors through the device it seeks to develop: a portable, wireless single prototype device with the capability to quickly test for different types of drugs, precursors and adulterants/cutting agents, with outstanding accuracy and reduced false positives and false negatives.



**Project COMPASS2020** has the objective to demonstrate the combined use and seamless coordination of manned and unmanned assets to achieve greater coverage, better quality of information and shorter response times in maritime surveillance operations.



**Project ANDROMEDA** strives to unlock the full potential of Common Information Sharing Environment (CISE), by validating over a long period of time CISE-compatible command, control and coordination systems from several Coast and Border Agencies.



**Project ILEAnet's** key objective is to develop a sustainable Law Enforcement Agency (LEA) practitioners' network, encouraging and organising the dialogue between those practitioners and the research community to raise awareness about the innovative solutions available to help with their daily work.



**Project MEDEA's** goal is to establish a network of practitioners and organisations across the Mediterranean and Black Sea countries responsible for enhancing safety, security and resilience of its societies.



**Project ITFLOWS** is focused on providing accurate predictions and adequate management solutions of migration flows in the European Union. In parallel, it proposes solutions for reducing potential conflict/tensions between migrants and EU citizens, by taking into account a wide range of human factors and using multiple sources of information.



**Project METICOS** aims to introduce Big Data Analysis in the field of border control information systems in order to provide a step-change towards more modern and efficient Smart Border management and towards societal and political acceptance of modern control technologies of EU borders such as 'no gate solutions'.







**Project ISOLA** aims to develop, integrate, test, deploy, demonstrate and validate a systematic and fully automated security approach by incorporating innovative technologies for sensing, monitoring, data fusion, alarming and reporting in real-time, in the case of on-board incidents.



**Project ENTRANCE** is set to develop and validate a comprehensive user-based ENTRANCE Toolbox for risk-based non-intrusive inspection (NII) of cross-border freight movements, with particular focus on the EU Customs Union border. The aim of the ENTRANCE Toolbox is to enhance border security practitioners' capabilities to protect society against a wide range of dangerous and illicit materials with minimum disruption of cross-border flow of goods.



**Project BorderUAS** will combine a multi-role lighter-than-air (LTA) unmanned aerial vehicle (UAV) with an ultra-high-resolution multi-sensor surveillance payload supporting border surveillance as well as search & rescue applications, in border areas with difficult terrain. The sensor payload will include synthetic aperture radar (SAR), laser detection and ranging (LADAR), shortwave/longwave infrared (SWIR/LWIR) and acoustic cameras for direct target detection, as well as optical and hyperspectral cameras for indirect detection (via vegetation disturbance).



**Project iMARS** will seek to reinforce the security of ID Documents and will provide solutions to address gaps in the lifecycle of an ID Document to match the requirements formulated by ICAO and operators of Automated Border Control (ABC) systems.



**Project EFFECTOR** aims to enhance maritime surveillance, improve decision support and foster collaboration of maritime stakeholders by implementing an Interoperability Framework and associated Data Fusion and Analytics services for Maritime Surveillance and Border Security that will allow faster detection of new events, better informed decision making and achievement of a joint understanding and addressing of situations across borders.



## 6. Providing research capabilities for EBCG

### Research study on Artificial Intelligence-based capabilities for the European Border and Coast Guard

In 2019 Frontex contracted Rand Europe to deliver the study on artificial – intelligence based capabilities for the European Border and Coast Guard. The study was delivered in Q3 2020 while its dissemination on the Frontex website took place later, in early 2021<sup>8</sup>.

The purpose of the study was to provide an overview of the main opportunities, challenges and requirements for the adoption of AI-based capabilities in border management. Frontex's intent was also to find synergies with ongoing AI studies and initiatives in the EU and contribute to a Europe-wide AI landscape by adding the border security dimension.

The knowledge collected during the study on the AI state-of-play, cross-cutting enablers and the key challenges to the wider adoption will support Frontex in shaping the future landscape of AI-based capabilities for Integrated Border Management. The study also identified AI-related research and innovation use cases which could be initiated by Frontex (e.g. under the EU Innovation Hub for internal security) or recommended to be conducted under the EU Research and Innovation Programme (Horizon Europe).



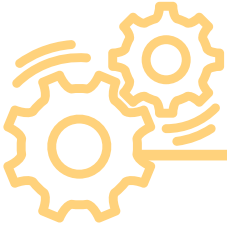
Cover page of the Research study on Artificial Intelligence-based capabilities for the European Border and Coast Guard (© Frontex, 2020)

The final report of the study includes:

- a characterisation of the evolving landscape of AI-based capabilities in border security and mapping of the technology, capability areas and border security functions to which AI may be applied;
- mapping of the current and desired capability levels for nine selected technology areas, as well as pathways for their adoption;
- discussion of cross-cutting enablers and barriers for the adoption of AI-based capabilities in border security;
- reflections on the implications for Frontex.

<sup>8</sup> [Artificial Intelligence-based capabilities for the European Border and Coast Guard \(europa.eu\)](https://europa.eu/artificial-intelligence-based-capabilities-for-the-european-border-and-coast-guard/)





## 7. Technical industry dialogues

### Frontex Industry Days

Frontex Industry Days are organised to carry out the Agency's mandate as per Article 66(1) of the European Border and Coast Guard Regulation, which states that the Agency "shall proactively monitor and contribute to research and innovation activities relevant for European integrated border management".

To this end, Frontex organises regular technical dialogues with companies: 'I-Days'. These events bring together industry players active in the European Integrated Border Management (EIBM) sector with Member State representatives, EU agencies and institutions, partner international organisations and Frontex entities and staff. Information on these events as well as the process applied is available on the Frontex website.<sup>9</sup>

The aim of I-Days is to facilitate industry dialogue in an operational area of crucial interest to the EBCG community, to map out the market for innovations and to update our knowledge base on developing trends and technological advancements. We are looking for state-of-the-art technologies and services available on the market, as well as newly developed products able to cover multiple and complex operational scenarios. Emphasis is placed

on cost-effectiveness and operational efficiency.

Frontex aims to apply a harmonised approach across the Agency, ensuring equal treatment, transparency, and traceability of dialogue with industry. At the same time, efforts are made to increase the effectiveness of dialogue on technology, research, state-of-the-art innovative and commercial solutions. Frontex I-Days, while offering a level playing field for the industry, also provide valuable opportunities for the entire EBCG community to keep abreast of the dynamic and highly competitive market of products relevant to EIBM.

### Meetings with industry on innovation organised by Frontex:

- Industry Dialogue on Procurement of handguns, ammunition and holsters for the standing corps of the European Border and Coast Guard, 9-10 December 2019, whose outcome was published in 2020 and is available under [Outcome of Industry Dialogue – Procurement of handguns, ammunition and holsters for the European Border and Coast Guard standing corps \(europa.eu\)](#)
- Industry Days, 12-14 May and 26-27 May 2020 (virtual) which presented

<sup>9</sup> Invitations to the planned I-days are published in the Announcements section [Announcements \(europa.eu\)](#)  
e.g.(1) [Invitation to Frontex Industry Days \(europa.eu\)](#) (2) [Invitation for Industry Dialogue – Procurement of handguns, ammunition and holsters for the standing corps of the European Border and Coast Guard \(europa.eu\)](#) [Industry Exhibition on EES equipment – call to industry \(europa.eu\)](#)  
General contact information for companies and a summary of the process is available on the Frontex website: [Industry contact point \(europa.eu\)](#)



Meeting announcement: I-Days November 2020 (© Frontex, 2020)

technologies for border surveillance, border checks with focus on fingerprint capture, latest technologies for command and control systems for law enforcement.

- Industry Days on Shift Management Solutions, 16 June 2020 (virtual) dedicated to solutions for scheduling of multiple shifts with staff responsible for various functions, interconnected with other applications.
- Industry Days, 16-20 November 2020 (virtual) in which technologies presented included border surveillance, artificial intelligence for area monitoring of maritime/land border areas, solutions for border checks, counter UAV systems. A wrap up of the meeting is available on the Frontex website under [Frontex Industry Days: Shaping the future of European integrated border management \(europa.eu\)](https://www.frontex.europa.eu/industry-days-shaping-the-future-of-european-integrated-border-management)
- Industry Days on Technologies for Counter Terrorism at Borders, 30 November 2020 (virtual) presenting solutions utilising the application of artificial intelligence to detect persons of interest automatically, such as facial recognitions algorithms, biometric databases and cross-sensor analyses.
- EES equipment exhibition (online), integral part of the International Conference on Biometrics for Borders, 1-3 December 2020.



## 8. Testing new services relevant for border management and border security

### Maritime Surveillance Aerostat pilot project

This pilot project was hosted by the Hellenic Coast Guard with the participation of Portugal's National Republican Guard (GNR). The deployment phase took place from 30 July to 31 August 2019 on the Greek island of Samos. The technical solutions were contracted and provided by In-Innovative Navigation GmbH following an open tender procedure (OP/659/2018/JL<sup>10</sup>). Following implementation in 2019, the evaluation and final results of this pilot project were performed and used in 2020 to prepare the follow up pilot project Maritime Surveillance Aerostat II, which was tendered and contracted in 2020 (implemented in 2021). The results will be included in the next issue of the report on results of research and innovation in 2021.

The first pilot project on Maritime Surveillance Aerostat proved that a system consisting of an aerostat platform, carrying as payload a set of sensors and equipped with powerful processing software, can support the task of maritime/coastal border surveillance for law enforcement purposes. From an operational point of view, the system proved helpful in detecting objects of interest at sea. However, there were a series of

issues that rendered the test inconclusive, such as limitations caused by the inadequacy of the payload, obstructions of field of view, and the low number of events happening north of Samos Island. Therefore, the recommendation was to arrange further trials addressing these issues. The new system to be piloted should be of a higher performance, deployed in a more relevant area of the coast and tested for a longer period.

The following findings could be derived from the pilot project:

- The solution itself was not as mobile as initially expected. The possible mooring sites were limited by the aerostat's size and the preparation to set up the system took a few days, up to a week. It is assumed that after transport to a new site, the system could be ready to use for surveillance tasks in about 2-3 days. The difficulty of finding mooring sites could be eased by using a shorter, rounder aerostat, which would also ease the problem of payload stabilisation as it is expected to have more moderate tilting movements.
- Another interesting conclusion is that enhanced situational awareness capacity should be combined with enhanced reaction capability to be able to address irregularities on the spot.



<sup>10</sup> [Services – 185944-2018 – TED Tenders Electronic Daily \(europa.eu\)](https://ted.tenders.europa.eu/)

- In relation to the Portuguese Maritime Mobile Surveillance System (MMSS) deployed simultaneously with the aerostat, no final conclusions could be reached as the deployment sites were sub-optimal and the number of events which could be observed simultaneously by the MMSS and the aerostat, few. Still, the MMSS deployed (equipped with state-of-the-art payload) contributed to an enhanced situational picture.
- Some of the issues experienced were related to geography, as the original location chosen for the pilot was the island of Lesbos, but due to the lack of suitable sites it had to be moved to the island of Samos. This led to a series of technical issues: the surveillance equipment loaded on the aerostat was calibrated for Lesbos, where the Turkish coast is much closer – therefore the surveillance could not cover a 360° angle, being limited by the mountainous nature of Samos and the short range of the surveillance equipment.
- Lastly, the equipment, in certain circumstances, did not allow detection of smaller boats. The weakness of internet bandwidth compromised remote access to the aerostat from the Local Coordination Centre and from the Hellenic Coast Guard Headquarters in Piraeus. Moreover, it was suggested that the system would work better if operated by the Contractor's own operators, under strict command and control of local authorities and Frontex staff.

### Testing Remote Piloted Aircraft Systems (RPAS) for border surveillance

In 2018 Frontex started testing the use of Remotely Piloted Aircraft Systems (RPAS) at the external borders of the EU Member States, covering several operational situations and targeting a broad maritime surveillance capability. Thus, the operational scope of testing included surveillance of the sea, support of Search and Rescue operations, detection of vessels suspected of criminal activities, such as drug and weapon smuggling, and information sharing with multiple users in real time. The pilot project was implemented via two subsequent trials, the second one completed by the end of 2019, with results evaluated and available in early 2020: MALE RPAS and small MALE RPAS. The technical solutions were contracted via an open tender (OP/800/2017/JL)<sup>11</sup> with two lots defined on the basis of platform performance, in particular their weight and their endurance.

- Lot 1: where a MALE RPAS was defined as an aircraft without a pilot on board, with a Maximum Take-off Weight (MTOW) above 1 000 Kg, capable of performing long endurance flights, typically more than 20 hours.
- Lot 2: Small MALE RPAS, defined as an aircraft without a pilot on-board, with an MTOW weight above 500 Kg but less than 1 000 Kg, capable of performing long endurance flights, typically more than 10 hours.

The results of the pilot and conclusions thereof were used in the preparations for the tendering procedure launched in 2020 for MALE RPAS surveillance services, followed by a contract signed in 2021.

11. Contract award notice available under: [Services – 10629-2018 – TED Tenders Electronic Daily \(europa.eu\)](#)





Frontex tested the use of Remotely Piloted Aircraft Systems (RPAS) in Greece (© Frontex, 2020)

**MALE RPAS trial**

A trial on Medium Altitude Long Endurance (MALE), Remote Piloted Aircraft Systems (RPAS) conducted by Frontex and the Hellenic Coast Guard took place in Greece, Athina Flight Information Region (FIR). The implementation stage of the trial took place during the last quarter of 2018. Following an open tender (OP/800/2017/JL), a contract was signed with IAI-Ltd MALAT Division, which subcontracted a role to Airbus DS Airborne Solutions GmbH to operate the system and to provide 600 surveillance flying hours, to be delivered over a period of 120 calendar days in 2018.

The overall conclusions of the trial, conducted within the planned time and budget, supported the idea that MALE RPAS surveillance services could potentially be used by Frontex, based on (1) their operational running cost efficiency and (2) their operational performance effectiveness.

These maritime aerial surveillance capabilities, in the form of a service, need to be considered through the analysis of end-user requirements and the potential benefits presented by this solution.

The MALE RPAS framework of employment, in non-segregated airspace, represents significant operational benefits compared to flights within a segregated airspace, which, through the coordination with the MS authorities (to overcome the third-party safety constraints of operating unmanned systems within non-segregated airspace), enabled the unmanned aerial vehicle in the trial to provide a regular, reliable and efficient capability during long-endurance aerial maritime surveillance missions. It should be noted that the service was provided during winter months in the Mediterranean Sea.



The following conclusions derived from the MALE RPAS trial in Greece:

- The close, pro-active cooperation of Greek national authorities made it possible to fly the MALE RPAS in non-segregated airspace; in fact, the operations were conducted 'accommodating' the platform flights in controlled airspace, under several agreed constraints.
- The platform fulfilled the maritime surveillance missions assigned, as any other surveillance asset deployed, with the added advantage of its extended endurance.
- The platform registration solution used for this pilot –registering it as a Greek state aircraft– would, in principle, not be repeated by the Hellenic Coast Guard. Any future deployment of MALE RPAS should carefully investigate the platform registration issue aiming to have it already registered before the RPAS is deployed to start the contracted service.

The conclusions were turned into proposals for a way forward:

- The potential for conversion into / acquisition of a fully-fledged service of similar platform and payload configuration of MALE RPAS surveillance services was confirmed in the trial and may be considered by Frontex for operational use.
- As the requirements for deployment of RPAS may vary depending on the geographical area, for each future potential deployment a case by case analysis of the requirements (cost-efficiency and/or performance) versus benefits should be performed. Only if the analysis confirms the benefits, an open procurement procedure for MALE RPAS aerial maritime surveillance services is recommended to be initiated.

### Small MALE RPAS trial

The test of a small Medium Altitude Long Endurance (small MALE), Remote Piloted Aircraft Systems (RPAS) was conducted by Frontex and by Italian and Maltese authorities in the Central Mediterranean Sea. To implement the small MALE RPAS trial, Frontex conducted an open procurement procedure (OP/800/2017/JL) resulting in contract award<sup>12</sup> and signature with Leonardo S.P.A. The trial took place in the Central Mediterranean, in close cooperation with the host Member State, Italy, specifically the Italian Guardia di Finanza, and in cooperation with Malta (the Armed Forces of Malta and Malta Civil Aviation Directorate). The second trial of the pilot comprised the delivery of 300 flying hours, as contracted. Regarding the implementation timeframe, initially the services were planned for delivery in Q2–Q4 2018, however, the actual period was longer as the contract was extended till Q2 2019 following operational considerations.

The objective of the project was to assess the ability of small MALE platforms to deliver maritime surveillance services in a regular, reliable and efficient way. In particular, whether small MALE RPAS can deliver long endurance (more than ten hours) maritime surveillance in high seas supporting coast guard operations (operating beyond line of sight when needed).

The outcome of the trial flights allowed Frontex to derive the following conclusion: small RPAS can perform coast guard missions, albeit with restrictions, which can be classified as procedural, technical and operational.

Specifically, the use of the FALCO EVO vehicle in this trial was affected

12 Contract award notice available under: [Services – 10629-2018 – TED Tenders Electronic Daily \(europa.eu\)](#)





by external procedural factors, that included:

- the issuing of flight permissions and Notices to Airmen (NOTAMs) to separate the RPAS from other air traffic;
- the NOTAM areas keeping the platform always in Line of Sight range from the base airport;
- the need for a single national authority in the host country to coordinate all stakeholders' involvement in the trial;
- the need for Frontex to deploy internal coordination in the use of aerial assets operating from the same base airport or flying in the same area of interest.

Emerging technical challenges and initial problems of reliability derived from changes in the platform configuration (to comply with the contract requirements) were solved during the extended trial period, which required an additional six months in implementation:

- the reliability of the platform improved over the extended trial time and, during the last month of the trial, the service provided was very close to Frontex's service requirements, although flights were not conducted in BLOS (beyond line of sight) as the area of interest was within the line of sight (LOS) of the base airport;
- the meteorological situation during the winter months limited the capacity of the small RPAS to fly, although the situation improved at the end of the trial period.

The FALCO EVO was used in different areas during this trial: Frontex Joint Operation Themis operational area, Lampedusa Aerodrome Traffic Zone (ATZ) and a pre-frontier area. The following conclusions could be drawn from the testing activities:

- Lampedusa airport is a complex environment for RPAS deployment as it is a busy civilian airport

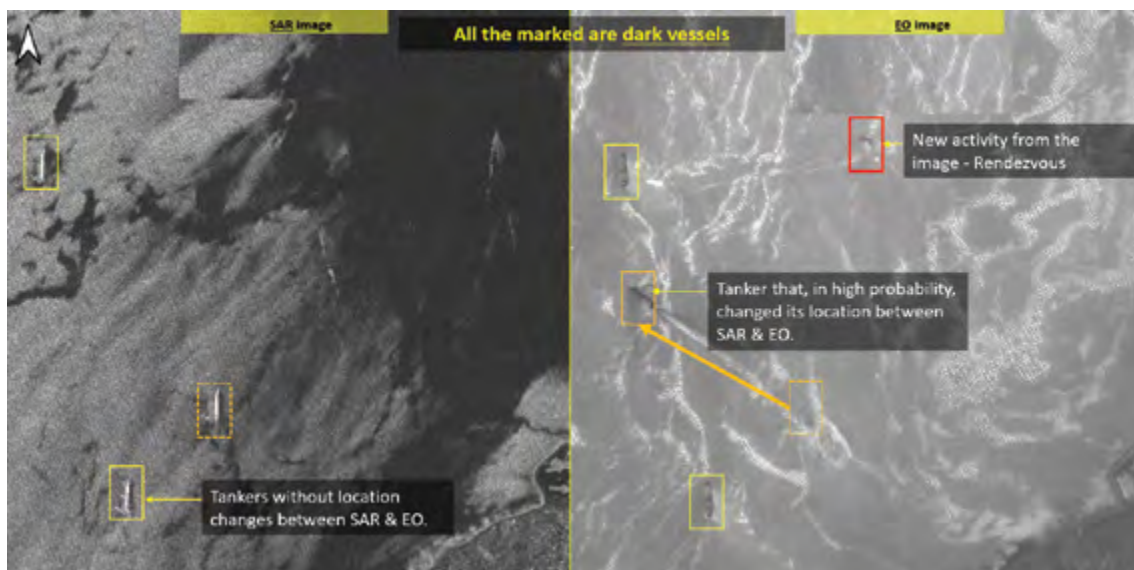
in the summer period, and because of strong winds during the winter months. The presence of ferries in the port also affects the use of the airport.

- During the first two phases of implementation, in the operational area of JO Themis and Lampedusa ATZ flights, the pilot project was affected by the lack of availability of the platform caused by technical problems and by the seasonal bad weather conditions.
- Positive results were obtained during the last phase of the trial, i.e. flights in the pre-frontier area. The platform performance was improved technically, and better meteorological conditions favoured the platform's capacity to perform most of the scheduled missions.
- There were some sensor limitations pointed out by operational end users: the camera capacity was evaluated as having a limited resolution, both in the visible and the infrared spectra.
- There were some information management issues in need of improvement identified by operational users: (i) the lack of remote interactive use of the compiled picture (interactive map, chat with pilot) and (ii) the time lag in the transmission.

Although the FALCO EVO platform showed an increase in reliability and endurance during the extended trial period, the limiting factors encountered during the trial prevented Frontex from reaching definite conclusions on the actual capacity of small MALE RPAS to perform coast guard operations. Therefore, it was concluded that further assessment is needed to confirm the use of Small MALE RPAS for regular operational use and to assess its use in BLOS mode.



## 9. Testing new earth observation services relevant for border management



Sample result of the pilot project on combined time/area imagery: example of combined SAR and EO service findings (© Frontex, 2020)

Frontex research and innovation tests the feasibility and usability of new earth observation services (so-called evolution services) for the purposes of border security, within the framework and budget of Copernicus Delegation Agreement (DA)<sup>13</sup>. In 2020 the testing of the evolution service called combined time/area surveillance was concluded. The information on the implementation of the Copernicus DA is presented in annual reports to EU Commission DG DEFIS (previously DG GROW).

The combined time/area surveillance service consisted of several parts: a systematic capture of imagery using a wide area space-borne Synthetic Aperture Radar (SAR) imagery; the automatic search and detection of Frontex defined objects/events of interest within the area; the automatic tasking of an electro-optical high resolution imagery focusing on the located objects/events of interest; and the automatic delivery to Frontex of high resolution imagery capturing Frontex's pre-defined events of interest.

<sup>13</sup> [Frontex to implement border surveillance services as part of Copernicus \(europa.eu\)](https://frontex.europa.eu/media/default.aspx?mediaid=1111)



The service testing and evaluation were outsourced via an open procurement procedure (OP/1499/2018/RS) contracted with the company Edisoft<sup>14</sup> which, in turn, had ISI as subcontractor. The testing activities started in the third quarter of 2019 with a set-up phase preparing the production phase that started in January 2020. The results of both set-up and production phases proved that the combination of time/area surveillance is feasible. The image below shows how a radar image, taken in an area of interest located in the eastern Mediterranean Sea, was used as a cue for the capture of an optical image of the vessels found in previously clustered radar images.

Despite the service being feasible, the conclusions and recommendations of

the testing were that the service is not ready to become operational, with the main findings as follows:

- the limited number of SAR and EO satellites available today resulted in a long-time gap between SAR and EO acquisitions (best 1.5 hr and a frequent gap of 7-8 hrs);
- better results were obtained when pre-available information (intelligence, AIS) was used to task both the SAR and the EO acquisitions.

Following the trial, Frontex keeps on standby the use of time/area surveillance services as newly deployed constellations with inclined orbits may provide enhanced acquisition options. Additionally, Frontex is exploring new capacities, technologies and tools that could improve the concept.



14 [Services – 74109-2020 – TED Tenders Electronic Daily \(europa.eu\)](https://ted.europa.eu)

## 10. Testing novel biometric solutions for border checks

### Biometrics on the Move Pilot Project

In the beginning of 2019, Frontex launched a procurement procedure (Frontex/NP/1333/2018/MS) for the provision of pilot services for distance biometric data acquisition and travellers' identity verification. In the context of this pilot project, biometric data consisted of face and fingerprint identification.

The pilot was implemented at Lisbon airport during October 2019, in cooperation with the Border Service of Portugal (SEF) and the Lisbon Airport Authority (ANA). The evaluation of the results of the pilot was completed in Q1 2020.

The pilot activities considered EU citizens leaving the Schengen Area, and in general tested whether biometric solutions can decrease waiting time at the borders. The specific objectives of the trial were: to assess opportunities to replace the automatic gates or other physical obstacles, to give passengers an 'on the move feeling' thanks to biometric identification and validation, and to reduce the time to control documents, improving the overall passenger experience.

The pilot proof of concept was considered as having positive results as it managed to deliver evidence-based outputs founded on high participation rates from travellers, of various nationalities and all ages. Most respondents said that they were satisfied or very satisfied with their experience. Participating border guards also expressed positive feedback.



*Biometrics on the Move pilot project at Lisbon airport (© Frontex, 2020)*

Public acceptance of the solution was good, with some frequent flyers insisting on repeating the experience.

The main advantages of the system were the reduction of border control time for passengers, without compromising security, and improved efficiency for border guards combined with a decrease of workload. Human supervision is still required to strengthen security, primarily to prevent unauthorised persons being enrolled.

Key observations and considerations from this pilot suggest that a fully working system may be deployed and used when interconnected with national systems for developing advanced biometrics systems for border control (checks). This would require further testing in more evolved pilot projects on seamless travel, which should be implemented over a longer timeframe enabling the gradual integration of advanced technologies already under research and development.





# 11. Improving operational performance of EBCG capabilities

## Developing Standards for Technical Equipment

The development of Technical Standards is part of an overarching process of standardization within the framework of European Integrated Border Management. Defining Technical Standards is not a mere technical demand, it is an essential precondition to achieving European Integrated Border Management. Technical Standards guarantee a compatible and interoperable level of performance of equipment across the EBCG, including during Frontex joint operational activities. Technical Standards enable the convergence of the capability development plans of Member States and the multiannual planning of the Agency's resources.

To ensure compatibility and interoperability in the use of technical means during European operational activities, the Agency's mandate foresees the need to define and develop, in close cooperation with Member States and the Commission, Technical Standards for equipment.

During 2020 the Agency worked intensively on the preparation of a first iteration of Technical Standards covering an ample spectrum of equipment for border control:

- maritime equipment, providing, for example, the characteristics of Offshore Patrol Vessels (OPVs), Coastal Patrol Vessels (CPVs) and Coastal Patrol Boats (CPBs);
- aerial equipment for fixed-wing aircraft and helicopter, as well as Remotely Piloted Aircraft Systems;
- land border surveillance equipment, including sensors, transport and communication equipment;
- document inspection equipment, covering document readers and document authentication software.

These four Technical Standards will be released as part of a Management Board Decision, thereby ensuring that Member States' equipment part of the Technical Equipment Pool managed by Frontex complies with the requirements.

In addition, the Agency developed, in close cooperation with EBCG stakeholders, a Technical Guide for border checks on EES related equipment, supporting Member States' in their preparations for the entry into operation of the Entry/Exit System (EES).



### Facilitating knowledge transfer on biometrics relevant for border security

As of 2019, Frontex organises an annual conference called the International Conference on Biometrics for Borders (ICBB), dedicated to the topic of biometrics, their (possible) use and application in border control, and the challenges they may pose to border security, including issues related to privacy, ethical use of technologies and data protection. Various areas of interest are covered each year, informed by Member States' needs.

The contents and programmes of major conferences on biometrics in the context of border control are largely set and dominated by organisations and industry related players in the field of biometrics, who do not necessarily focus on biometrics for borders or may not entirely represent the priorities of national border management authorities. For this reason, Frontex initiated the ICBB, to enable the Agency to contribute more effectively in support of Member States and the European Commission to the technology discussion on biometrics for borders, including the possible applications and implications, and to increase the interaction with the relevant players in the sector from the angle of border management, within the process of research and innovation.

The organisational approach of the ICBB is two-fold. It offers a conference programme accessible to experts from the border management authorities of all EU Member States/Schengen States and selected non-EU countries, European institutions and international organisations, as well as academia. Second, alongside the conference programme

the ICBB offers participants access to an industry exhibition where companies showcase their technologies. These companies are selected based on objective criteria following an open call published on the Frontex website, in accordance with the Agency's procedures for contacts with the industry.<sup>15</sup>

Frontex organised the first ICBB on 9-10 October 2019 in Warsaw, Poland, with focus on the topic of morphing and its implications for border management. The second ICBB was organised on 1-3 December 2020, hosted online in response to the COVID-19 pandemic situation. The ICBB2020 focused on the topic of the practical implementation of the European Entry/Exit System (EES) at the external borders. A dedicated ICBB2020 Virtual platform offered a combination of recorded welcome messages, keynote speeches, livestreamed focus sessions and panel discussions. In addition, it offered a live industry exhibition with a total of 23 Industry Exhibition Sessions, where selected companies were invited to present their innovative technologies for the implementation of the EES, presenting a variety of solutions in the area of facial recognition, fingerprint capture, integrated biometrics solutions, touchless solutions and mobile solutions. Presentations were held on three virtual stages.

Most of the focus sessions were concerned with providing MSs with relevant information on the different efforts and activities undertaken by Frontex aimed at offering practical support to MSs in relation to the implementation of the EES at the EU's external borders. These sessions focused on the delivery to border guards of targeted training on EES implementation; the development of operational research models

15 The public call regarding industry exhibition along ICBB 2020 [Industry Exhibition on EES equipment – call to industry \(europa.eu\)](#)





The logo of ICBB 2020 (© Frontex, 2020)

and simulation tools that assist States to make decisions on which technologies, business processes and types of infrastructure to implement at the border in view of the EES implementation; and the development of minimum technical and operational requirements for the technical solutions to be deployed at Border Crossing Points as part of the EES. Turning to the international stage, one focus session invited international partners to discuss their experiences with national entry and exit solutions operated at their borders, giving their perspective on the EES. The remaining focus sessions provided important

insights into different aspects of system performance and system vulnerabilities.

The closing panel discussion shifted the focus onto the broader theme of the practical implementation of the EES and the smart borders package, and the interoperability regulation in general. The discussion addressed questions of interoperability between EU information systems and the challenges ahead from the EU policy level perspective, the perspective of the central implementation of EU information systems, and from the national perspective of the Member States.



## 12. Other research and innovation activities

In addition, during 2019-2020 Frontex has made available its research and technology innovation expertise as follows:

- Frontex has been sharing technical expertise in various fora (e.g. DAPIX and Frontiers Working Party meetings, Informal Working Group on the implementation of the PNR Directive, ICAO TRIP 2019 Symposium and Exhibition) and with the European Commission in the framework of the evaluation of the API Directive, the interactive API Feasibility Study and the Impact Assessment.
- Frontex has been utilising its internal research expertise in the implementation of the Instrument for Pre-accession Assistance (IPA) II 'Regional Support to Protection-Sensitive Migration Management in the Western Balkans and Turkey' Project<sup>16</sup>. The research expertise provided was in relation to the identification and registration of mixed migration flows aiming at developing IT systems and communication infrastructures in that area in line with EU standards and best practices.
- Frontex organised two study visits on Advance Information in the Netherlands and Germany for the six Western Balkan Beneficiaries to raise their awareness of the implementation of API Programmes, use of API data for border management purposes and EU requirements, including in relation to data protection.
- Frontex collaborated with and contributed to border security research capabilities e.g. the *Study on Opportunities and Challenges for the use of Artificial Intelligence in Border Control, Migration and Security* contracted by EU Commission DG Home.
- Frontex Research and Innovation provided consistent research services and support to other entities within Frontex, following requests and management instructions. Among others, during 2019 and 2020 research and innovation performed a mapping exercise of the Member States' existing capability and capacity to support the recruitment of Category 1 of the standing corps, produced a desk research on Shift Management Systems and, as part of research support to the development of internal EBCGA capabilities, delivered a survey on rules applicable in the Member States on the use of non-lethal weapons by law enforcement officers, which also included a mapping of technical specifications of equipment in use by Member States.

Most of the outputs of these research activities focused on supporting the planning and implementation of the Agency's new tasks, in accordance with the Regulation 2019/1896.

<sup>16</sup> The Western Balkan IPA II beneficiaries are Albania, Bosnia and Herzegovina, Kosovo\*, Montenegro, North Macedonia and Serbia.

\* This designation is without prejudice to disposition on status and is in line with UNSCR 1244/1999 and the ICJ Opinion on the Kosovo declaration of independence.



# 13. Ongoing research and innovation activities

## **Maritime Surveillance Aerostat II technology pilot project 2020-2021**

In 2020 preparations for the Maritime Surveillance Aerostat II pilot project were launched, as a follow up and drawing on the recommendations of Aerostat I pilot project. Aerostat II will be implemented in Greece in 2021, while its outcomes will be available in 2021/beginning of 2022. The main objective is to assess the performance and cost efficiency of an integrated multiple aerostat solution performing maritime surveillance in a real operational environment.

## **Entry-Exit System Land border pilot projects 2020 – 2021**

To support Member States in the implementation of the Entry Exit System, in 2020 Frontex in coordination with Member States, launched preparations for two pilot projects testing new technologies, including mobile solutions and self-service kiosks at land BCPs. It is planned that the deployment phase of the pilot projects will start in the first semester of 2021 in Bulgaria (BCPs Kalotina, Kapitan Andreevo) and Spain (la Linea/Gibraltar). It is expected that a high number of Third Country Nationals will use the system for entry and exit on an everyday basis in these locations, though border traffic will be impacted by the development of the COVID pandemic. Both pilots will finalise in 2021 and their outcomes will be shared with Member States immediately.

## **Supporting Member States' performance on EES**

Frontex has been using operational research and simulation solutions to support MSs in the optimisation of business processes at their border crossing

points (e.g. when implementing new technologies/systems or solving issues such as long waiting times or assessing vulnerabilities). Since 2019, Frontex has been focusing on using such solutions to support MSs in the optimisation of business processes and infrastructures, and redesigning of their BCPs to implement the Entry/Exit System (EES). Concretely, with the use of such simulation solutions, MSs can be helped in their decision-making about, for instance, the type and number of pieces of equipment/technology (e.g. manual booths, e-gates, self-service kiosks, mobile solutions) to install, the number of border guards to deploy or the physical installation of the equipment in the area of the BCPs. Upon request, Frontex provides support to MSs in respect of process optimisation and infrastructural re-design at specific BCPs. Some BCPs were assessed, and outcomes shared with MSs, allowing them to use the results of simulations for the preparation of procurement procedures for EES-related equipment. Other BCPs are planned to be assessed in 2021, depending on the development of the COVID-19 pandemic. A final report on this activity is also planned for 2022.

## **Supporting Member States' capabilities on utilising advance information**

The Study on Advance Information on Land and Sea Borders is planned to be published by the end of 2021.

## **Technology Foresight on Biometrics**

At the end of 2020, Frontex contracted the provision of a Technology Foresight Research Study on Biometrics for the Future of Travel. The main objective of

this research is the delivery of a study on the future of biometrics for its implementation in border control systems that may benefit the work of the EBCG community in a short – (1-5 years), medium – (5-10 years) and long-term (10+ years) perspective. The study will be finalised by the end of 2021.

#### **Green Deal and the European Border and Coast Guard**

In 2020 Frontex started preparing a research study on the Green Deal and the European Border and Coast Guard with the aim to support the EBCG community in reducing the environmental footprints of its facilities, operations and services, in order to achieve, and then maintain, a high level of environmental sustainability. The study is planned to be launched and finalised by the end of 2021, while the results will be gradually shared with other EU JHA Agencies before the completion date.

## 14. Annex I – Key research and innovation products

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1. Frontex Research Glossary v 1.0 [Frontex research glossary – Publications Office of the EU \(europa.eu\)](#)
2. Artificial Intelligence – based Capabilities for the European Border and Coast Guard Final Report [Artificial Intelligence-based capabilities for the European Border and Coast Guard \(europa.eu\)](#)
3. Artificial Intelligence – based Capabilities for the European Border and Coast Guard Final Report, Executive summary [https://frontex.europa.eu/assets/Publications/Research/Frontex\\_AI\\_Research\\_Study\\_2020\\_executive\\_summary.pdf](https://frontex.europa.eu/assets/Publications/Research/Frontex_AI_Research_Study_2020_executive_summary.pdf)

## 15. Annex II – Budget and cooperation partners of research and innovation activities

The data presented in this Annex comprise the following types of data:

- **Total budget EUR** refers to the total budget paid for the contracts relevant for the implementation of specific research and innovation projects/activities, as signed with the contractors listed. This amount does not include the cost of workshops organised in relation to a specific activity, the cost of publications, or the cost of Frontex staff missions. The cost included for the International Conference on Biometrics for Borders pertains to the cost of conference logistics in relation to ICBB 2019 and ICBB 2020.
- **Cooperation partners – contractors** refers to the contract signatories.
- **Cooperation partners – contributors** are entities which hosted or participated in the testing of technology solutions.

### Frontex technology innovation projects

Title	Total budget Eur	Cooperation partners: contractors	Cooperation partners: contributors
<b>Trial of Maritime Surveillance Aerostat</b>	616 453	In-Innovative Navigation GmbH	Portugal, Guarda Nacional Republicana Greece, Hellenic Coastguard
<b>Trial of Biometrics on the Move</b>	40 283	VisionBox	Portugal, Serviço De Estrangeiros E Fronteiras (SEF)
<b>Trial of RPAS for long endurance multipurpose aerial surveillance</b>	4 750 000	IAI Ltd Malat Division subcontracting a role to operate the system to Airbus DS Airborne Solutions GmbH	Greece, Hellenic Coastguard
<b>Trial of small MALE RPAS</b>	1 697 000	Leonardo S.P.A.	Italy, Guardia di Finanza Malta, Armed Forces of Malta, Malta, Civil Aviation Directorate

### Frontex capacity development activities, concerning new technologies

Title	Total budget Eur	Cooperation partners: contractors
<b>International Conference on Biometrics for Borders 2020 (online)</b>	16 481	Defacto Event Factory, Pomilio Blumm S.r.l.
<b>R&amp;I support to the development of training content on Vulnerability assessment, ABC, Advance Information</b>	172 598	Services purchased through External Experts Database <sup>17</sup> .
<b>Trial of RPAS for long endurance multipurpose aerial surveillance</b>	4 750 000	IAI Ltd Malat Division subcontracting a role to operate the system to Airbus DS Airborne Solutions GmbH
<b>Trial of small MALE RPAS</b>	1 697 000	Leonardo S.P.A.

### Frontex standardization activities

Title	Total budget Eur	Cooperation partners: contractors
<b>Compilation of inputs for documents on standards on technical equipment</b>	8 550	Services purchased through External Experts Database.

### Frontex research activities

Title	Total budget Eur	Cooperation partners: contractors
<b>Research Study on Artificial Intelligence</b>	114 075	RAND Europe Community Interest Comp

### Service evolution tests implemented under the framework and budget of Copernicus Delegation Agreement

Title	Total budget Eur	Cooperation partners: contractors
<b>Combined time/area imagery testing</b>	253 000	Edisoft-Empresa

<sup>17</sup> List of contracts with External Experts above 15,000 EUR available here: [Microsoft Word – 2019 contracts over 15 k \(europa.eu\); 2020\\_contracts\\_over\\_15\\_k.pdf \(europa.eu\)](#)





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