Rules of the competition

ENAIRE | OPEN INNOVATION

# Technology Challenges in Air Traffic Management Competition 2025

Call open until June 30th, 2025

ENAIRE

CRIDA I+D+i - ATM

AD Active Development

SILO Science & Innovation Link

# Index

# 1. The Organization

**ENAIRE** is the company of the Ministry of Transport, Mobility and Urban Agenda that manages air navigation in Spain. It provides **aerodrome control services at 21 airports**, including those with the highest traffic, and **en-route and approach control**, through five control centres: Barcelona, Madrid, Gran Canaria, Palma and Seville. In addition, **45 air traffic control towers** receive communication, navigation and surveillance services from ENAIRE.

**CRIDA** (Reference Centre for Research, Development and ATM Innovation A.I.E.) has the mission of **improving the efficiency and performance of the Spanish air traffic management system** through the development of ideas and R&D&i projects that provide quantifiable solutions through system performance indicators, all while considering the Spanish system as an integral part of a global system.

CRIDA is a fundamental support in ENAIRE's R&D&i activities and one of the activities it has delegated is to **promote open innovation as a** means of solving the future challenges posed by the evolution of the ATM (Air Traffic Management) system. CRIDA and ENAIRE are committed to open innovation as a fundamental lever to maintain their position as an international benchmark.

Being aware that the business of providing air navigation and air transport services is not known by the general public, it is necessary to manage different initiatives, among which are this contest of technological challenges.

For the **execution of this Technology Challenges Competition**, CRIDA has the support of **Active Development SL and Science and Innovation Link Office (SILO) S.L.** hereinafter "UTE AD-SILO", companies specialized in carrying out corporate innovation and entrepreneurship programs[1].

[1] The UTE AD-SILO is the company awarded the "Technical and Administrative Specifications. Support for Open Innovation" published in the Public Sector Procurement Platform on 07/Aug/2024 with File Number 2024-07-18-01.

# 2. The Contest

This year, ENAIRE is launching the 4th edition of the **Technology Challenges in Air Traffic Management Competition**.

This competition aims to find solutions to technological challenges in the field of air transport in the medium and long term. This competition may be entered by university research groups or any other type of research.

Technological solutions applicable to any sector of activity are allowed, provided that they focus on the field of **air traffic/air transport service provision.**

Unlike previous editions, in this edition two research groups will be awarded, whose prize will consist of research agreements funded by CRIDA.
The agreement is signed between two parties, CRIDA and the company or university to which the research group belongs.

# 3. Challenges

Technological challenges within the framework of open innovation in ATM are defined as those challenges that can be solved **with technologies from areas other** than ATM. That is why the technological challenges defined in this competition are transversal **in nature** and seek to take advantage of the knowledge and experience acquired in other technological areas for use in the air traffic management environment. The technological challenge seeks to attract **innovative solutions** that are not already being researched in this environment.

We look for total or partial solutions to any of the following 5 challenges.

## Challenge 1. Towards an explainable and safe AI in air traffic management through certification

**INTEGRATING EXPLAINABILITY, SECURITY, AND RELIABILITY INTO THE INNOVATION LIFECYCLE**

The incorporation of Artificial Intelligence (AI) in Air Traffic Management (ATM) opens up new possibilities to improve the efficiency, safety and capacity of systems. However, to ensure their

secure and reliable implementation, it is essential to establish a certification framework that validates these solutions from development to operational deployment.

This challenge seeks to promote research that allows the development of specific methodologies, tools and standards for the certification of AI systems in ATM environments. These solutions must be auditable, explainable and capable of operating in highly automated environments, while ensuring transparency in decision-making, risk mitigation and resilience to failures or attacks.

One of the main challenges is AI explainability (XAI), which must ensure that the models used are understandable to humans, especially regulators and system operators. Techniques are required to interpret and verify the reasoning of the algorithms used in critical processes, as well as mechanisms to draw decisions in complex scenarios and in real time.

Another key aspect is the validation and certification of these solutions. There is a need to develop regulatory frameworks and testing methodologies to assess the performance of AI-based systems both under nominal conditions and in unforeseen situations. This involves the creation of test benches and simulation environments where solutions can be validated in realistic contexts and clear metrics can be defined for acceptance.

The reliability and robustness of AI models also represents a fundamental challenge. Systems must be designed to operate in dynamic environments with minimal human intervention, avoiding biases or errors that could compromise their performance. It is also essential to integrate cybersecurity measures that protect these systems from possible attacks or external manipulations.

Finally, this challenge addresses the integration of AI in the innovation lifecycle, promoting the development of test platforms and test benches that facilitate the transition of prototypes to operational environments in compliance with current regulations. In addition, it seeks to establish strategies for the progressive certification of these systems, allowing their staggered implementation in the ATM ecosystem and ensuring mechanisms for their maintenance and secure updating over time.

Expected impact of the solutions to be developed in this challenge: Solutions are sought to build a regulatory and technological framework that facilitates the safe adoption of AI in the ATM environment and certification. Likewise, it is expected that the results obtained will contribute to generating confidence in the use of these systems in critical operations, establish standardized certification processes at European and international level and optimize the efficiency and capacity of ATM systems without compromising safety or human supervision.

# Challenge 2. Operational Resilience in ATM: Automated Systems Failure Recovery Strategies

## RETURN TO NORMAL IN THE EVENT OF SYSTEM FAILURE AT HIGH LEVELS OF AUTOMATION

Increasing automation in Air Traffic Management (ATM) promises to optimize the efficiency and safety of operations, but also introduces a greater reliance on advanced technological systems. In this context, any failure in automated systems can generate significant disruptions, compromising service continuity and operational safety.

When an ATM system experiences a partial or total failure in its automated components, it enters what are called "degraded conditions". In these situations, the technological infrastructure may not operate at its full capacity or some critical functionalities may be affected, requiring the intervention of redundant systems, emergency protocols or even human supervision to avoid interruptions in service. The system's ability to continue operating safely under these conditions is key to minimizing risks and reducing the impact on air traffic.

To address this challenge, it is essential to develop redundancy and resilience models that ensure service continuity even in the face of partial or total system failures. Having robust architectures that include self-diagnosis and recovery mechanisms will minimize the impact of these disruptions, ensuring that air traffic can be managed with the least possible impact.

Detecting and mitigating failures in real time is another essential challenge in this context. The incorporation of artificial intelligence and machine learning will make it possible to identify anomalous patterns in automated systems, facilitating the prevention and early correction of errors. However, automatic detection is not enough; It is necessary to have strategies that activate immediate responses and allow a smooth transition to a safe state, avoiding the escalation of operational problems.
In a highly automated environment, ensuring efficient interaction between technology systems and human operators is key to operational safety. To do this, it is essential to have "fallback" strategies, i.e. mechanisms that allow the controlled transition from automation to human intervention when a critical failure occurs in the systems. These strategies will ensure that controllers can regain control without creating a disproportionate increase in workload or compromising decision-making under pressure. An effective design of human-machine interfaces will be decisive to facilitate this transition smoothly and safely. In addition, it is essential to have simulation and validation environments that allow different failure scenarios to be tested. Assessing the impact of disruptions and analyzing the effectiveness of response strategies will help optimize system resilience and identify improvements in operational procedures.

On the other hand, cybersecurity plays a key role in the resilience of highly automated ATM systems. The increasing digitalization and connectivity of these systems makes them vulnerable to possible attacks that could compromise their stability and operation. It is crucial to develop advanced protection solutions that enable real-time threat detection and neutralization, ensuring that the integrity and security of the airspace are not affected by cyber incidents.

Expected impact of the solutions to be developed in this challenge: The solutions developed in this challenge will allow the ATM system to be more resilient against unexpected failures, ensuring operational continuity with minimal impact on air traffic management. Advances in this area are expected to contribute to improving the safety and efficiency of the system, allowing for better integration between automation and human supervision.

## Challenge 3. Oversight in ATM: transparency, supervision and control of AI in real time

**ENSURE HUMAN AI "OVERSIGHT" ON THE MACHINE IN REAL TIME. RELIABILITY AND HUMAN SUPERVISION IN ATM AUTOMATION**

The move towards highly automated systems in ATM poses the critical challenge of ensuring that human operators maintain effective control of decisions made by AI. Since these systems can process large volumes of data and react in milliseconds, it is critical that operators understand their actions and have the ability to intervene when necessary. Without this real-time monitoring, confidence in automation could suffer and compromise operational safety.

To meet this challenge, it is imperative to develop explainable AI (XAI) models that allow operators to interpret and audit automated decisions. A system that cannot justify its behavior generates uncertainty and can make it difficult to make decisions in critical situations. Explainability should not only ensure transparency, but also facilitate the traceability of each decision within the ATM system.

At the same time, the design of advanced visualization and alert interfaces is required, capable of presenting relevant information in an intuitive and prioritized way. Automation must be translated into tools that improve the operator's situational awareness, avoiding information overload and ensuring that critical alerts are easily detectable and understandable.

Ensuring real-time intervention capability is another essential pillar for human monitoring in automated environments. It is necessary to develop efficient validation and correction mechanisms, which allow operators to approve, modify or annul automated decisions without

unnecessary delays. Agility in this interaction is key to mitigating errors and ensuring that automation functions as a support, rather than a barrier, in decision-making.

In addition, ATM systems must dynamically adapt to the operator's cognitive load. Flexible automation, able to adjust its level of intervention according to the operational context, will help avoid both over-reliance on AI and overloading controllers. This requires the implementation of strategies that balance human intervention and system autonomy efficiently and safely.
Finally, the implementation of these systems must ensure that human oversight remains a fundamental pillar of aviation safety. The combination of explainability, intuitive interfaces, and adaptability will allow for the right balance between the speed and efficiency of automation and the ability for operator monitoring and control.

Expected impact of the solutions to be developed in this challenge: Advances in this area will allow automation in ATM to be more reliable, transparent and efficient, without compromising human supervision. This will strengthen trust in AI systems, reduce the cognitive load on operators, and ensure that decision-making in air traffic management maintains the highest standards of safety and reliability.

## Challenge 4. ATM Assisted Automation: Digital Assistant for Air Traffic Controllers

### DEVELOPMENT OF A PROACTIVE DIGITAL ASSISTANT FOR AIR TRAFFIC CONTROLLERS

The increasing complexity in air traffic management requires advanced tools that optimize decision-making and reduce the cognitive load of controllers. In this context, the development of a proactive digital assistant represents a key innovation to improve operational efficiency and safety, enabling a more seamless collaboration between the human operator and automated systems.

This challenge poses the creation of an AI-based assistant capable of learning from the beginning of the controller's training, adapting to their routines, decision-making patterns and air traffic management strategies. Throughout the training, the assistant must provide personalized recommendations for conflict resolution, progressively evolving until they are able to anticipate situations and propose autonomous solutions, always under human supervision.

To achieve this, the solution must address the specific challenges of the ATM environment by applying advanced technologies such as generative AI, deep learning, optimization algorithms, and natural language processing. These tools will allow the assistant to not only analyze large volumes of data in real-time, but also to interpret the operational context and adjust its suggestions to the dynamic conditions of the airspace.

One of the fundamental aspects of this development is the assistant's ability to adapt to each controller's style, providing support that complements their skills rather than imposing a generic solution. Assistant personalization should be based on progressive learning, integrating models that identify individual patterns and adjust suggestions based on user experience and performance.

In addition, interaction with the assistant must be intuitive and efficient, which is why the design of advanced human-machine interfaces is required to facilitate the understanding of suggestions and ensure fluid communication. The integration of augmented reality interfaces, voice commands or dynamic visualizations can significantly improve the usability and adoption of this technology in high-pressure operating environments.
Another key challenge is ensuring that the attendee not only learns, but can also justify their recommendations in a transparent manner. AI explainability will be crucial to building trust in the system, allowing controllers to understand the reasoning behind each suggestion and, when necessary, adjust or reject proposed decisions.

The evaluation of the assistant in simulation and operational test environments will be key to validate its effectiveness in realistic scenarios. To this end, it will be necessary to implement validation methodologies that analyse their impact on the performance of controllers, as well as on the efficiency and safety of air traffic. Ensuring effective integration into the ATM ecosystem will require a rigorous approach that avoids compromising human decision-making and reinforces trust in the system.

Expected impact of the solutions to be developed in this challenge: This development will transform the way controllers interact with ATM support systems, offering an adaptive digital assistant that increases operational efficiency and reduces cognitive load without compromising human supervision.

# Challenge 5. Multi-Objective Optimization: Dynamic Balance Between Safety, Capacity, and Sustainability in ATM

## DYNAMIC AND ADAPTIVE MANAGEMENT OF OPERATIONAL PRIORITIES IN ATM FOR AN OPTIMAL BALANCE BETWEEN SECURITY, CAPACITY AND SUSTAINABILITY

Air traffic management faces increasing challenges in optimizing its operations, where multiple objectives must be considered simultaneously. Operational safety remains the non-negotiable pillar of the ATM system, as does cybersecurity when it is directly related to the protection of aviation safety. However, other factors such as capacity, environmental sustainability and economic efficiency can be managed with a degree of flexibility, allowing the exploration of operational balances depending on the conditions and priorities of the moment.

Current operational scenarios require decision-making models that are not based on a single criterion, but on a broad set of interdependent factors. At certain times, an air navigation service provider may prioritize maximizing capacity to absorb a peak in demand, even if this means higher operating cost and environmental impact. In other contexts, the priority might be to reduce environmental impact, which may lead to decreased capacity and increased delays.
To meet this challenge, it is essential to develop multi-objective decision and optimization models that allow the different operational criteria to be dynamically managed. The flexible assignment of weights to each objective will allow the ATM system to be adapted to different strategic needs, ensuring that operating modes can be adjusted according to factors such as traffic, weather conditions, regulatory restrictions or sustainability policies.

The development of these models requires the application of advanced techniques such as mathematical optimization, artificial intelligence, evolutionary algorithms and machine learning, capable of evaluating large volumes of data in real time and offering recommendations adapted to changing scenarios. These solutions should be able to manage conflicts between objectives and provide balancing strategies that maximize efficiency without compromising safety.

Another key aspect is the integration of decision support tools that make it easier for ATM system operators to interpret the different scenarios and their implications. Intuitive interfaces and dynamic visualizations will allow for a better understanding of the trade-offs between capacity, costs, and sustainability, facilitating informed decision-making in real time.

In addition, the validation of these models in simulated environments will be essential to measure their effectiveness and ensure their applicability in the operational management of

air traffic. The evaluation of different scenarios will allow multi-objective optimization models to be adjusted so that they can be integrated into strategic and tactical decision-making within the ATM ecosystem.

Expected impact of the solutions to be developed in this challenge: The development of multi-objective optimization tools will contribute to a more flexible and adaptive ATM, where decision-making can be adjusted to the needs of the moment without losing sight of safety and sustainability objectives.

# 4. Conditions of participation

University research groups or any other type of research (such as research centres) that meet the following requirements may participate:

- Accept the commitment to participate in the 18-month research agreement, which represents the prize of this competition.
- Demonstrate proven ability in the field described in the challenge.
- Duly fill in the information required in the registration form, within the period established in these rules.
- Submit an original project that does not infringe the industrial or intellectual property rights of third parties and that does not transmit or disseminate illegal, defamatory, offensive content or content that violates the values and dignity of people.
- Not be an employee of CRIDA or ENAIRE.

Each contestant will be responsible for the veracity of the data provided and will be solely legally responsible for any controversy that may arise due to non-compliance with the law regarding intellectual and/or industrial property rights.

Contestants give up the necessary rights to film, photograph the presentations, use the images of the contestants and the presentations for communication purposes. They also authorise the use of the material presented and obtained during the competition for the preparation and dissemination of newsletters, press releases, social networks, blogs, etc., for promotional and communication purposes.

The organisers of the Technology Challenges in Air Traffic Management Competition reserves the right to exclude from the competition all those contestants who do not meet the requirements established in these rules or provide false, incomplete or unauthorised data, in particular, discarding those contestants who do not have potential application in the field of the provision of air traffic or transport services.

# 5. Documentation to be submitted

Each contestant must complete the registration document available for download on the contest website, emphasizing the description of the proposed solution, on the contest website, where questions will be asked about their solution to any of the technological challenges proposed in section 3 of these rules.

# 6. Evaluation criteria

The solutions presented will be evaluated based on the quality of the information provided in the registration form according to the following evaluation criteria, which can be classified into three groups:

## 6.1. Technicians (maximum 60 points)

ADAPTATION TO THE CHALLENGE (20 points): The degree of adaptation and the effectiveness of the solution to solve any of the proposed challenges will be assessed.
APPLICABILITY (5 points): The degree of application of the proposal will be assessed.
VIABILITY (15 points): The technical, time-bound and economic ease of deployment of the solution after the research phase will be assessed.
DEGREE OF INNOVATION (10 points): The degree of technological disruption will be assessed.
OPERATIONAL IMPACT (10 points): The benefits provided by the solution will be assessed.

The organization may consider the disqualification of a contestant if he or she obtains a total score of less than 40 points in this block.

## 6.2. About the research group (maximum 30 points)

TEAM COMPOSITION (15 points): The profiles of each of the team members who are going to participate in the research phase, their areas of knowledge, as well as other available profiles that can add value will be assessed.
PROJECTS EXECUTED BY TEAM MEMBERS (15 points): Projects carried out by a team member related to the challenge and the solution will be valued.

The organization may consider the disqualification of a contestant if he or she obtains a total score of less than 15 points in this block.

## 6.3. Final presentation (maximum 10 points)

FINAL PRESENTATION (10 points): Criterion only applicable to the finalist solutions that have obtained the highest score in the criteria described in sections 6.1 and 6.2 of these rules. The clarity of the explanation in the presentation of the solution will be valued, as well as in the answers provided to the doubts that the Selection Committee may have. Additionally, it should be mentioned that, after the clarifications obtained in the presentation, the Jury may reevaluate some of the previous scores.

The organization may consider the disqualification of a contestant if he or she obtains a null grade in any of the blocks or a total score of less than 50 points.

Judging will be confidential and will not be shared with contestants.

# 7. Selection and Jury Committee

**Selection Committee**: composed by the work team of open innovation consultants of UTE AD-SILO, which has extensive experience executing entrepreneurship promotion programs and integrates profiles from the fields of strategy, business, innovation and technology. Its functions will be to collect information on the candidatures and pre-select those that meet the criteria for admission to the competition.

**Jury**: composed by professionals from the fields of entrepreneurship and innovation in the Air Traffic Services sector, both from the UTE AD-SILO, as well as from CRIDA and ENAIRE.

# 8. Phases of the competition

## 8.1 Submission of proposed solutions

Contestants must submit their applications by completing the template documentation available on the retos.enaireopeninnovation.com competition website and sending it by email to retostecnologicos@enaireopeninnovation.com

The deadline to complete the form is **June 30, 2025 at 23:59h CET time (UTC+1)** (the organization reserves the right to extend the deadline).

## 8.2 Evaluation of proposed solutions

The Selection Committee will analyze all the applications received and will select the finalists according to the evaluation criteria described in section 6 of these rules.

The evaluation of the proposals will end on **September 30, 2025**.

## 8.3 Submission of finalist proposals

Once the finalist solutions have been selected, a final event will be held in October in which the finalist research groups will have the opportunity to present the solution proposed and the Jury will evaluate them and may ask questions to clarify any point that needs further explanation.

The duration of the presentation and clarifications to the questions raised by the Jury will be one hour.

## 8.4 Selection, notification and acceptance of the challenge

**On 31 October 2025**, the two winning research groups of the competition will be notified of the aforementioned condition through their email address provided in the registration form.

After the selection of the winning solutions, the winning research groups will have five (5) working days to contact the organization through the info@enaireopeninnovation.com email and expressly express their willingness to accept the challenge.

The organization will have two months, November and December, to draft a research agreement between CRIDA and the entity identified in the winning proposal as the sole responsible for it. Any collaboration and/or subcontracting will be part of the internal organization of the researchers, although CRIDA must be informed of its terms.

## 8.5 Winning solution research phase and follow-up

The research work will begin from the date of signing the agreement and will have a duration of 18 months.

At the beginning, each winning research group must generate a report detailing the specific scope of the activities, the planning of the activity and the resources initially involved. All reports must be expressly accepted by the parties and signed.

Periodic follow-up meetings will be held (at least quarterly) and, additionally, when agreed between both parties. Each winning research group will keep a record of the action points agreed upon at all these meetings, as well as their status.

These meetings will address both management and technical monitoring aspects of the activities that are being carried out to ensure that the action plans are developed as planned.

Close collaboration activities are planned to ensure the correct monitoring of the project. Any proposal to carry out these activities (preparation of reports on technical results achieved – periodic or not – face-to-face or telematic meetings, emails, etc.) will be positively valued.

At the end of the research phase, each winning research group will present the final result of the research, which, according to its proposed solution, must consist of a feasibility study of the possible solution and/or presentation of a prototype.

# 9. The Prize

The winning research groups of the competition will sign a research agreement with a duration of 18 months with an amount of €60,000 (VAT not included), of which €40,000 will be delivered in 2026 as an advance and €20,000 in 2027 after the closure of the activities. This agreement will be signed exclusively by CRIDA and by the leading University/Company in case the winner belongs to a group. The objective is to develop the proposed solution to demonstrate its suitability and technical and economic feasibility.

Payments will be settled by Science & Innovation Link Office, S.L. in the bank account indicated by the winner and will be subject to the legally established withholding (if applicable), upon the presentation of an initial report of the activities and expected results as an advance (2026) and a closing report detailing the results achieved (2027). Once the organization accepts the reports, the corresponding payments will be made.

In addition, it is expected to have periodic reports prepared by the winning groups detailing the expected scope and the results achieved in each task.

If any of the winners rejects their prize, the prize may be offered to the contestant who has been in the directly lower position in the evaluation phase. The prize may be void if the Jury so decides.

# 10. Acceptance of the rules

The contestants, by their mere participation, declare that they are aware of and accept these rules in their entirety. All contestants expressly waive the right to challenge any of the decisions of the Selection Committee and the Jury.

Nominations are free and voluntary. Participation in this call implies full acceptance of these rules and the explicit waiver of any subsequent claim, so participants are obliged to strictly comply with them at all times.

Failure by any participant to comply with these Terms and Conditions will result in the automatic cancellation of participation.

CRIDA/ENAIRE reserves the right to modify these terms and conditions. Likewise, it reserves the right to modify the mechanics of participation, as well as the reward to the winning research group.

These modifications will be made with criteria of total impartiality and CRIDA/ENAIRE will notify the participants sufficiently in advance by means of notification through their contact email. In the event that the participant does not indicate his/her willingness to desist from participating in the contest, it will be understood that he/she accepts the new rules.

# 11. Intellectual Property

The participants of the contest will be responsible for their idea and will maintain the intellectual and industrial property of the ideas they submit.

# 12. Duty of information: data protection

In accordance with the GDPR and the LOPDGDD, the UTE AD-SILO **will process the data** provided in order to be able to manage your **registration and participation** in the Competition.

Your data will only be used by the UTE AD-SILO and **will not be transferred to third parties**, except for compliance with legally established obligations. However, the identification of the finalists and also the winners **will be published** on the **website** of the Competition, of the UTE AD-SILO and of CRIDA and its subsidiaries or partners, and on their respective social networks, in accordance with the legislation on transparency. Your **image and voice may also be published** with your consent. Your data will be kept during the edition of the contest and as long as legal responsibilities may arise from its realization.

The **consent** of the person concerned may be withdrawn at any time. In any case, the interested parties may exercise their rights of access, rectification, deletion and others recognized by law, **by sending their request** in writing to the email address info@silocompany.com, or by postal delivery to the address Claudio Coello 52, Planta 1ª 28001 Madrid.

Under the provisions of the General Regulation (EU) 2016/679 on Data Protection, we inform you that the personal data you may provide us with will be processed under the **responsibility** of SCIENCE & INNOVATION LINK OFFICE, S.L, with address at C./ de Claudio Coello, 52, Planta 1, 28001 Madrid, (Community of Madrid) in order to provide you with our professional services.
You can exercise your rights of **access, rectification, deletion, limitation, opposition and portability** at any time, in writing, accompanied by a copy of an official document that identifies you, addressed to raul.sanchez@silocompany.com or to the email info@silocompany.com. You can consult additional and detailed information on Data Protection on our website https://www.silocompany.com/

In the event of rights requests, the data controller will carry out the **appropriate and necessary inquiries** to verify and ensure your identity.

In the event that you feel that your rights regarding the use of your personal data have been violated, you can file a **complaint** with the competent Data Protection Supervisory Authority (**Spanish Data Protection Agency**), through its website: www.aepd.es.
You can request more information about the processing of your personal data by emailing info@silocompany.com. For more information, please access the privacy policy available on the Contest website.