1 Description of the use case

1.1 Name of the use case

ID	*Application Domain(s)*	*Name of Use Case*
UC.ATM.1	Air Traffic Management	Airspace sectorisation assistant

1.2 Version management

Version Management			
Version No.	*Date*	*Name of Author(s)*	*Changes*
0.1	04.12.2023	Clark Borst (TUD)	Initial document
0.2	15.01.2024	Clark Borst (TUD)	Major revision
0.3	03.02.2024	Ricardo Bessa	Revision
0.4	26.02.2024	Cristina Félix	Revision
1.0	15.04.2024	Cristina Félix	Final revision with new KPI's and ATM Workshop feedback update
1.1	12.05.2024	Clark Borst	Update scenario details with steps
1.2	14.06.2024	Anna Fedorova	Update
1.3	19.06.2024	Cristina Félix Joaquim Geraldes Tiago Lima Reis	Final Revision
1.4	08.07.2024	Ricardo Bessa	Final version

1.3 Scope and objectives of use case

Scope and Objectives of Use Case	
Scope	Air traffic density in European airspaces is steadily increasing. At the same time, pressing economic and environmental concerns force a fundamental shift towards time- and trajectory-based air traffic operations. Taken together, increased traffic loads and operational complexities may eventually drive the workload peaks of the tactical air traffic controller (ATCO) beyond acceptable thresholds, threatening the overall safety of the Air Traffic Management (ATM) system and hindering a smooth transition toward a sustainable future of ATM. Solutions to manage the workload of ATCOs can already be applied in pre-tactical phases, for example, by splitting a large Flight Information Region (FIR) into several smaller airspace sectors that each are under the control of a single ATCO. Generally, pre-tactical ATM Sector Management ensures optimal sector configurations are always used to split traffic (and workload) over more ATCOs during tactical operations. Sectorisation is primarily meant to better handle daily traffic fluctuations, making optimal use of the personnel available. Today, sectorisation is the sole responsibility of the ATC supervisor, who exclusively decides *when* and *how* to split and merge sectors best, warranted by situational demands and available ATCO personnel. Only scattered information is available on different platforms to aid supervisors in this task. Still, there is currently no traffic pre-analysis tool and/or integrated decision-support system to assist in or even fully automate the sectorisation process.
Objective(s)	The system's objective is to partially and fully automate the sectorisation process to assist or replace the ATC supervisor in deciding when and how to split and merge sectors to balance the workload of tactical ATCOs.

1.4 Narrative of use case

Narrative of Use Case

Short description
At ATC centers, such as Santa Maria Oceanic Area Control Centre (OACC), as part of NAV Portugal ANSP, a staff manager (i.e. ATC supervisor), exclusively decides *when* and *how* to split best and merge sectors, warranted by situational demands and available ATCO personnel. The degrees of freedom in sectorization involve considering horizontal (2D geometry) and/or vertical (altitude) constraints and can thus result in split sectors horizontally and/or vertically. Typically, under nominal conditions, the supervisor can install several pre-fab sectorization options. However, unexpected events, such as deteriorated weather conditions, flight emergencies (e.g., aircraft equipment failure), and unscheduled ATC personnel shortages (e.g., due to sickness) may require non-standard sectorisations to be installed. An AI-assistant, capable of operating under various levels of automation, will provide recommendations or even execute decisions on how to split the sector best horizontally, vertically, or both to balance ATCO workload while ensuring safety (i.e., adhere to horizontal and vertical separation criteria) and efficient traffic flows (i.e., reduce inefficiencies in flown track miles). The AI-assistant will also act in a bidirectional way by allowing the human operator to nudge the AI-generated recommendations in directions that seem more favorable.
Complete description
Description of the sectorization task: Sectorisation involves retrieving and integrating several data information sources that are often gathered from different (digital) platforms, such as: • Expected traffic counts (available from EUROCONTROL CFMU) • Air-ground and coordination message count • Weather Information (METEO fore- and now casts) • Airspace Reservations (e.g., military airspace, temporary 'no-fly' zones) • Coordination Complexity (e.g., between area and arrival controllers) • Terminal Area Complexity (e.g., weather-related airport capacity limitations) • Equipment issues (e.g., communication issues between pilots and air traffic controllers) • ATCO staff schedules (depending on traffic demands) Based on the available ATCO personnel, including accounting for mandatory breaks after a 2.5-hour work cycle, the FIR is divided into several smaller airspace sectors, each under control by a single ATCO. How and when to best split and merge sectors horizontally and/or vertically depends on how well the traffic situation can be predicted over a specific time horizon. In general, the shorter the prediction horizon, the less uncertainty plays a role, but the more ad-hoc fluctuations in sectorisations can be expected with changing traffic loads. Therefore, a successful sectorization should be predictable and robust over a sufficiently long time horizon. At Santa Maria Oceanic Area Control Centre (OACC), as part of NAV Portugal ANSP, there are 3 pre-defined sectorization plans to be used by the supervisor under nominal operational conditions: 1. **Unified Position**. Used in low traffic and/or complexity situations – one ATCO is responsible for working the full airspace. 2. **VHF sector and non-VHF sector**. Used medium/high traffic and/or complex situations. This sectorization is used mostly when there is much terminal traffic or high volume inside the VHF coverage area. If the situation justifies, there is the possibility to vertically split the non-VHF sector into several sectors to adjust the workload accordingly. The supervisor can also horizontally split the VHF sector into 3 different zones. 3. **North sector and South/Planning sector**. Used in medium/high traffic and/or complex situations. This sectorization is used mostly in low terminal traffic or low volume inside the VHF coverage area but high frequency of inbound coordination messages. If the situation justifies, there is the possibility of removing the VHF sector, creating 1 north sector, 1 south/planning sector, and 1 VHF coverage sector. In any of the examples above, the staff manager can split the South sector into several vertical sub-sectors. There might exist more unexplored sectorization options, especially for novel/off-nominal operational conditions. In addition, the ATM community expects ATC staff shortages in the near future, requiring more flexibility in sector organisations. A hybrid AI system, based on supervised and unsupervised AI methods, could predict and provide sectorization solutions for nominal and off-nominal situations by learning from historical data and exploring new sector structures based on synthetic data generation. **System description and role of the human operator:** The sectorization task is performed in a highly automated manner by an AI-based system. This system automatically observes the real-time data from all relevant ATM platforms, makes predictions on how and when to sectorise, and implements prediction results either as recommendations (to the human supervisor) or automatically installs the sectorization plan and bypasses the human. The AI system can be considered a new tool supervised and evaluated by a human expert. The AI system communicates its decisions on an auxiliary display that, for example, visualises sector configurations on a map-like interface.

The role of the human operator (here, the ATC supervisor) is to evaluate the AI-based recommendations by requesting additional information and explanations, accepting or rejecting advisories, and nudging AI decisions in a different direction by manual interventions. All decisions and interactions will be logged, allowing the AI system to learn from human preferences continuously.

Steps involved in the use case. The following steps are performed in the ATM sectorization use case:

1. **Definition and identification of the critical system parameters.** Here, the relevant ATM system and contextual data needed for the sectorization task are gathered from (various) digital ATM platforms and integrated into a coherent, time-stamped "feature space" that drives sectorization predictions. Training and validation of the AI system are based on historical and synthetic/artificial data.
2. **Sectorisation implementation**: Based on predicted traffic, environment, and staffing conditions, a sectorization plan is predicted. The solution is presented to the human supervisor as a recommendation on an auxiliary interface. When the AI system acts at a lower level of automation, the human supervisor manually implements the sector plans. At higher levels of automation, the AI recommendations are executed based on "management by consent" (= AI implements only when the human accepts) or "management by exception" (= AI implements, unless the human vetoes). At the highest level of automation, the AI system automatically implements, and the human can only revise the system's decisions afterward.
3. **Triggering sectorization revisions**: (Significant) changes in traffic loads, environment conditions, and staff availability can all trigger sectorization revisions. Parameters and thresholds warranting revisions will need to be defined and should be configurable for operational scenario generation.
4. **Human review and adjustment**: Depending on the level of automation set for the AI system, the role of the human supervisor ranges from manually implementing a sectorization plan to revising AI-implemented plans (see step 2). Humans can consult additional information and explanations underpinning AI's decisions on demand, which is expected to foster trust in and acceptance of the AI system. As all human interactions are recorded, data will become available on what type of explanation is used most frequently and how certain explanations impact the acceptance of AI decisions. Such data can be used to improve the combined human-AI team performance.

Stakeholders

ATC staff manager/supervisor: Staff manager/supervisor located at the operational control room, responsible for the sectorization task.

ANSPs responsible for the FIR: e.g., NAV Portugal, the Portuguese Air Navigation Service Provider (ANSP), responsible for the Santa Maria Flight Information Region (FIR) and the Lisbon FIR.

Other ANSPs: Neighboring ANSPs, connected to the NAV FIRs (e.g., ONDA (Morocco) and ENAIRE (Spain)).

Tactical Air Traffic Controller: A single human ATCO responsible for maintaining safe, efficient and expeditious flows of air traffic within a single airspace sector.

Airlines and pilots: Airlines for adhering to planned operations; flight crew responsible for a safe and efficient execution of a planned flight.

Stakeholders' assets, values

ATC staff manager / supervisor

- Available personnel: low-quality AI predictions may yield infeasible sectorization solutions (e.g., insufficient ATC personnel to handle all sectors)
- Reputation: low performance of the AI system can lead to a bad reputation of the supervisor in devising workable and acceptable sectorisations (e.g., adhering to the mandatory ATCO breaks and preserving stability of a sectorization decision within a time window)

ANSPs (incl. NAV and neighboring ANSPs)

- Reputation: ability to maintain efficient airspace usage and ability to coordinate traffic flows with neighboring FIRs
- Safety: AI system recommendations should avoid creating traffic hotspots

Tactical Air Traffic Controller (ATCO)

- (Mental) workload and Situation awareness: AI-recommended sectorization should balance traffic loads in ways that adhere to acceptable workload limits and enable ATCOs to maintain situation awareness

Airlines and pilots

- Reputation: adhering to planned flights while reducing inefficiencies in flown track miles, possibly leading to delays

System's threats and vulnerabilities

Accountability: who is responsible for the bad performance of the AI system

Unexpected events: Air traffic operations can be affected by events related to unexpected weather (e.g., local adverse weather cells, off-nominal wind conditions), flight emergencies (e.g., aircraft equipment failure), and unscheduled ATC personnel shortages (e.g., due to sickness). The scale of such events could lead to invalid or no solutions at all, for example, in the event of a volcano eruption or hurricane that requires closing off one entire airspace.

Quality of data exchange infrastructure: To ensure optimal decision-making, access to high-quality, real-time data will be required. Currently, information is scattered over various ATM systems, requiring a sufficiently robust IT infrastructure that can distribute data over the network to and from various Air Traffic Service (ATS) units. Delayed and uncertain information could negatively impact the quality of decisions.

1.5 Key performance indicators (KPI)

Name	*Description*	*Reference to the mentioned use case objectives*
Acceptance score	Measure of acceptance degree of the generated AI solution for human operators	Reflects the acceptance choice in the AI's system decision. (0% - 100%). Measured directly from yes/no/revision input, translated into % across the operator's multiple interactions with AI generated solutions
Agreement score	How much the supervisor agrees with the AI-generated sectorisation. Note: agreement and acceptance are not the same. One can accept a solution but not necessarily agree with it. A good system fosters a high-level agreement	Reflects the agreement degree of the AI system. (Likert, 7-points scale)
Trust in AI solutions score	How much of the operator's confidence in the AI-generated solution, with and without the need for additional explanations.	Reflects the trust in the AI's system decision. (Likert, 7-points scale)
Decision Support satisfaction	System effectiveness in supporting the efficient decision making by airspace managers	Reflects the effectiveness of the AI system. (Likert, 7-points scale)
Efficiency score	How many times an AI-generated solution was revised. A good system would minimise the number of human interventions.	Reflects the efficiency of the combined human-AI team performance. (0% - 100%). Measured directly from user input (was the solution modified? yes/no), translated into % across the operator's multiple interactions with AI generated solutions
Significance of human revisions	The extent of human revisions compared to the AI decision. Here, small, localized revisions (e.g., merging two small adjacent sectors in the northeast corner of the FIR) would be rated differently from larger or multiple revisions across various areas in the FIR.	Reflects the AI system performance. (LOW, MED, HIGH interaction %). Measured directly from user input (of the modified solutions, how much interaction was measured? LOW number and extent of changes, MEDIUM number and extent of changes HIGH number and extent of changes), translated into % across the operator's multiple interactions with AI generated solutions
System Reliability	System trustworthiness - operation as expected under several conditions without major failures.	Reflects the efficiency of the combined human-AI team performance. (0%-100%). Measured directly from how many times the AI generated solutions are sound or lead to failures

AI prediction robustness	How accurately and robustly does the AI system predict a certain sectorisation over a certain time horizon. Does re-evaluation of the sector structure in a shorter time horizon lead to different solutions? It is undesirable if small variations in capacity lead to significant differences in the sector structures/routings.	Reflects the efficiency of the combined human-AI team performance. Measured directly from the AI generated solutions. How big a variation in capacity has to be to cause the AI to revise its previous solutions.
Prompt demand rate	Assess how many times the ATCO prompts additional explanations from the AI generated solutions.	Reflects the AI system performance. (LOW, MED, HIGH interaction %) Measured directly from user input (how much interaction with explanations occurred and how the generated scenario is rated using the 'dynamic density index', measuring complexity), translated into % across the operator's multiple interactions with AI generated solutions
AI co-learning capability	Does the ATCO feel that by the end of the trial runs, the AI has learned his preferences?	Links to the desired output of the AI system. (Likert, 7-points scale).
Human Response Time	Needed response time to react to AI advisory/information	(LOW, MED, HIGH response time %). Measured directly from user input (dismiss a window when they feel satisfied after evaluating a scenario, LOW less than 5 min, MEDIUM 5-10 min, HIGH more than 15 minutes), translated into % across the operator's multiple interactions with AI generated solutions.

1.6 Features of use case

Task(s)	Planning, prediction, optimisation, interactivity, recommendation.
Method(s)	Supervised Learning (e.g., ensemble decision trees) and possibly Reinforcement learning.
Platform	BlueSky digital environment.

1.7 Standardization opportunities and requirements

Classification Information
Relation to existing standards
ISO/IEC 23894:2023, Information technology — Artificial intelligence — Guidance on risk management. Autonomous management and optimisation of sectorisation in pre-tactical ATM operations are high-stake tasks, and therefore, risk management specifically related to AI is fundamental. **ISO/IEC 38507:2022**, Information technology — Governance of IT — Governance implications of the use of artificial intelligence by organisations. Autonomous AI requires an analysis of governance implications and also a redefinition of the organization structure. **ISO/IEC 24029-2:2023**, Artificial intelligence (AI) — Assessment of the robustness of neural networks — Part 2: Methodology for using formal methods. Since artificial neural networks can be a component of the autonomous AI system, formal methods to assess the robustness properties of neural networks are fundamental to certify and monitor autonomous systems. **ICAO DOC 4444** – Standards and recommended practices in Air Traffic Management **ERNIP Part 3** – EUROCONTROL Procedures for Airspace Management, Airspace Management Handbook for the Application of the Concept of the Flexible Use of Airspace. https://www.sesarju.eu/masterplan2020 - European ATM Master Plan
Standardization requirements
Establish a standard set of KPIs for measuring the performance of AI-based sectorisation systems and how the AI performance compares to heuristic methods in prediction and planning systems.

1.8 Societal concerns

Societal concerns
Description
Increased air traffic density in Europe: The challenge of maintaining safe and efficient air traffic management under increased traffic loads, while adhering to the workload capacity limits of tactical ATCOs. **Privacy and data protection**: The use of AI in ATM sectorisation involves the collection and analysis of large volumes of data, including potentially sensitive information. There is a concern about how data is stored, processed, and protected, especially in compliance with data protection regulations like GDPR. **Transparency and accountability**: There is a societal demand for transparency in how AI systems make decisions, especially in high-stake transportation systems like ATM. The public might be concerned about the lack of understanding of AI decision-making processes and the accountability mechanisms in place in case of failures or errors. **Employment and skill shift**: The full automation of the sectorisation task might lead to concerns about job displacement and the need for reskilling of ATC staff. While AI can optimise operations, it also changes the nature of work, requiring a shift in skills for human operators who now need to oversee and interact with advanced AI systems. **Public trust and acceptance**: For the successful implementation of AI in air transportation, gaining and maintaining public trust is crucial. There may be apprehensions and resistance from the public regarding the shift to AI-driven systems, especially among those accustomed to traditional methods.
Sustainable Development Goals (SGD) to be achieved
SGD9. Industry, innovation and infrastructure / SGD11. Sustainable cities and communities / SGD13. Climate action

2 Environment characteristics

Data characteristics	
Observation space	Partially observable. Data update is near real-time with a certain look-ahead time (minutes up to hours). Domain: defined on a continuous space. Size: > 2000 flights per day, with > 10 observable states per flight, > 8 sectors with > 20 coordination points (entry and exit points) per sector. . Noise: The observation of flight and sector data can be noisy due to unsynchronized update frequencies and data quality of various data platforms (e.g., meteo updates).
Action space	Mixed action space: sectorisation decisions are discrete (e.g., 'split' and 'merge'), but sector geometry can vary on a continuous space depending on the algorithmic approach. Size: The action space of the human ATC staff manager is limited to the number of sectors to choose from and depends on ATCO staff availability, the number of flights and the weather condition (determining geographic restrictions) Time horizon: sectorisation actions range typically from a few minutes to a couple of hours (= pre-tactical operations)
Type of task	Human staff manager and AI assistant act in a sequential environment: the previous decisions can affect all future decisions. The next action of these agents depends on what action they have taken previously and what action they are supposed to take in the future.
Sources of uncertainty	Stochastic (weather forecasts, variability in traffic load, unpredicted ATCO staff shortage.)
Environment model availability	Yes (aircraft performance models, ISA standard atmosphere)
Human-AI interaction	Co-learning between the human and AI: AI assistant proposes a sectorization plan, human evaluates plan, and human accepts or revises the plan (= feedback to AI assistant).

3 Technical details

3.1 Actors

Actor Name	*Actor Description*
Staff supervisor	The human staff supervisor is responsible for implementing a sectorisation plan on a pre-tactical time scale. The staff supervisor needs to evaluate the outputs of an AI assistant that aims to support the staff manager in generating sectorisation suggestions.
AI assistant	The AI assistant provides sectorisation plan suggestions to the staff supervisor. It takes predicted information about the environment from various systems (e.g., weather forecasts from METEO services, traffic loads from Central Flow Management Unit, ATCO staff schedule, etc.) and historical data to aid the human staff manager. In the training phase, it can act on the environment to evaluate its recommendations. In the evaluation/testing phase, the actions on the environment should be performed by the human only.
Environment	The staff manager interacts with the BlueSky digital environment and with the AI assistant through a secondary interface. The AI assistant can also portray its sectorisation recommendations directly in the BlueSky environment (top-down Earth map).

4 Step-by-step analysis of use case

4.1 Overview of scenarios

Scenario conditions					
No.	**Scenario name**	**Scenario description**	**Triggering event**	**Pre-condition**	**Post-condition**
1	Nominal operational conditions	The AI sectorisation system responds to predicted traffic fluctuations under nominal operational conditions. Variations in traffic loads over a typical day (24-hours) will be used as inputs.	Fluctuations in traffic load over 24 hours, including periods of inbound and outbound of Santa Maria FIR.	Nominal ATCO staffing capacity	System proposes and/or executes acceptable sectorisation results and presents results on an auxiliary interface for the human supervisor to evaluate.
2	Environment perturbations	This scenario deals with sudden changes in airspace availability due to adverse weather conditions of different magnitudes/scales, impacting sectorisation results.	Over a 24-hour period, various durations and scales of weather-related perturbations (e.g., off-nominal wind conditions due to storms) may require off-standard sectorisations.	Nominal ATCO staffing capacity	System proposes and/or executes off-standard sectorisation results and presents results on an auxiliary interface for the human supervisor to evaluate.
3	ATCO staff shortage	This scenario deals off-nominal ATCO staffing capacities, impacting sectorisation results.	Over a 24-hour period, various perturbations in ATCO staffing capacities (e.g., due to sickness) will require off-standard, yet acceptable sectorisations. These events may be used in conjunction with environmental perturbations, simulating edge-case situations.	Off-nominal ATCO staffing capacity	System proposes and/or executes off-standard sectorisation results and presents results on an auxiliary interface for the human supervisor to evaluate.

4.2 Steps for all scenarios

For each scenario the number of steps are the same and in-line with current practices in sectorisation on medium- to long-term time scales.

Step no.	Event	Name of process/ activity	Description of process/ activity Service	Information producer (actor)	Information receiver (actor)	Information Exchanged

1	Start	The staff manager prepares his/her shift	Staff manager looks at estimated traffic counts, and operational conditions, and using his experience decides the sectorization plan. He/She looks at available ATCO staff during a shift, selects a maximum time horizon for a sector plan and enters that information into the system.	Staff manager	AI assistant	SET
2	Initialise sector plan	AI assistant generates an initial sector plan	The staff manager requests an initial sectorisation plan from the AI assistant. This plan includes portraying a horizontal and vertical sector layout on a map and/or secondary interface, timeline showing ATCO staff occupancy per sector, time slider enabling the staff manager to preview changes in sectorisation plans on a map. The predicted state of the system in terms of traffic movements and weather condition (e.g., wind) is also displayed and responsive to the time slider.	AI assistant	Staff manager	SPLAN
3	Plan evaluation	The staff manager evaluates the sector plan	The AI assistant may propose several alternative sector plans, each with a different probability value (based on historical data) and robustness score depending on available ATCO staff, fluctuations in predicted traffic load, and uncertainty in weather forecasts. Using the time slider, the staff manager can evaluate the probability and robustness scores for different times within the maximum look-ahead time horizon.	AI assistant	Staff manager	STATE
4	Human interacts	The staff manager interacts with the sector plan	The staff manager interacts with the suggested sector plan in one of the following ways: 1) accept the top-rated AI suggestion and implement it; 2) nudge the AI suggestions by making small changes (e.g., one merge or split); 3) revise large sections of the plan (e.g., revise multiple sectorisation events across various time horizons).	Staff manager	AI assistant	DEC

5	Re-schedule	Trigger an alert to re-schedule	The AI assistant monitors changes in predicted system and environmental states. When updated information deviates from the information and data that was used for the implemented sector plan, the AI assistant issues an alert, triggering the staff manager to go back to Step 2.	AI assistant	Staff manager	AL

5 Information exchanged

Information exchanged (ID)	Name of information	Description of information exchanged
SET	Inputs and settings for AI assistant	Staff manager sets maximum time horizon and ATCO staff availability for the AI assistant
SPLAN	Sector plan	AI assistant suggestions for sectorisation.
STATE	Predicted system state	Predicted system state over a certain time period, including: traffic load, weather conditions, ATCO shifts, sector topology, probability and robustness score.
DEC	Human decision / interaction with the AI assistant operator	Staff manager's choice in terms of accept, nudge and revise.
AL	AI assistant alert	AI assistant issuing an alert, signaling to the staff supervisor that data used for predictions have changed significantly, warranting re-scheduling.

6 Requirements

Requirements		
Categories ID	**Category name for requirements**	**Category description**
Ro	Robustness	Encompasses both its technical robustness (ability of a system to maintain its level of performance under a variety of circumstances) as well as its robustness from a social perspective (ensuring that the AI system duly considers the context and environment in which the system operates). This is crucial to ensure that, even with good intentions, no unintentional harm can occur. *Source: EU-U.S. Terminology and Taxonomy for Artificial Intelligence. First Edition*
E	Efficiency	Ability of an AI system to achieve its goals or perform its tasks with optimal use of resources, including time, computational power, and data.
I	Interpretability	Make the behaviour and predictions of AI systems understandable to humans, i.e., degree to which a human can understand the cause of a decision. *Source: Molnar, Christoph. Interpretable machine learning. Lulu. com, 2020*.
Re	Regulatory and legal	The AI system's capacity to meet its objectives while complying with relevant laws, regulations, and ethical standards.
O	Other	Other non-function requirements related to environmental concerns and maintenance
Requirement R-ID	**Requirement name**	**Requirement description**
Ro-1	System resilience to unexpected events	The AI system should work correctly under a variety of conditions and withstand operational disruptions. This includes resilience to unexpected events like adverse weather, and sudden changes in the ATCO staff availability.
Ro-2	Cyber and data security	Focuses on protecting the system against unauthorized access, cyber threats, and data breaches. This ensures the integrity and confidentiality of sensitive operational data and safeguards the system from malicious attacks.
Ro-3	System's reliable operation and decisions	Shall show the capacity to perform its required functions under stated conditions for a specified period. This includes maintaining consistent

		performance and minimising system failures or errors.
E-1	Capability to optimise resources and operations	System shall maximise airspace and ATCO staffing utilisation.
E-2	Scalability	Concerns the system's ability to handle growth in traffic loads, such as increased air traffic or airspace expansion, without performance degradation. This ensures the system remains effective as the scale of ATM operations increases.
I-1	Provide clear, understandable explanations for its decisions	It is crucial for human operators to validate and trust the AI's decisions, especially in complex sectorisation scenarios.
I-2	Usability of the system from the human and other stakeholders' perspective	Should include intuitive interfaces, ease of use, and effective communication of information.
Re-1	Compliance with legal standards and regulations	Adherence to data protection laws, safety regulations, and ethical guidelines governing AI systems in public transportation and the EU AI Act.
O-1	Maintainability	Involves the ease with which the system can be maintained and updated. This includes the ability to diagnose and fix issues, update software, and adapt to changing operational requirements.
O-2	Environmental Sustainability	Addresses the system's impact on the environment. This includes considerations such as energy efficiency of the AI algorithms, and the broader ecological footprint of the system's implementation and operation.

7 Common Terms and Definitions

Common Terms and Definitions	
Term	**Definition**
Air Traffic Controller (ATCO)	Human operator, responsible for directing air traffic through a volume of airspace in safe (i.e., maintain separation standards) and an efficient manner (i.e., expediting flow of traffic, reducing delays and avoiding inefficiencies in flow track miles).
Air Navigation Service Provider (ANSP)	Organisation that provides the service of managing the aircraft in flight or on the maneuvering area of an airport and which is the legitimate holder of that responsibility. In this use case, NAV Portugal is the considered ANSP.
Flight Information Region (FIR)	A three-dimensional area in which aircraft are under control of usually a single authority (ANSP). Sometimes one or more FIRs have a combined upper area control and/or FIRs are split vertically into lower and upper sections.
Airspace sector	A three-dimensional geographical area within a FIR under control by a single ATCO or multiple ATCOs (e.g., planner and executive controller). Commonly, a FIR is divided into multiple sectors.