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INTERNATIONAL CIVIL AVIATION ORGANIZATION
SOUTH AMERICAN REGIONAL OFFICE

Unmanned aircraft systems (UAS)

concept of operations (CONOPS)

UAS CONOPS

First edition – March 2023

Contents

Unmanned aircraft systems (UAS) concept of operations (CONOPS)

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Abbreviations

AAO	Approved Aviation Organizations
AC	Advisory Circulars
AIP	Aeronautical Information Publication
AMC	Acceptable Means of Compliance
ANSP	Air Navigation Service Providers
ASBU	Aviation System Block Upgrades
ATS	Air Traffic Services
BVLOS	Beyond Visual Line of Sight
C2	Command and Control Link
CAA	Civil Aviation Authority
CONOPS	Concept of Operations
FRZ	Flight Restriction Zone for UA (Unmanned Aircraft)
ICAOI	International Civil Aviation Organization
IFR	Instrument Flight Rules
ITU	International Telecommunication Union
LAR	Latin American Aeronautical Regulations
MTOW	Maximum Takeoff Weight
OM	Operations Manual
RPA	Remotely Piloted Aircraft
RPAS	Remotely Piloted Aircraft Systems
RPS	Remote Pilot Station
SAM	South American Region
SMS	Safety Management System
SRVSOP	Regional Safety Oversight Cooperation System
UA	Unmanned Aircraft
UAS	Unmanned Aircraft Systems
UAS CONOPS	Unmanned Aircraft Systems Concept of Operations
UOC	Unmanned Aircraft System Operator Certificate
UTM	Unmanned Aircraft Systems Traffic Management
UTM CONOPS	Unmanned Aircraft Systems Traffic Management Concept of Operations
VFR	Visual Flight Rules
VLOS	Visual Line of Sight

Definitions

Aeronautical Information Publication (AIP)	A publication issued by or with the authority of a State and containing aeronautical information of a lasting character essential to air navigation.
Air Traffic Service (ATS)	A generic term meaning variously, flight information service, alerting service, air traffic advisory service, air traffic control service (area control service, approach control service or aerodrome control service).
Beyond Visual Line of Sight (BVLOS)	Operation in which the remote pilot or UA observer does not use visual reference to the aircraft in conducting the flight.
C2 Link	The data link between the remotely piloted aircraft and the remote pilot station for the purposes of managing the flight.
Dangerous Goods	Articles or substances which are capable of posing a risk to health, safety, property or the environment and which are shown in the list of dangerous goods in the Technical Instructions or which are classified according to those Instructions.
Detect and Avoid	The capability to see, sense or detect conflicting traffic or other hazards and take the appropriate action.
Handover	The act of passing piloting control from one remote pilot station to another.
Maintenance	The performance of tasks on an aircraft, remote pilot station, engine, propeller or associated part required to ensure the continuing airworthiness of an aircraft, remote pilot station, engine, propeller or associated part including any one or combination of overhaul, inspection, replacement, defect rectification, and embodiment of a modification or repair.

Operator	The person, organization or enterprise engaged in or offering to engage in an aircraft operation.
Operations Manual (OM)	A manual containing procedures, instructions and guidance for use by operational personnel in the execution of their duties.
Remote Pilot	A person charged by the operator with duties essential to the operation of a remotely piloted aircraft and who manipulates the flight controls, as appropriate, during flight time.
Remotely Piloted Aircraft (RPA)	An unmanned aircraft which is piloted from a remote pilot station.
Remotely Piloted Aircraft System (RPAS)	A remotely piloted aircraft, its associated remote pilot station(s), the required C2 Link(s) and any other components as specified in the type design.
Remote Pilot Station (RPS)	The component of the remotely piloted aircraft system containing the equipment used to pilot the remotely piloted aircraft.
Safety Management System (SMS)	A systematic approach to managing safety, including the necessary organizational structures, accountability, responsibilities, policies and procedures.
Unmanned Aircraft (UA)	An aircraft that is intended to be operated with no pilot onboard.
Unmanned Aircraft Flight Restriction Zone	Specific area in which the flight of unmanned aircraft is not permitted under normal conditions.
Visual Line of Sight Operation (VLOS)	An operation in which the remote pilot or RPA observer maintains direct unaided visual contact with the remotely piloted aircraft.

1 Foreword

Unmanned aircraft (UA) should be integrated into the existing aviation system in a safe and proportionate manner and this integration should foster an innovative and competitive UA industry in South America, creating jobs and growth. The proposed regulatory framework should set a level of safety and of environmental protection acceptable to the society and offer sufficient flexibility for the new industry to evolve, innovate and mature. Therefore, the exercise is not simply transposing the system put in place for manned aviation but creating one that is proportionate, progressive, risk-based, and the requirements should express objectives that will be complemented by industry standards.

Considering the broad range of operations and types of UA, the South American Region (SAM) has established the categories of operations **open, specific and certified** and their associated regulatory regime.

The ***open*** operation category for small UA (drones) should not require an authorization by a civil aviation authority (CAA) for the flight, as long as they stay within defined boundaries for the operation.

The ***specific*** operation category requires a risk assessment that would lead to an operation authorization with specific limitations adapted to the operation.

The ***certified*** operation category comprises operations with a higher associated risk that would require integration in non-segregated airspace.

Protection of other public interests such as the privacy and security entailed by UA operations should be addressed at the same time as the safety risk and would be dealt with at both, national and regional level. Within this context, the regulatory framework could envisage provisions to reduce such risks. Likewise, the developing regulations should need to be complemented by safety promotion actions to support SAM States.

The continued development of UA and their integration in non-segregated airspace pose new challenges and a significant amount of additional research needs to be performed, therefore, this concept of operations (CONOPS), the CONOPS for UAS traffic management (UTM) (UTM CONOPS) and the CONOPS for remotely piloted aircraft systems (RPAS) (RPAS CONOPS) need to be further developed and evolved. In addition, the harmonization of regulations and availability of a frequency spectrum, essential for successful UA operations, should need to be envisaged. Finally, the development of the UA market and the development of the technologies should need to be carefully monitored and the planning adapted to the evolution of these aircraft.

2 Background

Unmanned aircraft systems (UAS) are a new component of the aeronautical system, which ICAO, the SAM States and the aerospace industry seek to understand, define and ultimately integrate. These systems are based on state-of-the-art aerospace technological developments, which offer breakthroughs that may give rise to new and improved commercial or civil applications, as well as safety and efficiency enhancements for all civil aviation. The safe integration of UAS in non-segregated airspace will be a long-term activity, with many stakeholders contributing their experience and expertise on topics as diverse as licensing and medical qualification of remote pilots, detect and avoid system technologies, frequency spectra (including their protection from unintentional or unlawful interference), requirements regarding separation from other aircraft, and development of a robust and effective regulatory framework.

Unmanned aircraft systems (UAS) are aircraft and their associated components that are operated with no pilot on board.

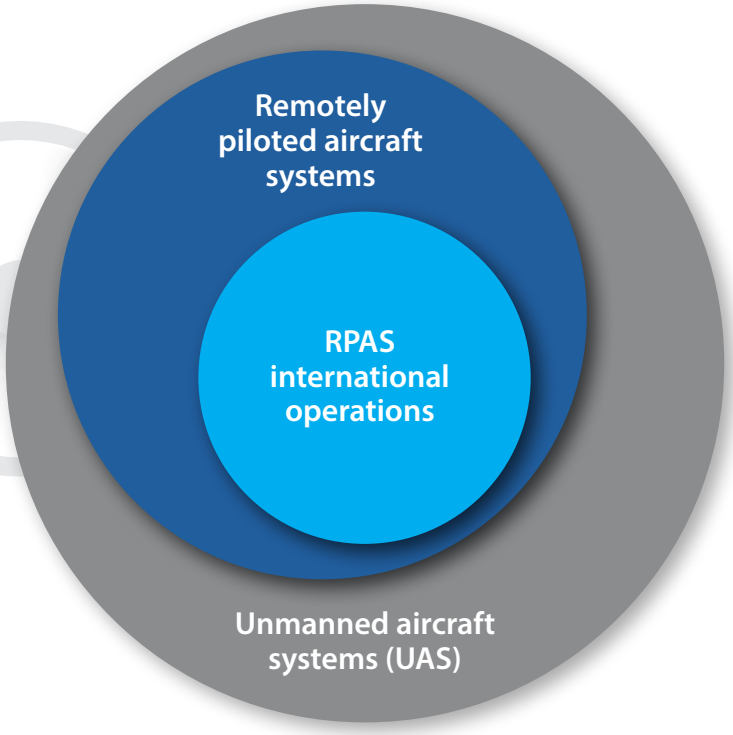
RPAS are a set of configurable elements consisting of a remotely piloted aircraft (RPA), its associated remotely piloted pilot stations (RPS), the required command and control (C2) links and any other system elements as may be required at any point during flight operations. RPA are a subset of UA.

A UA operator is a person, organization or enterprise engaged in, or offering to engage in, an operation of these aircraft. This definition assumes that UA will be remotely piloted and with no people on board.

The use of UA is developing at a quick pace worldwide. At present, the utilization of the UAs is extremely varied. Some examples are: precision agriculture, infrastructure inspection, wind energy monitoring, pipeline and power inspection, highway monitoring, natural resource monitoring, environmental compliance, regulatory compliance, atmospheric research, media and training, sports photography, filming, wildlife protection and research, hunting and anti-hunting monitoring and disaster relief, amongst others.

3 Classification of unmanned aircraft

The figure below shows the classification of UA and the key terms of unmanned aviation are described further below.



Unmanned aircraft (UA)

UA operate as part of an unmanned aircraft system (UAS) that also includes a remote pilot station (RPS), a command and control C2 link, and other necessary components.

Unmanned aircraft (UA) include a broad spectrum of aircraft, from unmanned free balloons and model aircraft to highly complex aircraft piloted from remote locations (RPA) by licensed aviation professionals.

Remotely piloted aircraft (RPA)

RPAs are a subset of UAs. An additional subset of RPAS is expected to have the capability for international operations in accordance with instrument flight rules (IFR) in the near future.

It is important to note that, although this document uses the term RPA to designate only certified UAs operating in integrated airspace, the definition of RPA, as presented in the previous section, is much broader, so some States may choose to use the term RPA, too, to identify other UAs that fall into the open and specific categories.

4 Concept of operations

The operation of UA should be regulated in a manner commensurate with the risk of the specific operation. Considering the broad range of operations and types of UA, three categories of operations -open, specific and certified- and their associated regulatory regimes have been established for the SAM Region through the Latin American Aeronautical Regulations (LARs), developed and published by the Latin American Regional Safety Oversight Cooperation System (SRVSOP).

UA flying in the **open** operation category should not require authorization by a CAA. However, the UA flight requests for access to non-segregated airspace should be registered based on the requirements of each State, in order to monitor and trace operations. Likewise, this operation should stay within the limitations defined by each State (e.g., distance from aerodromes, from people, etc.). The **specific** operation category should require an operations authorization by a CAA, with specific limitations adapted to the operation. The **certified**

operation category would be used for operations with the highest associated risk due to the type of operation. This category is being developed by ICAO and would cover international IFR operations conducted with RPAS and other types of operations outside the scope of IFR operations.

This UAS CONOPS has been developed to address two main goals:

a) the integration and acceptance of UA into the existing aviation system in a safe and progressive manner; and
b) the promotion of an innovative and competitive South American UA industry, creating new jobs for all the SAM States.

To achieve both goals simultaneously, the regulatory regime in SAM States needs to set a level of safety and of environmental protection that is acceptable to the society. Likewise, this would provide protection to other public interests, such as privacy and aviation security, on the one hand, and offer enough flexibility for the new industry to evolve, innovate and mature on the other hand.

The regulatory framework should not simply transpose the system put in place for manned aviation but should be proportionate, progressive, and risk-based, and the requirements should express objectives that will be complemented by industry standards. Only in this way, the SAM Region could address the challenges posed by the wide variety of UA and their operation, allowing us to learn and progress from simple operations to more advanced and higher risk operations as we gain experience with such operations.

The regulatory framework should be an enabler and not an impediment. Hence, the right balance would be struck between innovation and the societal concerns about safety, environmental protection, privacy and security.

This approach puts commercial and non-commercial operations (including classical aero models or UA used for recreational purposes) on equal footing. This concept focuses on safety risks but recognizes the importance of privacy and security risks to people and property. These subjects are briefly addressed at the end of this CONOPS.

The following main risks should be taken into account in the formulation of certification and operating regulations:

- mid-air collision with manned and unmanned aircraft;
- harm to people; and
- damage to property, in particular critical and sensitive infrastructure.

4.1 Open category

The open category covers those operations with small UA (drones) weighing less than 25 kg that are considered low risk. Operations in the open category should not require an operational authorization by the civil aviation authority (CAA) or a declaration by the UAS operator before starting the operation, unless otherwise required for particular operations by the national regulations of SAM States.

In this category, there are no direct requirements on remote pilot competencies and qualifications unless it is demanded by the competent authority of each State for certain type of operations.

In the open category, the following technical requirements regarding the UAs and their operation should be observed:

- have a maximum certificated take-off weight (MTOW) of less than 25 kg;
- be limited to a maximum height from the take-off point of 400 ft. (122 m);
- limited to operations within visual line-of-sight (VLOS);
- all operations should be supervised by a remote pilot who has the ability to intervene in flight control;
- the carriage of dangerous goods should not be allowed, unless expressly authorized by the State in accordance with its national regulations;
- the dropping of items from unmanned aircraft (UA) should not be allowed, unless specifically authorized by the State for occasions that shall be regulated;
- the State should include on unmanned aircraft, the registration number of the operator and/or of the UA; and
- the State should consider UA operations in airspace under UA traffic management (UTM).

In addition to the technical requirements, the SAM Region established the following operational and administrative considerations:

- for authorizing flight operations, no prior risk assessment would be required, as they are considered to be low risk;
- safety could be ensured through operational limitations, compliance with industrial safety standards, and by applying operational requirements;

- it is advisable that UA be controlled by the police in compliance with any legislation or regulations that may be enacted, and that each State do so in accordance with its own legislation and regulations;
- the take-off weight for this category should be defined as less than 25 kilograms (kg). However, each State could determine the fraction of kg and its technical requirements in its national regulations;
- the State may establish, according to its needs, flight restriction zones for UA, which could be published in the aeronautical information publication (AIP) of each State;
- the requirement for software to restrict access to areas defined by the State would be subject to the operational decisions of each State regarding this open category;
- the definition of subcategories are subject to the needs of each State as it deems appropriate, and should be set out in its regulations;
- each State could establish an operator and/or UAS registry, which should preferably be based on a web service;
- in the open category, flights not supervised by a person should not be allowed, since the remote pilot or observer should always have the aircraft in sight under VLOS conditions;
- the holding of licenses, ratings or certificates for a remote pilot to perform in this category in command of an aircraft would be defined in the regulations of each State;
- the responsibility of the remote pilot-in-command, the sole and ultimate authority while operating the aircraft under all circumstances, should be established in the regulations of each State;
- each State could establish requirements for safety devices when UAS operations in the open category are conducted over people, populated areas or protected flora or fauna sites;
- most States considered not having a specific regulation for sporting operations; and
- States may incorporate sporting UA operations into the open category.

4.2 Specific category

The specific category covers all operations with UA weighing 25 kg or more or UA weighing less than 25 kg but which do not meet the requirements of the open category.

The specific category should cover operations that do not meet the characteristics of the open category, where risk needs to be mitigated by additional operational limitations or higher technical capability of the UA and/or equipment and personnel involved.

This category is designed for operations involving higher risk. It is flexible in the sense that very few activities are prohibited. Instead, a UAS authorization or UAS operator certificate (UOC) should be granted on a case-by-case basis, once the CAA is satisfied that the operator has identified the hazards and their consequences associated with the operations and has a plan to mitigate the identified risks, in the scenario in which the operation is to be carried out

The safety risk assessment should address airworthiness, operational procedures and environment, competence of involved personnel and organizations, as well as airspace issues. These assessments could be based on guidance for an authorization for low-level operations or equivalent processes acceptable to the CAA, either as industry standards, advisory circulars (AC), or acceptable means of compliance (AMC).

The minimum level of safety for airworthiness should be based on the results of the assessment of identified safety risks. It may be defined and demonstrated through compliance to acceptable industry standards. Also, it may be acceptable to compensate certain airworthiness risk factors by operational risk mitigating factors, such as limitations on the operations, special qualifications for the personnel, etc. Conversely, in some cases the outcome of the assessment may require a certification of the UA or of specific functions [for example, safety devices, communication, navigation and surveillance capability to conduct operations beyond visual line-of-sight (BVLOS)], by the competent authority. Therefore, the approval certifications related to the equipment suppliers at their request could simplify the requirements in the evaluation of safety risks of the operators and, in this way, allow the operator to expand the scope of its operations.

The airworthiness assessment is closely related to the operational environment and procedures; *e.g.* the operation close to crowds could be acceptable when the UA has some additional functionality (*e.g.* automatic loss of link procedures, impact energy, such as parachutes; reliability and performance navigation systems suitable for BVLOS operations, etc.) and that the operating procedures are adequate and have the endorsement of the CAA, when the renewal of their permits corresponds.

The required competence of the staff involved should also be established on the basis of the safety risk assessment. It could range from specific training up to a license issued by the CAA, to carry out an aerial activity of this type. States could develop standards for the assessment of pilots and staff based on which such staff may demonstrate a basic competence.

An operations manual (OM) could be required to define the operating procedures, the required airworthiness level, as well as the required competence of staff involved and type of airspace, taking into account the results of the safety risk assessment.

As soon as an operation starts posing more significant aviation risks to persons overflown or involves sharing the airspace, the operation should be placed in the specific category. For these activities, the risks should be analyzed based on an operational risk assessment within the framework of safety management systems (SMS) and the mitigation should be agreed upon by the CAAs, according to the results, before a new operation. This process should be materialized with the issuance of an authorization.

4.3 Certified category

The certified category would include RPAS certified to operate in high-risk operating conditions or internationally within IFR controlled airspace, in non-segregated airspace and at aerodromes.

By 2030, a large number of RPA would share the airspace with manned aviation, some of which would operate under IFR. While some RPAS operations would take place under IFR for part of their flight, others would operate only under visual flight rules (VFR). Furthermore, RPA would operate on domestic and international routes, as well as in controlled and uncontrolled airspace. These RPA would take off from less congested areas and would land at similar destination aerodromes while others would use congested areas and aerodromes.

Other RPA would only operate at low altitudes where manned aviation activities are few or minimal. For example, for border protection, environmental applications, service inspection or forest fire-fighting activities, these RPA could fly in international airspace, depending on whether there are letters of agreement between the States.

All RPA are expected to comply with applicable procedures and airspace requirements defined by the State, including emergency and contingency procedures that would be established and coordinated with the respective air navigation service providers (ANSPs).

The operation of RPA in this category would be quite comparable to what is done for piloted aircraft. It may be expected that the competent authorities would be the same as for manned aircraft. These competent authorities could rely, as of today, on qualified entities to perform technical tasks.

A type certificate also covering environmental certification, an individual certificate of airworthiness, and an individual noise certificate would be issued for each RPA. Demonstration of capability for the designer and the manufacturer would take the form of design and production organization approvals, respectively. Combined approvals could be envisaged if the necessary requirements for these approvals are formulated.

Certification requirements would be adopted to cover different configurations: fixed wing, rotorcraft, airship, and powered lift. Requirements for the command and control station (C2) would be included.

Maintenance above a predetermined threshold would be performed in approved aviation organizations (AAO) and the maintenance personnel approving release to service would be licensed or authorized.

Pilots would be licensed and the operator would receive an approval by the organization (CAA), according to the regulations of each State.

Integration in non-restricted airspace would be subject to a safety assessment by the air traffic service (ATS) provider.

5 Safety promotion actions

The development of regulations and guidance material would be complemented by safety promotion actions that the SAM Region and the SRVSOP may undertake to support their member States. The following promotion actions are recommended for the open category:

- Develop support material to indicate the do's and don'ts for small UA (drone) operators in the open category. This material would be published on the SAM Office, SRVSOP and member States' websites and would be distributed with the support of the UA/RPAS community. This material would be translated into Spanish and Portuguese with the support of the UA/ RPAS community.
- That each State of the SAM Region and the SRVSOP carry out their educational campaigns and publish them on the SAM Office portal, in the same way that it is done on the ICAO Headquarters portal, in Montreal, Canada, using the following link:

  https://www.icao.int/safety/UA/UASToolkit/Pages/State-Regulations.aspx

- Organize public video campaigns.
- As the police and other law enforcement agencies in charge of citizen control are expected to support in the supervision of operations in the open category, an information manual and a training syllabus should be provided to these organisms, as considered by each State. It would also be necessary to translate these manuals into Spanish and Portuguese with the cooperation of member States.

In order to perform safety promotion actions, help and advice could be sought from the federations, clubs and associations that develop model UAS/RPAS throughout South America.

6 Data protection, privacy, security and spectrum

This concept document has focused on safety aspects, which is a top priority for aviation. However, the aviation security risks involved in UA operations would need to be addressed at the same time as the safety risks.

The privacy/data protection risk should be dealt with at national level. The regulatory framework may envisage provisions that could reduce that risk and also the aviation security risk. For example, the privacy (data protection) risk could be mitigated through the operators' self-registration in a web-based application maintained by the local authorities. Another solution would be to install remote identification devices, such as chips/sim cards in UA. Such a web-based application or chip/sim cards could also contribute to mitigate the aviation security risk.

It should be noted that operators may use the same process for managing safety, privacy and aviation security risks by taking an integrated approach.

To be able to support the regulations for the open category and to give information to the operators on applicable local regulations and restrictions, a standardized web portal could be established. This portal could inform about local regulations and temporary restrictions, *e.g.* due to aviation security concerns.

The registration of operations could solve some privacy, aviation security and enforcement issues. For example, a requirement in certain areas could be to have a printed copy of the registration with the applicable conditions.

The availability of spectrum is fundamental to the success of UA. Spectrum decisions are taken in the International Telecommunication Union (ITU). It is recommended that member States have an active coordination through this organism for the assignment of radio frequency spectrum to UA operations.

7 Outlook

The integration of UA in non-segregated airspace will pose new challenges. While today flying a single UA in non-segregated airspace with cooperative aircraft can be done with appropriate coordination and special procedures, operation of several of them, possibly with non-cooperative aircraft, will be much more complicated and will require additional measures. This CONOPS will need to evolve and be further developed to address the issues related to operations of UA fleets in non-segregated airspace.

UA fleet operations will pose new, unexplored challenges when conducted alongside manned aircraft operations. This integration will need to be done in full coordination with ICAO aviation system block upgrades (ASBU).

The key research areas for the integration in non-segregated airspace are as follows:

- detect and avoid;
- airspace and aerodrome access;
- command and control (C2) communications;
- human factors;
- contingency;
- aviation security; and
- autonomy.

This will need a significant amount of additional research to be performed, in particular by the SAM Region and SRVSOP. Cooperation will be necessary to increase synergies and avoid duplication of work.

Factors to be taken into account could be the following (not exclusive list):

- transfer of UA from one control station to another: some UA have a significant range and the transfer from one control station to another will be envisaged. Experience has already shown that such transfer must not coincide with the transfer from one ATC sector to another;
- operational control of several UA from one control station: this is a real possibility and will lead to formation flights, with coordinated flights of the various UA, for example for efficient fire-fighting or for crop spraying;
- ATC and operational control performed by the same person: this is an extension of the previous case, but will entail new risks and raise new liability issues;
- communications with ATC with an acceptable latency period;
- full autonomy and cooperative operations (for example, operation in swarms, network-centric operations); and
- extreme flight range (several days even months) at very high altitude (20 000 m): how to maintain the necessary surveillance to face emergencies.

Integration in non-segregated airspace will require the following for air navigation services and operators:

- minimum navigation, communication and surveillance performance standards;
- adaptation of the infrastructure;
- new procedures; and
- adaptable training.

The UTM CONOPS will need to be further developed, addressing short-, medium-, and long-term perspectives. However, these perspectives must be based on the development of the UA market and of the technologies. These should be carefully monitored and the planning adapted accordingly.

8 Planning

Planning will reflect a progressive introduction in non-segregated airspace. The development of rules will be market-driven, so the following short-, medium-, and long-term actions are identified in this CONOPS:

Short term: Until December 2023

- development and approval of the UAS CONOPS;
- development and approval of the UTM CONOPS;
- development and approval of UAS LARs 100, 101 and 102 and the related guidance material that includes:
  - ➢ the definition of subcategories in the open and specific categories; and
  - ➢ in the specific category:
    - ✓ risk assessments;
    - ✓ the development of OM; and
    - ✓ the competencies of the remote pilot and personnel in charge of operations;

- development of competencies, job profiles and functions and responsibilities (roles) of the personnel in charge of UA certification and inspection;
- development of training programmes and training plans for inspectorate staff;
- implementation of training plans for inspectorate staff; and
- start of operations in the open and specific categories.

Medium term: From 2024 to December 2026

- development and approval of the RPAS CONOPS;
- development and approval of the RPAS/ATM CONOPS;
- initiation of the development and approval of RPAS LARs and the related guidance material that includes:
  - the definition of subcategories in the certified category; and
  - the issuance of type and noise certificates for RPAs;
- development of competencies, job profiles and functions and responsibilities (roles) of the personnel in charge of RPAS certification and inspection;
- development of training programmes and training plans for inspectorate staff;
- implementation of training plans for inspectorate staff;
- development of model programmes for training centres (in order to achieve regional standards)
- development of maintenance programmes for UAS/RPAS equipment
- start of operations in the certified category;
- continued implementation of operations in the open and specific categories; and
- surveillance of operations in the open and specific categories;

Long term: From 2027 to December 2030

- implementation of the RPAS CONOPS;
- implementation of the RPAS/ATM CONOPS;
- completion of the development and approval of the RPAS LARs and the related guidance material;
- continued implementation of training plans for inspectorate staff;
- implementation of operations in the certified category;
- surveillance of operations in the certified category; and
- implementation of RPAS requirements, adjusted to industry requirements.

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