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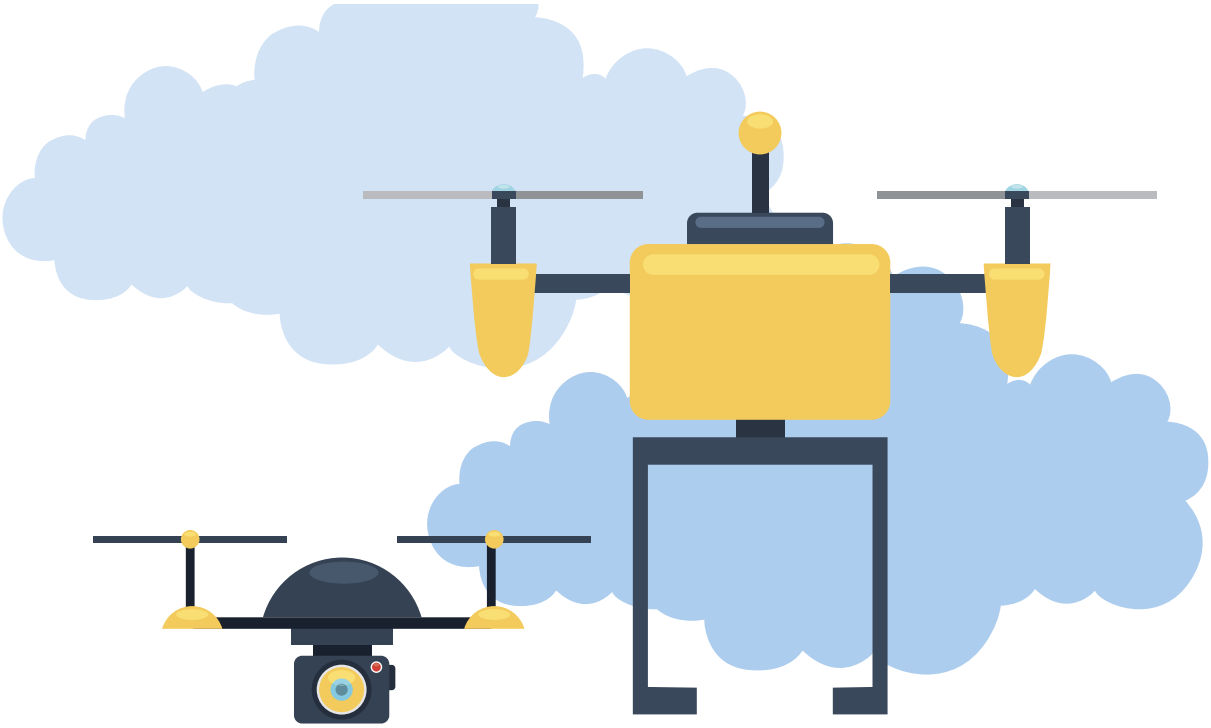

UNMANNED AIRCRAFT SYSTEMS

Shaping the future of our skies

ECAC • CEAC

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#73 – Summer 2021

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Raúl Medina Caballero
Director General of Civil Aviation, Ministry of Transport, Mobility and Urban Agenda, Spain, and ECAC Focal Point for Unmanned Aircraft Systems

With just a few weeks to go until the 39th Plenary (Triennial) Session in July, ECAC is pleased to present a special edition of ECAC News on one of the most innovative segments of the aviation sector that has been growing in size and popularity in recent years: unmanned aircraft systems (UAS).

Since 2014, when the European Commission gave the initial backing through its Communication "A new era for aviation", the drone sector in Europe has experienced exponential growth. Drones have proven their versatility in several applications, and they improve our efficiency and quality of life.

Since then, numerous regulatory initiatives have been promoted by States with the aim of regulating this new sector. In recent years, this effort has focused on harmonising the rules that make up the global framework for the design, manufacture, operation and marketing, amongst others, of these aircraft within a European context.

In addition to regulations, a myriad of advances have been made in the technological field. In Europe, projects have been promoted to demonstrate this technology, showing States' industrial capacity in the ECAC region and its potential to develop innovative solutions associated with drones. There is still some way to go, however; the complete harmonisation of drone operations, development of their full potential in cities and populated areas and urban air mobility are, among other things, significant milestones that are likely to be reached in the near future, always under the irrevocable premise of safety.

Society's acceptance of this type of technology will be a key element for a high social penetration of applications with this type of aircraft; this way, the sustainable growth of this technology will be possible.

On the other hand, it is absolutely essential to integrate operations harmoniously and completely safely with those of traditional aviation, respecting the operation of airport infrastructures and avoiding risks caused by unauthorised or unplanned incursions. To make this integration possible, regulatory and technological initiatives are being promoted to develop the U-space concept within the European context – a new UAS traffic management paradigm.

This edition of ECAC News promotes all of the above, and seeks to enhance the exchange of knowledge among ECAC Member States and to foster debate on strategic issues for UAS development. You will read about the challenges and opportunities of this segment of activity, regulatory issues, the latest progress towards developing the U-space concept, cyber security issues, and social acceptance and innovation, among others.

This has been made possible thanks to the expertise and collaboration of the authors, all of whom are noteworthy specialists participating actively in the development of this activity. We would like to thank each of them for their great contributions!

An integrated vision of transport planning with drones and smart mobility in Spain

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Setting the stage for smart mobility and U-space

The aerospace industry is moving incredibly quickly with innovations in aircraft types, sizes and flight capabilities. The introduction of these new vehicles is no longer a question of if, but when – and to support this growth, a more modernised and scalable approach to air traffic management is needed.

UTM (unmanned aircraft system (UAS) traffic management) – or U-space – is driving the eventual future of digital services for all airspace users. While key technology challenges such as autonomy are closely related to any UAS activity, it is the digitalisation of the airspace and traffic management with UTM as its accelerator that will guarantee the safe integration of new operations and new vehicles in our skies. In this sense, digitalisation and autonomy must go hand in hand.

The modernisation of our ATM system is not only relevant to facilitate fair access to new operations, but it also plays a key role in meeting Europe's self-imposed environment targets. There is no way around the much-needed digitalisation of our traffic management system and **now is the time to act.**

As a result of EASA's recently approved regulatory framework for drones and U-space, proposals for low-risk commercial operations are flourishing around Europe. Nevertheless, the main hindrance to nominal operations is the lack of U-space.

The COVID-19 pandemic has been a systemic shock, and the ripple effect of the global health crisis has severely impacted worldwide economies. With air travel severely reduced, aviation has been one of the hardest hit industries. Rebuilding is not an option but a necessity and we are compelled to do better by integrating key steps towards our sustainable and digital targets.

Thus, led by the Spanish Ministry of Transport, Mobility and Urban Agenda, through the Directorate General of Civil Aviation and a strong collaboration between Airbus and ENAIRE, together with many other key stakeholders both from private and public industries, it is time to establish a concrete roadmap towards a nationwide deployment of U-space and drone operations.

This roadmap starts by accommodating and subsequently integrating new drone operations that not only provide a quick benefit to society but can also help achieve social interest and acceptance. Examples of such operations are those supporting emergency medical services, sanitary transport of medicines and distress relief by transporting goods to areas with difficult access. Enabling these autonomous operations will support the identification of requirements and standards to push the European regulation further, and step by step will enable more complex operations until not only cargo transport in urban areas is achieved, but ultimately autonomous air transport of passengers in urban environments.

Benefitting from favourable weather in all its regions and having a relevant number of drone centres across the territory to test different instances of use and different approaches on how to secure, combine and integrate unmanned and manned operations, as well as the required communication, navigation and surveillance capabilities both on board and on the ground/in airspace, Spain is certainly a good partner to advance towards a fair and safe, sustainable and efficient access in the future of airspace and traffic management to enable seamless and interoperable progress all across the EU.

The Spanish institutional framework

The Ministry of Transport, Mobility and Urban Agenda, through the Directorate General of Civil Aviation (DGAC) and the Aviation Safety and Security Agency (AESA), has been deeply involved in the development of the civil drone sector in Spain, addressing the UAS operations as early as 2014 so as to later, by the end of 2017, issue a first UAS-specific regulatory framework. This interim regulation enabled the growth of drone operations in Spain until the entry into force of Regulation (EU) 2019/947.

At the end of 2020, the Ministry of Transport, Mobility and Urban Agenda published the Strategy for Safe, Secure, Sustainable and Connected Mobility. This strategy, foreseeing the adoption of the new regulatory framework by 2021, highlights in its part 5 – *Smart Mobility*, U-space services as the lever for growth of the Spanish drone service sector. This mobility strategy will be the enabler of a safe and secure integration of the urban air mobility (UAM) in smart cities, and identifies as essential the deployment and operation by the common information services provider (CISP) to support the provision of these services and the integration of recurrent and densified drone operations in the national aviation system with high integrity rates.

Furthermore, it is remarkable that last February ENAIRE and Airbus signed a collaboration protocol to share knowledge and exploit synergies to accelerate progress in the deployment of urban air mobility – in U-space particularly – in Spain. Through this collaboration and the signature of the protocol, ENAIRE and Airbus will maximise efficiency by their participation – together with other relevant partners, including institutional ones – in different initiatives, either programmatic, regulatory, or technological at national and European levels, and with a focus on projects to make urban air mobility a reality across Europe.

The concrete UAS and U-space challenge in Spain and the role of ENAIRE

The drone sector has increased exponentially in recent years in Spain: in 2020 alone, the drone operations coordinated by ENAIRE totalled 1646, a 207% increase compared to 2019 (536) and 362% more than in 2018 (358).

This increasing activity poses a challenge to ENAIRE for safely managing operations in coordination with manned aviation. ENAIRE has deployed different tools for drone pilots to improve the visual information of zones where drone flights are or are not allowed – ENAIRE Drones in 2018, and PLANEA in summer 2020, the webpage to request flight plans in controlled airspace for non-standard flights, such as drones, fireworks, paragliding, etc., cutting down the time to obtain the approval of the flight plans. But despite these efforts, as long as the requests for authorisation increase, the system runs the risk of collapse not only because of the increased number of manually processed authorisations and paperwork but also due to the ATC (air traffic controller) capacity supported by the system.

However, U-space, the European Union UTM concept first illustrated back in 2017 in the "U-space Blueprint" published by the SESAR Joint Undertaking (JU), comes to alleviate the digitalisation of the whole drone flight management, being able to automatically cope with a large number of simultaneous beyond-visual line of site (BVLOS) drone operations flying very low level (VLL) in the same part of the airspace. In this concrete context, in early 2018 the SESAR JU launched a call for U-space demonstrators to establish U-space demonstrators all across Europe and carry out demonstrations before the end of 2019 "to comprehensively prepare and eliminate the risk of a rapid deployment of U-space initial services (U2) as outlined in the U-space Blueprint."

ENAIRE led one of the six finally SESAR JU-awarded big projects for grants: DOMUS, a 17-partner consortium, €4 M budget, with the most complete set of U-space services for demonstration (from U1 to U3), over an architecture based on a

An integrated vision of transport planning with drones and smart mobility in Spain

central "Ecosystem Manager" looking after up to three different U-space service providers. From a U-space operations centre located in Madrid at the Ministry of Transport, Mobility and Urban Agenda's premises, the successful live-streamed demonstrations took place by late 2019 at the ATLAS (Air Traffic Laboratory for Advanced unmanned Systems) fields, a test flight centre for UAS and RPAS located in Villacarrillo (Jaen), and the Ancora Centre for UAS experimental flights in Lugo, run by ITG (Instituto Tecnológico de Galicia), with ENAIRE CED (Centro de Experimentación y Desarrollo) as the ATC unit. It provided an example for the full integration of drones in airspace and the maturity of current technologies to even reach U3 services and, most important, demonstrating the efficiencies and benefits of an architecture based on a central core element for data interchange and interface with ATM, later on enshrined in the U-space regulation as the single Common Information Service Provider. As indicated, the DOMUS project was integrated as part of the European network of U-space demonstrations contained within the SESAR2020 Programme.

From its experience with DOMUS and its participation in other national and European leading projects, ENAIRE has been able to actively participate in the development of the U-space package regulation recently adopted by the European Commission on 22 April 2021 after its approval by the EASA Committee in February 2021 and whose entry into force is scheduled for January 2023, either through contributions to the national representatives in the group of experts and CANSO or directly in the different workshops held all over the consultation period. This regulation introduces specific rules and procedures; at the same time it identifies the organisations involved to manage a large number of simultaneous BVLOS drones operations in segregated U-space airspace, with a high degree of automation and digitalisation for a safe, secure and efficient integration in the airspace, paving the way for the deployment of the urban air mobility, which is expected for 2025. In some studies, a worldwide turnover of €30 000 M is estimated for 2035, with 15 000 units of operational vehicles. Other European studies indicate that in 2025 we may have a market volume of more than €1 500 M.

In its initial phase, U-space will be limited to a defined, segregated airspace designated for the exclusive use of drones, mostly operating in VLL, although in the medium-long term future it will be able to guarantee drone operations in all operating environments and airspaces.

For the deployment of U-space, the regulation lays out the services needed for its operation, such as remote identification, authorised flight service, geo-awareness, traffic information as well as the common information service (CIS), an essential set of dynamic and static operational and non-operational data supplied reliably and in real time to ensure the safety and efficiency of operations.

ENAIRE is going to play a key role in managing unmanned aerial traffic as future provider of common information services in U-space in the different pieces of the Spanish airspace. In this regard, the current planning for the deployment of U-space services in Spain includes, between 2021 and 2022, the validation and implementation of initial basic services for users, and subsequently, in 2023, the launching of the CIS based upon a single CIS provider, in line with the U-space centralised architecture referred to in the European U-space regulation. At the same time, ENAIRE, born out of this particular architecture, will play an additional role as a public USSP (U-space service provider) for government and law enforcement agencies, among others, such as competent authorities and privileged users, as well as to ensure the provision of U-space services in the absence of other USSPs.

Additionally, ENAIRE continues to participate in some of the most innovative projects in the field of U-space; for instance, AURA, which – led by Indra and with the participation of Airbus – will explore and dig for ways and standards for defining data exchange between U-space and ATM. Other projects in which ENAIRE participates also have a big social impact, such as those related to urban air mobility which, under a U-space environment, aim to safely, securely, sustainably, orderly and efficiently run air taxi operations in a controlled and fully integrated airspace, without undue impact on safety and capacity or work overloading in ATM. These latter respond to pilot initiatives under the Single European Sky (SESAR JU) framework, with very large-scale demonstrations and validations with real flights to be carried out in 2022. Demonstrations of air taxi flights in Spain will be performed in Santiago de Compostela (AMU-LED project) and Villacarrillo (USPACE4UAM project), as well as unmanned urban parcel delivery flights at Playa de Castelldefels in Barcelona (CORUS-XUAM Project, a project coordinated by EUROCONTROL, led and carried out by the consortium which delivered

the CORUS U-Space Concept of Operations in 2019, which intends to also identify new U3/U4 U-space services).

ENAIRE is addressing all these challenges through its new strategic plan (2021-2025): Flight Plan 2025. Given the new outlook and the far-reaching transformation taking place in the European air navigation sector, this plan will follow on with ENAIRE's modernisation and transformation process, including a specific plan engaging the European Union developments, to provide for U-space/UAM traffic management services in total harmony with ATM, and to serve the future new entrants such as air taxis.

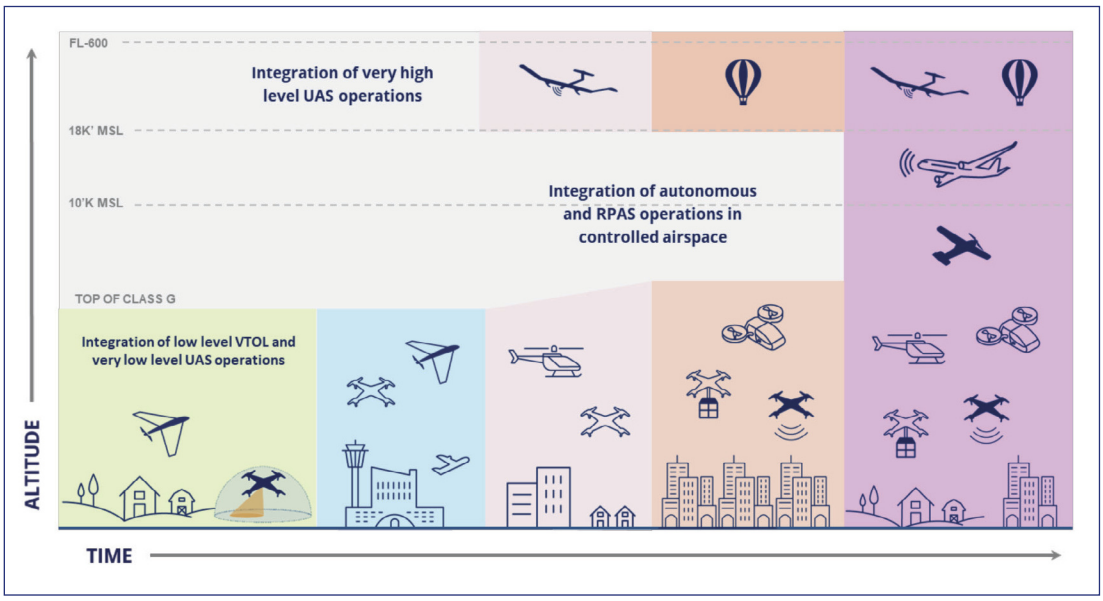
The role of Airbus to support the Spanish developments

Airbus is a pioneer of UAM and remains at the forefront of the transformation of global air transport into an environmentally sustainable ecosystem. Airbus has approached UAM in a holistic manner, focusing not only on new electric vehicles (eVTOLs or electric vertical take-off and landing) for urban and suburban passenger transport, but also considering the urban infrastructure, multimodality and airspace integration solutions required to enable UAM operations, with a key emphasis on UTM. Airbus has developed and successfully flown two eVTOL demonstrators (Vahana and CityAirbus) and has developed and deployed a set of UTM digital services that can enable the safe and fair integration of UAS and future UAM vehicles in non-segregated airspace.

Airbus UTM, which was launched as a core activity to enable future UAM operations, has now become a transversal organisation integrated with the ATM division of Airbus Commercial and headquartered in Getafe (Spain). Airbus UTM is designing and building the digital services necessary to enable new airspace users to access and operate in non-segregated airspace in a safe and efficient manner. Airbus UTM is currently providing services to UAS operators (for example through the provision of airspace authorisations services in the United States as a qualified provider under the LAANC (Low Altitude Authorization and Notification Capability) programme of the Federal Aviation Administration) while contributing to shape the future European U-space ecosystem in Europe and testing UTM-enabled automated shore-to-ship cargo delivery in Singapore, among other pioneering activities across the world. In order to contribute to the digitisation and automation of the future sky, Airbus UTM relies on research, simulations, and industry collaboration, contributing to the definition of future global standards. This transformation has to be a collaborative effort, not only across continents and countries but especially across private and public stakeholders.

From its headquarters in Spain, Airbus UTM is contributing to several SESAR activities aiming at the development and deployment of the future European U-space ecosystem. We collaborate closely with ENAIRE, especially in the aforementioned AURA and the VLD AMU-LED (https://www.sesarju.eu/projects/AMU-LED) projects. In these, Airbus UTM is leveraging advanced prototypes of UTM services, simulation tools and a cloud platform tailored to support UTM services at scale. In addition, Airbus UTM is also leveraging its experience as a key contributor to NASA's National Challenge on Advanced Air Mobility (https://www.nasa.gov/aamnationalcampaign).

Airbus is ready to focus on a large variety of digital services to support the integration of autonomous operations at different complexity levels, to meet the requirements and standards to push our European regulation, to identify roadmaps for the deployment of nominal autonomous operations incrementally, and to deploy



Integration of autonomous operations at different complexity levels

communication, navigation and surveillance solutions adapted to the capabilities required by the new operations, vehicles, performances and operational environments.

The importance of collaboration among all relevant stakeholders

All in all, an efficient development towards a smart mobility implementation supported by autonomous, unmanned operations necessarily urges the collaboration and joint proactivity among the different stakeholders and actors involved.

By signing the collaboration protocol, ENAIRE and Airbus will ensure complementarity from their respective areas of activity in aviation, and will maximise efficiency through their participation – along with other relevant partners, including institutional ones – in different initiatives: programmatic, regulatory, or technological, at national and European levels and with a focus on current projects to make UAM a reality across Europe.

As a first result of this collaboration, ENAIRE and Airbus are already enhancing coordination in the UAM, participating in the SESAR JU projects, AURA and AMU-LED to identify and deliver quick gains in the Spanish operations environment for an early implementation of the validated solutions.

But highly relevant and much more decisive for Spain is also the collaboration, along with other major Spanish stakeholders from the aeronautical industry, to take the initiative to work together and push for a coherent proposal on a national U-space/UAM project towards the national Plan for Recovery, Transformation and Resilience, approved last December by the Spanish government and to be funded through the European Commission Recovery and Resilience Facility instrument within the framework of the NextGenerationEU Programme. This will not only allow for resource optimisation and use of EU funds but will also provide the much-needed alignment among different regional and national initiatives, working together with the perspective of a homogenous, synchronised and prompt deployment of first full U-space operations. ■

Mariluz de Mateo holds a master's degree in telecommunications engineering from the Technic University of Madrid (Spain) and has over 32 years of experience in the space and ATM fields. She started her professional career in 1988 at the European Space Agency (ESA), Noordwijk (the Netherlands), where she was responsible for the technical management of various contracts with the European aerospace industry in the fields of satellite communications and navigation (GNSS). In 1995, she became responsible for the technical management of the European EGNOS navigation satellite system. Mariluz joined Aena (at that time the Spanish ANSP) in 1996 and was appointed head of the EGNOS Programme Office. In 2005, she was appointed head of the GNSS Development Division; in July 2008, head of strategy and planning; and in March 2012, head of international development and convergence. Since June 2017, she has been Business Development Director at ENAIRE (former Aena, and Spanish ANSP since 2014) where she is responsible for managing ENAIRE's strategic planning activities and all the international relationships, policies, business development activities and international programmes, including ENAIRE's participation in the SESAR programme. She is responsible for the deployment of the U-space services in ENAIRE. Mariluz has authored numerous technical publications in various international conferences and journals.

Isabel del Pozo de Poza has over 10 years of experience in the ATM field. She has been actively involved in the European ATM Master Plan updates and the European drone roadmap in the last decade. She participated in common initiatives between SESAR and NextGen, supporting the trajectory-based operation concept on both ATM modernisation programmes. Isabel studied aeronautics at TU Munich and holds a PhD addressing the "Assessment of Fairness and Equity in Trajectory-Based Air Traffic Management" from the University of Glasgow. She joined Airbus Helicopters in 2013 where she acted as an expert and subsequently as a senior expert in the field of ATM and civil operations while also heading the Department for Mission Management. She leads the ATM/UTM R&T roadmap across Airbus and in 2018 was appointed Head of Airspace Management – UTM within the Airbus Urban Air Mobility Organisation. As vice president, Isabel promotes the vision of an integrated air traffic management to ensure the safe, sustainable and efficient integration of more digital, autonomous, and new operations.

U-space: how digitalisation will disrupt aviation [1]

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Applications of UAS have grown rapidly in recent years. Let us think, for example, of logistics, agriculture, data mapping, surveillance, and disaster management. All of these cases suggest that UAS not only come with remarkable efficiency and safety gains, but also with increasing economic significance [2]. In order to make best use of the emerging potential of UAS, civil aviation authorities (CAAs) worldwide have developed effective regulatory and legislative frameworks and standards. An overview from a Swiss perspective.

What do the emergence of the steam engine, railways, telephone, electricity and the internet have in common? All of these technologies transformed the way people live and work, how they manufacture products, provide services, travel, and communicate [3]. Furthermore, they enabled great productivity gains, disrupted many industries and sectors and became an integral part in the global economy [4]. One particular technology that falls in the same basket of disruptive innovations is unmanned aircraft systems (UAS).

In order to make best use of the emerging potential of UAS, the European Union implemented regulations (EU) 2019/947 and (EU) 2019/945 and set the baseline for the safe operation of UAS in European skies. Switzerland actively contributed to the creation of this regulatory framework, especially when it came to integration of the operation-centric risk assessment for UAS that Switzerland has already successfully applied for several years. Within this framework, safety is addressed for a wide array of individual UAS missions that inform the specific risk mitigation measures implemented. For example, if a UAS flies over a rural area, the applicable risk mitigation will be considerably less rigorous compared to a similar UAS flying over an assembly of people or beyond visual line of sight (BVLOS). Even though this regulatory measure is a prerequisite for the evolvement of innovative UAS operations, it becomes apparent that a future-proof and well-functioning aviation system needs an additional architectural layer that allows for innovative, complex and scalable use of UAS. It was back in summer 2018 in the ECAC News #66 [5] when FOCA promoted a coordinated approach on the U-space, highlighting the need for a regulatory framework that will allow for the scalability of UAS. In April 2021, less than three years later, the European Commission published the first regulatory package for the U-space (managing airspace traffic for UAS), setting the conceptual baseline for UAS to access airspace safely in parallel to manned aviation [6].

By taking the regulatory framework for U-space as a starting point, the following article briefly introduces the main rationale of the U-space architecture, focusing on the economic characteristics that stand in contrast to manned aviation. In a subsequent section, the article further elaborates on this argument, highlighting the value of U-space when it comes to achieving key decarbonisation, digitalisation and resilience ambitions in aviation. The text outlines the relevance of the U-space regulation for the transport and logistic landscape as a whole, taking the United Nations' Sustainable Development Goals (SDGs) as analytical tool. In the last section, the text expands this framework by focusing on the ultimate goal of providing all aviation actors fair access to airspace [7].

Fostering new technologies for more efficiency

U-space – or UAS traffic management (UTM) – is the digitised air traffic management for UAS. It describes a specific volume of airspace, in which a set of automated and connected services enable sustainable, efficient, safe

(1) The author would like to thank all colleagues within the Innovation and Digitalisation Unit at FOCA involved in the subject, in particular Francine Zimmermann, Marcel Kaegi and Benoit Curdy for the critical read and the valuable contributions to this article.
(2) European Commission: https://ec.europa.eu/growth/sectors/aeronautics/rpas_en (last accessed 08 May 2021).
(3) Webster 1995.
(4) Bresnahan & Trajenberg, 1995.
(5) ECAC News #66 (last accessed 14 May 2021)
(6) https://ec.europa.eu/transport/themes/mobilitystrategy_en (last accessed 17 June 2021).
(7) ICAO, 2019; Hately *et al.*, 2019.

U-space: how digitalisation will disrupt aviation

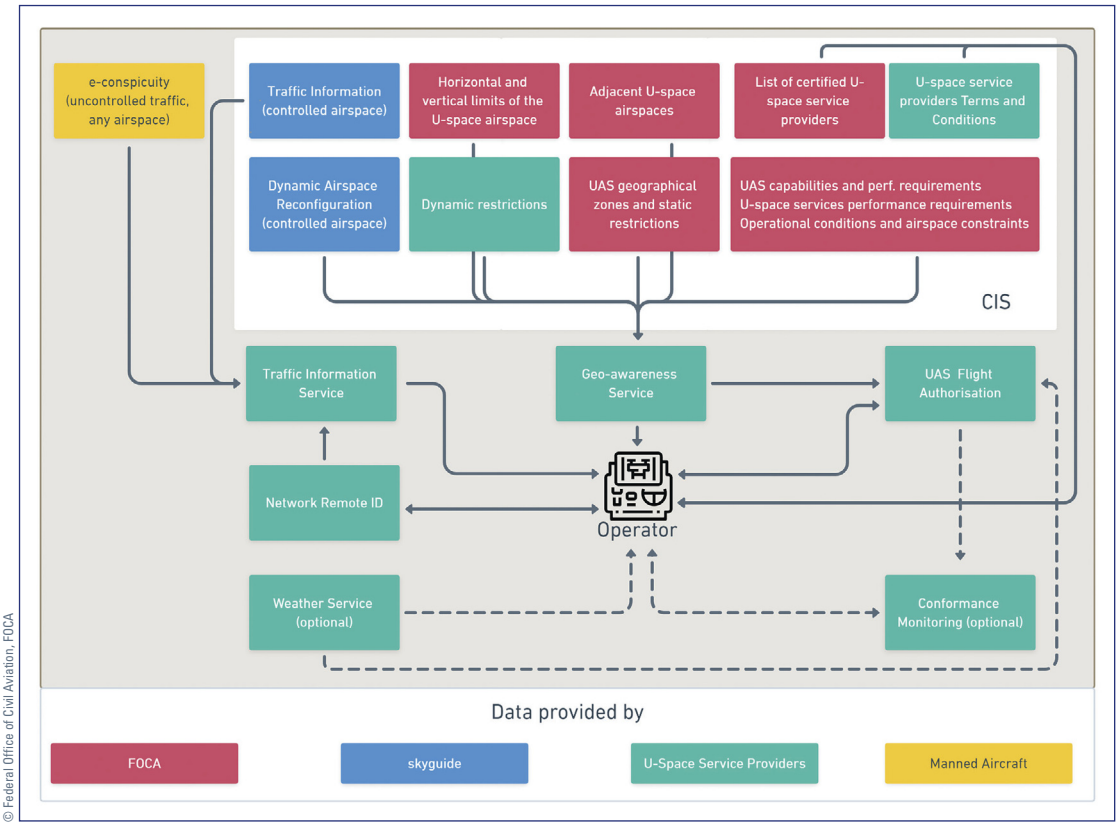

Figure 1: Swiss U-space from an operator's point of view.

and secure UAS operation at scale. The EU regulation for U-space defines the entities that are active in the architecture as well as their various roles. *Figure 1* provides an insight into the intended U-space structure, illustrating the responsibilities of the different entities within the architecture. The regulation uses the concept of common information services (CIS) to define a set of basic data that Member States must make available in all U-space airspaces (see white box at the top). As illustrated, the national air navigation service provider (ANSP) and FOCA intend to ensure the major part of the CIS, whereas private companies provide subsequent U-space services in a competitive environment. Bearing in mind the complexity of the underlying architecture, this article will have a deeper look at the part illustrated at the bottom of *Figure 1*.

It becomes clear that this sort of organisational structure fundamentally differs from the way air traffic management (ATM) is provided in manned aviation, where States have regulated national ANSPs to be the single service provider of ATM per one volume of airspace, particularly for safety and sovereignty reasons. Since ATM is a system-critical infrastructure, States have a mutual interest to have a certain level of control when it comes to ATM development and provision. In addition to this, the current characteristic of the ATM infrastructure suggests that it is more efficient to have one ANSP per volume of airspace than several. Under these conditions, the entry barriers for competitors are remarkably high. Comparable with other network industries such as railway or telecommunications, market entrants would need to build up a costly infrastructure parallel to the one managed by the incumbent [8]. The human-centric nature of ATM would make it even more challenging to ensure seamless coordination of the services [9].

In contrast, the EU regulation for U-space aims to establish a certain level of competition, allowing private companies to provide at least the following four services on a mandatory basis: network identification, geo-awareness, UAS flight authorisation, and traffic information [10]. After having tested a broadcast and networked solution of remote identification in September 2019 (*Figure 2*), Switzerland is now in the implementation phase of the network remote identification service (Net-RID). *Figure 2* offers an insight into the demonstration of the Net-RID. Six companies are currently soft launching Net-RID on a voluntary basis, providing greater choice for UAS operators when it comes to information sharing and accessing UAS operations via the internet in real time [11]. From a consumer perspective, this organisational structure comes with

(8) Finger, 2019.
(9) Listen to the innovation and digitalisation podcast by the Federal Office of Civil Aviation on competition in ATM and UTM for more information: https://anchor.fm/foca-admin.
(10) See Chapter IV in the regulatory framework for the U-space (EU) 2021/664 for a detailed description of the specific U-space services.
(11) See https://susi.swiss/swiss-remote-identification/ for more information.

> “It becomes clear that this sort of organisational structure fundamentally differs from the way air traffic management (ATM) is provided in manned aviation, where States have regulated national ANSPs to be the single service provider of ATM per one volume of airspace, particularly for safety and sovereignty reasons.”

additional benefits, including increased service quality and lower costs. Competition encourages companies to operate more efficiently and make sustainable investments. Furthermore, it creates the dynamics for innovative and creative processes. In addition, a competitive environment sets the necessary framework for a system for sanctions. As the Swiss Court of Auditors described in a recent report, a monopolistic structure makes it hard for regulators to enforce findings, as they have no alternatives that continue to provide the service of this critical infrastructure.

In terms of oversight, FOCA is currently developing an automated Net-RID monitoring environment for service providers, empowering them to self-audit the quality, compatibility and interoperability of their services. Automated monitoring comes with a range of benefits, particularly by enabling the development of compatible and high-quality services at scale, while reducing transaction costs. From a service provider’s perspective, such a “new form of auditing” increases efficiency, transparency and responsibilities.

U-space: flying towards sustainable development

Common rules and standards that ensure interoperable services and smooth communication structures are a key prerequisite for a functioning competitive environment in the U-space. Global ATM initiatives such as the System Wide Information Management (SWIM) that also aims to harmonise the data exchange of all users and stakeholders in the airspace are key for an efficient development of U-space. Conversely, concepts and projects of unmanned aviation can also offer manned aviation important impulses in these terms. For example, using interoperable services in a competitive structure may lead to optimised flight routes and coordination, whereas waiting time on the ground and empty loopholes are minimised. While recent reports argue that improvements in ATM could reduce up to 6% of carbon emissions, translating fundamental rationales of U-space into manned aviation might be a point to start[12]. In the same vein, the EU Commission has emphasised that the UAS industry can strongly support Europe’s twin transition to green and digital economy, elaborated in the European Green Deal and the European Digital Strategy[13]. In addition, the industry can also contribute to the post-COVID 19 recovery and the future resilience of the EU economy.

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Figure 2: The demonstration of the remote identification service by several service providers in September 2019 in Ittigen, Berne, proved to be successful.

Furthermore, U-space has a considerable impact on the development of a sustainable and resilient transport and logistic landscape as a whole. For instance, innovative UAS applications and associated practices provide an important extra value in terms of decarbonisation, digitalisation and resilience, as captured in the EU Sustainable and Smart Mobility Strategy[14]. In order to better conceptualise this argument, it is worth taking a step back and looking at the United Nations’ 17 Sustainable Development Goals (SDGs) as an analytical framework for sustainability assessments. In September 2015, the UN Member States adopted the 2030 Agenda for Sustainable Development, creating a consolidated approach to

(12) EUROCONTROL, 2020; Destination 2050: https://www.destination2050.eu/ (last accessed on 8 May 2021).

(13) See: https://ec.europa.eu/info/strategy/priorities-2019-2024/european-green-deal_en respectively https://ec.europa.eu/info/strategy/priorities-2019-2024/europe-fit-digital-age_en for more information (last accessed 17 June 2021).

(14) See https://ec.europa.eu/transport/themes/mobilitystrategy_en for more information (last accessed 8 May 2021).

Figure 3: The United Nations' Sustainable Development Goals (SDGs) allow policymakers to assess the sustainability impact and effects of a certain technology in a structured manner.

the greatest challenges the modern world is facing (*Figure 3*). At the heart of the Agenda are the 17 SDGs and the 168 dedicated sub-targets, balancing a multidimensional model of sustainable development. In this light, UAS not only generate economic value or have punctual ecological impacts, but also contribute to key solutions for tackling broader political and societal problems, such as clean air in cities, access to digital technologies to improve public services, or producing clean energy. A key strength of the SDGs is the fact that they provide regulators and policymakers with an international consolidated framework that allows them to navigate the relationships among social, environmental and economic development objectives in a proactive manner. Furthermore, they enable them to assess the impact of their activities or decision-making processes, while protecting broader societal and political interests.

First, U-space contributes to the development of safe and resilient cities, as captured in SDG 11. For example, the architecture facilitates logistics, relieves road congestion, multiplies mobility services, and supports inclusivity of remote areas through cargo deliveries. Second, U-space has a positive impact on SDG 9, the development of resilient and innovative infrastructure, particularly when it comes to upgrading and greater adoption of clean and environmentally sound technologies. In addition, specific UAS operations contribute to better health and well-being (SDG 3), enable new concepts for clean energy production (SDG 7), and reduce inequalities between States or regions (SDG 10).

> "Six companies are currently soft launching Net-RID on a voluntary basis, ensuring greater choice for UAS operators when it comes to information sharing and accessing UAS operations via the internet in real time."

Designing the U-space market, correcting market failures (15)

To make best use of the advantages outlined in the previous sections, it is key that U-space ensures fair and efficient access to airspace for all types of UAS and all types of missions. Although this vision has not been an operational problem yet, as the number of UAS applications has not warranted it, the recent publication of a series of new regulatory frameworks indicates the application of UAS at larger scale. When the number of UAS operations increases, the airspace becomes increasingly scarce. In turn, the inability to resolve conflicts might fundamentally affect the way this resource is used, raising concerns in terms of the fair allocation of a common

(15) The author would like to thank Prof. Dr Sven Seuken, Co-director of the Zurich Center for Market Design, for the valuable contributions to this chapter.

> “For instance, innovative UAS applications and associated practices provide an important extra value in terms of decarbonisation, digitalisation and resilience, as captured in the EU Sustainable and Smart Mobility Strategy.”

good. Without good rules in place, such dynamics might lead to market failures, known from other domains where resources are scarce but highly contested, as for example the inefficient allocation of personal protective equipment during the first months of the COVID-19 pandemic.

The fair and efficient allocation of airspace is addressed in the regulation for U-space by the UAS flight authorisation service that defines the key rationales for the conflict resolution of UAS that want to fly in the same volume of airspace at the same time. In doing so, service providers will receive a UAS flight authorisation request from UAS operators. In case of a potential conflict between two or more flight authorisation requests, the regulation suggests that service providers need to process requests on a first come, first served basis. Even though this policy has proved successful in manned aviation, there are several arguments suggesting that this might lead to challenges in the U-space context. First, UAS missions are highly heterogeneous and individual; therefore, an overly simple conflict resolution rule does not always lead to a fair outcome. From a utility perspective, the allocation of a certain volume of airspace to a certain type of operator might be in some situations fairer and more efficient than in others. For example, due to the high utility of emergency flights - the delivery of health critical equipment for example - this type of operation has a higher priority than recreational ones. Second, cancelling or postponing certain UAS missions might not be acceptable in some cases - thinking, for example, of applications where time is critical for the business models or vehicles that have very limited battery capacity. Third, a fair allocation mechanism may also point to encouraging long-run competition to prevent the resource being monopolised by one single UAS operator or company[16]. Such contextual, moral and economic factors are not taken into account by the established first come, first served solution.

Similar to the way regulators found ways to assess safety in an operation-specific manner for UAS, they may also need to address specific conditions and arrangements to resolve conflicts between them. Thus, the design of rules that guarantee an efficient and fair allocation of the airspace is an important challenge that should be approached in a careful and proactive way. To this end, FOCA has begun to work with the Zurich Center for Market Design that studies the design of resource allocation mechanisms that satisfy properties like fairness and efficiency. Professor Sven Seuken from the University of Zurich, world-leading expert on market design and co-director of the Zurich Center for Market Design, argues that “I see many interesting parallels between the design of the U-space and other problems like electricity markets, the allocation of food to food banks, and the distribution of medical goods such as COVID-19 vaccines. To achieve an efficient and fair allocation of the airspace, it is important to make sure that the stakeholders do not have an incentive to strategically misreport their preferences.”

As this case exemplarily shows, the collaboration and exchange between a broad range of private and public actors may help to tackle new challenges that aviation has never faced before, maximising the value of the U-space for its users and enabling the scalability of UAS technologies. ■

(16) Hately *et al.*, 2019.

Larissa Haas is employed as Scientific Advisor for Innovative Technologies at the Federal Office of Civil Aviation (FOCA). In her position, she contributes to the conceptual design of economic regulation and the analysis of potential new markets for emerging technologies, such as UAS. In addition, Larissa coordinates the assessment of emerging technologies with regard to sustainable development and the creation of respective strategies. She holds a master’s degree in sociology and global governance and completed further education on managing the impacts of technological disruption on society and politics.

Making urban air mobility a reality for Europe and its citizens

Patrick Ky
Executive Director of EASA

Urban air mobility (UAM) looks set to be a reality in our cities just three to five years from now. This puts aviation on the brink of the biggest change for the broader population since commercial aviation became commonplace. As with all developments on this scale, the evolution will have an impact on the public perception of the entire aviation industry. It presents an opportunity to demonstrate our ability to innovate. But it also underlines the importance of ensuring that safety must prevail, just as it does in other areas of aviation operations.

We are already seeing an increased desire to use unmanned aircraft systems (UAS) – and similar platforms with a pilot on board such as eVTOLs (electric vertical take-off and landing) – to enable the transportation of goods and people by air within individual cities – or from locations outside the city into a city area.

The use of UAS with new technologies and electric propulsion and enhanced battery capacity offer a new dimension to the aviation sector. Every day there are more and more innovative operations in the area of infrastructure surveys, medical services as well as photographic and digital services.

The decision to introduce, or permit, urban air mobility operations in a particular location does not lie with the European Union Aviation Safety Agency (EASA). But it is our role to set the rules that enable these operations, ensuring that they are safe, sustainable and efficient and that citizens' concerns about such operations are taken into account.

For citizens, UAM will bring the currently rather distant concept of "airspace" down to ground level, right next to where they are working, walking and living their daily lives.

This confronts EASA with a very specific challenge: how can we address citizens' concerns, worries – and even fears – and provide them with the needed assurances, while also paving the way for Europe to maintain its position as a leader in UAM?

> "...the evolution will have an impact on the public perception of the entire aviation industry."

To better assess the reality of this challenge, the Agency conducted an extensive study to measure the societal acceptance of UAM across the EU. This was the first EU-wide study of this type, encompassing a literature review, market analysis, a quantitative online survey of 4000 citizens from six different urban areas, 40 qualitative interviews and noise tests with 20 participants.

For EASA as a regulator this information is crucial. It will allow us to set up the rules and regulations in a way that is aligned with the expectations and perceptions of citizens. And it will help us to achieve this in a very short timeframe, to align with the progress being made to develop such aircraft.

Most important findings from the survey

First of all, we discovered that the citizens who took part in the survey were generally open to UAM developments and interested to try such services. 83% expressed an initial positive attitude and 71% said they were ready to try at least one of the UAM services considered in the survey (drone delivery or air taxi).

This initial positive stance is very helpful, as it allows a clearer focus on the specific concerns that need to be addressed.

The results were also surprisingly homogeneous across the six cities we focused on. For EASA, this was again good news and a good starting point, given that we are looking to create a single regulatory playing field at EU level.

The study results showed that the citizens' main concerns are related to safety, security, noise and the environment.

Safety of course for our agency is always the primary goal. What we discovered from the results is that while safety is extremely important for citizens, they also take it for granted that UAM will be safe, as they expect high standards in aviation. This is at once a positive endorsement for the safety of the industry and a challenge, as it sets

a high bar for safety achievements in this new environment. But this is a challenge we embrace.

As we expected, noise is definitely a concern – but some mitigation of this is possible if the type of noise fits in with typical city sounds. The tests we were able to do in this area were limited – both in terms of the number of participants and the type of tests. As these aircraft are at best available in a limited number of prototypes, no real experience was possible.

On the environment, we had anticipated that citizens would see UAM as a way to reduce congestion on the ground and have cleaner air in the city. And indeed, this expectation was confirmed. Additionally, the global environmental/climate impact and sustainability of the whole UAM industry (battery, vehicle, energy production) was highlighted as an important factor which needs to be adequately addressed.

However, there were some findings that we had not anticipated. These included concerns about the impact of UAM on wildlife, specifically the potential negative effect on birds and insects.

The participants also raised a quite specific fear of visual pollution, perhaps explained by the fact that European cities have old cultural heritage to preserve.

A further surprise came in the level of concern about security and cyber security. It is clear that the abuse of drones for terrorist attacks or for deliberately causing harm to individuals is a real concern for many.

> “...the citizens who took part in the survey were generally open to UAM developments and interested to try such services.”

Many of the concerns made visible by the survey fall within the competences of EASA and the Agency will have to identify and propose mitigation options as it proceeds to put further regulations in place for UAM.

What are the next steps?

Manufacturers tell us that they will be ready to have these types of aircraft in operation in just three to five years’ time. Delivery drones are expected to come first, followed by electric aircraft that can carry people.

It is EASA’s responsibility to create the full set of rules for how these new in-city services can operate and also to certify the aircraft – manned and unmanned – that will be flying.

On the certification side, several lead players in this area are European companies. This brings new challenges for all parties involved. UAM aircraft are quite different aircraft from the ones we are accustomed to certifying. Their manufacturers are a mixture of established aircraft manufacturers and start-ups. For the start-ups, working with a regulator such as us to gain certification is a completely new experience. It is also a new experience for EASA to work with companies that have the typical mentality and approach to working of a start-up. We are learning from each other.

On the regulatory side, EASA has already produced a series of “world first” regulations and building blocks to support UAM:

- On **airworthiness** with our special conditions for eVTOLs and light UAS as well as the design verification guidelines.
- On **operations and pilot licensing**, in early 2019 we launched preparatory activities that will lead to rules for the pilots/remote pilots of these vehicles, their operators and for the infrastructure required, such as vertiport operators.

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- On **airspace integration**, EASA has prepared the world's first U-space/UTM (unmanned traffic management) regulatory package. This defines what is needed for the safe integration of drone operations into an urban environment. It was adopted by the European Commission on 22 April 2021 and will become applicable in early 2023.

On the research and development side, EASA is already engaged in a large number of projects. It has signed the Manifesto of the UAM initiatives for several European cities coordinated through the EU Smart Cities Marketplace.

As we move on to our next tasks, the results of the study will be used as a reference, for example when developing the Regulatory Impact Assessment that will accompany the future EU regulatory proposals aimed at enabling the operations of UAS in the "certified" category and the UAM itself.

With these proposals, the Agency will address all operations with UAS and VTOL, typically commercial, that involve a high level of risk due to the scope of the operation itself, involving passengers or dangerous goods, or due to the complex environment in which they take place.

A comprehensive set of European rules will be amended or created to address the airworthiness of these new types of aircraft, their operations, the licensing of pilots (whether on board or remote), the aerodromes in which they will operate and the rules of the air by which they will fly.

> "Citizens have made clear that they expect all parties to work together to make UAM happen safely."

In parallel, research activities are being run to establish adequate noise levels associated to the new aircraft propulsion technologies that could be acceptable to the public at the level of familiar city sounds.

Another way in which we will take this further is by offering support to, and closely monitoring, the results of EU and national pilot projects, which can demonstrate publicly the feasibility and the reality of UAM and so trigger "real" feedback from citizens.

With respect to the results of our societal study, we will prepare a specific action plan to cover all the key findings and will integrate these actions as appropriate in our regulatory and certification activities.

Concerns on privacy, such as usage for tracking or stalking individuals, or on integration in the local environment and local transport networks, will need to be addressed by other authorities, at EU, national or local levels.

When it comes to the findings and conclusions for which EASA is not responsible, we will ensure the relevant information is made available to those entities and institutions that are best placed to take them into consideration.

The next years will require intense work by many different organisations to enable this evolution and to ensure that it happens safely. Citizens have made clear that they expect all parties to work together to make UAM happen safely. We all need to work together to rise to this challenge. ■

More on EASA's actions on UAM and the complete report of the EASA study on societal acceptance can be found:
https://www.easa.europa.eu/domains/urban-air-mobility-uam

Patrick Ky is Executive Director of EASA. Since 2013, his mission has been to further consolidate the role and responsibilities of the Agency and to make the European aviation regulatory system a reliable framework. Before EASA, he was in charge of the SESAR programme. He also held various positions in the French Civil Aviation Authority, EUROCONTROL and the European Commission. He has over 20 years of experience in civil aviation. A graduate of the Civil Aviation Engineering School in France, he holds degrees in economics from the University of Toulouse and the Massachusetts Institute of Technology.

European development of U-space and EUROCONTROL's projects and initiatives to support it

Article submitted by **EUROCONTROL**

Over the next ten years, Europe expects to unlock the potential of drones to provide economic benefits to society and to create jobs in multiple sectors enabled by drones, including transportation, healthcare, logistics, construction, maintenance, etc. To that end, a new air traffic management concept for low altitude operations needs to be put in place to cater safely for the complexity and high volume of the operations expected. This concept, referred to as U-space, will include new digital services and operational procedures.

U-space is expected to provide the means to manage safely and efficiently high-density traffic involving heterogeneous vehicles (small unmanned aerial vehicles (UAVs), electric vertical take-off and landing vehicles (eVTOLs) and conventional manned aircraft), including operations over populated areas and within controlled airspace. U-space will have to integrate seamlessly with the ATM system to ensure safe and fair access to airspace for all airspace users, including urban air mobility (UAM) flights departing from airports. UAM is expected to be the most challenging type of operation supported by U-space.

A number of research and innovation projects, funded by SESAR, the Horizon 2020 programme, and national grants are ongoing in Europe to address these challenges.

The European Commission adopted a new regulatory framework for U-space on 22 April 2021 with Acceptable Means of Compliance as well as guidance material expected to be published later in the year. This is a significant step forward and the focus has now changed to accelerating U-space implementation across Europe. Development of a set of standards has also started in Europe, which will provide a solid framework for safety and interoperability without hindering innovation.

EUROCONTROL is a pan-European, civil-military organisation dedicated to supporting European aviation. It is committed to the European Union's vision for a Single European Sky. Its expertise spans research, development, operations and performance monitoring. EUROCONTROL supports the European initiatives related to U-space in a multitude of ways, as described in this article.

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1] Research and development

As co-founder of SESAR Joint Undertaking (SJU), research and innovation is a key activity of EUROCONTROL where it provides in-kind contribution. It participates in a large number of projects providing domain expertise, including management of research projects, validation processes including experimental design, data analysis, simulation, human factors and the development of experimental prototypes. Key research projects related to U-space that EUROCONTROL is actively involved in are:

SESAR U-space projects

- CORUS-XUAM *(Concept of Operations for euRopean U-space Services – eXtension for Urban Air Mobility)* Coordinated by EUROCONTROL, a very large-scale demonstration (VLD) project that demonstrates how U-space services and solutions could support integrated UAM flight operations. It updates the existing U-space Concept of Operations (developed in an already completed project CORUS) to address the integration of UAM/UAS (unmanned aircraft systems) operations into the airspace, and identifying new U3/U4 services.
- BUBBLES *(BUilding Basic BLocks for a U-Space SEparation Management Service)*
- DACUS *(Demand and Capacity Optimisation in U-space)*
- ICARUS *(Integrated Common Altitude Reference system for U-space)*
- INVIRCAT (*IFR RPAS Control in Airports and TMA)*
- URCLerED *(Unified Integrated Remain Well Clear Concept in Airspace D-G Class)*
- AURA *(ATM U-Space Interface)*

Horizon 2020 U-space-related research projects

- 5D-AeroSafe (*5 services of Drones for increased airports and waterways safety and security)*
- LABYRINTH *(Unmanned Traffic Management 4d Path Planning Technologies for Drones)*
- Drone4Safety *(Inspection Drones for Ensuring Safety in Transport Infrastructures)*

Other research activities

In addition to its contribution to SESAR projects, EUROCONTROL – via its Drone Unit – and the SJU actively cooperate to:

- develop and maintain the U-space research baseline (CONOPS, requirements, link to the Master Plan, Business Model) through regular review update of the U-space baseline considering the latest SESAR project outcomes;
- update the European U-space community by organising workshops and events to promote, aid and accelerate the application of U-space/UAM research.

2] U-space and drones-related regulations

EUROCONTROL provides technical and operational support to development of international and European regulations related to remotely piloted aircraft systems (RPAS) and U-space in the following key areas:

ICAO	a I Member of the ICAO RPAS Panel and co-rapporteur of the RPASP WG 2 C2 Link, a datalink which is critical for ATS and ATC data/voice b I Member of the ICAO UAS Advisory Group
EASA	a I Supported U-space regulation, endorsed by EASA committee. b I Support ongoing development of Acceptable Means of Compliance and guidance material for U-space regulation: • Lead WP1 Airspace risk assessment and WP5 U-space – flight authorisation • Participate in development of WP5 U-space – flight authorisation, WP7 Electronic conspicuity (reg. amending SERA) and WP9 – Coordination with local authorities • Drone regulation 2019/947 and 2019/945. c I Work package management and technical support to EASA to prepare aerodromes to mitigate potential risks from unauthorised UAS (or drones). d I Promote the guidance material using the extensive stakeholder network of EUROCONTROL.

3] U-space and drones-related standards

As far as international and European standards related to UAS, C-UAS and U-space are concerned, EUROCONTROL provides technical and operational support to their development in the following key areas:

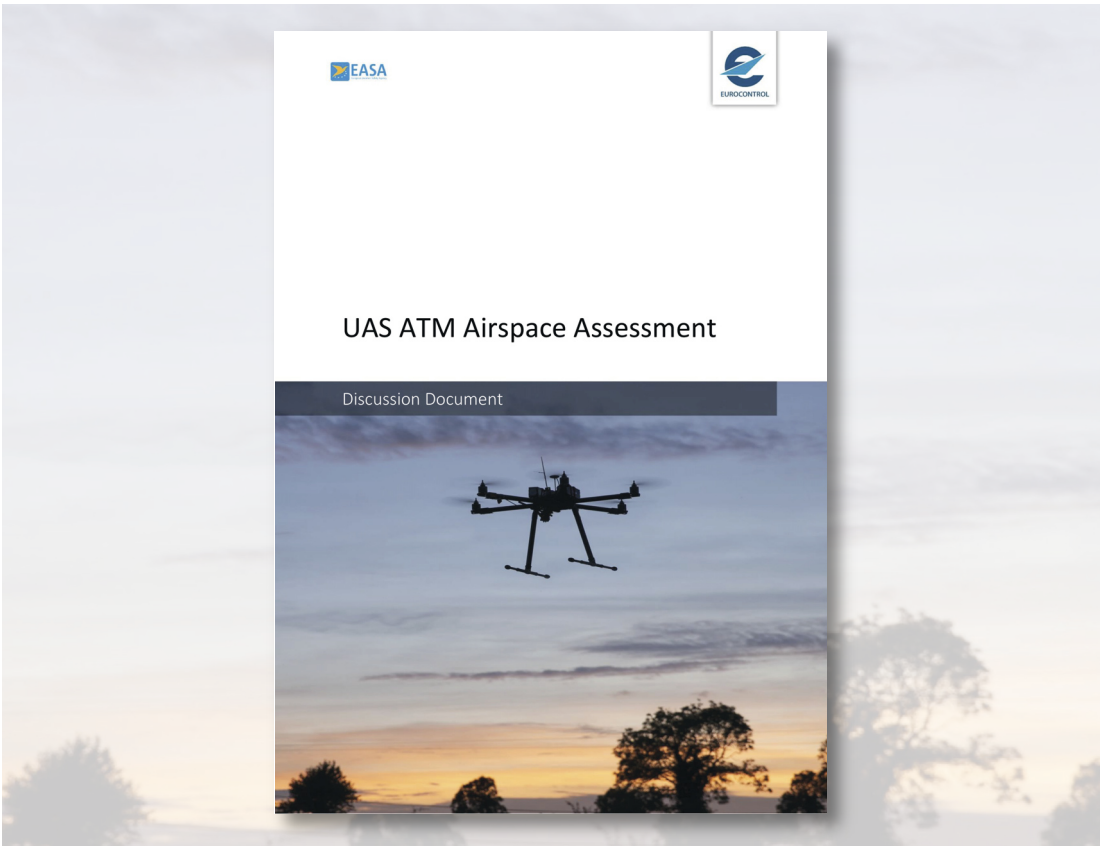
EUROCAE	a I Counter UAS (C-UAS) b I ED-286 OSED for C-UAS in controlled airspace c I Interoperability Requirements for C-UAS systems d I System Performance Requirements for non-cooperative UAS detection systems
IATA	Provide domain expertise in developing a document on "unauthorized UA incursions at the airport"

4] Support to States

On request from its Member States, EUROCONTROL supports them in technical and operational matters related to U-space and UAS. Some examples of ongoing support are:

- a I Establishment of a test corridor between EEC and Saint-Quentin-en-Yvelines (France) in order to validate scenarios and equipment for the purpose of the Paris Olympics.
- b I Conducting airspace assessments to identify where UAS are allowed to fly, what equipage they need and how they must interact with manned traffic. Estonia, Israel, Italy and Latvia are some Member States where EUROCONTROL is engaged in conducting airspace assessments.
- c I Technical guidance to implement U-space regulation to Moldova, Montenegro, Serbia and Turkey.

In order to promote interoperability of a future UAS and U-space system at global scale, EUROCONTROL coordinates and exchanges information with other geographical regions such as Australia, China, Japan and the United States.



5] Advisory service

In collaboration with its institutional and industrial stakeholders, EUROCONTROL provides technical advisory services on U-space matters. Key examples of ongoing advisory services include:

- Validation of U-space services in simulated environment at the European Experimental Centre located in Bretigny (France). The main near-term goals are the validation of drone services and airspace structures. EUROCONTROL is in a unique position to provide neutral validation against current standards and regulations. The main initial stakeholders to benefit from this effort will be CAAs, U-space service providers and UTM researchers (SESAR).
- CNS and operational expertise for RPAS instrument flight rules (IFR) to support ongoing work with Thalès on cyber security matters, ensure spectrum for drones is aligned with information gathered from relevant ICAO working groups, and to support DSNA to organise the security of future UTM in France.
- Promote EASA's efforts on disseminating best practices and ongoing activities with non-EUROCONTROL international States as part of the EU/EASA international workshops and activities.
- Technical and operational advice to international initiative on developing action plan on global Concept of Operation for UTM and a global action plan led by Airbus and Boeing (*Figure 1*).

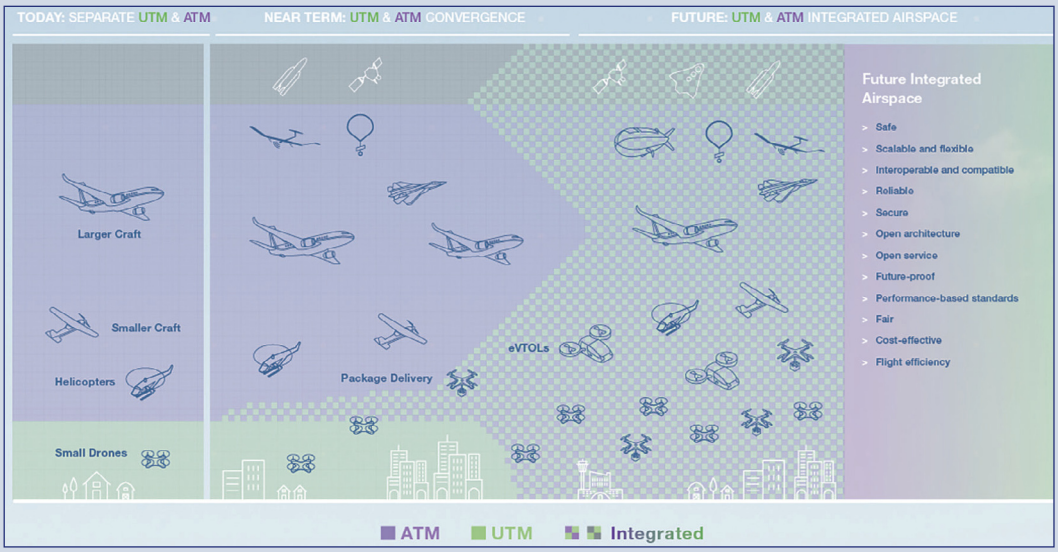


Figure 1: Unified traffic management vision of Airbus and Boeing

6] Promote transition from U-space demonstrations to implementations

In partnership with the European Commission, DG MOVE, EASA and the SJU, the Drone unit of EUROCONTROL facilitates sharing of lessons learnt via the European Network of U-space Demonstrators (refer to *Figure 2*) to support European businesses to transition from U-space demonstrations to implementations. Through conferences, webinars and surveys, the Network provides a platform for discussion and sharing useful resources for U-space-related businesses.

EUROCONTROL monitors and reports on an annual basis the status of U-space demonstration projects and implementation status of U-space services enabling very low-level operations in the Single European Sky (SES) Member States area.

- Building on state-of-the-art deployment of BVLOS operations
- Stimulate creation of regulations and standards
- Accelerate lead time to market
- Promote economies of scale
- De-risk implementations
- Reduce red tape

Figure 2: Objectives of European Network of U-space Demonstrators

7] Training

In partnership with EUROCONTROL Luxembourg, the Drones unit delivers training virtually and physically on matters related to U-space and UAS on a regular basis.

Remote ID and UTM: in the United States

Jay Merkle
Executive Director, Unmanned Aircraft Systems Integration Office, United States Federal Aviation Administration

If you have been following the rapid development of the unmanned aircraft system (UAS) industry in the United States, you may be wondering how the Federal Aviation Administration's new Remote Identification rule will affect our unmanned aircraft system traffic management (UTM) system under development. We understand people across the globe are interested in learning more about how this rule will affect the industry and help it grow. I have answers and insights I hope will frame the big picture on where we're headed.

We have made significant strides over the past few years developing, testing, and refining UTM concepts, principles and practices. We encourage an open dialogue with all global stakeholders to promote the development of safe, efficient and integrated UTM systems around the world. This work builds upon the ongoing activities in the United States, Europe and many other innovative nations.

UAS operators will rely on UTM services to help them plan routes, avoid weather and find safe landing sites during emergencies. UTM services communicate with each other to safely avoid other UAS through a process called "strategic deconfliction". Those services also use vast amounts of information to avoid manned traffic, making real-time course changes driven by detect-and-avoid systems on UAS. A networked solution will be central to a future UTM system, which will provide information about UAS in flight, such as the identity, location and altitude of the UAS.

Remote Identification (Remote ID) for UAS is the next incremental step toward integrating these aircraft into the United States National Airspace System (NAS). Remote ID serves as an "electronic licence plate" for UAS, much like ADS-B helps airplanes identify each other in flight.

Some UAS operators may be concerned that Remote ID will make their private information available to the public. I want to address that right up front – Remote ID does not make an operator's personal information, such as name and address, available to the public. Remote ID enables appropriate authorities to connect a UAS to its operator. Just like the licence plate on your car, others may be aware of the tag number under which a UAS is operating, but the operator's personal information such as name and address will not be broadcast.

> "It is imperative that we share information on our efforts with other countries because it supports harmonising UAS traffic management worldwide."

Remote ID will provide information about UAS in flight, such as the identity, location and altitude of the UAS and its control station or take-off location. The ability to share this information is the foundation of the security groundwork needed for more complex UAS operations.

The FAA is committed to working with the UAS community to continue to explore how sharing network information will support UTM development and safe integration activities. Operators can choose to share information using a network connection; robust infor-

Remote ID and UTM: in the United States

> "We are excited about what the future holds and grateful to be on this revolutionary journey with an innovative, engaged and safety-minded drone community."

mation sharing may provide operational insight that may get leveraged in the future.

Information sharing is not an activity exclusive to UAS operators. The FAA has ongoing discussions about information sharing with several international organisations, including the International Civil Aviation Organization (ICAO), the Civil Air Navigation Services Organisation (CANSO), the Global UTM Association (GUTMA) and the European Union Aviation Safety Agency (EASA). We also have similar bilateral discussions with civil aviation authorities in Australia, France, Poland, Singapore and Switzerland.

Last year, we held a UTM development workshop in Rwanda for 18 African organisations.

We value bilateral discussions with UTM innovators in other nations to help develop international standards and regulatory forums. As a member of GUTMA, the FAA shares its UTM experience with a diverse community of stakeholders. This is an example of how we learn from others as they learn from us. We share our experiences at GUTMA events with all parties. The FAA engages in these forums to develop and refine the ICAO UTM framework with information introduced by group members, such as at the annual Drone Enable symposiums to address evolving needs.

The FAA continues collaborating with ICAO, exchanging best practices with the Western Hemisphere regional offices on model regulations and UTM. In the fall of 2020, the FAA worked with ICAO's Cooperative Development of Operational Safety and Continuing Airworthiness Programme – South-East Asia Office, to put on a UAS integration virtual mini-workshop. More than 70 participants representing 12 South-East Asian countries attended the event.

It is imperative that we share information on our efforts with other countries because it supports harmonising UAS traffic management worldwide. Standards and procedures in the international commercial aviation community ensure that all passenger and cargo operations are conducted safely. We're working diligently to build the same safe and efficient traffic management system to integrate UAS operations in the NAS.

As we see more UAS in the sky, we all have a role to play in the future of UTM. The international community must work together to advance this innovative technology while ensuring the public's safety and security. The FAA plans to get there safely with all of you, the public. We are excited about what the future holds and grateful to be on this revolutionary journey with an innovative, engaged and safety-minded drone community. ■

Jay Merkle is Executive Director of the Federal Aviation Administration's Unmanned Aircraft Systems Integration Office. Merkle has over 30 years of extensive experience in engineering and programme management. He started his career as an engineer working in cockpit and crew station design on several aircraft, including the C-17 large transport aircraft. Jay holds a bachelor's degree in psychology from the University of Central Florida and a master's in industrial engineering and operations research from the Virginia Polytechnic Institute and State University.

UAS – a new paradigm for aviation regulators

Declan Fitzpatrick
Manager of Strategy, Policy and Compliance, Irish Aviation Authority

In the early days of civil aviation in the 1940s and 1950s, aviation played a critical role in helping to redefine and develop our island nation. It provided Ireland with key links to our neighbours, and helped shape our open economy and our ability to trade within Europe and further afield. The potential of aviation connectivity was recognised from an early stage, with the establishment of a national airline in 1936, and Ireland has always sought to maximise the opportunities from the growth in civil aviation in the intervening years. In 2019, over 93% of journeys to and from Ireland were by air, whilst Irish airlines carried over 150 million people. There were over 38 million passengers arriving at or departing from Irish airports, helping to drive our tourism and economic prosperity.

In 2021, unmanned aircraft systems (UAS) are now quickly redefining and reshaping our understanding and approach to aviation operations and airspace management. Drone use in Ireland is not completely new and has been regulated by the Irish Aviation Authority (IAA) since 2000. The regulations have been updated on several occasions to keep up with the rapidly developing technology and in 2015 Ireland was one of the first States to introduce a mandatory drone register, recognising the growing influence of drones.

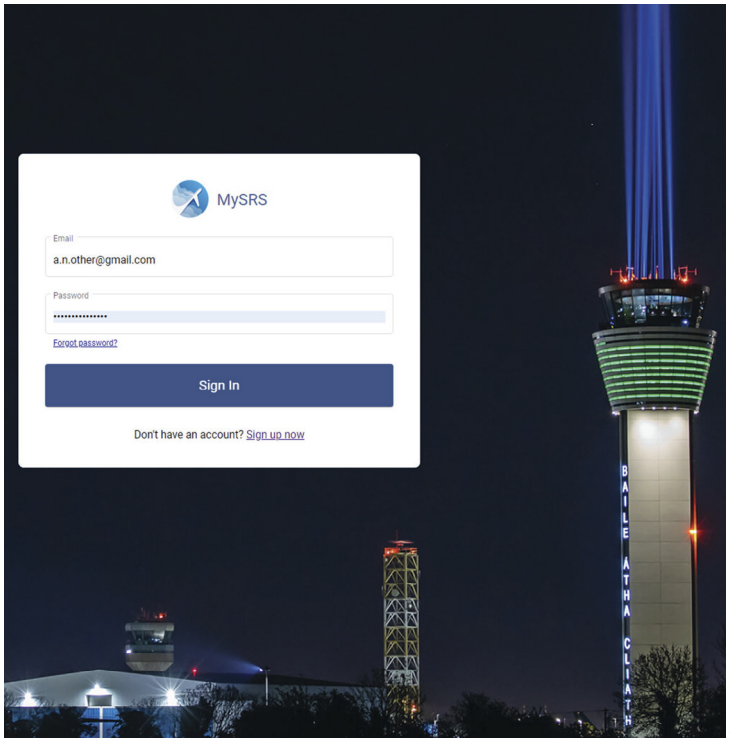
Nonetheless, the introduction of the pan-European regulation for the operation of UAS on 30 December 2020 represented a major change to the existing certification and oversight processes, and in 2019 the IAA performed a major change review on how UAS operations and the related industry will evolve in the coming years, and on how we can best perform our certification, oversight and enforcement tasks.

Digitalisation

Based on the data from our existing drone registry and national permissions system in operation since 2015, it was quickly identified that the number of drone operators was going to be in the thousands and declarations and authorisations would quickly rise. Likewise, the existing systems offered limited capability in terms of risk-based oversight and had no scope to offer pilot online training. It was very clear our existing systems would not be fit for future purpose.

The IAA had already embarked on a major digitalisation project, a project which was in its initialisation phase in 2019 and which would provide a 24/7 online digital solution for all applications and interface with customers. With the impending growth in drone operator registrations and in pilot competency online training, it was decided that the first module of the new digitalisation solution would need to address UAS.

In the last quarter of 2020, the IAA began its roll-out of its new



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"MySRS" solution. When complete, all communication with clients related to licensing and certification will be conducted through this solution. Clients will be able to log on 24/7 to access their certificates and licences, submit applications, pay fees and submit queries. The solution incorporates the latest digital identification standards, the "eIDAS-QES" requirements in Regulation (EU) 910/2014, removing the need for any paper transactions or records.

The roll-out is on a phased basis and the first UAS module chosen for deployment was drone operator registration and a drone pilot online training application launched in Q4 2020.

To date, the IAA has processed over 3500 operator registrations and over 6100 proof of completion of A1/A3 pilot online training. The solution also allows the IAA to securely link to EASA through the EASA broker solution, ensuring drone operator data is available to all EU Member States, a requirement in Article 14.4 of Regulation (EU) 2019/947 which requires Member States to "ensure that registration systems are digital and interoperable and allow for mutual access and exchange of information through the repository referred to in Article 74 of Regulation (EU) 2018/1139." The IAA was the first EU Member State to successfully complete this requirement.

Choosing the UAS regulation as the first solution to deploy in MySRS presented a number of development difficulties. As the regulation was new, interpretation and identification of the consequences of some requirements evolved during 2020, requiring multiple iterative changes in the MySRS solution. Nonetheless, our project team persevered and have delivered an excellent solution from which we are now reaping the benefits in terms of providing UAS operators, industry and the regulator an effective and efficient solution.

Over the rest of 2021, MySRS will be expanded to include all customer interfaces including declarations, authorisations, LUC initial applications and continuing oversight. When complete, the system will automatically provide intelligence on key performance indicators such as the compliance level and the safety performance of individual UAS operators.

UAS risk profiling

As part of our ongoing risk-based and compliance oversight programmes, the IAA develops sector and organisational risk profiles, identifying the key risks in each sector which then informs the annual oversight plans at a sector and individual organisation level. The MySRS platform provides a readily accessible and rich source of data to support risk assessment and risk profiling at both sector and organisational level that informs the IAA safety oversight policy and planning in this domain.

Under national regulation, operators were required to obtain specific permissions to perform operations, which included the completion of training in designated training schools. Despite many people starting without any background or experience in aviation, the approach adopted was successful in ensuring that all commercial operators gained the necessary skills and experience to perform operation risk assessments and to operate safely in Irish airspace.

Under the new 2019/947 regulation, the role of the training schools has evolved, with a greater focus on educating operators on how to complete declarations and submit authorisations. While the role has changed, the continuing role in educating drone operators is welcome and the IAA does not foresee a major change in the risk profile of organisations currently holding national permissions, as they transition to declared and authorised operators during this year.

"Open" category and enforcement

One area of identified UAS risk is the operation of drones by the general public for recreational purposes. Typically, when an operator purchases a smaller drone for recreational purposes they are unaware that they are subject to certain operational limitations in the open category. To address this risk, the IAA has invested in regular safety promotion campaigns with drone retailers and through traditional and online media such as YouTube, Facebook and Twitter.

In some cases, drone operators are aware of the requirements but do not comply. These pose a greater challenge for any regulator and can undermine the trust of compliant operators if not quickly identified and prevented from continuing to operate illegally. The IAA has enforcement powers to seize aircraft and to prosecute operators for non-compliance; however, it can be difficult to identify operators involved unless the IAA inspector witnesses the illegal operation.

The introduction of CE standard drones with mandatory remote identification capability will improve the ability of the general public, law enforcement and IAA inspectors to identify uncooperative operators. For example, it is anticipated the IAA will be able to establish "listening posts" in areas with reported illegal activity and quickly gather the required evidence. Combined with new powers being assigned to the IAA to issue on-the-spot administrative fines, the ongoing risk from uncooperative operators will be mitigated in the near term.

Occurrence reporting

The IAA publishes an Annual Safety Report, available on the IAA website at: https://www.iaa.ie/safety/annual-safety-performance-reviews. The report provides a detailed analysis of occurrences and key risks in each manned aviation sector. Despite highlighting as an emerging risk for some years, particularly to helicopters operating HEMS or SAR, there have been very limited reports of incidences with the potential for collision of manned and unmanned aircraft.

In general, the IAA has received an average of 26 reports per annum (2016-2019) from aviation professionals on drone sightings

while flying in Ireland. This figure increases to approximately 45 reports per annum for operations outside Ireland. Typically, these reports are in the vicinity of aerodromes and did not require any immediate avoiding action by the crew. There were three occurrences between 2016-2019 which caused temporary suspension of operations at Irish airports resulting in a small number of diversions and some short-term delays to aircraft arrivals and departures.

The IAA also receives voluntary reports from the public through its dedicated website: https://www.iaa.ie/safety/safety-reporting. The numbers received in this manner have been minimal to date and mainly address issues of local concern (e.g. commercial issues, public nuisance).

UAS as a disruptive technology

UAS represents a major disruptive technology, within aviation and for application in other industries. A simple example is the use of drones in place of manned helicopters for the inspection of infrastructure such as electrical power lines and windfarms. When a UAS operation replaces an existing process, it will typically be less costly, have a lower environmental impact in the context of noise and pollution, and/or have a lower risk to life (safety risk). Deployment of drones in search and rescue operations, at fires, and in dangerous environments such as close to high-voltage electrical cables greatly improve the overall threat of risk to life.

Deployment of drones for commercial purposes such as home deliveries, currently undergoing operational trials by Irish start-up company Manna Aero, can claim positive environmental credentials, replacing heavy carbon-based vehicles driving on congested roads with all-electric quiet deliveries in shorter timeframes. Rather than being a noisy intrusion, they are a quick, efficient delivery platform and have received outstanding support from communities where trialled to date. Concerns on the societal acceptance of UAS operations have not yet materialised.

Conclusion

UAS is quickly establishing a strong foothold in our society, deployed in a myriad of applications from food delivery, aerial photography, search and rescue, crop and forestry surveillance to name but a few. Societal familiarity and acceptance is growing.

The EU regulatory framework, while being somewhat complex and unwieldy for the general public, provides for all types of operations with drones from 1gr to 100 tonnes and will facilitate the rapid growth of UAS deployment across Europe in the coming years. While Europe's aviation regulators must adopt to new responsibilities as the competent authority, developing new competencies and UAS experience, they are being supported by EASA and other Member States through workshops, dedicated training and shared safety promotion materials.

The recent publication of U-space Regulation (EU) 2021/664 represents the next major challenge for Member States: how to facilitate high-volume UAS operations in our cities and towns in the future. The exact speed of adoption of UAS concepts such as urban air mobility will remain unclear for some time; there are still a number of major technical hurdles to be navigated. However, what is clear is that UAS will become a major part of the future aviation eco-system. Just like the growth of civil aviation in the 1940s and 1950s benefited Ireland and its people, so too will UAS operations bring benefits today, helping to address some of the key challenges facing our society in the coming years. As the aviation regulator, our focus is to facilitate and encourage this growth while ensuring safety remains our number one priority. ■

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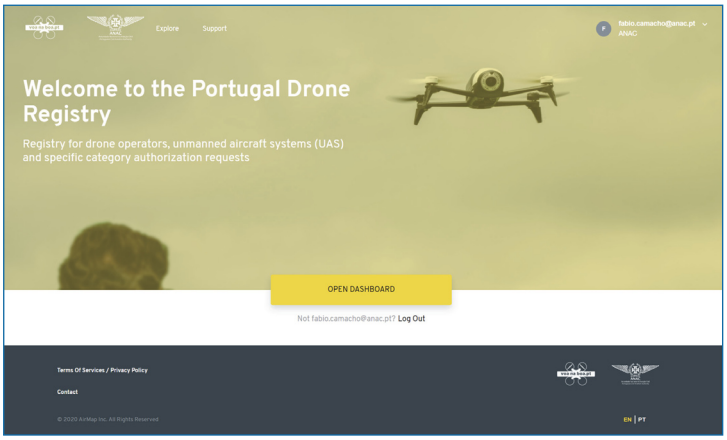
Registration system in Portugal and related legislation

Fábio Camacho
Head of Unmanned Aircraft Systems Department
Portuguese Civil Aviation Authority (ANAC)

Civil UAS (unmanned aircraft systems) operations have brought a sea of opportunities - but also a wide range of risks to society. Within this context, in 2014 the European Commission decided to develop a more inclusive and comprehensive regulatory framework to accommodate the new stakeholders' operations into the European Single Sky. Due to the safety, security, data protection and environmental concerns, rules and functions were governed – in a first approach – at national level. A joint and centralised effort was the final goal to promote operations and raise public acceptance at the European level. Therefore, during the gradual evolution and maturity of ideas, common understandings were identified as key factors, with the registry emerging as a building block to materialise UAS integration into the airspace and promote acceptance.

Gradually, the idea of achieving integration in a safe and secure manner was supported in an increased risk rationale: the *categories of operation*. Categorisation has a strong safety thinking and doesn't neglect the security aspects, recognising the need to control the players in the low- and increased-risks operations – the so-called "open" and "specific" – categories. Robust registry systems are founded in digitalised and trustable authentication systems, recognised as safe and secure by States. Because of genuine security concerns, an acceptable level of control of individuals and operators within Member States was indeed necessary. The European Commission therefore included Article 14 in the Commission Implementing Regulation (EU) 2019/947 of 24 of May 2019, allowing for establishment of harmonised requirements to execute the registry. As a result, new opportunities to create a fully digitalised registry are possible, furthering information exchange and including associated products, namely the authorisations and certificates.



Portuguese Civil Aviation Authority (ANAC) registry system (https://uas.anac.pt)

The UAS operator registry mandate is founded on the need for interoperability as a vehicle to be a step closer to SES digitalisation and decoupling, since it is a first contributor to creating a European network and a connected library – in this specific case for UAS operators and UAS subjected to registry. Interoperability is the ultimate tool needed to gain trust at European level, enhancing mutual recognition; it will simplify oversight and control by the law enforcement authorities through direct remote identification or simply by verifying the registry number attached to the UAS frame. Additionally, the purpose of the registry is not solely to control and identify operations or operators with a high-risk profile (safety, security, privacy protection of personal data or environment); it also seeks, indirectly – in accordance with Member State implemented solutions – to maximize the information gathered in the national database, therefore allowing such data to be available for future U-space service providers (USSP) established in the U-space. U-space milestones cannot be affected by the registry system itself. A registry supported in trustable authentication systems paves the way for generalised acceptance and could have a substantial dissuasive effect. In this context, we could assume that electronic identification services users are trustable, since connected UAS operators can be traced to the authority registry system and Member State-certified authentication database. Likewise, the benefits are extended to citizens and law enforcement authorities. Those who hold a valid UAS operator registry number issued by the competent authority are assumed to be trustable and should

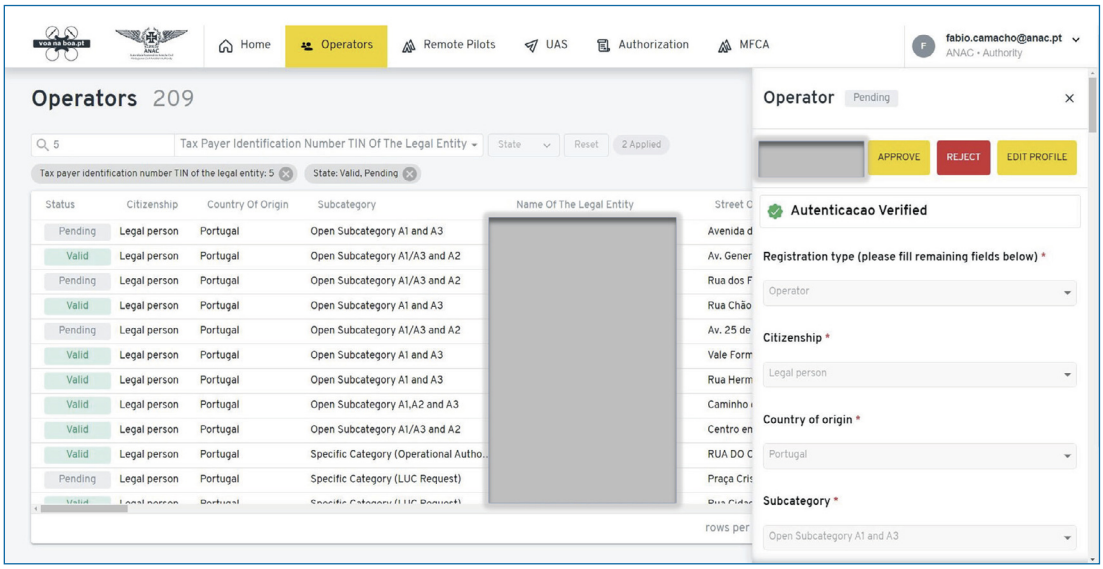
remain trustable if no infringements are detected during the planned oversight cycles, inspections or verifications. UAS operator registry systems do not eliminate the possibility of illegal acts by perpetrators nor compel the individuals to apply for a registry number; nonetheless, the registry is a fundamental starting point to differentiate registered operators from those who are not, and who may pose a risk.

The registry seeks to expand opportunities and increase the value chain in the aviation domain since it is the foundation of the integration process. Bearing in mind the registry objectives, the Portuguese registry system recognises the importance of the registration number to be used as an identification "tag" to achieve the full scope of the repository of information and the interoperability of data stated in Article 74 of the Basic Regulation (EU) 2018/1139 of the European Parliament and of the Council of 4 July 2018. The registry itself cannot be avoided since it is an essential requirement of Annex IX of the aforementioned basic rules. Therefore, Article 14 of Commission Implementing Regulation of 24 May 2019 on the rules and procedures for the operation of unmanned aircraft, commensurate with said basic rules, makes mandatory the registry of UAS operators and UAS that have a certification basis as follows:

1. If involved in low ("open" category) and increased risk operations ("specific"):
   a) When operating within the open category, unmanned aircraft:
      i. with a maximum take-off mass (MTOM) of 250g or more, or, which in the case of an impact can transfer to a human kinetic energy above the 80 Joules threshold (below the weight and kinetic energy threshold, the UA is assumed harmless);
      ii. that is equipped with a sensor able to capture personal data (for example, a microphone, camera or a video recording device), unless it complies with the "safety of toys" Directive 2009/48/EC;
   b) When operating within the "specific" category, regardless of the unmanned aircraft MTOM.
2. If the unmanned aircraft is subject to design certification by EASA, the individual registry of the UA is mandatory in line with ICAO Annex 7 (for example, the UA has a certification basis; thus, it has a type certificate or a restricted type certificate).

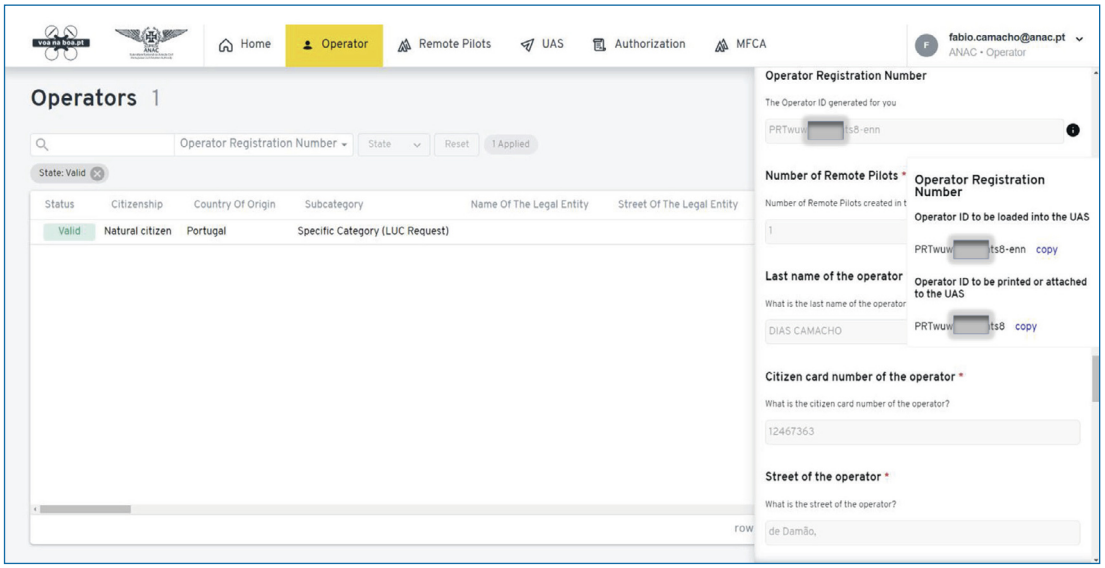
> "...the registry emerged as a building block to materialise UAS integration into the airspace and promote acceptance."

Nowadays, the interoperability is expected to be implemented through the EASA broker solution for a transitory period. The harmonised format established in the Acceptable Means of Compliance and Guidance Material is vital to develop the necessary applications to grant mutual access and exchange of information between national repositories, as referred to in Article 74 of the Basic Regulation



Authority view and issuance of the UAS operator registry number. User identity verified against Portuguese government-certified authentication system ("Autenticacao Verified").

Registration system in Portugal and related legislation



UAS operator dashboard. Issued UAS operator registry number.

> “A registry supported in trustable authentication systems paves the way for generalised acceptance and could have a substantial dissuasive effect.”

(EU) 2018/1139. Meanwhile, it is essential to focus on the first integration step based on the broker solution until the adoption of delegated or execution acts to rule-making the interoperability requirements.

Considering that the digitalisation of processes in the registry contributes to promoting interoperability, the web-based system was developed to capture the different interactions of the products associated with the registry (Figure 1). The “digital databases” not only integrate the mandatory registry requirements data of UAS operators and certified UA registry but also allow cross relationships, modules for model flying clubs and associations identification, a module to manage the remote pilots of the UAS operator (certificates), and non-certified UAS (legacy, class marked or privately built). Generated products are complementary to the UAS operator registry number. The solution intends to increase the feasibility of the oversight and prepare the registry for the next big step of integration – the U-space regulation package, officially adopted by the European Commission on 22 April 2021.

The added value of such an approach is obvious. The generated products will be immediately available once issued, so a change in the status will be immediately reflected in the availability of data to be exchanged. The reasoning behind this was to increase automation, decrease the number of tasks that can lead to errors, and avoid undue delays. Still, there are different solutions and enough flexibility to adapt the registry system to competent authority current management software simply by integrating a new module. The development of a specific registry application that integrates the information from different applications used by the competent authorities is also possible. The Portuguese solution was to implement a registry system specifically to cope with all regulation requirements by implementing a dedicated web-based software tailored to UAS operator needs. Registry software has two distinct views,

communicating with low latency to allow a quick request-authorisation flow:

1. the ***operator view***, to apply for a registry number, manage the remote pilots, request authorisations, verify the status of the requests (e.g. incomplete, pending, valid, rejected); and
2. the ***authority view***, with high-level permissions to verify, manage, change, suspend, revoke and authorise, as necessary.

Regarding the registry of certified UAS, we shall consider some already-known complex considerations related to aircraft transactions, namely the de-registration in one State, the registry in a new State, fines and unpaid taxes, debts, commercial contracts (lease), and ownership. Certified UAS registry starts with the first assessment by the legal directorate that will issue the UAS registration markings certificate to the operator, ensuring that the UAS is available for a proper digital registry by the owner. ANAC did not identify the need to declare a difference in the registry marks format and therefore decided to apply ICAO Annex 7 format requirements for certified UAS, as explained below:

Format: CS-DNNNN, where:

- CS represents Portugal country mark
- D: unmanned aircraft systems (D from the colloquial word "drone"), and
- NNNN: a four-digit random number from 0 to 9999 (excluding numbers that could lead to confusion, such as emergency, communications failure, unlawful interference and loss of communication link codes).

The format will not be static and represents an initial step to accommodate the first certified UAS in the Portuguese registry system. Further developments are conceivable in the subsequent U-phases of operations integration and maturity. Questions will undoubtedly arise, namely the format for the registry of certified "swarms" or certified UAS operating in beyond-visual line of sight (BVLOS) transport networks. Likewise, multiple

> "The Portuguese solution was to implement a registry system specifically to cope with all regulation requirements by implementing a dedicated web-based software tailored to UAS operator needs."

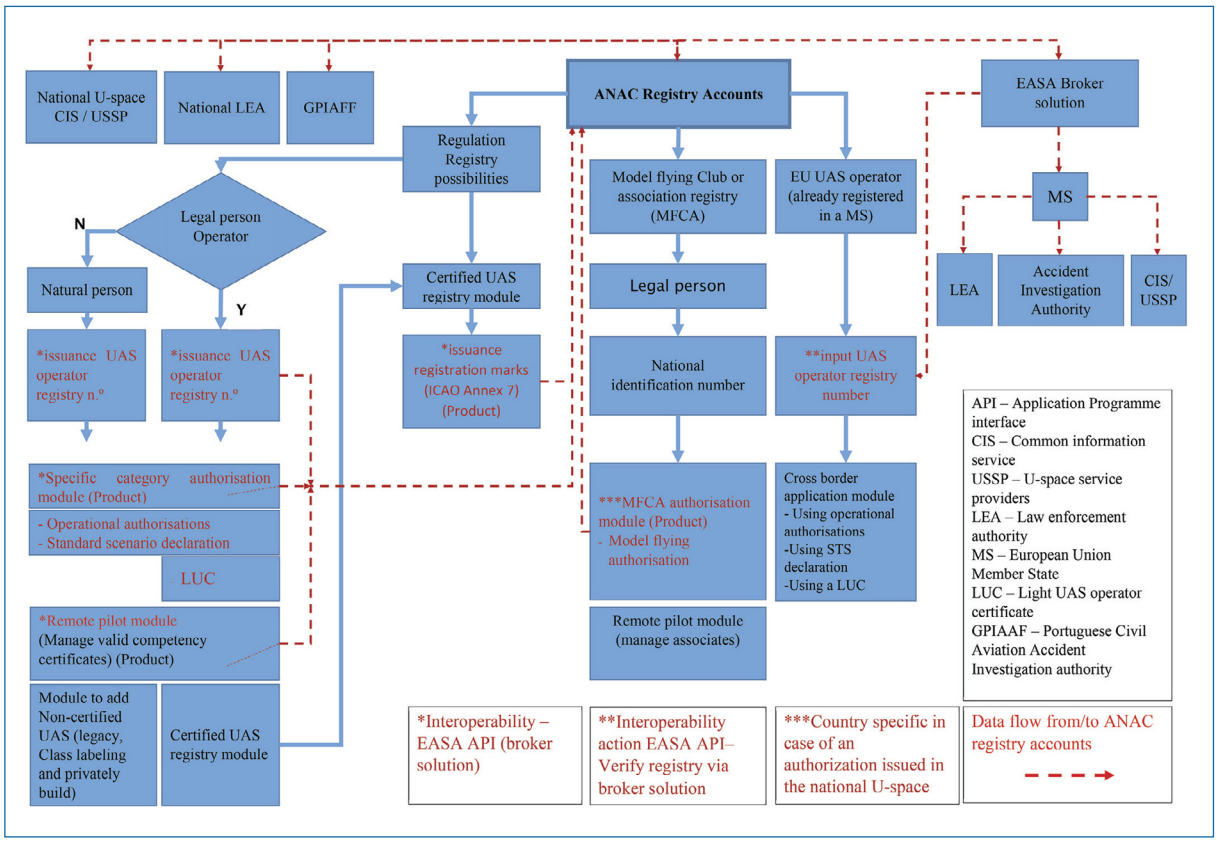


Figure 1: Context diagram of the Portuguese Civil Aviation Authority (ANAC) registry system full scope, incuding the associated products to the UAS operator registry number.

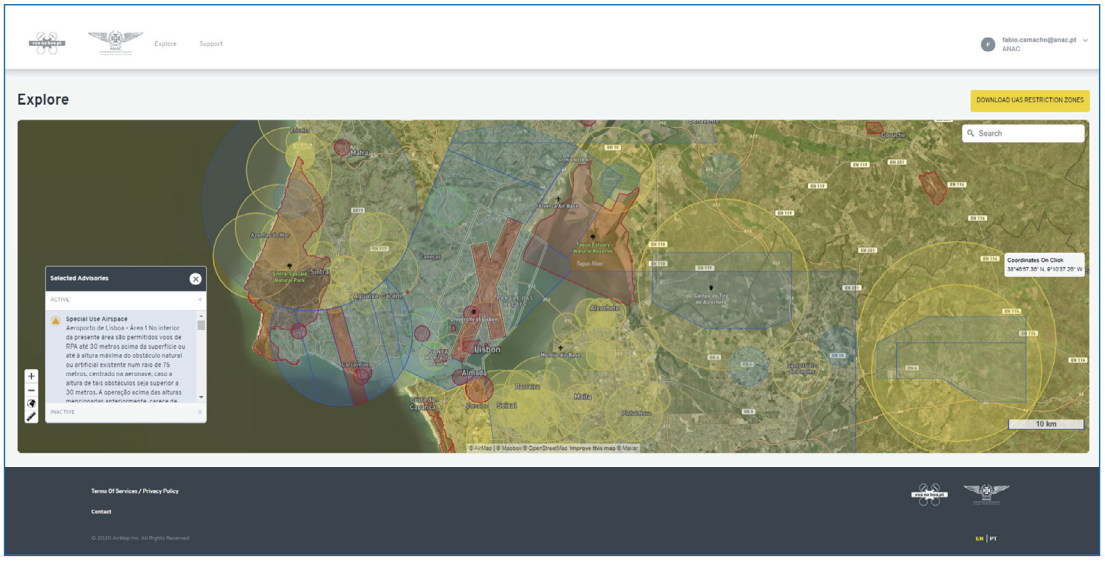
Registration system in Portugal and related legislation

certified UAS may be subjected to certification and registry in line with ICAO Annex 7, imposing the need to change the format and include letters to increase the availability of registry marks. Although the impact of such future complexity is most probably minor, the Portuguese registry is prepared to input, record, and "print" any registry format.

Immediately after the initial registry step, the certified UAS owner should enter the digital registry in the system. Uploading registry documents and approval by ANAC are necessary. Validation of the registry should be interpreted as a final step to include the certified UAS in the digital database for interoperability purposes, enabling participation in the said data exchange – of utmost importance to accomplish the interoperability objectives.

ANAC has worked on the means to implement a registry system specifically to support the operators, exceeding the minimum registry requirements by affording the same web-based system all the necessary digital functions to enhance integration, acceptance, process efficiency, and interoperability. Additionally, it is important to note that the Portuguese geographical zones are published in the registry system, either to be consulted by the operators or downloaded for planning.

Many of the described functions have already been successfully implemented. It is expected that authorisation modules will enter into production soon. ANAC is committed to improving the system in the coming months, integrating the required interoperability application programming interfaces, which are essential to share the UAS operator registry number, certified UAS information, and associated account products (e.g. authorisations). The web-based registry systems should go beyond the minimum requirements applicable to UAS operators and certified UAS. Eventually, the opportunity to encompass the digitalisation of SES in UAS matters, driven by the Member States' policies, the competent authorities' digital transition promotion, and the relevant stakeholders that execute operations, could be considered. ■



Geographical zones integration in the registry system.

Fábio Camacho is Head of the UAS Department at the Portuguese Civil Aviation Authority (ANAC). In this role, he is responsible for implementing regulations, participating in national rulemaking, consistent application of rules and procedures, developing guidance, and providing expertise in UAS-related policies at a national level. He represents ANAC for UAS and U-space matters, namely in the Commission Expert Group on aviation safety, EASA, ICAO, ECAC, and LSSIP implementation. Fábio has a strong air traffic control and flight operations background. He was an air traffic controller, flight operations officer, operations control centre (OCC) manager, and ATM/ANS auditor. Since joining ANAC, Fábio has focused his activities on ATM/ANS and UAS, allowing him to maintain close ties with the ATM/ANS and UAS national community, making bridges for the successful and safe integration of UAS into the Portuguese airspace.

Cyber security for UAS/drones

José Luis Del Carmen
Head of Technology & Aviation Cybersecurity Department, Ministry of Transport, Mobility and Urban Agenda, Spain

The rise of remotely piloted aircraft systems (RPAS) is well known. They are becoming a strategic sector of the first order, with new applications and services for the public and industry, which in turn implies a revolution in the aeronautical field.

Thanks to the entry into force of the regulations governing the use of this type of remotely piloted aircraft, which aim to ensure their complete development in full safety and secure conditions, the sector is expected to grow exponentially in a short period.

The introduction of RPAS into the aviation ecosystem entails the introduction of new threats (to be explored and identified) while at the same time increasing the risk of some existing threats materialising. In the case of cyber threats, the fact that there is no human presence "on board" reduces to some extent the ability to detect or respond, making the system more vulnerable. Cyber security is therefore considered a key factor in RPAS, because of their almost sole reliance on the use of technology. If in all aviation, cyber security is considered fundamental, in the case of RPAS it goes one step further.

This article reviews the regulatory framework developed at the European and international levels in recent years, to ensure that RPAS operations are carried out in a secure environment, to avoid conflicts between RPAS themselves and concerning manned aviation. However, there is one weakness in the system that has not yet been fully addressed and which may represent a threat: cyber security.

Regulatory requirements

One of the objectives of the regulation is that unmanned aircraft can use the same airspace as manned aircraft, without introducing new safety and security risks. A distinction should be made here between conventional airspace (A-G classification), where there will be both IFR (instrument flight rules) and VFR (visual flight rules) flights, and U-space.

> “Cyber security is considered a key factor in RPAS, because of their almost sole reliance on the use of technology.”

European Regulation (EU) 2018/1139 lays down essential requirements for the design, production, maintenance and operation of unmanned aircraft, as well as for personnel, including remote pilots, and organisations involved in these activities. This is the framework regulation for further regulatory development.

Regulation (EU) 2019/947 establishes three broad categories of unmanned aircraft systems operations:

- “Open”: safety is ensured through operations limitations, compliance with industry standards, and the requirement to have certain functionalities and a minimum set of operational rules. Enforcement mainly by the police.
- “Specific”: operations of medium risk and complexity. Authorisation by a civil aviation authority (CAA) possibly assisted by a qualified entity (QE) following a risk assessment on safety [and security] performed by the operator.
- “Certified”: operations of high risk and complexity. Requirements are comparable to those for manned aviation. Oversight by CAA (issue of licences and approval of maintenance, operations, training, ATM/ANS and aerodromes organisations) and by EASA (design and approval of foreign organisations).

Depending on the category, and therefore the risk, technical and operational requirements that operators must comply with are determined. These provisions increase in number and complexity as the risk of the operation increases.

This regulation has been amended by Regulation (EU) 2020/639, which sets out two standardised scenarios and the requirements to be met.

Delegated Regulation (EU) 2019/945 sets out requirements for the design and manufacture of unmanned aircraft systems intended for use under the conditions defined in Regulation (EU) 2019/947. It lays down rules concerning the placing on the market of RPAS intended for use in the open category. In addition, it lays down rules for third-country operators when

conducting operations under Implementing Regulation (EU) 2019/947.

This regulation has been amended by Delegated Regulation (EU) 2020/1058 to include two types of new classes of unmanned aircraft systems and related requirements.

It should be noted that none of the above-mentioned regulations introduces information security requirements.

Recently, Implementing Rule (EU) 2021/664 has been published establishing a regulatory framework for U-space. The regulation introduces the application of rules and procedures for the safety of UAS operations in certain airspace designated by the State, ensuring the integration of them into the aviation system. The regulation establishes the services to be provided in this airspace, which will be based on digital services and automation of functions. The regulation applies, within the defined airspace, to operators, U-space service providers and common information service providers. Cyber security requirements are only indirectly established for U-space service providers through the requirement to have a security management system under ATM/ANS.OR.D.010.

In addition, EASA is about to launch the opinion of the future information security regulation (PART-IS), which will establish requirements in this field for all entities in the aviation domain. However, this future regulation does not include UAS operators for the time being.

At the international level, ICAO adopted, at the fifth ICAO Council meeting at its 222nd session on 1 March 2021, the International Standards and Recommended Practices (SARPs), Annex 10 – *Aeronautical Telecommunications*, Volume VI – *Communication Systems and Procedures relating to remotely piloted aircraft systems C2 Link*. The Annex states the importance of avoiding unauthorised interference in the exchange of information between the remote pilot station (RPS) and the remotely piloted aircraft (RPA) for the safety of operations. It therefore establishes high-level SARPs that address the need to avoid interference from RPAs. The design of the RPAS C2 link, the monitoring system and the operational procedures should be such as to minimise the possibility of any unauthorised control of the RPA or RPS during any operational phase.

> “ UAS face threats not only very similar to those of manned aviation but also to those of information systems and those arising from the location of the remote pilot. ”

Components and vulnerabilities

ICAO divides UAS (unmanned aircraft systems) into two types: on the one hand, RPAs (remotely piloted aircraft), which are remotely piloted; and on the other hand, UAS that fly completely autonomously.

Before addressing the vulnerabilities of this type of vehicle, it is first essential to know that all RPAS are controlled by the remote pilot through a remote pilot station (RPS) which is connected to the RPA via a command and control link and the communications services implementing the link (hereinafter referred to as the “C2 link”), which is used by the pilot to manage the flight of the aircraft. The last leap of the C2 link is provided by a wireless communications channel.

In the case of an autonomous UAS, there is no pilot and it manages its own flight, so it does not need a C2 link. However, it could be assumed that there will be communications with a control centre, responsible for reporting its status at regular intervals and alerting in case of contingencies. This will require communication services and the last hop will again be wireless.

Currently, the C3 concept is emerging, in which command and control include “communications” between ATC and the mission control centre. This introduces new cyber security risks.

In any case, the problem is to define efficient and effective means with which the RPAS is protected against cyber attacks; how an attack is detected, how to react to it, how to neutralise it, or at least how to mitigate it. All this taking into account the partial or total absence in the loop of one of the important factors in the resilience of the manned aviation system: the human behind it. This implies placing more trust in the technology used and that a significant fraction of the resilience, which is normally taken care of by humankind, is taken care of by the system itself. This requires that the UAS is designed and developed using security by design principles to ensure that each element/subsystem has basic cyber resilience to achieve the required level of security. This is important as all technical subsystems consist of hardware and/or software, each of which has the potential to introduce cyber security vulnerabilities.

Vulnerabilities in hardware can be exploited through physical access or the exploitation of existing weaknesses or intentionally placed within the system architecture or lifecycle management (e.g. through the supply chain).

Software is designed and developed to control hardware. Software vulnerabilities can be introduced/exploited throughout the lifecycle, from design, development, deployment, operations and decommissioning.

It is therefore clear that UAS face threats not only very similar to those of manned aviation but also to those of information systems and those arising from the location of the remote pilot in open space, rather than in the protected space of the cockpit. Attacks can range from remote code injection, denial of service, to the disclosure of confidential information, spoofing, jamming, tampering, etc.

Risk-based approach

Many of the countries in the ECAC environment have conducted RPAS risk analysis and mitigation. Risk scenarios have been defined and the impact of the operation has been assessed. This analysis has been carried out from a safety and security point of view. For this risk analysis, scenarios in which an RPAS suffers a cyber attack have been analysed and their impact has been assessed. Although the probability of a scenario materialising in civil aviation does not seem to be very high at present, it is important to carry out this exercise and become situationally aware, as developments can change rapidly. In addition, this type of exercise can be used to rule out operational scenarios in which no major impact is detected so that cyber security requirements are not established, as this imposition can be a large and unnecessary barrier to the evolution of this aviation system. This could be the case for open category RPAS and some of the specific category scenarios. On the other hand, standardised scenarios can be identified in which cyber security measures can be imposed.

For those operational scenarios in the specific category that require operational approval from operators, operators should include cyber security risks in their risk analysis. A specific methodology for cyber security should be developed for this risk analysis.

For the certified category, the PART-IS should apply to the full extent, and therefore the implementation of an ISMS and external incident reporting should be required.

Supply chain and end-to-end security

In information security, it is often said that the system is only as strong as the weakest link, therefore supplier management and information sharing between entities to recognise and converge on risk analysis is important. The cyber security PART-IS should take this into account. As mentioned above, PART-IS applies to air navigation service providers and U-space service providers, but would not apply to RPAS operators. This aspect, therefore, introduces a new weakness to the aviation ecosystem that needs to be addressed.

Another vital point in cyber security is end-to-end security, i.e. that threats are mitigated from the initial design and manufacturing stages of UAS systems and components. In this regard, the possibility of requiring certification of systems and components (software, hardware and firmware) should be considered. As indicated in the previous paragraph, the aim is not to establish additional requirements that introduce difficulties in the development of this aviation system, but rather to identify those operational scenarios for which the manufacturers of the system or its components should comply with requirements for protection against cyber attacks, to reduce the risk of the scenario to acceptable levels.

Security

Another important point to take into account is the physical security of the RPAS systems. Physical security must be ensured, not only during the period of operation but also during the period of manufacturing (of systems and components), maintenance, provision, storage and transport of spare parts and shutdown. Unauthorised access at any of these stages to the RPAS may cause it to be modified and thus induce a risk to aviation. Therefore, another aspect to be taken into account.

Additionally, as a consequence of risk analyses carried out by the Member States, measures are being introduced to intercept RPAS in critical infrastructures using so-called anti-drone systems. During risk analyses from a security point of view (e.g. at airports), scenarios in which these measures are cyber attacked and the introduction of measures to mitigate a possible high risk should be taken into account.

Conclusion

As we have seen throughout this article, information security has not been fully taken into account in the UAS ecosystem. However, the requirements that are established must address this aspect from a risk-based approach so that it is carried out efficiently and does not include measures that prevent the evolution of this type of aviation, but is implemented while maintaining or increasing security levels. ■

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Drone incursions at airports – getting the response right

Phil Dykins
Head of Aviation Security Regulation
Civil Aviation Authority, United Kingdom

The series of incursions at London Gatwick Airport, which effectively closed the airport for two days in December 2018, marked a real escalation point in concerns about the threat to aviation from unmanned aircraft systems (hereafter referred to as "drones"), both in the United Kingdom and more widely.

Drone incursions were already a common occurrence at airports around the world, but these were normally short-lived and accepted as being non-malicious, in the sense that there was no underlying intent to cause harm or endanger safety. The risk of drones being used maliciously as a threat to civil aviation was certainly on the radar, but had not to that point materialised.

During the course of the Gatwick incident, it became apparent this was a deliberate attempt to disrupt, if not endanger, aviation. The duration of the incident and the behaviour of the drone made this clear. As a result, there was little choice but to close the runway, and it remained closed for nearly two days, with around 1 000 flights diverted or cancelled, affecting some 140 000 passengers.

This raised the obvious question – what could be done to stop this happening again? To which the answer was – and remains – it's difficult. A lot of work has been done since then to develop and exploit counter-drones technology for use at airports and other sensitive sites, but this technology is still in its infancy and is not widely available. Public education, regulation, registration and identification initiatives all have important roles to play in reducing non-malicious incidents, but will not deter a deliberate attack.

> "What could be done to ensure that the immediate response to the incident was not only rapid and effective, but also proportionate and informed?"

So this also raised other important questions – in the absence of technological solutions, how could we best prepare for other future incidents, malicious or otherwise? How could we identify which type of incident was which? And what could be done to ensure that the immediate response to the incident was not only rapid and effective, but also proportionate and informed?

Within the UK, we brought together airports, airlines, air traffic managers and law enforcement to look at these questions. Everyone quickly agreed, of course, that safety is, and would always be, the paramount concern. But some interesting nuances and differences of perspective emerged. Air traffic controllers pointed out that diverting large numbers of aircraft is also not without safety risks. Safety and airspace experts were not accustomed to factoring concepts like threat and intent into their risk assessments. Decision makers on the ground generally needed more information about reported sightings, whereas such information could actually be unhelpful for a pilot in the air. And ultimately, there was a balance to be struck somehow between protecting the safety of passengers and causing unnecessary disruption to their travel plans.

The best answer to these questions that began to emerge was around preparedness and contingency planning.

In the UK at least, there are several different agencies and interests that can be involved in an incursion incident at an airport. Their relative roles may depend on the nature and location of the incident, but may also vary from airport to airport. So rather than be prescriptive about how it should happen, we sought to develop some guiding principles, and asked each airport to develop its own local contingency plan based on those principles.

The guidance we eventually produced was set out in the National Civil Aviation Security Programme, which is of course a classified document, but available to all parties involved in the process.

This identified the keys to a response that is both effective and proportionate as:

- a clear and well-established decision-making process;

> “The inclusion of a threat assessment process was seen as a key component of achieving an effective and proportionate response.”

- effective communication between the different parties involved; and
- a robust process for assessing the threat and risk to the safety of aviation on the basis of the available information.

Each of these could and should be achieved through the development and regular exercising of local contingency response plans, which each airport was asked to take the lead in preparing in collaboration with local stakeholders.

In support of this, a number of tools were provided or recommended within the guidance, to be used in developing local response plans. These included:

- Local vulnerability assessments to be carried out by each airport.
- The preparation of three-dimensional zonal maps categorising the airspace over and around the airport according to the degree of safety risk for aircraft using the airport.
- Development of clear local arrangements for reporting and communicating information about drone sightings, including training or awareness-raising for airport staff, air traffic controllers and the local community.
- Decision-making protocols setting out the roles and responsibilities of those who should be involved in responding to incidents, and specifying the actions that it may be appropriate to take under a full range of different incursion scenarios. These scenarios could range from an unconfirmed single report of a drone well beyond the airfield at one end of the spectrum, to a direct kinetic attack on the airport at the other, with a gradation of different possibilities in between.
- The incorporation within the decision-making protocols of a threat assessment process as a method of capturing and assessing the available information in a rapid, consistent and pre-determined way.

The inclusion of a threat assessment process was seen as a key component of achieving an effective and proportionate response. The concept was borrowed from one that is well established in aviation security for assessing bomb threat warnings.

As in that case, a sample questionnaire form is provided in the guidance that can be used for rapidly recording and ordering available information as an aid to consideration by designated, trained threat assessors. Categories of information covered by the questions include:

- Details about the drone (or drones) sighted
- Reliability and verification of the information
- Location (in relation to the risk zones specified in the zonal map) and direction of travel
- Behaviour of the drone, as well as other possible indicators of intent.

These questions, and an accompanying flow diagram, can be used by the threat assessors quickly to categorise the incident based on the available information and to recommend an appropriate course of action at that point in time, which may range from monitoring for further information through to immediate closure of the airspace or airport. Given that initial information about a drone sighting may be quite limited or unverified, and that an incursion incident is likely to be dynamic, it is recommended that the assessment may need to be repeated several times if and when new information emerges, and again before an incident is declared closed.

The UK Civil Aviation Authority is currently in the process of developing specialised training for drone threat assessors. In the meantime, the guidance and tools we have developed are available for sharing with other ECAC Member States on request, and have also been shared with ICAO, which has used them in developing guidance on responding to drone incursions that is available in the latest edition of the ICAO Aviation Security Manual (Doc 8973). ■

Phil Dykins is Head of Aviation Security Regulation at the United Kingdom Civil Aviation Authority, a position he has held since 2018. Prior to this he was the head of Aviation Security Policy at the United Kingdom Department for Transport, during which period he was also a member of the ICAO Aviation Security Panel and chaired ICAO’s Working Group on Threat and Risk. He is also deputy chair of the ECAC Security Forum.

Drone collisions: myth versus reality

Bill English
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Catherine Gagne
Senior technical writer/analyst, Office of Aviation Safety, United States National Transportation Safety Board

The media has plenty of stories about drones reportedly colliding with – and causing damage to – various manned aircraft of all types and sizes. Add sensationalised headlines, dramatic images, and a few unsupported theories, and a "terror-in-the-skies" drone myth is born. Unsurprisingly, as with many initial media reports – or even reports from well-intentioned pilots – the reality behind these stories is not always what it at first seems.

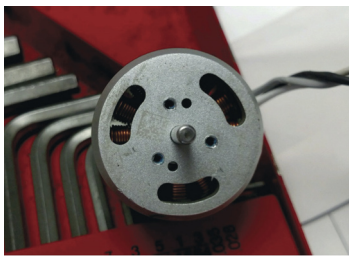
Mid-air collisions have been a risk in aviation since Orville said to Wilbur, "We should build another one." And, historically, the investigations of mid-air collisions have led to some major safety improvements in aviation. Getting to the bottom of myth versus reality on reported drone-involved collisions is critical for providing accurate data to drive focused, relevant safety improvements for this rapidly growing aviation sector.

In the United States (US), the National Transportation Safety Board (NTSB) investigates reported drone-involved collisions as thoroughly as it investigates any other aviation accident or reportable event, regardless of the level of aircraft damage. Investigators systematically gather facts and physical evidence to determine what happened.

In the spirit of this article's "myth versus reality" theme, we'll take a MythBusters-style look at the investigative evidence behind some of these reported drone-involved collisions and – using the popular television show's taxonomy – discuss them as either "Confirmed," "Plausible," or "Busted."

Big newsmakers: one "Confirmed," one "Busted"

Sikorsky UH-60 Black Hawk helicopter and DJI Phantom 4 drone. Many stakeholders in unmanned aircraft safety are aware that the first confirmed collision between a manned aircraft and an "off-the-shelf" small drone in the US occurred on 21 September 2017, when the helicopter and the drone collided at an altitude about 300 feet above the water near Hoffman Island, New York. Damage to the helicopter included a dent on one of its pressurised main rotor blades, which was not exactly a cheap part to replace. A rather obvious clue on this event included a separated drone motor and arm that were found in the helicopter. But where did it come from?



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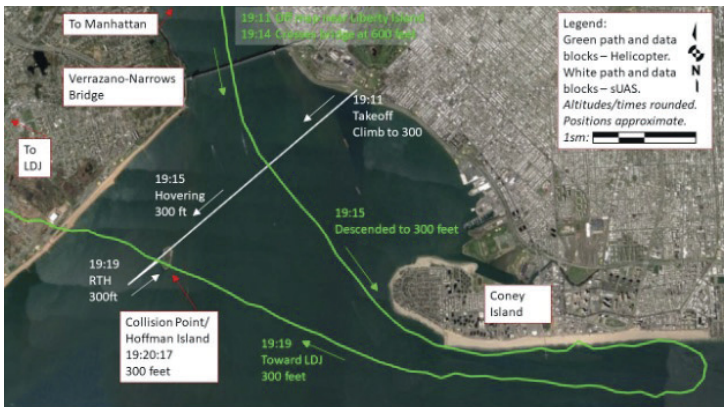
DJI Phantom 4 drone



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Collision between Sikorsky UH-60 Black Hawk helicopter and DJI Phantom 4 drone

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Boeing 737 radome damage

Using evidence from the recovered drone pieces, NTSB investigators worked with DJI to identify and contact the drone operator, who was a hobbyist with little to no awareness of federal aviation regulations (or that the drone failed to "return to home" because it had been involved in a collision). The drone's flight logs showed that the operator had flown the drone 2.5 miles beyond his position and that it was well beyond his visual line of sight at the time the collision occurred. (It was also flying in an area that was under an active Temporary Flight Restriction.) Flight path data from both aircraft provided further evidence of the collision.

Boeing 737 radome damage. Media reports showing dramatic photographs of the damaged radome – as well as their commentary about US/Mexico border crowds and security activity – fuelled widespread speculation that an Aeromexico Boeing 737 collided with a drone while descending into Tijuana, Mexico, on 12 December 2018.

NTSB investigators and the Directorate General of Civil Aeronautics in Mexico worked together to investigate for evidence of civilian or security drone activity on their respective sides of the border. However, inquiries to the Federal Aviation Administration (FAA), FAA DroneZone, Department of Homeland Security, and others found no evidence of such activity in either country.

> "Mid-air collisions have been a risk in aviation since Orville said to Wilbur, "We should build another one."

NTSB and Boeing investigators examined the radome in a laboratory and found no evidence of hard-body impact or bird residue. However, they did find that an interface seal had been installed around the entire periphery of the radome without the required 8-inch opening to allow for moisture drainage and pressure equalisation during flight. They also identified other reported events in which the absence of this gap resulted in radome collapse due to the differential pressure across the radome during flight. As a result of this thorough investigation, what started out as a media myth about drone threats to the travelling public resulted in real safety action that included a review of radome maintenance and overhaul procedures.

"Confirmed" collisions

Lindstrand 105A hot air balloon and DJI Mavic Pro drone. The balloon pilot reported that, on 10 August 2018, while the balloon was climbing through 300 feet above ground level (agl) after take-off in Driggs, Idaho, a drone struck the balloon's envelope repeatedly before falling to the ground. The balloon was undamaged, and the balloon pilot provided both the contact information for the drone operator and the drone itself (which her ground crew had retrieved). The drone operator, who was a hobbyist with little experience with the drone and little to no awareness of federal aviation regulations, was attempting to take video of the balloon – at an active airport – when he lost sight of the drone behind the balloon envelope. The drone operator applied full climb control inputs, which resulted in the collision. Telemetry data and imagery recovered from the drone were consistent with the reported sequence of events.

Three other confirmed collisions in the US. These include collisions between an Airbus AS350 helicopter and a DJI Mavic drone, both of which were operated by persons engaged in filming an off-road truck race in California on 6 February 2020; a hot-air balloon and a small drone in Del Mar, California, on 28 March 2021; and a DJI Mavic drone and a police helicopter near Los Angeles, California, on 18 September 2020.

"Plausible" collisions

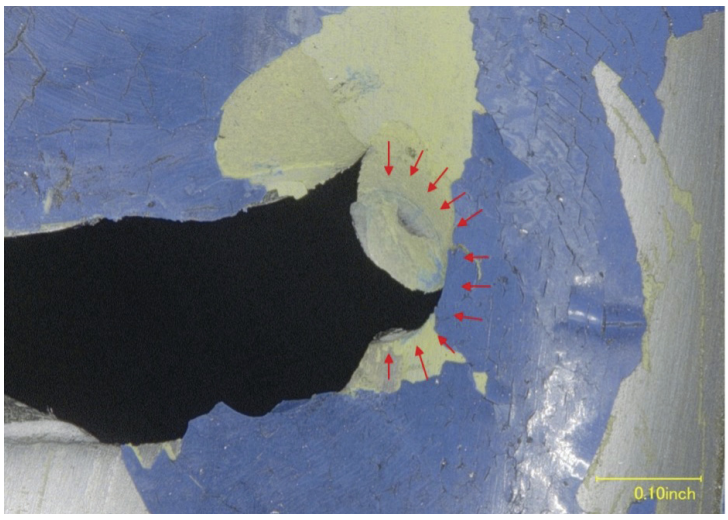
Cessna 170 report. The pilot of a Cessna 170 reported that the airplane's right wingtip struck a "black and blue" drone while flying about 2000 feet near Aurora, Oregon, on 29 May 2018. NTSB laboratory examination of the wingtip's minor damage found marks consistent with hard-body impact and no evidence of microscopic bird residue. Although a UAS NOTAM for a fire department training area was near the pilot's route of flight, the department was neither conducting any activities nor missing a drone. Neither the local airport authority nor the FAA had any evidence of drone activity.

NTSB investigators sent the damaged wingtip to the impact dynamics modelling lab at the National Institute for Aviation Research at Wichita State University, which is part of the Alliance for System Safety of UAS through Research Excellence (ASSURE). The lab created a three-dimensional scan of the damaged wingtip and incorporated it into an impact dynamics simulation with a representative model of a common small drone. The modelling resulted in damage characteristics consistent with the physical evidence observed on the incident airplane.

> "...what started out as a media myth about drone threats to the travelling public resulted in real safety action..."

Airbus EC130-B4 helicopter event. The helicopter pilot reported that a white drone (one of two he saw) struck the helicopter at 2900 feet msl (mean sea level) during a 9 February 2018 air tour flight in Kauai, Hawaii. The flight was over the floor of a narrow, scenic valley that was bordered by steep, rising terrain extending upward to a 2200-foot msl rim. Linear scratches were found on the helicopter's door. Although no drone was located, the reported location (and altitude) of the collision was adjacent to the Nu'Alolo Trail, which is a popular hiking trail that extends along the valley rim and where drone activity is common.

Airbus AS350-B2 helicopter in-flight collision with object. The helicopter was flying about 1100 feet msl (about 700 agl (above ground level)) near downtown Los Angeles, California, on 4 December 2019, when the pilot heard what he thought was a bird strike, and he diverted for landing. NTSB laboratory examination of the helicopter's damaged horizontal stabiliser and tail rotor found hard-body impact features. These included a mark that was consistent with the rotor shaft diameter common to many small drones and material transfer (discovered through infrared examination) that included polycarbonate polymer, which is common to many small drones. However, no drone (or evidence of an area drone operation) was found.



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Airbus AS350-B2 helicopter in-flight collision with object

"Busted" reports

Piper PA-23-250 with dents and cut marks. The airplane pilot reported that, while flying at 2500 feet msl (about 1920 feet agl) near Joliet, Illinois, on 27 August 2015, he heard a bang and felt a jolt in the flight controls. Upon landing, he found that the leading edge of the airplane's left horizontal stabiliser was dented with multiple cut marks on the de-icing boot. At first glance, a drone collision – with telltale rotor slash marks – seemed plausible.

However, NTSB laboratory examination of the boot revealed that the marks were actually tears in the boot material that occurred in overstress (as it flexed inward at the dent). Although there was no visible evidence of bird remains, NTSB investigators submitted a swab from the boot to the Smithsonian Institution's Feather Identification Lab, which found microscopic feather barbs from a type of pigeon.

> "...fact-based investigations of any reported drone-involved collision ensure that future safety actions and responses are based on reality - not myths."

Other "busted" reports in the US. On 14 May 2019, a Bombardier CRJ200 reportedly struck an in-flight object at 14 000 feet msl near Columbus, Mississippi, separating much of the left winglet. NTSB laboratory investigation found that the winglet separated along the location of a previous repair; however, a swab from the damaged area identified feather barbs from a turkey vulture. The investigation determined that the bird likely struck the winglet above the repair, and the winglet separated at the repair line. (Fun fact: Turkey vultures can fly as high as 20 000 feet.)

Also, on 2 August 2020, in San Jose, California, a Cessna 172 collided with what the operator described as "a large, unknown object" while flying in the traffic pattern at a Class D airport. The right wing sustained substantial damage. A ground search for the reported object located both a small, undamaged drone and the carcass of a golden eagle. NTSB laboratory examination of the damaged airplane wing identified biological material that the Smithsonian Institution's Feather Identification Lab identified as from a golden eagle.

In summary

We hope these examples serve to emphasise the importance of investigating reported drone collisions as thoroughly and systematically as any other aviation accident or reportable event. In many cases, it didn't take long for investigators to find evidence that the reported event involved something other than a drone. Birds, other animals, objects (including loose foreign objects or ground-fixed objects), and even maintenance issues have resulted in aircraft damage that media reports (or pilots) initially blamed on a drone. In other cases, the absence of evidence has complicated a determination as to whether or not a drone was really involved. NTSB investigators will continue to conduct thorough, independent, and fact-based investigations of any reported drone-involved collision to help ensure that future safety actions and responses are based on reality – not myths. ■

Bill English serves as the National Transportation Safety Board's (NTSB) UAS Program Lead, responsible for the technical knowledge base, procedures and policies for investigating accidents and incidents of commercial UAS, as well as the NTSB UAS flight operations team providing aerial imagery and mapping in support of investigations. Bill is an investigator-in-charge (IIC) in the NTSB Office of Aviation Safety. He has been the IIC on numerous major aviation accidents including the Asiana B777 in San Francisco, Atlas Amazon B767, and Sikorsky S76 carrying basketball star Kobe Bryant. He has been the US accredited representative on investigations worldwide including the B737/Legacy midair collision in Brazil. He is an active pilot and flight instructor.

Catherine Gagne is a senior technical writer/analyst in the NTSB's Office of Aviation Safety, where she works with investigative teams to write NTSB aircraft accident reports for major accident investigations. She is also part of the NTSB's Unmanned Aircraft Systems (UAS) Program team, for which she operates a small UAS to support investigations by providing accident site documentation through aerial imagery and photogrammetry products. She previously worked as an air safety investigator in an NTSB regional office, during which time she was the investigator-in-charge for numerous general aviation accidents.

Getting public support – the key to the future of drones in urban areas

Jonathan Nicholson
Assistant Director Communications, Civil Aviation Authority, United Kingdom (UK)

When we engage with the public around remotely piloted aircraft systems (RPAS), or "drones" as the vast majority of the population refers to them, their reactions range from "that's amazing, can I have a go" to "please make sure they never fly over my property." Or, in many cases, something very rude!

For most members of the public, their perception of RPAS is someone flying a small consumer drone for fun, or possibly photography, or sometimes infrastructure inspection. The perception constantly fed to them is that drones are dangerous, but at the same time will also shortly be delivering their pizza on a Friday night!

We know the reality of course is somewhat different.

Every year in the UK we undertake a wide-ranging survey of the public and drone users around their perceptions, knowledge and expectations of RPAS. This is a large consumer survey of over 2000 members of the public that enables us to accurately scale it up to represent the views of the total UK population.

Some of the latest key findings from the public survey include:

- 67% think there should be more regulation of RPAS, but this was slightly down on our last survey.
- 22% of people think RPAS users creating too much noise should be fined.
- 56% of people think that drone registration will increase safety.
- The top uses of RPAS people think they will see in the next five years are traffic monitoring, search and rescue, and infrastructure inspection.
- 27% of people would be positive to RPAS taxis operating in cities. An increase from 19% in our previous survey.

People certainly seem to think that there will be a general increase in RPAS use in the near future. For many, though, that belief may be around smaller RPAS operating in remote areas, rather than an electronic vertical take-off and landing (eVTOL) urban taxi. Plus, they may have a limited knowledge of the real impact that this rise in use might have for them personally and their local environment.

So, regardless of what they say in a survey, their reaction to it actually happening in their community may be different. When we ask people about their general views on the regulation of RPAS as part of our survey, some say things like "total ban" or "forbid drones in residential areas".

Historically, in the UK we have little inner-city aviation compared to other nations. And where we do, for example Inner London helicopter traffic, it does attract a considerable environmental pushback from local communities and authorities. In 2006, the Greater London Authority went as far as producing its own report into helicopter noise

following complaints from local communities. To put this into context, Inner London helicopter activity normally averages around 1 500 to 2 000 movements a month.

Building on this, we are currently looking at how we can undertake research around the noise impact of innovative technology.

So, getting the overflown and affected communities' support for all kinds of RPAS work will be key. People have been traditionally wary of new technology, particularly until they can see it is safe and useful to them.

Plus, there are many varied kinds of operation that are suited to urban use. A small RPAS conducting a building inspection may cause as much disruption and disturbance to a community as an eVTOL taxi passing overhead.

When we work with innovators, our innovation team stresses the need to develop a social licence. Public engagement is always an important part of a commercial strategy to help ensure success. And when it comes to introducing highly innovative ideas to a market, this need to actively and effectively engage becomes even more critical. Not only are they introducing something new and at the forefront of technology, it also brings direct safety considerations. To help guide innovators, we have put together a guide to going about getting that social licence: Social Licence to Operate: Concept Guide for New Technologies.

Basically, a social licence is the ongoing approval from stakeholders (including those affected by the flight) for an organisation's products, services, business practices and operations. Underpinned by a complete view of stakeholders, a social licence brings with it the tangible business benefits of being considered legitimate, credible and trustworthy. It is absolutely not, though, any form of replacement for regulatory approval.

We promote six principles in our guidance:

- **public safety** – operators must maintain high levels of safety;
- **transparency and openness** – it must be really clear to stakeholders how they could be affected;
- **accessibility** – good proposals are inclusive, legible and readable;
- **evidence-based** – decision making should be evidence-based and data should be shared;
- **stakeholder needs** – identify your stakeholders and what their needs are;
- **integrity** – acting with integrity maintains trust with stakeholders.

In reality, this advice is not specific to aviation and is just as appropriate to the success of any business or project. For many people, this may be common sense and part of their business as usual. But surprisingly, it's something that many people take for granted or really don't do.

Timing is also key. Being the first contact that stakeholders hear about the work enables the setting of the agenda and making sure the facts are available right from the start. To be effective and trusted, this absolutely has to follow the six principles.

Primarily, we would expect the social licence aspect to run throughout the life of a project and be tailored to the specific needs of the stakeholders.

Visible enforcement of the misuse of RPAS can also help to make stakeholders more comfortable about the increased use of the technology. Certainly, our surveys show that the public want to see harsh penalties in place for people using RPAS for criminal activity and even invading privacy.

In the UK, any enforcement that happens hasn't always been publicised, leaving many - including some RPAS users - to believe that if the rules are broken there will be no action. To help with this, we are running a joint campaign with the police and government to highlight the capabilities of the police, case studies around action that has been taken and reminding users of the rules. The work will help to join up police forces around the country and standardise how they talk about RPAS enforcement.

While this is primarily aimed at operators of small consumer RPAS, its impact does bleed into the wider public awareness. Currently, many stakeholders don't really differentiate between different types or levels of RPAS. Regulators and the industry may draw a distinction between a consumer model brought on the high street and an eVTOL people-carrying machine, but to the general public and media both are "drones". So, positive action across the RPAS world helps to increase public acceptance.

Getting public support – the key to the future of drones in urban areas

While the view of the public is critical, they are not the only stakeholder to consider. National governments are generally very supportive of new, greener technologies and are currently investing significantly in their development. But local governments and agencies may well be the bodies deciding on individual applications or infrastructure requests.

And other airspace users that will share this limited space with increased RPAS use are a high-profile stakeholder. Existing inner-city helicopter operations come immediately to mind, but as part of the bigger system we also need to consider other users such as General Aviation and the military. For these users, there can be an apprehension to address around how RPAS will safely integrate into existing airspace and structures and any implications for them that this brings. This is especially true of future roadmaps to allow RPAS to operate beyond visual line of sight of the operator on an everyday basis.

So, while much of the emphasis is quite rightly on the safety and regulatory aspects of the future use of RPAS, it's clear that really good engagement with the widest possible range of stakeholders will be required to gain the future use projected by many. ■

You can follow the CAA at www.caa.co.uk Twitter @UK_CAA.

Further reading:
UK CAA innovation team guidance
https://www.caa.co.uk/Our-work/Innovation/Updates-and-guidance-from-our-innovation-team/
UK CAA social licence guide for new technology
www.caa.co.uk/cap1900

Jonathan Nicholson comes from an aviation background (his father was an air traffic controller) and has been with the United Kingdom Civil Aviation Authority for over 30 years, primarily in the communications team. As well as all areas of media and stakeholder engagement, the team also runs safety campaigns and Jonathan is currently working to help run the United Kingdom's national drone safety education campaigns.

UAS applications for maritime search and rescue

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Luis Pérez Sanz
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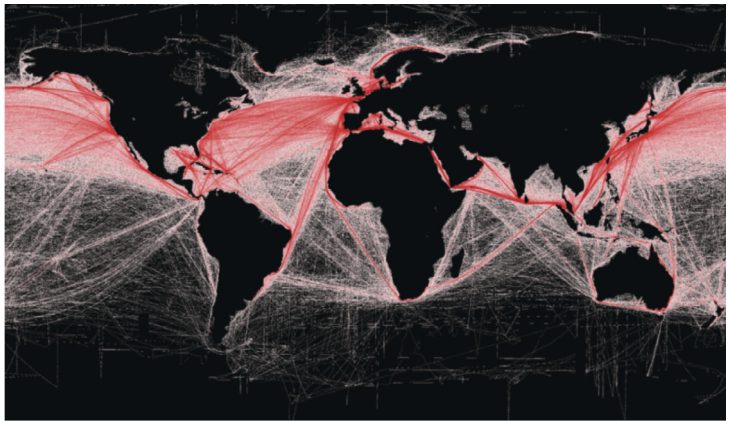
Currently, it is estimated that more than 80% of the goods traded in the world are transported by thousands of large ships that sail the world's seas and oceans on a daily basis: container ships, capable of carrying more than 18 000 containers; passenger ships, where more than 6 000 people travel and live together; supertankers, with the capacity to transport over 300 000 tonnes of crude oil from one coast to another; chemical tankers; gas tankers, and so on. A serious accident involving one of these powerful means of transport would almost certainly result in a major disaster involving large numbers of people and large areas of sea surface. If they sink, the cargo and fuel they carry are spread over hundreds of square kilometres, and recovery operations last for weeks or months. There are even occasions when such emergencies are aggravated by the occurrence of explosive or potentially hazardous atmospheres around the stricken vessels.

Besides the large vessels maritime traffic, there are other types of activity carried out at sea, such as fishing, recreational boating and nautical sports, as well as the heavy migration of people crossing from one continent to another in vessels that are often poorly maintained and overloaded. These other activities are not exempt from the risk of accidents either, especially on bad weather days. When accidents occur, long searches for people are carried out on the sea surface.



Maritime routes around the world

One of the major reasons why search and rescue (SAR) operations at sea are often so complicated – unlike search and rescue operations carried out on land – is that the sea is dynamic; it is in constant motion. Objects searched for are washed away by ocean currents and surface winds. Over time, this increases the size of the area of uncertainty where castaways are most likely to be found. In short, the search areas that SAR units must scour increase with each passing minute.

Fire-fighting operations on a merchant ship

UAS applications for maritime search and rescue

UAS of the European Maritime Safety Agency, manufactured by the Portuguese company Tekever and tested in southern Spain by the Customs Surveillance and Maritime Rescue Service.

Some of the main characteristics that a maritime emergency response system should have are:

- to respond effectively and rapidly;
- to have high levels of operability;
- to operate far from shore;
- to operate in adverse weather conditions;
- to scan large areas of the sea surface in order to detect and identify castaways, shipwrecks, small objects and chemical stains on the sea surface;
- to detect and identify explosive and hazardous atmospheres;
- to rescue people, recover objects, tug vessels;
- to operate underwater;
- to remain deployed in the area for long periods of time; etc.

Generally, most of the world's maritime search and rescue organisations build these emergency systems around a maritime rescue coordination centre (MRCC) responsible for designing the best response and mobilising the units at its disposal. These typically include: underwater teams, responsible for underwater operations; helicopters and ships, essential for rescue, recovery of objects and direct assistance to people and vessels; and finally, aircraft and satellites, mainly used in search and surveillance operations.

Undoubtedly, aerospace units are an essential element of these response systems due mainly to their speed, since aircraft are about ten times faster than maritime units. It is hard to beat a helicopter's swiftness when rescuing people in danger. Aircraft and satellites provide the best tracking capabilities, as they can sweep across large surfaces of sea in a short time. Additionally, aircraft and helicopters are often the first units to reach the location where the emergency occurred. However, these platforms alone are not sufficient and can hardly execute a given mission unless they are fitted with numerous and diverse equipment and sensors, such as rescue cranes, search and pollution detection radars, day and infrared cameras, searchlights, sea surface gas and chemical product detection and identification sensors, communication systems, auxiliary fuel tanks, SAR material, etc.

Nowadays, all these air units are perfectly fulfilling their duties, but there is always room for improvement and this is where new unmanned aerial system (UAS) technologies are coming into play. UAS for SAR operations are already a reality, and their numbers will grow rapidly in the future. Their usefulness is beyond dispute.

Although UAS are not currently involved in the direct rescue of a person – since these operations are currently reserved exclusively for helicopters and manned vessels – they will be advantageous for other types of actions. For example, they will provide coordination centres with all the information necessary for them to have situational awareness of what is happening at sea, so that they can quickly and efficiently decide what the best response to the emergency should be; they will carry out long searches, scouring the sea for hundreds and hundreds of kilometres, orbiting around the object found so as not to lose it until the rescue teams arrive; they will allow live monitoring of operations, sending in real time all the information required by coordination centres, crisis offices and other units; and they will provide support to large rescue vessels by sending images taken from the air, which will enable them to have a better perspective of what is happening during the rescue operations.

New Maritime Rescue tug vessel designed with the capacity to accommodate and enable UAS operations.

UAS for maritime rescue shall have some of the response system features described above, such as:

1) They must be reliable systems that can achieve high operational rates. To this end, a thriving UAS market needs to be created, which offers sophisticated products and fine-tuned after-sales services. It is fundamental to build up trust in potential customers that leads to increased demand, and this will only be achieved with the development of clear and internationally consistent regulations and certification standards. From a technical point of view, the protection against harsh saline environments will be a crucial feature.

2) They must be deployable quickly at any time, since emergencies cannot be programmed. This implies fully integrating these systems with the rest of aviation, not only in airspace, but also within airport infrastructures. Large trackers will continue to require take-off runs, due to the heavy weight of their fuel and specialised equipment.

3) They must be capable of operating in adverse weather conditions, which means creating aircraft of specific sizes and weights, with rain and storm protection, and capable of reaching speeds exceeding the prevailing wind on the day of the emergency.

4) They must be able to operate far from shore, remaining in the area for long periods of time and scouring long stretches of sea surface. Therefore, we need high-speed, long-range, high-autonomy units with communication systems that allow for operations such as command and control, as well as sending payload data beyond the line of sight. Developing these communication systems is currently a great challenge, since they need to be robust and secure, have low latency, high transmission speed and a wide bandwidth. In addition, their antennas must be able to be integrated into UAS whose size, carrying capacity and power supply are smaller than those of conventional aircraft.

5) They must detect and identify people, small objects, vessels, fumes, sea surface chemical stains, etc. This involves the capability to carry diverse and mission-specific tactical systems. UAS for maritime SAR must have sufficient space, weight and power supply to be able to move and operate them. Search radars, beacon locators, maritime transponders, etc. are of great use in maritime rescue operations and should also be part of the standard equipment for these systems. Additionally, all these sensors are expected to become increasingly smart and to perform in real time and automatically many of the tasks that are nowadays carried out manually, oftentimes after landing and retrieving the data collected by the numerous sensors. The UAS autopilot mode will need to be seamlessly connected and integrated with these mission systems to ensure that the majority of the flight is performed automatically, following the indications of the component sensors as they interpret the data. This, for instance, will be necessary to ensure take-off and landing on ships rocking offshore. In short, we are talking about robots whose mission systems will begin to be an important part of their airworthiness.

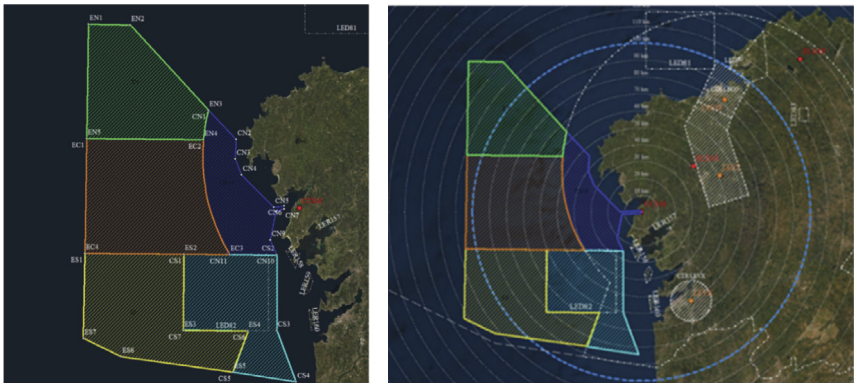
6) They must include the necessary features in order to be accommodated on large rescue tugs. Maritime emergencies involving a large merchant ship are usually complicated operations, which often take place in maritime traffic routes, i.e. far from the coast. In such emergencies, large rescue tugs remain in the area for long periods of time – weeks or even months. UAS are very useful, as they provide them with information and support in all their operations. Being able to avoid long positioning flights from their shore bases to the emergency areas and thus increase their actual mission time requires that these systems are capable of landing and taking off from their decks' limited space.

Due to the current difficulties in operating UAS from airport infrastructures as well as the great versatility provided by vertical take-off and landing, rotary wings will be, short-term, the most likely technological solution for UAS performing search and rescue operations at sea. However, there is a real need for large trackers and patrol craft. So, as conventional and unmanned aviation are more integrated, fixed-wing UAS will become increasingly important. On the other hand, the numerous and specific payloads that make up the mission system of a SAR unit, the high performance required of them and the communications systems they must integrate to allow for command and control as well as sending information in real time beyond the line of sight seem to indicate that the maximum take-off weights of these units will be above 300/400 kilos. And the future... will be about convertibles.

The Spanish Ministry of Transport, Mobility and Urban Agenda is intensively promoting the development of unmanned aviation in Spain. Thus, organisations of this ministry such as Salvamento Marítimo (Maritime Rescue), the Directorate General of Civil Aviation (DGAC), ENAIRE and AESA have been working for months, together with the European Maritime Safety Agency (EMSA) and the Technical University of Madrid, on an operation that will undoubtedly help to test this type of technology in search and rescue missions at sea.

This June, the Austrian company Schiebel's CAMCOPTER 100 helicopter is expected to begin maritime surveillance activities over the waters of Galicia (north-

UAS applications for maritime search and rescue



TSA plan view

west of Spain). For this purpose, a set of five elementary Temporary Segregated Areas (TSA) have been designed, which will be dynamically activated and deactivated, making the daily air activity of conventional aviation compatible with this new type of aircraft. Flights will take place between 1 000 and 6 000 feet, within a range of 100 km at speeds above 50 knots. For the first time, both aircraft and pilots will be included in maritime rescue operations within the Rescue Coordination Centre, together with ground personnel in charge of coordinating this type of mission. ■

MRCC Finisterre. Take-off and landing zone of the UAS operation to be deployed.

Néstor Perales, Head of the Aviation Service of Salvamento Marítimo, holds a master's degree in aeronautical engineering from the Technical University of Madrid. His professional career began in 1991, combining his university studies with occasional work in various companies, including Kayser Automotive Systems GmbH (Einbeck, Germany). In 2000, he joined the Technology Department of GE Power Controls (General Electric) in Madrid, where he remained until 2003, when he joined the Propulsion Department of the A380 programme at the Airbus headquarters in Toulouse. Upon his return to Spain in 2005, he joined the team in charge of managing the Aviation Service of Salvamento Marítimo. He participated in the purchase and commissioning of the CN235 aircraft and the AW139 and EC225 helicopters that make up the current SASEMAR air fleet. He is also part of the work group driving the iSAR integral innovation project for maritime rescue.

Luis Pérez Sanz is University Professor at the Technical University of Madrid attached to the Department of Aerospace Systems, Air Transport and Airports at the School of Aeronautical and Space Engineering (ETSIAE). He is also Head of the Air Navigation Research Group (GINA) at the Technical University of Madrid. He has a PhD in computer engineering (2005), a degree in physics – electronics and automatics (1993) and is an aeronautical engineer (1984). Luis is an expert in airspace design and instrumental flight procedures. He is currently developing his research activities in the field of definition of advanced air navigation concepts and their applications.
He has accumulated more than 35 years of professional experience in the field of air navigation, participating in many national and international projects.

Technology drivers and testing centres for the growth of the UAS sector

Patricia Argerey
General Director of the Galician Innovation Agency, Spain

The development of the unmanned aircraft systems (UAS) sector was identified five years ago by the regional government of Galicia (Spain) – in collaboration with the national government – as an opportunity to grow in the aerospace sector, boosting the development of technology and infrastructures through a public-private partnership. As a result of the investment of more than €164 M, a community of over 50 companies and research centres has worked on the main technology drivers for the future of the sector and created an aerodrome – Rozas – fully equipped to test and certificate platforms, systems and missions.

In recent years, the development of the UAS sector in Spain has been unstoppable. Since 2014, when the first regulation allowing drone operations was issued, driven by the Directorate General of Civil Aviation of the Ministry of Transport, Mobility and Urban Agenda and the Aviation Safety and Security Agency, the growth of the sector has been exponential. Experimentation centres have contributed significantly to this development, becoming key elements for knowledge creation about this new technology.

To this end, the Galician government has taken major steps for the development of the sector, through a fundamental support to this industry and the building of first-rate infrastructure to carry out the necessary tests to achieve this technology.

The development of the civil markets for UAS is the main objective of the Galician Civil UAVs (unmanned aerial vehicles) Initiative (CUI) for the 2021-2025 period. During this time, more than €500 M will be invested, in collaboration with the private sector, in science (TRL0-TRL4), R&D programmes (TRL4-TRL8), the creation of technological solutions (TRL7-TRL9), and scientific and industrial infrastructures. The Galician government – as well as other departments within national and regional governments in Spain – will act as the first client and user for the solutions proposed by the companies.

With a vision based on a public-private partnership model, the Galician government decided five years ago to be "agnostic" about the segments and technologies to be developed in the sector. The government poses challenges to private companies related to public services (fire management, sea rescue, civil security, land management, forestry, fisheries, agriculture, tourism, cultural heritage, and so on) and private business operations (passenger and freight transportation, infrastructure supervision, industrial digitalisation, etc.), but the selection of technologies and developments is driven by the private companies participating in this initiative.

This approach has focused investments over the last five years on what companies such as Indra, Boeing and Babcock among others (more than 50) have considered as the main technology drivers needed to create new products and solutions. A total of 59 projects have been developed under 12 different contracts; within the 519 results obtained, a total of 45 products and 13 new services have been developed. In addition, 18 new companies were launched through business acceleration and incubation calls, and broad promotion of aerospace vocation was fostered among the youth.

The open market consultations conducted during the year 2020 have provided insight into the emerging key technological issues for the industry, including other major players interested in the programme such as Airbus, Everis, EHang, Leonardo or Telespazzio.

A preliminary analysis of these trends shows that the new business in the UAS sector will be based on the following technology drivers:

- **Simulation:** a fast-track for the joint evolution of technology and regulation in the UAS sector needs high-capacity simulation facilities to enable safe verification and validation prior to operational tests.
- **UTM:** this is the basis for future operation of UAS in any environment.
- **Cyber security:** this will be a significant component of the UTM operations concept; certain specific operational components, such as 5G, will need to demonstrate their suitability; together with highly safe procedures, the use of 5G technologies to become part of the UAS communications loop is a must for any regulatory evolution towards a broad UAS market in urban, long-distance airspace.

Technology drivers and testing centres for the growth of the UAS sector

CIAR (Rozas Airborne Research Centre)

Just testing centres - or more than that?

With over €20 M already invested and a significant investment planned over the next five years, Galicia's regional government vision for the Rozas infrastructure goes far beyond its possible use as a testing centre. Both industry and society not only need testing centres to demonstrate their solutions, but also open scientific and technological infrastructures equipped with unique installations, which require large investments.

Together with the INTA (National Institute of Aerospace Technology), the Galician government (Xunta de Galicia) has launched this mixed centre, called CIAR (Rozas Airborne Research Centre), located at the Rozas Aerodrome in the province of Lugo, a rural area in Galicia.

In Spain, there are several other state-of-the-art scientific infrastructures, such as: GRAN TECAN, the Mare Nostrum Supercomputing Centre, the CENIEH in Atapuerca, Doñana, the Antarctic base or the Hespérides Scientific boat. The Rozas CIAR is looking forward to becoming the reference infrastructure for UAS development, not only at national level in Spain but also at European level. In this centre, scientific, technological and industrial activities go hand in hand.

To achieve this vision, an industrial park has been set up on the area adjacent to the CIAR, where the hangars of two large driving-force companies, Indra and Babcock, have already been built. A significant amount of land is still available for future allocation.

In line with this vision, all infrastructure acquisitions that have been made in the past, as well as those that will be carried out in the future, have a strong innovative component and have been conducted through innovation tenders.

We believe that a centre that intends to become a key element for such a rapidly changing economic sector as the UAS cannot be based on classical technologies; instead, it needs to anticipate and respond to supply, it needs to innovate in capabilities and foresight in order to provide companies and authorities all the tools they require to consolidate technological advances through joint technological and regulatory developments.

Consequently, the Rozas CIAR not only aims to enable the testing of unmanned aerial systems, but also to support companies and the administration verify that these new technological developments can be safely incorporated into the operating market. In fact, some of the developments carried out in the 2015-2020 period by large companies and other innovative small and medium-sized enterprises (SMEs) are already part of the centre's infrastructure.

In other words, CIAR's objectives go beyond the commissioning and implementation of testing means for UAS, instrumentation and system builders for the new market; they also aim to support the development of applicable regulations that allow flights to be carried out in a safe manner.

CIAR's capabilities

Approximately 25% of the investment in CIAR in the past five years has been allocated to physical infrastructure, which consists of an administrative and office area, a control tower and a hangar, all with direct access to the airfield runway.

The remaining 75% has been allocated to the provision of a technological infrastructure to manage, control and issue – where appropriate – the documentary evidence necessary for the certification of the activities carried out.

Since its inception, CIAR has been conceived to be a reference centre for the development of UAS-based systems and services, where all the necessary tests for the validation and future certification for this type of system can be developed. The aim is not only to test aerial platforms, but all the systems involved, both those to be installed on board and those to be deployed around them, including airspace management tools.

After the construction phase, CIAR has been equipped, through PPIT (Public Procurement of Innovative Technology) processes, with a series of unique infrastructures, the purpose of which has been to develop an innovative testing control centre, composed of the following elements:

1) Testing control centre.

2) Security system: secondary radar with a range of 180 km.

3) Communications system for five control posts with basic voice communications capabilities: air traffic control, other ground and air control centres, with VHF and UHF service with AM and FM modulations.

4) High precision meteorological system for weather forecasting and modelling.

5) U-space strategic simulator: security service for manned and unmanned aircraft testing operations.

With the infrastructures described so far, which are already installed, CIAR can now provide testing and certification services for UAVs and their components under representative unmanned aircraft traffic conditions, at least for the U-1 phase and some of the benefits of the U-2 phase of the European Roadmap.

6) Contingency simulator: research laboratory oriented to conduct traffic simulation tests (real, synthetic and mixed) under UAS contingency events.

The development of this laboratory will be completed in December 2021. Thanks to it, CIAR will be able to extend its testing services to all components of the U-2 phase and to a part of the components of the U-3 phase of the European Roadmap.

7) Rozas U-space simulation environment: it will allow for the modelling of the different digital services needed for the operation of U-space environments, including strategic capacity management, tactical management of conflict prevention and resolution, integration with simulations of in-flight emergency situations, as well as traffic management and control and management (ATC/ATM), etc., together with auxiliary services, such as meteorology and ground and airspace data.

The call for tender, in cooperation with the CDTI (Centre for Technological Industrial Development) will be issued in the coming weeks. Its completion is scheduled for March 2023. Once installed at CIAR, U-space functionality tests can be carried out for the U-3 and U-4 phases of the European Roadmap.

8) Numerous investments in technological improvements have been planned for the 2021-2025 period, among which we highlight the two that will be available by the end of 2023:
a | 5G Laboratory, in order to be able to test solutions using this type of network for UAS system communications in beyond visual line of site (BVLOS) operations.
b | Cyber security, secure communications system in all CIAR activity areas and its potential users, in order to test and assess the impact of connection security breaches within the different systems.

A sandbox needed to create the markets for the UAS

As it has been said before, the main objective of the Civil UAVs Initiative 2021-2025 is the development of civil markets for UAS. For this, it is not only necessary to have infrastructure and R&D in place, but the regulatory environment must also address key issues in parallel and at the same speed as the technological evolution itself.

For this reason, the value proposal from the public sector made by the regional government of Galicia – with the support of the Spanish government – is the creation of a regulatory sandbox in the Rozas area. A sandbox that allows experiments beyond regulation to be carried out in a fully safe environment and, above all, allows the legislator to experiment with, learn about and assess the legal alternatives that technological evolution opens up.

We firmly believe that this investment will allow CIAR to be part of the European regulatory sandbox ecosystem that allows the European industry to maintain a high level of competitiveness in this new and promising sector of activity. ■

Patricia Argerey has a PhD in economics and business from the Complutense University of Madrid and a master's in applied political studies. The first part of her career was spent as a teacher and researcher at CEU San Pablo and Complutense University of Madrid. She was also coordinator of R&D projects and later on the secretary general of the University Institute of European Studies at CEU San Pablo University. Since 2009, she has held various positions in the Galician regional administration: advisor to the cabinet of the presidency of the Xunta de Galicia and director of the cabinet of the Ministry of Economy, Employment and Industry. She has been Director of the Galician Innovation Agency (GAIN) since 2016.

ECAC Facilitation Sub-Group on the Transport of Persons with Reduced Mobility

Interview with **Marie Hauerová**

Senior Officer in the Civil Aviation Department at the Ministry of Transport of the Czech Republic, and chair of the ECAC Facilitation Sub-Group on the Transport of Persons with Reduced Mobility

1. What is the PRM Sub-Group?

The Sub-Group on the Transport of Persons with Reduced Mobility (PRMs) is a great platform for sharing experiences, exchanging information and best practices, and preparing new guidelines and information and working papers. All with the aim of improving travel for persons with reduced mobility and to ensure they benefit from the same opportunities to travel by air as everyone else.

Currently, the PRM sub-group comprises delegates from 24 ECAC Member States and 12 observers (including EDF, IATA, ACI, European Commission), and organises regular meetings with experts from the aviation industry on PRM assistance.

The legal basis for the work of the sub-group is mainly ICAO Annex 9, the *Manual on Access to Air Transport by Persons with Disabilities* (ICAO Doc 9984), and Regulation (EC) 1107/2006. All provisions are reflected in ECAC Doc 30, Part I, Section 5 and its Annexes (Annex 5A – Annex 5L), a very important tool on the effective implementation and harmonisation of these provisions in all ECAC Member States. The ECAC Secretariat maintains a database of PRM complaints and every year prepares an annual report which allows the sub-group to better identify the areas of concern in the implementation of Doc 30, Part I and Regulation (EC) 1107/2006.

2. What topics is the group currently focusing on?

The work of this group is extremely varied. Currently, there are four study groups working within the PRM sub-group. These are: the Study Group on Amendment to Doc 30, Part I, Section 5, the Study Group on Hidden Disabilities, the Study Group on Call-Point Signage, and the Study Group on PRM Charges, and I really appreciate the progress being made by these groups.

At the last meeting (FAL-PRM-SG/67, 18 February 2021), the new amendment to Doc 30, Part I and its Annexes was introduced, featuring the incorporation of guidance material on hidden disabilities, and the amendment to Annex 5-A - *Guidance leaflet for persons with reduced mobility who may be infrequent or first-time flyers*, which should now be clearer and more helpful for persons with reduced mobility.

In cooperation with the Network of Chief Economists, a document on PRM charges is being finalised. This paper presents key elements for Member States' consideration on PRM charges and takes into account the COVID-19 pandemic crisis and its effect on PRM charges as well.

I must also mention the sub-group's active cooperation with ICAO on Annex 9 and the manuals, especially this year, with the ICAO FAL Panel taking place in July. We expect the sub-group will present a working paper on upgrading some Recommended Practices to Standards in Chapter 8, and the new Recommended Practices proposal on health issues.

I really regret that pilot phase II of the ECAC Quality Assessment Programme on the Assistance to Persons with Reduced Mobility could not be pursued last year due to COVID-19. Five pilot assessments were organised very successfully in Italy and Romania between July and September 2019. Based on these assessments, the *Guidance Material for PRM Assessments* was created, which is included in Doc 30, Part I, Annex 5-L. This Annex is an important tool for ECAC Member States to ensure the effective and harmonised implementation of Doc 30, Part I, Section 5 recommendations. Several members of the sub-group expressed their continued support for taking part in this programme, as team members or host State, and we all believe the programme will be able to restart during the year.

3. What challenges do you see arising in the future?

As we all know, aviation faces the most difficult crisis in its history and it will be a challenge to restart it. COVID-19 has resulted in significant changes to the passenger experience when flying, PRMs included. It is clear that current legislation (Regulation (EC) 1107/2006, ICAO Annex 9) ensures that the opportunities for air travel for persons with reduced mobility are comparable to those of other citizens, as well as the availability of assistance to meet their particular needs, but this legislation does not (and could not) take into account the situation caused by the pandemic and its impact on them when travelling by air. The approach on health measures was not harmonised in the Member States and PRMs have faced many differing na-

tional requirements (for example face covering, entry to the terminal restricted to travellers only). Lack of a common approach and harmonised guidelines and communication related to COVID-19 measures, requirements and restrictions had a crucial impact on the PRM service providers. That is a great challenge for the sub-group – to update Doc 30, Part I, Section 5 to reflect the main developments and health-related matters, in particular relating to lessons learnt from the COVID-19 pandemic, and to develop best practices and guidance material for the assistance provided to persons with reduced mobility in case of pandemics generally. COVID-19 will be the main topic of a workshop and a meeting with experts on PRM assistance planned in autumn and - I hope - as physical meetings.

4. What main challenges for ECAC Member States do you see emerging/being discussed by the group at future meetings?

Some issues will continue to be the focus of the sub-group's attention. The first is the "assistance animal" (in accordance with ICAO Annex 9) or the "recognised assistance dog" (in accordance with Regulation (EC) 1107/2006). The sub-group is prepared to cooperate with the European Commission on this matter because it is necessary to define and harmonise the requirements for certifying assistance dogs in the EU and to ensure they are trained according to safe and recognised standards. The sub-group would be happy to discuss this issue with the Commission in connection with revision of Regulation (EC) 1107/2006 and its Interpretative Guidelines.

Other issues to be discussed by the group are the correct transmission of assistance needs, use of the right codes regarding certain persons with reduced mobility, improvement of the pre-notification rate for PRM assistance, and solving inappropriate and insensitive handling of PRMs. As I mentioned, the work of this sub-group is really varied and extensive.

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5. Some final words?

The position of chair of the sub-group is a great honour for me but mainly an enormous responsibility. Please allow me to be a little nostalgic: the PRM sub-group meeting was my first international meeting; it was in 2002 and the chair at that time was Ann Frye from the United Kingdom. I looked up to her and to all the group members with tremendous respect! I admired their knowledge, experience, professionalism and enthusiasm but mainly the cooperative and friendly atmosphere offered by the group. The subsequent chairs, Cinzia Mariani (Italy) and Teresa Antunes (Portugal), continued in this spirit and were excellent chairs. To be chair of this group is therefore a big commitment for me.

My aspiration as chair is to enlarge the group. I would like to encourage more Member States to join and participate actively, sharing their experiences and knowledge and contributing to the work of this group. ■

Marie Hauerová has worked in the Civil Aviation Department at the Ministry of Transport of the Czech Republic since 2001. In the field of facilitation, she is responsible for ICAO Annex 9 - *Rights of passengers*. She coordinates the National Facilitation Committee in the Czech Republic and also cooperated in developing the National Civil Aviation Facilitation Programme. Marie gained a lot of experience in facilitation as an alternate and later as the Czech Republic member of the ICAO Facilitation Panel. She has been a member of the ECAC Sub-Group on the Transport of Persons with Reduced Mobility (PRMs) since 2002 – from 2016 as deputy chair and since February 2021 as chair, and as a moderator of the ECAC Study Group on Amendments to ECAC Doc 30, Part I. Marie studied at the University of Transport in Žilina (Faculty of Operation and Economics of Civil Aviation) and at Charles University in Prague (Faculty of Education).

United for safe and secure aviation

27 May 2021

All 44 ECAC Member States, deeply concerned over the diversion of Ryanair flight FR4978 to Minsk on 23 May 2021, issued a joint statement recalling the founding principle of international aviation set out in the 1944 Chicago Convention on international civil aviation, that "development of international civil aviation can greatly help to create and preserve friendship and understanding among the nations and peoples of the world, yet its abuse can become a threat to the general security".

You can read here the full statement by the Directors General of Civil Aviation of the European Civil Aviation Conference.

ECAC President contributes to EU Aviation Day

Lisbon and virtually, 3 May 2021

ECAC President Ingrid Cherfils emphasised the importance of strong international cooperation for the success of recovery measures in the short and long term, at the Aviation Day conference organised under the Portuguese Presidency of the Council of the European Union.

Speaking in the first panel of the event, dedicated to the recovery of the aviation sector during and after the COVID-19 pandemic, Ms Cherfils underlined that to respond to the increasingly complex needs of the air transport industry in Europe and to restart aviation after the COVID-19 pandemic, ECAC Member States must combine their efforts and use their collective expertise through strong pan-European cooperation and coordination in order to deliver a common message.

During the closing ceremony of the meeting, Ms Cherfils introduced the Lisbon Declaration agreed by the Directors General of Civil Aviation of ECAC Member States on the recovery of European aviation.

The summer period and the progress of vaccination campaigns provide an opportunity for the travel and tourism sectors to restart, bringing economic and social benefits to all European countries and their citizens. ECAC Member States agreed to support the sustainable development of the aviation sector – heavily impacted by the coronavirus crisis – while protecting public health.

They also agreed that, while vaccination should not be a precondition for travel, the application of measures affecting travel should include consideration to determine how vaccination, in conjunction with other measures, could be reflected in the progressive easing of travel restrictions, including notably quarantine and the suspension of traffic rights as a major impediment to travel.

To fulfil the objectives of the Lisbon Declaration, a coordinated approach across Europe is essential, and one of ECAC's main roles is to provide a platform to support and strengthen inter-governmental cooperation in air transport matters in Europe.

Luís Miguel Ribeiro, Chairman of the Board of ANAC, Portuguese Civil Aviation Authority, speaking at EU Aviation Day, 3 May 2021.

Directors General adopt documents, review activities and appoint new Coordinating Committee members

5 May 2021

ECAC 's Directors General met virtually for their 156th meeting on 5 May, joined by observers from the European Commission, EASA, EUROCONTROL, ICAO and JAA TO.

The impact of the pandemic on the European air transport sector – including on civil aviation authorities – and the challenges associated with the recovery of the sector, featured high on the agenda.

Directors General heard an update from Slovenia on its priorities for the forthcoming presidency of the Council of the EU, which it will hold in the second half of 2021. The briefing was complemented by information from the European Commission stating that most of the work during the Portuguese Presidency had been devoted to the Single European Sky SES2+ proposal, and that under the Slovenian Presidency good progress was hoped for on the environmental component of the Fit for 55 legislative package to be adopted in July 2021. This would include changes in the EU Emissions Trading System (ETS) Directive, a new proposal for renewable energies use in transport, and the ReFuel EU Aviation initiative, aiming to boost the uptake of sustainable aviation fuels.

Other key topics discussed were related to preparations for the ECAC Triennial Session (12 July 2021), including the draft 2022-2024 ECAC work programme and related budget.

Two strategic documents were adopted by Directors General: the amendments to *ECAC's Strategy for the Future – A Policy Statement* (December 2015), and the new *ECAC Communication Strategy*. The Terms of Reference of the new European Coordination Group on Aviation Cyber Security matters were also adopted. On environmental matters, Directors General adopted a new ECAC environment capacity-building programme, and reviewed progress made on the definition of a Long-Term Aspirational Goal (LTAG).

The representative of the Netherlands (ABIS Group) on the ICAO Council briefed the meeting on the 222nd Session of the ICAO Council, held virtually from 22 February to 19 March 2021, and which addressed the following main topics: appointment of the Secretary General, ICAO Ethics Framework, work by the Council Aviation Recovery Task Force (CART), preparations for the ICAO High-Level Conference on COVID-19 (HLCC 2021), RPAS amendments, cyber security, gender equality, as well as enhancing the efficiency of the working methods of the Council and its subsidiary bodies.

Directors General also had the opportunity to receive an update on safety and ATM matters from EASA and EUROCONTROL.

New ECAC appointments

During DGCA/156, Directors General appointed by acclamation two new members of the ECAC Coordinating Committee: Elisabeth Landrichter, Director General of Civil Aviation of Austria, and Kemal Yüksek, Acting Director General of Civil Aviation for Turkey.

EaP/CA workshop on security culture

28-29 April 2021

Key elements of security culture were discussed virtually by more than 20 security experts, including industry representatives, from Armenia, Georgia, Moldova, Kyrgyzstan, Kazakhstan and Ukraine at a workshop on security culture organised by ECAC under the EU-funded and EASA/ECAC-implemented Eastern Partnership and Central Asia (EaP/CA) Project.

Combining presentations delivered by experienced speakers with virtual breakout sessions, the workshop offered participants the opportunity to share their knowledge, experiences and best practices for promoting and effectively implementing security culture at national and organisational levels. Participants also brainstormed on the potential benefits of implementing security culture and on measuring the level of security culture in an organisation.

Speakers and participants both recognised the value of the workshop and agreed that cooperation at international, national and organisational levels is one of the critical elements contributing to the establishment of a robust and resilient security culture in aviation.

CASE II Project

First CASE II Project workshop

22 April 2021

The CASE II Project is an EU-funded project implemented by ECAC and the follow-up to the CASE Project, which was completed in 2020. Its main purpose is to contribute to strengthening aviation security by delivering aviation security capacity-building activities in Partner States across Africa, Asia and the Middle East.

The first workshop of the CASE II Project was jointly organised with the African Civil Aviation Commission (AFCAC) and focused on the implications of COVID-19 for aviation security. This virtual event was well attended with 107 registered participants representing 33 Partner States from across Africa. Through a series of presentations, the first of two sessions introduced industry representatives from Africa and Europe who provided their perspective of the impact of COVID-19 on aviation security operations. The second session focused on the aviation security response to the pandemic and provided insight and guidance covering both strategic and operational themes from three European speakers. The workshop has received plaudits from attendees and it is hoped that this success will be followed by many more for the CASE II Project.

Events to come

JULY

1/	41st meeting of the European Aviation Environment Working Group (EAEG/41)
6/	79th meeting (Part II) of the Technical Task Force
7/	33rd meeting of the Security Programme Management Group (SPMG/33), Rome
8/	ECAC Environment Capacity-Building Programme monthly familiarisation webinar on basic knowledge on aviation and the environment
12/	39th Plenary (Triennial) Session of ECAC (ECAC/39)
13/	191st meeting of the Coordinating Committee (CC/191)
20-21/	50th meeting of the Common Evaluation Process of security equipment Management Group (CEP-MG/50)

AUGUST

26-28/	70th Special meeting of Directors General (DGCA(SP)/70), Albania

SEPTEMBER

7-8/	53rd meeting of the Guidance Material Task Force (GMTF/53), Paris
9-10/	48th meeting of the Training Task Force (TrTF/48), Paris
30/	63rd meeting of the ECAC Medium-Term Objectives Task Force (EMTO/63), Paris

UAS Bulletin

May 2021

ECAC is pleased to announce the recent publication of the first UAS Bulletin. This online publication addresses the key unmanned aircraft systems (UAS) initiatives in ECAC Member States and internationally, as well as the strategic aspects to be considered for the development of this sector. Read the first edition on the UAS activities page of the ECAC website, or download the pdf version here.

News from the JAA Training Organisation (JAA TO)

ASSOCIATED BODY OF ECAC

Editorial

Paula V. de Almeida, *JAA TO Director*

Dear readers of ECAC News,

Recently, representatives of the European Union (EU) and other Member States of the European Civil Aviation Conference (ECAC) jointly agreed on the Lisbon Declaration, reaffirming aviation's importance as an accelerator for social and economic life across the continent.

While these welcome developments feed the hopes of aviation professionals and citizens alike, the ongoing low air traffic sheds light on other sector domains, some of which have been discussed in recent ECAC publications e.g. sustainability, artificial intelligence, and security culture/human factor.

The present issue of ECAC News on unmanned aircraft systems (UAS, or drones) provides a multifarious entry into this newer domain whose significant growth and potential require regulatory integration, standardisation and training harmonisation for a safe and secure (shared) airspace. In the following news update, JAA Training Organisation (JAA TO) is pleased to present its drone training efforts, ICAO course developments, and event and portfolio expansion plans.

Furthermore, under the motto of the *ICAO Year of Security Culture*, JAA TO is ramping up its aviation security offer to provide training, tools and food for thought to foster the security culture practices needed to establish strong systems that can mitigate security risks. In line with recent virtual events and online fora reaching a global audience, it raises much-needed awareness of the topic.

Whilst home office and virtual training dictate the first half of the year, JAA TO is confidently looking to the summer months and beyond. As travel restrictions persist, virtual classroom remains the norm for JAA TO, instructors and trainees. The encouraging positive feedback from trainees fuels JAA TO's way forward in the digital sphere. But with vaccination campaigns progressing and aviation organisations restarting, JAA TO hopes to soon enrich the build-back-better missions by restarting its traditional classroom training and irreplaceable knowledge hub that is the office headquarters in the Netherlands.

Until then, training facilitation and harmonisation continue to provide the solid background for the aviation community to operate in and overcome the COVID-19 working circumstances.

Unmanned aircraft systems (UAS) – new sights in the sky

UAS are growing technologies creating new industries with large economic potential. The rapid development of drone activities such as design, manufacturing and R&D will further accelerate this aviation sub-sector growth while impacting traditional aviation systems and topics such as air traffic management (U-space).

The newer, more versatile and more individualised access to drones and its applications lower the entry barrier for many organisations or private individuals to penetrate the airspace with their own (autonomous) devices. This rather participative momentum challenges the secure and safe integration of UAS into the traditionally highly regulated and manned aircraft industry.

To ensure safety and security, the European Union Aviation Safety Agency (EASA) introduced EU regulations 2019/947 and 2019/945 to set the framework for the safe operation of drones in European skies (EU and EASA Member States). This airspace architecture creates the backdrop for harmonising rules and training mandates.

JAA TO's drone training sets benchmark

As a pioneer regulatory training provider in all aviation domains, JAA TO has long been working with its UAS subject-matter-experts (SMEs) on drone course development and training harmonisation. As a result, JAA TO has been delivering drone courses for more than six years already, starting with the initial *UAS-INI - Basics of European Regulations of Unmanned Aircraft Systems (UAS)* course. Reflecting on trends and changes in industry and regulation, the drone portfolio strength feeds on content quality, faculty expertise and constant adaptability/expansion. A highly regarded portfolio precedent was achieved in 2020, as four JAA TO UAS training courses received recognition by the Joint Authorities for Rulemaking on Unmanned Systems (JARUS):

- UAS-INI-Basics of European Regulations of Unmanned Aircraft Systems (UAS)
- UAS-SORA-Specific Operations Risk Assessment (SORA) for Unmanned Aircraft Systems (UAS)
- UAS-AWE-Airworthiness Requirements and Equipment for Unmanned Aircraft Systems (UAS)
- UAS-OPS-Professional Operations of Unmanned Aircraft Systems (UAS).

To date, these are the first and only JARUS-recognised training courses worldwide.

In line with JARUS's scope, the recognised UAS courses serve the technical, safety and operational requirements for all aspects linked to the safe operation of UAS. As these requirements transpose in the EU, JAA TO supports the global establishment of harmonised, safe and secure requirements for drone operations into the well-regulated traditional aircraft industry.

Looking to ECAC and its UAS focal points, JAA TO's UAS training ensures visibility and involvement to guide the drone future in Europe at a strategic level. Anticipating the next industry trends to adapt and strengthen the UAS portfolio, JAA TO's training hopes to set further benchmarks.

JAA TO UAS training sessions are scheduled multiple times a year and are also delivered virtually.

JAA TO innovates UAS

The quick development of the drone sector demands national strategies building on a pan-European cooperative and collaborative framework. Consequently, the training for drone operation will change as technology evolves. To avoid training facilitation trailing behind common practice, JAA TO continuously focuses on innovating its UAS faculty and proposes various training offers for drone stakeholders in order to prevent shortcomings. As the leading European ICAO Training Centre of Excellence (TCE), JAA TO expedites new course development – the newly published ICAO Training Package (ITP) *Competency and Licensing of UAS Remote Pilots (European Categories): Virtual Classroom* being the latest example. This ITP provides national authority policy advisors and remote pilot instructors/licence examiners with the necessary knowledge, skills and attitudes to apply the EU regulations for competence of remote pilots in accordance with ICAO SARPs (Amendment 175 to Annex 1).

Besides classical training, JAA TO provides additional offers and auxiliary services, such as the high-level brainstorm sessions for ECAC Directors General. The past forum on UAS opened means of communication and collaboration among ECAC Member States for safe and efficient regulation implementation at State level, and encouraged the sharing of ideas to find possible solutions for UAS. Dependent on COVID-19 measures, similar events are in the planning. Furthermore, as the JAA TO drone course portfolio shows growing potential with courses like UAS-SEC, UAS-ELP and UAS-SOC, drone operators can ultimately strive for the JAA TO Drone Diploma – a badge of excellence awarded to the most prolific trainees.

The size and impact of the drone industry will continue to grow. In its capacity to manage the trend, JAA TO sees training harmonisation and regulation as the checks and balances for efficient integration and safe airspace.

More information on JAA TO UAS training via our website: www.jaato.com

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