

Council Offsite:  
Charting ICAO's Course  
to the Future of Flight

Emerging:  
Supersonic, Flying Cars,  
High-Altitude Flight, Pilotless Aircraft

Regulatory Engagement,  
Future MRO,  
Future Traveller Identity

NEWS AND DEVELOPMENTS FROM THE INTERNATIONAL CIVIL AVIATION ORGANIZATION - VOL.74 - NO.1

# ICAO JOURNAL

## THE FUTURE OF AVIATION

THE CHALLENGES AND OPPORTUNITIES  
OF AN UNPRECEDENTED ERA  
IN AIR TRANSPORT INNOVATION



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UNITING AVIATION

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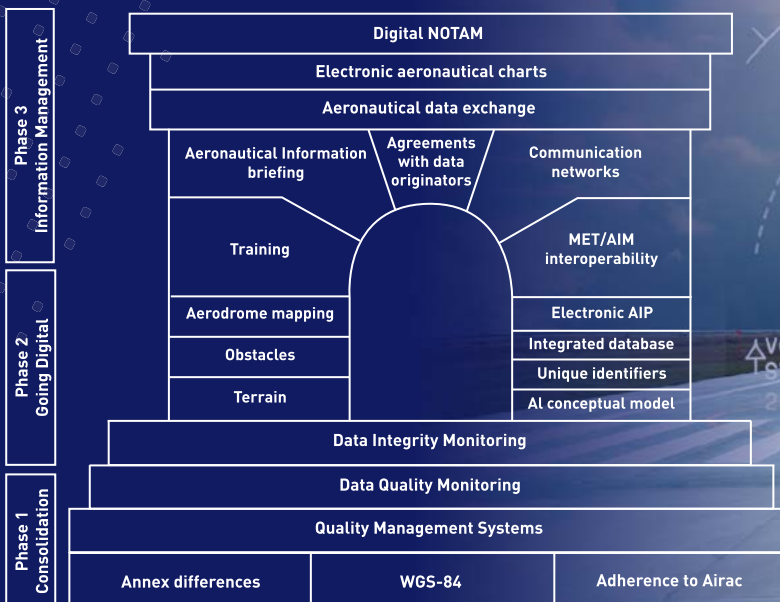
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ICAO Communications Unit  
+1 (514) 954-8221  
[www.icao.int](http://www.icao.int)  
[communications@icao.int](mailto:communications@icao.int)  
[twitter.com/icao](https://twitter.com/icao)

Editor: Rick Adams  
AeroPerspectives  
+(33) 603 73 05 12  
[rickadams@aeroperspectives.com](mailto:rickadams@aeroperspectives.com)  
AeroPerspectives.com

Graphic Designer: June Kim  
+1 (514) 954-8219 ext. 7168  
[jukim@icao.int](mailto:jukim@icao.int)

## Advertising

FCM Communications Inc.  
Yves Allard  
Tel: +1 (450) 677-3535  
Fax: +1 (450) 677-4445  
[info@fcmcommunications.ca](mailto:info@fcmcommunications.ca)

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+1 (514) 954-8022  
[sales@icao.int](mailto:sales@icao.int)

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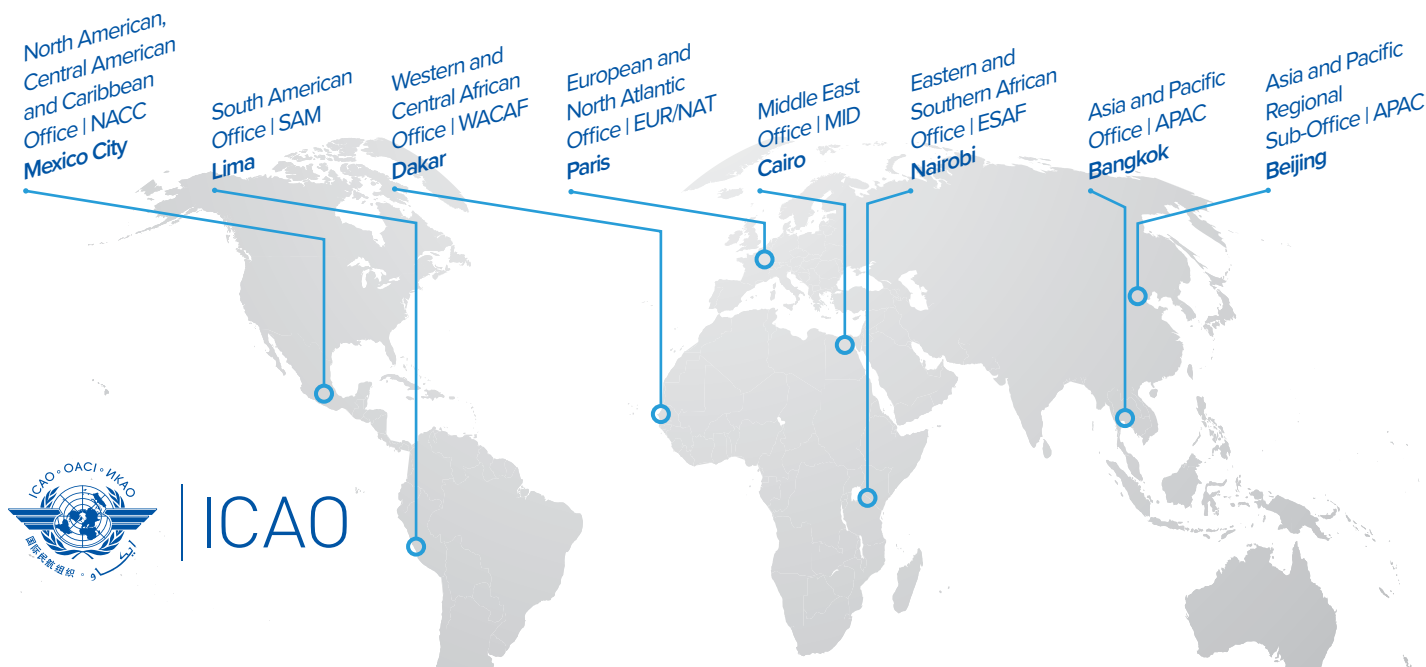
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## ICAO'S GLOBAL PRESENCE



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## MESSAGE FROM THE ICAO PRESIDENT

## Connectivity and Innovation:

# ICAO'S 75<sup>TH</sup> ANNIVERSARY AND THE FUTURE OF FLIGHT

Dr. Olumuyiwa Benard Aliu  
President of the ICAO Council



MESSAGE FROM THE ICAO PRESIDENT

✈ Aviation today is on the brink of some major transformations. These include the increasing deployment and application of new drone technologies, the launch of autonomous, suborbital, and supersonic activities, as well as other innovations in areas such as artificial intelligence and distributed blockchain applications.

These developments should signal to every leader and decision-maker throughout our global aviation network, including government leaders in our 192 ICAO Member States, that a tremendous modernization is now poised to take place over the years ahead.

And as ICAO Council President it is therefore beholden upon me to encourage States and industry to recognize and act upon this realization, and to embrace these transformations through the implementation of both new physical *and* regulatory infrastructure.

Only by assuring this will we keep our sector vital, efficient, and fully responsive to the needs and expectations of modern businesses and societies.

2019 is the 75<sup>th</sup> Anniversary of ICAO, and its theme as adopted by the ICAO Council suitably focuses on aviation's *75 years of connecting the world*.

This connectivity is not only a bi-product of the legal, political, logistical, and operational standards and frameworks realized through ICAO, but importantly as well it has helped many States and regions to realize some very significant socio-economic benefits which have become one of the most important legacies of international air transport.

This fact is reflected in how air transport connectivity can be seen to be so closely linked with governments' realization today of no fewer than 15 of the 17 United

Nations Sustainable Development Goals adopted under *Agenda 2030*.

And as the countries of the world continue to pursue these goals over the coming decade, the innovations now emerging in aviation will only make our sector's positive impacts more diverse and pervasive than ever before.

For ICAO and its Member States, it is essential that we integrate the new entrants and innovators in the world of aircraft design and operation more meaningfully into our existing regulatory processes. Furthermore, those processes themselves must also be innovated to become more responsive in terms of addressing and accommodating new technological or procedural capabilities in air transport more rapidly than is the case today.

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*“For ICAO and its Member States, it is essential that we integrate the new entrants and innovators in the world of aircraft design and operation more meaningfully into our existing regulatory processes.”*

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ICAO is seeking to bolster the emergence of this collective vision of the future of aviation, and in addition to our traditional anniversary events this year I have further requested that our World Aviation Forum in 2019, which takes place on 23 September the day before our Assembly, focuses the attention of ICAO's Member States and industry partners more closely on these issues.

This newly-oriented IWAF for 2019 will be augmented by a series of youth innovation competitions we are presently providing support for in all ICAO Member States, and in addition a special ICAO Aviation Innovation Fair will be hosted in our Headquarters on 22 and 23 September. Its specific purpose will be to complement the IWAF agenda and generate further excitement and momentum on this important issue during this critical moment in the evolution of aviation, and we expect both regulatory and technological innovations to be on display there.

Member States interested in reviewing how others are currently responding to

and optimizing these challenges to the benefit of their local air transport systems and stakeholders may wish to take note of the article presented in this issue of the ICAO Journal by the United Kingdom's Civil Aviation Authority (UK CAA). Entitled *Regulatory Engagement in the New Age of Aviation*, it provides a number of helpful points which should be appreciated by the Journal readership.

As we commemorate together the 75<sup>th</sup> anniversary of that historic moment when countries first came together, through the Convention and ICAO, to share their skies to their mutual benefit, we should take a moment together to appreciate just how far air transport has come over these past decades, and how important it remains today to the peace and prosperity of the nations and peoples of the world.

ICAO is proud to be focusing our sector's attention this year not only on aviation's past, but also its very exciting future, and we look forward to our 192 Member States and the entire global air transport community joining us in these celebrations and objectives. [J](#)

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# FUTURE FOCUS

AT 2018 COUNCIL OFFSITE (COSM18)

|| STRATEGY & PLANNING ||

## EVENT

### 5TH COUNCIL OFF-SITE STRATEGY MEETING (COSM 2018)

Estérel, Québec, Canada

## THEME

Aviation of the Future

## OBJECTIVE

To examine the potential impact of rapid technological change on civil aviation and discuss approaches that may be needed to ensure that the International Civil Aviation Organization (ICAO) maintains its global leadership.

## PARTICIPANTS LISTING FOR COUNCIL OFFSITE:

The President of the ICAO Council, Dr. Olumuyiwa Benard Aliu; 32 Council Members; 11 non-Council Member State Representatives; 5 Members of the Air Navigation Commission (ANC); representatives of the Civil Air Navigation Services Organisation (CANSO), the International Air Transport Association (IATA), Airports Council International (ACI) via video, the International Coordinating Council of Aerospace Industries Associations (ICCAIA), and the European Union (EU); the Secretary General, Dr. Fang Liu and members of the ICAO Secretariat (Headquarters and Regional Offices). Dr. Brian Havel, Director of the McGill Institute of Air and Space Law, facilitated.



# 4

## RECOMMENDATIONS

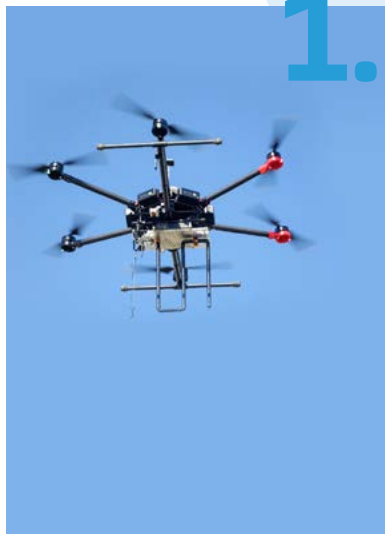
To guide the work of ICAO in the near-term and to adapt its work programme in the next triennium (2020-2022) in light of the Future of Aviation, the 2018 COSM recommended the following:

### 1.

#### UAS OPERATIONS

That the Secretariat include expanded activities within the next Triennial Business Plan to support and accelerate the development of regulatory frameworks for UAS operations.

To facilitate this expansion of ICAO's work programme, an innovative and flexible approach should be adopted, taking into account ongoing development at national, regional and international levels. The COSM agreed that there is a need to increase the rate of regulatory development to support the safe and socially responsible operation of UAS.



### 2.

#### BROADENING OF ARRANGEMENTS WITH OTHER INTERNATIONAL ORGANIZATIONS

That a plan be proposed for consideration by the 40<sup>th</sup> Assembly to engage in arrangements with other International Organizations that contribute to the technical work programme of ICAO in light of emerging modes of aerospace transport, including commercial space.

The COSM participants agreed that the Convention on International Civil Aviation has sufficient flexibility to accommodate an expansion of work within the ICAO mandate to include commercial space. However, it was also recognized that the Organization, at present, does not have the expertise, knowledge or experience in this area and would need to expand its partnerships to make a meaningful contribution.



### 3.

#### OPERATIONS ABOVE FLIGHT LEVEL 600

That the Secretariat include expanded activities within the next Triennial Business Plan to support the development of regulatory frameworks for operations above Flight Level 600, given the emergence of remotely piloted aircraft, unmanned balloons and other operations at these altitudes. (See "High Fliers," page 24.)



### 4.

#### COUNCIL ENGAGEMENT IN NEW AND EMERGING ISSUES

That the Council's Implementation Strategic and Planning Group (ISPG) develop a modus operandi to more actively engage on emerging issues with all relevant stakeholders, including States, industry and academia for consideration by Council in its 217<sup>th</sup> Session.

## At its latest Offsite Strategy Meeting, the Council and Senior Secretariat staff explored how ICAO should respond to rapid technological changes, including the emergence of new modes of aerospace transport.

*“The Organization will need to find new ways of working to adapt to the rapid pace of technological development ...”*

---

The President of the Council, Dr. Olumuyiwa Benard Aliu, emphasized that ICAO's Standards-making process would need to keep up with the pace of technological development in civil aviation, but also pointed out the paradox that many States were having difficulties in implementing ICAO Standards and Recommended Practices (SARPs) at the present rate of Annex amendments. ICAO may need new tools in the future, he said, to facilitate implementation, such as publishing “best practices.” While ICAO Standards are intended for international operations, the President also prompted the COSM participants to consider whether this paradigm may need to shift in the future.

The Aviation of the Future theme was addressed at CSOM2018 through focussed discussions and team activities that addressed an overview of related technological challenges and opportunities, ICAO's mandate and regulatory challenges, partnerships, and the future of work in the aviation sector. Industry representatives expressed that the pace of development is faster today than ever before in the history of civil aviation. For ICAO to respond appropriately, the Organization will need to focus on clearly defining the challenges associated with the introduction of new technologies; transition to a more data-driven approach to developing and prioritizing its work programmes; and look to the use of performance-based Standards as a means of keeping pace with development. The participants also noted that ICAO should not lose sight of the need for prescriptive Standards in some areas.

The President mentioned that emergence of new technologies in the aviation

sector was not a new issue and cited the experience gained by ICAO in using smart regulatory approaches to adapt to change. This approach strikes a balance between prescriptive and performance-based approaches, and has been used in the past to support the rapid emergence of technology and foster the advancement of industry, such as the performance-based approach used in Annex 8 – Airworthiness.

In its session on Future of Work in the Aviation Sector, the COSM benefited greatly by an impromptu panel of young boys and girls who provided their insights into their career goals and possible aspirations to pursue a future as an aviation professional. Council Members supported that to attract the next generation of aviation professionals, aviation would need to reach out to young people as early as possible during their education, and that this responsibility is both a collective and individual responsibility for all involved in civil aviation.

They also underscored that this is not the first time that the Organization has faced significant changes in civil aviation, and that lessons learned over the history of ICAO can be applied to civil aviation's future challenges. The Convention on International Civil Aviation has proven to be remarkably robust and is constructed in a manner that allows sufficient flexibility to adjust the organizational work programme when needed. It was also noted, however, that ICAO will need to find new ways of working to adapt to the rapid pace of technological development and the ever-increasing needs of the Member States. Expanding the existing partnerships and a proactive engagement with industry, to keep pace with technological change, will be essential. [J](#)

## THE FUTURE OF AIR NAVIGATION

13<sup>TH</sup> AIR NAVIGATION  
CONFERENCE SETS STAGE  
FOR 40<sup>TH</sup> ASSEMBLY

✈ The 13th ICAO Air Navigation Conference in Montréal hosted more than 1,000 participants from 112 Member States and 32 international organizations. The theme of the conference was “From Development to Implementation,” encompassing implementation of operational concepts, roadmaps and technologies. Participants discussed a wide range of topics, including revised policies and targets for the ICAO Global Aviation Safety Plan (GASP), new business case tools relating to infrastructure modernization projects and other revisions to the ICAO Global Air Navigation Plan (GANP), State endorsement of an International Trust Framework to bolster the security of future digital air transport requirements, and a new global approach to cost-effective safety collaboration. ICAO Journal Editor Rick Adams spoke with ICAO Air Navigation Commission (ANC) President, Capt. Claude Hurley, and Mr. Stephen Creamer, Director of the ICAO Air Navigation Bureau (ANB), following the 10-day event. Here are a few excerpts from their conversation.

“Technological innovations in unmanned aircraft systems, supersonic aircraft, operations above FL 600, and commercial space flights, to name but a few emerging sectors, will create wonderful new opportunities for the Next Generation of Aviation Professionals – and the travelling public they will serve – but will also bring with it significant challenges, as we together look for ways to safely integrate this new traffic into ever more congested airspace,” ANC President Hurley told delegates to AN-Conf/13. “This Conference is an essential

*“The recommendations here can bring measurable improvements to aviation safety, efficiency, capacity, security and the environment in a globally harmonized way.”*  
- Capt. Claude Hurley, President, ICAO Air Navigation Commission



Some of the more than 1,000 participants at the 13th ICAO Air Navigation Conference in Montréal.

element in reaching out to you ahead of next year's Assembly, to find ways that we can build a shared situational awareness of the challenges and opportunities ahead, and how best to prioritize our limited resources so as to build a better future, together, for aviation and our travelling public.”

ANB Director Creamer explained: “We essentially pre-positioned the technical dialogue which traditionally would have occurred in the Assembly's Technical Commission. We asked the States to move it forward a year and put it in the Air Navigation Conference so we could build a work program around their aspirations and then ask the Council to provide us with the resources for the priority items.”

Next steps: Recommendations from the Conference go to the ANC. The Commission will make recommendations by spring to the ICAO Council, and the Council in the course of its summer budget deliberations will decide how much of the work program it wants to address.

Here are a few highlights from the Conference:

**STABILITY IS GOOD**

“What we heard at the conference is that States don't want to see major changes in the plan from triennium to triennium.

They're making long-term budget and training decisions that they don't want disturbed by some massive shift that they aren't in a position to react to. Give States time to plan and invest properly, help them understand how the national planning interacts with regional planning and feeds into the global outcomes that are laid out in the new GASP and GANP.

"The largest part of what's drafted in the GASP and the GANP are performance targets. We have to learn how to measure together and then normalize that measuring process so the comparisons are valid and States can adjust their national plans to improve the performance in the various areas."

### MORE COMPREHENSION, AGILITY

"We heard a lot from the States that they're feeling they don't have enough comprehension of the intent of the global plans to properly integrate them into their national plans. We're always looking for more in the way of implementation support from the regions or through training, some sort of access to the information as it's being developed. The call for transparency and inclusiveness in the way we develop standards comes from that.

"On the other hand, because we're struggling with some of the disruptive parts of the industry, they're telling us they want us to go faster, they want us to be more agile.

"We're thinking about how best to articulate that to the Council through the Commission. We need to do a little bit of introspection into our long-term process to see if there's a way we can modernize some of our processes, perhaps do more recognition of other people's development work."

### GANP GOING ONLINE

"States want us to be more inclusive in the development of the GANP. We're going to expand the overall group that works on the future development, the governance and input on changes. We're making the technical portion of the GANP an online live resource, an online catalog of the ASBU (Aviation System Block Upgrade) elements,

as opposed to printing a document once and waiting three years to update it again."

### INTEGRATING RISK MANAGEMENT

"Throughout, there was a thread of connectivity between safety and security in terms of integrated risk management. That's going to require us to look inside ICAO, how we can better address these risks that have multiple dimensions to them.

"One example is in 2017 when carriage of laptops was banned on airplanes because they were thought to be a security risk. Passengers had to check them in the hold, so they became a cargo risk – a security risk morphs into a safety risk."

### SEEKING CYBER TRUST

"A big win was endorsement that ICAO should work toward developing a trust framework for cyber resilience, establishing a formal project involving States, international organizations and relevant stakeholders for the urgent and transparent development of a globally harmonized aviation trust framework. Priority should be given to governance principles, legal status, and setting out how this can work with a global internet that's properly protected and has in its core issuance of authentication through the directors general for civil aviation, a country-specific approval process."

### THE GASOS OVERSIGHT REVOLUTION

"The Global Aviation Safety Oversight System is a pretty revolutionary concept, ICAO recognizing a formal delegation of a responsibility by a State to a service provider to act on its behalf in doing its safety oversight duty. The first component is for ICAO to make clear how to delegate safety oversight responsibility within a State so it's clear the State remains responsible for the safety oversight of activities emanating from the State, creating a tangible, understandable and legally defensible delegation of some of that activity to another entity, in this case a regional oversight safety organization. A companion to that is finding a way to recognize the regional safety oversight organization as capable of doing that work on behalf of the State."

"All of this work builds on our experience to-date, including work with EASA and the European Union where they are providing airworthiness oversight and other functions on behalf of the EU Member States."

### FIND OUR VOICES

"The close collaboration between the Commission and the ICAO Secretariat ahead of the Conference was very useful in the Commission's review. This was meant to be the start of a conversation with the States to engage and to tell us if we're on the right path. For all of us to find our voice and to speak up with our opinions – whether we're from Industry or States – is key to ICAO getting early feedback on any proposals so that we, together, can build a shared situational awareness on any potential implementation challenges, and for us then to build consensus on how best to tackle these challenges together." 3

Videos of the entire AN-Conf/13 proceedings, presentations, conference papers and more are available on the ICAO website: <https://www.icao.int/Meetings/anconf13/Pages/default.aspx>



*"The challenge for us now is articulating these requirements in a way that is compelling for the Council and the Member States." - Mr. Stephen Creamer, Director of the ICAO Air Navigation Bureau*



# FUTU FLIG



# RE HT

Aerion. Boom. Cora. Elevate. PopUp. Spike. Vahana. These are just a few of the emerging names which could revolutionize commercial aviation across the next generation. ICAO Journal Editor Rick Adams offers an overview of the rapid pace of developments in supersonic, urban air transport, single pilot and pilotless aircraft.

FUTURE FLIGHTS

Photo: Aerion Supersonic



✈ It's possible that this year's graduating cadre of young cadets could be the last to enjoy full, four-decade careers as traditional commercial airline pilots. By the time they are ready to retire, around 2060, pilot jobs as we currently know them will "start to become obsolete," according to Richard de Crespigny. He's the Qantas captain who led a five-pilot team that safely landed a severely crippled A380 in Singapore in 2010.

Pilotless aircraft "will eventually be built," he predicted, perhaps in production by 2040. "Innovative airlines will buy them. Adventurous passengers will fly them."

Boeing is conducting flight tests related to autonomous or reduced-crew civil aircraft in a two-year project at Moses Lake, Washington. The tests include using a modified vehicle for autonomous taxi, autonomous flight algorithms in a simulator, flight tests of an artificial intelligence (AI)-based system in a Cessna Caravan, plus engine start, pushback, taxi, manoeuvre and takeoff roll using a Boeing 787 Dreamliner technology testbed. The objective is to determine if such aircraft could be operated for freight or passenger-carrying missions with the same levels of safety as current manned aircraft.

"A pilotless airliner is going to come; it's just a question of when," said James Albaugh — in 2011 when he was president and CEO of Boeing Commercial Airlines. "You'll see it in freighters first, over water probably, landing very close to the shore."

Sixteen years ago in 2002, Craig J. Mundie, then chief research and strategy officer for Microsoft (now senior advisor to the CEO), made a \$2,000 public wager with Eric Schmidt, then CEO of Google, that "by 2030, commercial passengers will routinely fly in pilotless planes." Mundie's logic was that "if we stay on this Moore's law kick — (computers) will be about 4,000 times more powerful," adding that "with computers increasingly a part of critical infrastructure, the industry is going to have to focus a lot more on making machines that just don't fail." Schmidt's contrary argument claimed "the training and timing around handling emergencies such as engine failure at rotation are not going to be transferrable to autopilots and machines."

"We are quite confident that technologically, the toolkit is filled. With respect to a commercial airplane, there is no doubt in our minds that we can solve the problem of autonomous flight," stated John Tracy, Boeing's chief technology

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*Pilotless aircraft  
"will eventually be  
built ... Innovative  
airlines will buy  
them. Adventurous  
passengers will  
fly them."*

---

*Capt. Richard de Crespigny, Qantas*

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officer, now retired, two years ago. "It's a question of certification procedures, regulatory requirements and, even more significantly, public perception."

"The future pilot will still be needed, but he or she will sit in an office flying and managing the aircraft from the ground like the drone pilots already do," said Capt. Tilmann Gabriel, chairman of the International Pilot Training Association (IPTA), which assists ICAO with expertise in developing training and simulation guidance.

Not surprisingly, many experts believe commercial airliners will never go pilotless. What happens if the computer flying the plane malfunctions? According to NASA data, an airplane system malfunction occurs on 20% of flights. Moreover, AI would follow "by the book" rules-based judgments and might not be able to make human-type "generative intelligence" decisions such as the emergency ditching in the Hudson River by Capt. Chesley Sullenberger. "Humans are particularly good at adaptive problem-solving and discovery, areas where there has been little machine intelligence progress," explained Michael Feary, a research scientist at NASA Ames Research Center.

Scenarios of "cascading failures" occur many times, noted Keith Hagy, the Air Line Pilots Association (ALPA) director of engineering and safety. "Those are the kind of abnormal situations when you really need a pilot on board with that judgment and experience and to make decisions."

### A SKEPTICAL PUBLIC

"The issue has never been could you automate an airplane and fly it autonomously?" said Dr. R. John Hansman, professor of aeronautics and astronautics at the Massachusetts Institute of Technology and Director of the MIT International Center for Air Transportation. "The issue is could you put paying customers in the back of that airplane?"

A majority of people, 54%, said they would not fly in a pilotless plane (even if the ticket price was cheaper), according to a UBS survey last year. Only 17% said they would, though this percentage increased for those with higher



*Volocopter – electric, autonomous, German (Left),  
London to Paris in an hour via Lilium (Top),  
Airbus Vahana concept (Middle),  
Embraer X's DreamMaker (Bottom)*

*“The future pilot will still be needed, but he or she will sit in an office flying and managing the aircraft from the ground like the drone pilots already do.”*

Capt. Tilmann Gabriel, chairman,  
International Pilot Training  
Association (IPTA)

educations and incomes. In the 25-34 age group, 30% responded that they were very likely or somewhat likely to fly in an autonomous airliner (versus 40% who were unlikely or very unlikely to do so). In the 55-64 bracket, the unlikely group rose to 60% with only 10% likely or unlikely.

Americans are far more interested with 27% very/somewhat likely to fly in a pilotless plane, compared with only 15% for respondents from the UK, France and Germany.

The 8,000 people surveyed are more inclined to try a driverless car (30%), though the research was conducted before a pedestrian was killed by an Uber test vehicle operating in autonomous mode. In a Travelzoo survey, 38% said they would prefer a Star Trek-style teleporter (at the moment, a fictional device).

The UBS report claimed the aviation industry could save up to \$35 billion a year by eliminating pilots in the cockpit: more than \$26 billion in pilot salaries, benefits and training costs, \$3 billion for business aviation, \$2.1 billion for civil helicopters, over \$1 billion in fuel savings from computer-driven flight optimisation, plus \$3 billion from lower insurance premiums.

#### HOW ABOUT ONE PILOT?

“The more disruptive approach is to say maybe we can reduce the crew needs for our future aircraft,” Airbus chief technology officer Paul Eremenko said recently. “We’re pursuing single-pilot operation as a potential option and a lot of the technologies needed to make that happen have also put us on the path towards unpiloted operation.”

Boeing Research and Technology vice president Charles Toups said it may take a “couple of decades” to persuade passengers to take a single-pilot jet, suggesting public support for the concept would start with proliferation of self-driving cars.

“They are going to remove the co-pilot,” stated Stephen Rice, a human factors professor at Embry-Riddle Aeronautical

*Will ground-based operators replace airline co-pilots?*



University. “The manufacturers like the idea because they can redesign the cockpit. The airlines I’ve spoken to like the idea because it saves costs in the same way that removing the third person from the cockpit did decades ago.”

To support a single-pilot cockpit, French Air and Space Academy (AAE) and NASA Ames / Rockwell Collins research recommends a ground-based operator, much like today’s military drone operators who control aircraft from half a world away. According to Jean Broquet, an AAE member and former designer of automated satellite control systems, Pilot-Ground operators (PGs), would be qualified as pilots, including holding a type rating (there goes some of those personnel and training cost savings.) The AAE estimates one PG can simultaneously manage up to five flights in short- to medium-haul operations. In the NASA “super-dispatcher” concept, a trained pilot could remotely oversee the flights of as many as a dozen airplanes at once. If an airborne pilot needed help because of equipment malfunction or medical emergency, the ground-based aviator could help fly the airplane.

The airline flight crews who participated in their single-pilot simulator-based research “weren’t as negative as I thought they would be,” said NASA research psychologist Walter Johnson. “They don’t want to fly alone, but what I got from them was that, [with a copilot on the ground], it probably would work.”

“The main issue for single-pilot operations is cybersecurity,” said Joel B. Lachter, NASA computer scientist. “In order for it to be done safely, automation or ground operators would need authority to be able to step in in the case of off-nominal issues such as pilot incapacitation. If they can eliminate the cybersecurity threats surrounding those operations, I think it is feasible.”

The chief executive of the International Air Transport Association (IATA), Alexandre de Juniac, said he is “not convinced by the single-pilot issue. I don’t see the plus. I do see the minus.”



Spike Aerospace

### FLYING ABOVE TRAFFIC JAMS

Mashups of technology companies, automotive companies, traditional aviation OEMs and startups are attempting to create a new market niche known as “urban air mobility” (UAM), aka “flying cars” or “flying taxis.”

Google is testing a two-person, electric-powered air taxi in New Zealand known as Cora, which uses three onboard computers to calculate its flight path – no pilot necessary – with 12 lift fans for vertical takeoff and horizontal flight, and with a parachute (similar to the Cirrus fixed-wing aircraft). Top speed 93 mph. Altitude 3,000 feet. Range 62 miles.

German startup Lilium, which has recruited key personnel from Airbus and Tesla, is touting a five-seat vertical takeoff and landing (VTOL) electric jet which could fly in excess of 180 mph and transit from London to Paris in an hour. First “functional crewed flight” is expected by next year and the on-demand air taxi service by 2025.

Airbus has multiple short-haul aircraft ventures spinning up. Project Vahana from their Silicon Valley-based A3 research centre is a self-piloted single-passenger VTOL with automated obstacle detection; a production model is targeted

for 2020. The CityAirbus with four ducted fans would seat 3-4, operated by a single pilot (but evolving to fully autonomous operation in the future) – look for a demonstrator and a piloted test flight in 2019. Airbus is also working with Audi on the Pop.Up Next driverless car / drone / air taxi.

A Dutch company unveiled the first production model PAL-V Liberty flying car at the Geneva, Switzerland motor show in March. The \$615,000 two-engine, two-seater can drive up to 105 mph on three wheels or fly at 112 mph using a rear-mounted propeller, traversing up to 300 miles on unleaded gasoline. Pal-V requires a short runway to takeoff and land, and operators will have to qualify as gyroplane pilots (there’s an unpowered rotor which serves as a parachute).

Bell Helicopter (Fort Worth, Texas) is partnered with ride-share company Uber in a flying taxi initiative called Elevate, scheduled to debut in Dallas-Fort Worth, Los Angeles and Dubai in 2020. Initially, traditional pilots will be required, but they are hoping that “pilot augmentation technology will significantly reduce pilot skill requirements, and this could lead to a commensurate reduction in training time,” similar to an FAA light-sport pilot licence. “Not only must the FAA be convinced, but

*“Supersonic aircraft contenders not only need to design for Mach 1.2 to 2.2 speeds, they must address challenges of fuel efficiency, carbon dioxide emissions, noise levels on takeoff and landing, and the ultimate dilemma, sonic booms.”*

the insurers who cover the risk of the operation will need to see that pilot skill and experience requirements are reduced.”

#### LOWERING THE BOOM

Several commercial supersonic aircraft programs are on the drawing boards in the US, Japan and Russia, and some of the initiatives are transitioning to a flight demonstration phase. Spike Aerospace (Boston, Massachusetts) flew an unmanned subscale version of their S-512 supersonic design in 2017. Denver, Colorado-based Boom Supersonic’s two-crew, one-third scale XB-1 “Baby Boom” demonstrator is scheduled to fly sometime of this year. Aerion (Reno, Nevada), which has worked with Airbus, General Electric and Lockheed Martin, plans to proceed directly to full-size pre-production AS2 aircraft. All three programs are targeting flight testing and initial production aircraft deliveries in the 2021-2025 timeframe.

To get there, the contenders not only need to design for Mach 1.2 to 2.2 speeds, they must address challenges of fuel efficiency, carbon dioxide emissions, noise levels on takeoff and landing, and the ultimate dilemma, sonic booms. Even so, they may not be allowed to overfly the US because of a FAA ban on flights exceeding Mach 1 – implemented

46 years ago in 1973. The FAA is collaborating with International Civil Aviation Organization (ICAO) technical working groups on recommended standards for noise and emissions, Mach cut-off (flight conditions in which sonic booms do not reach the ground’s surface) and “low boom.”

Dan Nale, Gulfstream senior vice president of programs, engineering and test, believes flying a supersonic business jet will be “very similar” to flying a subsonic jet. “Modern flight controls and fly-by-wire systems do an excellent job of compensating for the aerodynamic effects of transonic and supersonic flight. Where supersonic pilots are most likely to feel the effects of speed is on their displays. Distances will shrink at a surprising rate, airborne traffic will be quickly overtaken, and pilots will have to carefully plan their arrivals and descents to effectively transition from high and fast to the terminal environment.” <sup>3</sup>

*This article is reprinted and adapted by permission of Civil Aviation Training (CAT) magazine, Halldale Group.*

*Rick Adams, Editor of ICAO Journal, is a Fellow of the Royal Aeronautical Society (FRAeS).*

## TRANS-OCEAN “COMMUTING” AT HYPERSONIC SPEEDS



*Still conceptual and decades away from being built, Boeing has stirred excitement with its hypersonic aircraft announcement.*

Mach 5. 4000 miles per hour. New York to London in two hours. Tokyo to Los Angeles in three. Sydney to London, which currently takes 22-24 hours with one stop, could be reduced to only five hours.

Kevin Bowcutt, Boeing’s senior technical fellow and chief scientist of hypersonics, said, “We’re excited about the potential of hypersonic technology to connect the world faster than ever before. This aircraft would allow you to fly across the ocean and back in one day, which is all most people would want.”

The proposed airplane concept would be larger than a business jet but smaller than a 737, ie between 20 and 100 passengers. Passengers and crew would experience a “G-force feeling” for about 12 minutes as the plane accelerates to cruising speed, and the views at the 95,000-foot cruise level (two times higher than the average airliner today) would feature the earth’s curvature at the horizon.

Boeing estimates a prototype could be ready in 5-10 years and a production aircraft – including autonomous piloting – in 20 to 30 years.

## FLYING CARS

## IS THERE AN AUTONOMOUS FLYING CAR IN YOUR FUTURE?

✈ About 100 companies, large and small, are racing to develop certifiable airframes that can handle up to six passengers; some think they will be flying by 2021, most by about 2025, and there are predictions of thousands of such “flying cars” serving as on-demand air taxis, landing at “vertiports” atop tall buildings in megacities around the world.

“If you’re going to do anything interesting with this as a large volume, you’re going to have to get rid of the pilot license,” Dr Luuk van Dijk told *ICAO Journal*. For flying cars to be economically viable to build, he estimates 1500-1700 flight hours per year per aircraft. And since there’s already a shortage of licensed commercial airline pilots (and flight instructors), “You won’t have enough CPLs that want to be a taxi driver.” Van Dijk is the Founder and CEO of

Daedalean, a 22-person startup in Zurich, Switzerland which is developing autonomous guidance, navigation and control software for small electric personal aircraft.

“These electric vehicles are much simpler than aircraft with combustion engines. And because they’re simpler, they can be cheaper, they can be quieter, they can be safer. There’s no reason a Lilium or Volocopter should cost more than a Tesla Model S. And there’s no reason you shouldn’t be able to sell 50,000 of them,” Van Dijk explained.

The Daedalean leader, a physicist, has worked at Google and SpaceX (designing spacecraft flight control software), and several years ago led a project designing an autonomous ocean-going sailboat at ETH, Switzerland’s technical university which has produced 21 Nobel Prize winners (including Albert Einstein). Van Dijk said there are “five or six groups” in Zurich “that are at the forefront in robotics and autonomy, flying control theory, deep learning.”

In 2016 he founded Daedalean. “I wanted to do the most interesting startup I could possibly think of. The startup scene was clearly lacking in ambition, in my view. Startups go for acquisition really early and


when they get bought the talented students are shipped off, never to be heard from again. I thought that was a massive waste of opportunity. When hiring you have to compete with big companies that pay very comfortable salaries. So you can only lure people if you have something that is obviously more interesting.”

Daedalean has spoken with 30 to 35 of the electrical vertical take off and landing (eVTOL) developers. “Some people really know what they’re doing and they’re on a good track and they’re going to be on the market by 2021 – this is the median number being thrown around. Full autonomy is on everybody’s list.”

“We start with everything a human pilot does, then we will try to build systems that can outperform a human in every way. So to speak, a drop-in replacement for a human pilot,” described Van Dijk. “Not in the form of an R2D2 that sits in the copilot seat and has a robot arm control of the stick. Electric VTOLs are already fly-by-wire; the primary flight control computer already has sufficient control over the attitude, altitude, trajectory, etc. to fly reliably from A to B.”

The first part of the system that Daedalean is focused on – the Visual (X) – is designed to replace the eyes and the visual cortex of the pilot “to see where we are and what we’re looking at. We’re doing that for the ICAO-defined categories and we’re training neural networks to recognize them.” Systems using simultaneous location and mapping (SLAM) apply the parallax of onboard cameras “to solve the equations that tell you where you are in space and where all the other things are ... more accurate than a GPS.”

Van Dijk noted that software for safety-critical applications in aerospace must meet such standards as DO-178C (Software Considerations in Airborne Systems and Equipment Certification), DO-254 (Design Assurance Guidance for Airborne Electronic Hardware) and DO-160 (Environmental Conditions and Test Procedures for Airborne Equipment).

He said, “We have to convince EASA and the FAA that neural networks are safe enough. We also have to help develop the means of compliance to demonstrate the thing. We intend to be able to demonstrate safety in the way that the authorities are accustomed to, so we need not ask for special exceptions because that will never fly. Fortunately, they are moving to performance-based metrics rather than proscribing how it should be done; the winds seem to be even more friendly.” 

*Swiss startup Daedalean has recruited experts in robotics, mechanical engineering, computer vision, artificial intelligence and avionics. (And rescue dog, Daila.)*





ICAO 2019

75 YEARS OF  
CONNECTING  
THE WORLD

✈ To commemorate ICAO's 75<sup>th</sup> Anniversary in 2019, a new website has been established to celebrate civil aviation's storied past and exciting future, and to host the portals for three new aviation Innovation Competitions aimed at spurring the interest and enthusiasm of global youth and young adults.

Taking advantage of the momentum toward highlighting the importance of aviation innovation to address future air transport challenges, initiated by the ICAO Council at its latest Off-site Strategy Meeting (see full review page 6), the new Innovation Competitions are the first of several major innovation-related initiatives being pursued by ICAO this year, all of which will culminate in an innovation-focused World Aviation Forum and Technology Fair to be held just in advance of the 40<sup>th</sup> Triennial ICAO Assembly this September.

*Just a few of the prototypes to be found in the Charles Bombardier gallery on ICAO's Future Aviation website, available at: [www.icao.int/icao75](http://www.icao.int/icao75)*

The new ICAO75 website was launched in January this year, commemorating the Organization's 75<sup>th</sup> year by providing both a look back and a look ahead toward some of the incredible innovations now poised to revolutionize the world of air transport.

The Future Aviation portal of the ICAO75 site has been developed in response to the focus on innovation-related challenges and opportunities initiated at the ICAO Council's off-site strategy meeting in 2018, and has been designed and populated with the assistance of future aviation thought leader Charles Bombardier who is currently consulting with the Next Generation Aviation



Professionals (NGAP) programme under ICAO's Air Navigation Bureau.

The Future Aviation site features a new aircraft prototype gallery curated by Bombardier, in addition to a series of portals focused on frontier technologies and the future of aviation, the role ICAO will play in supporting and accelerating the implementation of new aviation technologies and operations, and an innovation start-up kit which provides helpful advice to aviation innovators respective of every step required to bring a new idea to market.

The last portal on the Future Aviation site is devoted to three competitions being pursued in ICAO Member States through June of 2019, with the assistance and support of their Civil Aviation Authorities (CAAs).

### INNOVATION COMPETITIONS TO SPUR INTEREST AND ENTHUSIASM OF WORLD YOUTH

Recognizing that everything begins with an idea, and that some of the best ideas come from the youngest imaginations, the first of these three competitions is encouraging world youth ages 6-12 to submit ideas for new aircraft types and how these can improve or expand

upon the way that powered flight serves humanity today. Submissions for piloted or unmanned aircraft of any size or shape are being welcomed, with virtually no limit to what contestants can propose that can be used for in our skies or outer space.

The second competition is seeking similar but more mature and developed concepts from youth ages 13-17, while the third completion requires a submission from young adults aged 18-and-over of maturely thought-out 3D renderings of either new aircraft types or operations designs.

In addition to the proposals submitted for the prototype competition, ICAO is also seeking a business case summary of 500 words or less which describes why the proposed technology or operation should attract investment, and how it be cost-effectively produced and implemented to improve people's lives.

### ICAO INNOVATION FAIR AND WORLD AVIATION FORUM

The winners of the three innovation competitions will be announced just prior to the 40<sup>th</sup> ICAO Assembly (A40 – 24 September through 4 October) at the special edition of ICAO's World Aviation Forum (IWAFF/5 – 23 September)

which will be focused on innovation for 2019.

IWAFF/5 will be complemented by an Innovation Trade Fair (22-23 September) which will feature a range of new aircraft and technologies which will be challenging many longstanding practices and expectations in the coming decades of how air transport can serve individuals, societies and businesses, and ICAO Member States and industry innovators are being encouraged to contact ICAO at [innovation@icao.int](mailto:innovation@icao.int) to express their interest in participating.

ICAO Council President Dr. Olumuyiwa Benard Aliu has been a main driver of the innovation competitions and exhibition being pursued, and he has also requested that the ICAO Secretariat develop a related event adjacent to A40 timeframe which will help to generate further global interest and excitement in aviation's future among world youth, consistent with one of the key objectives of ICAO's NGAP programme.

An ICAO State Letter was issued at the end of February bringing the innovation competitions and IWAFF/5 Innovation Fair to the attention of ICAO's Member States, and more information on the A40 youth event is expected later in 2019. [3](#)





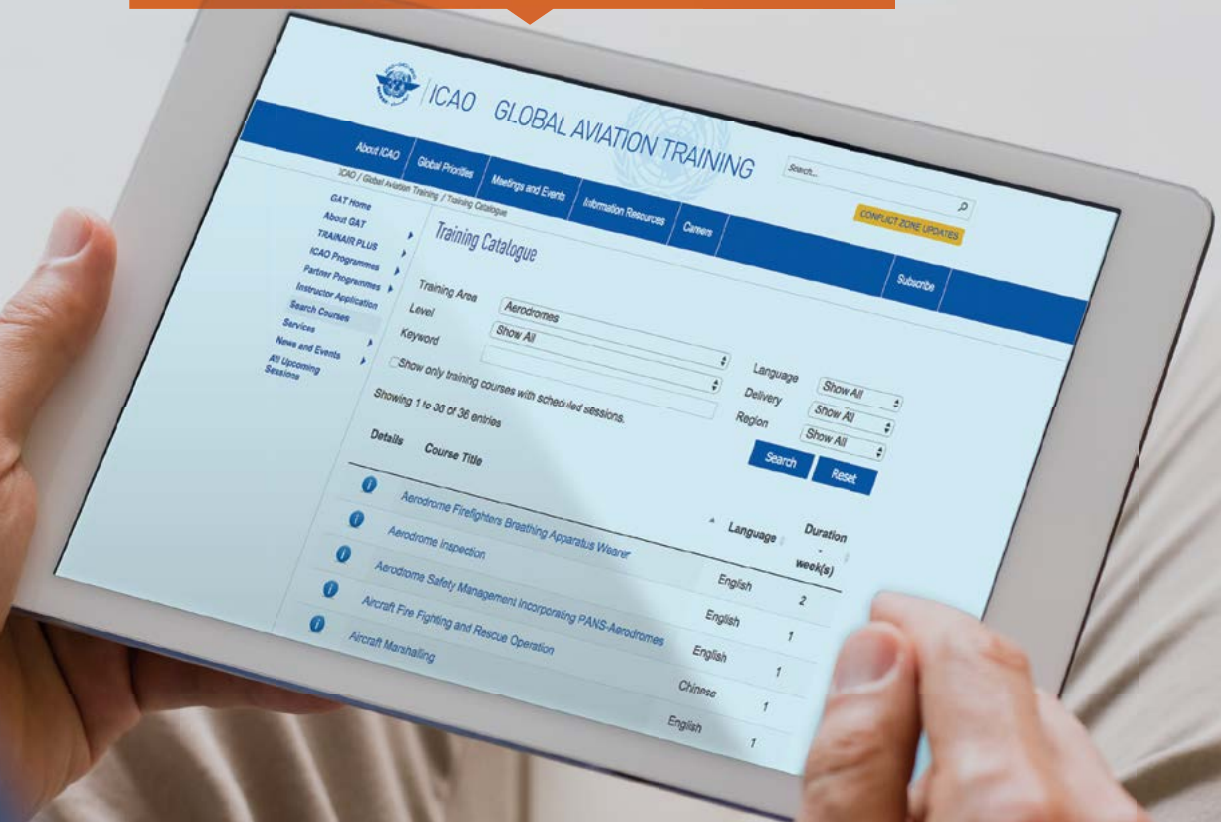
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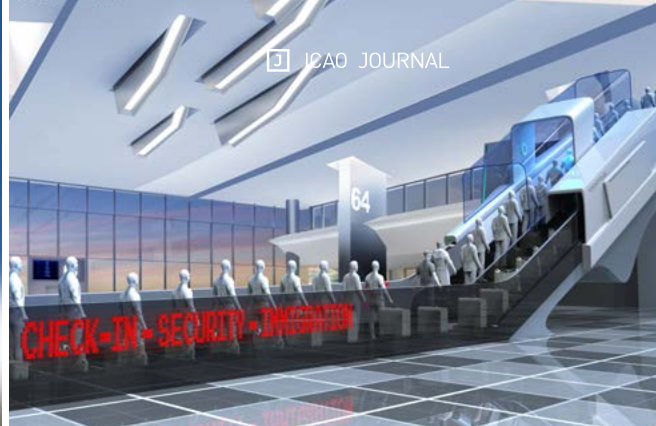
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# FAMOUS NAME, ACTIVE IMAGINATION

Charles Bombardier is collaborating with ICAO to inspire the Next Generation of Aviation Professionals

 You'll quickly recognize the name Bombardier for the companies which build aircraft, trains and recreational vehicles. Charles is the grandson of Joseph-Armand Bombardier, inventor of the iconic Ski-Doo snowmobile.


Charles Bombardier started in the family business at age 16 but left in 2006 to create electric vehicle prototypes. Five years ago, he focused his attention on the "ideation" process, forming a startup called Imaginative and collaborating with other designers to openly share concepts for cars, motorcycles, planes and boats. The designs are not patented but are rather meant to inspire and attract attention from potential developers.

To date, his organization has published more than 300 futuristic concepts. Bombardier has won awards for hypersonic jet concepts, urban mobility, sustainability, and innovative industrial design. He is a member of Mensa Canada and a private seaplane pilot.

In September 2018, Bombardier began working as a Senior Advisor to ICAO.

"My role is to create bridges between ICAO and innovators throughout the world – tinkerers, students, engineers, industrial designers, scientists, startups, medium and large companies."

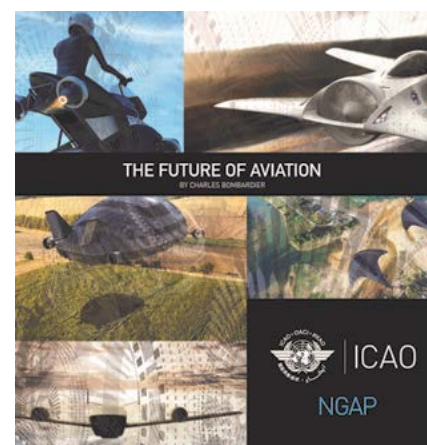
"My objective," he told ICAO Journal, "is to create an inspiring and ever-growing vision revolving around the future of flight." He is creating conceptual images, 3D models, animations, virtual reality experiences, a website and an annual book that can be used at ICAO events, by secondary schools and universities, and at national science museums.

"We keep an open eye for new technologies and imagine ways they could be integrated into civil aviation. My primary role is to inspire kids, teenagers, young adults and working professionals to join the civil aviation industry. We are focusing on the ideation phase of product development – the "fuzzy front end" – and collaborating openly with other innovators to brainstorm, define and conceptualize what's coming next." 

For more information please visit : <https://www4.icao.int/futureaviation>

Three of hundreds of Imaginative concepts: (left to right) the "Aerostratos," a regional airship concept, inspired by the Airlander 10, that could transport people and material to locations with limited infrastructure; the "Escatek," suggested by Bombardier's wife, Pascale, to enable travellers to pass security and immigration checks in less than a minute; and the "Jetsol," a recreational vehicle to fly over inconsistent ledging between sentences

Images designed by Ashish Thulkar, India.



Visionary Charles Bombardier released "The Future of Aviation" book at the ICAO NGAP Global Summit in Shenzhen, China.

# HIGH FLIERS

INNOVATION

✈ An innovative new category of aircraft is steadily emerging with the promise of offering lower-cost telecommunications to underserved parts of the world as well as surveillance and monitoring capabilities for commercial and government applications. These new aircraft would operate well above the typical 30- to 40,000-foot level of commercial air carriers and business aircraft – Flight Level 600 (FL600), or 60,000 feet and above – the area known as the “stratosphere,” the second layer of the earth’s atmosphere.

*“Essentially any payload that can fit within the capacity can be put inside it” (PHASA), according to Martin Topping, delivery director at BAE Systems. That could be 5G and 6G communications, border surveillance, agriculture and forestry, famine relief – it’s infinite. The vehicle is the carrier – the transit van.” BAE Systems concept.*

## High-Altitude Long-Endurance (HALE) Aircraft Are Seeking New Operational Flight Levels

The aircraft are also intended to remain airborne for long periods of time, perhaps up to a year. So their designs are somewhat unconventional and very lightweight. Some, such as the Airbus Zephyr, feature long wingspans and are solar-powered, much like the Solar Impulse II aircraft which circumnavigated the globe. Other High-Altitude Long-Endurance (HALE) aircraft being floated are simple balloons but guided by sophisticated electronics: foremost is from Google’s sister company, Loon.

And though these HALE aircraft will operate above traditional airways, at a minimum they must traverse those airways when they ascend and descend, and therefore must be factored into the global air navigation scheme.

“The biggest challenge we face is that consistent ‘rules of the road’ do not yet exist in a uniform manner around the world,” David Hansell told *ICAO Journal*. Hansell is former head of Global Aviation Policy for Facebook, which is partnered on some projects with Airbus; he is now

involved with public policy for drone manufacturer DJI. Hansell also chairs the Upper Airspace Working Group (UAWG), an industry organization within the Aerospace Industries Association (AIA), as well as its international partner, I-UAWG.

The UAWG is comprised of a diverse group of experts from across the aerospace industry, dealing with the challenges and opportunities of high-altitude airspace. Among the companies involved are Alta Devices, Boeing, GE Aviation, General Atomics, Google, Grumman, Harris Corporation, Lockheed Martin, Northrop Grumman, and Rockwell Collins.

The working group is developing positions on policies and strategies concerning national and international regulation, legislation, and standards unique to high-altitude unmanned and manned aircraft, spacecraft and other users. For the ICAO Air Navigation Conference in October, the UAWG helped the Secretariat produce a working paper (AN-Conf/13-WP/16) on “Operations Above Flight Level 600.”

Requirements for airworthiness certification, equipage, detect-and-avoid and pilot licensure “will challenge regulators to develop standards on new and rapidly evolving technologies which, more than likely, they’ve never encountered before,” said Hansell. Previously, such altitudes were reserved for supersonic jets such as the Concorde and the U2 and SR71 American spy planes.

Hansell noted that “ICAO States have been overwhelmingly supportive of this field for some time.” At the Second Global Air Navigation Industry Symposium (GANIS/2), in December 2017 in Montréal, the aviation community was briefed on the current state of higher airspace operations. At the First Safety and Air Navigation Implementation Symposium (SANIS/1), also December 2017 at ICAO Headquarters, the regulatory and air navigation services provider (ANSP) community that had experience with these types of operations provided information on how such operations were enabled. And the 39<sup>th</sup> Session of the ICAO Assembly in 2016 had noted that some higher airspace operations initiatives directly supported the United Nations Sustainable Development Goals (SDGs) 9 and 17.

As the industry moves toward expanding flight trials in 2019 and broader deployments in subsequent years, Hansell said, “We believe it is important for ICAO to develop near-term guidance material which will help States adopt a consistent general approach to accommodating international higher airspace operations. We want to be involved in the conversations and provide

States with the data they need to make smart decisions in ensuring aviation safety.”

### LOITERING ALOFT

What are some of the potential benefits of these highly automated, high-flying aircraft? Internet connectivity to unserved or underserved populations around the world. Overhead imagery for environmental monitoring and disaster management (such as wildfires and oil spills). Border and maritime surveillance. Reinforcement of the satellite-based Global Positioning System (GPS), aiding worldwide navigation.

In 2017, in the aftermath of Hurricane Maria, Puerto Rico went dark; an estimated 40 percent of mobile telecoms service was out for an entire month. “The routine eventually became get up in the morning, then try to check the news to see how much service has returned to normal,” said Juan Ramirez Lugo, president of the Caribbean division of the American Association for the Advancement of Science (AAAS).

Then came the Loon balloons to the rescue. In partnership with AT&T and T-Mobile, Loon was able to provide basic email and text messaging coverage to nearly the entire geography of the island of Puerto Rico, connecting more than 250,000 unique users.

How did Loon do it? They launched a cluster of helium-filled, polyethylene balloons, about 15 by 12 metres when



*The Loon balloon is like a floating telecommunications tower, high above commercial airways and weather events, using wind current data to remain above the desired internet coverage area.*

inflated, which are produced by Raven Aerostar. The balloons carry about 10 kilograms of electronics, including radio antennae and batteries to store solar power for night operations. There’s also a parachute which allows for a controlled descent and landing.

Think of the Loon balloons as floating cellular towers. They float 60,000 feet above the earth, and provide service to LTE (Long Term Evolution), i.e. 4G wireless mobile phones. Each balloon can provide internet coverage over 2,000 square miles and stay aloft for months.

The tricky part is keeping the balloons over the area where internet connectivity is needed, as the balloons have no navigation equipment nor propulsion to change direction. Rather, the Project Loon

team is taking advantage of the air currents in the stratosphere which move in different directions at different altitudes. If a balloon is drifting away from the coverage area, software can trigger a fan which forces air into the balloon, causing it to drop into an air current going the other way. Or remove air, in which case the now-lighter balloon ascends to a more favorable airway.

*Airbus graphic.*

# Zephyr

## Pioneering the stratosphere

**The world's leading solar-electric stratospheric unmanned aerial vehicle**

**What is it?**

Runs on sunshine in the **stratosphere**

Weights **75 kg**

Supports up to **5 times** its own weight

Manufactured from fibres no thicker than a human hair

Powered by **the sun**

Zephyr uses **solar energy, with secondary batteries** charged in daylight to power overnight flight

**25 m** wingspan

**Zephyr flies for longer than any other aircraft** during its successful maiden flight:

**25 days, 23 hours, 57 minutes**

**What will it do?**

Zephyr:

- See clearly
- Sense efficiently
- Connect precisely

Zephyr is able to **revolutionise missions** all over the world:

- Defence
- Humanitarian
- Security
- Environmental

**AIRBUS**

*How far can you throw a drone? The Airbus Zephyr, weighing less than 75 kilograms (165 pounds), can be launched from the shoulders of three or four stout individuals. No runway is required. Airbus image.*

## HIGHER AIRSPACE PRINCIPLES

The Upper Airspace Working Group (UAWG), an industry organization within the Aerospace Industries Association (AIA), recommends these key principles for developing risk- and performance-based regulatory initiatives for safe and orderly expansion of “higher airspace” operations:

- Uniform airspace organization and management principles will need to be applicable to all regions.
- Global principles will be applicable at all levels of density and will affect total traffic volume.
- Airspace management processes will need to accommodate diverse and dynamic flight trajectories and provide optimum system solutions;
- When conditions require that different types of traffic be segregated by airspace organization, the size, shape and time regulation of that airspace will be set to minimize the impact on all operations equitably;
- Complexity of operations may pose limitations on the degree of flexibility;
- Airspace use will be coordinated and monitored in order to accommodate the conflicting legitimate requirements of all users minimizing constraints on operations;
- For operations lasting longer than 24 hours, airspace reservations will be expected and planned in advance with changes made dynamically whenever possible. As occurs today, the system will also accommodate unplanned requirements;
- Structured route systems will be applied only where required to enhance capacity or to avoid areas where access has been limited or where hazardous conditions exist. Otherwise, airspace management principles will remain as flexible as practicable.

They are also equipped with Automatic dependent surveillance - broadcast (ADS-B) and use the callsign “HBAL” for identification by other aircraft.

Loon has collected millions of kilometres of wind data, and applies machine-learning techniques to predict wind directions at various altitudes. In 2016, a Loon balloon remained aloft for nearly 100 days, making nearly 20,000 adjustments to hover above the country. A year later, this data was used to provide telecoms service when Chimbote, Peru was ravaged by floods.

Loon’s first commercial project, to launch this year, aims to provide internet connectivity to parts of rural Kenya in partnership with the Telekom LTE network.

### SONS OF SOLAR IMPULSE

Airbus calls the Zephyr-S a high-altitude pseudo-satellite (HAPS), “with the capabilities of a satellite and the flexibility of a UAV,” according to Jana Rosenmann, senior vice president of unmanned aerial systems at Airbus. This summer, on its maiden voyage, the Zephyr-S established a new world record for the longest continuous flight in earth’s atmosphere – 25 days, 23 hours, 7 minutes at 70,000 feet.

At the Farnborough International Airshow, a collaboration of BAE Systems and RPAS specialists Prismatic, announced that its planned PHASA-35 solar-powered, high-altitude aircraft is expected to be able to stay airborne for an entire year. First deliveries are anticipated for 2020-21.

US company AeroVironment has formed a joint venture with Japanese telecon operator SoftBank to develop solar-powered HAPS aircraft for commercial operations. In 2001, the AeroVironment Helios prototype reached an altitude of 96,863 feet, setting the world-record for sustained horizontal flight by a winged aircraft.

Such aircraft are ideally suited for “local persistence,” the ability to stay focused on a specific area of interest (which can be hundreds of miles wide) while providing satellite-like communications and earth-observation services over long periods of time without interruption. And at lower cost than satellites.

The Airbus Zephyr-S has a wingspan of 25 metres (82 feet) and weighs under 75 kilograms (165 pounds). Zephyrs are powered by the sun during the day, which also recharges its lithium-sulphur batteries to power it by night. Current payload capabilities include high-definition optical / infrared video, aeronautical information service (AIS), narrowband mobile communications, and 100 megabits per second broadcast.

The future Zephyr-T will have a 32-metre wingspan, weigh 140 kg, and add radar, LIDAR (Light Detection and Ranging), electronic support measures (ESM), electronic intelligence (ELINT), and broadband comms.

Zephyr-S flights in the future will operate from the Wyndham airfield in Western Australia. [D](#)





# REGULATOR ENGAGEMENT IN THE NEW AGE OF AVIATION INNOVATION

The UK CAA is changing its approach to new products and services coming to market

✈ Ask a pilot about what matters to them when operating internationally and you are likely to hear about the importance of a known environment in which the same things happen the same way everywhere all the time. ICAO's traditional key role is to secure this international standard.

Ask innovators what matters to them and they speak of the same approval standards for their new product or business being applicable as widely as possible across the World. Harmonised international standards are a pathway to a single

approved design being offered immediately to the largest possible marketplace at the lowest possible entry price. Harmonisation of standards for a global aviation market is another key ICAO role.

And what about States? States can see how good, up to date, global standards can help their citizens to more quickly enjoy better safety, better security, a quieter and cleaner environment, fewer delays, better travel connectivity, increasing trading opportunities.

ICAO's structure, processes and outlook have reflected the importance of harmonised standards for business, for safety, for security and for the environment. What is now at issue is how ICAO can best serve its Member States by generating harmonised global standards in a fast-moving environment full of innovators.

How ICAO can best meet these needs is a question made all the more important when considering the consequences of failing to meet this challenge. Is it inevitable to expect the marketplace to find a way to adjust so that innovation finds its market without ICAO's input? And does that point to an ICAO capable only of maintaining that which already exists while other structures or approaches emerge to fill the innovation vacuum?

These questions apply equally to a national aviation authority, which led the UK CAA to organise an Innovation Conference last Spring. They asked what innovators thought the role of the regulator should be. Attendees were invited to suggest how the regulator could best position itself in engaging with innovators – not getting involved so early that there is no value to the innovator or regulator but

also not leaving engagement so late that outdated and inappropriate regulatory thinking, approaches and standards become unnecessary blockers or hurdles to innovation. Fundamentally, how could a State make sure that its citizens could enjoy the benefits of innovation as quickly as possible and yet be protected adequately from any related hazards or negative effects?

Among the Conference attendees were well-established figures in advancing global aviation development. However, a very significant number were innovators from outside aviation. This second group pointed to their difficulty in knowing who to talk to at the UK CAA or in Government about their ideas. They were concerned that engaging with the regulatory authorities would mean inevitable bureaucracy, delay and expense – and maybe even loss of commercial confidentiality and first mover advantage. They also suggested that the aviation regulator's traditional reactive approach favoured those already established in the aviation sector.

From the Conference findings, the UK CAA and UK Government worked together to secure funding for a step change in the UK CAA's approach to engaging with innovators.

## PRINCIPLES FOR ENGAGING INNOVATORS

The UK CAA Board set out a clear set of principles to guide the organisation's thinking about its new approach. The Board made clear that it regards innovation as being in the consumer interest and believes that effective engagement with innovators requires a consistent, collaborative and flexible approach.

The principles focus on how the organisation engages with innovators and how it prioritises the allocation of its finite resources. These principles inform colleagues across the UK CAA about new and ongoing engagement with innovators and support good corporate governance.

The UK CAA's engagement with innovators will, at all times, seek to uphold these principles while recognising the need to keep these principles under review. (Figure 1)

Given its limited resources for engaging with innovators, UK CAA applies these prioritisation principles to its engagement with innovators and innovations:

Figure 1

PRINCIPLE	OUTLINE
Public protection and support to innovation	At all times, the regulator's responsibility is to maintain appropriate levels of public and consumer safety, security and economic protection. Responsibility for the commercial success, or otherwise, of any individual product or service always remains with the innovator. The regulator has a role to facilitate innovation, including setting out how innovators should engage with the regulator.
Independence	The UK CAA develops a clear offer to stakeholders and treats all engagements in a similar manner. Regulatory resources are finite and so some limits or rationing of resources allocated to individual innovators are required.
Transparency	The regulator's guidance/standards and engagement mechanisms are clear and transparent.
Objectivity	The regulator's engagement with individual innovators is structured and non-exclusive.
Appropriate charging model	To facilitate innovation, UK CAA does not charge for initial discussions and support. However, in line with existing industry practice, there are charges when granting regulatory approvals.

PRIORITISATION	
PRINCIPLE	OUTLINE
Public and consumer interest	Innovations are prioritised, putting first those that aim to deliver benefits to safety and consumers within the aviation sector.
Safety	Innovations must comply with safety and consumer protection standards for the public whilst recognising that government and society's risk appetite may change over time.
Readiness	The regulator's facilitation effort is proportionate to the innovator's readiness for market.

## NEED FOR A DEDICATED INNOVATION ENGAGEMENT TEAM

The aviation sector is experiencing significant technological and business change. New digital and manufacturing technologies have reduced the time

needed to bring new products and services to market and increased the opportunities for new innovations to be created.

However, for these products and services to come to market, innovators need to address challenges such as scalability and integration of existing technologies. The UK CAA concluded that a new regulatory approach was necessary to support innovators as they face these challenges.

While legacy players continue to play a significant role in the aviation sector, they are being joined in the markets by new entrants with much more limited familiarity with traditional aviation regulatory practices and timescales. As well as the more evident projects such as drones and spaceplanes, many are developing increasingly autonomous systems that could prove valuable in easing skill shortages in key safety-critical roles in aviation. This is why the UK CAA has committed to ensuring that *“we do not act as a barrier to technological developments which have the potential to deliver significant benefits, including strengthening the already high standards of safety and consumer protection that consumers and the public expect.”*

The traditional approach of reacting to proposals when received from industry inadvertently favours legacy players with existing knowledge of regulation. The new approach aims to engage with innovators at the most effective point in their innovation development and provide a structured and transparent platform to provide targeted assistance as they prepare to meet the regulatory standards needed to give access to the market.

To make this new approach a reality, the UK CAA is building a team that will be dedicated to engagement with innovators. Though its ambition for the team is big, UK CAA's leadership wants to begin modestly, learn, prove the concept and scale up based on the experience gained and on the demand for this service. Key to the concept is the idea that the UK CAA team will engage with innovators directly in a targeted proactive way – reaching out to innovators and positively interacting with them rather than rely on the traditional more reactive model of regulation.

## GATEWAY, SANDBOX AND LAB

The UK CAA is overhauling its approach to innovation by setting up a function focussed on innovators and innovation. The intent is to significantly improve the regulator's ability to enable innovators to develop new products and services to come to market in the aviation sector.

A dedicated function within the UK CAA will deliver this improvement through better access to regulatory advice and through an engagement approach that helps the regulator to respond better to fast-paced developments while maintaining aviation safety and consumer protection.

The new function will run three new initiatives:

1. an Innovation Gateway,
2. a Regulatory Sandbox, and
3. a Regulatory Laboratory.

The **Innovation Gateway** is a public-facing advisory and engagement service that aims to reach out to innovators with new ideas and proposals and encourage them to come and talk with the UK CAA. The regulator's team provides fast feedback while also learning and building the CAA's own understanding of emerging innovations.

By **Regulatory Sandbox**, UK CAA means a safe environment for innovators to collaborate with the regulator. The regulator is not in the mode of assessing innovations for approval; rather, it is providing enhanced advice to help innovators to do controlled testing of new products and services with the help of controlled exemptions from aviation regulations. The innovators can develop their ideas about how to meet the requirements that will allow them to bring an innovation to market. During the process, the regulator gathers evidence that allows it to develop its own capabilities and expertise as well as enabling regulations to be developed in an iterative manner such that, longer term, case-by-case approvals for these operations are replaced by a revamped regulatory environment.

The **Regulatory Lab** is a forum that brings together regulators, government, industry and broader stakeholders. It is aimed at innovations that are closer to a concept than an offering ready for market. The Lab

*“The UK CAA has committed to ensuring that “we do not act as a barrier to technological developments which have the potential to deliver significant benefits, including strengthening the already high standards of safety and consumer protection that consumers and the public expect.”*

is a regulatory environment that provides a means to tackle significant technological, regulatory and policy challenges which stand in the way of innovations in mobility and transport and find solutions.

## CONSIDERATIONS: TEAM, FOCUS, EVIDENCE

**Initial team:** A team of seven people is currently being recruited. The UK CAA is looking for experience already gained through engagement with innovators and emerging technologies in the aviation or similar sectors of any emerging trends and challenges in technology. Also sought is experience of developing regulatory frameworks in aviation or another similar industry with a strong emphasis on emerging technology. Finally, there is a need for proven ability to communicate effectively to both technical and non-technical audiences and to produce concise, unambiguous advice for presentation to various audiences.

**Initial focus:** The new function will work with a range of UK bodies already dedicated to supporting academic, business and industrial innovation in the UK. The focus will be on topics supporting UK airspace modernisation,

the management of drones, the integration of unmanned traffic management solutions into UK infrastructure to help tackle the challenge of sustainable urban passenger transport in UK cities, and the facilitation of new concepts in artificial intelligence (AI), machine learning and green growth in transport, including the development of electric propulsion systems.

Evidence of the need for a new regulatory approach: The UK CAA is frequently approached by global technology firms,

venture capitalists, SMEs (small and medium-size enterprises) and traditional aviation and aerospace players who are driving innovation for the sector and establishing new products and services that will shape the future for mobility. These initiatives recognise the changing nature of aviation, with increasingly autonomous systems and the use of new types of aircraft in complex environments such as cities.

At the UK CAA 'Enabling Innovation in Aviation' conference in London and the 2018

World Economic Forum Drone Innovators Network, industry strongly expressed its desire for a new approach to regulatory advice at earlier stages in the development of technologies. In 2018, PA Consulting found that nearly one in three businesses in the transport sector view regulators as blocking innovation. Most want regulators to retain or increase their enabling role with an increase in driving innovation.

This demand challenges the UK CAA, whose primary engagement model is one

## INTERVIEW

# HOW TO ENABLE NON-AVIATION PLAYERS IN THE NEW AIRSPACE

## A CONVERSATION WITH THE UK CAA'S REGULATORY INNOVATION LEADERS

How does a regulator go about evaluating a new technology from companies which have had no previous experience with airspace and safety requirements? ICAO Journal editor Rick Adams spoke with Tim Johnson, UK CAA Policy Director, and Emma Simpson, Head of the CAA's new innovation project.

### WHAT TRIGGERED THE AUTHORITY TO LAUNCH THIS INNOVATION INITIATIVE?

**Johnson:** People were coming to us, asking how can you help us deliver my new innovation to market? People who are new to the sector and know nothing about aviation regulation or who the CAA is and what it does. The challenge they put to us was can you be clearer as to the role of the regulator in this space and what you will do to support us?

Our job continues to be keeping passengers physically and economically safe. But we also want to think about some of the growth consequences and not regulating in a way that is unnecessarily burdensome on innovation.

**Simpson:** We were seeing things like the proliferation of drones, and we had an expectation around larger military-type drones and how we might integrate them into our airspace. But then we saw different aspects of that market that we hadn't quite anticipated: recreational small drones were flooding the market. At the same time, cybersecurity became an increasingly important element we had to factor in. And the third thing we needed to face was people wanting to do commercial space launches within the UK.

These are not things that we have traditional skill sets for regulating, and we also have

people coming into the market who are not traditional customers. How do we take a really different and fresh approach to this?

### ONE OF THE CHALLENGES IS THAT MANY INNOVATORS NEW TO THE AVIATION SECTOR ARE STARTUPS BACKED WITH PERHAPS SIX MONTHS OR A YEAR OF FUNDING. THEY VIEW THE TRADITIONAL REGULATION PROCESS AS AN INNOVATION KILLER. HOW CAN A REGULATOR ACCELERATE THE APPROVAL PROCESS?

**Johnson:** A regulator cannot be responsible for the commercial success of each individual venture, but what we can do is recognize that for new types of technology coming into aviation we need to have a sensible and proportional regulatory role to first protect the safety of passengers but that doesn't necessarily get in the way of good progress. The more we can get to a sector-wide approach to some of these issues, that will be a much clearer way how we interact with innovators.

There's also a very practical limit on the resources and time we've got available; it's not limitless. The more we can be clear – here's the regulatory framework, here's how you go through it – the better we'll be able to manage our engagement with innovators.

**Simpson:** The traditional reaction of the regulator is to make sure it's safe. The

of issuing approvals for existing aviation products to legacy players, under a set of core safety and consumer protection requirements. The UK CAA finds it difficult to respond to the growing demand to facilitate and enable innovation at the same speed as the technological developments driven by industry.

While there is important pre-existing contact with innovators across several domains, this is not structured, formalised or transparent. A new approach is essential if the regulator

is to offer transparent access to innovators, whether they are legacy players or new entrants, and on a level playing field.

## GLOBALISED INNOVATION REGULATION?

The UK CAA's initiative aims to create an opportunity to actively bring business improvement to the aviation sector and its regulatory approach, to deliver public aspirations for the future of air travel and to assist the UK in playing its part in developing global and domestic

regulatory policy and legal frameworks for a globalised aviation market. Although still in the early stages of evolving its thinking, UK CAA leaders have offered to share their experiences – good and bad – with ICAO. Other States too are developing new approaches to innovation and will have much of value to contribute too. Maybe, we can learn together? **J**

default position of civil aviation authorities is to make as sure as we can that there's going to be no additional risk.

We want to enable growth and sustainability. It's much more sensible to say what it is you're looking for from us earlier, so by the time you're ready with your new technology we've been involved in the conversation. We've been able to work with you, and we're prepared for what's coming.

The dynamics of some of these markets is that operators don't have the business model to support a two-year application process. We need to be engaged earlier. We want people who are non-aviation to approach us in the first instance regarding who and how and what time scale.

It's much better to be involved upfront as they're developing and we can set out the things that are important to us so innovators can take those issues into account. It's much harder if those developers are further down the track and you're trying to insert your requirements late. We will be able to be a better regulator if we're clearer earlier as to what the requirements are rather than being reactive.

## MANY REGULATORS WORLDWIDE ARE FACING SIMILAR ISSUES. WHAT DO YOU SEE AS PRIORITIES?

**Johnson:** A key priority, if we're seeing 20 different versions of the same thing,

is to get to a system-wide approach for dealing with those technologies. The question becomes do regulations move at a global pace or are there different levels of ambition among different architectures or regions in the world?

At the ICAO Air Navigation Conference, we came away with a strong sense that there are parts of the world that have an appetite to move much more quickly with innovative technology developments. Does everyone move together, or do you have a slightly more dynamic approach where some countries can move more quickly, either unilaterally or in a group and that can help set the scene for potential changes at a more global level?

We absolutely recognize that we work within and contribute to international frameworks of regulation at ICAO and with EASA. We want a standard approach to regulation, at a minimum at the regional level, preferably at a global level because that makes a clear, common path that is much easier to navigate.

## WHERE ARE YOU AT IN THE PROCESS OF ESTABLISHING THE UK CAA INNOVATION TEAM AND PROCESS?

**Simpson:** There is a lot we enable already. We're trying to improve the process by which we enable those nonstandard operations by being smarter and sharing

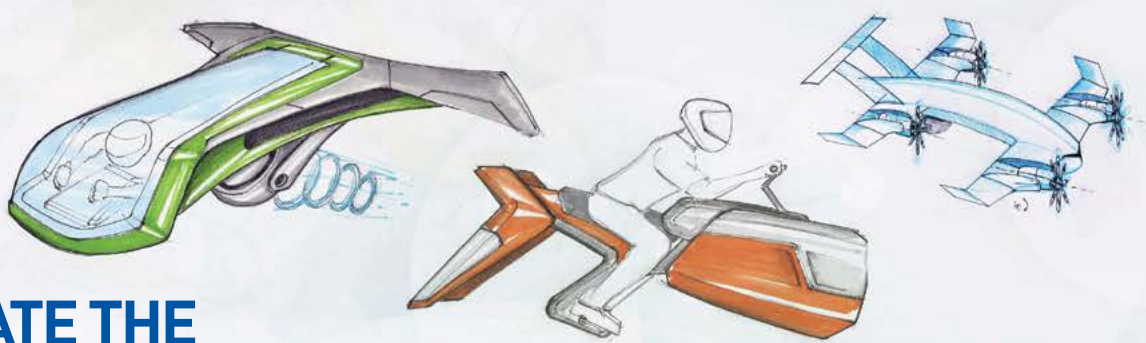
information, including with non-aviation regulators such as environmental protection, transport integration, telecoms.

It's not that we need to start again and write a whole series of new rules. It's more helping to demystify regulation and entrance into the aviation market, and then consider whether there are areas for which there is no precedent and we need to start building a new framework for those.

We're working on what our operating model will be and where the needs might lie. We have identified areas of focus such as urban air mobility, and we're working with industry to flesh out what those skill sets should be, such as software developers and different talents we haven't had to recruit for previously. There will be jobs that people can apply for.

We're looking at how we harness the considerable expertise and links we already have within the organization, and how we harness communication flows between the innovation team and those that have those outward links.

This is a key cultural shift at the CAA, not only in how we operate internally but in how we're perceived externally.



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# THE FUTURE OF MRO

## EMERGING TECHNOLOGIES IN AIRCRAFT MAINTENANCE

✈ Maintenance is a major contributor to aircraft operating costs, flight delays and cancellations. Despite longer-lasting aircraft and more durable engines, airlines now spend more on maintenance than on fuel or crew. The need to keep assets operationally available while cutting maintenance, repair and overhaul (MRO) costs is a pressing issue. Aircraft operators are pushing for faster troubleshooting, automated aircraft inspection to reduce downtime; better task planning, and optimized parts management.

OEMs, MROs, and suppliers are responding with a range of innovative technologies and techniques, including robots, drones, virtual / augmented / mixed reality aids, machine learning / neural networks / artificial intelligence, blockchain, 3D printing, additive manufacturing, and more.

*Inspired by cockroaches, a prototype of Rolls-Royce's engine-inspection robot.*



Highlighted here are just a few of the hundreds of initiatives in process to maintain aircraft smarter, faster, cheaper.

### INSPECTION ROBOTS AND DRONES

Today, typical visual inspections of commercial aircraft can take up to six hours. Robots and drones have the potential to cut this time dramatically while offering greater accuracy of checks, freeing up engineers' time, reducing maintenance costs and improving safety.

Miniature, cockroach-inspired camera robots, deployed in "swarms," will be able to be turned loose inside an engine to help inspection of difficult-to-access components. Rolls-Royce plans to develop 1-cm-long (0.4-in) versions which can even remove and replace defective material,

EasyJet and Thomas Cook Airlines have experimented with an autonomous drone, developed by MRO Drone, that can inspect a full narrowbody exterior in 30 minutes and a widebody in one hour. Using technology borrowed from nuclear reactor inspection, the RAPID (Remote Automated Plane Inspection and Dissemination) system can also inspect specific structures such as after reports of a bird strike.

Zurich-based SR Technics is using a robot from Invert Robotics (New Zealand) that

*The Airbus Air-Cobot robot could be connected with a flying drone to access the top of the aircraft and speed up data capture.*

uses a patented suction mechanism to adhere to and traverse a range of surfaces including aluminium, glass and carbon fibre; even when aircraft surfaces are wet or require an upside-down inspection. Equipped with high-definition cameras and sensor technology, the robot records and transmits video images to a ground-based screen for real-time analysis by line-maintenance staff, enabling efficient visual inspections on the tarmac or in the hangar. The robot may soon also include ultra-sound and thermographic testing.

The SPIRIT project is bringing together eight partners from Austria, Germany and Italy to develop a robotic inspection solution using a range of various inspection devices – such as 3D surface inspection, thermography or X-ray – that will eliminate complications involved in programming a robot motion path. The project aims to reduce the time-consuming and expensive process when programming robots for an application-specific solution.

### HANGAR OF THE FUTURE

Airbus' Hangar of the Future (HoF) project combines various technologies to digitize and automate maintenance activities to increase overall maintenance



## Standardizing Maintenance Organization Requirements

Aircraft Maintenance Organizations (AMOs) performing maintenance on an international basis may face a multiplicity of requirements and must maintain duplicative procedures manuals, quality assurance systems, and personnel requirements, as well as undergo inspections from the various States whose operators use their services. One AMO, for example, reports having to deal with more than 100 audits a year.

Not only is this practice inefficient, it is also a significant burden to an AMO, does not provide a stable platform for standardization of maintenance practices and, consequently creates a potential for errors, leading to a safety concern.

It has become more urgent for ICAO to develop improved harmonized and simplified provisions that enhance the efficiency of aircraft transfers, certifications, importation, and the acceptance of maintenance carried out by AMOs.

In 2010, at a High-Level Safety Conference in Montréal, it was recommended that ICAO develop a globally harmonized approach to the approval and recognition of maintenance organisations by other Contracting States to improve safety and efficiency. A second High Level Safety Conference in 2015 made further recommendations for the development of a global framework and regional initiatives to reduce duplication of certification and surveillance activities of maintenance organizations.

The first and second phases have been delivered by the Airworthiness panel of experts and have been adopted by the ICAO Council as amendment 106 to Annex 8, and amendment 43 to Annex 6 Part I, with applicability in November 2020. They include the transfer of the AMO requirements from Annex 6 to Annex 8 to make it clear that the responsibility for AMO approval lies with the State of Registry, as well as Standardization of the AMO approval certificate.

The third and fourth phases, targeted for applicability in 2022 and 2024, take into consideration the HLSC2015 requesting ICAO to consider the development of a global framework and regional initiatives to reduce duplication of certification and surveillance activities of AMOs. This includes reviewing the existing ICAO SARPs and associated guidance material to incorporate more detailed requirements to be met by AMOs, as well as a standard rating system.

Ms. Maimuna Taal, technical officer in the ICAO Air Navigation Bureau, said the objective is for States “to adopt this template as a starting point. At some point in the future, it is envisaged that it will become a Standard, including any need for amendments, as was done with the AOC (Air Operators Certificate) process.”

“ICAO is taking a step-by-step approach to address the issues of mutual recognition,” she added. “We will learn from experiences gained to move forward with this initiative until we reach our end goal.”

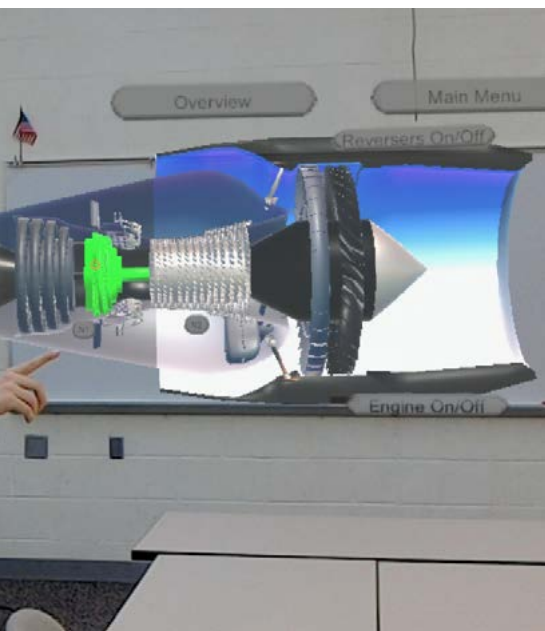
process efficiency. HoF combines the use of innovative technologies and smart, IoT (internet of Things)-connected equipment such as ‘cobots’ (collaborative robots – like the “Air-Cobot” shown in the photo), drones, scanners, cameras, non-destructive sensors, with aircraft technical documentation and aircraft in-service data collated through Airbus’ open data platform, Skywise.

### AUGMENTED AND MIXED REALITY

“The Next Generation of Aviation Professionals (NGAPs) entering the aviation industry represent a new generation of learners. To engage and meet their needs, the aviation community has been harnessing innovative technologies to look beyond tradition training methods and enhance workforce practices,” says Ms. Lori Brown, a professor at Western Michigan University and the ICAO NGAP programme Outreach Chair.

Brown has teamed with Microsoft to apply HoloLens to overlay 3D holographic content onto the physical world to train technicians how to maintain aircraft. Students can be immersed, for example, inside a jet turbofan engine or interact with 3D cockpits.

“HoloLens is intuitive and offers a natural means of interaction. There’s no mouse, wire or touch screen. All you need are simple gestures to create and alter holograms, your voice to communicate with apps, and your eyes to navigate and analyze content,” Brown explains.



Through Professor Lori Brown's HoloLens work, Western Michigan University was the first university aviation program to use augmented reality in the classroom.

Boeing is using “smart glasses” augmented reality (AR) from Upskill to simplify the complex process for wire installation, resulting in a 25 per cent reduction in production time and lowered error rates to effectively zero. The AR system that enables kitting of 3D drawings based on wire installation plans, which are presented to the end user, spatially aligned to an aircraft, on a wearable device.

### BIG DATA

By 2025, more than 38,000 new aircraft will be in operation worldwide, producing many times more data than previous generation aircraft. The proliferation of sensors on modern aircraft combined with better data routers has led to a 60-fold increase in the number of data parameters collected from each flight, says Mr. Serge Panabiere, Airbus head of services business development. The newest engines can generate up to one terabyte of data each cycle. For MROs, this means an increasing amount of data knowledge along with a growing complexity of their businesses.

To better manage this deluge of data, MROs are turning to big data, machine learning, deep learning, neural networks, artificial

intelligence, blockchain and other developing information management technologies.

Lufthansa Technik, the world's largest independent provider of MRO services, has created a digital platform for the aviation industry, AVIATAR, using a hybrid “cloud” infrastructure based on enterprise open source software from Red Hat. The company's application development teams collaborate with data scientists, airplane engineers and other experts to better predict events using a shared repository of industry data, such as aircraft sensor data, as well as operational data, such as flight plans and delay information.

Airbus developed the Skywise open platform to collect the vast amount of data coming from in-service aircraft, combine them with airline and OEM data and conduct in-depth data analysis to develop applications aiming at anticipating and optimizing maintenance. Airbus offers free access to anonymized operational data to any airline that submits its own. Thus, participating airlines benefit from a useful benchmarking tool, while Airbus receives the data it needs to refine its paid-for predictive maintenance product. [J](#)

Switzerland-based information technology company SITA says half of airlines responding to a survey plan to invest in artificial intelligence (AI) and cognitive computing in the next three years.



## THE FUTURE OF TRAVELLER IDENTITY

# NTWG DEVELOPING HYBRID DIGITAL TRAVEL CREDENTIAL

Secure, trusted traveller ID remains an ever-present need amidst global turmoil. How can the airline industry adapt to meet changing needs?

 In a world of ever-increasing digital transactions and ever-increasing international air traffic volumes, how can border authorities manage traveller facilitation without compromising security and while maintaining interoperability?

ICAO's New Technologies Working Group (NTWG) established a specialized sub-group to work on standardizing a digital travel credential (DTC) using the ePassport as the benchmark, given that it offers a secure, portable, verifiable and "unclonable" token. An estimated 139 States have issued more than one billion ePassports to date. The growing number of ePassports improve the travel network by enhancing facilitation for travellers and improve security for border management.

One particular advantage of the ePassport is the digitization of the traveller's biographic and biometric data stored in an integrated circuit (a "chip") embedded in the book. Not only does this chip data verify the passport bearer's identity through facial recognition, it also provides authorities with the tools to authenticate the travel document. However, the ePassport has yet to be fully leveraged to provide all of the possible benefits to change the way travellers clear checkpoints.

The DTC envisioned by the NTWG uses the technology available in the ePassport to create a credential that can bring additional benefits, while maintaining a balance between security and facilitation.

## LEVERAGING KEY ATTRIBUTES

For a DTC to be effective and practical it needs to maintain the key attributes already contained in the ePassport:

- Verifying entities must be able to authenticate the credentials supplied;
- Inclusion of a means to protect against cloning;
- Capable to accept and store pertinent holder and/or travel data;
- Protection of the privacy of the user; and
- Verification processes must be at least as secure as for ePassports.

A DTC essentially serves the same functions as an ePassport in reliably confirming the identity of the traveller. Additional benefits include:

- An improvement to passenger flows by allowing travellers to provide their data in advance and engage in more self-service;
- The ability for airports and airlines to link additional data, such as a boarding pass, to the DTC; and
- Advance provision of passenger data to aviation stakeholders to support biometric matching through controlled

checkpoints, to facilitate biometric boarding and assist in improving prearrival security and/or risk assessment.

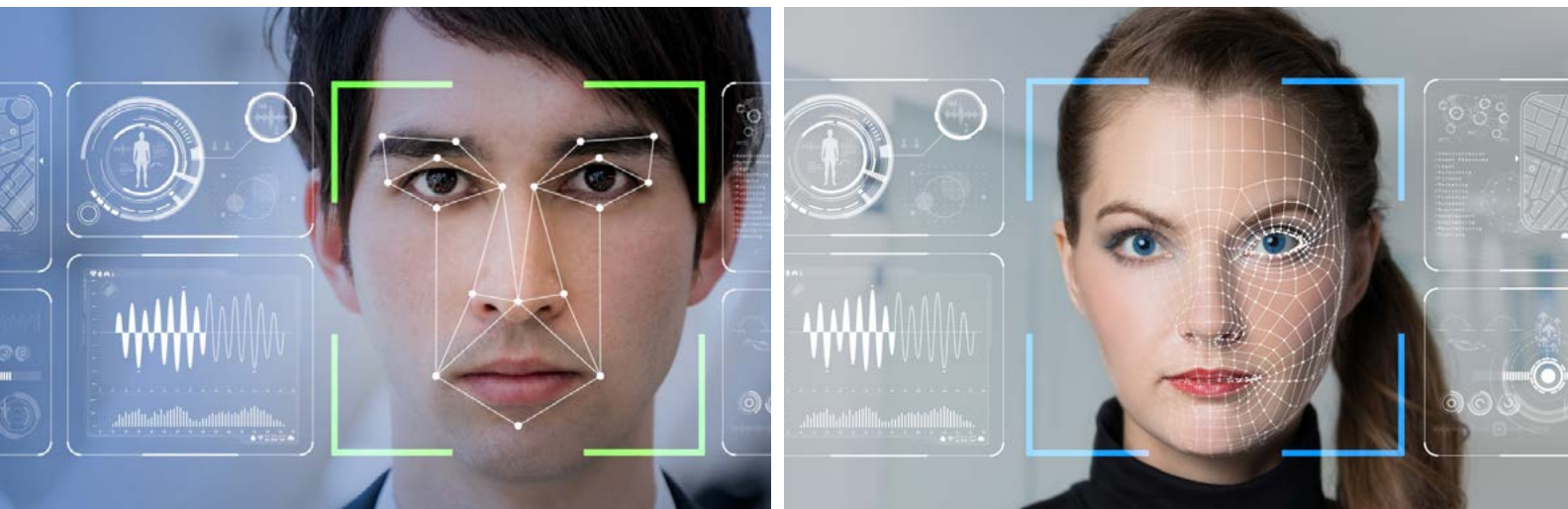
For these benefits to be realized, wide acceptability of globally interoperable features and an issuers ability to control the credential are paramount.

## THE CHALLENGE OF BALANCE

There a number of established and emerging e-Identity schemes around the world; airports and airlines have an increasing number of stand-alone traveller facilitation schemes. These solutions leverage a range of differing technologies and use a variety of form factors.

The sub-group considered a range of technologies, or 'form factors,' such as smart devices, closed servers, remote servers, and distributed ledgers. The form factors were evaluated against four basic criteria to ensure the credential could be:

1. Produced from a Travel Document Issuing Authority.
2. Capable of being provided unaltered to verifying entities in advance of the traveller's journey or arrival.
3. Globally interoperable to ensure that it could be used in different environments.
4. Adopted by travellers. This requires creating trust that the DTC is as, or more, secure than an ePassport, and biographic and biometric data will be handled in a manner ensuring the protection of the traveller's personal data and privacy.



Each form factor has positives, but each also presents limitations that would result in a solution less secure than an ePassport. Few would be globally interoperable, and all would present security concerns unacceptable for most, if not all, border authorities. However, by combining one or more of the form factors with available technology in the ePassport, there is opportunity to create a hybrid credential that would meet all the basic criteria and key attributes, and bring additional benefits without losing the balance between security, facilitation and interoperability.

## THE PREFERRED SOLUTION

### – a Hybrid DTC

A hybrid credential is a combination of a virtual token (credential) linked to one or more physical tokens (authenticators). The credential could be stored in a remote system, such as a database or webserver, and the authenticator could be an ePassport, smart card, or mobile phone. This combines the virtual and the physical in a way that merges the advantages of both approaches, while minimizing disadvantages.

When defining options for issuance of these tokens, virtual credentials would have to include many of the same security elements of the current ePassport, including authentication, when required by inspection authorities. Authentication currently takes place when the chip in the ePassport is electronically validated by the border authority – a simple electronic check that ensures the ePassport is authentic. This

check verifies the digital signature in the chip and that the digital certificate was used by a bonafide authority when the data in the chip was sealed. It confirms that the biographic and biometric data endorsed in the document when it was issued has not been altered. The authority can then confidently rely on the information in the chip to compare against the information printed in the physical passport book, and if need be, against the traveller themselves.

Can a hybrid credential match this level of confidence? Linking the virtual travel credential to one or more physical tokens enables the verifying entity, such as a border agent, to perform additional active authentication of the credential when required for increased security. The physical token can be used to retrieve the data from the remote system by authenticating the holder of the virtual credential to that system.

This model is preferred by the ICAO NTWG because the credential is already securely linked to the issuing authority. The physical token allows the verifier to select the correct virtual credential (potentially provided in advance). It also provides the flexibility to decide whether the virtual credential is sufficient, or the physical token (the authenticator) is additionally required.

One of the advantages in the DTC is that it provides several options for creation and form without losing the benefits of interoperability. The DTC itself could be derived from an existing ePassport. Or the issuing authority could create the

DTC and has the option to store the virtual component on a remote system or securely on a smart device.

When booking or checking in, travellers could send their virtual component in advance to the border authority in an electronic system for travel authorization (ESTA) process or using API / PNR etc. When they arrive at the airport, they could use their token, whether it is a physical token such as their phone, or purely virtual token, such as their facial biometric, to pass through the different checkpoints in the airport journey. If not sent in advance, the virtual component must be able to be read in a standardized method using passive authentication.

## ON TRACK FOR 2020

Development of technical specifications, proof of concept and testing methodologies for the Hybrid DTC are underway. The Working Group continues to resolve policy issues such as issuance, revocation and inclusion of additional travel data. Their aim is to have the DTC technical specifications presented for endorsement by the ICAO TAG / TRIP conference in 2020. <sup>3</sup>

*This article was adapted from  
Uniting Aviation.*

**LOUISE COLE**

Manager of Information Partnerships for the  
Department of Internal Affairs, New Zealand.

# REGIONAL ACHIEVEMENTS

## Recent Highlights relating to Projects, Statistics and Events in the ICAO Regions

ICAO maintains seven Regional Offices to provide closer support and coordination for Member States. Their areas of general responsibility include Air Navigation Functions, Air Transport Functions, Technical Co-operation Functions, Legal, Aviation Security, and close co-operation with the regional bodies to ensure harmony in the development of the international air transport system as a whole,

- Council President Awards to Guyana, Paraguay, Uruguay for improving their EI USAOP
  - › 2018 goal to increase EI to 80% and begin SSP implementation
- 2018: Technical assistance from CAAi to Suriname, in need of a new civil aviation act to provide a proper government civil aviation organization

# SAM

SOUTH AMERICAN  
LIMA, PERU

- Commitment from all Member States signing the Declaration of Intent for implementing the NACC No Country Left Behind strategy
  - › Eight new States received NCLB Technical Assistance Missions
  - › Three States achieved an NCLB EI over 80%
- Airport certification at 51% (77 aerodromes) – 20 airports initiated (20 more expected for 2018)
- Achieved targeted MEVA II Communications Network availability
- Initiated and received support concerning “Champion States” to help other NACC States
- Runway Safety Teams implemented in 5 States (7 more expected in 2018)
- 13 States updated their USOAP Corrective Action Plans (CAPs)
- ADS-C / Controller Pilot Data Link Communication implemented in the Central America Pacific area by COCESNA
- 2018: Initial development of the Regional Accident Investigation Group within the Caribbean region
- 2018: Regional leadership of Performance-Based Navigation, Air Traffic Flow Management, and Search and Rescue

# NACC

**NORTH AMERICAN  
CENTRAL AMERICAN  
AND CARIBBEAN**  
MEXICO CITY, MEXICO

■ **HEADQUARTERS**  
MONTREAL, QUÉBEC, CANADA

- Resolution of 3 SSCs
- Dedicated missions to support 9 States on the EUR list of air navigation deficiencies
  - › At end of 1<sup>st</sup> Phase, 5 have rectified deficiencies
- Established and trained a network of PANS-OPS experts to provide sustainable oversight capability
  - › 106 PBN experts / national inspectors trained in Phases 1 and 2
- Supported 5 States in development of effective local Runway Safety Teams
- Supporting States in preparation and update of their Environmental Action Plans

# EUR/NAT

**EUROPE AND  
NORTH ATLANTIC**  
PARIS, FRANCE

- Endorsement of the Muscat Declaration and MID Region NCLB Strategy
  - › Regional EI increased to 70.5%
- Convened the NCLB Aerodrome Certification / Workshop
  - › Aerodrome certification increased to 58%
- With GAT, convened the 1<sup>st</sup> ATM Inspectors Course – 17 inspectors completed the course
- 4 AVSEC assistance missions – 5 trained
- Safety Management for Practitioners Course – 6 participants from 4 States
- 2018: Establishment of MID Flight Procedure Programme in Lebanon
- 2018: Establishment of MENA RS00
- 2018: Support NCLB Plan of Action, including possible implementation of capacity-building projects for States such as Iraq, Libya, Yemen

# MID

**MIDDLE EAST**  
CAIRO, EGYPT

NO COUNTRY LEFT BEHIND

- Convened Regional Ministerial Conference on Aviation Security in Africa and the Middle East
  - › Endorsed GAsEP: Global Aviation Security Plan
- Established 1<sup>st</sup> AVSECAL group
- Endorsed new Asia and Pacific Aviation Security Roadmap to align national and regional programmes
- Assistance to 6 States in SSP gap analysis
- Potential SSPs addressed by timely intervention of Regional Office Safety Team missions
- Resolved three SSeCs and prevented emergence of six new SSeCs
- WACAF States with tailored ICAO Plans of Action increased to 23
- Assisted 4 States in certification of international aerodromes
- Collaborated with AFCAC and African Union Commission organizing High-Level Search and Rescue Conference
  - › Adoption of Lomé Declaration on SAR and Action Plan
- Coordination meeting to facilitate implementation of 36 RNAV routes
- Supported IWAF / 3 in Abuja
  - › Declaration and Framework for Plan of Action for Development of Aviation Infrastructure in Africa
- Promoted Single African Air Transport Market (SAATM) and Yamoussoukoro Decision on Air Transport Liberalization
  - › Declaration of Solemn Commitment increased to 14 States
- Coordinated Forum on RS00s for Global Aviation Safety and Ministerial meeting that adopted:
  - › Global Strategy and Action Plan for the improvement of RS00s
  - › Ezulwini Declaration on RS00s in Africa
  - › establishment of a Global Aviation Safety Oversight System (GASOS)
- Coordinated endorsement of the Windhoek Declaration and targets on Aviation Security and Facilitation by the AU Summit
- Coordinated SECFAL projects in travel document authenticity and legal instrument ratification
- Performed 6 security assistance missions
  - › EI above 65% increased to 7 ESAF States
- Provided assistance through 16 Regional Office Safety Teams to 65% of accredited States
  - › States with safety above EI increased from 10 to 12 (average safety in Region increased to 49.81%)
- Aerodrome certification increased to 51%
- RPAS workshop in Rwanda attended by 62 participants from 11 States
- Convened SAR workshop / training in Nairobi
- Combined Action Team (CAT) missions to 8 States to help improve USOAP Effective Implementation (EI) scores
  - › Within one year, 5 States improved EI to above 60% (GASP target)
  - › SSC status of two APAC States resolved
- Special Implementation Project (SIP) focused on common training needs
- IPAV VF Assistance Missions using volunteer professionals
- Technical assistance mission to Pacific Island States, training in AGA and Aerodrome Certification
- Aviation Security Implementation Plans (ASIPs) commenced through the Aviation Security Training Centre (ASTC) Network
  - › 99 participants from 19 APAC Member States attended ASTC training activities

WACAF

WESTERN AND  
CENTRAL AFRICAN  
DAKAR, SENEGAL

ESAF

EASTERN AND  
SOUTHERN AFRICAN  
NAIROBI, KENYA

APAC

ASIA AND PACIFIC  
BANGKOK, THAILANDASIA AND PACIFIC  
SUB-OFFICE  
BEIJING, CHINA



# AVIATION SECURITY WEEK CONFRONTS THREATS

## AVSEC

✈️ “The present threat environment is more dynamic, diverse, and challenging than ever before,” declared Dr. Olumuyiwa Benard Aliu, President of the ICAO Council. He tasked participants to the 2<sup>nd</sup> High-Level Security Conference with defining security measures which are effective, efficient, operationally viable, and economically sustainable, recognizing the important need to assess the impacts of any considered measures on air transport’s much more prevalent low-risk passengers.

*Experts from around the world discussed risk awareness, security culture, technology and innovation, quality control and oversight and capacity building.*

### || SECURITY & FACILITATION ||

#### EVENT

#### AVIATION SECURITY WEEK

26-30 November 2018

ICAO Headquarters,  
Montréal, Québec, Canada

- Inaugural Industry Engagement Day
- Global Aviation Security Symposium (AVSEC2018)
- Second High-Level Conference on Aviation Security (HLCAS/2)

#### PARTICIPANTS

More than 500 delegates representing 107 countries and 22 international organizations.

#### OUTCOMES

The security of global air transport operations took important steps forward with a series of new agreements and recommendations.

Dr. Aliu included threats from insiders; remotely-piloted aircraft systems (RPAS); chemical, biological and radiological (CBR) attacks; and cybersecurity vulnerabilities as key areas of aviation security concern.

ICAO Secretary General Dr. Fang Liu underscored that “ICAO, its Member States, the industry and our other partners are addressing the threat to civil aviation with great determination, ambition, and unity of purpose.” She focused on the importance of striking a balance between the effectiveness of security measures and their impacts on the air transport customer base, noting that “from the consumers’ standpoint, it is nothing short of vital that we address security risks with solutions which pose a minimum of passenger or shipper inconvenience. Any other approach will not be sustainable.”

The Symposium and Conference assembled senior government officials and invited representatives of international / regional organizations and other invited aviation stakeholders to formulate recommendations on key aviation security priorities and issues. They considered progress on the implementation of the Global Aviation Security Plan (GASeP) and potential adjustments to the Plan based on the outcomes of the regional aviation security conferences organized in 2017-2018. These recommendations will be submitted for approval to the Council for subsequent endorsement by the 40<sup>th</sup> Session of the Assembly in 2019.

A series of pre-Symposium events – including an Industry Engagement Day in collaboration with ACI World and the International Air Transport Association (IATA) – featured workshops, presentations and table-top exercises to stimulate AVSEC2018 plenary discussions.

You can view the presentations on the Uniting Aviation blog: <http://bit.ly/2E05bN3> #AVSEC2018



## KEY THEMES

Each session's topic aligned with one of the Global Aviation Security Plan (GASeP) priority outcomes and provided an opportunity for extensive delegate participation and exchange of implementation case studies and experiences.

### RISK AWARENESS

A viable national or local risk assessment must be based on an accurate and up-to-date threat assessment. However, information sharing is often hampered by dissemination restrictions invoked by intelligence agencies. Participants explored the necessary level of detail to be shared between States and with industry, the conduits for sharing this information, and acceptable data protection measures.

### SECURITY CULTURE

Robust application of enhanced security measures depend on engagement of front-line employees. Concerns about the ‘insider threat’ highlight the potentially negative implications of providing detailed information to an employee who has been corrupted. Participants discussed the positive and negative consequences of disseminating threat information to all employees involved in aviation.

### TECHNOLOGY AND INNOVATION

The aviation security regime is highly reliant on technology solutions to ensure accurate, expedient threat detection but specific data are often highly classified. This impedes the ability of manufacturers to ensure new technology that can provide the necessary detection capabilities. Experts discussed current constraints affecting rapid development and possible solutions.

### QUALITY CONTROL AND OVERSIGHT

Because of the interconnected nature of commercial aviation, shortfalls in one airport could be exploited by a malefactor, resulting in an attack on another State. Participants debated the establishment of a stronger aviation security oversight regime so that effective countermeasures can be implemented more comprehensively to protect each State's citizens.

### CAPACITY BUILDING

The GASeP implementation targets reflect increasingly more robust levels of security over the next 12 years. These goals can only be realized through partnerships between contributing and recipient Member States. Participants explored how such arrangements can be brokered and the information exchange that must ensue.

### IMPLEMENTING THE GASeP

Following an accelerated development and review process, the Global Aviation Security Plan (GASeP) provides foundations for a global aviation security framework. ICAO Regional Offices held aviation security conferences and tailored Roadmaps were developed to guide achievement of GASeP's aims and objectives. Member State and Industry representatives discussed observations and experiences during their implementation activities.

# DISCUSSION HIGHLIGHTS AND RECOMMENDATIONS

## HLCAS/2 – 2<sup>ND</sup> HIGH-LEVEL CONFERENCE ON AVIATION SECURITY

### 1. AVIATION SECURITY THREAT AND RISK CONTEXT

#### DISCUSSION

The Conference took stock of the latest developments in the threat environment faced by the international civil aviation network, with a particular look at **improved explosive devices (IEDs)** and the **insider threat**. Failing to implement robust and sustainable measures aimed at mitigating the risk associated with the insider threat compromises the aviation security system in its entirety by enabling the circumventing of airport security measures.

**Employees remain the first layer of defence** against suspicious activities within aviation premises. As they play a key role in mitigating the threat through their commitment to aviation security, their vigilance and overall security awareness.

Some participants cautioned against an overly prescriptive approach and called for more risk-based and outcomes-focused measures to combat the threat.

#### RECOMMENDATIONS

- a) States refer to the ICAO Global RCS as a useful tool to assist stakeholders in developing **evidence-based risk assessments** and in identifying possible mitigating actions;
- b) the ICAO Council, taking into consideration the advice from its Aviation Security Panel, expedite the development of strengthened Standards and Recommended Practices in Annex 17 to deal with the insider threat, based on a **multi-layered approach**;
- c) States and industry ensure the effective implementation of **regulatory measures** aimed at addressing the insider threat;
- d) States and industry promote an effective **security culture** among their aviation workforce and raise public awareness to help further address the insider threat; and
- e) States enter into collaborative arrangements for **sharing security information** about threats, risks and

vulnerabilities in order to enhance the effectiveness of aviation security measures, address security gaps at the national, regional and global level, and avoid unilateral and/or uncoordinated implementation of security measures.

### 2. FUTURE APPROACHES TO MANAGING AVIATION SECURITY RISKS

#### DISCUSSION

Potential **cyber-attacks** on air traffic management, aircraft, and airports remain a concern within the aviation community.

The Conference supported the development of an **ICAO Global Cybersecurity Strategy**. In addition, State representatives discussed ICAO infrastructure for addressing cybersecurity, currently dealt with by the Secretariat Study Group on Cybersecurity (SSGC).

States noted the importance of **outcomes-based security measures**, with innovation focusing on the security output rather than prescriptive Standards. However, there must be some performance indicators to measure progress on meeting Standards that concentrate more on the end results rather than the security practice.

A **well-trained workforce** is instrumental to protecting aviation security targets from attack. Essential to building human capability is the implementation of a robust security culture.

A **reporting system** that allows staff to confidentially and safely report possible gaps in the security system or suspicious activities should be embedded in every entity in the air transport arena.

#### RECOMMENDATIONS

- a) ICAO and Member States should continue to develop **risk assessments** to identify vulnerabilities within their aviation security systems and implement the most effective security measures to mitigate threats;

- b) ICAO, Member States, and industry organizations should continue to develop a **comprehensive Cybersecurity Strategy** as well as mechanisms to identify and manage risk, including the sharing of appropriate information related to cybersecurity;
- c) ICAO should commence a **feasibility study** for the establishment of a Cybersecurity Panel, without delaying the ongoing work of the Secretariat Study Group on Cybersecurity;
- d) ICAO, Member States, and industry organizations should ensure existing training remains up-to-date with **aviation security best practices** and technological advancements.
- e) States develop security culture and security awareness programmes using best practices and tools that reflect their **unique operating environments**.

### 3. GLOBAL AVIATION SECURITY PLAN (GASeP)

#### DISCUSSION

Note was taken on the current level of implementation reported by ICAO, which indicated a need for a **much stronger effort** by Member States to achieve aspirational global targets established by the GASeP.

The Conference also deliberated on the **future evolution of the Plan**, recognizing a number of Annex 9/Facilitation and Annex 17/Security provisions related to border facilitation that are mutually complementary.

There was support for **regional initiatives** and mechanisms designed to ensure the successful implementation of the region-specific roadmaps.

Delegates noted the **shared experiences** concerning implementation of the GASeP in States. These include coordination between authorities and operators, innovation in liquids screening technology, electronic security management systems, and checkpoint operator performance monitoring systems.

Efforts by ICAO to implement **targeted assistance** to address identified security deficiencies within Member States, as well as capacity-building by the aviation industry, were supported.

Support was expressed for the essential role played by the Universal Security Audit Programme – Continuous Monitoring Approach (**USAP-CMA**) in enabling the successful implementation of the GAsEP and in building and maintaining confidence in the global aviation security system.

#### RECOMMENDATIONS

- a) continued efforts are made by States to implement the GAsEP and its associated Roadmap towards achieving the **aspirational global goal of 80 per cent** of audited States achieving the minimum level of 65 per cent EI by 2020;
- b) ICAO map existing capacity-building resources and providers, on-going and planned capacity-building activities, so as to have a **comprehensive overview** of the situation;
- c) subsequent iterations of the GAsEP promote a **longer-term vision** of ensuring strengthened security, timely sharing of aviation security information, increased operational efficiency, in part by drawing upon relevant components from Annex 9/Facilitation; and
- d) a **holistic review** of the objectives and methodology of the USAP, including the indicators used to report audit results, for decision by the 40<sup>th</sup> Session of the Assembly.

#### 4. ACHIEVING BETTER SYNERGIES WITH OTHER AREAS

##### DISCUSSION

A **complementary approach** in security, safety and border control was strongly encouraged, both within ICAO and on the State level.

**Cooperation between different State authorities** is extremely important and exists in many States, even when not formalized.

Integrating border facilitation elements into aviation security requires further

investigation; consideration should be given to **possible legal constraints** related to the sharing of information between different State authorities.

The Conference recognized the importance of efforts by ICAO and its Member States to implement United Nations (UN) **Security Council resolution 2309** (2016).

Advance Passenger Information (**API**) data and Passenger Name Records (PNR) data have proven to play an important role in combatting terrorism.

Due consideration should be given to the protection of **fundamental rights of passengers** in the collection, processing, analysis and sharing of personal data.

#### RECOMMENDATIONS

- a) ICAO explore ways in which the relationship between aviation security, safety and facilitation can be strengthened, including the relationship between the **Aviation Security Panel** and the **Facilitation Panel**;
- b) ICAO and its Member States **continue to collaborate** with the United Nations agencies involved in counter-terrorism; and
- c) further consideration be given to how **passenger information** can be better used to inform, assist, and support aviation security objectives.

#### 5. ENSURING SUSTAINABILITY OF SECURITY MEASURES

##### DISCUSSION

There was overwhelming support by the Conference for ICAO to establish **parity** between aviation security and safety within the ICAO organizational structure.

Many delegates supported the proposal to conduct a feasibility study to determine options for establishing an Aviation Security and Facilitation Bureau under a **zero nominal growth budget**.

Collaboration will help find **new ways of mitigating security risks** to civil aviation, and facilitate the sharing of relevant information, including on threats to aviation, wherever possible.

More attention should be given to the **protection of information** to be shared.

Delegates noted the benefits of implementing **One-Stop Security**, including increased efficiency and more effective use of resources. However, delegates cautioned that States should ensure that they establish a robust monitoring and oversight regime that appropriately guarantees effectiveness and sustainability.

Although some delegates recognized the benefits of focusing on outcomes-based security standards, many States stressed that **baseline Standards**, which tend to be more prescriptive by nature, should not be overlooked.

#### RECOMMENDATIONS

- a) The proposed feasibility study should consider the extent to which this could contribute to the enhancement of ICAO's **practical aviation security capability** and should be completed in sufficient time for the Council to review it and make a decision prior to the 40<sup>th</sup> Assembly;
- b) ICAO ensure the **sustainability of aviation security funding** in accordance with applicable Assembly Resolutions, recognizing that increased contributions by States in the next triennium, whether regular budget or voluntary, whether financial or in-kind, will further enhance the Organization's leadership in global aviation security matters;
- c) ICAO, States and industry continue to **assess the suitability of outcomes-focused approaches**, where appropriate, in accordance with the specific regulatory language contained in Annex 17 – Security and the Aviation Security Manual (Doc 8973); and
- d) encourage States to enter into collaborative arrangements and implement One-Stop Security arrangements in order to **increase the sustainability** of the aviation security system. **[J]**

**ICAO AVSEC2018**

Global Aviation Security Symposium

THE NEED TO **KNOW**

## EVENT

# 55<sup>TH</sup> CONFERENCE OF DIRECTORS GENERAL OF CIVIL AVIATION (DGCA), ASIA AND PACIFIC REGION

22-26 October 2018

Denarau Island, Nadi, Fiji

## HOST

The Honourable Mr. Aiyaz Sayed-Khaiyum, Attorney General and Minister for Civil Aviation, Fiji

## PARTICIPANTS

300 delegates from 41 States: regional directors general and chief executive officers of civil aviation, international organisations, industry partners, stakeholders and observer countries outside the region

## THEME

Collaboration and Harmonisation for a Safe, Secure and Sustainable Aviation in the Asia Pacific Region

# FAST-GROWING ASIA & PACIFIC STATES NEED CERTAINTY, INVESTMENT

## DGCA APAC

✈ The tremendous growth in air transport in the Asia Pacific Region “also constitutes significant challenges,” Dr. Olumuyiwa Benard Aliu, ICAO Council President, advised the directors general. “Your Region remains the world’s largest in terms of the total percentage of global traffic being managed with more than a third of all commercial flights occurring here each year. Air traffic volumes are also growing faster here – at close to 11 per cent annually, more than anywhere else in the world.”

“This growth,” he emphasised, “needs to be managed safely, efficiently and securely” – citing the ICAO Global Plan for Aviation Safety (GASP), the Global Air Navigation

Plan (GANP), and the new Global Plan for Aviation Security (GASep), which set out key expectations, priorities and targets for States in each area of strategic concern.

Dr. Aliu noted that, as of a year ago, the APAC Region has a detailed GASep Roadmap, adopted at the ICAO Asia and Pacific Regional Security Conference. “A sustained level of secure and safe civil aviation operation contributes toward preventing human, economic, financial and other losses. And a strengthened aviation security provides a more conducive environment for economic growth and development.”

The Council President advised, “Much of what we are discussing in terms of our key strategic objectives for this Region will require your States to directly invest in, or attract financing for, the modernised infrastructure and technologies being targeted.”

He added, “It’s also very important that success requires certainty, and that investor certainty in air transport is greatly dependent on local regulatory stability. Shifting regulatory goalposts – especially concerning economic provisions which can have major adverse impacts on a proposed project’s financial models and targeted returns – are exactly the sorts of risks which the investors you may be seeking are trained to avoid.”



A list of 47 action items arising from the conference included:

- To support the ICAO Asia/Pacific SWIM Task Force and related demonstrations;
- To actively share experiences on civil-military cooperation, not only limited to efficiency matters but also to safety management;
- To remain engaged with ICAO on the development of the Global Aviation Safety Oversight System (GASOS);
- Adoption of a holistic approach to unmanned aircraft (UA) integration and regulation;
- To implement the ICAO TRIP Strategy in order to achieve enhanced aviation security and to prevent the movement of potentially inadmissible persons;
- To cooperate with ICAO and among States to further the development of their State Action Plan on CO<sub>2</sub> emissions reduction from international aviation;
- To nominate suitable young aviation professionals for the remaining scholarships and fellowships specially set aside for the Region under the Singapore-ICAO Programme for Young Aviation Professionals (PYAP).



ICAO Secretary Dr. Fang Liu pointed out that the efforts of ICAO's Combined Action Teams (CAT), led by Asia and Pacific Director Mr. Arun Mishra and the Bangkok Regional Office, have led to a number of States exceeding the current global average for Effective Implementation (EI) of ICAO's Universal Safety Oversight Audit Programme (USOAP) and have also improved States' ability to make use of and benefit from the Continuous Monitoring Approach (CMA) Online Framework (OLF).

"I have been very encouraged by the continuing success of the Regional Office's CAT initiative," she said, noting eight such missions delivered in 2017 and another nine in 2018. Five CAT-visited APAC States improved their EI score to above 60 per cent in 2017 and two others resolved persistent Significant Safety Concerns (SSCs).

Nonetheless, "we still have some work ahead of us," she cautioned. The current

average USOAP score for States in APAC is 61.96 per cent, below the world average of 66.27 per cent. Also, 14 States in the Region have EI scores below the minimum target of 60 per cent.

The lowest EI category in the region is in the area of "qualified personnel." Dr. Liu encouraged: "Programmes should be initiated as soon as possible to augment the skills and numbers of APAC's qualified safety inspectors."

She also highlighted the importance of certifying all international airports by 2020, implementing the APAC Seamless ATM Plan, and putting in place State Safety Programmes (SSPs) by 2025 to fulfil the commitments of the Beijing Declaration.

The Secretary General announced to the delegates that the ground work is almost completed on a feasibility study (requested at the 39<sup>th</sup> ICAO Assembly) to determine

ICAO Secretary General Dr. Fang Liu (centre left) honoured the professionalism shown by Anthonius Gunawan Agung, a young man who sacrificed his life to ensure the safety of a flight of passengers while performing his duties as an air traffic controller during the recent earthquake and tsunami in Indonesia. She presented a plaque to an AirNav Indonesia representative, who accepted it on behalf of the family of Mr. Agung.

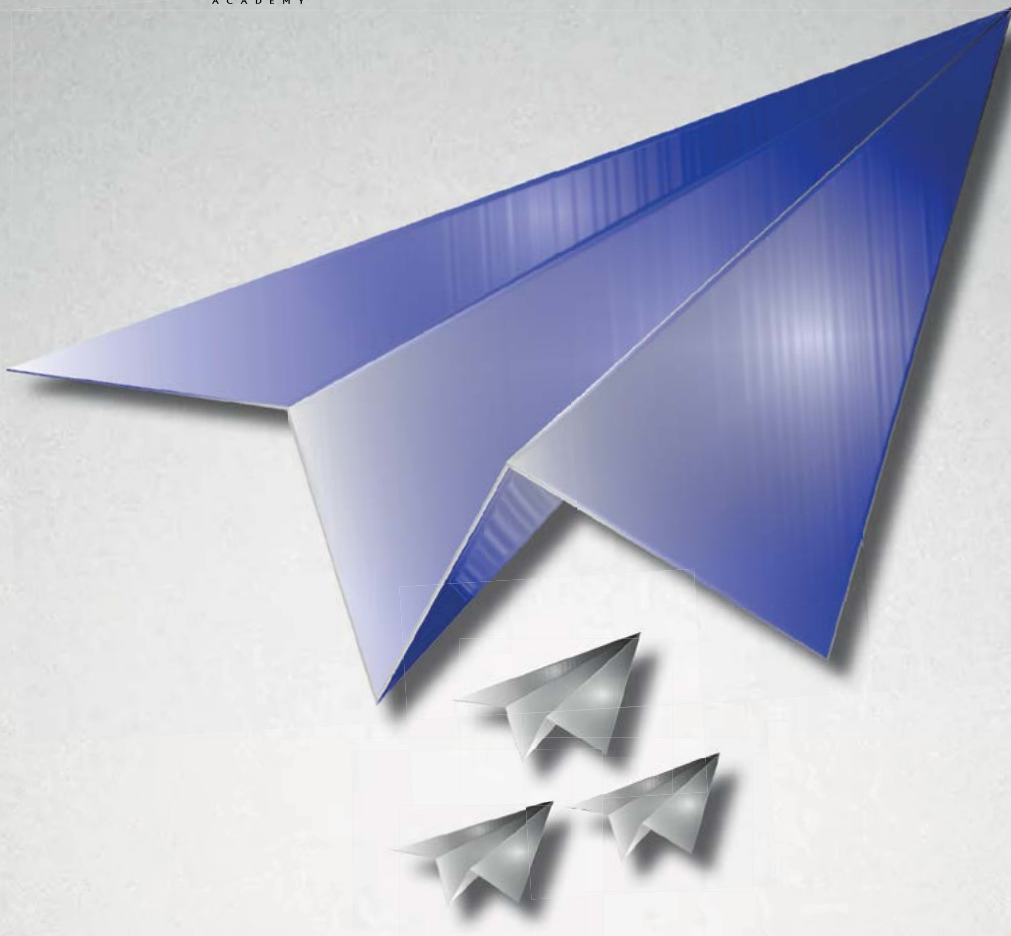
the current challenges and needs of Small Island Developing States (SIDS) with respect to aviation safety, air navigation and aviation security. She stated, "The study will begin to be implemented soon by a group of international experts."

On the sidelines of the conference, Dr. Liu held meetings with local Fiji authorities, States and Regional bodies, including a meeting with the Solicitor General and Permanent Secretary of Fiji, Mr. Sharvada Sharma, in which she discussed the ongoing developments of civil aviation in Fiji and emphasised the importance of investment in civil aviation infrastructure which has direct positive impact on the economy. Dr. Liu also met the CEO of Fiji Airways (Mr. Andre Viljoen) and the Executive Director of Airports of Fiji (Mr. Faiz Kahn) and visited the Nadi International Airport – the first airport in the South Pacific to receive Level 1 Airport Carbon Accreditation.

The 56<sup>th</sup> DGCA Conference of Asia and Pacific Regions will be held 19-23 August 2019, hosted by Nepal. [J](#)



Dr. Olumuyiwa Benard Aliu, ICAO Council President (right) with Fiji Attorney General and Minister of Civil Aviation, The Honourable Mr. Aiyaz Sayed-Khaiyum.



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# SUSTAINABLE AVIATION

IWAF/4

 **Pan-American States** established a framework commitment to collaborate in the sustainable growth of air transport at the 4<sup>th</sup> annual ICAO World Aviation Forum in Fortaleza, Brazil, adopting a “Declaration to Promote Connectivity through the Development and Sustainability of Air Transport in the Pan-American Region – Vision 2020-2035” (see next page for excerpts). The Declaration intends to promote investment for the development of civil aviation throughout the Americas for a 15-year period.

ICAO Council President Dr. Olumuyiwa Benard Aliu, after outlining the challenges of aviation infrastructure development, emphasized, “These challenges leave us few options other than to work together, so that

*IWAF/4 was hosted by the Federal Government of Brazil in the coastal city of Fortaleza, guarded by the statue of Iracema, the main character of a novel by Brazilian writer José de Alencar.*

collaboratively we can minimize or eliminate any hardships being faced by each individual State. ICAO is committed to work with you to ensure that in spite of these challenges, all States will benefit from the contributions of aviation, and the socioeconomic benefits it brings to each State.”

Worldwide, air traffic volumes for passengers and freight are poised to more than double by 2035. The economic benefits of aviation will also double in magnitude during the same period, supporting more than 100 million jobs and generating more than six trillion dollars in global GDP.

ICAO Secretary General Dr. Fang Liu emphasized that “our top priority must be to ensure that air traffic growth is managed safely, securely and efficiently, with due respect for our sector’s concrete environmental commitments, and in a manner which fully optimizes all related social and economic benefits.”

She noted the need to target a dedicated portion of related capacity building on investment in ‘soft infrastructure,’ in addition to technology and innovation. “National planners must keep one eye very clearly focused on the need for adequate numbers of skilled professionals to be on hand to operate their new facilities and technology.”

|| NO COUNTRY LEFT BEHIND ||

## EVENT

### ICAO WORLD AVIATION FORUM (IWAF/4)

17-19 September 2018

Fortaleza, Brazil

## PARTICIPANTS

High-level government officials responsible for aviation, transport and infrastructure, finance, economy, and tourism, and key industry and financial partners from ICAO member countries

## THEME

Promoting Investment for Aviation Development

## OBJECTIVES

- Develop practical solutions to the challenges on aviation development, with particular focus on infrastructure, investment and innovation, and in the overall context of the national economic development;
- Provide space for engagement and forward-looking dialogue on planning, funding, financing for aviation-related projects, especially the development and modernization of quality aviation infrastructure;
- Establish a coordination framework and multi-stakeholder partnership of transport and urban planning to improve connectivity with a balanced development of transport modes; and
- Address challenges for the air transport growth in the Latin America and Caribbean region.



ICAO Council President Dr. Olumuyiwa Benard Aliu told IWAf/4 delegates, "An investment in aviation is an investment in humanity; in a prosperous future for the world's peoples, businesses and nations; and ultimately in a more assured global peace and security."

## Declaration to Promote Connectivity through the Development and Sustainability of Air Transport in the Pan-American Region – Vision 2020-2035

### EXCERPTS FROM THE DECLARATION

We, the Ministers and Authorities of Pan-American Member States, representatives of international and regional organizations, and of the industry, participating at the Fourth International Civil Aviation Organization (ICAO) World Aviation Forum (IWAf/4), held in Fortaleza, Brazil, from 17 to 19 September 2018, who have gathered to "promote investment for the development of civil aviation" through the establishment of a framework commitment to collaborate in the sustainable growth of air transport in our Region for the next 15 years, declare the following:

We envisage our Region offering to the population greater access to the benefits of air transport in which the development of our populations will count with the timely support of a heterogeneous, seamless, dynamic and safe air transport network at all levels, whose efficiency in its infrastructure and services will be of global reference, achieving a greater degree of connectivity between the people of the Region and the rest of the world, and thus encouraging a greater commercial, social and cultural exchange.

We envisage the leadership of our Region within the global context of safety, in compliance with international civil aviation standards, and within a harmonized environment that makes it possible to take advantage of economies of scale for the civil aviation authorities in order to offer an appropriate level of oversight to Air Navigation Services Providers (ANSPs) in an effective and efficient manner, without creating unnecessary costs to States and

the industry, and building an enabling environment for the development of the air transport business.

We envisage that the State' entities in charge of guaranteeing the safe, orderly and sustainable development of air transport will be empowered institutions able to develop their functions efficiently and effectively, generating confidence, stimulating innovation and promoting the continued growth of the sector.

We envisage an aviation system responsible for the sustainability of the environment that is developed in harmony with nature while protecting life on the planet and preserving the natural values that coexist day by day with the aviation activity.

We announce today our Agenda that will frame the vision of the Region, and we aim to work in collaboration among our States and the industry, in order to promote measures necessary to guarantee the implementation of actions required to achieve our overarching goals.

We recognize that aviation in the Region is a growing industry that is vital for the promotion of regional connectivity, and that its sustainable development depends on: the availability of capacity and efficiency of its operations, through coordinated actions, in alignment with the GANP (Global Air Navigation Plan); the promotion of systemic actions to promote safety, security and facilitation, through measures aligned with the GASP (Global Aviation Safety Plan)

and the GAsEP (Global Aviation Security Plan); and the adoption of actions to create economic stimuli for the development of air transport business plans in the Region, and the application of environmentally responsible measures.

Therefore, we have, as a vision, the following general objectives for the promotion of connectivity through the development and sustainability of air transport in the Region to:

- become a Region where air transport is **available, affordable, seamless and sustainable** for all our users, ensuring that it is even more accessible and efficient to overcome current logistical challenges;
- become a Region that **plans and integrates civil aviation** into the development plans of the States, in order to meet the growing demand for air transport services;
- become a Region where States and the industry systematically adopt civil aviation **safety improvement measures**, progressively reducing fatal accidents;
- become a Region where the **culture of air transport security** is incorporated into the training and operations of civil aviation organizations;
- become a Region that encourages and **supports civil aviation authorities** to succeed in their functions of promoting a safe, orderly and sustainable development of air transport; and
- become a Region where the **growth of air operations is sustainable** and keeps stable and to reduce the contribution of carbon emissions to the environment stable. 3

# GACS/3 TO CONVENE IN THAILAND

GACS/3

✈ The ICAO Technical Cooperation Bureau (TCB) organized the first Global Aviation Cooperation Symposium (GACS) five years ago in the fall of 2014. At the heart of the first GACS was establishing a forum covering the full spectrum of civil aviation, so that States and other industry stakeholders could exchange on the challenges they faced. By offering a holistic and comprehensive approach, the Symposium successfully offered a central platform for discussions on key issues, the exchange of views and the latest trends and innovations in air transport, as well as sharing best practices to support a safe and efficient future for global aviation.

The theme of the original GACS was “Building Cooperation for the Future of Civil Aviation: Innovation, Growth and Technical Cooperation.” The event was hosted at ICAO Headquarters and

attended by more than 400 participants from across the globe. In addition, 35 industry and Government sponsors and exhibitors contributed to ensure the event’s success.

Three years later in 2017, TCB collaborated with the Hellenic Civil Aviation Organization (HCAA) and the Athens International Airport (AIA), to organize the second Global Aviation Cooperation Symposium (GACS/2). The theme was “Managing Change: Building a Safe, Secure and Sustainable Aviation Community.” Over 350 participants participated in the event, which included panels, workshops and industry exhibition. This helped to foster a unique forum for regulators, service providers, operators and other industry stakeholders to discuss and share their experiences and best practices in implementing technical cooperation projects, with the aim of fostering a solid aviation community.

This year, 2019, TCB will be organizing the third edition of the GACS, this time in close collaboration with the Civil Aviation Authority of Thailand (CAAT) and the ICAO Regional Office in Bangkok. The symposium’s theme is “ICAO: Bridging the SARPs Compliance Gap with Quality and

|| NO COUNTRY LEFT BEHIND ||

## EVENT

**GACS/3**

22-24 July 2019

## THEME

Global Aviation Cooperation Symposium to address SARPS compliance and capacity building through ICAO technical support programmes.

Efficiency.” High-level key-note speakers will outline the vision of aviation’s future and how to overcome the challenges we will face as an aviation community.

GACS/3 will feature speaker sessions, discussion panels, and workshops covering all main areas of civil aviation, including infrastructure development and compliance improvement through technical expertise. Enabling topics will address cooperation through regional projects, capacity building through training, and project funding and resource mobilization. Moreover, the event will offer a unique opportunity to obtain in-depth knowledge of ICAO’s Technical Cooperation Programme and how it can meet States’ needs.

ICAO and CAAT invite all States and other stakeholders to participate in GACS/3. For more information on the event, email [gacs@icao.int](mailto:gacs@icao.int).



## The TCB Vision

There is a need for increased technical cooperation and assistance across the full spectrum of civil aviation to achieve the goals of the ICAO No Country Left Behind (NCLB) initiative. In this respect, the vision of ICAO's Technical Cooperation Bureau (TCB) is to enable States to attain a high standard of Standards and Recommended Practices (SARPs) compliance, thereby reaping the economic and social benefits related to air transport. TCB understands the needs and challenges of the aviation world and from experience knows how to overcome those problems with efficiency and effectiveness.

TCB assists States to improve their operational safety, security, and efficiency to contribute to the global and uniform implementation of ICAO SARPs. With more than six decades of experience, and drawing upon all of the technical expertise and knowledge available within ICAO, TCB's mission is to provide unrivalled in-depth assistance to States with their aviation projects.

## The main goals of GACS/3:

### GOAL 1 – BRIDGING THE GAP: COMPLYING WITH THE STANDARDS AND RECOMMENDED PRACTICES (SARPS).

The Symposium will set the stage of aviation today, underscoring the challenges the aviation community faces in the near future and discuss how best to decrease the SARPs compliance gap in order to build and maintain a safe, secure and sustainable aviation system.

### GOAL 2 – DETERMINING UNIQUE SOLUTIONS FOR CAPACITY BUILDING THROUGH TECHNICAL COOPERATION AND ASSISTANCE PROJECTS.

States will have the occasion to capture commonly found issues, solutions and best practices shared through the presentation of Technical Cooperation and Technical Assistance projects. In order to build a safe, secure and sustainable air transport industry, potential solutions will be discussed, organized in topics, including

infrastructure development, training, and capacity building through experts, regional cooperation, and leveraging synergies with development partners.

### GOAL 3 – PROMOTE THE ROLE ICAO'S TECHNICAL COOPERATION PROGRAMME IN ASSISTING STATES TO ACHIEVE THEIR GOALS.

The Symposium will also provide a general overview of ICAO's TC Programme services and best practices assisting Member States and regional organizations to bridge the non-compliance gap.

### GOAL 4 – STRENGTHEN INSTITUTIONAL AND CROSS-INDUSTRY RELATIONSHIPS.

The Symposium will bring together ICAO experts, Member States, industry providers, national, regional and international organizations to enhance collaboration between regulators, industry, donors and other stakeholders through technical cooperation. [\[3\]](#)



NGAP/2

# NEXT GENERATION OF AVIATION PROFESSIONALS

✈️ “Air transport’s contributions to the peace and prosperity of nations, and to their sustainable socio-economic development, has never been more important or pervasive from the global standpoint than it is today. We presently forecast current flight and passenger volumes to double by just the mid-2030s. This is truly a monumental challenge for air transport leaders and planners today, and one which is presently engaging our entire global community in every aspect of aviation’s strategic, technological and operational development,” stated ICAO Secretary General Dr. Fang Liu at the 2<sup>nd</sup> Next Generation of Aviation Professionals (NGAP) Global Summit (NGAP/2), held in Shenzhen, China.

“At the same time as our sector is growing, its workforce is also shrinking due to the inevitable demographics of aging populations, lowering birth rates, and other attrition factors,” she cautioned. “This means fewer air transport professionals being available to pilot future aircraft and to effectively maintain and manage our ever-expanding fleet. These challenges to air transport workforce planning are further aggravated by the increasing number of high-tech careers in other industry sectors which compete with aviation for up and coming technical talent. These and similar dynamics have forced us to recognize that aviation has to do a much better job of both attracting and retaining the skilled workers and managers it requires.”

ICAO has recently updated its forecasts for pilots, air traffic controllers, and aircraft technicians: 620,000 pilots will be needed by 2036 to fly the world’s 100-seat-and-larger aircraft. About 80 percent of these future aviators will be new entrants to the profession who

## EVENTS

2<sup>nd</sup> Next Generation of Aviation Professionals (NGAP) Global Summit (NGAP/2)  
Model ICAO Forum  
12 - 14 December 2018  
Wuzhou Guest House, Shenzhen, China

## HOSTS

ICAO  
Shenzhen Municipal People’s Government of Guangdong Province  
Chinese Society of Aeronautics and Astronautics  
Beihang University

## PARTICIPANTS

More than 1000 academic, government and industry representatives from 32 countries and all regions of the world  
Beihang University

## THEMES

- Fast forward to the future
- Employer challenges now and in the future
- Women in aviation now and in the future
- Innovations and solutions to address NGAP challenges
- Setting up a national NGAP strategy
- The way forward
- ICAO’s expanded NGAP Programme
- Addressing future environmental needs

are not yet flying today. A similar story is playing out with respect to the future air traffic controllers, maintenance personnel and other technicians needed, as well as hundreds of direct and indirect aviation-related career categories which will potentially be impacted.

# 协议签订仪式

SHENZHEN • CHINA 2018年12月12-14日 DECEMBER 12-14, 2018



“NGAP Global Summits provide a unique opportunity to discover and embark on new relationships and partnerships; these are being focused today around critical foundational needs which will establish the future aviation workforce – for example, the need to more proactively engage and connect to today’s youth, or to do more to promote STEM resource access and assure gender parity when doing so,” Dr. Liu said. “ICAO’s consensus-based approach to air transport progress has long recognized the value of such exchange of knowledge, ideas, and experiences, and certainly the same is true of our NGAP strategies and objectives.”

Highlighting the progress being achieved toward previous calls to action raised at last year’s inaugural NGAP Summit, ICAO announced the expansion of its NGAP Programme and a new initiative to support young researchers and innovators. “It is very important that ICAO maintains this NGAP momentum, and just as important that we elevate the scope of these challenges to the global level,” the Secretary General underscored. At a Model ICAO Forum conducted adjacent to the Summit, 180 students participated in discussions on civil aviation topics prepared by ICAO technical

experts. The Forum provided a unique opportunity to raise university-level awareness on the role of ICAO on the international stage, and the challenges associated with forging global consensus on critical air transport issues.

On the sidelines of the Summit, a range of agreements were also forged between ICAO and some key partners. These included:

- a new intent to cooperate with Airbus more meaningfully toward NGAP-related and other objectives,
- a Training Services Agreement with the Shenzhen Airport Group,
- an MOU with Turkey regarding future cooperation on analytics and data visualization for aviation, and
- a project with Beihang University focused on NGAP capacity-building, aviation data, and cyber safety and security.

An agreement with numerous attending universities encouraged the sustainable establishment of a new International

Association of Aviation and Aerospace Education (ALICANTO) – see “New Aero Education Association Launched” on page 55.

“This is such a very exciting time in the history of aviation, and a just-as-exciting moment for those of us involved in finding new ways to assure a dedicated and qualified Next Generation of Aviation Professionals,” the Secretary General said.

ICAO officials accompanying Dr. Liu in Shenzhen included Mr. Arun Mishra, ICAO Regional Director, Asia-Pacific; Mr. Jiefang Huang, Director of ICAO’s Legal Affairs and External Relations Bureau; Mr. Henry Gourdji, ICAO Head for Strategic Planning, Coordination and Partnerships; Ms. Jiarong Yan, Director of the Office of the Secretary General; Mr. Catalin Radu, ICAO Deputy Director for Aviation Safety; and Mr. James Wan, ICAO Deputy Director, Information Management and General Administration.

*The objectives of the second Model ICAO Forum was raising awareness on issues pertaining to civil aviation inspiring a new generation of aviation professionals. The Forum engaged 180 university students from 28 different countries. Participants worked together in teams to propose solutions to these aviation case studies: Unmanned Aircraft Systems, Dangerous Air Cargo, Socio-Economic Benefits of Air Transport, Strengthening Aviation Security Systems. A panel of aviation experts awarded top prize to Stream 1/UAS.*





ALICANTO signatories

## NEW AERO EDUCATION ASSOCIATION LAUNCHED

### PROMINENT GLOBAL UNIVERSITIES UNITE TO ADVOCATE FOR AVIATION EDUCATION



More than 30 prominent universities engaged in aviation and aerospace education – ranging from McGill University Institute of Air and Space Law in Canada and Embry-Riddle in the United States to école Nationale de l'Aviation in France, Moscow State Technical University of Civil Aviation in the Russian Federation, Singapore Institute of Technology and Nanjing University of Aeronautics and Astronautics in China – signed an agreement in December to form ALICANTO, the International Association of Aviation and Aerospace Education.

#### ALICANTO'S OBJECTIVES INCLUDE:

- Create a forum where academics, students, regulators and worldwide industry can meet, exchange ideas, and conduct research surrounding issues and advances in the field of aviation education.
- Assist members in development of strategies and actions for attracting and educating the next generation of aviation professionals in a sustainable global society.
- Enhance educational efforts through public awareness of the economic and social importance of civil aviation.
- Promote gender equality in aviation and support sustainable development in the field.
- Cooperation with various stakeholders, as well as with governments and international organizations such as ICAO, the International Air Transport Association (IATA), Airports Council International (ACI), and others.

- Maximize cooperation and mutual assistance among higher educational institutions.

The new cooperation framework was forged on the sidelines of ICAO's 2nd Next Generation of Aviation Professionals (NGAP/2) Global Summit in Shenzhen, China in mid-December. The signing was observed by Dr. Fang Liu, Secretary General of ICAO.

The agreement underscores the importance of the NGAP programme in bringing together States, educational and training institutions, United Nations

organizations, industry and other stakeholders to address existing and future aviation personnel shortages.

In Chilean mythology, the alicanto is a mythical bird whose wings shine at night with beautiful metallic colours.

For more information or to apply for membership, visit the ALICANTO website: <https://alicanto.org/>.

Or submit inquiries to Mr. Pascal Revel, Alicanto Membership Committee Chair, at [pascal.revel@enac.fr](mailto:pascal.revel@enac.fr).

### THE ALICANTO VISION

address aviation education and research issues  
synthesize widely consensual positions

## THE 34 FOUNDING SIGNATORIES TO ALICANTO LISTED BELOW HAVE COMMITTED TO INVITING OTHER RELEVANT UNIVERSITIES FROM AROUND THE WORLD TO JOIN.

**Canada:** McGill University, Institute of Air and Space Law

**China:** Beijing Institute of Technology, Beihang University, Central South University, Chongqing Jiaotong University, Dalian University of Technology, Jilin University, Guang Zhou Civil Aviation College, Guilin University of Aerospace Technology, Guizhou Institute of Technology, Harbin Engineering University, Nanjing University of Aeronautics and Astronautics, North China Institute of Aerospace Engineering, North University of China, Northwestern Polytechnical University, Shanghai Jiaotong University, Shenyang Aerospace University, Shenzhen MSU-BIT University, Tongji University, University of Electronic Science and Technology of China, Xi'an Jiaotong University, Xihua University, Zhengzhou University of Aeronautics

**France:** École Nationale de l'Aviation Civile

**Georgia:** Georgian Aviation University

**Italy:** Università Telematica Giustino Fortunato

**Republic of Korea:** Korea National University of Transportation

**Russian Federation:** Moscow State Technical University of Civil Aviation, Samara National Research University

**Singapore:** Singapore Institute of Technology

**South Africa:** University of the Witwatersrand

**Turkey:** Cappadocia University, the University of Turkish Aeronautical Association

**Ukraine:** National Aviation University

**United States:** Embry-Riddle Aeronautical University

### THESE UNIVERSITIES HAVE EXPRESSED THEIR SUPPORT:

**Australia:** University of New South Wales

**Belarus:** Belarusian State Aviation Academy

**China:** University of International Business and Economics

**Czechia:** Brno University of Technology, CVUT Prague

**France:** ISAE Ecole Nationale Supérieure de Mécanique et Aérotechnique (ENSMA), ISAE Ecole de l'Air Salon de Provence, Ecole Supérieure des Techniques Aéronautiques et de Construction Automobile

**Germany:** Universität Stuttgart

**Italy:** Politecnico di Milano, Politecnico di Torino, Università degli Studi di Bologna, Università degli Studi di Napoli Federico II

**Poland:** Politechnika Warszawska

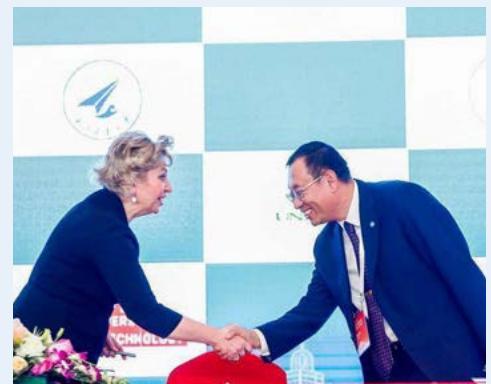
**Slovakia:** University of Zilina, Pan-European University

**South Africa:** University of Pretoria

**Turkey:** Maltepe University, Eskişehir Technical University of Turkey, Ozyegin University, University of Samsun

**United Kingdom:** Coventry University, University Institute of Civil Aeronautics

The launch of ALICANTO is further supported by the Chinese Society of Aeronautics and Astronautics (CSAA), the Aerospace College Alliance of Sino-universities (ARCAS), the Partnership of a European Group of Aeronautics and Space Universities (PEGASUS), the Romanian Aeronautical Association/European Aviation Institute and the Directorate General of Civil Aviation of Turkey.



ICAO's NGAP Programme Officer, Ms. Michelle Millar (above), oversees the Alicanto agreement signings during the 2019 NGAP Summit in Shenzhen.



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