

# ENACalumni

N°27 - JANUARY 2020

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VERSION FRANÇAISE  
AU DOS

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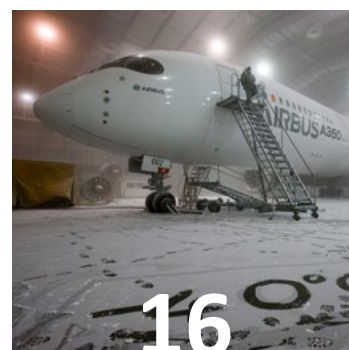
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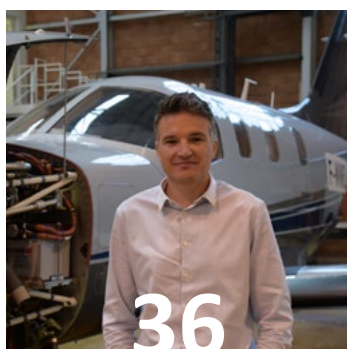
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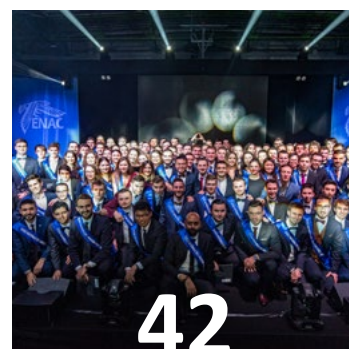
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TRANSLATION : Lucy Translating Matters, Richard FAUL

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ENAC ALUMNI, 7 avenue Edouard BELIN, CS 54005, 31055, TOULOUSE CEDEX 4

05.62.17.43.39 - [contact@alumni.enac.fr](mailto:contact@alumni.enac.fr)

# EDITO

On behalf of the European Union and its Member States, the European Union Aviation Safety Agency (EASA) has been exercising exclusive competence with regards to the certification of aeronautical products for over 16 years.

Our team of experts – project managers, engineers and test pilots, continually ensures that manufacturers ensure, in compliance with the applicable regulations, a high level of safety starting from the design – before a newly developed aircraft model may enter into operation – and throughout the lifecycle of the aircraft.

The success of a certification process is mostly measured afterwards and varies in a way that is inversely proportional to the contribution of design factors to incidents and accidents.

Certification relies on teams of enthusiasts seeking technical excellence and whose sole mission is to deliver a safe product. The job involves updating applicable technical standards, methodologies and skills requirements for our experts. Consequently, it calls for continuous improvement.

Hot topics in aircraft certification include:

- The growing automation of the cockpit and of our knowledge of human performance,
- New technologies (electric propulsion, additive manufacturing methods, artificial intelligence, etc.),
- The globalization of industrial stakeholders contributing to the value chain (design, production, operations),
- New threats (cybersecurity, malicious acts),
- New types of aircraft or operations (drones, air-taxi, etc.),
- New methods of demonstration (simulations and "virtual" certification).

Facing these challenges, it is essential that Europe keeps a strong role of independent and competent certification body.

Rachel Daeschler  
Certification Director, EASA



**25 200 ALUMNI  
WISH YOU A VERY  
HAPPY NEW YEAR!**



# ALUMNI LETTERS

## THE AVIATOR WATCH

BY JEAN-PIERRE CELTON, EPL75

There are vital accessories for pilots or men (and also women, but these accessories are more discreet) who would like to show their passion for the world of aviation:

- The brown leather jacket, preferably that of the crews of US bombers from the Second World War, A2 model,
- Ray Ban Aviator sunglasses of course,
- A few badges from prestigious units,
- The silk scarf,

And... the aviator's watch.

Various top-end watch brands today refer to it and have an iconic model in their range.

- Breitling and the "Navitimer" with its circular slide rule,
- IWC (International Watch Company) and the "Big Pilot" model worn by fighter pilots in the Second World War and today associated with Antoine de Saint Exupéry, Top Gun or the Spitfire,
- The much revered and renowned brand "Breguet" is also known for its "Type XX" watches worn by pilots in the 50s in France and for its flight instruments on aircraft built from 1911 to 1971 by Louis Charles Breguet, descendant of Abraham Breguet, the master watchmaker,
- Longines, official timekeeper for the transatlantic flight of Charles Lindbergh, was commissioned by the latter in 1927 to create a special watch to calculate his position,
- In Japan, pilots in the Second World War wore a Seiko watch,
- Bell and Ross, A French watchmaker brand with its square casing (BR Aviation) imitating flight instruments, associated for example with the Rafale "a tool for their mission". However, many other brands offer this type of watch: Hamilton, Omega, Alpina, Vulcain, Zenith and its "Pilot" model, Oris and its "Big Crown" issued by the RAF during the Battle of Britain, etc.

### WHAT IS AN AVIATOR WATCH?

What are its characteristics?

What makes it an instantly recognisable timekeeper and a defining object, associated with a specific universe with which the wearer would like to identify?

But first, why is time measurement necessary in flight?

### SOME BACKGROUND:

The first aircraft at the beginnings of aviation in the 1900s had very few flight instruments and time measurement was necessary to check

autonomy and flight duration or the time for an engine to reach working temperature.

Alberto Santos Dumont did not find it very practical to consult his pocket watch to read the time during flight so asked Louis Cartier, during a socialite event, to find him a solution to make it easier to read the time. A while later in 1904, the watchmaker offered him a watch attached to a wrist strap, which was easier to read. The principle of the wrist watch would gain popularity throughout the world, but the "Santos Dumont" watch, which cannot be considered an aviator watch, is still in the brand's catalogue and has been since 1911.

Rapidly, with the development of aviation, pocket watches for the general public were no longer able to withstand the specific restrictions of flight: variations in pressure and temperature, acceleration, strong vibrations, resistance to humidity and therefore corrosion, problems with handling using flight gloves (it is very cold at a high altitude in an open cockpit). The pocket watches designed for rail, where "making time" is a rule in a very vibratory environment, were a good basis for developing aviation instruments. These instruments gradually developed to meet flight limitations and were integrated in the instrument panel for easy, continuous reading.



During his attempt to cross the Mediterranean in 1911 from Fréjus to





Bizerte in Tunisia, Rolland Garros procured two watches, one to tell the time and the other set to midday and activated when he left to check the flight time and therefore his fuel consumption. He landed with less than 5 litres of fuel in his tank!

The First World War was characterised by the advent of the air-borne weapon in combat.

The aviation watch, as well as checking fuel consumption and monitoring navigation, was also associated with aircraft used to take photographs and was able to give an exact time for the photos taken by reconnaissance aircraft. These photos, with identification of time, enabled tracking for example of the speed of movement of enemy troops and prediction of the time of attack.

So as not to affect the magnetic compass, an instrument that enables the pilot to keep the heading and therefore navigate, aviation watches must also be amagnetic.

#### STOPWATCHES: FROM THE INSTRUMENT PANEL (BACK) TO THE WRIST

During the First World War, the Swiss manufacturer Zenith offered the RAF a leather bracelet with housing for the onboard watch. Pilots misused these bracelets to wear stopwatches on their wrists out of vanity or as a sign of recognition.

With the development of more sophisticated navigation techniques, aviation watches had to become more reliable still and accurate to the second. Already, a basic instrument for heading and watch navigation or astronomy navigation, the watch became even more accurate with the introduction of radio-navigation means.

At the end of his historic Atlantic crossing in 1927 timed by Longines, Charles Lindbergh suggested an improvement to the brand's timekeeper, which would become a legend in the world of watchmaking: Longines "Hour Angle Watch" which enabled even more precision in navigation calculations.

The accurate reading of the second required the addition of a central second hand and a totalizer.

Criteria for high visibility at day or night (hands and faces with Arabic numerals that are large and luminescent) were added to these basic characteristics, which required the integration of large calibres<sup>\*\*\*</sup> in solid casing (42 mm) made of stainless steel.

There are very few pilot watches for female wrists apart from the 36mm calibre IWC pilot watch.

The stop-watch function (time totalizer) was introduced from the 30s as well as the complication<sup>\*\*\*\*</sup> referred to as flyback for resetting the timer and relaunching via a single push of a pushbutton, generally at 4 o'clock. The timer became specialised and therefore included in the instrument panel.

[http://www.aguttes.auction.fr/\\_fr/vente/horlogerie-drouot-31305?affiche=vignettes&page=4](http://www.aguttes.auction.fr/_fr/vente/horlogerie-drouot-31305?affiche=vignettes&page=4)

Today still, the timer watch remains a vital instrument for navigation, measuring the flight time, checking procedures or monitoring



consumption.

From the 30s, it was used definitively on the wrists of pilots. Various watch brands started to offer pilot watches in addition to flight instruments. During the Second World War, we remember the time-setting ceremony for the crew watches to the very second as "to hack the clock" at the end of every pre-flight briefing: hours, minutes and seconds were then displayed on the onboard timers for the thorough synchronisation of air operations (with second stop function).

Watch manufacturers gained glory and recognition when they were selected by an air force such as the Armée de l'Air (Breguet) or the Royal Air Force (Zenith-Omega-Oris).

Today, measuring time has taken another form and another dimension with the development of onboard electronics, yet still remains necessary.

#### THE AVIATOR WATCH TODAY:

<sup>\*</sup> This watch has a mobile face and a graduated lens for angle measurement. By adjusting the true time equation and thanks to reception of a radio signal, it is possible to determine longitude. Longines reinvented this time piece at the 90th anniversary of the Atlantic crossing between New York and Paris.

<sup>\*\*</sup> Calibre = mechanical movement of the watch

<sup>\*\*\*</sup> Complication = additional feature other than that to give the hour/minute/second.

<sup>\*\*\*\*</sup> Dial = round part that you rotate to reset the watch mechanism so it is on time



The classic pilot wrist watch still remains an iconic, identity-forming object for anyone interested in aviation.

The aviation watch takes account of operating constraints and has therefore earned its place as a highly-technical time-keeping instrument, and the main watchmaker brands have a model derived from their history in their catalogues, often referring to the world of aviation when a new design is manufactured.

For easy handling with thick flight gloves, aviator gloves generally have a large, notched or grooved dial\*\*\*\* to show the mechanical movement and large pushbuttons to start or stop time measurements.

An aviator wristwatch (a real pilot's watch) in addition to a high precision calibre (mechanics), must have a large dial, hands and high-visibility face for daytime or night-time use, with Arabic numerals, a timing function with flyback, a totalizer and a rotating lens to store and read time frames.

#### DEFINITION OF AN AVIATOR WATCH:

Unlike diving watches where the definition is perfectly defined by standard ISO 6425, there were no specific specifications for pilot watches until 2012.

To date, the University of Aachen – Faculty of aerospace technology has created the TESTAF (Technischen Standard Fliegeruhren) standard, where, in addition to the previous characteristics, the following are taken into account: impact resistance, an anti-reflection screen, a secure strap resistant to aviation fluids including kerosene and casing that must be

"water-resistant".

Lastly, the glass (sapphire) must be secured against the risks of accidental depressurisation.

Obviously, the timer can also be certified as COSC (official Swiss timer inspection) or ISO 3159 (allocated by the Besançon observatory), i.e. can meet very high criteria for accuracy and stability in measuring time to the

second for a mechanical movement.

For serious travellers, the pilot's watch can also have a UTC/GMT (second time zone) feature. According to the history of timekeeping, this new feature was introduced by Rolex at the start of the 50s upon a request from the US Pan Am airline to indicate the GMT or a second time zone to the crews. A second large hand went round the face in 24 hours. Historical irony: this was also the favourite watch of Fidel Castro!

All new complications obviously have a cost and such models are sold by luxury watchmakers. Therefore, it is not surprising that aviator watches can literally have "sky high" prices - €3,000 to 10,000!

In addition to being a vital tool for professionals, the aviator watch is also for the general public as it

offers the happy owner of such an iconic time piece the satisfaction of showing that he/she owns a time measurement instrument brimming with history that belongs to a demanding, prestigious world of excellence.







## TRIBUTE TO MICHEL DE VRIÈS

Michel De Vriès, IENAC54 graduate and ENAC Alumni board member, passed away on 14 November 2019.

He attended the Lycée Hoche de Versailles preparatory school and in 1954 passed the ENAC Air Telecommunication Works Engineer competitive exam after four years of preparation (two attempts). This must have encouraged him to become an examiner in the ENAC competitive exams until just a few years ago.

He performed his military service in the Navy on the Bois Belleau aircraft carrier, where he met a pilot named Hubert de Gaullier, who was to remain one of his friends.

For his first assignment to the French Air Navigation Department (DNA) he led the factory inspection team and at the same time prepared for a PhD in Mathematics, specialising in Statistics, where he worked with Louis de Broglie and Jean-Louis Destouches.

In 1963, he passed the internal Air Navigation Engineer competitive exam and, when he left the school, was assigned to the French Air Transport Department for aviation programmes (Airbus, Concorde, Mercure and Dassault business aircraft).

He then went into budgetary affairs and the plan at the DNA. He mastered the new techniques for the rationalisation of budget choices.

In 1977, he came to ENAC in Toulouse under the management of Louis Pailhas to lead the General Teaching Department. He set up a core course in the teaching of engineers and managed the library and printers, the civil aviation engineer cycles, etc.

In 1984, he returned to Paris and worked at rue Descartes, in the former Ecole Polytechnique at the Ministry for Research with Hubert Curien. There, he prepared aerospace research programmes in conjunction with the DGAC, Onera and the CNES. He also helped prepare the European programmes on these subjects (PCRD). With Olivier Carel, he encouraged the development of the GPS EGNOS system and later the Galileo system for satellite navigation.

Further to his retirement, he took part in the work of the French Institute for Navigation, contributing to studies for the European Commission and articles on satellite navigation.

He gave classes at ENAC and the Ecole des Ponts et Chaussées, but above all he was an enthusiastic and kind mathematics examiner for the ENAC competitive exams. Since the creation of TIPE (supervised personal initiative work), he would spend six months a year proposing an original subject to the applicants.

Michel was involved in ENAC Alumni since its creation by Robert Aladenyse and was a member of the Board of Directors. Last February, he wrote:

**"As a graduate of the ITTA (Air Telecommunication Works Engineer) class of 1954, I am willing to remain a member of the board, if God should bless me with more time on this Earth, because we really must, whilst there are still ENAC-ONLY students alive, so as to remind the Board of the global fundamentals that still justify the existence of this school. Also, you always need someone on the board to complain!"**

He carefully proofread all the texts we submitted to him and, with an eagle eye, detected all mistakes and language errors. He was not able to proofread this text.

Everyone who met him shares the memory of interesting, fruitful and friendly discussions, delicious meals and fine wine.

You will not be forgotten.

Thank you Michel

WRITTEN BY DOMINIQUE COLIN DE VERDIÈRE, IAC70

## THEY LEFT US

Bernard PERRIN D'ARLOZ - IENAC70

Philippe MOULINIER - TSEEAC76

Patrick GOTTENEGRE - FCTLA13

Arthur CAWIDRONE - TS15A

Anaïs NATIRAN - TS16A

Samuel HEBERT - TSEEAC02B



# ASSO NEWS

## [DIARY]

28<sup>th</sup> January - Toulouse  
Thematic Afterwork

6<sup>th</sup> February - Paris  
Forum Feminine Network & Careers

19<sup>th</sup> March - Toulouse  
Visit AKKA

From 2<sup>nd</sup> to 8<sup>th</sup> March - International  
Girls on the move week

From 10<sup>th</sup> to 12<sup>th</sup> March - Madrid  
WAC

31<sup>th</sup> March - Paris  
"The futur of airports" at Passenger Terminal  
Expo

2<sup>nd</sup> April - Paris (CDG)  
General Assembly

16<sup>th</sup> April - Toulouse  
Visit Sopra Steria

14<sup>th</sup> May - Toulouse  
ENAC Entreprises Day

23<sup>th</sup> May - Muret  
Airexpo



### NETWORKING AT MONTREAL

At the General Assembly of the ICAO, our Alumni present for the occasion and those living in Montreal met for an evening at the Sarah B bar.

With the presence of Mr Olivier Chansou, Director General of ENAC, Mr. Farid Zizi, Director of France Aviation Civile, Mr. Florian Guillermet, Executive Director of SESAR and many other Alumni, discussions were fruitful and many business cards were swapped. This is what the ENAC Alumni network is about! Many thanks to our two Alumni facilitators Jean-Luc Salinas and Hugo Virchien for their involvement in the ENAC Alumni network.

### SHOOTING OF THE MOVIE "LA BOITE NOIRE"

The 14<sup>th</sup> of November 2019, some of our alumni had the chance to participate in the shooting of the movie "La boîte noire" with Pierre Niney. A great experience that goes off the beaten track! The movie is scheduled to be released the 18<sup>th</sup> of November 2020.

### AIREXPO 2020 TEAM



### DARE TO NETWORK ! A SUCCESSFUL FIRST EVENT!

On Thursday 10 October, over 200 students were present for this first Osez Networker [Dare to Network] event. At this conference, around twenty Alumni came to meet ENAC students. On the agenda: a quiz to find out more about the organisation, a speed job meeting to break the ice, a cheerleader show and, of course, the evening finished with a round of pizza!

During this evening, ENAC Alumni offered all students present a welcome pack. It is a real survival kit for the working environment. In it, students are offered advice from several Alumni on how to correctly manage their search for a work placement as well as job seeking in addition to other advice for their careers. You can find this guide online on the organisation's website.

We would like to extend another warm welcome to the students from the student office, the cheerleaders and the students at the Foyer for their help on the evening.



### VISIT OF AIRBUS ATI

The students of ENAC had the opportunity, thanks to Nabil Tahiri IENAC97T, to visit Airbus Transport International on 28<sup>th</sup> of November. A rich and interesting day focused on the operation of this very special airline company!





## CAPTAIN JOE AT ENAC

BY SONJA SCHWEICKER, IATOM18

On 14th November, ENAC welcomed the special guest and famous Cargolux Boeing 747 pilot Joseph Diebolder, better known as Captain Joe. It was a wonderful opportunity for all students who have always wanted to meet him in person. For those of you who do not know him:

Captain Joe started his flying career in 2005 by getting his private pilot licence in Austria and later, in 2008, he completed his ATPL training in Germany. A perfect training for his take-offs and landings was his first job, where he worked as a sky diving pilot on a Pilatus Porter and later as a commercial pilot on the Beechcraft King Air 200. Two years later, he was hired by Air Berlin, and switched to big jets. After 8 years of flying and collecting more than 5 000 flight hours on the A320 family, he moved on to Cargolux where he fulfilled his life-long dream to fly the Boeing 747. Besides flying around the world, he shares his passion for aviation on his YouTube channel and other social media, where he has more than 1 million subscribers.

During the summer of 2019 we, the EUROAVIA Toulouse board members from ENAC, had the idea to invite Captain Joe to ENAC for an extraordinary evening talk, as we really appreciate his technical and motivational videos. From the very beginning we have had full support for the idea from ENAC Alumni. Thanks to the joint forces of both associations, the organization of the event went smoothly, and we were ready to accommodate more than 300 people in Amphi Bellonte, and it was full house! During the evening, Captain Joe told us about his flight for Cargolux wherein he transported 2 Belugas whales from captivity in a Chinese water park back to their natural habitat near Iceland. Dynamic and enthusiastic, Joe captivated the audience with notions from flight operations, navigation, ATC and piloting, but also a touch of humour, some warm-up exercises and great communication skills. After reviewing his journey, he also talked about the impact of his profession in his personal life, about motivation, inspiration and dedication. He explained how to define achievable goals and how he uses the FORDEC method for structured decision-making in his everyday life. The evening ended with a very

lively and funny Q&A session, with many questions from pilots, air traffic controllers, engineers and professionals, and the opportunity to network with other attendees over drinks and snacks.

Rita Chewie attended the talk and shared her experience with us: "As a first-year master's student at ENAC, I decided to join EUROAVIA, as I was eager to be part of a community that shares the same enthusiasm for aviation as me. Through an event organized by the association, I was able to meet Captain Joe! This was such a surreal experience. I never imagined that I would have the opportunity to not only meet the famous pilot YouTuber but also get to hear him talk about his adventures in the sky. Looking back, I am glad that I made the decision to join the European Association of Aerospace Students!" Indeed, it was a very good experience for the EUROAVIA team, and we are happy that the participants liked the event. Once again, we would like to thank all those involved in ENAC for their support!

## ABOUT EUROAVIA

EUROAVIA, the European Association of Aerospace Students, is an organisation that connects aerospace and aviation students from more than 40 European universities, aiming to tie bonds between students and industry partners. EUROAVIA Toulouse is composed of students from ISAE-SUPAERO and ENAC. Being both a non-political and non-profit association, EUROAVIA Toulouse is entirely financed by membership fees and sponsorship and managed by voluntary students. The association board organises various events for the members, such as visits to companies and research centres operating in the aerospace sector, networking events with industry professionals, conferences and international meetings.



## AFTERWORK AT PARIS

To celebrate the end of the year, the members of ENAC Alumni Paris chapter organized an Afterwork that brought together more than 50 people ! A beautiful evening that promises a year 2020 rich in sharing opportunities !



## BIRTHDAY OF THE IENAC09 PROMOTION

The 19<sup>th</sup> of October 2019, IENAC09 got together at ENAC to celebrate their birthday of promotion. For their 10 years, they invited the new promotion of IENAC19 to share a friendly aperitif !



## ENAC ALUMNI SIGNE A NEW PARTNERSHIP WITH LUXAIR !

LuxairGroup is a key player and major employer in the economy of the Grand Duchy of Luxembourg and the surrounding Greater Region. LuxairGroup is the umbrella entity for four major activities linked to the fast-paced domain of air transport:

- Luxair Luxembourg Airlines, the flagship activity of LuxairGroup and doubtlessly the one best known to the general public. It defines itself as a regional airline offering fast air service to most of Europe's largest cities, business centers and international hubs.
- LuxairTours, the tour operator. It is well-established in Luxembourg and the surrounding Greater Region.
- LuxairCARGO, the air freight handler. With a World-Class latest technology terminal and outstanding air and motorway links, the Cargocenter is one of the largest freight distribution centers in Europe.
- LuxairServices, the airport services provider. It provides various services to LuxairGroup's entities as well as to other airlines operating at Luxembourg's Findel Airport.

The company employs about 2,900 people working in a multicultural and dynamic environment, constantly putting their skills and know-how at the service of customers in order to satisfy the high expectations of today's sophisticated clientele who wants the best at all time and every time. The reason why we launched this partnership with ENAC Alumni is first of all to attract and hire talents in our dynamic and multicultural environment, cause we want to offer to ENAC Students the possibility to develop their skills and enhance their willingness to evolve in our challenging and complex company. Data science, revenue management, flight analyses, project management, pricing... those are, among lots of other, some key words we'd like to employ while offering opportunities in our Group.

Luxembourg Airlines

**Luxair**

## NEW FONCTIONS ON ENAC ALUMNI WEBSITE

ENAC Alumni website got a makeover !

- The home page is now made up of a large banner, for a lighter and elegant design.
- Our content has been enriched with a new section "[The future of airports](#)" which presents the work carried out by the [Airport Think Tank](#) through posters and white papers.
- In the directory, the training courses are now grouped together so that you can easily find all the training courses allowing access to the same functions in the professional world.



## SPORTS PROPOSED AT EAG



## EAG ORGANIZING TEAM INVITES YOU : CREATE AN ALUMNI TEAM !

From 9 to 11 April 2020, the 11th European Aerostudent Games (EAG - formerly called the TGEA - Tournoi des Grandes Ecoles Aeronautiques) will take place. This is a three-day sports competition that brings together schools and universities in the PEGASUS (Partnership of a European Group of Aeronautics and Space Universities) network, from all over Europe. It will take place on the ENAC and ISAE-SUPAERO campuses. Its organisation committee, which changes every year, is composed of ENAC and ISAE-SUPAERO students, who make sure that the values of sport, sharing and festivity are always present. The EAGs have the specific feature of offering a wide range of sports. Here they are! At the same time as the competitions, special events are also planned. This will be an incredible opportunity to see each other again and catch up. For your information, the last event brought together over 800 people.

Alumni, form your teams, come and face the new ENAC students and continue taking part in the school's organisations! Start warming up! We are counting on you! See you very soon!

Organising team, EAG 2020.





## ENAC ALUMNI IS COMMITTED TO SUSTAINABLE DEVELOPMENT



Air transport has long been attacked due to its impact on the environment, increasingly so in recent times. The emblematic movement behind these attacks has materialised on social networks under the name of flygskam, which literally translates from the Swedish as "flight-shaming". Now, mainly in Europe, we are witnessing a real witch-hunt, which is completely irrational and stigmatises air transport and its environmental impact.

After the initial stupefaction, it seemed important to the ENAC Alumni organisation to provide rational and scientific information to the debates on sustainable air transport with full transparency. The meeting with representatives of the nation, which took place at the National Assembly on 16 October, is one component of this effort to inform about the relationship between air transport and sustainable development.

In the preamble, we were reminded that air transport, despite the fact that it is a significant economic activity for France (4.3% of GDP, 32,000 direct jobs and 1.1 million indirect jobs) is, first and foremost, a tool for bringing people together, reciprocal understanding and discussions between peoples and cultures. Incidentally, the annual number of passengers worldwide is around the same as the number of people connected to the internet: 4.4 billion, whilst digital business

generates twice as many CO2 emissions from human sources than air transport. Find the integrality of this report here : <https://www.alumni.enac.fr/en/news/summary-of-report-on-air-transport-and-sustainable-development-781>.

Air transport stakeholders' commitment to sustainable development is not limited to climate change. They are also very heavily investing in much social and environmental action such as the circular economy, protecting biodiversity and recycling waste and aircraft at the end of their service lives.

Thanks to the discussion with our elected representatives, they were able to see the determination of the aviation community, which is committed to continuing to reduce its carbon footprint by achieving carbon neutral growth from 2020, producing aircraft using new energies (electric or hybrid) from 2030 and halving CO2 emissions compared to 2005 by 2050.

As you have seen recently in our social network, ENAC Alumni is conducting a communication campaign to make this topic highlighted for most of people. In the same time, we organize some meeting, debates and afterwork to discuss on this issue from 2020.

You would like participate in this movement, take part to the discussion, join us to the [Sustainable Development Think Tank](#).



### SALY AIR SHOW

The 6<sup>th</sup> & 7<sup>th</sup> of December the first Air Show in Sub-Saharan Africa was held : the Saly Air Show ! Supported by Bamba Fall, MSMTA12, with the great help and participation of ENAC, Un Morceau de Ciel Bleu and the fonds de dotation ENAC this event brought together many national and international players of the aeronautical sector. A great success for this first edition !



### FILM & DEBATE LES ELLES DE L'ENAC

On Tuesday 8 October, les Elles de l'ENAC organised a film & debate night with the projection of the film Numéro Une (Number One). This night was an opportunity to meet and discuss the difficulties encountered by women in the world of work.

Lots of male and female students came to discuss the subject but also the difficulties young people face when discussing a sensitive subject with their superiors.



### SINGAPORE GET TOGETHER !

The Enac alumni of Singapore held a get-together last November at the heart of the Southeast Asian capital. This event was the opportunity to reminisce about the years spent at the Enac in a relaxed and warm atmosphere... like in Toulouse! Alumni from all generations were also able to exchange views on the transformations that our school and our industry have been going through. See you this year in 2020 for more events!





## NEWS OF THE U.S. CHAPTER

**A**s we are celebrating the first anniversary of the foundation of ENAC Alumni USA, the U.S. chapter of ENAC Alumni, let's reflect upon these past 12 months of operations. In December 2018, the ENAC community in the United States overwhelmingly supported the creation of this chapter through a vote and survey online – the first of its kind in the history of the ENAC presence in the U.S. Right after, the Board of the association gave its approval. ENAC Alumni USA was born! During our first quarterly call in March 2019, we defined our strategic goals and operational objectives at +2 years. Over the following months, we launched several initiatives toward our alumni and students in line with the priorities given by our President Marc Houalla: provide relevant services serving the ENAC community.

We have now a mentoring program coordinated by Pierre Bougeard (IENAC17). It brings together a dozen of participants, with ENAC students in the United States being coached by their mentors. These mentors can include non-alumni. For instance, Geoffrey Scozzaro (IENAC17) who was doing a research internship at University of Central Florida (UCF) on delivery drone fleet noise mitigation was paired with Moses Koyabe (IENAC85) – but also Basil Yap and Dishan Divakaran, two non-alumni in charge of the UAS initiative of the Division of Aviation of the North Carolina Department of Transportation (NCDOT). This mentoring program is open to young professionals as well. During Hurricane Dorian, we checked on our alumni and students on the potential track of life-threatening conditions. We reached out individually to each one of our students in Florida to make sure they were safe. We decided all together that we will renew this effort at each major event that could expose the members of our community, and facilitate mutual assistance as far as practicable.

I am working with Loup-Giang Nguyen (IENAC15) on mapping the various professional licenses and certifications applicable to the broad scope of jobs accessible to the ENAC graduates. Beyond this mapping, we want to define strategies to help our alumni to get the credentials they need for growing in the United States. Foreign academic backgrounds are not always understood by the institutions in charge of delivering these licenses. We hope our initiative will provide a useful resource to our alumni to obtain their A.A.E, AICP, C.M., P.E., and other licenses and certificates. We are also exploring with ENAC how to have some of our degrees better recognized in the United States.

Pierre Bougeard (IENAC17) prepared our first brochure in English and French for promoting our chapter. This document is now available on the website of the association. Pierre is now starting a mapping of the professional organizations and institutions. This document will help us with working on potential partnerships, and our alumni as well when they are looking for more involvement with their industry. Remy Lucette (IENAC05) recently volunteered for taking over a task force that aim at fostering relationship between ENAC, its community, and the U.S. universities. Last November, we celebrated Thanksgiving with a special discount on the annual fee for both the alumni and student memberships. Your membership is important! You can see your money at work through all the initiatives your alumni association is doing in Toulouse and all around the world, for the benefit of the alumni but also our students.

We have a thriving and diverse alumni community in the United States,

from coast to coast and even in Alaska. In 2020, I wish to see our first regional events take place. I want also more cooperation between ENAC and the U.S. chapter. We need Toulouse to help us more when it comes to promoting opportunities in the U.S., identifying students with an American Dream, and making the ENAC degrees recognized in the U.S. Finally, we will offer more online events to the ENAC community – professional webinars to the alumni and coaching sessions to the students, some of them co-organized with other universities and institutions.

I wish you a wonderful year 2020!

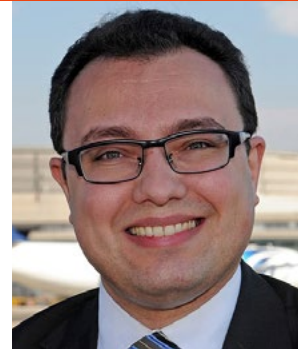
Gaël Le Bris, C.M., P.E. (IENAC07T)

Contact : [gael.le-bris@alumni.enac.fr](mailto:gael.le-bris@alumni.enac.fr)

Page of ENAC Alumni USA : <https://www.alumni.enac.fr/fr/groupe/enac-alumni-usa-1082>

### GAËL LE BRIS

Gaël Le Bris (IENAC 07T), Senior Aviation Planner & Technical Principal at WSP USA in Raleigh, NC took the Oath of Allegiance of the United States last December and is now a U.S. citizen. He also obtained his license of Professional Engineer (P.E.) in California and North Carolina. He is our first alumnus to be licensed as a P.E. in the United States.



### MAXIME J. VALENCIK

Maxime J. Valencik, EI, CAPM (IENAC11T) joined last December aviation consultancy firm Landrum & Brown in New York City as Senior Consultant. He is also an Adjunct Professor at Boise State University where he teaches CAD for civil engineering applications. He used to be the President of the Southwest Idaho Chapter of the Women's Transportation Seminar (WTS) and looks forward to being involved in the NY Chapter.



### U.S. CHAPTER LEADERSHIP

- Chair of the U.S. Chapter: Gaël Le Bris, C.M., P.E. (IENAC07T), Senior Aviation Planner, WSP USA. Since Jan. 2018.
- Coordinator, Mentoring Program: Pierre Bougeard (IENAC17), Student, ENAC/FIT. Since June 2019.
- Coordinator, Licenses & Certifications Task Force: Loup-Giang Nguyen (IENAC15), Aviation Planner, WSP USA. Since June 2019.
- Coordinator, Professional Organizations Task Force: Pierre Bougeard (IENAC17), Student, ENAC/FIT. Since December 2019.
- Coordinator, Friendship Initiatives with U.S. Universities: Rémy Lucette (IENAC05), Airport Consultant, Ricondo & Associates. Since Sept. 2019.
- Coordinator, Membership: \*\* Vacant \*\*



**AFTERWORK IN NEW YORK CITY IN DECEMBER 2019**

We promised. We delivered! ENAC Alumni USA organized its first local afterwork event last December. At the invitation of Gaël Le Bris, Chair of ENAC Alumni USA, the alumni of the Greater New York City had dinner together at View of The World in the World Trade Center area. They discussed about the latest news of ENAC Alumni, their ambitions for the U.S. chapter in 2020, and the hot topics of the NYC community. was the first afterwork event of ENAC Alumni in the United States, and other events will be held in 2020. Stay tuned!

### **FROM THE FAR WEST TO FLORIDA : AN IENAC INTERNSHIP FOR REDUCING THE NOISE IMPACT OF DELIVERY DRONES**

My internship at a research laboratory in the United States was my first professional experience outside of France. The aim was to conduct research effort and prepare a paper on noise abatement trajectories for a fleet of Unmanned Aerial Systems for delivery purpose. This internship started at the Arizona State University (ASU), located in Tempe, AZ. Thanks to Gaël Le Bris (Chair of ENAC Alumni USA), I met Moses Koyabe (IENAC 85L, VP Business Development at Aerosmith) during a lunch. He gave me valuable advice for my project and helped me to understand the operational context of UAS operations in the U.S. For the second part of my internship, I left the dry climate of Arizona for the subtropical conditions of the University of Central Florida in Orlando, FL. Once again, ENAC Alumni USA supported me and put me in contact with Basil Yap and Darshan Divakaran, in charge of the UAS program of the North Carolina Department of Transportation (NCDOT). Their Division



of Aviation is top of the nation in terms of UAS public policies and innovations. Thanks to all these discussions, I wrote my paper with a better understanding of the UAS operational context. The paper has been accepted for the SESAR Innovation Days that will be held in Athens, Greece in December 2019. This was a rewarding experience and I would like to do a PhD through the CIFRE program (located in France) while keeping relations with United States.

**Geoffrey Scozzaro, IENAC 17 OPS**

### **THE MENTORING PROGRAM SUPPORTS OUR YOUNG MEMBERS IN THE UNITED STATES**

ENAC Alumni USA has implemented this year its mentoring program, in line with the overall objective of the association of providing service and support to the ENAC community. This program is offered to students preparing an internship, international experience, or academic exchange in the United States, and young professionals who plan to join us in the United States. Once their project is defined, mentees are paired with alumni considering the mentee's project and interests. The exchanges are usually based on a monthly call. The mentoring program aims at providing members with information about training and professional opportunities in the U.S and support regarding the preparation of their experience and their daily life overseas.

This year, we have paired 4 IENAC17 students with 9 mentors. They have been very satisfied and we received very positive feedback about the initiative. Many alumni have expressed their wish to join the program next year, and our goal is to enroll every student that will opt for an experience in the United States.

Based on this 2019 edition, we want to formalize a check-in and check-out process, and develop information materials specific to the United States towards the students and young professionals.

### **Q&A SESSION ON STUDY AND LIFE IN THE UNITED STATES**

ENAC Alumni USA held on November 22, 2019 its first online Q&A session to students looking for information on study and life in the United States. The session was open to the IENAC18 graduate students as they will have to choose soon to send applications for an internship, a research project, an academic exchange, or a double-degree program. The meeting was organized and advertised by Pierre Bougeard (IENAC17) and the ENAC Alumni staff. Pierre Bougeard is the Coordinator of the Mentoring Program of ENAC Alumni USA, and currently pursuing a master's degree in Aviation Development and Management at Florida Tech in Melbourne, FL in addition of his IENAC aviation engineering master's degree. He and Gaël Le Bris (IENAC07T), Chair of ENAC Alumni USA, replied to the questions of six IENAC18 students eager to learn about life and opportunities in the United States. ENAC Alumni USA will organize similar online sessions in the future, and is encouraging the other chapters and think tanks of ENAC Alumni to do so. Are you a ENAC student or a young professional with an American Dream? Contact ENAC Alumni USA now!





## Léa PINEAU, IENAC16

### TRAVEL DIARY VOLUNTEER IN THE PHILIPPINES

**I**t is with great pleasure that I would like to tell you about my humanitarian trip as a volunteer to the Philippines. I flew to the Philippines on Sunday, May 26th for a great adventure of a month and a half. In this adventure, I was supervised and above all accompanied by the largest humanitarian association in the Philippines: Gawad Kalinga. It has many partnerships with leading engineering and business schools and it is through a request for reinforcement from the Special School of Public Works (ESTP) that I set off on this crazy adventure.

Gawad Kalinga (meaning "Taking Care" in Tagalog, the local language) is an association founded in 2003 by Tony Meloto, highly respected within the association and in the Philippines. It aims to eradicate poverty for 5 million Filipino families by 2024. Ambitious program, isn't it? Indeed, it is not only financial poverty but also "heart and mind poverty". Social isolation and addictions are also a form of poverty that the association wants to fight. A way to fight it used by GK is entrepreneurship. Many small businesses, and even a school, grow in the Gawad Kalinga villages. Indeed, everywhere in the Philippines, the association finances more than 2,500 villages in the Philippines. I have been welcomed in one of them: GK Munting Paraiso. After a few days of training full of good humour and hope, we will remember "Don't let poverty end our dreams, instead, let our dreams end poverty," and are now able to join an incredible community, in which I stayed for more than a month.

For our village, we defined the missions we would like to carry out. First, we want to supply the cooperative with rice to help the women of the village, so that they don't have to walk under the sun every day. They can now get their supplies directly in the village. The cooperative is a small shop at the entrance to the village where food and toiletries can

be found, but it remains very limited in choice and stock. Rice is a basic ingredient in all meals, they eat it at least 3 to 4 times a day (out of 6 meals because the Filipinos eat very often in the day). The cooperative did not have the necessary cash to supply its inventory. During the whole stay we were able to supply him with 7 bags of rice and reinforced its entire stock (household products, hygiene products, canned food...).

Secondly, we wanted to repair, move and improve the children's playground, which was located under the coconut trees (dangerous because coconuts fall regularly and randomly) and consists of two sets: a gantry without a swing and another broken game for kids.

Then we noticed that an enormous pile of waste was half buried in a ravine, which shows that the waste wasn't properly treated nor evacuated from the village. We have learned that they burn them in the evening to get rid of them, leaving foul-smelling vapours that are very bad for the environment and for the children playing around. Our first mission would be to set up a waste sorting system in order to limit them and make compost to fertilize the plantations already set up. We also wanted to find a way to evacuate them out of the village, which involved setting up garbage containers and negotiating with the city's garbage collectors, who were not currently collecting the village's garbage. We have set up selective sorting bins and built a composter made of coconut and bamboo

wood.

We also noticed that half of the church, a porch surrounded by bamboo fences, was not painted in white like the rest of the church, so we repainted it.

Throughout the stay, we participated in the ongoing project: the construction of new houses to welcome new residents. The houses are built by the future inhabitants themselves; they show great solidarity and each inhabitant participates in the construction of all the houses of



**Don't let poverty  
end our dreams,  
instead, let our  
dreams end  
poverty**





the village. We are very quickly integrated into the construction team.

Life in the village is very exotic, the rules are not the same and it is not always easy to get used to it. Fortunately, Filipinos are incredibly kind and generous: enough to inspire our Western countries! It is wonderful to be that integrated into a culture so different from ours, to adapt to a new way of life and to end up feeling at home in the house of people we met just a few weeks ago.

At the end of our stay, we left for 10 days to visit another island of the Philippines, incredible, unreal landscapes are then offered to us, we are welcomed in another Gawad Kalinga village but this time to enjoy and not to work, rest is well deserved!

Looking back now, I think that going on a humanitarian trip is the best way to discover a country. Beyond discovering incredible and unforgettable landscapes, I especially had the unique opportunity to meet the population, to live with them and to confront their culture. We are looking for exoticism in the most touristic places of the planet, while millions of isolated people with an incredible kindness are waiting to share their daily lives and culture with us, European people.

If you want to try yourself or just satisfy your curiosity, I would be very happy to share my experience with you in more details, contact me!

### My trip in figures:



42 days



200 card games



4 villages



7 new cities



300 new meetings



15 new friends



27 000 km







A350 prototype inside “McKinley Climatic Laboratory” facilities by - 40°C



# CHALLENGES OF CERTIFICATION

by Michaël BENHAMED, IENAC94

The challenges associated with certification are appearing with much force since the tragic accidents involving the two B737 MAX aircraft.

The extraordinary development of the aviation industry has taken place thanks to technological advances, the ever enhancing reliability of aircraft and their components and constantly improving safety. The role of certification in this development should not be overlooked.

The certification of a new aircraft or engine or the approval of equipment requires a set of complex processes to be implemented. The tragic events mentioned above reiterate the real importance of certification in the safe (but also sustainable) development of our industry.

We are facing new challenges. Our industry must drastically reduce its carbon footprint. Everyone is affected. The regulatory organisations, the (regional or national) certification authorities and companies with DOA (Design Organisation Approval) thus accredited to design new products must adapt to new technologies and offer new certification regulations.

The special segment in this magazine presents initiatives and projects supported by the EASA, Akka Technologies, Daher, Airbus and Regio Lease.

We would like to extend a warm thank you to all Alumni and the authors of these articles for the quality of information on these essential topics.

Please take part and join the Aircraft & System, Design & Certification think tank.

We hope you enjoy reading the magazine!

Join the Aircraft System, Design & Certification Think Tank : <https://www.alumni.enac.fr/en/groupe/aircraft-system-design-certification-think-tank-994>





# AVIATION CERTIFICATION

## CIVIL AVIATION: ONE OF THE MOST REGULATED HUMAN ACTIVITIES

The aviation sector is one of the most regulated human activities and, in proportion to its size, one of the safest - there has to be a cause and effect relationship between these two constants.

Management of the activities related to civil aviation is comprehensive - a concept theorised in Europe under the name: Total System Approach. Therefore, the regulated chain of aviation activities starts at the design phase for aviation products and includes the production, operation and maintenance of aviation products, airport services and air navigation, the licences of the various professionals involved, etc.

In this article, we will look at the most upstream activity: **aviation design**.

The Contracting States of the International Civil Aviation Organization (ICAO), complying with the Chicago Convention<sup>4</sup>, have signed up to a certain number of obligations. In particular, they have undertaken to supervise the aviation design activities conducted by organisations under their jurisdiction. Annex 8 - Aircraft airworthiness - includes the obligations applying to the Contracting States concerned. Note that whilst most ICAO Contracting States supervise air navigation service providers or air operations, proportionally not many States have significant design activities taking place in them.

## AVIATION CERTIFICATION: WHICH PRODUCTS?

To which products do these obligations apply? Annex 7 of the Chicago Convention defines an aircraft as "Any machine that can derive

support in the atmosphere from the reactions of the air other than the reactions of the air against the earth's surface". Traditionally, aviation products subject to Type Certification were classified as fixed-wing aircraft, rotary-wing aircraft, balloons, airships, engines and propellers. Various other parts, such as certain equipment, are also certified, but this article will just cover aircraft certification.

We can also note that the advent of new types of product such as the AW-609<sup>5</sup> (aircraft with tilting rotors), the Volocopter<sup>6</sup>, the Lilium<sup>7</sup> and the Pal-V<sup>8</sup> blurred the traditional categories. For this reason, we are increasingly categorising them as vertical take-off and landing (VTOL) or horizontal take-off and landing (HTOL) products.

In the future, the presence of an onboard or remote pilot or the autonomy of the flight system may once again change the classifications used.

## HOW TO CERTIFY AN AIRCRAFT. SPECIFICS OF EUROPE

In Europe, aircraft certification mainly uses the principle of a triple safety net.

### 1.Designer Liability

The organisation in charge of design is primarily liable for the safety of the products it develops. Various regulations, as well as concepts such as Safety Management Systems (SMS) manage the running of these organisations, their safety liabilities and their duty to systematically analyse risks.



## 2. Aviation Design Organisation Approval

En Europe, un second filet réglementaire – lui-même composé d'un In Europe, a second regulatory safety net, itself with a twofold inspection, was added to this first level: firstly, an organisation wishing to perform an aircraft design activity must, beforehand, show that it is able to, as an organisation. This capability is inspected in a centralised way by the EASA (European Union Aviation Safety Agency). The European legislator granted this agency a certain number of powers<sup>9</sup>, notably under the principle of subsidiarity. Therefore, although a certain number of executive powers are still exercised at national level (e.g. issuing pilot licenses), aviation design organisation approval is now an exclusive power of the Union, exercised on behalf of the EASA Member States. When an organisation meets all the administrative and technical requirements under European law (particularly Annex 1 of regulation (EU) 748/2012 - Part 21), it receives DOA (Design Organisation Approval).

To obtain DOA, an organisation must therefore show that it has a structure and a set of procedures, skills and resources that correspond to the framework and scope of its design activity.

The organisation defines all the items in its Design Assurance System required by the Part 21J regulation in a manual (Design Organisation Handbook). In particular, it sets out a set of independent monitoring activities. This system, among other things, includes a check of demonstrations of compliance with the regulatory prerequisites of the certification basis.

## 3. Product Certification

Lastly, the third level - products designed by these organisations are subject to a regulatory inspection specific to each "type". This inspection

involves a certificate being issued by the EASA (except for a few aircraft, e.g. certain lightest aircraft, for which Member States have retained executive power), called a "Type Certificate". This certificate certifies the compliance of all design data with the requirements under European law, set out in a complex regulatory system composed of regulations and technical specifications (e.g. regulations (EU) 2018/1139 or (EU) 748/2012, CS-23, CS-25, CS-27, CS-29, CS-E<sup>10</sup> etc.).

In practice, a certification team typically includes a project manager, the PCM (Project Certification Manager), and some experts. At the EASA, the experts are classified by "panel". There are currently 19 panels covering all technical design activities: flight tests, structure, mechanical and electrical systems, avionics, propulsion, environment, cabin safety, etc.

The Type Certification process typically follows the following four main phases:

- Technical familiarisation and establishment of the certification basis.  
The designer presents the project to the EASA when it has reached a good enough level of maturity, enabling the certification team to stipulate design rules and technical specifications (e.g. including CS-25 for an airliner), which will form the Type Certification basis.
- Establishment of the certification schedule  
The designer and the EASA define and agree on the compliance means used to meet each regulatory prerequisite of the Type Certification basis. Experts from the EASA certification team then define their degree of involvement in checking these compliance means.





#### - Demonstration of compliance

The designer must demonstrate the compliance of the product with the regulatory prerequisites of the Type Certification basis. This demonstration may take the form of tests (ground tests, flight tests, tests on a static test bench) and analyses that the EASA certification team experts examine during detailed documentary reviews and the direct monitoring of certain tests. This phase is the longest of the phases in the Type Certification process, which has a limited total duration, in principle 5 years for an airliner, with the possibility of an extension if necessary.

#### - Technical finalisation and certificate issuance

When the demonstration of conformity is complete, the certification project enters the final phase. Usually, for large projects, a final Type Board meeting sets out the final action to be taken so that each panel in the certification team is able to issue its final statement as regards satisfaction to the PCM - this is its technical agreement with the activities that demonstrate compliance for its area of expertise. The PCM then closes the technical investigation, issues a technical stamp recommending approval and the EASA issues the Type Certificate and publishes the Type Certificate Data Sheet.

Another specific feature of the European system is the inclusion of data developed by the aviation product designer for operators in the Type Certificate, such as data on simulators or the qualification of mechanics or flight crew. This data, called Operational Suitability Data, is an integral part of the Type Certificate issued by the EASA.

Certifying an aircraft generally takes several years and requires thousands of working hours from the designer and the Authority.

Amongst the Type Certificates issued by the Agency over the past few months, we can list the Arden 1U light helicopter engine<sup>11</sup> (Safran), the P2012 light transport twin engine<sup>12</sup> (Tecnam), the Beluga XL<sup>13</sup> (Airbus), the A320 Neo<sup>14</sup> and the A350-1000<sup>15</sup>.

#### CERTIFICATION IN AN INTERNATIONAL CONTEXT

The Chicago Convention sets out the obligations of the State for the

design of aviation products, notably the issuance of a Type Certificate. However, the national legal framework of a certain number of Contracting States of the ICAO provides for the issuance of a Type Certificate from the Registration State too. We therefore refer to validated Type Certificates and the validation authority.

Thus, the European legislator has set out that a State of the European Union can only register an aircraft on its national register if the aircraft in question has been certified (or validated) by the EASA in most cases and by national authorities in a few specific cases. When the organisation that designed the aircraft is not based in Europe, the EASA must validate the Type Certificate of the primary authority, i.e., the aviation authority of the Design State. To prevent this process from requiring far too much effort from the designer, with no added value in terms of safety, the major aviation authorities in the area of aviation certification - or their political authorities, have provided international cooperation measures.

The European Union is accredited to sign Bilateral Aviation Safety Agreements (BASAs) as per a process defined by the Treaty on the Functioning of the European Union. To date, the European Union has signed such agreements with the US<sup>16</sup>, Canada<sup>17</sup> and Brazil<sup>18</sup>. The European Commission has received negotiation mandates for two new agreements with China and Japan. With China, a BASA was signed on 20 May 2019. The ratification process for this agreement is under way.

In addition, the EASA has signed working arrangements with numerous States in which aviation design activities take place<sup>19</sup>.

To varying degrees, the objectives of these agreements and arrangements are identical: to organise and optimise the relations between the primary certification authority (Design State authority) and the "validation" authority. Depending on the existing level of confidence between the Authorities, the validation process takes more or less account of the certification work performed by the primary authority. For example, in a bilateral aviation safety agreement, to varying degrees depending on the case, each party provides credit to the certification investigations of the other party, which can include the mutual recognition of certain certificates.





Within the EASA, the management of these international cooperation issues in the certification domain requires the pooling of technical, legal, diplomatic and political skills.

#### THE FUTUR

A certain number of technical developments call for adjustments to the way the aviation authorities will certify aircraft transporting freight or passengers in the future. In addition to protecting passengers, there is an obligation to protect people below flight paths.

The advent of drones, plans for operations with fewer crew members, preventive maintenance and Big Data linked to the increase in sensors and the exponential growth of data flows managed by onboard and ground equipment, the digitisation of processes, and the boom in the use of algorithms using Artificial Intelligence are all technological breakthroughs requiring developments in the way future aviation products will be certified. In addition, the increasing complexity of aviation products and the environment in which they are used makes the role of the certifier even more delicate. It is probable that inspections performed in the future will be increasingly systemic - accompanied by one-off inspections on products, and marked by the omnipresence of digitised processes, notably with the advent of new compliance means based on simulation and modelling.

Lastly, the empowerment of new players - various different start-ups in the areas of drones, sub-orbital flight, urban mobility and supersonic flight, poses specific difficulties as these agents do not have the same experience of the certification process and relations with a regulator as the more conventional designers.



#### THE AUTHORS



**Charles LEBOEUF IENAC94T**

Chief Project Certification Manager – Validation Process ;  
Certification Directorate – EASA



**Grégory LIEVRE IENAC94T**

Section Manager – Certification Strategy and International  
Validation ; Certification Directorate – EASA

*The authors of this article only are individually responsible for it. They wrote this document as former ENAC students. Their employer, the EASA, is in no way responsible for this article.*

<sup>4</sup> <https://www.icao.int/publications/Pages/doc7300.aspx>

<sup>5</sup> <https://www.leonardocompany.com/en/products/aw609>

<sup>6</sup> <https://www.volocopter.com/de/>

<sup>7</sup> <https://lilium.com/>

<sup>8</sup> <https://www.pal-v.com/>

<sup>9</sup> <https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX:32018R1139>

<sup>10</sup> Pour plus de détails : <https://www.easa.europa.eu/regulations>

<sup>11</sup> <https://www.safran-helicopter-engines.com/fr/media/safran-recoit-la-certification-easa-pour-le-moteur-dhelicoptere-ardiden-1u-20191108>

<sup>12</sup> <https://www.tecnam.com/aircraft/p2012-traveller/>

<sup>13</sup> <https://www.airbus.com/aircraft/freighter/beluga.html#BelugaXL>

<sup>14</sup> <https://www.airbus.com/aircraft/passenger-aircraft/a320-family/a320neo.html>

<sup>15</sup> <https://www.airbus.com/aircraft/passenger-aircraft/a350xwb-family/a350-1000.html>

<sup>16</sup> [https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=uriserv:OJ.L\\_.2011.291.01.0001.01.ENG](https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=uriserv:OJ.L_.2011.291.01.0001.01.ENG)

<sup>17</sup> [https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=uriserv:OJ.L\\_.2009.153.01.0010.01.ENG](https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=uriserv:OJ.L_.2009.153.01.0010.01.ENG)

<sup>18</sup> [https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=uriserv:OJ.L\\_.2011.273.01.0001.01.ENG](https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=uriserv:OJ.L_.2011.273.01.0001.01.ENG)

<sup>19</sup> <https://www.easa.europa.eu/document-library/working-arrangements>

# ELECTRIC AND HYBRID AIRCRAFT CERTIFICATION



Caption : Lilium Jet

Source: "Lilium aims to operate all-electric air taxis in several cities by 2025", Deezen, Augusta Pownall, 20/05/2019, Available online

<https://www.dezeen.com/2019/05/20/lilium-jet-electric-air-transport/>

The aeronautical sector is experiencing a technological renaissance that promises the emergence of revolutionary aircraft architecture in the decades to come, in parallel to a new approach to air transport as a whole. In fact, the need for mobility and alternatives to road and rail transport, coupled with congestion in cities, pave the way for unprecedented aircraft configurations with a controlled environmental impact. Though the idea of a fully electric commercial airliner is still a long way off, we might at least see electric or hybrid propulsion systems for light aircraft transporting a small number of passengers on a regional or urban scale, for example.

The principle of hybrid vehicles is to combine thermal and electric energy sources. This might involve a distributed hybrid propulsion system, generated by associating a turbogenerator with batteries in an optimised way, powering electric engines that are generally linked to propellers. This multi-rotor VTOL (Vertical Take-Off and Landing) architecture might be used for air taxi missions that limit noise pollution. One example worth mentioning would be the Bell Nexus, a five-seater air taxi powered by a distributed propulsion system with six large orientable fans.

Aircraft manufacturers are also imagining a combination of conventional and electric propulsion. The electric propulsion system would take over from the turbojet engine in the less power-consuming phases, such as when cruising, but also in the transition phases to reduce the work of the turbines and have them operating at their point of minimum consumption; in take-off and landing phases to reduce noise and emissions; or even in the event of a failure in one of the thermal

engines, to provide back-up power. This type of architecture is aimed at powering regional transport shuttles with a capacity of around ten passengers.

Finally, we can imagine fully electric propulsion, but for short distances transporting just one or two passengers, or in the field of drone technology. In these cases, the batteries alone can provide enough energy to propel the aircraft. This is the case for the VoloCity, equipped with nine rechargeable batteries powering 18 electric engines, designed by German start-up Volocopter and currently in its EASA certification phase. In the same category, characterised by a canard design and 36 shrouded propellers, is the Lilium Jet, which aims to enter into service in 2025.

The entry into service of this future generation of aircraft poses a considerable challenge: introducing new (and in some cases immature) technologies into air transport, without reducing the current level of safety. None more so than for the European Aviation Safety Agency (EASA), responsible for monitoring safety and environmental protection in civil aviation in Europe, and for issuing aircraft type certificates. The certification requirements for each aircraft category are published in the Certification Specifications (CS) laid out by EASA in Europe (CS-25 and 29 for large aircraft and helicopters respectively, CS-E for engines, etcetera).

There are numerous challenges involved in the certification of electric and hybrid aircraft. The big-name aircraft manufacturers are interested in contributing to the air transport revolution, but so are the start-ups and smaller companies with no experience of aviation regulations and





**Caption: Lines of Nexus de Bell Helicopter**

Source: "Bell Helicopter launches the Nexus at CES 2019 with Safran and Thales", Le Journal Aviation, Léo Barnier, 08/01/2019 :

<https://www.journal-aviation.com/actualites/41670-bell-helicopter-lance-le-nexus-au-ces-2019-avec-safran-et-thales>



**Caption: VoloCity de Volocopter**

Source: « Volocopter presents VoloCity, its flying taxi ready for commercialisation and compliant with European standards », L'Usine digitale, Julien Bergounhoux, 22/08/2019:

<https://www.usine-digitale.fr/article/volocopter-presente-volocity-un-taxi-volant-pret-a-la-commercialisation-et-conforme-aux-normes-europeennes.N876240>

requirements. This makes managing the electric air mobility market a genuine challenge. What's more, the diversity of actors means a variety of projects and architectures appearing all over the world, such as those put forward by American company Joby Aviation, or EHang in China. But there's also a broad range of potential usages (ASH 26 electric powered glider, Flying Whales LCA60T Large Capacity Airship, Extra 330LE electric aerobatic aircraft, air taxis). This makes it complicated to implement a generic set of regulations.

Moreover, from a technical point of view, the difficulty lies in the fact that the propulsion system is deeply integrated into the aircraft. New propulsive architectures tend to incorporate the lift, propulsion and flight controls, which differs considerably from traditional aircraft, where such functions are separate. Certain start-ups plan to design the entire aircraft, including the propulsive system, which makes it necessary to review the role of engine makers and aircraft manufacturers and the interaction between the two, in order to preserve the experience and skills acquired through decades of industry.

There are a few major technical sticking points when it comes to certifying this type of architecture: the risks linked to new energy sources (lithium-ion or fuel cell batteries); electric power management; distributed propulsion and the pilot interface; and coupling of functions. In this context of innovation and electrification of aircraft propulsion, EASA recently carried out a global restructuring operation on its Certification Directorate, to grasp and anticipate new technologies as best it can, and to adapt to the frenetic pace of industrial and technological innovation. For the moment, certification of this future generation of aircraft is being performed on a case-by-case basis. The choice of certification basis with its existing categories is an early stumbling block, due to their unprecedented characteristics (drone, CS-23, CS-27 etcetera).

Also, new regulations are taking form at EASA. In particular, Special Condition SC-VTOL, which lays out the technical specifications for Vertical Take-Off and Landing, was published in July 2019 and is used for certification of the VoloCity by Volocopter and the Lilium Jet. A new Special Condition, SC-EHPS for Electric and Hybrid Propulsion Systems, is set for imminent publication, offering a more generic, less

prescriptive framework, based on safety objectives, with the possibility for manufacturers to prove compliance by various means. SC-EHPS has been developed in cooperation with the Federal Aviation Administration (FAA), EASA's American counterpart, and therein lies another major challenge linked to new technologies: promoting European and global safety standards, and harmonising regulations internationally.

But certification is not the only challenge these hybrid aircraft face. This type of aircraft will have to tackle public acceptance, particularly when it comes to environmental and noise pollution, as proximity to populated areas increases. Using batteries made from rare, non-recyclable materials also raises ethical, geopolitical, environmental and supply-related issues. What's more, the operational aspect will also require special attention, with the need for adapted airport infrastructure and licences for crew and maintenance. However, the outlook for future aircraft is positive. There's no doubt that the technological obstacles will be overcome in the next few years. You only have to look at the diversity of electric and hybrid aircraft projects and their unlimited number of applications to grasp the utility and potential of these technologies, which will have a major impact on the mobility of tomorrow's world.

*[With thanks to R. Rossotto, EASA Electric and Hybrid Propulsion Project Certification Manager]*



## THE AUTHOR



**Camille SIPOS IENAC15 OPS**

Intern Support Engineering - Dassault Aviation  
Paper realised after a gap year at EASA



# FLIGHT TESTS ROLE IN AIRCRAFT CERTIFICATION

## WHAT ARE WE TALKING ABOUT ?

From light to large aircraft, all manufacturers must go through a certification process, by regulatory obligations.

For large civil aircraft (Maximum Take-Off Weight higher than 5700kg), the certification is a particularly long and complex exercise which aims at demonstrating an appropriate safety level both for the crew and passengers onboard the aircraft as well as population overflown. This is materialized by this issuance of a "Type certificate", (or TC) ensuring that a given aircraft type complies with airworthiness requirements and that its design is approved, before its serial production and commercial flights.

The certification process is under the control and monitoring of competent civil aviation authorities, depending on geographical jurisdictions.

Nowadays, the two main civil aviation certification entities are led by the American "Federal Aviation Administration" (or FAA) and the "European Union Aviation Safety Agency" (or EASA) but other countries with a long tradition of aeronautical industry have developed a strong expertise in certification (Russia, Canada and Brazil for instance).

For some years now, consistently with its will to develop its own aeronautical industry (ARJ21, C919), China is also developing its own authority.

Aircraft manufacturers, such as Airbus, are allowed to design new aircraft (or aircraft modifications) thanks to a "Part 21 / Design Organization Approval" (or DOA).

The DOA, granted by civil aviation authorities, recognizes and approves the manufacturer's design organization and its associated processes.

For any new aircraft type, the manufacturer applying for a TC must demonstrate the compliance of its product with a set of requirements, which depend on the aircraft category.

For large aircraft to be certified in Europe, all these requirements are expressed in the "Certification Specifications for Large Aeroplanes", also named CS-25.

The requirements cover all aircraft related subjects connected to safety such as handling qualities and performance, structure, systems, engines operations, cabin. Environmental requirements

concerning aircraft emissions and external noise must be satisfied as well through CS-34 and CS-36.

The demonstration of compliance to CS-25 is achieved through several MoC (Means of Compliance) including evaluation in flight during a Flight Test campaign.

## WHAT DOES A FLIGHT TEST CAMPAIGN CONSIST OF ?

A flight test campaign starts with tests aiming at checking aircraft behavior or characteristics vs. prediction.

It continues, if necessary, with tests aiming at correcting the discrepancies between prediction and reality.

It concludes with tests aiming at showing compliance to applicable requirements.

The number of disciplines to be covered by flight tests usually lead the manufacturer to share all subjects amongst several prototypes.

It is indeed crucial to parallelize tests as much as possible, in order to ensure a flight test campaign duration compatible with industrial constraints and market expectations.

For example, the Airbus A350-900 flight test campaign has required five flight test aircraft who accumulated about 2600 flight test hours.

Two aircraft shared flight physics related tests (e.g. handling qualities, performance, loads...).

One aircraft was equipped for systems and engines checks, whereas two prototypes were dedicated to cabin related subjects.

During the campaign, flight (and ground) tests are scheduled as often as possible (up to 2 flights per day), each one being more or less dedicated to a given technical perimeter.

Should any misbehavior be detected during these development tests, it will lead to modifications which will be checked again up to getting satisfactory results in front of certification requirements.

Each test may require a specific aircraft configuration in terms of installed pieces of equipment, computers and hosted software, engines settings, sensors and instrumentation but also weight and center of gravity etc.





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AIRBUS

A350-1000 prototype during a ground test through « water trough ».

Globally, the campaign aims at evaluating the aircraft in normal conditions, beyond normal conditions (e.g. very low speed, very high speed...), but also in failure conditions or under extreme external conditions, such as exposures to hot or cold weather, high altitudes airfields, turbulent atmosphere...

As part of CS-25 demonstration needs, several critical tests are conducted during the campaign.

For example, minimum speed take-offs (named VMU for "Velocity Minimum Unstick") are realized, leading to put the aircraft tail on the runway during the aircraft take-off run, up to its actual lift-off at very low speed.

It is an impressive and delicate exercise which requires very high piloting skills !

Some water ingestion trials are also performed in order to ensure engines normal behavior, as the aircraft rolls into a water trough simulating a runway flooded with water.

"Flutter" tests aim at evaluating the aircraft response in terms of aero-elasticity by generating oscillations on the flight controls, directly through their computers.

Some very specific tests may also be performed, sometimes beyond pure CS-25 requirements.

The A350 XWB campaign has included cold weather trials in Iqaluit (Canada), high altitude assessments in La Paz (Bolivia) and a hot weather campaign in Al Ain (United Arab Emirates).

Exposure to extreme conditions is mandatory to test the aircraft behavior, its systems and its engines over their entire operating range.

In 2014, the A350 XWB Manufacturer Serial Number (or MSN) 002 has been the first Airbus aircraft to perform a 3 weeks tests campaign in the "McKinley Climatic Laboratory", located on Eglin

United States Air Force base in Florida.

The entire aircraft, its systems and cabin installation were subject to cold and hot temperatures, ranging from -40°C to +40°C in a climate-controlled hangar, and in a testing environment.

Starting the engines of an A350 in a closed hangar by very negative temperatures, whereas the outside temperature is close to +30°C is not so common...

But that may be part of flight testing too !

Out of CS-25 scope, some Early Long Flights (ELF) were part of the A380 and A350 campaigns.

These flights consisted in operating a cabin-equipped flight test aircraft with real "passengers" (Airbus employees) and cabin crew coming from airlines in order to evaluate cabin systems under normal "airlines-like" conditions.

Depending on the size of the aircraft, some airport compatibility trials can also be performed.

At the end of the A380 and A350 XWB flight test campaigns, the so called "route proving" was one of the last steps before certification.

These endurance flights aimed at demonstrating that the new aircraft can fly non-stop standard airlines routes, without having significant technical issues.

For the A350 XWB, about 320 flight hours were demonstrated including the visit of 14 major airports on four different routes, covering approximately 81,700 nautical miles in 180 hours of flight.

## WHO ARE THE ACTORS OF A TEST FLIGHT ?

During the flight test campaign, for each test flight, the crew is composed of two test pilots and one test flight engineer installed



© AIRBUS S.A.S. 2014 - photo by S. RAMADIER



A350 test campaign in the « McKinley Climatic Laboratory », by -40°C.

in the cockpit, and from one to three flight test engineers installed in a dedicated working environment in the cabin. Certification authorities— pilot and / or flight test engineer depending on the nature of the tests – take an active role in the certification flight test campaign.

The test pilots, whether coming from the manufacturer or the authorities, evaluate and give recommendations regarding the aircraft handling qualities, the cockpit layout, the procedures and the human factors aspects.

Their evaluations always take into account the hypothesis that, once certified, the aircraft will be flown by pilots having average piloting skills and which will apply published and approved procedures.

Test pilots working for a manufacturer are also deeply involved in cockpit designs, long time before the first flight of the related prototype.

Flight Test Engineers (or FTE) are specialized on a given technical subject (handling qualities, auto-pilot, engines etc.) but they also have a good knowledge of other disciplines so that they can manage the uncertainties inherent to flight test activity.

Before each flight, FTEs work with design offices in order to create flight test orders describing the tests to be executed in flight, together with the procedures associated to safety of tests. Within Airbus organization, they are supported in this task by Flight Test Specialist Engineers (or FTSE), also specialized by technical perimeters but which are not onboard the aircraft.

During the flight, FTEs act as test conductors, using flight test stations displaying all needed parameters to be monitored.

It is up to the FTEs to decide in flight, whether a test point is valid or not and then go further in accordance with their flight test order.

For complex flights and in order to consolidate their decision, they can be supported in real time by engineers from the design office or from the test analysis team which are following the flight on ground, from a telemetry room.

The aircraft can indeed be monitored in real time thanks to data transfer flow of up to 12 Mbits / second combining video, audio and flight parameters...

After flight, the FTEs are responsible for debriefing the test flight, highlighting the flight test points which were potentially not satisfactory and requiring corrections or modifications.

The Test Flight Engineer (or TFE) is responsible for a prototype from its birth in final assembly line up to the end of its life in the flight tests environment.

TFEs participate to all flights of their prototype, seated on a so-called “jump seat” between the two pilots.

During flights, they monitor the aircraft systems and take care not to go beyond operational limitations applicable to their prototype.

They also assist the pilots during complex maneuvers, operating systems and even engines during flight (relights, precise thrust settings etc).

Once back on ground, the TFE coordinates all necessary





maintenance activities with flight line teams, responsible for performing all the work on the aircraft.

Furthermore, the TFE discusses needs for aircraft configuration changes with engineering teams and allows their implementation.

All these flight test specialists are constantly supported by many other highly qualified professionals, from maintenance teams to design office, programs, flight operations, test instrumentation etc.

### AND WHAT ABOUT SERIAL AIRCRAFT ?

Once all necessary tests are completed and certification criterions are met (including the approval of a maintenance program) the manufacturer is granted the type certificate for the new aircraft. From that moment, the company is allowed to produce and deliver serial aircraft, hence each aircraft rolling out of the final assembly line should be identical to the prototype, or modified with certified modifications.

Aircraft manufacturers, such as Airbus, are allowed to produce new aircraft thanks to a "Part 21 / Production Organization Approval" (or POA).

The POA, granted by civil aviation authorities, recognizes and approves the manufacturer's production organization and its associated processes.

Within Airbus organization, a "Production flight tests" team is deeply involved in the production and delivery processes by testing each individual aircraft.

They intervene from the aircraft first high speed taxi (named RTO for "Rejected Take Off"), aiming at checking the braking logics before the aircraft first flight.

Then, they perform the production aircraft first flight.

This major milestone consists in checking all the aircraft systems, its engines, and its proper behavior under degraded situations such as a controlled cabin depressurization as well as a check of its low speed protections etc.

When a serial aircraft is clear of any default and ready to be sold, it is transferred to the delivery center for some last ground and flight checks together with the customers, in view of their aircraft acceptance (the flight is called "Customer Acceptance Flight").

The aircraft delivery process ends up by issuing an "Individual airworthiness certificate", which allows the aircraft to be used by its commercial operator, after payment, named "Transfer of Title".

### CONCLUSION

As far as large civil aircraft are concerned, certification is a very complex but mandatory and necessary process highly contributing to the safety of civil aviation.

Flight tests are a significant part of the certification exercise, and even if this very specific aeronautical activity has drastically evolved since times of pioneers, testing a prototype at its limits remains necessary.

Amongst all specialists being involved in flight tests many people are graduated from the ENAC, either flying or not, working for a manufacturer or the authorities.

Furthermore, be they Flight Test Engineer, Test Flight Engineer or Flight Test Specialist Engineer, the IENAC are largely represented within Airbus flight tests community !



### THE AUTHORS

**Laurent CAPRA IENAC92T**

Flight Test Specialist Engineer / Handling Quality expert  
&

**Cédric FAVRICHON IENAC17 OPS VAE**

Test Flight Engineer



# « POST TYPE CERTIFICATION, ACCELERATOR FOR INNOVATION AND UPGRADES OF IN-SERVICE FLEETS »

**A**s the number of aircraft in commercial operation is set to double over the next twenty years, to reach a global fleet of over 47,000 aircraft, the aviation market must meet various expectations so as to be able to achieve its green transition ambitions, whilst ensuring the continuity of its technological development and economic viability.

In this globalised era, where demand for travel is ever increasing despite limited resources, requirements are becoming more stringent and market players must demonstrate originality and ambition if they are to meet consumer expectations. This is a big part of retaining a competitive edge today: providing a travel experience that is increasingly innovative, whilst offering the latest technological advances, which must consider environmental concerns and, above all, guarantee a good enough level of safety.

Nobody can argue against the last point. As global air traffic increases, so does the risk of incidents and fatal accidents. With over 4.4 billion passengers transported in 2018, regulators have no other choice than to continue to develop certification and airworthiness regulations to manage this race towards best performance and keep the number of air disasters to a minimum.

**However, although the latest generations of aircraft make use of the most recent innovations as per the latest regulations, what is to be done with in-service aircraft that are sometimes already considered obsolete as regards their successors?**

As they cannot continuously renew their fleet, operators will look to modify their aircraft, to upgrade them with aerodynamic and avionics improvements, and so on, and also with new entertainment and comfort systems for their passengers. Besides the significant financial aspect, operators will also save time compared to procuring a new aircraft.

The final equation is therefore relatively simple: the bigger the growth

of the aviation market, the higher the number of in-service aircraft. Consequently, the demand for modifications should also increase. With this in mind, manufacturers are not always able to meet the after-market demand, and a number of third-party design organisations have been emerging in recent years. These design organisations are accredited by the civil aviation authorities to offer design and integration solutions that are approved for in-service aircraft via Supplemental Type Certificates (STCs).

Just like AKKA Technologies, which has two design organisations approved by the EASA (European Union Aviation Safety Agency) and TCCA (Transport Canada Civil Aviation), these organisations will operate on the airline market to offer airlines reconfigurations in line with their development plans (upgrades of cabin environments, fleet conversions, new types of operations, etc.), but will also provide mandatory retrofit solutions to equip them with systems that comply with the latest regulatory requirements (e.g. ADS-B out (260B) system, which will be mandatory for operations from 2020).

They will also provide their services to commercial aircraft lessors to reconfigure their aircraft at the end of the leasing contract to make sure they are in line with the requirements of the following operator. This may simply entail standardising the appearance, with changes to the cabin colour, for example, to be in line with the airline brand image, or requesting to modify several avionics or emergency equipment systems, to meet the local regulations of foreign authorities when the aircraft changes country of registration.

Lastly, these organisations are also special partners to the developers of new equipment, as they enable them to qualify and integrate their latest onboard aircraft systems. Via this individual post type certification for a specific aircraft or fleet, operators can claim exclusivity to cutting-edge technologies and be the first to offer unique and innovative experiences to their customers.





### Can anyone become accredited by the international authorities to issue airworthiness approvals?

To date, the EASA has granted this recognition (known as DOA – Design Organisation Approval) to fewer than 400 entities amongst the 32 Member States, covering modification areas from a simple carpet replacement in the cabin to a modification of the engines or wings. In exchange for their privileges, these organisations must permanently show the authorities that they have the technical and human capacities to design and certify their modifications.

For such broad scopes, these organisations must have varied areas of expertise to demonstrate compliance with all the different requirements affected by their projects (structural calculations, electromagnetic compatibility, knowledge of aircraft systems and architecture, safety of passengers and crew, performance, aerodynamics, etc.). In addition, given the diversity of the configurations and the modified aircraft, this requires these organisations to be able to quickly and effectively adapt to produce demonstration methods in line with often limited technical documentation and the expected safety level. With the current trend for innovation, this is a twofold challenge. They have to be able to both integrate new systems functionally in the aircraft, but also demonstrate compliance with requirements that may not yet exist, which will be specifically created on a case-by-case basis by the authorities to control new risks generated by certain systems.

### Actual Examples

Within the AKKA Technologies (Aeroconseil) DOA, we cover both full reconfigurations of the cabin and cargo compartment interior and the installation of avionics equipment. In particular, we are internationally renowned for our expertise in aircraft smart onboard systems, which offer passengers access to Wi-Fi or GSM points throughout the entire flight.

Faced with the growing demand over the past few years for these "smart" technologies, we were the first DOA to obtain an EASA STC for these smart systems by equipping Emirates' whole long-haul fleet in 2009.

Also, with the current development of our communications means, the need to remain online during flight is becoming more evident even on medium and short-haul (shuttle) flights.

In 2014, Orange, as a service provider, approached Air France to offer to test the new "Global AirConnect" system on one of their medium-haul aircraft, to offer passengers "open world" Wi-Fi access during their flight. The system supplier was GEE (Global Eagle Entertainment), then called ROW 44. The test was a success and Air France decided to deploy this new Wi-Fi system on their whole Airbus A320 Single Aisle (SA) Family fleet (114 aircraft).

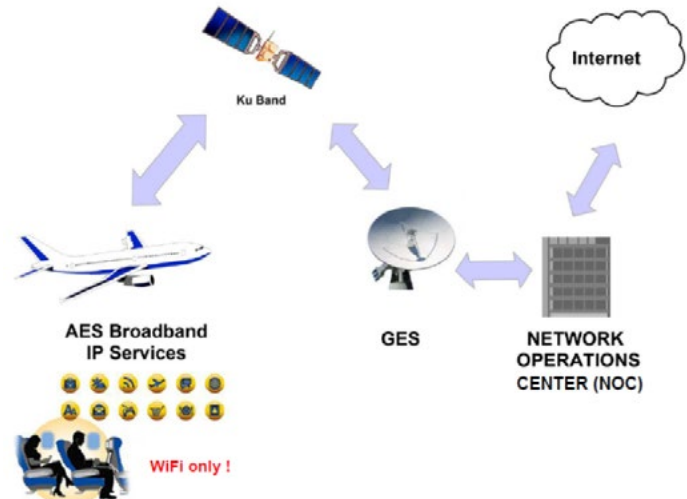


Figure 1 - Global AirConnect System - Architecture

Therefore, in 2018, AKKA Technologies (Aeroconseil) was mandated to develop the EASA (STC) installation and approval dossier to install the system on all of the airline's aircraft.

This system includes:

- One Ku-band (GSAA) satellite antenna installed using a plate to standard A791 on the fuselage, protected by a radome,
- Equipment enabling the generation of Wi-Fi signals (KRFU and MODMAN) and distribution throughout the whole cabin (SMU and CWLU),
- Equipment used to control the system (activation, deactivation and maintenance).

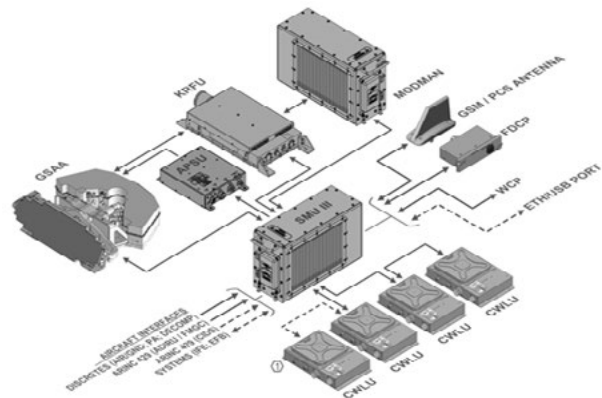


Figure 2 - Global AirConnect System – Equipements



The design to install a smart system with a Ku-band satellite antenna requires several areas of expertise to be covered. This includes significant structural reinforcement of the fuselage zone on which the antenna is attached. Therefore, specific reinforcement (intercostals) are used to connect the aircraft frames to each other and external doublers are added to the aircraft skin. The electrical design involves defining harnesses (wiring) and routing to connect the various equipment, control panels and electrical supplies.



Figure 3 - Renforts structure – internes (intercostal) / externes (doubleurs)

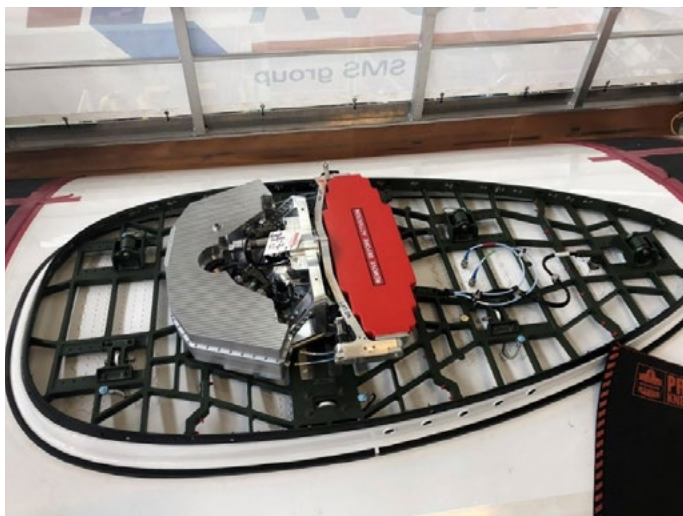


Figure 4 - Antenne installée sur le fuselage au travers de sa platine

The certification of this type of system may be complex, but is interesting in more than one respect as it requires coordination between several professional areas, from avionics systems to flight tests through structural aspects (installation of the antenna on the fuselage), vibrations measurements, icing and bird strike aspects, aerodynamic and safety aspects, and so on.

To demonstrate that the installation of the GEE system on Air France Airbus SA aircraft was in line with the applicable regulations (CS-25) and the special conditions required by the EASA, various analyses were

required, such as:

- Analysis of the aerodynamic loads caused by the antenna on the fuselage,
- Aerodynamic analysis of the effects of the antenna on aircraft drag and the potential impact on aircraft performance,
- Analysis of potential build-up of ice on the radome,
- Analysis of lightning strikes and check of the radome protection system,
- Analysis of potential vibrations and buffeting,
- Analysis of the capacity of the radome to contain over-pressure linked to the sudden breakage (opening) of the fuselage (below the radome),
- Analysis of bird strike on the radome,
- Structural analysis (static and fatigue) of the reinforced part of the fuselage,
- Analysis and qualification of equipment installed on board the aircraft, etc.

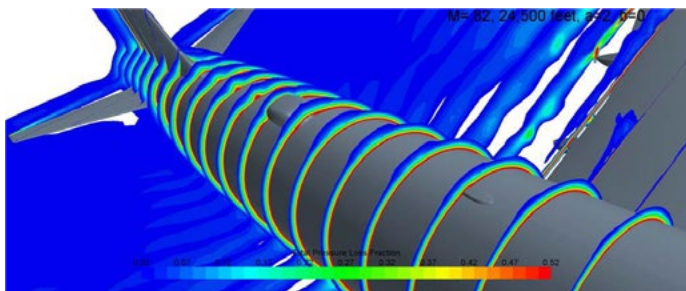


Figure 5 - Simulation numérique (Computational Fluid Dynamics)

This analysis was then supplemented by physical tests on the aircraft (certification tests) that took place with the aircraft on the ground (ground tests) and in the air (flight tests).



Figure 6 - Avion « Prototype » prêt à démarrer les essais en vol

The approval of this dossier, with the various analyses, tests and configurations to be taken into account (different aircraft skin





thickness values, Wi-Fi interfaced with various IFE systems already installed onboard or aircraft already equipped with A791-compatible reinforcement) took place over nearly two years.

The physical modification of aircraft in the fleet started in August 2018 and should last until March 2021. In total, 114 aircraft will eventually be equipped with this new onboard Wi-Fi system. You may already have used the "Air France Connect" service (email, instant messaging and full internet), as the airline is already offering this service on the first modified aircraft!

From another viewpoint, to retain their competitive edge with increasingly demanding customers, operators will also look to overhaul their cabin interiors to offer their customers flight experiences that are increasingly comfortable and more entertaining. This is currently the case for Brussels Airlines and its upgrading project for its long-haul service with a total reconfiguration of seven A330-300s, amounting to several million euro per aircraft.

AKKA Technologies (Aeroconseil) was the special partner for these operations and helped the operator during the whole design phase for the new cabin to guarantee the correct qualification and integration of the various systems created specifically for this project. Whether for new business seats with electrical positioning and a massage system, the development of premium and economy seats towards better weight/comfort standards, the design of new galleys integrating Nespresso® machines or the integration of new colour LED atmosphere lighting, AKKA was at the centre of these technical specifications for the various suppliers of this cabin equipment. Beyond this, AKKA also integrated the new latest generation passenger entertainment system with touch screens and USB charging sockets and 115v AC power in the seats, and the provision of an innovative WAP (Wireless Access Point) enabling customers to individually stream their personal media content on their seat screen.



Figure 8 - Business Class Brussels Airlines (Source: press. brusselsairlines.com)



Figure 9 - Premium Economy Class Brussels Airlines (Source: press. brusselsairlines.com)

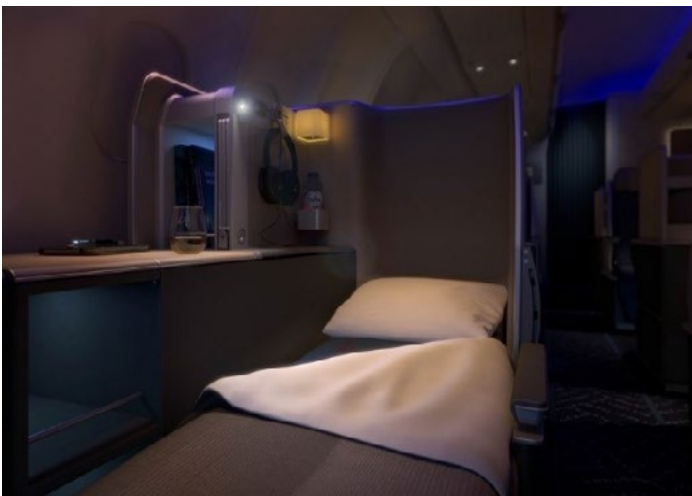


Figure 7 - Business Class Brussels Airlines (Source: press. brusselsairlines.com)



Figure 10 - Business Class Bar Brussels Airlines (source: press. brusselsairlines.com)

This type of modification generally involves various combined skills as various aircraft systems are affected (oxygen, electrics, potable water, drainage, etc.) as well as structural items and passenger and crew safety aspects. Around one hundred requirements were demonstrated, with two covering innovation aspects such as cybersecurity being created especially for the project. Therefore, various justification means were also used here, such as calculation analyses, but also various tests performed on the equipment itself (9g static strength tests, 16g

dynamic structural tests, material flammability tests, environmental tests, etc.) or directly on the aircraft (electromagnetic interference tests, functionality test, etc.). These major cabin reconfigurations also require a final inspection of the aircraft to demonstrate compliance with passenger protection and evacuation requirements. These inspections also ensure the correct positioning of safety instructions and limitations, guarantee that crew procedures are not affected and, finally, state that the aircraft is safe for operations with respect to minimum certification requirements.

Beyond the technical challenges that may appear in the design and certification of these retrofit solutions, offering them by increasingly short deadlines so as to minimise the time the aircraft are immobilised on the ground is also a huge challenge. Whilst type development will take several years, all these modifications take place over very short time periods, from a week to a year for larger projects, which generates a significant dynamic that needs to be controlled.

Remember that in addition to the time required for the technical development of the solution, you also have the time required for coordinating the various stakeholders. Each component of the end solution is usually developed by different suppliers, so the role of the DOA as an integrator is also to ensure that everything can be integrated perfectly on the aircraft and show that it will all be functional and compliant, taking account of the correlation several items of equipment may have as regards a single system. At the same time that design advances, compliance demonstrations must validate the design choices and it is therefore also necessary to coordinate exchanges with the approval authorities and foreign local authorities when the aircraft must also subsequently be exported.

At the end of the day, a modification project may require various technical and organisational aspects, and when there are limited deadlines and resources, we have to be able to offer innovative ideas to meet customer requirements and, above all, remain able to demonstrate compliance with regulatory requirements.

This is absolutely indisputable, because the basis of our profession is, and always will be: Safety First.



## THE AUTHORS

**Jennifer PERIN IENAC13T**

&

**Jean-Yves BELANGER IENAC96T**

Certification and airworthiness engineers  
Akka Technologies – Aircraft Modifications Department, DOA  
EASA.21J.039 & DAO TCCA #18-Q-01





# LUXAIR HAS DEVELOPED ITS VERY OWN ELECTRONIC FLIGHT BAG

**A**fter 2 years of development, Luxair Luxembourg Airlines equipped their aircraft with their own Electronic Flight Bag in 2015.

The Electronic Flight Bag was an internal project carried out entirely by Luxair teams and initiated by Christophe Destombes, Luxair pilot and engineer. The Electronic Flight Bag's development, successful testing and certification by the Luxembourgish Directorate General of Civil Aviation was made possible due to the collaboration and professional expertise of flight engineers, pilots and staff in charge of managing Luxair flight operations.

The Electronic Flight Bag brings together all the interactive flight information that was previously available in paper format (maps, routes, weather reports and charts, aircraft loading plans, airport notifications, passenger lists etc.) in an electronic system directly linked to the aircraft providing pilots with instant access to data. Cabin crew can also access their specific data via a tablet connected to the

Luxair network. Documentation is collected automatically from official sources in real time.

This solution is supposed to improve flight operations by providing quick and reliable access to flight data, whilst considerably reducing weight and the use of paper. Flight parameters and aircraft performance may be optimised, thanks to direct interaction with Luxair flight operations control systems, which allows data to be sent to the pilots instantly via digital updates to information available on systems in the aircraft cockpit. This system has enabled fuel savings of 200,000 litres per year and has had a significant impact on Luxair's efforts to reduce its CO2 emissions.





# CERTIFICATION DURING OWNERSHIP CHANGE



REGIO LEASE is an EASA approved CAMO and one of the world leading company in providing aircraft asset transition solution and airworthiness certification support to Leasing companies, Banks, and Airlines. Regio Lease has a wide range capability on its certificate and deals with the most popular commercial aircrafts such as Airbus, Boeing, Embraer, ATR and Beechcraft.

Considering the aircraft situation and ownership structure, Regio Lease suggests the customer the most suitable option to ensure a smooth and cost effective transition. This support can be provided for aircraft between leases, transition between the aircraft owner (Lessor) and operator (airline) or, only for Airline to assist them with the induction of an additional aircraft in their fleet. Various Registry for temporary registration can be used such as a French temporary register (F-W), US register (N-), Isle of Man (IOM) or even Guernsey register (2REG) as well as many others over the world to ensure the most efficient service. The use of a registry

is closely linked to the situation we have identified and the applicable jurisdiction (FAA, EASA or others) where the Aircraft will be operated or export/import.

The jurisdiction will be the main key driver for the selection of a Registry. As such the transition process to or from an EASA member states will require an Airworthiness Review Recommendation issued by a CAMO (PART M as per the EASA regulation) with the privilege "I". Privilege "I" allows Regio Lease to made recommendation for an Airworthiness Certificate renewal or for an aircraft EASA Import or Export.

The recommendation issued by Regio Lease consists of an exhaustive review of the aircraft maintenance records and a physical inspection to ensure the Aircraft has been maintained in accordance with the EASA requirements but also for confirming the Aircraft complies with the Air Ops regulation according the area where the aircraft is to be operated.

Several Air Ops requirements are coming into

force next year or became already mandatory few months ago. This requirements must be verified for compliance when importing an aircraft in EASA such as the LF-ULD (Low Frequency Underwater Locator Device). LF-ULD are devices that emit acoustic pulses permitting authorities to locate aircraft wreckage when an accident happens in oceanic areas.

Particular attention is to be made also on the modification embodied and repairs performed. Specific rules applies considering the aircraft manufacturer and organisation which designed the modification or repair to be embodied. As an example an Airbus A320 or ATR42/72 (EASA product) under FAA registration cannot be imported in the EASA if an FAA major modification has been embodied and doesn't hold any EASA approval, same as if Boeing product under EASA registration if an EASA major modification has been embodied and doesn't hold any FAA approval.

However thanks to a bilateral agreement import of a Boeing (FAA product) aircraft

## CERTIFICATION PATHWAY OF B3501



The plane during its exploitation in Austria (EASA)



The plane returned to US registration when it went on sale (FAA)





Expertise and consultancy office of the French civil aviation, we provide support in the fields of regulation, safety oversight and air navigation

# NEW

FRACS is now managing the ATD databases in partnership with ENAC

## Our Data Since 1970



### Airlines (600+/year)

- Finances
- Traffic
- Fleet



### Traffic flows (50000+/year)

- Passengers by route



### Airports (2500+/year)

- Movements
- Passengers
- Cargo

## Our Services

### Providing Statistical Data

- ✓ Selected according to your needs
- ✓ Reliability always checked (Multi-sources)
- ✓ Delivered ready to be used (Formats excel, csv)

Several commercial offers are available to be the closest to your needs

You are welcome to contact us for a personalized quote or more information!

*In addition to these business services, we will continue to support researchers, students and staff of ENAC and DGAC by providing them the data they need for their work! (do not hesitate to come and meet us at the Villa Voisin on the ENAC campus)*

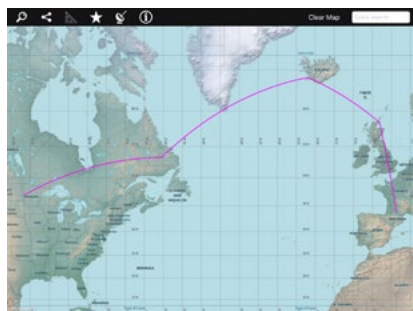
Contact : [atd@fracs.aero](mailto:atd@fracs.aero)

Website : [fracs.aero/products-and-services/#atd](http://fracs.aero/products-and-services/#atd)

with FAA modification is automatically accepted. These rules will also apply for importing an Aircraft in an FAA jurisdiction i.e. All EASA major modification on a Boeing product would require an FAA approval for operation in the USA.

Others situation leads Regio Lease to select other non-EASA member Registry. Several airlines bankrupts these last three years and the needs to support in the most efficient way the leasing company to ferry out and secure their asset dramatically increased. This years Regio Lease handled 15 repossession this year with temporary registrations due to Airlines falls. Most of these aircraft are now placed under the Regio Lease CAMO controlled and inducted in a storage program or are planning to be redelivery to a next Operator after undergoing heavy maintenance and a full records review to meet the next contractual deliveries conditions and potential loss of records during the repossession process.

Through an extensive experience and close relationship with several Aviation Authorities, Regio Lease is able to offer a tailored support for all type of operations in various complex environment with the aim to support their customers with efficient and cost effective options.



FW conveying from Fargo to Toulouse



The plane in FW registration passing through Goose Bay



The plane operating under the French flag (EASA)



# ALUMNI INTERVIEW

## PATRICK MORERE // IENAC98S

### CERTIFICATION, WHAT'S THAT?

When I was asked to write this article, I set myself the challenge of explaining my job to someone who knows nothing about the subject, trying to keep it simple but without leaving anything out. It wasn't easy...

#### So what is certification? And what's the point of it?

When we talk about certification, it's easy to imagine a horde of austere-looking folk in suits and ties writing incomprehensible rules. But you'd be wrong!

First of all, the aim of certification is to ensure aircraft safety, so that each passenger who boards an aeroplane can do so without risking their life.

So, to ensure this safety, rules were needed to apply to all aircraft manufacturers, and organisations to keep these rules up to date and to make sure they're adhered to. In Europe, this task is entrusted to the European Aviation Safety Agency (EASA), based in Cologne.

#### How's it applied, concretely?

Concretely, any aircraft manufacturer (or entity working on aircraft) must abide by a certain number of rules. First of all, it must get approval to design aircraft (Design Organisation Approval or DOA). The requirements of a DOA are listed in Part 21.

Among other things, Part 21 lays out the rules to follow in terms of organisation and procedures.

Each DOA holder must meet the requirements of Part 21 and apply them in its organisation. It's worth noting that every aircraft manufacturer must have a DOA, but certain companies that aren't manufacturers also hold a DOA in order to make modifications to aircraft in service, for example.

A DOA hinges on certain key positions, and on a design manual.

This approval is regularly monitored by EASA, which carries out regular audits.

#### And what about the aircraft themselves?

An aircraft (aeroplane or helicopter) being built for the first time will have to meet a certain number of certification requirements. These requirements are grouped into Certification Specifications (CS) that differ based on the type of aircraft.

For big transport planes, such as those made by Airbus or Boeing, it's CS25 that applies; whereas for smaller aeroplanes with less than 19 seats, it's CS23. For helicopters, it will be CS27 and CS29, and so on.

These Certification Specifications cover all areas that can impact aircraft safety, such as its structural soundness, behaviour in flight, engine system, piloting systems, cabin safety, and many other aspects.

Once it's been demonstrated that a new aircraft meets all the certification specifications, it gets a type certificate attesting to its airworthiness. This certificate is the fruit of a joint labour between the manufacturer and EASA.



Later on in its service life, the aircraft will be modified, upgraded, reconfigured. These modifications to the type certificate are only possible provided the airworthiness of the aircraft is maintained. The term for this is Supplemental Type Certificate (STC) if the modification is carried out by the manufacturer (holder of the TC) or indeed by someone else. Any entity (manufacturer or other DOA holder) wanting to modify an aircraft must demonstrate that it's still airworthy post modification. Concretely, it will need to meet the applicable certification requirements for the nature of modification in question.

For example, if a DOA holder wishes to install WiFi on an aircraft, by adding a satellite antenna and a system for making WiFi available in the cabin, it will have to demonstrate that the new antenna does not affect the aircraft's structural soundness, and that the WiFi doesn't cause interference problems with other onboard systems.

This is proven by analyses (e.g. structural analyses), tests (e.g. non-interference tests), operational tests (flight and ground tests), etcetera.

#### And what's my job, among all that?

All these activities represent the core of aircraft certification, and thus the core of my practice. I'm currently working

in the airworthiness department of Daher Aerospace, manufacturer of the TBM, a high-performance turboprop aircraft.

In the past, I've worked for a DOA-holding company (PMV Engineering) that carried out modifications to "big planes".

The airworthiness department of a DOA holder is tasked with ensuring that the aircraft under its responsibility are airworthy. To do so, they call on technical experts with perfect mastery of the certification requirements. These experts are called Compliance Verification Engineers (CVE). CVEs are duty-bound to remain entirely independent and put safety first.

As well as these activities, a DOA holder must guarantee to maintain airworthiness in relation to any incidents occurring in service, and propose corrective actions as necessary. In certain cases where flight safety is at stake, an airworthiness directive may be published by EASA, obliging operators (airlines or owners) to apply the corrective action within a set timeframe.

To sum up, certification is a vast area involving many stakeholders and challenges, a far cry from the unappealing image that you might have at first!







# IT HAPPENS AT ENAC



## BUDDY PROGRAMME

The buddy system, established in 2016 by the "Study Abroad Office (DER/PPP)" and coordinated by Véronique Zavan, puts a French ENAC student in contact with a student on an academic study abroad programme for 1 or 2 terms or studying for a dual-qualification, to help with their integration at ENAC and in Toulouse (welcome, outings, sports, French language help, etc.).

For a more accurate idea of what a buddy programme is, visit the ENAC International Club website, created in 2019, where there is a whole section dedicated to it: <http://bit.ly/2RknF0z>.

The Buddy Programme would like to thank you in advance for taking part and for kindly supporting an international student.

## ENAC AT THE ICAO SYMPOSIUM



The 6<sup>th</sup> ICAO symposium on training, the "Global Aviation Training & Trainair Plus Symposium", took place in New Delhi from 4 to 6 December 2019 on the topic of "Innovative training for New Horizons". Represented by Nicolas Cazalis, Deputy Director General, ENAC presented the essential role of research in innovation and the continuous improvement of our training, whether academic or vocational. Through real examples, we showcased the quality of our training and research activities to all the professional global aviation training stakeholders.

## SIGNATURE OF THE UAF & FA/ENAC AGREEMENT



ENAC and the UAF & FA (Union of French and Associated French-speaking Airports) signed a cooperation protocol on 7 November 2019.

The aim of this agreement is to strengthen the ties between the two organisations in various areas:

- Sending the ENAC work placement offer to the whole UAF & FA network
- Welcoming trainees within French and French-speaking airports
- Recruiting young ENAC graduates
- Having ENAC teachers take part in the UAF & FA technical committees.

The first example of this cooperation and its potential will become evident at the end of the first quarter of 2020, with the online publication of a remote training module on the assessment and communication of the runway surface condition.





## ROBAFIS 2019: A VICTORY FOR ENAC!

On 3 and 4 December 2019 in Pau, a team of student engineers from ENAC won the RobAFIS robot contest, coming first out of the ten teams in the competition. RobAFIS is an annual contest organised by AFIS (French Systems Engineering Association), open to students from engineering schools, masters programmes and specialist masters programmes.

The aim is to create an autonomous robot from a Makeblock ultimate Robot Kit, to best perform a number of tasks defined in specifications provided by the organisation.

The RobAFIS contest is an excellent opportunity for students to put the various engineering techniques taught from their first year at ENAC into practice, and is part of the synthesis project of the Systems Engineering course offered to student engineers in the SITA major in their third year.

Classed third at the end of the operational trials, ENAC won first place in the general classification (ahead of INSA), by presenting the best technical dossier. This first place (which came with a prize of €2,000) shows the excellence of our students and the expertise of the school as regards complex systems engineering training.

Well done to the IENAC 17 team, SITA option (systems engineering):

- Imane Laanaiya
- Marie Gourvennec
- Thibaud Pereira
- Paul Watfeh

## SUCCESS FOR THE ENAC OPEN DAY !



With 3,299 visitors this year, the figures almost doubled compared to the 2018 event! We can therefore declare that this day was a great success! Young people and their families from all over France and even abroad came to discover the campus and attend conferences and demonstrations and receive explanations and advice from various teams of teachers and researchers, as well as around 100 students from all year groups who worked together to make this day a success. All disciplines taught at ENAC and the professions they lead to were represented. The interactions between students, trainers, teachers, researchers, alumni and visitors were very exciting during the presentations! The hard work and responsiveness of all volunteers was palpable, and it was clear they were happy to represent ENAC!

## LAUNCH OF HANDITUTORAT



As part of the "Donnez des ailes à votre avenir" [give your future wings] initiative, ENAC is providing a "Handitutorat" (disabled-tutoring) programme. In partnership with Sopra-Steria, volunteer ENAC students will support disabled sixth-form students at the Lycée Pierre Paul Riquet in Saint Orens de Gameville. The aim is not only to provide educational support to help these young people work towards their baccalaureate and higher education, but also to provide interpersonal support to help them build confidence. For our students, this is also an opportunity to gain new skills for their future careers as managers. ENAC volunteers have been trained and will be supported throughout the year by Sopra Steria and one of its HandiManagers.





# BACK TO THE ENAC GALA





# FONDS DE DOTATION

## ATR and Egis induction on the ENAC's donor wall



*Wednesday, November 20, 2019, ATR and Egis induction on the ENAC's donor wall was celebrated. On this occasion, the ENAC Foundation and ENAC Alumni invited the Alumni working in these two companies to visit ENAC and share this moment. Olga Renda-Blanche, Human Resources Director at ATR, and Julien Pratx, Key Account Director at Egis, were the company representatives, welcomed by Olivier Chansou, ENAC President, Eric François, President of the ENAC Foundation and Michaël Benhamed, ENAC Alumni Vice President.*

### A special thanks to faithful ENAC partners

Egis and ATR have been historical partners of the school and have also been donors of the ENAC international scholarship programme respectively since 2016 and 2018. Thanks to their support, ENAC students benefit from financial assistance each year to facilitate their international experience.

In addition, Egis is a faithful contributor of a major event organised at ENAC: the "Assises de l'Aéronautique et du Développement Durable" (the Aeronautics & Sustainable Development Symposium). This event has twice brought together the most important players in the field, and has been a real source of knowledge for ENAC students. It has also given them a new perspective on the major challenges ahead

in terms of the environment and sustainable development in aeronautics.

More recently, ATR has chosen to support the "Solidarité Sénégal" project led by ENAC alongside the association "Un Morceau de Ciel Bleu" and ASEPMA, and coordinated by the ENAC Foundation. This project is part of the joint action of ATR and ENAC to promote gender equality and the internationalisation of human resources profiles. Its objective is to provide the resources and support the students of Mariama Bâ, a girls high school on the island of Gorée (Senegal), for the creation of an aeronautical club. The aim, in the long term, is to create a "Certificate of Introduction to Aeronautics".

The inclusion of these two companies in the Donor Wall is a recognition from ENAC and its Foundation for their continued support. This

gives them access to the "Silver Circle" of ENAC Foundation donors.

### A guided visit and two Alumni testimonials

The event allowed ENAC graduates to return to their school and see its recent changes. They were able to discover the new ENAC library and the ACHIL research platform, dedicated to Human-Machine Interactions in aeronautics (air traffic control and piloting) and to attend demonstrations of these research projects. This friendly exchange time was also an opportunity for two of our Alumni to give an inspiring testimonial of their career since graduation: Zuzana Hrnkova, VP Marketing at ATR and Christian Le Goer, Head of the Systems Implementation division at Egis.





# GRADUATION







# CEREMONIES 2019

