



The Future of Airports

A Vision of 2040 and 2070

Topic No. 11: Human Resources and Education

White Paper

ENAC Alumni – Airport Think Tank

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Foreword



In February 2019, ENAC Alumni – the alumni association of the National University of Civil Aviation (ENAC) – organized a day of discussion and education on the current and future challenges in air transportation: **The State of the Air (“Les Etats de l’Air”)**. This event, held at the headquarter of the French General Directorate for Civil Aviation (DGAC), was part of a broader effort to fulfill some of our primary missions toward our 24,000 members: to maintain their knowledge up to date, to provide them platforms where to express and exchange ideas, and to promote excellence in aviation & space.

In addition to master classes on Airports, Aircraft and Systems, Design & Certification, Airline Operations, Air Traffic Management, Aircraft Maintenance, Pilots & Flight Operations, Safety & Compliance, and Entrepreneurship, **the State of the Air** featured a series of roundtables bringing together key leaders of the industry in the sectors of air transportation, tourism and general aviation who presented their vision of the future.

Following the large success of the State of the Air, and considering the dedication and expertise of our alumni, it has been decided to take the momentum and invite our think tanks to launch projects on the future of aviation. These think tanks reflect the diversity and excellence of our alumni community: air traffic management, airline operations, airports, digital innovation, and sustainable development.

The Airport Think Tank chaired by Gaël Le Bris is one of the most active of our research groups. The Future of Airports is an important study that brings a significant value added to help us foresee future challenges and prepare our industry for the changes to come. The participants of The Future of Airports have provided remarkable work. The output of the working sessions and the research findings are being released as white papers and other practice-ready materials that will be shared and brought to decision makers and leaders of both the public and private sectors worldwide. I am confident that the outcome of this Think Tank will be a huge move forward for the promotion and recognition of the ENAC Alumni.

Marc Houalla, President of ENAC Alumni

Introduction



From March 2019 to April 2020, the Airport Think Tank of ENAC Alumni conducted a research project on the long-term future of the airport industry: “The Future of Airports”. The project involved thought aviation leaders from diverse backgrounds and affiliations who looked at the trends and potentially disruptive changes, emerging transformational innovations, their impact on practice and their challenges for air transportation, and the needs in research, education, and policies for anticipating and facilitating these changes.

The future of airports cannot be envisioned without considering the future of our societies. At the 2040 and 2070 horizons of our study, we will count more fellow human beings than ever. Overall, we will be wealthier and more educated, and have a longer life expectancy. However, we will all face increased impacts from climate change that will put pressure on resources and communities, and might increase inequalities. We will have different social expectations. How can aviation address these new paradigms and continue to provide mobility?

First and foremost, we shall never forget that safety always comes first. As we are making air transportation increasingly automated and connected, we shall remember that our top priority must be to safeguard life, health, and property, and to promote the public welfare.

Human-induced climate change is the most formidable threat to our civilization. Transportation must become greener if we want to sustain the development of our societies without degrading our well-being and endangering public health at a horizon increasingly visible. Aviation shall keep pioneering green policies.

As aviation professionals, we are on the front line to tackle the fundamental issues arising and still continue to interconnect people and move freight. Aviation shall remain a world of opportunities and “create and preserve friendship and understanding among the nations and peoples of the world” as stated in the Convention of Chicago of 1947.

By 2040 and 2070, it is likely that unforeseeable groundbreaking technological innovations, scientific discoveries, and social and political changes will occur and deeply impact our world. When reading these pages, remember that we conducted our work and prepared these materials with our eyes of 2019.

We are all part of this future, and we can make a difference individually if we make ethical and sustainable decisions. Aviator and writer Antoine de Saint-Exupéry said that when it comes to the future, “it is not about foreseeing it, but about making it possible”. Let’s make a bright aviation future possible together.

Gaël Le Bris, Chair of the Airport Think Tank of ENAC Alumni

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The World Changes and the Workplace as Well

Most of the job descriptions of 2040 and 2070 will include requirements and missions that do not exist today. 50 years or even 20 years ago, airports had no Community Manager or Safety Manager. They are now essential functions in modern airports. Technology is a big driver as well. For instance, Airport GIS created jobs and has proven itself to be an invaluable tool for others with applications from asset management to aeronautical information.^a Many vital jobs of the 2040 and 2070 horizons do not exist yet. Moreover, we might not even be able to imagine them.

The workplace itself is changing. Part of the jobs can now be performed from remote locations – including home – with the same or higher productivity. Virtual meeting rooms, document management, document sharing solutions, collaborative tools (e.g., BIM), and workflow management software are among the tools that can power partially remote organizations. These tools also allow employees to work on different projects and sites and have a better balance between their professional life and personal time without compromising work efficiency. This revolution will impact operational jobs as well. It already did it. For instance, ground handling operations are now supervised from hub control centers at several airports. Construction supervisors can be virtually present on a project site. Security perimeters can be inspected from a control center via automated vehicles and sensors. However, teams in the field will still be needed to resolve complex tasks where the machine is not proficient or expert enough, or where direct human interactions are required or preferred due to social choices and cultural acceptance. The most recent Airport Operations Centers (APOC) are good examples of this collaborative work between managers and coordinators at the APOC, systems, and sensors ensuring reporting, alert and assistance to decision-making, and teams in the field that are the arms of this organization and directly interact with the airport environment.

More generally, humans are social animals. They need to gather and share together. Well-being at work and a collaboration environment are keys to performance and efficiency. Being a “great place to work” is also important to attract and retain talents. Studies show that younger workers prefer having the option to work from home, but at the same time, they want a higher level of interaction with their coworkers and their management. The future cannot be about systems but about humans with more freedom and flexibility, interacting with each other and advancing at a faster pace thanks to the systems. Workers are increasingly giving importance to the values of their organization, the meaning of their work, the interaction with their management, the collaboration with their teammates and stakeholders, and the flexibility they can have in managing their daily routine.

Change and Knowledge Management will be Part of Regular Operations

As new technologies are constantly appearing and the succession of innovational breakthroughs is accelerating, we will need a new approach for change and knowledge management. Technological shocks similar to the first IT revolution that required generations to learn and transition to computers and information systems not so long ago will be more frequent. Freshly graduated young professionals might already have to start learning new vital skills shortly after leaving school. Organizations might have to adapt as well. Change management will be part of regular operations. Successful airports will identify these emerging changes early, evaluate their effects on existing conditions, and adapt their organization and train their staff. It would not be surprising to have full-time change manager positions at many airport and stakeholder organizations.

^a GIS that was theorized in the late 1960s but its application to airports is mainly a thing of the 21st century.

The next big revolution might be another “IT” revolution with the emergence of intelligence technologies. We are at the threshold of the introduction of artificial intelligence and machine learning on a large scale. Thinking about this second IT revolution as a modification of the way we interact with existing electronic devices and systems is missing the point. This will open a broad field of completely new applications and systems that we can barely envision as of today. Some of them will assist human operators. Some others might even replace human decision-makers. It will create new needs for specialists able to develop and maintain these systems, make sure they interact adequately, and interpret their output – such as what-if scenarios – for final decision-making. This is going to deeply change our interactions with our world, including the way we move, communicate, enjoy, consume and work.

A New Gold Rush to Skilled Workers and Subject Matter Experts

As a consequence, there will be a growing need for continuing education to align skills to needs. As we see major firms creating e-learning hubs accessible to their employees from their computers, this mode of acquiring new skills might become increasingly widespread and organized. Airport training centers are emerging as well for fostering mutual learning across the internal and external stakeholders – such as the “University of Services” of Groupe ADP, the Dubai Airport Launchpad, or the Universidade Infraero. Some of these programs might be developed in partnership with legacy aviation universities to connect these new knowledges to the forefront of the research. Smaller airports will most likely outsource to specialized continuing education firms or utilize the resource of larger airports – raising the question of the financial burden of such a challenge. Mutualization and support from professional organizations are already proven to be a good way to address this, such as AAIE in the United States with training solutions, including the ACE programs¹ or the C2FPA in France that provide training programs and facilities for airport firefighters^b.

Few universities in the world offer airport-specific programs to prepare the industry leaders of tomorrow. Remote learning and continuing education might fill part of the gap. However, some of the new skills that airports and their stakeholders will need at the 2040 and 2070 horizons might be so technically specific and out of their core business that outsourcing will be evident especially at smaller facilities. Most of the airport operators and aviation administrations will not be able to recruit and retain highly specialized experts able to master new critical tasks out of these core missions. Specialized firms and their subject matter experts will compete for providing the needed services. It is vital for the success of these collaborations that the specificities of airports are not missed by these experts. Aviation itself is an expertise, and moderators educated in aviation might be needed for helping future experts in these new technologies and processes to understand the needs of their aviation clients.

Let's close the gaps and get rid of biases once for all

Gender-based discrimination alone costs up to 12 trillion USD for the global economy – 16% of the global income. Women are historically underrepresented among the transportation workforce, and victim of biases during their career. Only 3% of the CEOs of the aviation industry are women, compared to 6.5% of all the Fortune 500 CEOs – which is still mind-blowing, considering that 49.6% of humans are females. However, pioneers have led the way for the next generations, and airport organizations are changing as well. Prominent female airport leaders among the top 10 busiest airports and major institutions include Angela Gittens, Director General of ACI World^c and former Director of ATL and MIA, Jamie Rhee, Commissioner of the Chicago Department of Aviation (CDA), Matrice Ellis-Kirk, Chair of the

^b C2FPA was founded in 2007 by a coalition of airport operators and The French-Speaking Airports (UAF&FA). Ownership was transferred to the private firm Groupe 3S.

^c Angela Gittens will step down from the leadership of ACI World in June 2020 after more than a decade serving this institution.

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Board of Directors of DFW Airport, and Deborah Ale Flint, former CEO of Los Angeles World Airports recently appointed President and CEO of GTAA.

Because the world is our guest, we must reflect on the diversity of our clients and our communities to remain competitive and innovative. A diverse workforce and management are crucial for embracing and addressing the complexity of the challenges to come. Diversity is not limited to gender and ethnicity, but it includes and is not limited to age, sexual orientation, special needs, cultural background, socioeconomic status, and non-airport or aviation experience. Studies have shown the clear benefits of diversity in organizations. Organizations with a diverse workforce are significantly more likely to achieve above-average financial returns.² Firms with a diverse management team generate 19% more innovation revenue than those with average or lower levels of diversity.³ Many leading airports now have a top executive manager in charge of diversity. They have also various initiatives for promoting diversity in their recruitment. However, they shall also ensure inclusion, with a diversity-friendly environment promoting fairness and mutual respect and assuring equal opportunities to everyone. Also, airports and their stakeholders should not be alone in this journey. They should ensure that their contractors and their supply chain embrace the same values and effectively implement diversity and inclusion programs.

While the 20th century fell short in delivering expectations of freedom, justice, and progress for all, we must not let this 21st century follow the same path. Our world cannot afford discriminations and biases. It is not only a question of fairness that should be enough to enact strong policies and effectively enforce them. It is also a matter of resilience of our societies while resources are becoming scarce, and our way of life is being challenged by threats that will strike blindly – even so, everyone is not necessarily equal facing them. Discriminations and biases do not only go against the very fundamental values of aviation that are expressed in the Convention of Chicago on Civil Aviation and are reflected in our diverse clients and workforces.^{d, 4} They prevent talents from emerging, innovations from blooming, and opportunities from coming true. To address the challenges of 2040 and 2070, let's close now these gaps and get rid of biases once for all.

^d The Preamble specifies that “the future development of international civil aviation can greatly help to create and preserve friendship and understanding among the nations and peoples of the world”.

Appendix 11-1 - Emerging and Potential Airport Jobs at the 2040 and 2070 Horizons

Job Title	Horizon of Emergence	Main Airport Stakeholder(s)	Potential Mutualization	Potential Outsourcing	Description
Database Specialist	2000	Airport Operator	Low	Medium	Database specialists support operations by organizing large amounts of data. They are responsible for making sure data is stored properly and backed up, while using necessary security measures so that the data remains protected.
Safety Manager	2004	All Stakeholders	Low	Low	The safety manager is responsible for providing guidance and direction for the planning, implementation and operation of the airport's Safety Management System (SMS).
CDM Manager (Airside)	2010	AO/ATCT	High	Low	The CDM Manager is the project/program manager of the A-CDM initiative appointed by the Steering Group. He is responsible for the implementation of A-CDM at the airport.
A-CDM Project Manager	2010	AO/ATCT	High	Medium	The A-CDM Project Manager is responsible for the management of the day to day airport project coordination between stakeholders.
Community Manager	2010	All Stakeholders	Low	Low	Community Managers serve as a public virtual face of the airport. They are generally responsible for managing and handling communications in both directions. Community Managers are involved in various activities such as communications, PR, social media, events, and content creation.
Climate Resilience Specialist	2015	Airport Operator	Medium	High	Climate Resilience Specialist is responsible for establishing a framework to design, operate and maintain facilities and systems to decrease their vulnerability to impact of climate change.
Big Data Specialist	2025	Airport Operator	Low	High	Big data Specialists are responsible for utilizing data analytics to evaluate an organization's or system's technical performance and providing recommendations on enhancements.
UAM Coordinator	2025	AO/ATCT	Medium	Low	UAM Coordinator coordinates with the stakeholders to establish a safe operational environment for the UAM traffic.
Airport Operations Planner	2030	Airport Operator	High	Low	Airport Operations Planner will be responsible for the establishment and continued updating of the Airport Operations Plan (AOP).
Personal Hosting Manager	2030	Airport Operator	Low	Low	Personal Hosting Managers at airports will be responsible for managing the airport hosting programs and their customized services to passengers – e.g., personal shoppers, customized offers, etc.

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Job Title	Horizon of Emergence	Main Airport Stakeholder(s)	Potential Mutualization	Potential Outsourcing	Description
CDM Manager (TAM)	2030	Airport Operator	High	Low	The CDM Manager is the project/program manager of the A-CDM initiative appointed by the Steering Group. He is responsible for the implementation of a broader Total Airport Management at the airport.
Proactive Cyberdefence Mgr.	2030	All Stakeholders	Medium	Medium	Proactive Cyberdefence Managers will develop security systems, analyze current systems for vulnerabilities, identify potential threats, prepare for future attacks and reconfigure the IT infrastructure in consequence, and handle any and all cyberattacks at the airport in an efficient and effective manner.
Blockchain Specialist	2030	Airport Operator	Low	High	Blockchain Specialist will develop blockchain based solutions for airport business and management purposes.
AI & Machine Learning Specialist	2035	AO/ATCT	Low	High	IT professional specialized in developing Machine learning, a branch of computer science that focuses on developing algorithms which can “learn” from or adapt to the data and make predictions.
Knowledge Manager	2040	AO/ATCT	Low	High	HR professional specialized in handling knowledge management programs including the identification of present and future organizations’ needs, analyzing gap with current individual knowledges and skills, and the definition and management of training programs for addressing these gaps.
Meta-CDM Job-Related	2040	AO/Airlines/GND	High	Medium	All jobs related to the Collaborative Decision Making of multimodal and efficient transportation from, to, and at the airport.
Spacecraft Operations Manager	2040	AO/ATCT	Medium	Medium	Spacecraft Operations Manager will be responsible for the management of scheduling and logistics of passenger and freight spacecraft operations.
Biowarfare Expert	2070	Airport Operator	Medium	High	Biowarfare Experts are responsible for the protection from the threat of biological weapons of mass destruction.
Complex Fleet Mix Expert	2070	ATCT	Medium	High	Complex Fleet Mix Experts will be responsible for analyzing and addressing the impact of new additional fleet mixes at the airport on all the aspects of airport operations.

Appendix 11-2 - Selected Higher Education Programs in Airport

University	Campus, Country	Program	Level
Purdue University	West Lafayette, Indiana, USA	Airport Management and Operations	Bachelor's Degree
Florida Tech	Melbourne, Florida, USA	Airport Development and Management	Master's Degree
Ecole Nationale de l'Aviation Civile (ENAC)	Toulouse, France	Aviation Engineering, Advanced Masters in Airport Management, ATM and ANS	Master's Degrees
Instituto Tecnológico de Aeronáutica (ITA)	São José dos Campos, SP, Brazil	Engenharia de Infraestrutura Aeronáutica	Master's Degree / Ph.D.
Cranfield University	Cranfield, England	Airport Planning and Management	Master's Degree
University of West London	West London, UK	Airline and Airport Management	Bachelor's Degree
City University of London	Northampton Square, UK	Airport Management	Master's Degree
University College of Birmingham	Birmingham, UK	Aviation and Airport Management	Bachelor's Degree
Vaughn College	Queens, New York, USA	Airport Management	Bachelor's Degree
Everglades University	Boca Raton, Florida, USA	Aviation / Aerospace Concentration in Airport Operations Management	Bachelor's Degree
University of North Dakota	Grand Forks, North Dakota, USA	Airport Management	Bachelor's Degree
Modern College of Business and Science	Oman	Airport Management	Bachelor's Degree
Civil Aviation University of China	Tianjin, P. R. of China	Aviation Engineering, Air Traffic Management, Air Navigation	Master's Degree / Advanced Masters
Southern New Hampshire University	Manchester, New Hampshire, USA	Aviation Management (BS) Concentration in Airport Mgmt.	Bachelor's Degree

Important: This table is not an exhaustive inventory of airport-related academic programs. It provides a short-selection of higher education programs with a major or concentration in airports for illustrative purpose.

Abbreviations

ACRP	Airport Cooperative Research Program
AI	Artificial Intelligence
AMS	Amsterdam Airport Schiphol
ATAG	Air Transport Action Group
ATC	Air Traffic Control
ATL	Hartsfield-Jackson Atlanta International Airport
AV/CV	Automated Vehicles/Connected Vehicles
BREEAM	Building Research Establishment Environmental Assessment Method
CAGR	Compound Annual Growth Rate
CDG	Paris-Charles de Gaulle Airport
CDM	Collaborative Decision Making
DFW	Dallas-Fort Worth International Airport
DOK	Donetsk Airport
EASA	European Aviation Safety Agency
ENSO	El Niño–Southern Oscillation
FAA	U.S. Federal Aviation Administration
FAB	Força Aérea Brasileira
FAB	Functional Airspace Block
FIT	Florida Institute of Technology
GANP	Global Air Navigation Plan
GASeP	Global Aviation Security Plan
GASP	Global Aviation Safety Plan
GBI	Green Building Index
GRU	GRU Airport / São Paulo/Guarulhos–Gov. André Franco Montoro Intl. Airport
GTAA	Greater Toronto Airport Authority
GTC	Ground Transportation Center
HCC	Hub Control Center
HKG	Hong Kong International Airport
HOV	High Occupancy Vehicle
HST	High Speed Rail
IAD	Washington Dulles International Airport
IATA	International Air Transport Association
ICAO	International Civil Aviation Organisation
Infraero	Empresa Brasileira de Infraestrutura Aeroportuária
IoT	Internet of Things
IPCC	Intergovernmental Panel on Climate Change
IST	Istanbul Airport
JFK	John F. Kennedy International Airport
KIX	Kansai International Airport
KUL	Kuala Lumpur International Airport
LAC	Latin American and Caribbean
LAMP	Landside Access Modernization Program
LAWA	Los Angeles Airport World
LAX	Los Angeles International Airport
LCY	London City Airport
LEED	Leadership in Energy and Environmental Design

LGA	New York LaGuardia Airport
LGP	LaGuardia Gateway Partners
LGW	London Gatwick Airport
LHR	London-Heathrow
LRT	Light Rail Transit
MaaS	Mobility as a Service
MIA	Miami International Airport
ML	Machine Learning
MRS	Marseille-Provence International Airport
MUC	Munich International Airport
MWAA	Metropolitan Washington Airports Authority
NEXTT	New Experience Travel Technologies
NFC	Near-Field Communication
NM	Network Manager
NOAA	U.S. National Oceanic and Atmospheric Administration
ORD	Chicago-O'Hare International Airport
ORY	Paris-Orly International Airport
PHL	Philadelphia International Airport
PPP	Public-Private Partnership
PPP	Purchasing Power Parity
PKX	Beijing Daxing International Airport
PRT	Personal Rapid Transit
RAM	Rural (or Regional) Air Mobility
RPA	Regional Plan Association
RPK	Revenue Passenger Kilometer
SAF	Sustainable Aviation Fuels
SAT	San Antonio International Airport
SARP	Standards and Recommended Practices
SDI	Space Data Integrator
SDL	Sundsvall–Timrå Airport
SES	Single European Sky
SFB	Orlando Sanford International Airport
SFO	San Francisco International Airport
SIIED	Surgically Implanted Improvised Explosive Device
SIN	Singapore-Changi International Airport
SJU	San Juan Luis Muñoz Marín International Airport
SMS	Safety Management System
SWIM	System Wide Information Management
TAM	Total Airport Management
TIP	Tripoli International Airport
TNC	Transportation Network Companies
TRB	Transportation Research Board
UAM	Urban Air Mobility
UATM	Urban Air Traffic Management
UTM	Unmanned Traffic Management
VAT	Value-Added Tax
VCE	Venice Marco Polo Airport
WGBC	World Green Building Council

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