The Future of Airports

A Vision of 2040 and 2070

Topic No. 9: Mobility and Communities

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

Topic No. 9: Mobility and Communities

Airports are Part of their Community

Airports do not have "surrounding" or "neighboring" communities. They are part of and a member of these communities. Airport communities can take different forms and meaning even at a single airport, depending on the matter. For the purpose of this paper, the concepts of inner and outer communities are defined. Their exact extend and composition might vary from an airport to another.

The inner community, in the direct vicinity of the airport, is exposed to specific, direct economic benefits but also negative externalities (higher noise exposure). The inner community includes cities where the airport is sitting on, and adjacent ones turned toward the airport because they depend on it economically or are directly exposed to its externalities. A key attention from the airport should be seeking a peaceful and mutually beneficial coexistence with its "neighbors". This could be achieved by helping them insulate homes and workplaces against noise when relevant and developing an adequate land use plan for allowing a fair and balanced development.

The outer community is served by the airport and may encompass its primary catchment area to include the macro-region. The outer community encompasses a large diversity of parties benefiting from or concerned by the airport. This includes local passengers flying their community airport, business and economic development community looking for a dynamic airport supporting them with more direct flights, local governments, and various agencies involved with the wide range of airport-related challenges and opportunities, etc. Its footprint could include the metropolitan area and a broader region, depending on the aspects considered. Large hub airports are gateways for entire regions and countries. Airports in remote and scarcely populated areas enable opportunities for vast territories.

Inner Community: Mitigating Adverse Impacts and Making the Airport a Center for Opportunities

The inner community of the future should be connected to and supported by its airport. Adverse impacts and in particular noise must be better taken into considerations in countries where land-use policies and insulation programs are not yet in place or enforced. But community issues go beyond the noise and pollution aspects that are developed further in Topic No. 10. Accessibility around an airport can be paradoxically an issue when all ground transportation is directed toward the airport and designed for draining passengers to other centers of residence, consumption, and decision. Airports should be an opportunity to better connect territories and communities – not to divide or isolate them further. Mobility on and around airports should be improved, and it can be a testbed for sustainable solutions to prevent negative impacts on local air quality. Airports such as Amsterdam Airport Schiphol or Zurich International Airport are exemplary regarding local mobility with multiple modes serving the airports and extending to communities around – especially bike lanes and bus services. At the airport itself, multimodal hubs and other Ground Transportation Centers (GTC) facilitate the connection between the airport and the local public transportation.

Airports increasingly promote a recruitment in their inner communities for fostering the integration of their population, reducing unemployment and providing opportunities for social mobility, and growing an airport-centric community. In return, a dynamic inner community can develop a whole ecosystem of small businesses that can ultimately be connected to airport-based activities and an airport trade center that will be served by various local services. This is a positive "aerotropolis"-like dynamic that can be fostered by an adequate holistic vision of airport strategic planning. Airports and local governments should work closely to make coordinated plans to achieve these objectives. Similarly, the airport and local long-term visions and plans should align or at least be consistent. This requires a continued partnership for success between their governances and a crossed involvement in their respective planning initiatives.

Ideally, the nearest and most exposed land around the airport should be prioritized for industrial, commercial, and greenspace purposes.

However, several airports around the world have residential areas in their immediate vicinity. They are often inhabited by lower income households – and voiceless communities in some parts of the world. Sometimes, these communities relocate around airports pushed away from their original settlements because of uncontrolled gentrification without the social justice component. Climate gentrification is an emerging issue that might make this phenomenon more severe. At the same time, the same lands around airports might become the target of industrial or business real-estate developers. This calls for a special attention to social justice in planning and development. Comprehensive and inclusive public involvement and community outreach are vital for ensuring a fair and just representation of the local population – and compensation when insulation or relocation are warranted. Local governments and airports can also be innovative. For instance, participatory democracy has shown great achievements at non-airport locations in the improvement of the quality of life, the development and beautification of neighborhoods, and the enhancement of the local political system[1] with residents being in charge of part of the decision-making process regarding future orientations and budget allocation.

Figure 9-1 - Inner and Outer Airport Communities

Outer Community: Achieving a New Mobility on the Ground and in the Air

One of the main challenges of the 2040 and 2070 horizons for airports serving large outer communities will be mobility. Virtually all major metropolitan areas are facing some kind of acute congestion symptoms. Moscow, Istanbul, Bogota, Mexico City, Sao Paulo, London, Rio de Janeiro, Boston, Los Angeles, Roma are among the worst cities in the world for the average accrued number of hours spent sitting in traffic annually. Accessibility has a direct impact on the attractiveness of airports as both transportation mode and workplace.

We are at the edge of a revolution in urban mobility, and airports shall embrace it in order to increase their attractiveness and their connectivity to their communities. Mass transit is being implemented in new cities, including countries that have been historically reluctant to fund public transportation systems. Bus Rapid Transit (BRT)[2] that emerged in the 1970s in Brazil and Canada is sometimes seen as a less expensive and more flexible alternative to light rail as it can leave the dedicated BRT lanes to extend services on shared roads.[3] High-speed or express (higher-speed) rail corridors are conquering new territories – such as Central Florida[a]. More direct trains are being built to connect airports to downtowns (e.g., Paris, São Paulo). Maybe closer to us than it might appear, automated and connected vehicles (AV/CV) will unlock new perspectives with widely available and accessible low-cost ridesharing that could even replace individual car ownership at some point. However, as AV/CV could optimize the utilization of roads through network coordination using artificial intelligence, they will not provide a relief to existing congestion as they share the ground-level resource available with existing modes and vehicles. AV/CV will replace or add vehicles to the existing traffic. If they are highly affordable, the AV/CV-based TNC offer might even seduce current users of mass transit, take revenues out of public transportation, and worsen congestion issues.

We have to rethink mobility and think out of the box to develop new capacities that are complementary to existing modes. In large cities that already have such systems but are still facing acute congestion issues, innovative modes are emerging. With the resource being scarce at ground level, they explore options underground and in the air. The City of Chicago has selected The Boring Company to implement a service of underground shuttles and individual car electric trailers based on its signature concept of Maglev-like electric skates[b]. More traditional metro might benefit as well from lower boring costs thanks to the technologies and processes developed by The Boring Company. Start-up developing hyperloop systems have proposed lines including airport stations. Urban Air Mobility (UAM) is promising as well for providing point to point connections from the airport. In some cities, waterboats and ferries might revive or increase services to airports. Venice (VCE), Boston Logan (BOS), London City (LCY) have active docks nearby. In large metropolitan areas, the future is most likely a combination of these urban mobility solutions – like it is often already the case – to address the demand.

Ultimately, the evolution of ground airport access has an impact on airport planning and development. All these different users (passengers, aviation and airport professionals, local residents) and modes need to converge at some point, and this can be achieved through multimodal centers that increase interconnectivity, mutualize resources, and make a better utilization of space. This diversity of modes leads to a higher demand in space and infrastructure on the landside. At many historical airports, expanding or redeveloping the immediate curbside area might be excessively costly and impactful to ground accessibility. A solution can be to create a reasonably remote Ground Transportation Center (GTC) connected to the airport by a people mover.

[a] Brightline/Virgin Trains USA plan to start express services to Orlando International Airport from South Florida via Cocoa starting in 2022.

[b] This concept has recently evolved toward a car-centric tunnel system used by electric AV/CVs equipped with alignemnt wheels.

From an operations stand-point, these new modes will have an impact on revenues. The rise of AV/CV and Urban Air Mobility could deplete airport parking garages. Passengers might ride to the airport using automated ride share vehicles ordered from their smartphones. Personal vehicles themselves could be replaced by some kind of fractional ownership alternatives. Airports have to anticipate this change that might be more impactful and brutal than the development of Transportation Network Companies (TNCs). They could consider levying a user fee for future on-request AV/CV drop-off and pick-up. Existing parking garages could be turned into heliport/vertiport for Urban Air Mobility (UAM), office spaces, or hubs and maintenance centers for AV/CV fleets.

Another operations aspect of these new modes is their compatibility with the future remote service that will be offered to passengers. For instance, it is possible in many large cities to check-in bags at the train station in downtown (e.g., Hong Kong, Kuala Lumpur). The practicality of some of these services can be hampered by other aviation-specific needs. In particular, the value proposition of modal options should not adversely affect safety and security.[c]

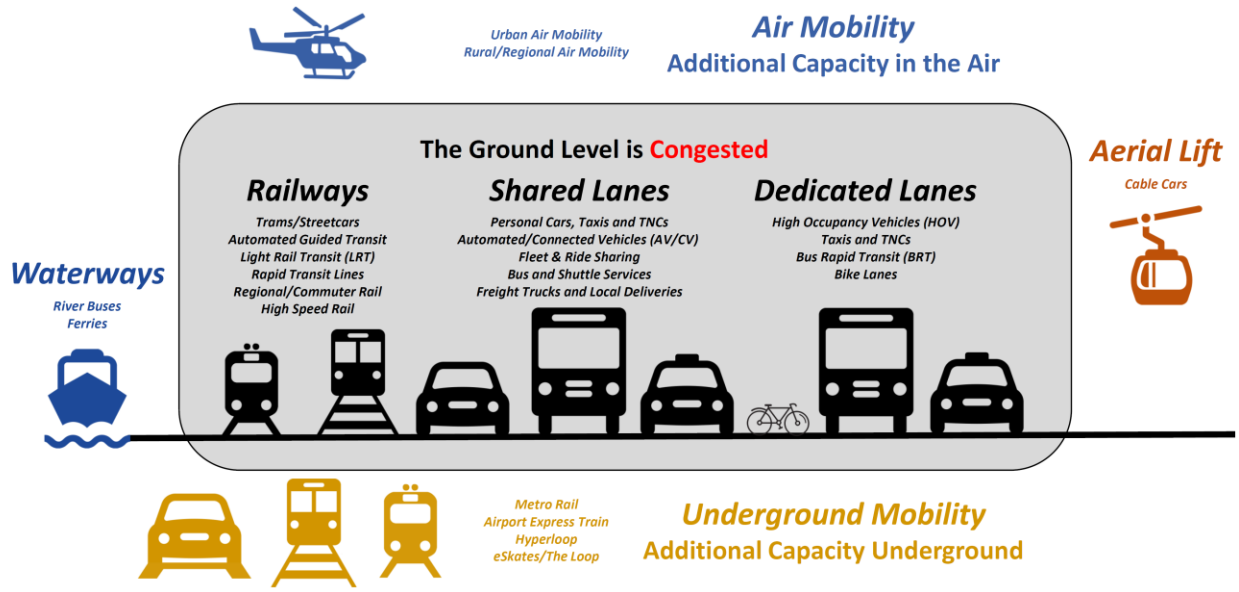

Figure 9-2 - Innovative Modes of Transportation Can Help Relieving Acute Urban Congestion

[c] From 1956 to 1980, the Silver Arrow rail-air service proposed to passengers between Paris and London to ride by train from Paris to Le Touquet–Côte d'Opale Airport (LTQ) and take a plane from there to cross the Channel. From a period of time, the train was stopping on the apron and passengers could walk straight to their plane. Such seamlessness cannot be achieved today as it might require additional safety and security nets.

Appendix 9-1 - Existing and Emerging Modes of Transportation to Airports

Mode of Transportation	Examples	EIS	Description and Opportunity for Airports
Direct Express Train	AirTrain-JFK Express (JFK), CDG Express (CDG), Heathrow Express (LHR), Gatwick Express (LGW), Flytoget (OSL), KLIA Ekspres (KUL), Skytrain (CGK)	1970s	Direct Express trains usually make a small number of stops, usually major destinations, allowing faster service than local trains that stop at most or all of the stations along their route. Airports utilize this mode of transportation for faster commutes for passengers, unlike the normal trains.
Metro Rail, Light Rail and Regional Train	Berlin U-Bahn (BER), Blue Line (ORD), RER B (CDG), CPMT Line 13 (GRU), OrlyVAL-RER B (ORY), TER (MRS), VLT Carioca Linhas 1 e 3 (SDU), SRT Dark Red Line (BKK)	1972	Light Rail is a form of passenger urban rail transit characterized by a combination of tram and metro feature. Utilization of light rail at airports will aid in the reduction of traffic congestion at the curbside of the airport and also reduce carbon emissions.
Bus Rapid Transit (BRT)	Linha 208 (CWB), Luton Busway (LTN), MICiTi (CPT), Transcarioca (GIG), Viva(Canada non-airport),	1973	BRT is a bus-based public transport system designed to improve capacity and reliability relative to a conventional bus system. BRTs are not new, but some regions of the world are not yet widespread to connect airport. Utilizing BRTs at airports would cut down the travel times for passengers to reach their destinations or get to the airports since they have dedicated bus lanes, and also will help in the reduction of carbon emissions.
Personal Rapid Transit (PRT)	T5-Parking (LHR), Morgantown PRT (non-airport)	1975	The PRT is a public transport mode featuring small automated vehicles operating on a network of specially built guideways. The PRT system in Heathrow will replace shuttle buses. This compared to the Airport Automated People Movers (AAPM) would result in short wait and trip times combined with seated travel to provide an exceptionally high level of service
High Speed Train (HST)	Brightline (Florida), ICE (Germany), TGV (France), InterCity 125 (Britain), Fuxing Hao Dolphin Blue (China), Haramain Western Railway(Saudi Arabia)	1964 (Shinkansen) 1994 (TGV at CDG)	High-speed Train (HST) is a type of rail transport that runs significantly faster than traditional rail traffic, using an integrated system of specialized rolling stock and dedicated tracks. This system can connect customers from one point to another as fast as air travel.
Maglev	Shanghai Maglev Train (SMT)	2002	Maglev is a system of train transportation that uses two sets of magnets, one set to repel and push the train up off the track, and another set to move the elevated train ahead, taking advantage of the lack of friction. With the use of Maglev in airports, it can connect passengers to their final destinations quicker and more efficiently compared to other modes of transportation.
Transportation Network Companies	Lyft, Ola Cabs, Snapp, Uber, Cabify (Spain), Taxify/BOlt (Estonia), Grab (Singapore), Gett (Israel), Ola (India), DIDI (China), Shebah (Australia), TappCar (Canada), Enshika (Ghana)	2017 (Uber)	They offer door-to-door, nonstop transportation at the request of customers via smartphone applications, or apps, that the companies offer and operate. They have increased the transportation options available to airport customers by expanding the menu of available ground transportation services and, offering a service that customers consider to be reliable, convenient, and comfortable
Autonomous Personal Vehicles	None	2025?	AVs are vehicles where some aspects of a safety-critical control function such as steering, throttle control or braking occurs without direct driver input. This will reduce traffic congestions and aid in climate control by reducing CO2 emissions

Mode of Transportation	Examples	Entry into Service	Description and Opportunity for Airports
Electric Skates and High-Speed Tunnels	The Boring Company "Loop" a.k.a. The Elevator (prototype)	2025?	A concept of vehicles transported through tunnels on autonomous electric skates capable of carrying cars and people at speeds of up to 125-150 mph. The most recent evolution of The Loop concept of The Boring Company does not feature electric skates anymore.
Urban Air Mobility	Blade, UberElevate	2025?	It is an on-demand and automated passenger and cargo air transportation services, typically without a pilot, also known as 'flying taxis'. This mode of transportation will add to the industry's stakeholder revenue, and also create more airport transportation jobs.
Vactrain/Hyperloop	Chicago Downtown-ORD (Project)	2025?	Vactrain/Hyperloop is a sealed tube or system of tubes through which a pod may travel free of air resistance or friction conveying people or objects at high speed while being very efficient, thereby drastically reducing travel times over medium-range distances. This may be an alternate option to air transport since it might be as fast or faster than flying.

Abbreviations

ACRP	Airport Cooperative Research Program
AHA	Aviation Hazard Areas
AI	Artificial Intelligence
AMS	Amsterdam Airport Schiphol
ANN	Artificial Neural Network
APOC	Airport Operations Center
APM	Airport People Mover
ATAG	Air Transport Action Group
ATC	Air Traffic Control
ATL	Hartsfield-Jackson Atlanta International Airport
ATM	Air Traffic Management
AV/CV	Automated Vehicles/Connected Vehicles
BVLOS	Beyond the Visual Line of Sight
CAG	Changi Airport Group
CAGR	Compound Annual Growth Rate
CAH	Capital Airport Holding
CDG	Paris-Charles de Gaulle Airport
CDM	Collaborative Decision Making
DFW	Dallas-Fort Worth International Airport
DGAC	Direction générale de l'aviation civile (France)
EASA	European Aviation Safety Agency
ENAC	Ecole Nationale de l'Aviation Civile
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
GMF	Global Market Forecast
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
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
MDAD	Miami-Dade Aviation Department
MEP	Mechanical, Electrical, and Plumbing
META-CDM	Multimodal, Efficient Transportation in Airports and CDM
MIA	Miami International Airport
ML	Machine Learning
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
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
TOSC	Technical, Operations & Safety Committee
TRB	Transportation Research Board
TRT	Turnaround Time
UAM	Urban Air Mobility
UATM	Urban Air Traffic Management
UTM	Unmanned Traffic Management
VCE	Venice Marco Polo Airport

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