

This PDF is available at <http://nap.nationalacademies.org/26813>



## The Future of Aviation (2022)

### DETAILS

50 pages | 8.5 x 11 | PAPERBACK

ISBN 978-0-309-69708-8 | DOI 10.17226/26813

### CONTRIBUTORS

Airport Cooperative Research Program, Federal Aviation Administration; Airport Cooperative Research Program; Transportation Research Board; National Academies of Sciences, Engineering, and Medicine

BUY THIS BOOK

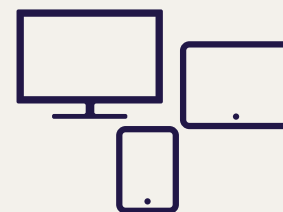
FIND RELATED TITLES

### SUGGESTED CITATION

National Academies of Sciences, Engineering, and Medicine. 2022. *The Future of Aviation*. Washington, DC: The National Academies Press.  
<https://doi.org/10.17226/26813>.

Visit the National Academies Press at [nap.edu](http://nap.edu) and login or register to get:

- Access to free PDF downloads of thousands of publications
- 10% off the price of print publications
- Email or social media notifications of new titles related to your interests
- Special offers and discounts



All downloadable National Academies titles are free to be used for personal and/or non-commercial academic use. Users may also freely post links to our titles on this website; non-commercial academic users are encouraged to link to the version on this website rather than distribute a downloaded PDF to ensure that all users are accessing the latest authoritative version of the work. All other uses require written permission. ([Request Permission](#))

This PDF is protected by copyright and owned by the National Academy of Sciences; unless otherwise indicated, the National Academy of Sciences retains copyright to all materials in this PDF with all rights reserved.

Conference Proceedings on the Web 29

# The Future of Aviation

*Proceedings of an ACRP Insight Event*

Mary Ellen Eagan  
HMMH  
*Rapporteur*

March 22–23, 2022  
National Academies of Sciences, Engineering, and Medicine  
Washington, DC

*Organized by the*  
Airport Cooperative Research Program

*Sponsored by the*  
Federal Aviation Administration

**NATIONAL  
ACADEMIES** *Sciences  
Engineering  
Medicine*

**TRB** TRANSPORTATION RESEARCH BOARD

Washington, DC  
2022

[www.TRB.org](http://www.TRB.org)

## Conference Proceedings on the Web 29

Transportation Research Board (TRB) publications are available by ordering individual publications directly from the TRB Business Office, through the Internet at [www.TRB.org](http://www.TRB.org) or [nationalacademies.org/trb](http://nationalacademies.org/trb), or by annual subscription through organizational or individual affiliation with TRB. Affiliates and library subscribers are eligible for substantial discounts. For further information, contact the Transportation Research Board Business Office, 500 Fifth Street, NW, Washington, DC 20001 (telephone 202-334-3213; fax 202-334-2519; or e-mail [TRBSales@nas.edu](mailto:TRBSales@nas.edu)).

NOTICE: This report has been reviewed by a group other than the authors according to the procedures approved by a Report Review Committee consisting of members of the National Academies of Sciences, Engineering, and Medicine. The members of the committee responsible for the project were chosen for their special competencies and with regard for appropriate balance.

This conference was organized through TRB's Airport Cooperative Research Program (ACRP) and sponsored by the Federal Aviation Administration. Any opinions, findings, conclusions, or recommendations expressed in this publication do not necessarily reflect the views of any organization or agency that provided support for the project.

© 2022 National Academy of Sciences. All rights reserved.

Printed in the United States of America.

Suggested citation: Transportation Research Board. *Conference Proceedings on the Web 29: The Future of Aviation*. Proceedings of an ACRP Insight Event. Washington, DC: The National Academies of Sciences, Engineering, and Medicine, 2022.

# NATIONAL ACADEMIES

*Sciences*  
*Engineering*  
*Medicine*

The **National Academy of Sciences** was established in 1863 by an Act of Congress, signed by President Lincoln, as a private, non-governmental institution to advise the nation on issues related to science and technology. Members are elected by their peers for outstanding contributions to research. Dr. Marcia McNutt is president.

The **National Academy of Engineering** was established in 1964 under the charter of the National Academy of Sciences to bring the practices of engineering to advising the nation. Members are elected by their peers for extraordinary contributions to engineering. Dr. John L. Anderson is president.

The **National Academy of Medicine** (formerly the Institute of Medicine) was established in 1970 under the charter of the National Academy of Sciences to advise the nation on medical and health issues. Members are elected by their peers for distinguished contributions to medicine and health. Dr. Victor J. Dzau is president.

The three Academies work together as the **National Academies of Sciences, Engineering, and Medicine** to provide independent, objective analysis and advice to the nation and conduct other activities to solve complex problems and inform public policy decisions. The National Academies also encourage education and research, recognize outstanding contributions to knowledge, and increase public understanding in matters of science, engineering, and medicine.

Learn more about the National Academies of Sciences, Engineering, and Medicine at [www.nationalacademies.org](http://www.nationalacademies.org).

---

The **Transportation Research Board** is one of seven major programs of the National Academies of Sciences, Engineering, and Medicine. The mission of the Transportation Research Board is to provide leadership in transportation improvements and innovation through trusted, timely, impartial, and evidence-based information exchange, research, and advice regarding all modes of transportation. The Board's varied activities annually engage about 8,000 engineers, scientists, and other transportation researchers and practitioners from the public and private sectors and academia, all of whom contribute their expertise in the public interest. The program is supported by state transportation departments, federal agencies including the component administrations of the U.S. Department of Transportation, and other organizations and individuals interested in the development of transportation.

Learn more about the Transportation Research Board at [www.TRB.org](http://www.TRB.org).

*The National Academies of*  
SCIENCES • ENGINEERING • MEDICINE

**Consensus Study Reports** published by the National Academies of Sciences, Engineering, and Medicine document the evidence-based consensus on the study's statement of task by an authoring committee of experts. Reports typically include findings, conclusions, and recommendations based on information gathered by the committee and the committee's deliberations. Each report has been subjected to a rigorous and independent peer-review process and it represents the position of the National Academies on the statement of task.

**Proceedings** published by the National Academies of Sciences, Engineering, and Medicine chronicle the presentations and discussions at a workshop, symposium, or other event convened by the National Academies. The statements and opinions contained in proceedings are those of the participants and are not endorsed by other participants, the planning committee, or the National Academies.

For information about other products and activities of the National Academies, please visit [www.nationalacademies.org/about/whatwedo](http://www.nationalacademies.org/about/whatwedo).

## Conference Planning Committee

Agatha Kessler, *Fentress Architects, Chair*

Angel Ramos, *AECOM*

Marianne Csaky, *LanzaJet (formerly with Alaska Airlines)*

Ken Davidian, *Federal Aviation Administration*

Basil O. Dosunmu, *Greenville–Spartanburg Airport District*

Aneil Patel, *Airports Council International—North America*

Amanda Simpson, *Airbus Americas*

## Transportation Research Board Staff

Joseph D. Navarrete, *Senior Program Officer*

Stephanie L. Campbell-Chamberlain, *Senior Program Assistant*

## ***Publications Staff for Conference Proceedings on the Web 29***

Natalie Barnes, *Director of Publications*

Heather DiAngelis, *Associate Director of Publications*

Janet M. McNaughton, *Senior Editor*

Jennifer J. Weeks, *Publishing Projects Manager*

Jennifer Correro, *Assistant Editor*

## TRANSPORTATION RESEARCH BOARD 2022 EXECUTIVE COMMITTEE\*

### OFFICERS

CHAIR: **Nathaniel P. Ford, Sr.**, *Chief Executive Officer, Jacksonville Transportation Authority, Jacksonville, FL*  
VICE CHAIR: **Shawn Wilson**, *Secretary, Louisiana Department of Transportation and Development, Baton Rouge*  
EXECUTIVE DIRECTOR: **Neil J. Pedersen**, *Transportation Research Board, Washington, DC*

### MEMBERS

**Michael F. Ableson**, *CEO, Arrival Automotive–North America, Detroit, MI*  
**James F. Albaugh**, *President and Chief Executive Officer, The Boeing Company (retired), Scottsdale, AZ*  
**Douglas C. Ceva**, *Vice President, Customer Lead Solutions, Prologis, Inc., Jupiter, FL*  
**Marie Therese Dominguez**, *Commissioner, New York State Department of Transportation, Albany*  
**Ginger Evans**, *President, Tower Consulting, LLC, Arlington, VA*  
**Michael F. Goodchild**, *Professor Emeritus, Department of Geography, University of California, Santa Barbara*  
**Diane Gutierrez-Scaccetti**, *Commissioner, New Jersey Department of Transportation, Trenton*  
**Stephen W. Hargarten**, *Director, Injury Research Center, Associate Dean, Office of Global Health, Professor, Emergency Medicine, Medical College of Wisconsin, Milwaukee*  
**Chris T. Hendrickson**, *Hamerschlag University Professor of Engineering Emeritus, Carnegie Mellon University, Pittsburgh, PA*  
**Randell Iwasaki**, *Leader of State and Local Transportation, Amazon Web Services, Walnut Creek, CA*  
**Ashby Johnson**, *Executive Director, Capital Area Metropolitan Planning Organization (CAMPO), Austin, TX*  
**Joel M. Jundt**, *Secretary of Transportation, South Dakota Department of Transportation, Pierre*  
**Drew Kodjak**, *Executive Director, International Council on Clean Transportation, Washington, DC*  
**Carol A. Lewis**, *Professor, Transportation Studies, Texas Southern University, Houston*  
**Julie Lorenz**, *Secretary, Kansas Department of Transportation, Topeka*  
**Michael R. McClellan**, *Vice President, Strategic Planning, Norfolk Southern Corporation, Norfolk, VA*  
**Patrick K. McKenna**, *Director, Missouri Department of Transportation, Jefferson City*  
**Russell McMurry**, *Commissioner, Georgia Department of Transportation, Atlanta*  
**Craig E. Philip**, *Research Professor and Director, VECTOR, Department of Civil and Environmental Engineering, Vanderbilt University, Nashville, TN*  
**Steward T.A. Pickett**, *Distinguished Senior Scientist, Cary Institute of Ecosystem Studies, Millbrook, NY*  
**Leslie S. Richards**, *General Manager, Southeastern Pennsylvania Transportation Authority (SEPTA), Philadelphia*  
**James M. Tien**, *Distinguished Professor and Dean Emeritus, College of Engineering, University of Miami, Coral Gables, FL*

### EX OFFICIO MEMBERS

**Michael R. Berube**, *Deputy Assistant Secretary for Sustainable Transportation, U.S. Department of Energy, Washington, DC*  
**Amit Bose**, *Administrator, Federal Railroad Administration, Washington, DC*  
**Carlos M. Braceras**, *Executive Director, Utah Department of Transportation, Salt Lake City*  
**Tristan Brown**, *Deputy Administrator, Pipeline and Hazardous Materials Safety Administration, U.S. Department of Transportation, Washington, DC*  
**Ann Carlson**, *Acting Administrator, National Highway Traffic Safety Administration, Washington, DC*  
**Steven Cliff**, *Executive Officer, California Air Resources Board, Sacramento, CA*  
**Nuria I. Fernandez**, *Administrator, Federal Transit Administration, Washington, DC*  
**LeRoy Gishi**, *Chief, Division of Transportation, Bureau of Indian Affairs, U.S. Department of the Interior, Germantown, MD*  
**William H. Graham, Jr.** (Major General, U.S. Army), *Deputy Commanding General for Civil and Emergency Operations, U.S. Army Corps of Engineers, Washington, DC*  
**John T. Gray II**, *Senior Vice President, Policy and Economics, Association of American Railroads, Washington, DC*  
**Robert C. Hampshire**, *Deputy Assistant Secretary for Research and Technology, U.S. Department of Transportation, Washington, DC*  
**Robin Hutcheson**, *Administrator, Federal Motor Carrier Safety Administration, Washington, DC*  
**Eleftheria Kontou**, *Assistant Professor, University of Illinois at Urbana–Champaign, Urbana, and Chair, TRB Young Members Coordinating Council*  
**Billy Nolen**, *Acting Administrator, Federal Aviation Administration, U.S. Department of Transportation, Washington, DC*  
**Stephanie Pollack**, *Acting Administrator, Federal Highway Administration, U.S. Department of Transportation, Washington, DC*  
**Susan A. Shaheen**, *Professor and Co-Director, Transportation Sustainability Research Center, University of California, Berkeley*  
**Karl Simon**, *Director, Transportation and Climate Division, U.S. Environmental Protection Agency, Washington, DC*  
**Paul P. Skoutelas**, *President and CEO, American Public Transportation Association, Washington, DC*  
**Polly Trottenberg**, *Deputy Secretary of Transportation, U.S. Department of Transportation, Washington, DC*  
**Jim Tymon**, *Executive Director, American Association of State Highway and Transportation Officials, Washington, DC*

\* Membership as of November 2022.

# Contents

---

<b>Preface</b> .....	<b>ix</b>
<b>Abbreviations</b> .....	<b>x</b>
<b>Introduction</b> .....	<b>1</b>
<b>Opening Remarks</b> .....	<b>3</b>
<b>Keynote Address</b> .....	<b>8</b>
<b>Panel Sessions</b> .....	<b>10</b>
Panel Session 1: Passengers and Customers .....	10
<i>Lance Lyttle, Port of Seattle</i>	
<i>Billy Shallow, Airports Council International—World</i>	
<i>Patrick Murray, SSP America</i>	
<i>Michael Zureik, SITA</i>	
Panel Session 2: Aviation Workforce of the Future .....	12
<i>Candace Blair Cronin, ICF</i>	
<i>Donald Armstrong, Raleigh–Durham International Airport</i>	
<i>Linda Frankl, ADK Consulting &amp; Executive Search</i>	
<i>Tammera Holmes, AeroStar Avion Institute</i>	
Panel Session 3: Airport Infrastructure .....	16
<i>Khaled Naja, Dallas/Fort Worth International Airport</i>	
<i>Kevin Cox, Ferrovial Vertiports</i>	
<i>Peter Ricondo, Ricondo</i>	
<i>Cindy Simpson, Gensler</i>	
<i>Scott Tumolo, C&amp;S Companies</i>	
Panel Session 4: Airspace Integration and New Entrants .....	18
<i>Amanda Simpson, Airbus Americas</i>	
<i>Max Fenkell, Joby Aviation</i>	
<i>Max Li, Sr., MITRE Center for Advanced Aviation System Development</i>	
<i>and University of Michigan</i>	
<i>Leslie Riegle, Boom Supersonic</i>	
Panel Session 5: Technology and Innovation .....	20
<i>Aneil Patel, Airports Council International—North America</i>	
<i>Brian Cobb, Cincinnati/Northern Kentucky International Airport</i>	
<i>Kwang Chen, Massachusetts Port Authority</i>	
<i>Zihong (Zee) Gorman, San Francisco International Airport</i>	
<i>Jimmy Hahn, CLEAR</i>	



Panel Session 6: Climate Change and Sustainability .....	23
<i>Marianne Csaky, Alaska Airlines</i>	
<i>Stephanie Meyn, Port of Seattle</i>	
<i>Saleem Chapman, City of Philadelphia</i>	
<i>Adam Klauber, World Energy</i>	
<i>Stanley Young, National Renewable Energy Lab</i>	
<b>Breakout Sessions.....</b>	<b>26</b>
Breakout Session 1: Workforce of the Future, Airports and Airspace of the Future .....	26
<i>Mohamed Charkas, Dallas/Fort Worth International Airport</i>	
<i>Max Li, Sr., MITRE Center for Advanced Aviation System Development</i>	
<i>and University of Michigan</i>	
<i>Angel Ramos, AECOM</i>	
<i>Rikki Scantlan, RS&amp;H</i>	
Breakout Session 2: Technology, Innovation, and Environment.....	27
<i>Aneil Patel, Airports Council International—North America</i>	
<i>Brad Rolf, Mead &amp; Hunt</i>	
<i>Steve Van Beek, Steer</i>	
<i>Adrian Leung, Steer</i>	
<b>Closing Remarks .....</b>	<b>29</b>
<i>Mary Ellen Eagan, HMMH</i>	
<b>Appendix A: Program Agenda.....</b>	<b>31</b>
<b>Appendix B: List of Attendees .....</b>	<b>38</b>

# Preface

---

“The Future of Aviation” Insight Event [ACRP Project 11-08(20-01)], held March 22–23, 2022, at the Keck Center of the National Academies of Sciences, Engineering, and Medicine (the National Academies) in Washington, DC, brought together airport representatives, community planners, universities and research institutions, and others in the aviation industry to discuss the future of aviation across multiple perspectives. The Transportation Research Board’s (TRB’s) Airport Cooperative Research Program (ACRP) organized the event as part of its series of convening activities titled “ACRP Insight Events.” ACRP Insight Events are forums that foster dialogue between professionals across sectors, institutions, and industries. ACRP Insight Events convene airport industry leaders and subject matter experts in various fields to encourage discussion and promote broader and deeper insight on topics of significance to airport operators. These in-depth, face-to-face gatherings are designed to promote communication and collaboration, foster innovation, and help identify areas of future interest and research, especially for topics of emerging importance.

This proceedings document, prepared by rapporteur Mary Ellen Eagan of HMMH, is a compilation of the presentations and a factual summary of the ensuing discussions at the event. The planning committee for the event was solely responsible for organizing the Insight Event, identifying speakers, and coordinating activities during the event. The views contained in this proceedings are those of individual ACRP Insight Event participants and do not necessarily represent the views of all participants, the planning committee, TRB, or the National Academies.

This proceedings document was reviewed in draft form by individuals chosen for their diverse perspectives and technical expertise. The purposes of this independent review are to provide candid and critical comments that will assist the National Academies in making the published proceedings as sound as possible and to ensure that the document meets institutional standards for clarity, objectivity, and responsiveness to the project charge. The review comments and draft manuscript remain confidential to protect the integrity of the process.

TRB thanks the following individuals for their review of this proceedings: Gaël Le Bris, WSP USA, and Agatha Kessler, Fentress Architects. TRB also thanks Daniel Talmage for reading and providing helpful comments on the manuscript.

Although the reviewers listed above provided many constructive comments and suggestions, they did not see the final draft of this proceedings before its release. The review of this proceedings was overseen by Chris T. Hendrickson (National Academy of Engineering), Carnegie Mellon University (emeritus). Appointed by the National Academies, he was responsible for making certain that an independent examination of this proceedings was performed in accordance with institutional procedures and that all review comments were carefully considered. Responsibility for the final content rests entirely with the author and the institution.

# Abbreviations

---

AAM	Advanced Air Mobility
ACRP	Airport Cooperative Research Program
AI	artificial intelligence
AU	Airport Urbanism
BOS	Boston Logan International Airport
CORSIA	Carbon Offsetting and Reduction Scheme for International Aviation
CVG	Cincinnati/Northern Kentucky International Airport
EJ	environmental justice
eVTOL	electric vertical take-off and landing
FAA	Federal Aviation Administration
HVAC	heating, ventilating, and air-conditioning
ICAO	International Civil Aviation Organization
IFR	instrument flight rules
Massport	Massachusetts Port Authority
PHL	Philadelphia International Airport
RDU	Raleigh–Durham International Airport
SAF	sustainable aviation fuel
SAJF	sustainable aviation jet fuel
SFO	San Francisco International Airport
STEM	science, technology, engineering, and mathematics
TRB	Transportation Research Board
TSA	Transportation Security Administration
UAM	urban air mobility

# Introduction

---

“The Future of Aviation” (“Insight Event”) was organized by the Transportation Research Board’s (TRB’s) Airport Cooperative Research Program (ACRP) under ACRP Project 11-08(20-01) as part of its series of convening activities, “ACRP Insight Events.” This event focused on the topic of the future of aviation. As the industry emerges from the greatest challenge to commercial aviation in recent memory and heads into recovery from the global pandemic, aviation professionals seek to understand how the aviation industry should prepare for the next set of challenges and disruptions. Even more than deregulation changed the industry dramatically in the 1970s, recent and emerging technologies are currently transforming the aviation industry today. It is important for industry practitioners to understand, prepare for, and adapt to emerging trends such as Advanced Air Mobility (AAM); on-demand aviation services; smaller aircraft and intraregional flights; electrification of fleets and, eventually, aircraft; commercial supersonic flight; digitization and automation; and sustainable aviation fuels (SAF) as well as other emerging fuels such as hydrogen. These trends must also be considered in the context of climate change and the evolution of social expectations.

Preparations for this Insight Event included a thorough literature review, which served to identify the key themes that became organizing principles for the two-day event: People, Infrastructure, Technology and Innovation, and Climate. Several of the thought leaders and practitioners who were involved in the theme selection were then selected to serve on the planning committee for the event. A summary of the literature review is available on the ACRP Insight Event web page at <http://www.trb.org/ACRP/ACRP-Insight-Events.aspx>. Readers who are interested in more information can e-mail the ACRP Senior Program Officer for the event, Joseph Navarrete, at [JNavarrete@nas.edu](mailto:JNavarrete@nas.edu).

The Insight Event took place March 22–23, 2022, at the Keck Center of the National Academies of Sciences, Engineering, and Medicine (the National Academies) in Washington, DC. The event brought together experts from across the industry for 2 days of thought-provoking dialogue to consider what the next 20, 30, and 50 years might look like for aviation, centered around the four key themes. The program agenda for the event is provided in Appendix A. More than 100 people registered for the event. Registrants’ professional affiliations included airports, airlines, academic institutions, consulting, and more. The full list of registrants is provided in Appendix B.

The event led off with opening remarks and an introduction, which set the scene for later discussions. The remainder of the event included a keynote address; six panel sessions, each of which included a moderator and three to five topic experts; two facilitated breakout sessions on previous topics; and a final “Participants Choice” open discussion among all participants. Each panel included several discussion topics identified by the moderator, followed by open discussion sessions with the audience.

ACRP is an industry-driven, applied research program that develops near-term, practical solutions to problems faced by airport operators. ACRP is managed by TRB, a part of the National Academies, and is sponsored by the Federal Aviation Administration (FAA).

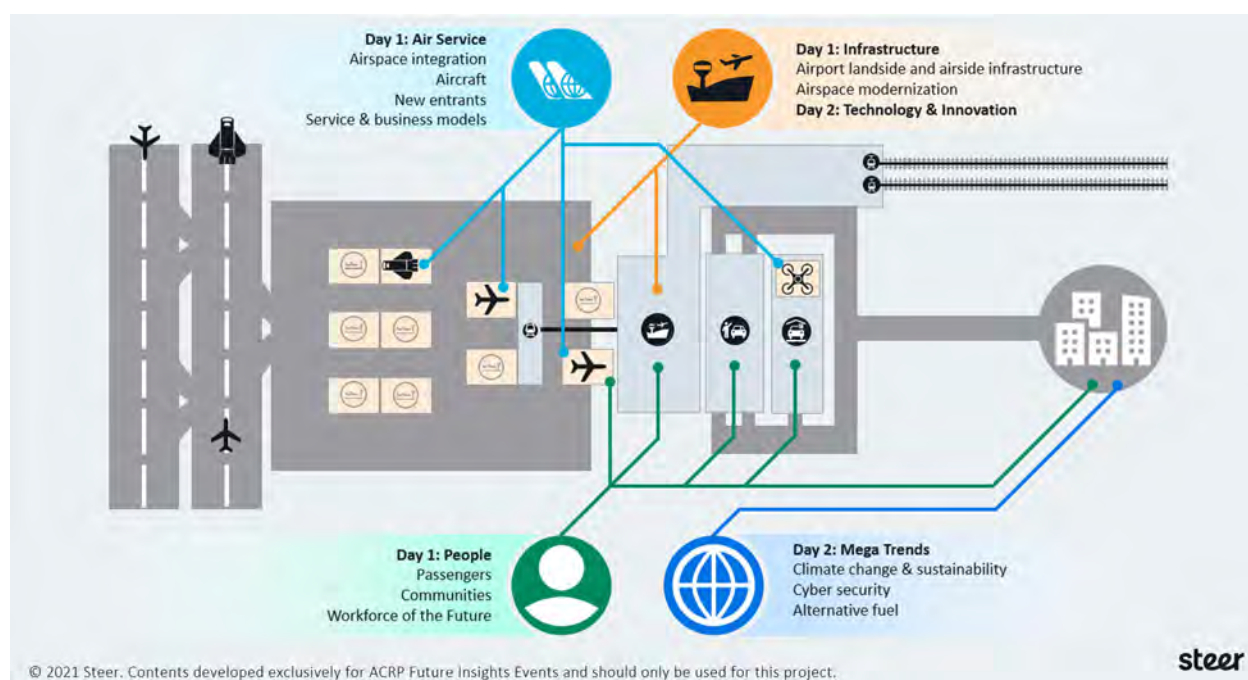
ACRP Insight Events are forums that foster dialogue among professionals across sectors, institutions, and industries. ACRP Insight Events convene airport industry leaders and subject matter experts in various fields to encourage discussion and promote broader and deeper insight on topics of significance to airport operators. These in-depth, face-to-face gatherings are designed to promote communication and collaboration, foster innovation, and help identify areas of future interest and research, especially for topics of emerging importance.

# Opening Remarks

Agatha Kessler, *Fentress Architects, Chair*

Gaël Le Bris, *WSP USA*

**Agatha Kessler** opened the event by welcoming the attendees. She discussed a graphic that showed the interplay of the four key themes of the event (Figure 1). Specifically, while there are myriad future issues that airport professionals need to address, these can be categorized into four general themes: infrastructure, air service, people, and megatrends. The structure and agenda of the Insight Event follows these general themes, but the graphic depicts how they are all interrelated. Kessler also set the bounds of the 2-day discussion: “We are talking about the emerging technologies of today and seeing how they may be adapted/adopted for use over our planning horizon.”



**FIGURE 1. Interplay of the four key themes of the Insight Event.**

She then turned to **Gaël Le Bris** to provide an introduction and food for thought to the attendees based on recent research initiatives such as *The Future of Airports: A Vision of 2040 and 2070* with the Airport Think Tank of ENAC Alumni,<sup>1</sup> and the workshop “Airport

<sup>1</sup> <https://www.alumni.enac.fr/en/the-future-of-airports/summary-of-findings-3559>.

Electrification and Automation for Emerging Aerial Mobility” held during TRB’s 2022 annual meeting.

Le Bris started by stating, “We need to write our own future as an industry. If we want to control destiny, we need to build our own future.” He quoted pioneering aviator Antoine de Saint Exupéry: “When it comes to the future, it is not about foreseeing it, but about making it possible.”

Le Bris also recalled the predictions of the General Secretary of the War Ministry in the Provisional Government of the French Republic, Alain Bozel, who, in 1944, wrote a memorandum, *The Airport of Paris (L’aéroport de Paris)*, to advocate for the construction of a large-hub aviation facility that would be an international gateway not only for the French capital but also for the entire country. This document provides a vision of the future that includes some modern features that airport planners still struggle to implement. Three main concepts that Bozel described with the words of his time were: (1) the “hub and spoke” system, (2) the aerotropolis concept, and (3) the need for first- and last-mile intermodality.

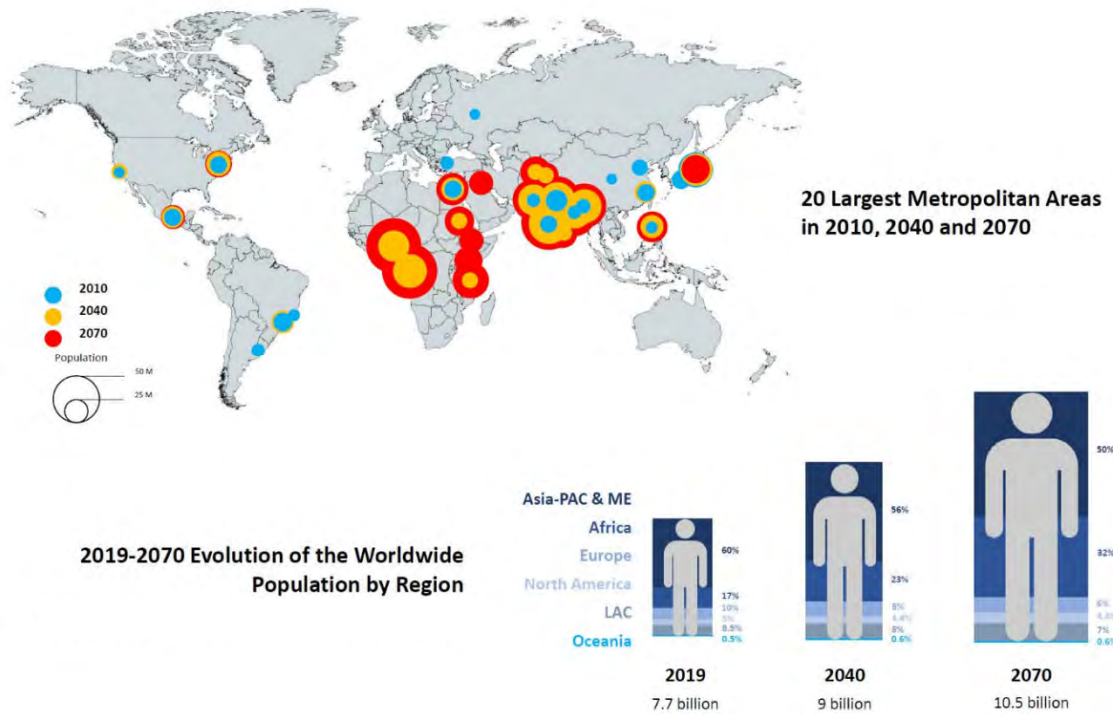
Le Bris encouraged participants to think about the following concepts as they engaged in conversations throughout the Insight Event:<sup>2</sup>

- **The world of 2040 and 2070:** By 2040, the United States will be a “majority-minority country;” that is, the majority of the population will be racial or ethnic minorities. The aviation community needs to consider the diversity of passengers and the aviation workforce in its work, including addressing generational and cognitive diversity. Le Bris also recommended that the industry carefully look at long-term demographic and economic trends worldwide. For example, the emergence of Africa as a demographic and economic giant over the second half of the 21st century will result in airlines and airports competing for offering direct service to large African metropolitan areas, similar to what has been seen on routes from the United States to Asia (Figure 2).
- **Sustainability:** Sustainable business plans and new sources of funding: While there have been very few fully privatized airports in the United States (e.g., Luis Muñoz Marín International Airport in San Juan, Puerto Rico), “privatization” has been successful under other forms, such as public–private partnerships, concessions, and other mechanisms. Examples include Terminal 4 at John F. Kennedy International Airport and LaGuardia Airport in New York City. Also, the funding of airports needs to be rethought to help them modernize terminal facilities and address emerging needs that concern all airports, from small general aviation to large hubs (e.g., AAM, new aviation fuels).
- **Smart airports:** In the era of information technologies, information systems have made a deep impact on air transportation. At airports, travelers can now interact with their environment to get personalized, georeferenced information. Airports can leverage this technology to improve wayfinding, for instance. Smartphones enable customization to special needs (e.g., a more Americans with Disabilities Act- or autism-friendly journey

---

<sup>2</sup> Le Bris, G. Way of the Future: Airports at the Horizon of 2040 and 2070. *TR News*, No. 331, January–February 2021, pp. 3–11.





Note: Asia-PAC & ME: Asia, Pacific, and Middle East; LAC: Latin America and Caribbean.  
 Sources: D. Hoornweg and D. Pope, *Population Predictions of the 101 Largest Cities in the 21st Century*, Global Cities Institute, 2014; *World Population Prospects: The 2019 Revision (Median-Variant Prospect)*, United Nations, 2019.

**FIGURE 2. Evolution of the worldwide population.**

through the airport) and provide opportunities for providing directions in multiple languages, something that can be complex and costly with physical signage. Electronic wayfinding can also promote local and endangered languages (e.g., Native American languages, French, Indian French, and Creole languages). The second information technology (IT) revolution is coming. With intelligent systems, airports and their stakeholders will be able to integrate big data into their operations and leverage it to enhance real-time operations, enable predictive resource management, and support the operations community during adverse conditions.

- **Security threats and unlawful activities:** Cyberattacks are on the rise. Airports and their stakeholders are not spared by cyberthreats.<sup>3</sup> Collaboration between the stakeholders and across the industry is necessary. Also, the industry needs to collaborate with operators and agencies from other industries to learn from their lessons learned (e.g., Colonial Pipeline), as well as with cybersecurity experts (e.g., MITRE ATT&CK).
- **Enhancing aviation safety:** Historically, the aviation industry was reactive to safety and security events. Currently, the industry is proactive, but, in the future, it will be predictive, thanks to big data and artificial intelligence (AI) that will be able to identify patterns and nascent safety issues through accident/incident reports. Also, the next

<sup>3</sup> Murphy, R. J., Sukkarieh, M., Haass, J., and Hriljac, P. *ACRP Report 140: Guidebook on Best Practices for Airport Cybersecurity*. Transportation Research Board, Washington, DC, 2015.



generation of airside safety systems might rely on onboard equipment as well. For instance, it is possible to get an estimate of the runway friction coefficient through aircraft braking action, which is measured by the most recent airliners and which, in turn, could be used to assess and refine the runway condition assessment for everyone's benefit.

- **Airside and airspace compatibility:** Airports already need to accommodate a greater diversity of aircraft, including single-aisle international, supersonic, hypersonic airplanes and new generations of airliners that are longer, wider, and more power-demanding than the previous ones. Soon, airports may see electric aircraft and uncrewed and unmanned vehicles as well as supersonic and hypersonic aircraft. This diversity will create new challenges in the air (e.g., fleet mix with aircraft of very different approach speeds) and on the ground (e.g., new aviation fuels/energy vectors). Airports, including smaller facilities, might become energy hubs to address the new energy paradigm that is emerging, thereby creating opportunities for new revenue streams and increasing community power resiliency.
- **Operational performance and resilience:** As aviation facilities throughout the National Airspace System—including small hubs and regional airports—are increasingly interconnected, and in the context of more frequent disruptions due to factors including climate change, there is a need for airports to have more resilient operations. Solutions include, for instance, Airport Collaborative Decision Making to manage adverse conditions together with stakeholders<sup>4</sup> and use of a microgrid to ensure power resiliency when the electric grid is deficient.<sup>5</sup>
- **Passenger terminals and customer experience:** Dubai International Airport and Singapore Changi Airport, two hub airports abroad, are praised for their underground shopping mall and indoor tropical forest, respectively. Le Bris explained that U.S. airport terminal facilities are improving in terms of customer experience and that, instead of pursuing a “wow” effect similar to DXB or SIN, we need to listen to passengers and focus on what they want as well as to balance costs. We shall imagine and develop a 21st-century American experience that shall not make any compromise when it comes to the efficiency of the passenger journey from the curbside to the gate.
- **Mobility and communities:** AAM is on the horizon, and it will change air transportation forever. AAM-like operations already exist in cities such as São Paulo, Brazil, whose downtown accommodates over 400,000 helicopter operations annually (pre-COVID-19) as well as New York City with operators such as Blade. However, aerial innovation should not divert precious public resources away from mass transit. Also, the development of advanced ground access solutions present opportunities to improve the mobility offer and transportation accessibility for the communities around airports that should be involved with their planning. Sustainability and airport-citizens: Aviation generates only about 2% global carbon emissions and about 3.5% of the drivers of

---

<sup>4</sup> Le Bris, G., Nguyen, L.-G., Tagoe, B., Churchill, A., Vail, S., Benaman, H., Fleet, D., Zajkowski, T., and Krieger, J. *ACRP Research Report 229: Airport Collaborative Decision Making (ACDM) to Manage Adverse Conditions*. Transportation Research Board, Washington, DC, 2021.

<sup>5</sup> Heard, R., and Mannarino, E. *ACRP Synthesis 91/TCRP Synthesis 137: Microgrids and Their Application for Airports and Public Transit*. Transportation Research Board, Washington, DC, 2018.

climate change<sup>6</sup> but was one of the first sectors to work on the reduction of its carbon footprint. The industry's first innovations to address climate were developed in mid-2000s. Today, the global aviation industry has committed to achieving net-zero carbon emissions by 2050. Keys to achieve this objective include operational enhancements, new aerospace technologies, as well as the implementation of non-fossil fuels such as the SAFs as well as electric aviation and hydrogen technologies.<sup>7</sup> Aviation is also the first sector to agree on a global initiative such as the International Civil Aviation Organization's (ICAO) Carbon Offsetting and Reduction Scheme for International Aviation (CORSIA). Sustainability is not limited to climate and ecosystems per se. It shall address quality of life, social and environmental justice, and community resilience.

- **Human resources and education:** Change management and knowledge management will be part of the fundamentals of any efficient and resilient organization in order to adapt the workforce to constant changes and breakthroughs similar to what was the “first IT revolution” with the emergence of information technologies. One of this big change enablers will be the “second IT revolution,” made of intelligent technologies. 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 also includes age, sexual orientation, special needs, cultural background, and socioeconomic status.<sup>8</sup> Studies have shown the clear benefits of diversity in organizations.<sup>9</sup> Le Bris stated that we have the duty to have diverse groups within the aviation industry and absolutely no excuse not to. The nation has never been more diverse, the world is our guest, and our workforce needs to reflect our commitment to provide affordable, greener, fast, and efficient air mobility to everyone and to connect people together.

---

<sup>6</sup> Lee, D. S., Fahey, D. W., Skowron, A., et al. The Contribution of Global Aviation to Anthropogenic Climate Forcing for 2000 to 2018. *Atmospheric Environment*, Vol. 244, 2021.

<sup>7</sup> Le Bris, G., Nguyen, L.-G., Tagoe, B., Jonat, P., Justin, C. Y., Reindel, E., Preston, K. B., and Ansell, P. J. *ACRP Research Report 236: Preparing Your Airport for Electric Aircraft and Hydrogen Technologies*. Transportation Research Board, Washington, DC, 2022.

<sup>8</sup> Ivey, S., Powers, M., and Clark, A. Building a Business Case for Increasing Diversity in the Transportation Workforce. *TR News*, No. 323, September–October 2019, pp. 22–27.

<sup>9</sup> McMahon, A. M. Does Workplace Diversity Matter? A Survey of Empirical Studies on Diversity and Firm Performance, 2000–09. *Journal of Diversity Management*, Vol. 5, No. 2, 2010, pp. 37–48.

<https://doi.org/10.19030/jdm.v5i2.808>.

# Keynote Address

---

Max Hirsch, *Airport City Academy*

Hirsch's keynote focused on his thoughts about the following two questions: (1) What will the airport of the future look like? and (2) What will it take to get from here to there?

His research views airports through the lens of airport urbanism (AU), looking at changes in technology and at business models, among other things. AU is a people-focused approach to designing airports and their surrounding area. It focuses on the needs and desires of people who use the airport on a regular basis, who live and work near an airport, and who work at an airport. This approach allows for site-specific development strategies. For example, the Finance Ministry of Iceland has applied this thinking in developing a land use/commercial development strategy for land around its airports by considering the needs of people nearby.

Hirsch offered three predictions for future airports:

1. **The future airport will be green.** For instance, it will be decarbonized through the use of renewables and electrified ground operations. Terminals will rely on a carbon-neutral building and the circular economy. Airports will lead the way to energy independence and will serve as an energy hub, as airport design is conducive to energy storage and charging.
2. **The future airport will be multimodal.** It will be repositioned as a regional mobility hub. There will be regional traffic in electric planes and AAM in local areas. Passengers in traditional commercial airliners will fly in and out on various fuel sources and will be seamlessly integrated into multimodal ground transportation (rail). Airports will also serve as mobility hubs for cargo, with fulfillment centers near the airport. The airport will be the integrator. Passenger transfers will be frequent, reliable, and painless.
3. **The future airport will have a stronger and more resilient business model.** The COVID-19 pandemic exposed risks in the current passenger-related revenue business model. During the pandemic, airports that relied on passenger fees did worse than those that had non-passenger-related revenue, such as cargo, landside real estate, and landside terminal concessions. In the future, airports will need to diversify revenue, since revenue diversification will result in financial resilience. There are disruptive events on a regular basis, so airports will need to have a diversified revenue stream to thrive.

How will this be achieved? Hirsch presented four possible solutions:

1. Airports need to prioritize sustainable automation and adapt to climate change. Projects such as long-range cargo drones with a 1,500-mile range may address some of these challenges.

2. Airports need to improve the relationship between technology and the workforce. For example, a European Union airport with a brand-new automated baggage handling system had no backup plan for system failure. As airports adopt new technology, they should focus on contingency planning with a prepared workforce.
3. With the potential for a changing workforce, airports need to provide training. Automation will reduce frontline staffing and will increase the need for programmers and data analysts. The overall workforce may shrink, but the need for technical knowledge will increase, resulting in fewer but higher-skilled, higher-paying jobs.
4. Airports need to focus on collaborative development with stakeholders and find a balance to leverage land assets. U.S. airports own enormous amounts of land. From an outside perspective, this represents many missed opportunities for development. For example, the main airport in Iceland is 45 minutes from the city center, but the airport houses numerous activities that benefit from its infrastructure, such as security and ground transportation. Now other companies are building facilities for data centers, strategic medical reserves, and package shipping to utilize the land and environment.

# Panel Sessions

---

The discussion panels of the Insight Event addressed its four themes and specific topics within each theme. The structure is presented in Table 1.

**Table 1. Structure of the Panel Sessions.**

Theme	Session Topics
People	Passengers and customers
	Aviation workforce of the future
Airports and airspace	Airport infrastructure
	Airspace integration and new entrants
Technology and innovation	Technology and innovation
Climate and sustainability	Climate change and sustainability

## Panel Session 1

### Passengers and Customers

Lance Lyttle, *Port of Seattle*, Moderator

#### Speakers

Billy Shallow, *Airports Council International—World*

Patrick Murray, *SSP America*

Michael Zureik, *SITA*

The first people-themed panel discussion explored topics and trends related to passengers and customers in the aviation industry. The speakers explored the future passenger journey experience, the services future passengers and customers might want and expect, how automation and AI will impact or facilitate the journey, challenges and opportunities surrounding passenger data and privacy, and public health considerations.

**Lance Lyttle** opened the panel by stating that passengers and other customers are the foundation of the future of aviation. Therefore, it is critical to think about the passenger journey.

Lyttle posed the first question to the panel: “Ten years from now, what does the airport journey look like?”

**Billy Shallow** described his vision of the future passenger experience. He stated that the journey will start at home. Booking tickets will be easier, because all requirements (e.g., visas) will be in a centralized location. After booking, the journey should be as frictionless as possible; there should be no queues at all. Airports need to work with governments to

share data to make operations more efficient through airport processing. Airports also need to acknowledge that not all passengers are the same and that some have hidden disabilities and needs.

Next, **Patrick Murray** talked about the need to provide “catering for all.” There are many trends in the food industry that will reverberate through the aviation industry (this has already started in the rest of the world). In part because of the COVID-19 pandemic, airports now have many kinds of food delivery, including food and concession delivery to the gate. Technology, such as facial recognition, will affect how food is delivered at airports. Technology allows ordering on phones, for example. On the back end, robotics and other technology will assist in delivery. The technology for packaging and utensils is evolving as well. In short, restaurant design should be included as an integral part of terminal design, not as an afterthought.

**Michael Zureik** said that airports need to look past the COVID-19 pandemic in their security planning. The future of air travel will not start with booking, but with travel planning, as travelers will virtually visit their planned destinations. Travel behaviors will evolve as more digital information is available. Travel will be more expensive as demand increases (the number of passengers is expected to double by 2035). With an increased number of passengers, more emphasis will be on identity, not credentials. Biometrics will facilitate automation to reduce congestion points. However, all parties will need to coordinate and share controls, security, and trust in order to ensure a cohesive journey.

**Lyttle’s** next question to the panel was, “What specific technologies will make for a frictionless journey?”

**Zureik** responded that it starts with regulation. Progress is a challenge in an industry that is highly regulated. There has been a lot of work with the Transportation Security Administration (TSA) and the International Civil Aviation Organization (ICAO), but it is slow and challenging. He further added that airports’ current security challenge is not with technology, but with security screeners: for example, how to detect small items in people’s bags. Instead of the checking of bag tags, screening and baggage handling can be done by AI. However, airports need to lower the barriers to entry for aviation systems.

**Murray** added that the food industry at airports needs to innovate more, for example, by adopting the use of food delivery apps.

The panelists identified a need for “light-touch security.” They also discussed the need for airlines and airports to work better together to share their big data (relevant customer data) to facilitate a more seamless passenger journey.

**Lyttle** next asked: “What role does blockchain<sup>10</sup> play in the aviation industry?”

---

<sup>10</sup> Aviation blockchain is a shared ledger technology for tracking tangible and intangible assets and recording transactions for aviation business and passengers. See also <https://crp.trb.org/acrptransformativetech/technology-focus-articles/blockchain/>.

**Zureik** responded that it is better to talk about what airports want blockchain to achieve. Airports want to be able to have travelers present a credential for the purpose of the interaction (i.e., boarding). Does the airline need to know all the information, or just that it has been attested by an authority (i.e., government)? A person's face should be the token that validates his/her status. Governments have the discretion to ask for a lot of data from passengers. Whatever technology provides that assurance (e.g., Bitcoin) must be able to work with ICAO requirements.

**Lyttle's** final question was, "Are you concerned that the airport of the future is so efficient that concessions will be obsolete?"

**Zureik** responded that Amazon has changed the way products move. If aviation business doubles and more airports are not built, airports will have more congestion. Zureik also discussed the potential impact of the metaverse on aviation demand.

**Shallow** replied that the finances of the ease of operation are still not clear—will passengers be willing to pay for it?

**Murray** responded, "No." In 1944, food in America was not about enjoyment or socializing; however, it has become so over time. Some elements of our expectations will never go away. Airports will need people to cook and serve food to passengers.

## Panel Session 2

### Aviation Workforce of the Future

Candace Blair Cronin, *ICF*, Moderator

#### *Speakers*

Donald Armstrong, *Raleigh–Durham International Airport*

Linda Frankl, *ADK Consulting & Executive Search*

Tammera Holmes, *AeroStar Avion Institute*

The second people-themed panel focused on the main drivers and trends regarding the future of aviation workforce. Specific topics included the skills and abilities that will be needed in the future, the roles that might be replaced by technology, how universities and the academic community are preparing the future workforce, what careers will be in highest demand, and how aviation will compete with other industries and nontraditional career paths.

**Candace Blair Cronin** started the discussion by stating that when building the workforce of the future, the aviation industry should focus on desired skills and behaviors, not on the qualifications of individuals applying for those positions. Cronin reminded the audience that *ACRP Research Report 186: Guidebook on Building Airport Workforce Capacity*<sup>11</sup>

---

<sup>11</sup> ICF Consulting and Steer Davies Gleave. *ACRP Research Report 186: Guidebook on Building Airport Workforce Capacity*. Transportation Research Board, Washington, DC, 2018.  
<https://doi.org/10.17226/25263>.



identifies mission-critical jobs in aviation. These include many trade jobs (electricians), but all of them require computer skills. The industry needs to acknowledge that there are some communities that do not have access to technology. There are not enough people with the appropriate skills, and this needs to be used as an opportunity to expand industry requirements. Minimum qualifications within the industry are not necessarily mapped well for the job requirements. For example, is a 4-year degree necessary for every job? The industry needs to be able to evolve and be inclusive. The industry's current labor shortage presents an opportunity to reevaluate.

Cronin then asked the panel, "What is your experience with young folks?"

**Donald Armstrong** responded that early investment in the talent pipeline is critical. This is not foreign to American culture, which, for example, invests significantly in sports. However, it is less common for science, technology, engineering, and mathematics (STEM) professionals and other workplace jobs. Reinvigoration of the current workforce to address future needs will require an effort similar to the one after World War II. After the war, America made a significant investment in retraining returning soldiers to help them secure civilian jobs and meet the industry needs of the post-World War II economic boom.

**Tammera Holmes** added that most people in the aviation industry either started out in aviation or fell into it because of specialized skills (e.g., airport noise management). The industry needs to focus specifically on youth and their aptitude for learning and then get them on to pathways to receive a credential that reflects their aptitude. The industry needs to find innovative ways to invest in the young-talent pipeline. The FAA's Youth Access to American Jobs in Aviation study showed that early investment in youth increases the workforce in any area, and the best age to get people interested in any industry is 10 years old.<sup>12</sup>

**Cronin** asked, "What is your experience with the great resignation?"

**Armstrong** responded that airports are competing for talent. There are labor shortages in certain areas, but it is particularly acute in law enforcement. Raleigh-Durham International Airport (RDU) has completely revamped its approach to recruiting for law enforcement. At one point during the pandemic, the airport security staff was down by one-third. RDU established signing and retention bonuses. This resulted in only three new hires, which suggests that the challenge is not just about money. Employees are now looking for benefits such as parental leave, flexibility, and support in a post-pandemic world.

**Linda Frankl** added that she sees a similar labor shortage on the executive search side, where there is a global competition for top talent. The aviation industry needs to start thinking differently, especially on the airport side, where the industry has been quite rigid. Is it legally defensible that the industry needs certain degrees and certifications to address the responsibilities required for some of these positions? In many recent searches, employers have realized they can accept equivalent experience. As a result, Frankl has seen

---

<sup>12</sup> FAA Task Force Focuses on Youth Access to Jobs, April 1, 2021. <https://www.faa.gov/newsroom/faa-task-force-focuses-youth-access-jobs>.



three or four positions that have been revised to not require a degree. Further, the industry does not have the population to serve in some required areas in next 10–15 years. Technology will assist with some of this, but the industry will need to develop a lot of it.

**Cronin** added that to nurture the current workforce, the industry needs to talk about flexibility. Scientists look at social science literature. Of course, fair compensation is important, but what drives people to stay at an organization is feeling that they are supported, especially in their personal lives, and that they would, for instance, have opportunities to take care of loved ones.

Cronin then asked the panel how the industry should approach workforce development in a more inclusive way. She noted that if inclusivity equals a sense of belonging, it should follow that employee engagement is the biggest driver to retention.

**Armstrong** responded that the workforce shortage in the aviation industry is at critical point. The industry has not begun to see what it will look like as even more people retire in the next 2 to 4 years. For example, airlines are canceling flights because there are not enough crew members because of recent retirements. As in the post–World War II era, when people did what they needed to do, the industry needs to adopt a similar mindset now.

**Holmes** added that for pilot education, the cost of training can become a barrier. The industry needs to work with schools with career technical education programs so that students can graduate from high school with an associate’s degree; this is a real opportunity for investment. Young people who have had internships with companies are more likely to stay there as loyal employees. What if the industry developed leaders at the internship stage? The industry needs to find ways to motivate and inspire youth. It also needs to think about diversity, equity, and inclusion separately. Diversity does not equal equity, and equity does not equal inclusion. White males should be an advocate for diversity, equity, and inclusion. If you have a place at the table, you need to make space for others.

**Cronin** asked what airports are doing internally to make sure the future workforce will be supported once hired.

**Frankl** responded that airports need to focus on appreciation for others, including others’ perspectives and experiences. Hiring managers often try to clone the person being replaced or themselves. Managers do not often think they want someone who thinks or acts differently. Aviation is not necessarily a diverse industry. Perhaps airports should think about people outside of aviation and how bringing new skills into an organization is invigorating. There is a well-known “similar-to-me” effect found in selection bias in hiring. The industry needs to actively challenge itself to call attention to bias. Studies have also shown that people rate people like themselves more highly. More-diverse organizations are more innovative; in an industry that needs to be innovative, this is a business necessity.

**Cronin** asked Armstrong to provide some detail on RDU’s recruiting programs.

**Armstrong** responded that pipeline and internships are crucial. They are important not just for management tracks but also for trades such as electricians, plumbers, and heating, ventilation, and air-conditioning (HVAC) technicians. These positions are the backbone of the airport that keeps it functioning. A typical example of bias in recruiting is a statement such as “I will know what talent I’m looking for when I see it,” which reinforces many stereotypes and results in people hiring new staff who are like them.

**Holmes** added that the industry also needs to talk about youth apprenticeship programs. The rates of matriculation are as high as 70%. These programs are evenly split between male and female participation. There is also a great need for vocational programs—perhaps even at airports.

Holmes also added that the industry does not know what the job of the future will be. The industry does know that future jobs will be done by children who are kindergartners now. Those children’s brains are wired for extraordinary innovation. For example, children with attention-deficit/hyperactivity disorder are completely competent with flight simulators, while more-traditional (i.e., academically focused) children tend to be risk averse.

The panel talked about various approaches to establishing internship programs. **Cronin** offered, for example, that the Commonwealth of Massachusetts utility sector is going into sectors in environmental justice (EJ) communities to teach job-related skills. The goal of the program is to invest in internship/apprenticeship to develop long-term successful hires.

Cronin asked the panel which airport department designs internship programs at airports.

**Armstrong** responded that at RDU, the intern is most often hired directly by the department that needs the intern, and the department then works with Human Resources to support the hiring.

**Holmes** observed that some of the most successful programs are those that allow interns to rotate around to various offices. She further added that the City of Chicago requires its contractors to also have internship programs. This ensures that vendors and suppliers are bringing in talent to airports.

**Cronin** noted that leadership investment and buy-in in these programs are critical. Also, providing airport personnel exposure to different areas within the airport system builds professional capacity. How do we make sure people have skills that are transferable? The more exposure airport personnel are given, the more invested they are in the success of the whole organization. This approach also helps when airports are short-staffed. For internship programs, a well-rounded opportunity to experience different departments is important for success and builds a foundation for future success. This is also important at the manager level.

Cronin asked the panel if AI can address the shortage of people. If so, how do airports reconcile the tension between AI and people?

**Armstrong** offered that AI would help airports optimize experiences and environments for processing. Airports need to work with existing staff/teams to be adaptable and to accept and champion change. He further offered that the industry should look at cars to see where aviation is going; electric vehicles will become a standard and air mobility will happen. First movers will easily adapt and others will resist. The more the industry understands it and sees it, the better off the industry will be. Humans do not like change. This will require the industry to relocate people whose jobs have been replaced by automation. One critical factor is people skills. For instance, are airports providing opportunities for staff to engage with others and improve their critical thinking skills?

## Panel Session 3

### Airport Infrastructure

Khaled Naja, *Dallas/Fort Worth International Airport*, Moderator

#### *Speakers*

Kevin Cox, *Ferrovial Vertiports*

Peter Ricondo, *Ricondo*

Cindy Simpson, *Gensler*

Scott Tumolo, *C&S Companies*

The first panel of the infrastructure theme focused on significant drivers shaping airports as they plan, design, and build infrastructure to meet future needs. Panelists discussed the following topics:

- Evolution of airport infrastructure and how to consider multimodal travel;
- Resiliency to acute shocks and chronic stressors;
- Planning and design for new entrants and flexible infrastructure for changing demands;
- Sustainability and environmental constraints and opportunities such as sustainable alternative fuels, electrification, and shifting community and public expectations;
- Automation;
- Increasing types and availability of data; and
- Revenue and financial considerations.

**Khaled Naja** introduced the session on infrastructure by stating that the theme of many panelists' remarks was on "unlearning" the things that have not gone right in the past with regard to a number of topics, including resilience, the future of mobility, innovation and technology, the customer journey, and alternative delivery methods.

**Peter Ricondo** focused on having a broader understanding of infrastructure, including green and multimodal, and a stronger business model/revenue diversification. Buildings are fixed assets with limited adaptability, so airport planners should build infrastructure to provide more adaptability. Safety and capacity will continue to be important, but now additional focus will be on resilience and sustainability, which can be framed as durability and adaptability. One good example of this is the modular construction of Terminal C at Dallas/Fort Worth International Airport, which allowed the terminal to be built quickly.

**Scott Tumulo** added that the definition of resiliency has changed in the minds of airport planners, such that financial resilience is now equally important as environmental resilience. There will always be a need for capacity and safety, but to make progress on sustainability and resilience, airports need to design infrastructure differently.

**Kevin Cox** added that there is a lot in urban mobility that the industry needs to unlearn. The market is emerging quickly, and many people do not appreciate that some of these vehicles are more advanced than others and are only a year or so out from operating. The industry needs to build infrastructure for them to operate (vertiports). These vehicles will operate with different business models: from airlines (city to airport), between two cities, and intracity. Each model solves a different problem and has different needs. All have different challenges, the most important being electricity, which is a significant need. These vehicles also need charging equipment, and there are many different types of aircraft, all with different charging and other infrastructure needs. Cox believes there will be situations in which some communities/airports embrace new technology and others fight it. Cox added that the business model of urban mobility is centered around addressing the first- and last-mile challenge.

On the topic of innovation and technology, the panel focused on a number of changes that will affect airports, including fueling [either sustainable aviation fuel (SAF) or hydrogen], cybersecurity, and how to implement changes in technology before they are stale. Airports will continue to evolve toward being places where people gather for nonaeronautical reasons (e.g., airports becoming comparable to shopping malls).

Regarding passenger experience, the focus of the panel's discussion was how to be more flexible in accommodating passengers and their baggage, and especially how to make the passenger journey frictionless and touchless, a lesson airports have learned from the COVID-19 pandemic.

Regarding alternative delivery methods, **Naja** indicated that the success of alternative delivery projects depends on the procurement process: good procurement processes educate stakeholders and regulators; bad ones drive talent away. For example, when connecting electric vertical take-off and landing (eVTOL) aircraft to existing airports, planners should decide whether the vertiport should be airside or landside, depending on stakeholder/passenger needs. One example is the siting of a vertiport at Palm Beach International Airport. The location of the facility is outside the airport by design, in order to avoid security; however, it is near the rental car facility to provide access for passengers and allow them to have a more seamless journey over that last mile.

## Panel Session 4

### Airspace Integration and New Entrants

Amanda Simpson, *Airbus Americas*, Moderator

#### *Speakers*

Max Fenkell, *Joby Aviation*

Max Li, Sr., *MITRE Center for Advanced Aviation System Development  
and University of Michigan*

Leslie Riegle, *Boom Supersonic*

The second panel in the infrastructure theme addressed airspace infrastructure, modernization and transformation, the integration and impact of new and reimagined technologies such as supersonic and hypersonic aircraft, commercial space, integrated multimodal networks, AAM, and automation.

The first question **Amanda Simpson** posed to the panel was, “In 10 years, how will airspace be different?”

**Leslie Riegle** responded that airspace will include supersonic aircraft that will be taking off and landing at higher rates of speed than current aircraft. However, this should not result in significant changes to airspace integration, as these aircraft will be at 60,000 feet altitude, and will not pose a conflict.

**Max Fenkell** added that AAM will not need new infrastructure; AAM can operate in the system as it is, but the pressure on the aviation system will be as a result of scale. Dense urban environments likely will be different from rural environments.

**Max Li** responded that from a systems perspective, there are different issues, depending on the technology. Urban air mobility (UAM)/AAM can use legacy infrastructure, but at scale there may be issues. The industry may need to evaluate autonomous air traffic control. For supersonics, the industry will have to evaluate upper airspace, which is currently reserved for high-altitude weather balloons and military operations. Commercial space operations have the most interactions with current airspace during launch and re-entry.

**Simpson** asked Riegle about supersonics: If overland flight is still prohibited, what will be the impact to Boom’s business case? **Riegle** responded that Boom’s business case assumes that supersonic operations will only occur over the ocean, although the aircraft could fly more effectively without restrictions.

**Simpson** asked Fenkell about weather restrictions for AAM activity. **Fenkell** indicated that Joby is partnering with Garmin to certify instrument flight rules (IFR) equipment and noted that it is hard to do high-volume IFR operations under the current environment. The leading markets for UAM are mostly those that have generally good weather. However, this is not a restriction to beginning operations.

**Simpson** asked Li if the current American air traffic management system is scalable. **Li** responded that managing air traffic flow is currently a great challenge. Disruptions in the national airspace today are generally to enable controllers to focus on deconflicting the 15%–20% that are problematic. Academia is trying to define the next-generation airspace with a goal of lightening controller workload.

On the topic of sustainability, **Simpson** asked Riegle how Boom will meet its net-zero commitment when SAF is not net zero. **Riegle** responded that Boom is looking at power-to-liquid fuel<sup>13</sup> and is also incorporating specific features in engine design to make the aircraft 100% SAF capable from the beginning. Boom's operations will, as a whole, not be completely net-zero emissions, but its aircraft will be flying with 100% SAF.

**Fenkell** acknowledged that Joby will be pulling power from the grid and that consumption will be high until the grid is decarbonized. Joby has just completed an evaluation of its carbon footprint and will take sustainability into account in the design of its facilities. Last year, Joby announced a partnership with Signature and JetBlue for in-sector offsets. This will allow the sector to meet net-zero standards by 2050.

**Li** indicated that air traffic management options include ground holds both for safety and to save fuel; holding at the gate for an extra couple of minutes will add to significant fuel savings rather than queuing. These are complicated challenges to network optimization, but they are solvable. Similarly, unrestricted climb and delayed descents also result in optimal fuel burn for sustainability.

**Simpson** asked the panel to address their noise challenges.

**Riegle** indicated that noise is Boom's "Number 1 hurdle." At the airport, Boom will meet current subsonic noise standards, though she acknowledged that Stage 5 will be difficult to meet. Some of the design changes with materials will allow the Boom Overture to be more lightweight and have better performance.

**Fenkell** also responded that addressing noise is fundamental to Joby. Electric propulsion is a game changer, but electric vehicles will not necessarily be quieter. Joby has designed high torque motors and will spin propellers slowly, always catching new air. Joby believes this will result in noise levels of 65 decibels at 100 meters' hover and 45 decibels during overflight. Joby does not believe that this will be a community concern in an urban environment.

**Li** indicated that implementation of GPS has allowed for precision approaches that resulted in concentrated approaches. Air traffic managers are now evaluating how to spread that traffic to reduce noise complaints. From a research perspective, while spreading out the noise would be interesting, it would have a negative effect on efficiency. There are two design points to consider: maximum efficiency, which results in maximum noise impact; or maximum dispersion of noise, which is less efficient operationally.

---

<sup>13</sup> Power-to-liquids, or PtL, is a production pathway for liquid hydrocarbons based on electric energy, water, and carbon dioxide as resources.



**Simpson** asked Fenkell if vertiports would have a significant impact on the community.

**Fenkell** responded that Joby is focusing on building vertiports only in communities that want them and where there are unique community needs. Joby supports legislation that would encourage 1-year planning studies for communities to understand how AAM works in communities.

**Simpson** asked about the business models of AAM and supersonics and what aircraft they would replace. **Fenkell** responded that in a zero-emissions aviation era, each aircraft type would serve a different use case. For example, battery-powered aircraft will allow only about a 150-mile range with four passengers and a pilot. Other manufacturers are looking at different battery technology that would allow different types of operations. In the short term, AAM will be a flexible, small urban aircraft; in the longer term, it might challenge regional jets. Riegle responded that supersonics will play a role in an interoperational future; a passenger might take an AAM to a regional jet to a supersonic aircraft. Boom's supersonic aircraft will be complementary to United's system.

**Simpson** asked about equity issues related to eVTOL: Is there a future vision in which this is a way to get people from suburbs? And what about emergency medical services? **Fenkell** responded that there are many use cases, including cargo and medevacs. In the early days, Joby needs to focus on a single-use case for certification, but it will expand as it moves to other use cases.

**Simpson** asked the panel, "What is biggest gap/congestion point in infrastructure that needs to be addressed?"

**Riegle** responded that Boom has designed its aircraft to fit with existing infrastructure and will not require modifications. However, the biggest challenge may be supplying 100% SAF, as availability may be a challenge for operations.

**Li** also acknowledged that standard airport environments will be sufficient for eVTOL operations. There may be some challenges finding areas that will not interfere with existing arrival/departure routes. These will need to go through master plan cycles with airports to be implemented.

## Panel Session 5

### Technology and Innovation

Aneil Patel, *Airports Council International—North America*, Moderator

#### Speakers

Brian Cobb, *Cincinnati/Northern Kentucky International Airport*

Kwang Chen, *Massachusetts Port Authority*

Zihong (Zee) Gorman, *San Francisco International Airport*

Jimmy Hahn, *CLEAR*

This session focused on how technologies can increase passenger experience and efficiency, as well as nonaeronautical revenue.

**Aneil Patel** began the discussion by asking panelists to identify one example of technical innovation from the pandemic that will last.

**Kwang Chen** responded that Boston Logan International Airport (BOS) has experimented with a number of applications, including virtual queueing and a security reservation system for travelers. The Massachusetts Port Authority (Massport) has implemented indoor wayfinding and is now looking at a system for its garages.

**Jimmy Hahn** agreed that touchless experiences, such as quick response (QR) codes, are going to stay. For example, CLEAR has moved to mostly using eye scans instead of fingerprints and is now at 85%–90% for that technology.

**Zihong (Zee) Gorman** responded that San Francisco International Airport (SFO) had developed a continuity plan that assumed 50% of staff would not be able to work after the SARS epidemic. Then, when the COVID-19 pandemic hit, 100% of staff went home, constantly texting and on video calls. SFO's lessons learned include the following: the importance of predicting and the need to be ready to change (i.e., to be agile), especially when technology is obsolete so quickly.

**Brian Cobb** talked about the growth of Amazon Prime Air over the pandemic. Cincinnati/Northern Kentucky International Airport (CVG) is Prime Air's mega hub. As a result, Amazon is expanding and is looking for 2,000 more staff. CVG was already understaffed, and airlines are also understaffed. CVG has worked with the state of Ohio to attract a firm to convert baggage tugs to autonomous cargo tugs, so as to reduce the need for baggage handlers. CVG is the only airport to have autonomous Level 5 tugs operating around people and aircraft on ramps.

**Steve Van Beek** asked the panel about data privacy, specifically, what information the panel is requiring tenants to provide about its customers.

**Chen** responded that Massport collects a lot of data but it is not yet mining it. The passenger data will definitely help with decision-making.

**Gorman** indicated that SFO is collecting point-of-sale data and has implemented parking reservations; the airport is looking to connect that information with other data, such as a guest comment system. However, airports do not yet have a structure to respond or analyze the data.

At CVG, said **Cobb**, the airport has implemented an application programming interface and request for proposals that require tenants to share data with the airport. Similarly, while the airport collects a lot of data, it is not doing enough with the data.

CLEAR is an opt-in organization, said **Hahn**, and has committed to its customers that it will never sell its data. However, it is interested in a broader conversation between airports and



vendors to share anonymized data in order to adjust staffing levels and change consumer behavior.

**Patel** asked the panel what skill sets will be needed in the future workforce as airports continue to implement technology and innovation.

**Chen** responded that BOS is automating “back-office functions” to minimize clerical work because Massport cannot find workers. He expects they will need staff who can do more analysis of data.

**Cobb** indicated that airports will need to better understand what automation is and how to implement it, for example, understanding automated flows. He also noted that the industry has lost a generation of skilled trades workers because of the decades-long focus on sending people to college.

**Gorman** said that SFO is seeing the death of the trades and the birth of the unicorns (i.e., people with multiple, adaptable skill sets). In 5–10 years, Generation Z will be entering the workforce, and we still do not know what skills they will have nor what skills the industry will need. On a daily basis, the industry lacks human-experience designers who understand sociology and psychology. The old method of top-down planning is not going to work with this generation.

At BOS, **Chen** expects to see a shift from equipment operators to a more sophisticated skill set on the trades side as the industry automates equipment.

At CLEAR, said **Hahn**, employees must have strong customer service skills but must also be skilled in technology.

**Agatha Kessler** stated that Ph.D. students are in search of data. Would it be possible for airports to share some of these data sets for students to use in conducting research?

**Cobb** responded that CVG has partnered with six universities to develop technology to address the customer experience in various areas of the airport, such as restrooms. He cautioned that wearable devices such as electronic watches are subject to cyberattacks and that airports need to increase cybersecurity.

At SFO, said **Gorman**, the challenge with cybersecurity is to get ahead of those who are ill intentioned.

CLEAR has changed its operational procedures to intentionally evaluate whether security needs to be involved in every meeting, said **Hahn**.

**Yolanka Wulff** noted that the arrival of AAM proposes to turn the whole city into an airport. How will the industry define landside versus airside?

**Cobb** responded that CVG has acquired two general aviation airports that will host the initial wave of AAM operations. CVG has partnered with the State of Ohio and the National Aeronautics and Space Administration to make this a spoke airport with top-five AAM

operators. However, passengers need to fly somewhere within 50 nautical miles, which is a challenge at the moment. CVG finds this is a great location to test cargo delivery and is socializing the product with consumers. CVG expects to do the same thing with drones.

**Patel** asked what role innovation and technology will play in airports' ability to achieve net-zero goals.

CVG, said **Cobb**, is analyzing what will be needed to achieve net zero and whether it will need to partner (e.g., to add a microgrid).

At SFO, IT staff are part of the net-zero committee, said **Gorman**. The IT staff help to measure the consumption level of each building. Sustainability by design starts with the electrical grid.

## Panel Session 6

### Climate Change and Sustainability

Marianne Csaky, *Alaska Airlines*, Moderator

#### *Speakers*

Stephanie Meyn, *Port of Seattle*

Saleem Chapman, *City of Philadelphia*

Adam Klauber, *World Energy*

Stanley Young, *National Renewable Energy Lab*

Climate change is a global threat that requires action from governments, industry, organizations, and individuals. The aviation industry's ability to address its contributions to the effects of climate change and adapt to them is already having an impact on the industry and continues to grow in significance. This panel discussed the challenges and opportunities presented to the future of aviation by a changing physical and regulatory climate.

**Marianne Csaky** started the panel by asking what changes will be seen at airports, assuming they meet 2050 net-zero targets.

**Stephanie Meyn** noted that airports are an energy hub. Airport operators need to engage with internal and external utility providers, including gas, electricity, and liquid. Seattle-Tacoma International Airport has good clean energy. At most airports, capital project planning is integrating a new priority into existing priorities. Revenue-generating projects typically are higher priorities.

**Csaky** asked **Adam Klauber** to talk about SAF, embedded carbon, and hydrogen and electric aircraft.

Klauber responded that aviation needs a license to operate and psychological buy-in by travelers to widely adopt SAF. The cost of implementing SAF will be staggering. The biggest challenge for SAF at present is access to feedstock, which currently costs more than

finished jet fuel. The industry also needs to maximize the use of sustainable lipids, but this is a small percentage of flying in the United States. Finally, the industry needs to look to other technologies. If the industry adds SAF from cover crops, it might be able to increase production, but only to about 30% of demand in the United States. The best technology is alcohol to jet, which means it is from agricultural waste to jet fuel. This technology might provide another 25% to 30%. Finally, power-to-liquid fuel from direct air capture is being studied at a small demonstration plant in Germany. To scale up, the industry will need additional research and development to drive costs down.

Klauber added that he thinks hydrogen is a distraction. Supply chains for hydrogen will be very costly; the industry may be able to build up at large airports, but what happens at reliever airports? Creating international infrastructure to all airports is the biggest challenge.

Klauber stated that electrification may be really good for short-haul aircraft and UAM, but that expectations about its effectiveness should be moderated.

**Csaky** asked **Saleem Chapman** to describe the climate effects of Philadelphia International Airport (PHL) on the community.

Chapman responded that PHL's focus is broad resilience planning—the airport cannot exist in isolation from communities. The industry needs to develop a comprehensive approach to thinking about cumulative impacts. Part of the approach will be focused on EJ implications that airports have had. How does the acceleration of climate impacts affect EJ impacts? As airlines include operations, what are the burdens of extreme heat on EJ communities? At PHL, major developments include a refinery and naval bases that are being redeveloped. Those sites will be taking steps to mitigate their own risk, but PHL needs to make sure that the sites are not making it worse off, and vice versa.

**Csaky** asked **Stanley Young** about the climate impact of transportation to and from the airport.

Young responded that airports are very focused on the energy used at the airport, but not necessarily as a mobility hub getting people to and from the airport. Airports have a great variety of mobility options that users can access, such as cars, shuttles, and ride-hailing services. The airport is a key stakeholder in the larger city discussion about mobility.

By 2050, in certain locations where the population density is above a to-be-determined density, society should make vehicles optional. EVTOL and high-speed rail are all options. The poor perception of public transportation needs to be changed so that more people are willing to use it.

**Csaky** asked how PHL is addressing heat islands and local air quality issues from taxiing aircraft and vehicle traffic.

**Chapman** responded that the most important step is to reduce exposure by reducing emissions. PHL is also looking at sensitivity by identifying who is most exposed, both physically and economically, and whose jobs will be displaced (e.g., outdoor jobs at the

airport that are susceptible to high heat). Climate change is a risk multiplier, but also an opportunity multiplier. PHL intends to use it as an opportunity to align with values, for example, by thinking about how to treat runways to reduce heat island effects.

**Klauber** added that SAF has significant air quality benefits, specifically in the reduction of particulate matter. This is beneficial to ground crews and adjacent communities. A related source is renewable diesel fuel, which can balance out the effect of the fuel used by vehicles coming to and from the airport.

**Csaky** asked panelists to identify some of the biggest hurdles to get to net zero.

**Klauber** responded that to scale up the production and use of SAF, the industry needs to educate the traveling public about the benefits of SAF. SAF presents an alternative to not flying; there is a real antiaviation stigma growing as more nongovernmental organizations promote not flying at all.

**Chapman** responded that the industry will need to continue to do multiple things at the same time. For example, PHL has responded to the pandemic for the last 2 years, had the second warmest summer on record, and experienced a major tropical storm that devastated the adjacent community. Yet the airport and community still consider these isolated incidents instead of developing a holistic response. Airports need to think strategically about how to apply lessons from one risk to another.

**Meyn** stated that many of these barriers are largely psychological but that regulatory change will be required. The future cannot look like the present. The industry needs to talk about putting a price on carbon. Once that happens, the discussion will be transformed.

# Breakout Sessions

---

The discussion panels of the Insight Event addressed the event's four themes, and specific topics within each theme. The structure is presented below.

## Breakout Session 1

### **Workforce of the Future; Airports and Airspace of the Future**

#### *Facilitators*

Mohamed Charkas, *Dallas/Fort Worth International Airport*  
Max Li, Sr., *MITRE Center for Advanced Aviation System Development*  
*and University of Michigan*  
Angel Ramos, *AECOM*  
Rikki Scantlan, *RS&H*

The main theme of the breakout discussions was the social impacts of airports, especially workforce development, including

- How to retract and retain staff.
- How to get children involved in aviation. (Can airports develop more activities for them?)
- The need for critical research on bringing jobs to the industry.
- The need for airports to acknowledge that they do not know what kinds of careers will be needed in the future.

With regard to airport development, the breakout groups discussed the following topics:

- The importance of flexibility in design.
- How to think about making concessions more flexible (e.g., use of modular and/or mobile units or pods instead of fixed structures; seasonal changes in cuisine).
- Partnership between airports and airlines in enhancing the passenger journey. [Passengers do not know that there is a difference in responsibility between airports and airlines, but both need to make the journey frictionless. They need to collaborate not only to provide a great experience but also to identify and address together issues that affect this experience (i.e., the airport collaborative decision-making approach).]
- The importance of sustainability and resilience:
  - Work that needs to happen to achieve net zero by 2050.
  - How what is happening in the utility sector will be critical.
- Lessons learned with COVID-19.

## Breakout Session 2

### Technology, Innovation, and Environment

#### *Facilitators*

Aneil Patel, *Airports Council International—North America*

Brad Rolf, *Mead & Hunt*

Steve Van Beek, *Steer*

Adrian Leung, *Steer*

**Brad Rolf** reported that the theme of his breakout group was “practice makes better.” Following are some common threads included in the discussion:

- 2050 is closer than we think; getting to net zero will be hard.
- Airfield facilities: Airports need to address current and future pain points on passenger facilities and landside.
- The industry should look at how best practices are captured and shared between airports and how data are shared between airports. Could there be something like the Sustainable Aviation Guidance Alliance (SAGA) for collecting and sharing airport energy data?

Research ideas generated by the group included the following:

1. How should SAF be integrated in planning? What kinds of questions should be asked in looking toward net zero?
2. What are best practices for accommodating flexibility?
3. How are airport data being collected and used?
4. How are airports organizing cost centers?
5. What are the industry roadmaps to net zero? How can existing research be leveraged?
6. As airports move functions away from terminals, what does a decentralized airport look like?

**Adrian Leung** reported the following from his breakout group:

- The experience of travel is important with regard not only to intermodal hubs, but to hubs for community activity.
- Airports as data hubs is a key idea for potential research and would allow the industry to develop common standards and practices for airports. The discussion focused on how to leverage the data that airlines and TSA collect. Also, what does it mean for airports to be data hubs?
- How can the industry enable a culture of innovation and risk? How can it create a regulatory environment and incentives?
- How can the industry create a more human-centered environment?

**Aneil Patel** reported that his group identified the following themes and ideas for research:

- Incorporating emerging technology into concession programs to adapt to passenger spending habits, for example, with mobile food ordering. ACRP could develop a guide comparing/and contrasting those programs.
- Data sharing: Airports need to stitch all data elements together to develop operation-wide elements for airports. However, airports need to develop a value proposition for why they want the data and, specifically, how the data will benefit the stakeholder who is asked to share the data.
- Climate change and sustainability: The industry needs to think about how to communicate the message to stakeholders and the general public. Perhaps this communication would include an educational primer of all the initiatives airports are undertaking as well as a communications toolkit.
- AI and machine learning: How can airports incorporate machine learning into their budget cycle and overall airport strategy?
- Small airports and general aviation airports: The industry cannot focus exclusively on large airports, but should identify spin-off projects specifically targeted to small airports.



## Closing Remarks

---

Mary Ellen Eagan, *HMMH*

Rapporteur **Mary Ellen Eagan** provided closing remarks for the event, offering a summary of what she considered to be major takeaways derived from the following key ideas:

1. **Inflection point:** As the world is starting to emerge from the pandemic, we find ourselves in a position not unlike that at the end of World War II. This inflection point provides the aviation industry an opportunity to take stock as it thinks about the challenges of rebuilding the industry. It also provides an opportunity to reflect on lessons learned during the pandemic as well as the opportunity to make permanent some of the positive adaptations the industry made in response to COVID-19, for example, making more things touchless, virtual queuing, and remote work.
2. **More collaboration:**
  - The industry needs to collaborate across the sectors of airports, airlines, and regulators.
  - The industry needs to collaborate outside the sector to engage its neighbors and other transportation planners, utilities, climate planners, and government agencies.
  - The industry needs collaboration within its organizations. These are often stovepiped and could benefit from the perspectives of participants from other disciplines. For instance, meetings of the net-zero committee could benefit from the participation of IT staff who understand technical issues and can communicate them.
3. **A frictionless journey should be the goal of the system:**
  - Aviation is not primarily about airports but about people and about moving them and their goods from one place to another. It is useful to understand and internalize the notion that passengers and customers are the focus of the future of aviation.
  - How does the industry remove those points of friction that exist at every stage of the journey, from booking to aircraft and back home again?
4. **Resilience:**
  - The pandemic has made those in the industry understand the need to build redundancy into the system as well as the need to plan for events that may or may not happen.
  - The industry needs to bring that same attitude to thinking about climate challenges to make sure that the future is not something the industry envisions, but something the industry creates.
5. **Flexibility:**
  - Along with resilience, the pandemic provided a lesson about flexibility. The industry learned that it is possible to do many jobs from home.
  - Another lesson in flexibility the industry is starting to learn is about its workforce in the United States. The old trope that necessity is the mother of invention has driven the development of automated tugs because people were not available. However,



the discussions at the Insight Event also addressed the need to make sure that as jobs are replaced with automation, those workers are given training so that they can add more value to the system in higher-value jobs.

6. Inclusivity:

- Along those lines, there is a need for the industry to think more broadly about the people who are needed to fill the jobs. This means that employers should not hire in their own image, but rather hire for required skills. The industry does not know what the need will be in the future, but it does know that the people who will be hired in the industry will need to be adaptable, will need to be digital natives, and will need to have excellent communication skills.
- The industry should start engaging with students at all levels to interest them in the aviation industry. Eagan stated, “I am one of those people who fell into aviation as a career, but my husband can point to the very day he decided to become a pilot: July 20, 1969. Anyone remember what happened on that day? He was not quite 7 years old.”

7. Sustainability: Sustainability is a balance between the environment, the economy, and equity that will define much of the future of aviation.

Audience members also offered the following comments:

- **Curt Fentress** mentioned that it is essential to have human experience designers or passenger experience designers to “curate” a seamless experience for passengers. These designers will work with airports and architects to plan the infrastructure for a much better passenger experience.
- **Brian Cobb** mentioned that using data to make decisions in airports is still new and rare, but important.
- **Agatha Kessler** posed a questions about cybersecurity: What are airports doing to prevent cybercrime?

## APPENDIX A

# Program Agenda

---

MARCH 22-23, 2022  
WASHINGTON, DC

# FUTURE OF AVIATION



**Event Location:** Keck Center, 500 5<sup>th</sup> St. NW, Washington D.C., Room 100

**Event Dates:** March 22-23, 2022

## ACRP INSIGHT EVENT: Future of Aviation

The aviation industry is constantly changing. Some trends we can predict and others we can barely imagine. As we emerge from the greatest challenge to commercial aviation in recent memory and head into recovery from the global pandemic, practitioners are seeking to understand how the aviation industry can prepare for the next set of challenges and disruptions. Just as deregulation changed the industry dramatically in the 1970s, recent and emerging technologies are currently transforming the aviation industry today. It is important for industry practitioners to understand, prepare for, and adapt to emerging trends such as Advanced Air Mobility (AAM), on-demand aviation services, smaller aircraft and intraregional flights, electrification of fleets and eventually aircraft, commercial supersonic flight, digitization and automation and sustainable aviation jet fuels (SAJFs) for example.

There is no shortage of events that focus on the near-term future of aviation; however, this event provides a venue for thought leaders to discuss and consider the opportunities and trends that will shape aviation and airports in the mid to long term. This in-depth, face-to-face gathering is designed to promote communication and collaboration, foster innovation, and help identify areas of future interest and research. The Future of Aviation Insight Event will bring together experts from across the industry for two days of thought-provoking dialog to consider what the next 20, 30 and 50 years might look like for aviation, centered around four key themes: People, Infrastructure, Technology & Innovation, and Climate.

## DAY 1 MORNING THEME: PEOPLE

**Day 1**

**8:45-9:15 AM**

### **Event Introduction and Scene Setting**

Our Panel Chair and speaker will offer welcoming remarks and set the stage for the event and discussion, provide their insight into what the Future of Aviation could look like in the mid to long term. This session will provide preview of the four main themes of the event – People, Infrastructure, Innovation and Technology, and Climate, and an overview of event outcomes.

### **Speakers:**

- Agatha Kessler, Chairman, Fentress Architects, Aerial Futures and Insight Event Panel Chair
- Gaël Le Bris, Senior Aviation Planning, WSP

### **Passengers and Customers**

The first panel discussion will explore topics and trends related to passengers and customers in our industry. The speakers will consider what the future passenger journey experience will be, what services passengers and customers might want and expect, how automation and

**9:15-10:15 AM**

MARCH 22-23, 2022  
WASHINGTON, DC

# FUTURE OF AVIATION



artificial intelligence will impact or facilitate the journey, challenges and opportunities surrounding passenger data and privacy, public health considerations and more

**Moderator:** Lance Lyttle, Managing Director, Aviation Division, Port of Seattle

**Speakers:**

- Billy Shallow, Director of Innovation and Technology, ACI World
- Patrick Murray, Executive Vice President, SSP America
- Michael Zureik, Lead Engineer, Digital ID Research, SITA

10:15-10:30 AM

*BREAK*

## Aviation Workforce of the Future

The second People-themed panel will focus on the main drivers and trends regarding the future of aviation workforce. Specific topics to be address in this session include the skills and abilities that will be needed in the future, what roles might be replaced by technology, how universities and the academic community are preparing the future workforce, what are the careers will be in highest demand, how aviation will compete with other industries and non-traditional career paths.

**Moderator:** Candace Blair Cronin, Ph.D., Senior Director, Workforce Innovations, ICF

**Speakers:**

- Donald Armstrong, Vice President and Chief Human Resources Officer, Raleigh-Durham International Airport
- Linda Frankl, Senior Practice Leader, ADK Consulting & Executive Search
- Tamera Holmes, Founder and CEO of Aerostar Avion Institute
- Guillermo Miranda, Chief Learning Officer, The Boeing Company

**Keynote Speaker:** Max Hirsch, PhD, Managing Director of the Airport City Academy

Max Hirsh (PhD, Harvard) is Managing Director of the Airport City Academy and a leading global expert on airports and urban development. Dr. Hirsh pioneered the airport urbanism (AU) method: a customer-focused approach to developing airports and planning the airport area. His research and consultancy services focus on airport real estate, non-passenger revenue, and airport-led urban development. Passionate about aviation, he works with airports, municipalities, developers, and design firms around the world to help shape the future of airports and the cities that they serve. Focusing on technology, sustainability,

10:30-11:45 AM

11:45-12:15 PM



MARCH 22-23, 2022  
WASHINGTON, DC

# FUTURE OF AVIATION



innovation, and the future airport business model, his inspirational talks offer a fresh perspective on the key challenges facing airports and cities today

12:15-1:10 PM

*LUNCH*

## DAY 1 AFTERNOON THEME: AIRPORTS AND AIRSPACE

### **Airport Infrastructure**

The first panel of the infrastructure theme will focus on significant drivers shaping airports as they plan, design, and build infrastructure to meet future needs. Panelists will consider topics including: the evolution of airport infrastructure and how to consider multi-modal travel; resiliency to acute shocks and chronic stressors; planning and design for new entrants and flexible infrastructure for changing demands; sustainability and environmental constraints and opportunities like sustainable alternative fuels, electrification, and shifting community and public expectations; automation; increasing types and availability of data; and revenue and financial considerations.

1:15-2:30PM

### **Moderator:**

Khaled Naja, Executive Vice President, Infrastructure & Development, Dallas Ft. Worth International Airport

### **Speakers:**

- Kevin Cox, Chief Executive Officer, Ferrovial Vertiport
- Peter Ricondo, Senior Vice President, Ricondo
- Amit Rikhy, President and CEO, Carlyle Airport Group (CAG) Holdings
- Cindy Simpson, Regional Managing Principal, Gensler
- Scott Tumolo, Director, Terminal Planning, C&S Companies

### **Airspace Integration and New Entrants**

The second panel in the infrastructure theme considers airspace infrastructure, modernization and transformation, the integration and impact of new and reimagined technologies such as supersonic and hypersonic aircraft, commercial space, integrated multi-modal networks, AAM and automation.

2:30-3:30 PM

### **Moderator:**

Amanda Simpson, Vice President, Research and Technology, Airbus Americas

### **Speakers:**

- Max Fenkell, Policy and Government Affairs Lead, Joby Aviation

MARCH 22-23, 2022  
WASHINGTON, DC

# FUTURE OF AVIATION



- Max Li, PhD, Senior Data Scientist, MITRE Center for Advanced Aviation System Development, and Assistant Professor, University of Michigan
- Leslie Riegle, Senior Director, U.S. Policy and Regulatory Affairs, Boom Supersonic

3:30-3:45 PM

*BREAK*

## Participant Breakout Discussions

Our Panel Chair and speaker will offer welcoming remarks and set the stage for the event and discussion, provide their insight into what the Future of Aviation could look like in the mid to long term. This session will provide preview of the four main themes of the event – People, Infrastructure, Innovation and Technology, and Climate, and an overview of event outcomes.

3:45-4:45 PM

## Facilitators:

- Mohamed Charkas, Senior Vice President, Airport Development
- Zach DeVeau, Aviation Planner, Kimley Horn
- Max Li, PhD, Senior Data Scientist, MITRE Center for Advanced Aviation System Development
- Angel Ramos, Senior Project Manager, AECOM
- Rikki Scantlan, Environmental Specialist, RS&H

## DAY 2 MORNING THEME: TECHNOLOGY AND INNOVATION

9:00-9:15 AM

### Preview of Day 2

Opening remarks, synthesis of discussions from Day 1 and an introduction of topics for Day 2 including technology, innovation, climate, and sustainability.

**Speaker:** Gaël Le Bris, WSP

9:15-10:30 AM

### Technology and Innovation

In this session, panelists will touch on a broad range of topics related to emerging technologies and innovation that will transform the aviation sector to inspire participant dialog and

MARCH 22-23, 2022  
WASHINGTON, DC

# FUTURE OF AVIATION



discussion. Topics may include digitization, integration of platforms and data streams, cybersecurity, data verification and validation, artificial intelligence and virtual reality.

**Moderator:** Aneil Patel, Vice President, Air Policy, ACI-NA

**Speakers:**

- Brian Cobb, Chief Innovation Officer, Cincinnati / Northern Kentucky International Airport
- Kwang Chen, Chief Information Officer, Massport
- Zihong (Zee) Gorman, Innovation & Design Director, San Francisco International Airport
- Jimmy Hahn, Vice President, Operations - Member Experience, CLEAR

10:30- 10:45 AM

*BREAK*

10:45-12:00 PM

## **Climate Change and Sustainability**

Climate change is a global threat that requires action from governments, industry, organizations, and individuals. The aviation industry's ability to address its contributions to and adapt to the effects of climate change is already impacting the industry and continues to grow in significance. This panel will review the challenges and opportunities presented to the future of aviation by a changing physical and regulatory climate, including topics such as operational impacts, emerging alternative fuels, electric aircraft, decarbonization, infrastructure requirements, passenger and community expectations, flight shaming, etc.

**Moderator:** Marianne Csaky, Director of Environmental Affairs, Alaska Airlines

**Speakers:**

- Stephanie Meyn, Climate Program Manager, Port of Seattle
- Saleem Chapman, Chief Resilience Officer, City of Philadelphia
- Adam Klauber, Vice President Sustainability and ESG, World Energy
- Stan Young, PhD, National Renewable Energy Lab

12:00 - 1:00 PM

*LUNCH*



MARCH 22-23, 2022  
WASHINGTON, DC

# FUTURE OF AVIATION



## DAY 2 AFTERNOON THEME: CLIMATE AND SUSTAINABILITY

<b>1:00-2:00 PM</b>	<p><b>Participant Breakout Discussion- Technology, Innovation and Climate</b></p> <p>Audience divided into several groups for a breakout discussion on technology, innovation and climate topics. Each group will be managed by a facilitator and will consider the trends in the midterm and long term (2035 vs 2060+), and ACRP research needs.</p> <p><b>Facilitators:</b></p> <ul style="list-style-type: none"><li>• Marianne Csaky, Alaska Airlines</li><li>• Adam Klauber, World Energy</li><li>• Aneil Patel, Vice President, ACI-NA</li><li>• Julia Nagy, Senior Consultant, HMMH</li><li>• Brad Rolf, Business Unit Leader, Aviation Services, Mead &amp; Hunt</li><li>• Steve Van Beek, Director &amp; Head of North American Aviation Steer</li></ul>
<b>2:00-2:45 PM</b>	<p><b>Participants Choice Discussion</b></p> <p>This session is an opportunity for discussion and Q&amp;A on topics provided by participants through a live poll or issues raised during the breakout discussion groups. The moderator will also prompt the audience for future research ideas.</p>
<b>2:45-3:15 PM</b>	<p><b>Closing Session</b></p> <p>Recap of Day 2 discussion, key takeaways, and closing remarks.</p> <p><b>Speakers:</b></p> <p>Agatha Kessler, Chairman, Fentress Architects and Insight Event Panel Chair Mary Ellen Eagan, President and CEO, HMMH</p>

## APPENDIX B

### List of Attendees

---

**Peter Aarons**, Burns & McDonnell  
**Donald Armstrong**, Raleigh–Durham International Airport  
**Geoffrey Ax**, Populous  
**Gloria Bender**, TransSolutions  
**Florencia Bialek**, Illustrate My Design  
**Saleem Chapman**, City of Philadelphia  
**Mohamed Charkas**, Dallas/Fort Worth International Airport  
**Kwang Chen**, Massachusetts Port Authority  
**Brian Cobb**, Cincinnati/Northern Kentucky International Airport  
**Kevin Cox**, Ferrovial Vertiports  
**Candace Blair Cronin**, ICF  
**Marianne Csaky**, Alaska Airlines  
**Basil O. Dosunmu**, Greenville–Spartanburg Airport District  
**Zach Duvall**, The Aviation Planning Group  
**Mary Ellen Eagan**, HMMH  
**Max Fenkell**, Joby Aviation  
**Curtis Fentress**, Fentress Architects  
**Steven Ferrell**, Amazon Web Services  
**Linda Frankl**, ADK Consulting & Executive Search  
**Arturo Garcia**, Avports  
**Michael Goldman**, Silverberg Goldman  
**Zihong (Zee) Gorman**, San Francisco International Airport  
**Jimmy Hahn**, CLEAR  
**Steven Hampton**, Embry–Riddle Aeronautical University  
**Belinda Hargrove**, TransSolutions  
**Sheri Hashemi**, Boeing  
**Max Hirsh**, Airport City Academy  
**Tammera Holmes**, AeroStar Avion Institute  
**Oscar Izaguirre**, HMMH  
**Stacy Jansen**, Burns & McDonnell  
**Brian Kalish**, American Association of Airport Executives  
**Alex Kashani**, American Association of Airport Executives, Northeast Chapter  
**Agatha Kessler**, Fentress Architects  
**David Kipp**, Burns Engineering, Inc.  
**Adam Klauber**, World Energy  
**Gaël Le Bris**, WSP USA  
**David Leech**, Delta Airport Consultants, Inc.  
**Adrian Leung**, Steer  
**Max Li, Sr.**, MITRE Center for Advanced Aviation System Development  
and University of Michigan

**Daniel Liem**, HMMH  
**Lance Lyttle**, Port of Seattle  
**Apoorv Maheshwari**, Quantitative Scientific Solutions  
**Laura McKee**, Airlines for America  
**Scott McMahon**, Morristown Municipal Airport  
**Stephanie Meyn**, Port of Seattle  
**Nayla Mosley**  
**Patrick Murray**, SSP America  
**Julia Nagy**, HMMH  
**Khaled Naja**, Dallas/Fort Worth International Airport  
**Joe Navarrete**, Transportation Research Board  
**Brett Oakleaf**, National Renewable Energy Laboratory  
**Sylvia Palmer**, Airport Consultants Council  
**Aneil Patel**, Airports Council International—North America  
**Greg Pecoraro**, National Association of State Aviation Officials  
**Wayne Place**, North Carolina State College of Design  
**Katherine Preston**, HMMH  
**Angel Ramos**, AECOM  
**Peter Ricondo**, Ricondo  
**Leslie Riegle**, Boom Supersonic  
**Brad Rolf**, Mead & Hunt  
**Nick Ryan**, RS&H  
**Melissa Sabatine**, Neste  
**Nick Sabo**, Winchester Regional Airport Authority  
**Rikki Scantlan**, RS&H  
**Eugenia Schenecker**, Compass  
**T. J. Schulz**, Airport Consultants Council  
**Billy Shallow**, Airports Council International—World  
**Kevin Shertz**, Burns Engineering, Inc.  
**Cody Shulman**, Xovis  
**Amanda Simpson**, Airbus Americas  
**Cindy Simpson**, Gensler  
**Scott Tumolo**, C&S Companies  
**Steve Van Beek**, Steer  
**Rawley Vaughan**, Steer  
**Matthew Wenham**, C&S Companies  
**Leah Whitfield**, The Aviation Planning Group  
**Louis Wolinetz**, WSP  
**Yolanka Wulff**, Community Air Mobility Initiative  
**Stanley Young**, National Renewable Energy Laboratory  
**Yu Zhang**, University of South Florida  
**Michael Zureik**, SITA  
**Barbara Zylinski**, Secure Insights LLC