Urban Air Mobility: History, Nuts and Bolts, and State of the Industry

TRB Policy Session: August 18, 2020

Adam Cohen, Researcher, UC Berkeley

Presentation Overview

- History and Evolution
- Use Cases and the On-Demand Aviation Marketplace
- Potential Concerns with UAM
- Public Perception and Community Integration
- Industry Developments

History and Evolution of Urban Air Mobility

Arrowbile 1937

Airphibian 1946

1910s-1930s

1940s

1950s-1960s

1980s

2010s-2020s

Curtiss Autoplane 1917

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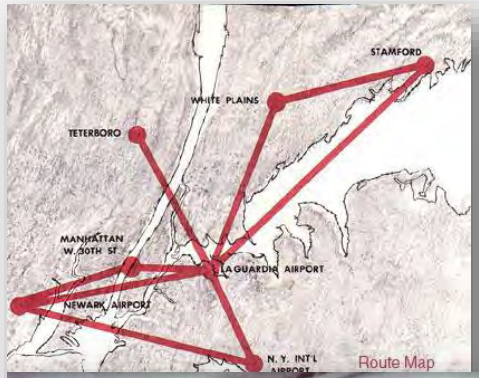
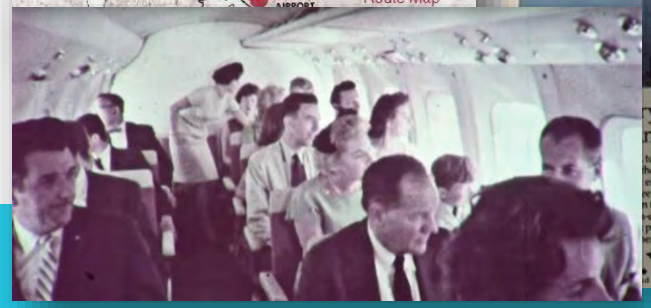
Evolution of Urban Air Mobility Passenger Services



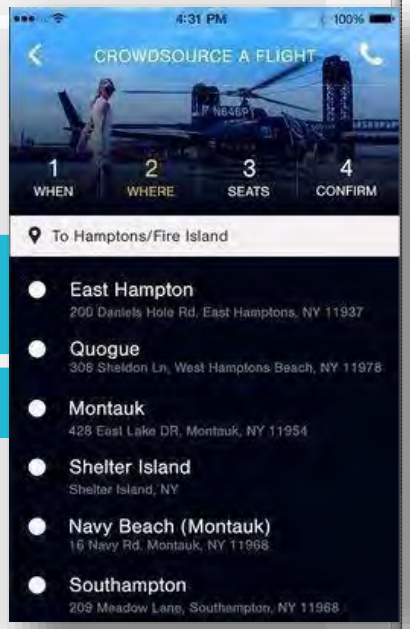


Giuliani Plans To Reduce Copter Flights

One Heliport to Be Shut, To Ease Noise Pollution

By CLIFFORD J. LEVY

Responding to a cascade of complaints about noise and safety, the Giuliani administration said yesterday that it would scale back the number of helicopter flights in New York City by closing one heliport and



1950s

- New York Airways offers passenger services between Manhattan and LaGuardia in the mid 1950s.

1960s and 70s

- Between 1965 and 1968 (resuming in 1977), PanAm offers first/last mile airport connections between JFK and Manhattan/Newark
- In May 1977, a rotor blade breaks off a helicopter on the roof of Manhattan's Pan Am Building, killing 5 people

1980s

- Trump Air provides scheduled helicopter service between LaGuardia and Wall Street, connecting to Trump Shuttle flights.

2010s

- A number of new services launch on-demand helicopter and fixed-wing services that arrange flights between passengers and charter operators
- Notable R&D into electrification and autonomous operations

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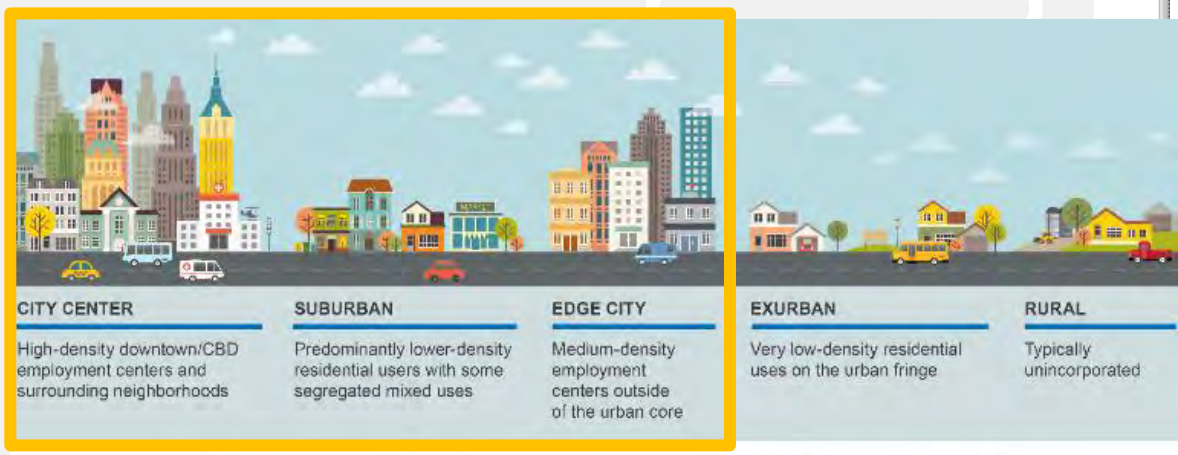
UAM and the Role of the Built Environment

- Advanced Air Mobility (AAM) - *a broad concept focusing on emerging aviation markets and use cases for on-demand aviation in urban, suburban, and rural communities*
  - Local use cases of 50-mile radius and intraregional use cases up to a few hundred miles within/between urban and rural areas
- Strategies must be tailored to meet a diverse array of needs, use cases, and urban contexts
  - Small and rural communities
  - Auto-oriented mega regions
  - Transit-oriented mega regions



Shaheen and Cohen 2017; Shaheen et al. 2017

Use Cases and the On-Demand Aviation Marketplace

- Passenger mobility, goods delivery, emergency response and other use cases using a variety of manned and unmanned aircraft
  - Twelve operational passenger helicopter services globally as of March 2020 (*excludes pre-arranged charter services*)
  - More than 250 vertical take-off and land (VTOL) aircraft and electric rotorcraft under development
- Market valued at approximately $5B USD in 2018
- Forecast Market Potential
  - Global: $74 to $641B US in 2035
  - Goods delivery: $3.1 to $8B US in 2030
  - Passenger mobility: $2.8 to $4 billion US in 2030
- Many studies estimate profitability for passenger mobility and goods delivery between 2028 and 2030

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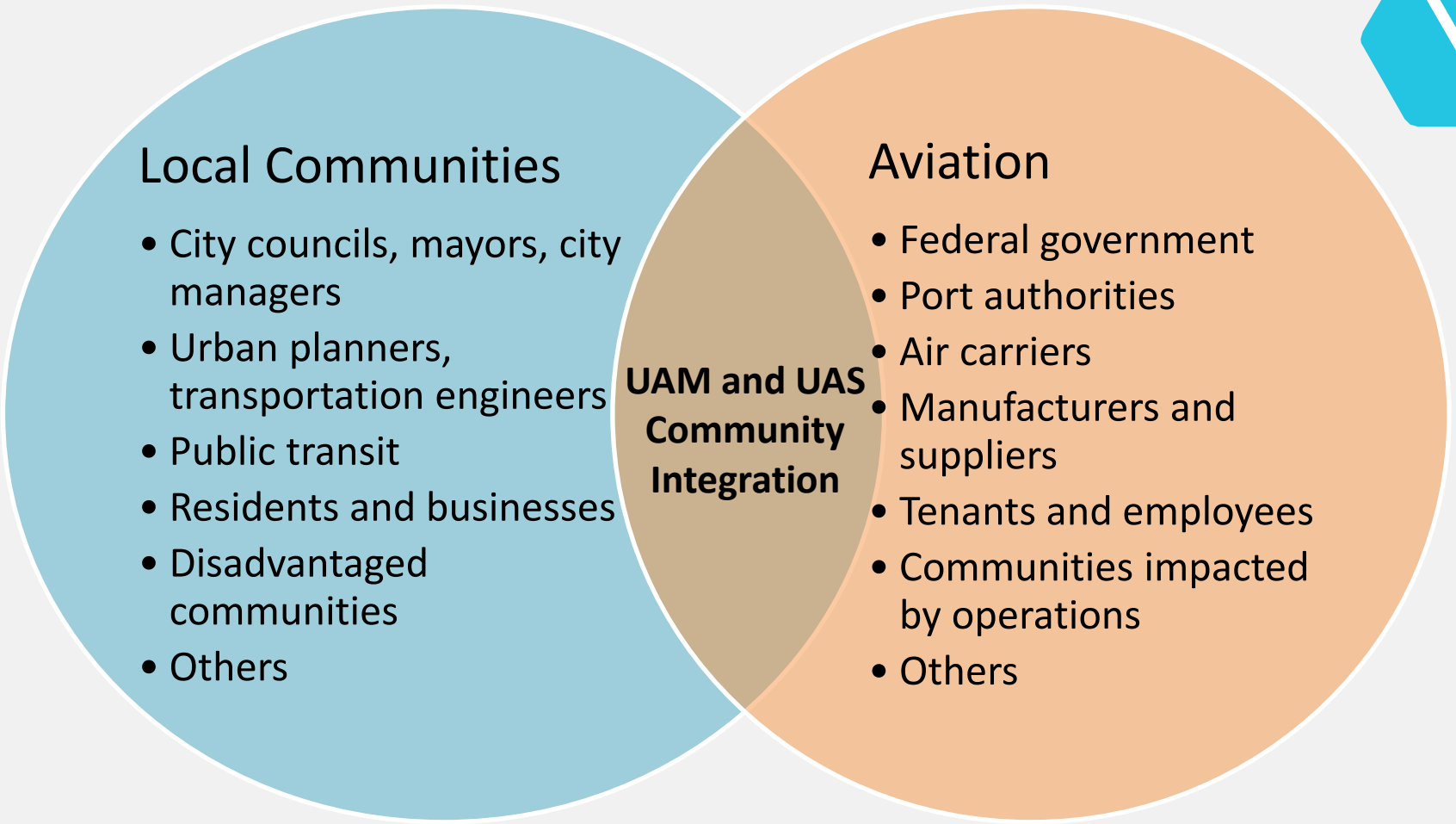
Understanding Community Integration: The Convergence of Two Historically Distinct Disciplines



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Potential Concerns with Urban AirMobility

- Legal and regulatory
- Safety
- Weather and Air Traffic Management
- Equity, Accessibility, and Affordability
- Noise and Visual Pollution
- Privacy and Increased Air TrafficOver Residential Areas
- Impacts of Vertiports on Neighborhoods

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In many cases, more policy guidance is needed for

- Governing the manufacturing, operation, and maintenance of aircraft
- Certifying pilots, aircrew, maintenance, and other ground personnel
- Certifying aviation facilities
- Operating a network air navigation, airspace, and air traffic management facilities, including developing air traffic rules and assigning the use of airspace

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Systemwide Safety Critical Risks

- Flight outside approved airspace
- Unsafe proximity to people and/or property
- Critical system failure
- Loss of control
- Cybersecurity risks

Other issues:

- Autonomy and highly complex software
- Electric propulsion and energy storage
- Unmanned and optionally piloted aircraft
- Ratio of aircraft to operators less than 1

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Weather

- A variety of weather conditions could present a number of safety, operational, and reliability challenges
- Could be an important factor why UAM may succeed in some markets and not others

Air Traffic Management

- **FAA's UAM ConOps** describes the envisioned operational environment to support UAM
  - UAM Corridors
  - Providers of Services for UAM (PSUs)

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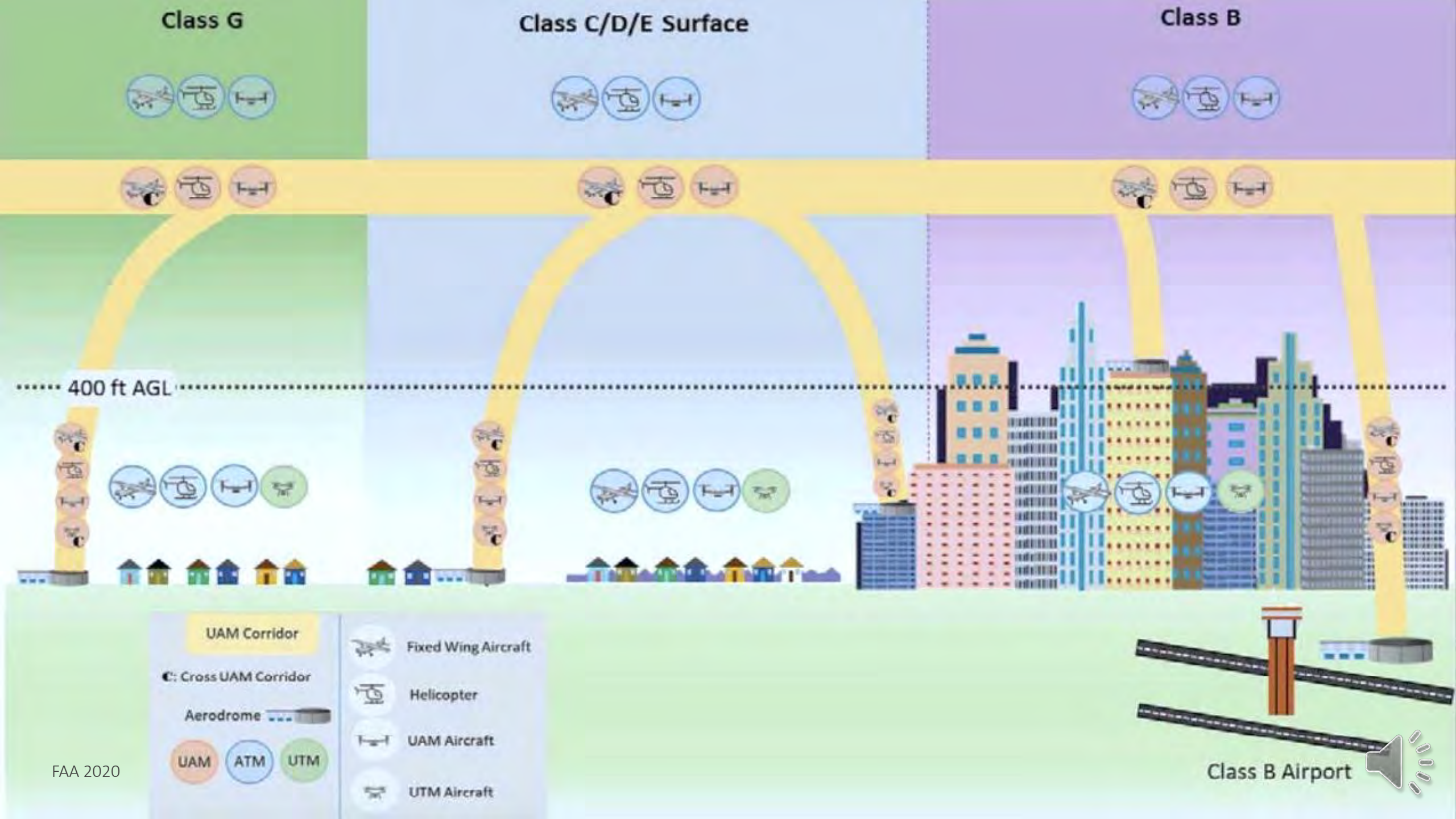
Class G
Class C/D/E Surface
Class B
400 ft AGL
UAM Corridor
C: Cross UAM Corridor
Aerodrome
UAM
ATM
UTM
Fixed Wing Aircraft
Helicopter
UAM Aircraft
UTM Aircraft
Class B Airport

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Equity: Opportunities and Challenges

- ADA access
- Affordability
- Impacts on disadvantaged communities
- Workforce and economic development

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Noise and Visual Impacts

- Aircraft impacts vs. scaled impacts
- Location/land use and time of day
- UAM will likely need to meet a stricter noise standard due to low-level flight over urban areas

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Privacy

- Ability to equip UAS with a variety of cameras and sensors have raised awareness of aerial privacy concerns among communities and civil liberties groups
- Restricting the use of certain equipment, flight over residential land uses, and increasing altitudes over sensitive areas could help mitigate concerns

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Early Understanding of Potential Societal Barriers

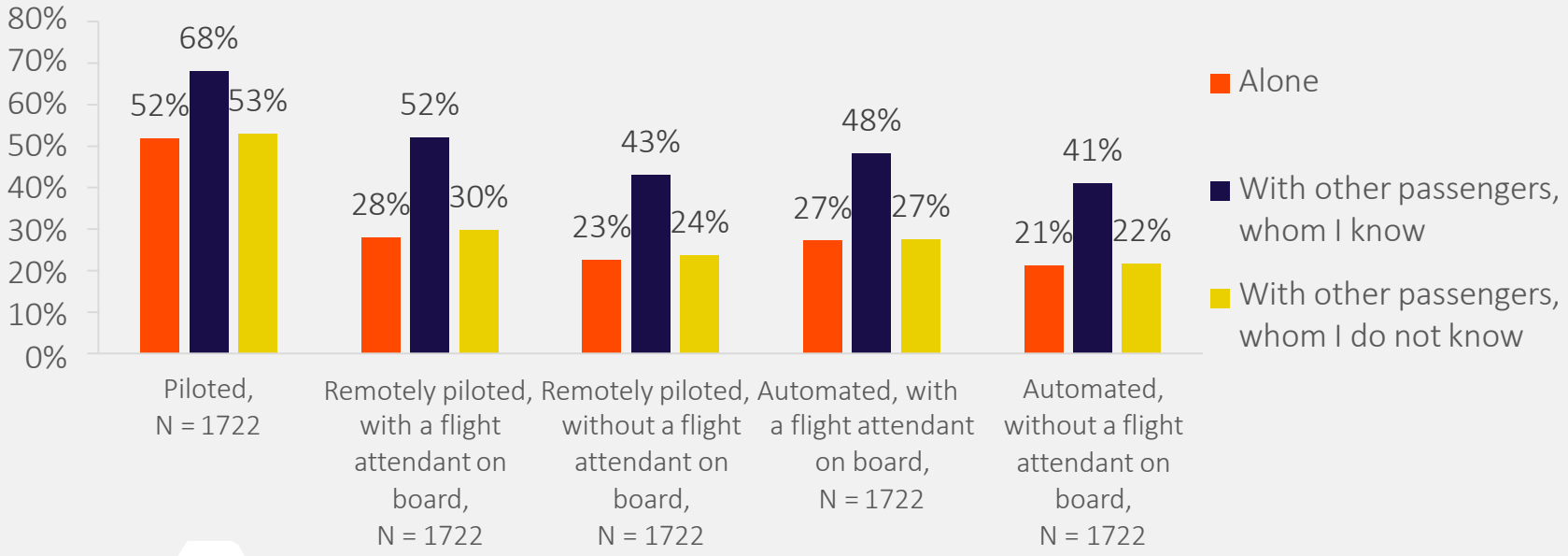
- Generally, neutral to positive reactions to the UAM concept, with some skepticism
- Cost is a primary consideration
- Personal security was an important factor (e.g., confidence in the aircraft, security/safety from flying with potentially dangerous or unruly passengers)
- Some respondents expressed privacy concerns (e.g., people flying overhead, sight lines into homes/yards) and increased noise levels)
- Public perception of fully autonomous aircraft is one of the largest barriers

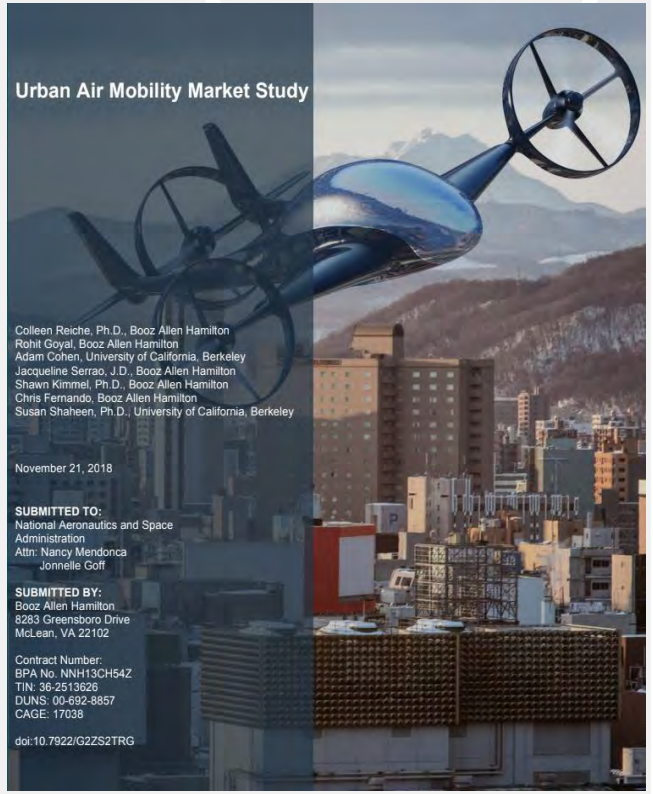
	Excited	Happy	Neutral	Confused	Concerned	Surprised	Skeptical	Amused
GEOGRAPHIC LOCATION				**Survey Results**				
Houston, N = 344	32%	24%	27%	8%	9%	11%	19%	3%
San Francisco Bay Area, N = 337	33%	25%	27%	8%	9%	11%	20%	3%
Los Angeles, N = 345	32%	24%	27%	8%	9%	11%	19%	3%
Washington, D.C., N = 341	32%	24%	27%	8%	9%	11%	20%	3%
New York City, N = 344	32%	24%	27%	8%	9%	11%	19%	3%
GENDER				**Survey Results**				
Female, N = 976	26%	22%	26%	10%	11%	11%	20%	4%
Male, N = 734	37%	23%	23%	6%	10%	8%	18%	4%
INCOME				**Survey Results**				
Less than $10,000, N = 78	14%	17%	40%	8%	3%	4%	10%	3%
$10,000 - $14,999, N = 53	19%	23%	30%	6%	6%	6%	6%	6%
$15,000 - $24,999, N = 101	25%	12%	36%	7%	3%	6%	7%	3%
$25,000 - $49,999, N = 212	28%	15%	27%	8%	5%	3%	11%	2%
$50,000 - $74,999, N = 210	28%	22%	25%	7%	4%	5%	8%	0%
$75,000 - $99,999, N = 192	30%	30%	14%	7%	5%	2%	9%	1%
$100,000 - $149,999, N = 182	36%	14%	25%	4%	6%	1%	12%	2%
$150,000 - $199,999, N = 101	27%	21%	20%	8%	6%	6%	9%	2%
$200,000 or more, N = 112	35%	12%	21%	7%	11%	4%	11%	0%
AGE				**Survey Results**				
18 - 24 years, N = 110	22%	25%	34%	5%	2%	4%	5%	2%
25 - 34 years, N = 271	32%	28%	19%	4%	4%	3%	8%	1%
35 - 44 years, N = 191	43%	16%	17%	6%	5%	2%	8%	3%
45 - 54 years, N = 132	30%	16%	21%	8%	9%	3%	9%	2%
55 - 64 years, N = 178	26%	15%	29%	9%	7%	4%	8%	1%
65 - 74 years, N = 169	14%	12%	33%	9%	6%	4%	18%	1%
75+ years, N = 42	10%	14%	31%	10%	7%	2%	24%	0%

Reiche, Goyal, Cohen et al. 2018

Early Understanding of Potential Societal Barriers

Please select whether you would be willing to travel in an Urban Air Mobility aircraft in the following situations (i.e., piloted, remotely piloted, or automated) by yourself, and/or with other people on board.





Study available at:
https://escholarship.org/uc/item/0fz0x1s2

Reiche, Goyal, Cohen et al. 2018

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Industry Developments

State of the Industry

- **Community Air Mobility Initiative (CAMI)** launched to support local and state UAM stakeholders
- NASA's **AAM National Campaign** aims to improve safety and accelerate scalability through demonstrations and ecosystem challenges in the U.S.
- FAA's recent release of the **UAM ConOps**
- In April 2020, the USAF launched **Agility Prime** to identify opportunities of vertical flight for military applications prior to civil certification
- **SAE JA3163**
- Impacts of COVID-19 uncertain
  - Possibly reduction in R&D
  - New UAS applications could increase exposure to aviation innovations but also raise community concerns
  - Long-term shifts in behavior, such as the growth of telework and suburbanization could change the use cases for UAM

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Thank You

Special thanks to the TRB executive committee and staff

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www.innovativemobility.org