Advanced Air Mobility: Integrating the Third Dimension into Metropolitan Transportation Systems

American Planning Association
August 28, 2020
Advanced Air Mobility: Integrating the Third Dimension to Metropolitan Transportation Systems

Agenda

- Introductions
- What Is Advanced Air Mobility?
- Planning for Urban Air Mobility
- Understanding Infrastructure Considerations
- Understanding Airspace Considerations
- Understanding the Integration Challenge
- Q&A
Supporting the responsible integration of the third dimension into our daily transportation needs through education and advocacy.

CAMI is a 501(c)(3) nonprofit organization dedicated to the responsible integration of advanced air mobility into communities by providing education, communication, collaboration and advocacy.

CAMI understands the importance of connecting communities and industry by working with all stakeholders to develop advanced air mobility that integrates with existing and future urban and regional transportation systems.

CAMI educates and equips state and local decision makers, planners, and the public with the information they need to set policies and design infrastructure and systems to successfully integrate aviation into daily transportation options.
Presenters

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Introduction to Advanced Air Mobility

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TECHNOLOGY IS REDEFINING FLIGHT

 Courtesy of Radius Capital

Tech Drivers

Propulsion
Electrification

Autonomous
Systems

Mobility Services

New Capabilities

Solution Areas

Moving goods

Moving people

Automating tasks

Thematic Benefits

Lowers the barriers for leveraging UAVs to get jobs done
Lowers the operating cost of small aircraft on short routes
Increases the number of access points to the air
Stimulates latent demand for flight where ground transportation is used today
What is Advanced Air Mobility?

Nothing new: regional airline travel and helicopter service (e.g., Blade) are current/historical forms of AAM in service today.

Everything new: electric aircraft make AAM safer, quieter, greener, and more economical than ever before.

Urban Air Mobility, or UAM, refers to shorter distance urban use cases. Regional Air Mobility, or RAM refers to travel over longer distances away from the urban core.

AAM may share airspace with UAS* but is not UAS: autonomy helps pilot operators but (in most concepts) doesn’t replace them in initial operations.

Zones of Operation:
- City Center
- Suburbs to City
- Edge City to (Edge) City
- Rural Access
- Hub Airport Access

Types of Operation:
- Airline (micro haul)
- Air Metro
- On Demand (air taxi)
- Airport Shuttle
- Emergency Services

*UAS = unmanned aircraft systems
Today’s aviation industry operates separately from other forms of urban transportation

- Passengers leave behind the urban environment when they enter airport premises
- Ground traffic is restricted and controlled

Advanced Air Mobility requires aviation to integrate into an existing urban transportation system that has its own challenges

- Traffic Congestion
- Urban Sprawl
- Environmental Impacts
- Transit under/over use
- Noise
- ... and others
AAM also requires the aviation industry to interact with new jurisdictions and players

- FAA – certification, airspace management
- Federal code & preemption
- State and local regulations – e.g., land use, zoning, transportation regulation
- State common law – liability, property rights, nuisance
Public Acceptance is multifaceted.

- Vehicles
- Vertiports
- Operations

- Emergency Services
- Increased travel options
- And More

- Existing transit
- Curb space
- Grid capacity
- Social equity

- Noise
- Visual
- Emissions
- And More

Safety

Public Benefit

Integration

Limited adverse impacts

© CAMI 2020
Reduced need for vehicle traffic within urban core

Reduced emergency response times

Increased range of access to the urban core

Additional transportation demand management options

Urgency-trip pairing with commuter transit

Some potential public benefits may be surprising

- Stronger connection of rural areas to urban opportunities
- Increased utility of GA airport infrastructure
- Additional disaster response capabilities
- Increased electrification for lower in situ emissions
- Elimination of transportation deserts
- Workforce development and economic opportunities
There will be some level of undesirable impacts. Being transparent about this will help minimize them and build trust with the public.

- Electric vehicles are only as green as their grid and battery disposal
- Visual impact
- Congestion may just shift
- Risk of urban sprawl
- Noise
Integration needs to consider the existing transportation landscape, accessibility, social equity, and secondary impacts.

- Integrate with transit options to provide « urgency travel »
- AAM can address transportation deserts in underserved areas
- Social equity and broad public benefit are important, not just the most profitable locations
- Use zoning advantageously
- Ensure grid capacity
Public Acceptance is multifaceted.

- Are communities prepared to adopt AAM and successfully integrate it?
- Is industry prepared to support communities and make long-term beneficial decisions?
Planning for Urban Air Mobility

August 28, 2020

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Planning for Urban Air Mobility - Overview

- What planners need to know
- On-demand aviation use cases
- Introduction to understanding community integration
- Understanding potential concerns with UAM
- The role of the built environment
- Long range planning considerations
- The “Complete Trip”
- UAM Mobility Hubs
- UAM Infrastructure Considerations

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What Planners Need to Know

- What is UAM and what are the various use cases?
- What are potential concerns with UAM?
- Who, what, and how is UAM regulated?
- What types of tools can planners use to guide the evolution of UAM in communities?
- How does the built environment relate to UAM?
- What are some planning and implementation considerations?
- What is the role of the built environment and how can planners help?

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On-Demand Aviation Use Cases

- 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: $74B to $641B USD in 2035
  - Goods delivery: $3.1B to $8B USD in 2030
  - Passenger mobility: $2.8B to $4B USD in 2030

- Several studies estimate profitability for passenger mobility and goods delivery in the late 2020s and early 2030s

Cohen and Shaheen 2020
Understanding Community Integration: The Convergence of Two Historically Distinct Disciplines

Local Communities
- City councils, mayors, city managers
- Urban planners, transportation engineers
- Public transit
- Residents and businesses
- Disadvantaged communities
- Others

Aviation
- Federal government
- Port authorities
- Air carriers
- Manufacturers and suppliers
- Tenants and employees
- Communities impacted by operations
- Others

UAM and UAS Community Integration

Cohen 2020
Understanding Potential Concerns with UAM

- Safety
  - New aircraft designs
  - Electric range anxiety
  - Remotely piloted and autonomous operations
- Equity, Accessibility, and Affordability
- Visual Pollution
- Noise Pollution
- Privacy and Increased Air Traffic Over Residential Areas
- Impacts of vertiports on neighborhoods

Cohen 2020
Early Understanding of Potential Societal Barriers

- Generally, neutral to positive reactions to the UAM concept, with some skepticism
- Public perception of fully autonomous aircraft is one of the largest barriers
- 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

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<th>Neutral</th>
<th>Confused</th>
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| GENDER | Survey Results | Female, N = 976 | 26% | 22% | 26% | 10% | 11% | 11% | 20% | 4% |
| Male, N = 734 | Survey Results | 27% | 23% | 23% | 6% | 10% | 8% | 21% | 4% |

| INCOME | Survey Results | Less than $10,000, N = 78 | 14% | 17% | 20% | 8% | 3% | 4% | 10% | 3% |
| $10,000 - $19,999, N = 53 | 19% | 23% | 20% | 6% | 6% | 6% | 6% | 6% | 6% |
| $20,000 - $24,999, N = 101 | 25% | 12% | 30% | 7% | 3% | 6% | 7% | 9% | 3% |
| $25,000 - $49,999, N = 212 | 28% | 15% | 27% | 8% | 5% | 3% | 11% | 2% |
| $50,000 - $79,999, N = 210 | 28% | 22% | 25% | 7% | 4% | 5% | 8% | 0% |
| $75,000 - $99,999, N = 192 | 30% | 10% | 14% | 7% | 5% | 2% | 9% | 1% |
| $100,000 - $149,999, N = 182 | 16% | 14% | 25% | 4% | 6% | 1% | 13% | 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 - 34 years, N = 110 | 22% | 25% | 34% | 5% | 5% | 2% | 4% | 5% |
| 35 - 44 years, N = 221 | 23% | 28% | 19% | 4% | 4% | 3% | 8% | 3% |
| 45 - 54 years, N = 192 | 33% | 16% | 17% | 6% | 5% | 2% | 8% | 3% |
| 55 - 64 years, N = 178 | 30% | 16% | 21% | 8% | 9% | 3% | 9% | 2% |
| 65 - 74 years, N = 169 | 26% | 15% | 29% | 9% | 7% | 4% | 8% | 1% |
| 75+ years, N = 42 | 14% | 12% | 33% | 9% | 6% | 4% | 18% | 1% |

Shaheen, Cohen, Farrar 2019
UAM and the Role of the Built Environment

- Context in the built environment matters
- One size does not fit all
- 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
A Few Key Issues for Planning Consideration

- How is UAM defined in local policies/ordinances
- How should rights-of-way be designed and preserved (vertiport curbspace and airspace access)
- Should there be policy differentiation between use cases (e.g., emergency response, goods delivery, passenger mobility)
- How to manage demand among multiple service providers for vertiport access
- Determining the monetary value of vertiport access
- How to address administrative issues, such as insurance, liability, signage, etc.
Long Range Planning Considerations

The public and private sectors need to work together to:

• **Understand how UAM could fit into the transportation ecosystem**
• **Identify and mitigate societal barriers and equity concerns**
• **Consider inclusion into long range policies and planning**
  • Incorporate UAM into general/comprehensive, community, and specific plans
  • Include UAM into multimodal capital projects
  • Plan to adapt other infrastructure for UAM
• **Planners have a variety of tools at their disposal**
  • Ex. Planning and vision documents, community engagement, form-based code, incentives, overlay zoning, permitting, code enforcement etc.
UAM Mobility Hubs

MOBILITY AREAS

CATCHMENT AREA
The area from which a major destination or transit service attracts people to use its service. The size of a catchment area may vary based on the type of destination/focal point at the core (e.g., a high-speed rail station will have a larger catchment area than a light rail stop).

ZONE
An area with a network of free-floating and station-based mobility options. Typically, up to 30 sq. miles (about 77.7 sq. kilometers).

CORE
Public transit station, major destination/focal point (e.g., government center). Typically, up to 1 sq. mile (about 2.6 sq. kilometers).

Transportation Modes
- Shared mobility, micromobility, public transportation, AVs, UAM
- Last mile delivery, UAS, robots, courier services

Transportation Services
- EV charging, AV parking

Amenities
- Dining, retail, entertainment, fitness

Land Use
- Residential, hospitality, retail, mixed-use, public spaces

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UAM Mobility Hubs: Other Planning Considerations

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- Airspace access
- Aircraft parking
- Battery charging and swapping
- Facility security
- Open access to accommodate a variety of aircraft types, operators, and users
UAM Infrastructure Considerations

• What is the built environment we are trying to serve?
• Are we building new or repurposing existing infrastructure?
• What types of land uses/infrastructure need to be repurposed, renovated, or redeveloped to support UAM?
• What first- and last- mile connections are needed?
• How do we prioritize public transportation, pooled vehicles, and active transportation?
• How do we integrate vertiports into nearby land uses?
• What are the adverse impacts and how do we mitigate them?
Understanding The Infrastructure – The Built Environment

08 28 2020

Darrell Swanson, Director
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Economics of Hydrocarbon v Electric Aviation

Hydrocarbons

- 43MJ/Kg

- Engines require complex engineering = high capital & maintenance costs

- Efficiency only 24%, the rest is noise and heat

- Large aircraft = large airports to process sufficient passengers to pay for the infrastructure

Battery technology is sufficient for:

- eSTOL at 650nm 10 pax
- eVTOL 130nm 4 pax

Electric motors

- 94% efficient

- Electric motors = lower capital, operating and maintenance costs

- Electric motors are 94% efficient

- Operating economics requires long ranges at altitude making aircraft large

- More SM airfields closer to pax origin / destination than LG airports with great surface access

- Todays regional and GA airports will be tomorrows sub-regional hubs + Future Vertiports

Hybrid Options

- Hydrocarbons
- Electric

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# THE NEW TRANSPORTATION LEADERSHIP

The leading tech companies transforming how we get from A to B

## AVERAGE DISTANCE PER TRIP

- **0 – 4km**
- **4 – 6km**
- **20 – 300km**
- **20 – 1000km**

## MICRO MOBILITY

- Bird
- Lime
- mobike
- VOGO
- DIDI
- SWL
- GooFun
- Cruise
- JOBY
- AVIAN
- CHYBA
- Lithuanian InnoSpace

## URBAN MOBILITY

- GOJEK
- UBER
- VIO
- TAYLOR
- WARR
- JAUNT
- AIR MOBILITY
- BlaBlaCar
- FlixBus
- WHEELS UP
- BOOM
- SPACEX

## PUBLIC TRANSPORT

- NIO
- MOIA
- REV CARD
- NURO
- ZEHNT
- Turo
- SoMo
- OUIBUS
- TRANSPO
- ISPACE
- VICTOR
- BENTEN
- SPARK

## SHORT-HAUL TRAVEL

- Spin
- Jump
- Beeline
- Ola
- ZipGo
- SOCAR
- RIVIAN
- CITYGO
- Shuttu
- OORT
- ZELOGS
- STELLAR
- REACTION ENGINE

## LONG-HAUL TRAVEL

- voi.
- coup
- Lime
- Grab
- MOIA
- SYCARDS
- NURO
- Turo
- SoMo
- OUIBUS
- TRANSPO
- ISPACE
- VICTOR
- BENTEN
- SPARK

## TRANSPORTATION OPTIONS

- Scooters
- Bikes
- Taxis
- Ride-Hailing
- Van-Pooling
- Car-Sharing
- Air-Sharing
- Car-Sharing OAM
- Electric Bikes
- Hyperloop

## TRAVEL LANDMOBILITY

Source: Lithuanian InnoSpace

communityairmobility.org
Vertiports - Types

- **Small Airfields** - Existing airfields with close proximity to urban areas with a natural affinity to a destination city.

- **Dedicated Regional / Urban Vertiports** - Purpose built landing facilities for EVTOL and or ESTOL near large urban areas with a natural connection to a destination city.

- **Commercial City Vertiports** - Either existing heliports, city based airports or purpose built vertiports. Key characteristics - ability to handle a high volume of ATMs during peak periods (commuter peaks). Can be single FATO vertiports on the top of buildings. These may be non commercially operated.

- **Support Vertiports** - Purpose built vertiports for the maintenance and or recharging of EVTOL. Can be co-located with other business where there is a synergistic relationship i.e. cargo distribution warehouses.
City Vertiport Concepts

- **Capacity is Key** - Commercially operated city based vertiports will need to have high hourly capacity to service **peak morning and late afternoon demand** to make them financially viable.
- **Location, Location, Location** - Co-location with existing public transport networks is key to helping to secure planning permission. It is not about competition its about complementing.
- **Social Acceptance** - Achieved through demonstrating social utility, low noise impact and accessible to a wider range of society via lower costs to the user.
Start with a plan

- A system plan for the incorporation of electric aviation into the macro regional fabric
  - Identify existing aviation assets both for VTOL and CTOL operations and assess their current contributions
  - Develop a thorough understanding of how electric aviation can enhance or hinder the movement of people and goods in the area of study
  - Assess large vertiport concepts vs smaller vertiport concepts and how they would affect road and public transport systems
  - How will high volume vertiport impact public transport networks? Redistribution and congestion reduction or concentration leading to insufficient capacity at peaks?
  - What airspace restrictions are applicable?
  - Understand what automation does to capacity of vertiports
    - There are natural limits – recharging time, passenger processing space
What Built Infrastructure does Urban Air Mobility Need?

- A good public transportation system
- Acceptance of micro modes of travel and supporting infrastructure/system
- A robust utility system (electricity, water, waste water, hydrogen?)
- Airspace – it's not built infrastructure but it is designed and has a finite capacity
Challenges for Built Infrastructure

- **Space** – Although eVTOL have a relatively small footprint you still need lots of space to site a sufficient number of parking stands and passenger processing facilities to support commercial volumes of traffic.

- **Electricity** – Recharging will require significant amounts of power during peak times thus a robust utility strategy needs to be put in place.

- **Public Transport Capacity** – Ensuring that the public transport system is able to accommodate influx of passengers.

- **Social Acceptance** – Noise & commoditisation of the service.

- **Zoning** – Zones being identified because of other issues which make them incompatible with the service that electric aviation offers.
Example Study: Waterloo Vertiport
London Helicopter Routes
Quieter eVTOL could open new routes
Selection Criteria:
Close to public transport
Preferred approach paths over Thames or dense rail lines
Waterloo Vertiport
Exploded View

- Airfield
- Lift access to aircraft
- PAX process
- Vertical circulation
- Gate lounge ‘pods’
- EV public vehicle drop-off / pick-up
- Interchange Plaza
- Direct connection to station
- Public transport connection: ferry / water taxi
- Vertiport designed to span existing buildings or to be purpose built
- Mixed use functions / opportunities (commercial / offices / F&B)
Interchange Plaza

Sustainable Multimodal Transportation Hub

Vertiport City - How will vertiports influence the local community?

Ref. Airport City by John D. Kasarda
Vertiports need to compliment and not compete with public transportation.
10 mins walk v 10 mins micro mobility
2 Tube Stops + 10 mins micro mobility
Recap – Infrastructure – What you are looking for

- Provides context to aviation system planning linking vertiports and wider transportation system regardless of geographic and local, county, state boundaries
- Understanding of local transportation policy
- Understanding of impact on local road transportation network
- Seeks to compliment and not compete with public transportation
- Drives passengers onto local transportation systems for journeys between 1 & 3 miles which may include commercial micro mobility.
- Addresses social inequality by supporting local job opportunities
Understanding Airspace Considerations

August 28, 2020

Basil Yap, V.P. Hovecon
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Urban and Suburban Airspace

- Mixture of controlled and uncontrolled airspace
- Commercial Service airports, General Aviation airports, heliports
- Segregated operations by altitude and aircraft type
- Utilize geographic features
FAA Urban Air Mobility (UAM) Concept of Operations

- Published Jun 26, 2020
- Joint work of FAA, NASA and industry
- “UAM ConOps Version 1.0 is initial stage of work in progress and the concept will be continuing to mature and modified through ongoing Government and industry stakeholder collaboration.”
FAA UAM CONOPs – UAM Corridors
From CONOPs document:

- Minimal impact to existing airspace traffic management and unmanned traffic management
- Public interest stakeholder needs (e.g., local environmental and noise, safety, security)
- Stakeholder utility (e.g., customer need)
Where does zoning and the national airspace intersect?

- Zoning protects taxpayer's investment in airport infrastructure
  - Airspace Hazards
  - Compatible Land Use

- Authority
  - Airspace - Federal
  - Zoning/Land Use - State/Local
Ohio - Airport Zoning – Chapter 4563

- 4563-02 Airport hazard a public nuisance
- 4563.03 Airport zoning boards
- 4563.031 Zoning regulations
- 4563.032 Adopting federal obstructions standards
- 4563.04 Conflict between zoning regulations
- 4563.05 Airport zoning commission.
- 4563.06 Adoption of airport zoning regulations - procedure.
- 4563.07 Zoning regulations shall be reasonable.
- 4563.08 Determination of airport hazard area.
- 4563.09 Zoning regulations not to interfere with continuance of nonconforming use.
- 4563.10 Political subdivision or zoning board not granted power to prohibit certain uses.
- 4563.11 Administration and enforcement of zoning regulations.
- 4563.12 Permit required prior to substantial change or alteration.
- 4563.13 Airport zoning boards of appeals.
Land

How can local planners approach airspace issues?

- Safety
  - Height limitations, protection of investment, population density

- Noise/Visual
  - Parks, Amphitheaters, Stadiums
  - Building Codes

- Expansion
  - Future growth, sustainability

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Community Feedback Regarding Aircraft Operations

- Noise
- Congestion
- Traffic
- Frequency
- Security
- Safety
Conclusion

- **UAM operational routes evolving**
  - Must integrate with existing manned and unmanned traffic
  - UAM Corridors proposed, evolve over time based on demand
  - Engage in conversation now!

- **Utilize experience and tools from the past**
  - Airport Zoning and Land Use protects existing aviation infrastructure investment

- **Engage all stakeholders**
  - FAA
  - UAM Operators
  - UAM Customers
  - General Public
Integrating The Third Dimension

August 28, 2020

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In Los Angeles, you can reach 12 times as many jobs in an hour by *car* as you can by *transit*. 
Traditional Airport Planning

Project Elements

1. Expand existing Terminal 2 West with 10 new jet gates
2. Construct new aircraft parking and replacement Remain-On-Night (RON) aircraft parking apron
3. Construct new apron and aircraft taxi lane
4. Construct new second level road/curb and vehicle circulation
5. Construct a new parking structure and vehicle circulation serving Terminal 2
6. Relocate and reconfigure SAA Park Pacific Highway
7. Construct a new access road to North Area facilities from Sassafras St./Pacific Highway intersection
8. Construct new general aviation facilities including access, terminal/hangars, and apron on 12.4 acres
9. Demolish the existing general aviation facilities
10. Reconstruct Taxiway C and construct new apron hold pads and new Taxiway east of Taxiway D

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Then, UAM came to town
What is my role?
What happens when the **entire city** is an airport?
What happens when there are many types of aircraft?
Planners now have to decide:

1. What is a city airport or vertiport, exactly?
3. How do I express those desires and changes?
4. If I’m doing this, what does the FAA do?
The Good News

UAM is just another mode of transportation
Where Will They Land?
Land-Use, Landings & Takeoffs

A15E-10

NASA Tooling

Attributes: a, zoning, train stations, power grid, fire stations, hospitals, noise (plus others like Airspace, ground congestion, etc.)
Classification of Vehicles

**A15E-10**

**Energy Class**
- E - Electric
- P - Petroleum

**Vehicle Weight Class (mass / 100)**
- 05 - 500-599 lbs
- 25 - 2500-2599 lbs

**Urban Vehicle Class (A-F)**
- A - Quietest, most acceptable aircraft (Modern Car)
- F - Most Offensive, least quiet vehicle (2-blade helicopter w open tail-rotor)

**Frequency**
- 10 - Landing / Takeoff Events per hour
- XX - Prohibited
- NULL - Unlimited
Land-Use Policy Making

Research, Public Engagement, and Outreach

Framework

Land-Use Policy

Landing & Takeoff

Permitting

Digital Tools

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How will it work?

City Policy & Planning

Digital Policy Tools

UAM Operations & Regulations
Iyana lives in downtown LA and buys a product online.

The Retailer contacts a shipper and notifies that a package is ready to be delivered.

The Shipper dispatches a Class A vehicle to the landing zone in compliance with Land-Use Policy.

The FAA monitors the flight en-route ensuring the vehicle is safe.

The Mayor issues a policy directing public/private partnerships to co-invest in UAM infrastructure.

A City Planner determines where to place this infrastructure and authors a Digital Policy.

The package arrives at Iyana's location according to city policy.

The Shipper was able to deliver the package safely and efficiently.

The city was ensured that the package arrived without disrupting neighbors.
Parting Thoughts

- This future is still very much in development -- you’re right on time
- Now is the time to make your voice heard
- Collaboration & Community Engagement is Key
- Decisions made today will impact the next 50+ years of planning practices
- Technology will be a catalyst
CAMI’s Online Resources

- UAM 101 videos
- Why We Need Advanced Air Mobility for our Cities (coming soon)
- Resource Library:
  - What is Urban Air Mobility?
  - Community Benefits of Urban Air Mobility
  - eVTOL Aircraft: What they are & why they matter
  - Urban Air Mobility Operations Overview
  - Legal Considerations for Urban Air Mobility Part 1: Aviation Law
CAMI’s 2020 Activities:
Executing on our mission
one year after our founding

- Online resource library
- UAM 101 half day workshop for state and local transportation leaders
- Over a dozen presentations at other symposia, conferences, working groups and meetings
- Participation in industry groups including UAM Coordinating Council, NASA AAM Working Groups, NASA / VFS TVF Working Groups, Cascadia Urban Air Mobility Group, WEF UAM Working Group
- Targeted audience webinars – APA, NASAO, etc.
- Topical deep dive webinars (coming soon)

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Supporting the responsible integration of the third dimension into our daily transportation needs through education and advocacy.

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