Urban Air Mobility Business and Market Forecasting

Geo-Coding the Future of Urban Air Mobility

July 27, 2021

Presentation to: North Central Texas Council of Governments
What is Driving Urban Air Mobility

World Population Growth to 2050

- According to the United Nations, the urban population of the world has grown rapidly from 751 million in 1950 to 4.2 billion in 2018.
- By 2050 over 6 billion people may be living in urban areas.
- **Congestion:** Mobility of people, delivery of goods and services, quality of life suffer.
- Urban air mobility has potential to use airspace above cities to restore mobility and decongest city streets.
- Advancement of aerospace technologies, composite materials, batteries, motors and automation systems now make this possible.
Many and Varied Concepts of Urban Operations
84 Cities Studied for Potential UAM Services
We Analyzed 84 Greater Metro Areas

- The metro areas analyzed in this body of research are listed, ranked by GDP in the millions of U.S. dollars.
- Purchasing power parity (PPP) is a method of measuring economic variables in different countries so that irrelevant exchange rate variations do not distort comparisons.
- Note that these cities comprise some 25% of global GDP.
- 37 metro areas are in the U.S.
World Markets for UAM

- UAM Geomatics Analyzed Five Services...
  - Airport Shuttle
  - On Demand Air Taxi
  - Regional (>200Mi) On-Demand
  - Corporate Campus/Business Aviation
  - Medical/Emergency

- Four global supply chains were included by necessity to ensure the business case closes ...

Key:

Revenue Production
Economic Impact

Total Global 84 City Opportunity $1.15 T
What is the outlook for 84 of the most significant metropolitan areas globally, and what policy, technology, and financial issues will individually define their success?

What will be the plan, and the minimum investment to move these urban areas to the tipping point of success?

What is the expected size of UAM markets over the next 25 years, but especially the next 5?

City Demographics
- Population and Density
- GDP per Capita
- Age Distribution
- Airline Enplanements
- Congestion
- Taxi Fleets and On-Demand
- Public Transport
- Emergency Facilities
- Airports and Heliports
- Corporate HQs
- Business Aviation Fleets

Infrastructure Costs
- Nominal Heliport or needed vertiport Facilities
- Passenger Handling
- UATM Systems
- ANSP Interfaces

Vehicle & Supply Chain
- OEM Fleets
- Electric/Hybrid/Hydrogen
- Battery and Charging
- Power Grid
- Supply Chain and MRO

Demand Assumptions
- Phasing
- Pricing

Regulatory and Community Constraints
- Noise
- Safety
- Public Perception

UAM Financial/Economic Tools

UAM Geomatics, Inc.
A NEXA Capital Company

Denotes Unique Supply Chain

IMPLAN

# Infrastructure Cost Components

## UAM Ground Vertiport Infrastructure Components/Costs

- Network design studies
- Environmental study
- Airspace flight approach study
- Concession agreements
- Secure project financing
- Purchase or lease land
- Construction permitting
- Architectural and engineering
- Site preparation
- Site construction
- Foundation modifications
- Platforms
- Egress, walkways
- Elevators
- Passenger shelters
- Lighting landing systems
- CNS systems (ILS, beacons, etc.)
- IT and security systems
- Perimeter systems
- Parking
- Power grid updates
- FAA (etc.) permitting and certification
- Recharging capability and systems
- Fire suppression systems
- Aeronautical chart preparation
- Etc.

## UATM Traffic Management Infrastructure Components/Costs

- UATM interoperability standards and drone/eVTOL agrmts.
- UATM one-time facilities planning
- Site/network optimization study
- Systems specifications
- Power grid studies
- Cyber security architecture studies
- Physical security architecture
- Facilities (offices) rental costs
- Automation Systems and Stations
- Flight Decision Support Tools
- Flight Plan and Flight Operations Database
- SCADA for Systems and Networks
- Computers and Equipment
- Power Grid and Backup Systems
- Network Design and Site Selection Studies
- Weather Information Systems - Areal
- Micro Weather Detection Sensors
- Beacon Navigation Nodes
- Resilient Communications Nodes
- High Density Radar
- Etc.
AAM - Geospatial Mapping of the State of Ohio

- Geographic Boundaries
- Waterways
- Bridges
- Property Boundaries
- Roads
- Major Transportation Corridors
- Surface Logistics Centers
- Water Ports
- Public Lands
- Hospitals
- Blood Banks
- Clinics
- Airports
- High Resolution Airport Facilities Maps
- Heliports
- Military Bases
- Government Buildings
- Transmission Lines
- Electrical Sub Stations
- Traffic Congestion
- NASA Facilities
- Sports Venues
- F1000 Corporations
- Major Manufacturing Facilities
- Part 91 Facilities and Aircraft
- Part 135 Facilities and Aircraft
- Universities and Colleges
- Shopping Centers
- Music Venues
- Zoning Districts (Limited)
- Etc.
Six Ohio Metropolitan Areas

Showing: Hospitals, Blood Banks, Fire Stations, and Universities

Cincinnati
Pop: 2.2M
Metro GDP: $138B

Columbus
Pop: 2.1M
Metro GDP: $130B

Cleveland
Pop: 2.1M
Metro GDP: $134B

Dayton
Pop: 780K
Metro GDP: $48B

Toledo
Pop: 600K
Metro GDP: $36B

Akron
Pop: 700K
Metro GDP: $36B
Ohio AAM Forecast - Key Model Outputs

<table>
<thead>
<tr>
<th>Ground Infrastructure</th>
<th>Demand</th>
<th>2021-2024</th>
<th>2025-2029</th>
<th>2030-2034</th>
<th>2035-2040</th>
<th>2041-2045</th>
<th>SUM</th>
<th>Pillar Totals</th>
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<td>OPEX</td>
<td>$30,378,000</td>
<td>$78,782,000</td>
<td>$142,435,000</td>
<td>$213,474,000</td>
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<td>CAPEX</td>
<td>$80,366,000</td>
<td>$74,474,000</td>
<td>$118,745,000</td>
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<td>UATM</td>
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<td>$7,299,000</td>
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<td>Cost OPEX</td>
<td>$23,614,000</td>
<td>$69,156,000</td>
<td>$35,421,000</td>
<td>$40,481,000</td>
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<td>Cost CAPEX</td>
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<td>$350,162,000</td>
<td>$623,322,000</td>
<td>$1,363,453,000</td>
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<td>$4,609,822,000</td>
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<td>AAM Operators</td>
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<td>$253,564,000</td>
<td>$443,737,000</td>
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<td>Passenger Revenues</td>
<td>$75,999,000</td>
<td>$197,417,000</td>
<td>$348,617,000</td>
<td>$670,269,000</td>
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<td>Emergency Services Revenues</td>
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<td>Cargo Revenues</td>
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Total Impact = $12.97 B
R/I = 5.9
R/I_w = 2.2
Five Logistics Corridors

The 5 major corridors in Ohio connect metropolitan regions, transporting both people and goods across the state.

These corridors provide an important starting point for visualizing Cargo AAM operations, as well as Regional Air Mobility services.
Observations:

- Cargo categories:
  - Time sensitive
  - High Value
  - Cargo Weight 50, 500, 1,000 Lb.

- US-33 is “Smart Corridor” between Columbus and Athens

- Other corridors carry vastly more cargo and freight traffic on daily basis

- I-71 carries most cargo traffic today

- I-80 is projected to grow more rapidly over forecast period
Ohio Economic Impact Results: GDP and Jobs

Observations:

- Ohio’s GDP will increase by an estimated 1.63% annually over 25 years.
- By 2045, AAM will have created over 15,000 new permanent jobs.
- New and existing industries will create high-paying jobs in aviation, engineering, and finance.

Top 10 Occupations (Not in Order)

- Engineering, Intelligent Transportation Systems
- AAM Operators (Pilots, etc.)
- AAM Operational Support (Maintenance, etc.)
- Vehicle Design and Manufacturing
- Business and Financial Operations
- Quality Control and Safety Engineering
- Medical and Supporting Services
- Travel Support Services
- Hospitality
- All Other
Ohio Economic Impact Results: Tax Revenues

Observations:

• Incremental economic growth produces majority of tax revenues; 2019 tax rates applied, over 25 years
• Cities, townships, and counties will earn $464 million in taxes
• Ohio will earn $541 million in state taxes
• Federal taxes increased by $1.5 billion
Thank You!

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Proud Member of AUVSI - Lone Star

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- 400’ Maximum Altitude
- Drones must be registered.
- Required Airspace Authorizations
- Operate within Line of Sight

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THE BASICS

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Software

Planning & Flight

Processing

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DAC Tasking Group 9;  
Improving Low Altitude situational awareness  
for manned and unmanned aircraft  
Subgroup 3

Presenter:  Mark Colborn, DAC Member & Dallas PD

Note: The Tasking Group 9 is aware and members are participating in Tasking Group 10 regarding Gender Neutral Language recommendations for the FAA and aviation community. We will use the term UAS Operator in this set of recommendations and will use agreed-to terms in the future. By “UAS Operator” we include the individual who is controlling the flight of the UAS, frequently called the Remote Pilot in Command.
Task Group #9 Remit

Tasking Group 9 FAA Tasking:

• **Opportunity:** Can Remote ID be used to increase situational awareness between manned aviation that routinely operates at low altitudes away from airports and UAS operating in the same airspace?

• FAA only received 30 responses to their RFI issued in February 2020. Tasked DAC to study issue further.

• **Tasking:** DAC to engage operators in low altitude airspace to obtain feedback on how remote identification might be used to increase situation awareness and use this feedback to develop recommendation on how the FAA can address responses to the RFI.
Sub Group Remits

Sub-Group 1 (AMA, AOPA)
Review available RFI responses; develop survey to send to low-altitude community; interview subject matter experts in industry, government, academia.

Sub-Group 2 (BNSF, UPS)
Explore the applicability of existing/developing technologies to manned and unmanned aircraft including range, human factors, and cost.

Sub-Group 3 (Dallas PD, Skyward)
 Identify areas outside of the scope of Task Group 9 that are important to consider with respect to situational awareness in low-altitude airspace
  ➢ How can information be better used to make the airspace safer?
  ➢ Are there outstanding policy or regulatory discussions?
• Our Recommendations span immediate to longer term
• Each Recommendations was created to assist with the evolution of the Unmanned Traffic Management system

| Voluntary ADS-B-In Use by UAS Operators | Radio use by UAS Operators | Voluntary Onboard Access for Low Altitude Aviators | Voluntary Notify & Fly | Ground Based RID-In Detection Network |
#1) Propose the FAA encourage UAS Operators, developers and manufacturers to implement and use ADS-B-In technologies.

- **Voluntary Use**
- **Builds on UTM ConOps v2.0 Scenario** *V2-3: Option 3 – UAS and Manned Aircraft On-Board Cooperative Equipment*
- **Primary stakeholders:** Both Manned & UAS Operators
- **Considerations:**
  - Leverages an existing technology
- **Work required to make this a reality**
  - ADS-B technologies exist and are on the market today
  - FAA should encourage ADS-B equipage
#2) Propose the FAA considers amending AC 107-2A, Instructions on Radio Communications and How to obtain a FCC Restricted Radio Telephone Operator’s License.

• **Builds on UTM ConOps v2.0 Scenario V2-3**: Option 3 – UAS and Manned Aircraft On-Board Cooperative Equipment

• **Primary stakeholders**: Both manned & UAS Operators. Radio monitoring and usage is of value for all airspace, controlled and uncontrolled

• **Considerations:**
  o UAS Operators do not meet the FCC requirements of Aircraft Station restriction:
  o 47 C.F.R, Part 87 defines Aviation Radio Services, including Aircraft Stations and Ground Stations
  o Leverage training available with the FAA’s WINGS program (As a method of informing Part 61 Pilots about UAS Operations and RID).
#3) Voluntary On-board access to Remote ID information for Low Altitude Aviators

- Propose the FAA develop an acceptance and/or certification path for voluntary adoption of low-cost on-board remote-ID monitoring capability for manned aircraft.

- Builds on UTM ConOps v2.0, Scenario V2-3: *Option 3 – UAS and Manned Aircraft On-Board Cooperative Equipment.*

- **Primary stakeholder:** All aircraft pilots and UAS Operators. Additional stakeholders include all UTM participants, public safety, cities, airports and the general public

- **Considerations:**
  - Suggest the implementation might include current infrastructure and technology; EFB, NORSEE and be optionally TSO’ed
  - **Work required to make this a reality**
    - FAA development of an acceptance and/or certification path for voluntary low cost on-board Remote ID monitoring capability for manned aircraft.
    - Industry production and sale of on-board RID receivers and software for aircraft pilots and owners
    - Leverage Training available with WINGS program
#4) Propose the FAA consider Notify & Fly as a candidate for UPP 3 validation.

- **Voluntary Use**
- **Builds on UTM ConOps v2.0, Scenario V2-3: Option 4 – Voluntary Passive UTM Participation**
- **Primary stakeholders:** UAS Operators as well as manned aircraft pilots
- **Considerations:**
  - UAS Operator and aircraft pilot enters flight intent into app
  - Facilitates increased UAS communications for un-towered, uncontrolled airspace
  - N&F could be a 1st step to educating UAS communities on rigor of UTM
  - **Work required to make this a reality**
    - Recommendation to FAA to evaluate how to scale LAANC-like features in uncontrolled airspace
    - Uncontrolled airports may be good locations for proofs of concept
    - Leverage Training available with WINGS program (As a method of informing Part 61 Pilots about Notify and Fly)
#5) Ground Based Detection Network. Recommendation: Propose the FAA explore methods by which broadcast Remote ID information can be received by ground based Remote ID receivers and transmitted to UTM systems, and when appropriate, to manned aircraft via TIS-B or other mechanisms.

- Builds on UTM ConOps v2.0, Scenario V2-3: **Option 2** – Ground-Based Detection for UAS and Manned Aircraft
- **Primary stakeholders:** Manned aircraft pilots and UTM participants, public safety, cities, airports and the general public
- **Considerations:**
  - Ground based first installations would be near airports & sensitive installations
  - Adds detection of VLOS operators
  - Appropriate filtering would be required for TIS-B.
- **Work required to make this a reality**
  - Development of regulations and UTM industry standards for small UAS
  - Industry development of networked receivers and connection to UTM infrastructure
  - Installation of ground based networked receivers
Thank you for all the work Sub-Group #3!

• A great team with a broad and deep aviation background agreed on these recommendations.

• Academy of Model Aeronautics
• Airline Pilots Association
• Aircraft Owners & Pilots Association
• Agriculture Aviation Organization
• Dallas Police Department
• DJI
• Drone Service Provider Alliance
• FPV Freedom Coalition
• Helicopter Association International
• Influential Drones, Inc.
• Kittyhawk
• Los Angeles Department of Transportation
• National Agricultural Aviation Association
• National Air Traffic Controllers Association
• Northeast UAS Airspace Integration Research Alliance
• Praxis Aerospace Concepts International, Inc.
• Robotic Skies
• Skyward
• University of Alaska Fairbanks
• Wing
• XiDrones, Inc.
HB 1758 (Krause) - Relating to the operation and use of an unmanned aircraft.
  • Defines “drone”
  • HB 1758 also ensures that law enforcement agencies seeking to use drones must adopt written policies detailing the agency’s use of force via drone and transmit those policies to the Texas Commission on Law Enforcement annually.

SB 149 (Powell) - Relating to the prosecution of the offense of operation of an unmanned aircraft over certain facilities.
  • Also adds airports and military installations to the list of critical infrastructure

SB 763 (Powell) - Relating to the creation of the urban air mobility council.
  • TxDOT and the TTC must appoint a UAM council to study policies that will facilitate integration
  • North Texas has been identified as an early test location for UAM
Questions and Comments

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