GAO Work on Issues to Address for Advanced Air Mobility (AAM)

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MISSION

- Support the Congress in meeting its constitutional responsibilities and to improve federal government performance and accountability for the benefit of the American people
- Provide timely, objective, fact-based, nonpartisan and non-ideological information to the Congress
- GAO's mission (and its name) has evolved since its establishment in 1921

General Accounting Office established

1921

Mission: Oversee financial management processes

1970

Mission: Oversee program performance and government-wide issues

Name changed to Government Accountability Office

2004

Mission expanded to cover oversight, insight and foresight

GAO'S CIVIL AVIATION PORTFOLIO

- Aviation Safety and Operations
- Airline Competition and Consumer Protection
- COVID-19 Preparedness, Federal Assistance, and Impacts
- Airport Development and Financing
- New and Emerging Entrants (UAS/AAM/Commercial Space)

GAO'S WORK ON ADVANCED AIR MOBILITY

- TRANSFORMING AVIATION: Stakeholders Identified Issues to Address for 'Advanced Air Mobility' (GAO-22-105020)
  - Consolidated Appropriations Act, 2021 included a provision for GAO to conduct a study of the AAM industry's workforce needs.
  - Final report published in May 2022
- Upcoming report on infrastructure issues and financing (GAO-23-105188) to cover:
  - FAA's current and anticipated future expenses to support safe operation of AAM;
  - Forecasted capital costs of AAM ground-based infrastructure;
  - Considerations for how AAM ground-based infrastructure might be financed; and
  - How the existing excise tax structure that supports the Airport and Airway Trust Fund applies to AAM
  - Final report will be publicly available later this month.

How did GAO perform this work?

- Interviewed AAM stakeholders from:
  - Industry
  - Trade associations
  - Federal, state and local government
  - Advocacy organizations
  - Academia
- Reviewed programs at FAA, NASA, and the Air Force's Agility Prime
- Reviewed literature on:
  - AAM aircraft and operations
  - Workforce

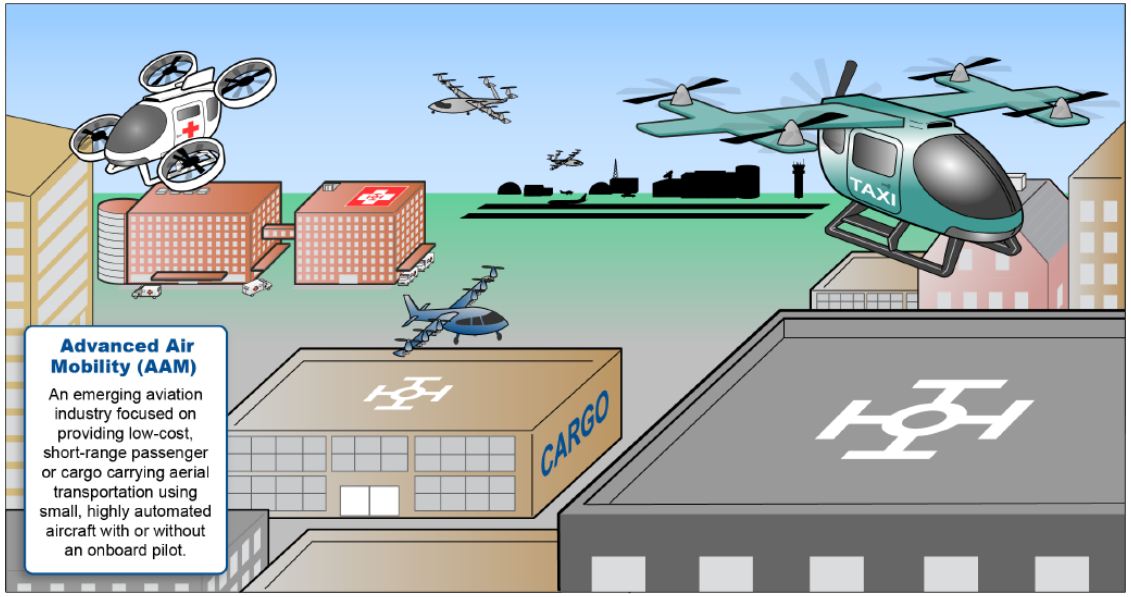
What is AAM?

- According to the Advanced Air Mobility Coordination and Leadership Act of 2022, AAM is:
  - A transportation system that transports people and property by air between two points in the United States using aircraft with advanced technologies, including electric aircraft or vertical take-off and landing aircraft, in controlled or uncontrolled airspace.
- For GAO's AAM reports, we focused on:
  - small, highly automated aircraft operating short-range passenger and cargo aviation services with or without a pilot onboard

Sources: Beta Technologies (left) and © 2022 Wisk Aero LLC (right). | GAO-22-105020

GAO-22-105020: Transforming Aviation

- Issues the AAM industry needs to address
- Challenges in developing a skilled AAM industry workforce
- Timelines for the AAM industry's development



Source: GAO. | GAO-22-105020

Key Issues Identified by Stakeholders

- Aircraft Certification
- Airspace Management
- Public Acceptance
  - Aircraft
  - Operations
- Infrastructure Development
  - Location
  - Funding
- Workforce Development
  - New skills
  - Competing for workers with existing industries

Public Acceptance Issues Identified by Stakeholders

- Public Acceptance of Aircraft:
  - Safety of new technologies
  - Community noise impacts
- Public Acceptance of Operations:
  - Integration of services
  - Close-in locations
  - Public perceptions of who benefits

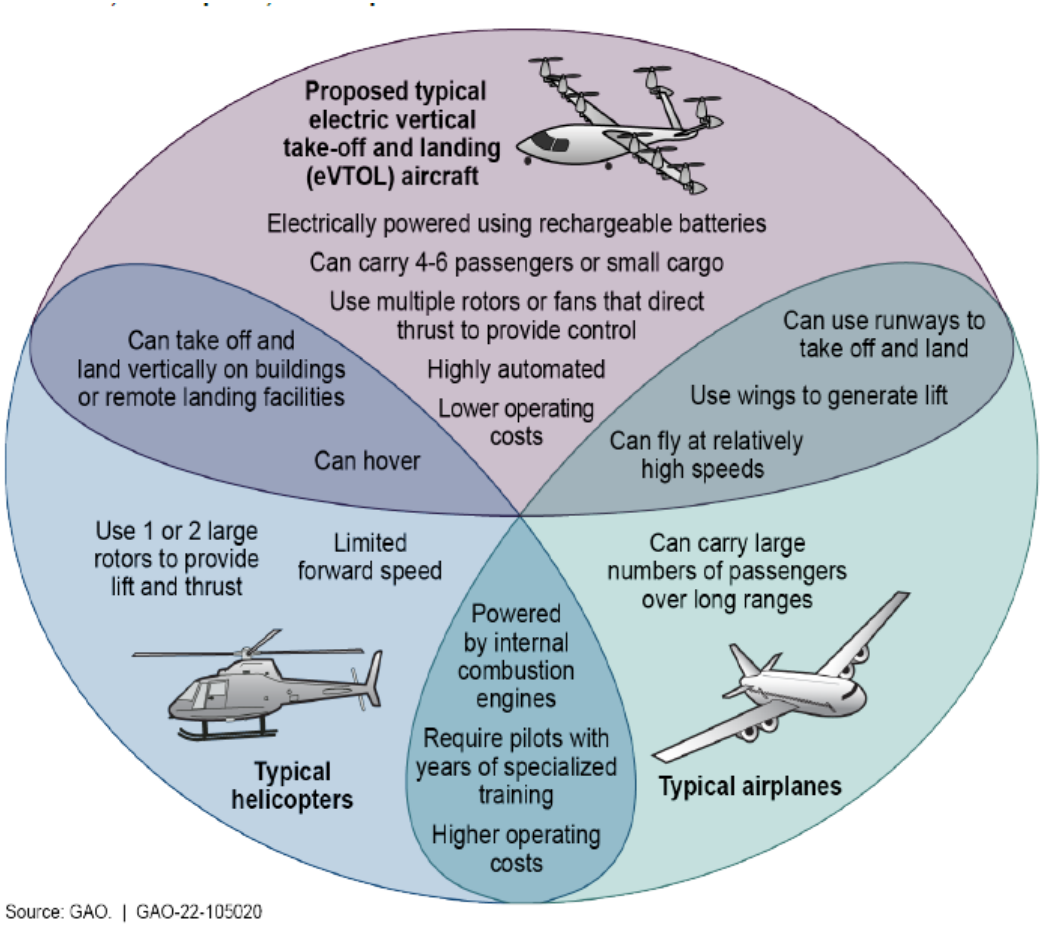
One AAM Industry Stakeholder's Perspective

"The public has yet to embrace a future that includes AAM systems or services. The industry will need to continue to develop important partnerships with communities, as well as demonstrate the capabilities and safety of AAM systems, in order to achieve public appreciation and demand for the new capability."

Source: GAO Interviews with Selected Advanced Air Mobility Industry Stakeholders. | GAO-22-105020

Public Acceptance – Safety of New Aircraft Technologies

- Electric Propulsion
  - New types of motors and propeller controls
  - New systems for energy storage
- VTOL and multi-rotor designs
  - Define what certification standards to use
  - Develop standards for new capabilities
- Automation
  - New types of flight controls that use differential thrust
  - Remotely piloted operations



Source: GAO. | GAO-22-105020

Public Acceptance – Community Noise Impacts

- Electric powered aircraft are quieter
  - For close proximity operations, aircraft will need to be much quieter than existing aircraft
- The exact noise profile of the aircraft is very important
  - Are they closer to helicopters or airplanes?
- Noise location may be different
  - New types of operations could expose new people to aircraft noise

Public Acceptance – Integration of AAM Services

- Complementing existing transportation networks
  - AAM will need to work with legacy networks in order to provide maximum benefits
- Serving all types of customers
  - Equitable access
  - Fit the needs of the entire community

Public Acceptance – Close Proximity Operations

- 'Air Taxi' AAM operations would be in closer proximity to homes, neighborhoods and business than existing aviation services
  - Considerations for noise

- Public confidence in safety
  - Government and operators will need to show safety by conducting safe, reliable operations

Public Acceptance – Who Benefits from AAM?

- AAM as a luxury item for the wealthy
  - AAM operators may face challenges in pricing services to ensure profitability and public acceptance
- Public benefits of AAM services
  - AAM operators should demonstrate how their services benefit everyone in the community
  - Medical transportation or emergency services could demonstrate AAM

Infrastructure Development Issues Identified by Stakeholders

- Types of and locations of infrastructure
  - AAM companies have proposed using new and existing facilities
  - These facilities will require extensive modification and construction
- Financing
  - Sources of funding
  - Public vs. private facilities
- Standards
  - Aircraft charging
  - Takeoff and landing facilities
- Electrical infrastructure upgrades for AAM charging

Infrastructure Development – Financing

- It remains unclear how AAM operators will fund infrastructure projects
  - Will facilities be for public or private use?
- Industry may need to demonstrate viability to secure financing
- We will explore more financing issues in the forthcoming GAO-23-105188

Infrastructure Development – Standards

- New standards for building and operating landing facilities

- Existing helicopter facility standards will not be adequate
  - AAM vehicles use different sources of power
  - AAM vehicles may have different performance characteristics

- Charging standards
  - Avoid compatibility issues such as those in the surface transportation industry

Infrastructure Development – Electrical Infrastructure

- AAM will require significant electrical infrastructure
  - Charging uses large amounts of electricity
- Electricity infrastructure projects are costly and time consuming
  - Many different grid operators and regulators
  - May take years to plan and execute
- Some charging patterns may require grid upgrades for large-scale AAM operations
  - Time of day, frequency, and volume of operations will determine grid impacts

One AAM Industry Stakeholder's Perspective

"Fast charging multiple eVTOLs at the same time (like would be required for high density, quick-turnaround operations) will require megawatts of power to be delivered to vertiports… Developing the necessary electrical standards and infrastructure are major requirements for AAM services to scale up past the initial stages."

Source: GAO Interviews with Selected Advanced Air Mobility Industry Stakeholders. | GAO-22-105020

Workforce Development Issues Identified by Stakeholders

- Training standards
  - AAM jobs will require new skills
  - Curriculum development
- Employment opportunities
  - Industry-wide challenges attracting sufficient workers
  - Potential competition between traditional aerospace and AAM for workers
- Barriers to AAM Industry Employment
  - High education costs
  - Awareness of employment opportunities
  - Cultivating a diverse workforce

Workforce Development – Training Standards

- AAM jobs will require new skills
  - Piloting AAM vehicles requires different skills than traditional aircraft
  - Maintenance on electric motors, batteries, and software instead of engines and metal airframes
  - Engineering for vertical lift is a specialized skill set within aerospace engineering
- Curriculum development
  - Training standards are a chicken and egg dilemma because AAM vehicles aren't yet in service
  - It takes years and significant investments to develop appropriate curriculums

One AAM Industry Stakeholder's Perspective

"Traditional maintenance skills such as repairing fossil fuel powered engines and sheet metal work will be less needed, but eVTOL maintenance technicians will need to know how to work on composites, batteries, electric motors, and advanced electric power control systems, which are not skills that current aircraft mechanics use all that much."

Source: GAO Interviews with Selected Advanced Air Mobility Industry Stakeholders. | GAO-22-105020

Workforce Development – Employment Opportunities

- Aerospace's longstanding challenges attracting sufficient workers
  - Pilots and Aviation Maintenance Technicians are in particular demand
  - AAM's new technologies and employment opportunities may help attract new workers to aerospace

- Traditional aerospace competing with AAM for workers
  - Large-scale AAM services may make existing workforce challenges worse

Workforce Development – Barriers to AAM Industry Employment

- High education costs
  - Many potential AAM jobs will require specialized skills and expensive degrees
  - Stakeholders suggested potential ways the industry and federal government could alleviate the cost of education
- Awareness of employment opportunities
  - The AAM industry may not be highly visible to potential workers
  - Therefore, potential workers may not be aware of opportunities in the sector
- Cultivating a representative workforce
  - Aerospace lacks workforce diversity due to a narrow pipeline of workers
  - Stakeholders told us the AAM sector so far reflects a similar deficiency in recruitment from underrepresented groups

Stakeholder Suggestions for Community Engagement

- Demonstrate safe, reliable, and beneficial operations early
  - Prove that the aircraft are as safe as advertised
- Give priority to medical and public service operations
  - The public is more likely to accept unproven AAM operations for air ambulance or evacuations
  - These operations are an opportunity to demonstrate the safety and capability of AAM vehicles
- Operators and regulators should engage with the broader community
  - Conduct outreach and get input beyond the local airport community
  - Take the lessons of FAA's 'metroplex' airspace redesigns

Factors Stakeholders Identified as Affecting AAM Timelines

- Pace of aircraft certification
- Infrastructure development
- Identifying markets with sufficient demand

Sources: Archer Aviation inc. (top) and courtesy of Joby Aviation. ©Joby Aero, inc. (bottom).

DISCUSSION/QUESTIONS