How the Aviation System Fits Together

Aircraft, Operations, Airspace, and Infrastructure (Oh My!)

One of the most important concepts for communities to understand when evaluating Advanced Air Mobility (AAM) and unmanned aircraft systems (UAS) is that aviation systems do not operate as isolated parts. Aircraft, operational rules, airspace, and infrastructure are interconnected. Changes in one part of the system often influence the others, which is why AAM planning cannot be reduced to a single aircraft, facility, ordinance, or use case.

A useful way to understand the system is to follow the sequence from aircraft to community. Aircraft capabilities and limitations shape what operations are possible. Those operations determine what airspace access, procedures, and protections may be needed. Airspace requirements then influence where infrastructure can be located and what capabilities it must provide. Finally, communities experience the combined effects of those operations and infrastructure through noise, access, safety, emergency response, land use, utilities, workforce, and public benefit.

This relationship is especially important when discussing emerging aviation concepts because many assumptions about safety, infrastructure, and operational readiness are shaped by experiences with traditional airline travel. However, not all aviation operates within the same regulatory, operational, or infrastructure environment. Some parts of aviation are highly standardized and tightly integrated, while others remain more variable, decentralized, or locally dependent.

At a high level, the aviation system can be viewed as five connected layers:

- Aircraft
- Operations
- Airspace
- Infrastructure
- Community

Each layer influences the next. Aircraft capabilities shape the types of operations that can be conducted. Operational rules and mission needs determine how those aircraft may be used. Airspace structures define where those operations can occur and what protections or constraints may apply. Infrastructure provides the physical and supporting environment needed to conduct those operations safely and reliably. Communities then experience the combined effects of aviation activity through land use, public safety, utilities, workforce, economic development, public benefit, and quality-of-life considerations.

Aircraft Certification as the Starting Point

Everything begins with the aircraft because aircraft certification establishes how an aircraft is designed, what safety standards it must meet, what operational limitations apply, how it performs, and what environments it can safely operate within. Those aircraft capabilities then influence the operational rules, airspace needs, and infrastructure requirements that follow.

Under Title 14 CFR Part 21, the FAA establishes the certification framework for aircraft. Different aircraft categories are then certificated under different standards. Part 23 typically applies to smaller normal-category airplanes, Part 25 applies to transport-category airplanes, Part 27 applies to smaller rotorcraft, and Part 29 applies to transport-category rotorcraft.

Emerging eVTOL and powered-lift aircraft do not fit neatly within one traditional category. Under Part 21.17(b), manufacturers may work with the FAA to establish certification criteria using elements from multiple certification standards where appropriate. This allows the FAA and manufacturers to develop aircraft-specific certification approaches while still maintaining equivalent safety expectations.

Aircraft certification influences every downstream part of the aviation system. Larger transport aircraft require longer and stronger runways. Rotorcraft may operate vertically and therefore require different infrastructure and airspace considerations. Some aircraft require instrument procedures, advanced firefighting capability, or additional operational protections. Other aircraft can safely operate in environments where larger or faster aircraft cannot. This is one reason AAM cannot be treated as a single category; different aircraft concepts create very different operational, airspace, infrastructure, and planning requirements.

Operations: What Is the Aircraft Being Used To Do?

Communities rarely experience aircraft certification directly. Instead, they experience operations. The same aircraft may be used in different ways depending on the mission being performed. A drone used for bridge inspection may create different planning, infrastructure, and public-safety considerations than a drone used for package delivery. Similarly, a passenger aircraft, cargo aircraft, air ambulance, and agricultural aircraft may all operate under different rules, despite sharing similar airframes.

Understanding the operation is often more important than understanding the aircraft alone because operations drive infrastructure needs, airspace requirements, emergency response considerations, and community impacts.

Once an aircraft is certificated, operational rules determine how it may legally operate. Different operational frameworks apply depending on aircraft type, mission, passenger carriage, compensation, operating environment, and operational complexity.

Relevant operational frameworks include Part 91 for general aviation operations, Part 103 for ultralight operations, Part 107 for small unmanned aircraft systems, Part 121 for scheduled airline operations, Part 135 for on-demand and commuter operations, Part 136 for commercial air tours, and Part 137 for agricultural aviation. These frameworks establish different requirements for pilot qualifications, dispatch, maintenance, oversight, operational control, crew requirements, weather minimums, and acceptable operational risk.

A Part 25 transport-category aircraft operating under Part 121 airline rules exists within one of the most standardized and tightly regulated operating environments in aviation. By contrast, a Part 27 rotorcraft operating under Part 91 may operate within a much more flexible and decentralized environment. The same aircraft may also operate under different rules depending on the mission. A transport-category aircraft commonly associated with airline service may still operate under Part 91 private-use rules or Part 135 charter operations depending on how it is being used.

This operational flexibility is common throughout aviation and helps explain why aviation governance cannot be reduced to one set of assumptions. When evaluating AAM proposals, communities should ask what aircraft is being used, what mission is being proposed, and what operational framework applies before drawing conclusions about safety expectations, infrastructure needs, or local responsibilities.

Airspace Supports and Protects Operations

Airspace forms the next layer of the system because operations must occur within an organized aviation environment. Part 71 establishes controlled airspace classifications such as Class B, Class C, Class D, Class E, and Class G airspace. These classifications help organize aircraft operations around airports and other aviation environments.

Aircraft operating under more structured operational environments often require more structured airspace protections and procedures. Within these airspace environments, Part 77 establishes imaginary surfaces and obstruction evaluation processes designed to protect aircraft during critical phases of flight, particularly arrival and departure. Instrument procedures developed under FAA terminal procedure criteria further protect aircraft operating in low visibility or instrument conditions.

The highest degree of harmonization exists within the traditional airline environment. A transport-category aircraft operating under Part 121 at a Part 139 airport within protected and highly managed airspace represents one of the most harmonized transportation systems in the world. When communities hear that aviation is the safest mode of transportation, that statement is often most reflective of this highly integrated airline operating environment.

Rotorcraft operations and many emerging AAM concepts do not yet operate within the same degree of harmonized standardization. Rotorcraft operations, private-use facilities, rooftop operations, distributed logistics hubs, and future vertiport environments often involve more variable infrastructure, less standardized oversight, less protected operating environments, and more localized compatibility challenges. This does not mean those operations are inherently unsafe, but it does mean communities should understand that different aviation systems operate within different operational and regulatory environments.

Infrastructure Supports the Entire System

Infrastructure forms the physical environment that supports aircraft, operations, and airspace integration. Infrastructure requirements are heavily influenced by aircraft performance, operational rules, mission type, and airspace complexity.

Part 25 aircraft operating under Part 121 airline service typically use Part 139 certificated commercial service airports. These airports operate under extensive federal oversight and standardized infrastructure requirements involving runway dimensions, pavement strength, firefighting capability, lighting, snow removal, emergency response, maintenance standards, and operational procedures. This creates a highly harmonized operating environment where aircraft certification, operational rules, airspace protections, and infrastructure standards work together in a tightly integrated system.

General aviation operates differently. Part 23 aircraft operating under Part 91 or Part 135 commonly operate from general aviation airports with more variable infrastructure environments and lower regulatory standardization. Rotorcraft infrastructure introduces additional complexity because Part 27 and Part 29 rotorcraft often operate from heliports, hospital landing facilities, rooftop pads, temporary operating areas, and general aviation airports.

Unlike Part 139 airports, heliports do not operate within the same level of standardized federal certification oversight. Although FAA heliport design guidance exists, many heliports and private-use facilities depend heavily on state or local oversight structures, which vary significantly across the country. That distinction becomes especially important for AAM because many eVTOL concepts build upon the vertical-lift operating environment rather than the airline airport environment.

Infrastructure discussions also extend well beyond the landing surface itself. Emerging aviation systems may depend on supporting infrastructure such as charging or fueling systems, electrical grid upgrades, micro-weather sensing, communications systems, navigation systems, surveillance and detect-and-avoid systems, emergency response access, operational control systems, and multimodal transportation connections. Some of this infrastructure may not be visible to the public, but it can still significantly affect feasibility, safety, operational scalability, and long-term viability.

Community Experiences the System

Communities experience aviation differently than regulators, manufacturers, pilots, or operators. Most residents do not interact directly with aircraft certification, airspace classifications, or operational regulations. Instead, they experience aviation through the operations being conducted and the infrastructure that supports them. Noise, visual impacts, emergency response, transportation access, workforce opportunities, utility demand, economic activity, public benefit, and land-use compatibility are often the most visible parts of the aviation system from a community perspective.

This is one reason local governments play such an important role in aviation planning. While federal agencies primarily regulate aircraft, operations, and airspace, communities often influence how aviation integrates with the built environment and how its benefits and impacts are experienced locally.

Why This Matters for AAM

Many AAM discussions focus heavily on the aircraft itself. That focus is understandable because the aircraft are often the most visible and novel part of the system. However, the long-term viability of advanced aviation systems may depend just as much on operational integration, airspace compatibility, infrastructure readiness, emergency response, utility coordination, and community planning.

A highly capable aircraft operating within an immature operational or infrastructure environment may still face significant limitations. This is especially relevant in Utah, where mountainous terrain, high density altitude, rapidly changing weather, wildfire risk, and long regional travel distances may influence which aircraft concepts and operational models become practical.

Understanding how aircraft, operations, airspace, and infrastructure interact provides an important foundation for evaluating future AAM proposals realistically and consistently. It also helps explain why local governments may have limited roles in aircraft, operations, and airspace while still having significant responsibilities related to infrastructure, compatibility, emergency response, and community planning.

Key References

- 14 CFR Part 21
- 14 CFR Part 23
- 14 CFR Part 25
- 14 CFR Part 27
- 14 CFR Part 29
- 14 CFR Part 71
- 14 CFR Part 77

- 14 CFR Part 91
- 14 CFR Part 103
- 14 CFR Part 107
- 14 CFR Part 121
- 14 CFR Part 135
- 14 CFR Part 136
- 14 CFR Part 137
- FAA Order 8260.3
- FAA Advisory Circular 150/5390-2D
- FAA Engineering Brief 105A
- GAO-24-106451, Advanced Air Mobility: Legal Authorities and Issues to Consider for Operations