AEROSPACE, DEFENSE, AVIATION & SPACE

Unlocking the Challenges of Advanced Air Mobility

Advanced Air Mobility (AAM) offers the potential to shift the way people and goods move through the air. Like SpaceX's disruptive entry in the space industry, AAM manufacturers — who produce advanced manned and unmanned air vehicles — are engaged in fierce competition to become pioneers in this emerging field. But are AAM manufacturers ready to lead in their respective product segments? And how should existing aerospace original equipment manufacturers (OEMs) and suppliers react?

Industry players will need to overcome eight challenges to meet the rapidly-expanding sector and the pressures of growing production needs:

1. Understand the Pace of Growth in Innovation and Investment
2. Find Creative Solutions to Ensure Suppliers Can Meet Demand
3. Adopt New Approaches to Rapidly Scale Production
4. Prepare for Disruption Among Incumbent Players
5. Develop Solutions to Establish and Ensure Certification Requirements
6. Optimize Maintenance Repair and Operations Support
7. Take a Lesson Learned from the Electric Vehicle Automotive Industry
8. Prepare for the Future of AAM through Investment, Capital and Plant Footprint Strategies.

The Rising Innovation of Advanced Air Mobility

AAM comprises four broad segments: manned Electric Vehicle Take-Off and Landing (eVTOL), unmanned eVTOL, inter-city e-Regional and cargo drones.

Among the early movers in the manned eVTOL sector, Joby Aviation has secured the largest cash and short-term investments at $924 million by Q1 2024 with plans to enter the commercial market as early as 2025.[1] Trends in lighter unmanned eVTOL platforms are emerging faster in Asia, with companies like eHang from China already in mass production and the South Korean K-UAM consortium demonstrating urban air mobility operations that leverage 5G communications.

At the larger end of the spectrum are e-Regional aircraft. Beta Technologies aims to deliver its CX300 all-electric fixed-wing aircraft in 2025 and Heart Aerospace has secured 250 orders for its ES-30 hybrid-electric airplane, aimed at helping reduce emissions while reaching longer distances.[2,3] Lastly, cargo delivery drones have already transformed the fast delivery of packages and emergency response, particularly in remote areas.

The global AAM market size is estimated at $10.8 billion in 2024 and is projected to continue growing by 17 percent in 2025. The year-over-year compound annual growth rate is expected to exceed 20 percent between 2024 and 2029, resulting in a forecast market size of $26.1 billion by 2030.[4] As AAM technology becomes real, companies will have to overcome a range of challenges as these sectors mature and integrate into everyday transportation.

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1. Company Press Release, "Q1 2024 Shareholder Letter", May 7, 2024
2. AIN, "Hybrid Pragmatism Could Be Vanguard for Aviation's Electric Dreams", Mar 4, 2024
3. Company Press Release, "Heart Aerospace opens US R&D hub, enters new development phase for hybrid-electric airplane", May 15, 2024
4. Barnes Report, "2024 Global High Tech & Emerging Markets", 2024

Supply Chain and Manufacturing

Impact to Established Suppliers

The majority of AAM OEMs are newly-established companies with ambitious goals. For systems and components suppliers, the new customer base adds to the already significant challenge of transforming their product lines and capabilities to meet new requirements. Incumbent suppliers must strategically decide when to transition to serving the AAM market, which capabilities to prioritize, what volume to project and how much investment is warranted.

One approach is to engage early with multiple potential AAM OEMs, diversifying investments across a broader spectrum of AAM platforms. This allows suppliers to hedge against market volatility and OEM financial risk while increasing their chances of success when transitioning to AAM. Honeywell is making this move, expanding its contracts with six AAM partners totaling $10 billion before the end of 2023.[5]

Suppliers need to develop technology roadmaps early and implement agile product development processes to enhance their responsiveness to shifting market dynamics. SpaceX in space launch and Micron in semiconductors have both shown the benefit of aggressive use of agile engineering development processes, enabling them to stay ahead of the innovation curve.

We see clients in rapid agile ecosystems investing in platform-agnostic research and development (R&D), offering a pragmatic solution to the uncertainty over which OEM or platform will ultimately prevail. By focusing on solutions irrespective of specific customer platform requirements, suppliers can future-proof their investments. For example, in the composite industry, investing in out-of-autoclave process development provides the capability to deliver a lower-cost manufacturing process that can be applied to many customer platforms. Similarly, in the software sector, investing in base code that can be tailored for specific applications ensures R&D effort is customer- and platform-agnostic.

The Expanding eVTOL Supply Base

	Archer	Joby	Lilium	Vertical	Volocopter
Airframe	FACC	Joby	Aciturri (airframe)	GKN (wing)	DG Flugzeugbau
			Aernnova (ducts/flaps)	Leonardo (fuselage)	
Composites	Hexcel	Toray	Toray	Solvay	–
Motors	Archer	Joby	Honeywell/Denso	Rolls-Royce	–
Batteries	Molicel	–	CustomerCells/Ionbox	Molicel	–
Flightdeck	Garmin	Garmin	Honeywell	Honeywell	
Flight control	–	Joby	Honeywell	Honeywell	Diehl
Systems	Honeywell (actuators)	–	Mahnaghi (gear)	GKN (wiring)	Crouzet (controls)
Training	–	CAE	LFT	–	CAE

Source: Aviation Week Network

5. Company Press Release, "Honeywell's Advanced Air Mobility Business Reaches $10 billion in Wins to Help Build The Future of Sustainable Flight", Nov 13, 2023

Scaling to Production Volumes

The future demand for AAM vehicles will surpass existing aircraft production rates by an order of magnitude. These unprecedented rates not only shatter the paradigm of established aerospace manufacturing methods, but they also require significant capital investment and skilled labor. Many players, like Lilium and Volocopter, already face significant financial pressures, characterized by large cash burns, but have shrinking funding options.[6]

Manufacturers should embrace agility, and A&M has partnered with clients to configure their manufacturing capabilities to support flexible production processes (see Case Study). This strategy supports the ability to quickly iterate design changes while deploying digital and automation systems to enhance operational efficiency. SpaceX and its fail-fast principle expedites design maturity as well as accelerates development cycles.[7]

By adopting a design-for-volume manufacturing philosophy and design-for-maintenance approach, clients can leverage technology to streamline end-to-end processes and diminish reliance on labor, increase supply chain productivity and eventually achieve targeted lifecycle cost.

A&M Case Study

Situation: A PE-backed unmanned aerial systems manufacturer needed to increase output from less than 100 units per month to more than 300 units per month in less than six months

Our Approach:

- Rapid deployment of A&M Manufacturing Operations System tool suite (Daily Management, SIOP and Change Control Boards)
- Accelerated design, build-out and commissioning of 50,000 square feet of additional production space in less than four months from facility identification to first article

Results Delivered:

- Increased revenue from $8M to $300M in less than a two-year period
- Quadrupled operational footprint for highly-configurable and multi-model assembly line capabilities
- Delivered three times the customer's rate expectations in less than six months

6. Aviation Week Network, "Podcast: Europe's Air Taxi Startups On The Brink", May 2, 2024
7. Medium, "Elon Musk's 6 Productive Principles for Success", July 9, 2023

OEM Business Model

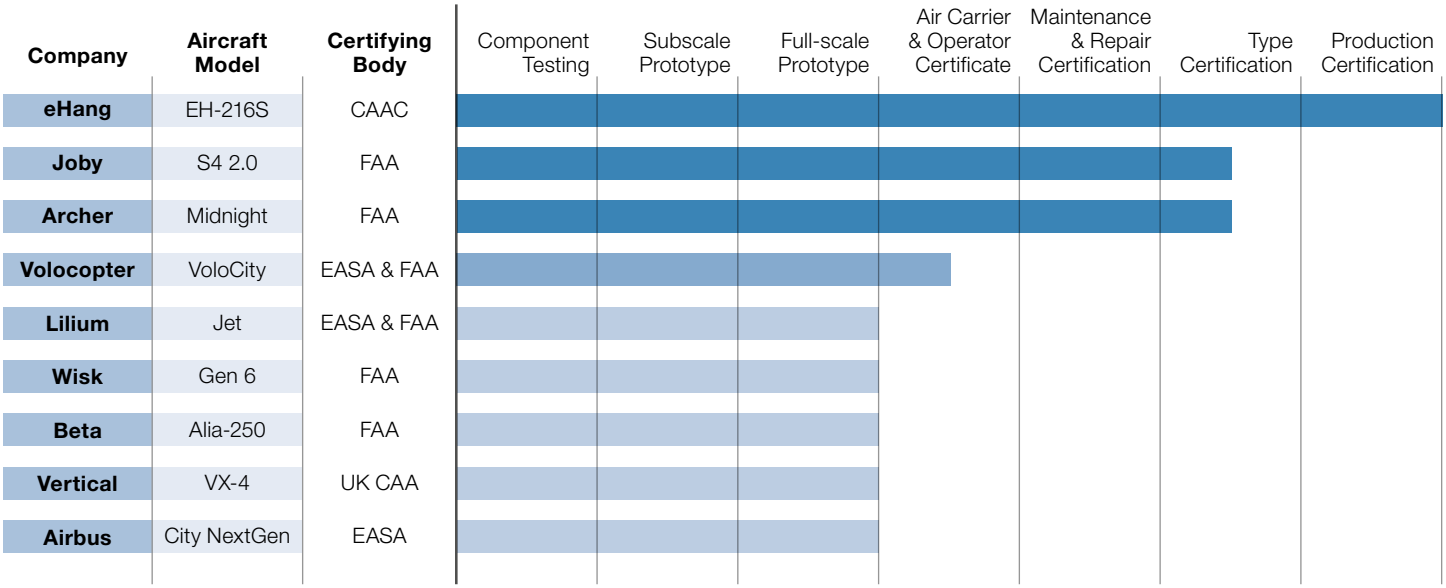
Disruption to Incumbent Solutions

AAM vehicles will compete with helicopters, short-haul and regional airlines, and ground-based transportation, impacting travel preferences, networks and public infrastructure. Incumbent service providers are at risk of losing revenue share as customers adopt AAM services. We believe incumbents need to proactively address current cost structures and be ready for new price point expectations. A key question will be whether they enter the AAM markets themselves, and, if so, when and how.

Existing service providers can always engage with AAM players and explore collaborative business models. When Uber Elevate was sold to Joby, Uber augmented their investment in Joby by $75 million in 2020 and each incorporated their services into each other's apps.[8] Two years later, Delta Air Lines also made an initial investment of $60 million in Joby, aiming to provide mutually exclusive service for a wait-free, home-to-airport experience.[9] Not only do these investments help Joby to mature its technologies, but they also position Delta and Uber to meet customers' growing expectations.

Path Certification

Progress to Certification as of June 2024



Source: Company Press Release, TNMT.com, Aviation Week Network, Aviation International News (AIN)

The Federal Aviation Administration, European Union Aviation Safety Agency and Civil Air Administration of China (FAA, EASA and CAAC, respectively) are actively collaborating with AAM manufacturers to ensure a clear path to compliance and to accelerate the introduction of AAM into existing airworthiness regulatory frameworks. The timeline to secure certification impacts the whole supply chain. Suppliers must accelerate production to provide certifiable subsystems for AAM producers to launch in a timely manner, yet the timelines for certification of operations remain highly uncertain. Honeywell has positioned itself as a mediator between manufacturers and regulators by launching the AAM industry's first certification reference guide.[10] As of July 2024, Joby and Archer have agreed with the FAA final airworthiness criteria for their aircraft, and eHang has secured production certification from the CAAC.[11]

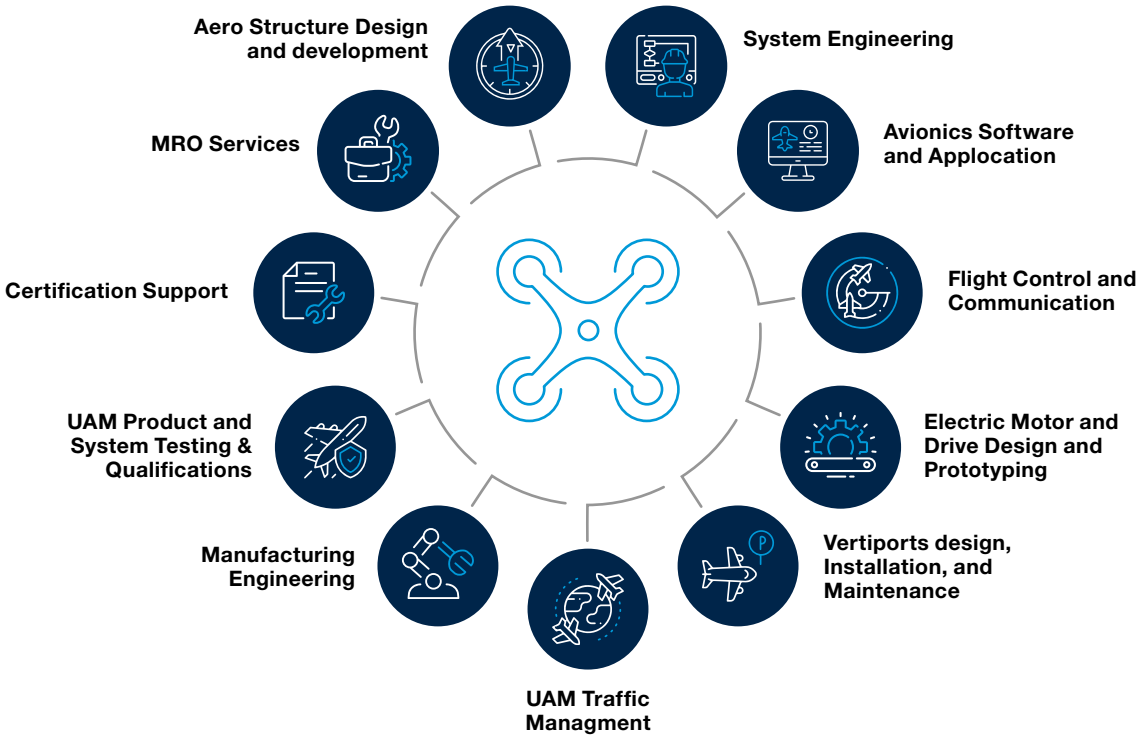
8. Company Press Release, "Joby Aviation Welcomes New $75M Investment from Uber as it Acquires Uber Elevate and Expands Partnership", Dec 8, 2020
9. Company Press Release, "Delta, Joby Aviation partner to pioneer home-to-airport transportation to customers", Oct 11, 2022
10. Company Press Release, "Honeywell Develops Advanced Air Mobility Industry's First Reference Guide on Vehicle Certification", May 8, 2023
11. Flying Magazine, "FAA, EASA Release New Certification Criteria for Air Taxis", June 11, 2024

Support Infrastructure

Establishing Aftermarket and MRO Support

The current lack of standardization in parts and maintenance procedures creates challenges in maintenance, repair and overhaul (MRO) support from day one of commercial operations. A&M has worked with aerospace suppliers to adopt lean principles to produce components with modular standardized design and to have accessible service points. Turnaround time for vehicle maintenance is expected to more closely mirror the efficiency of automobile servicing rather than traditional aircraft MRO turnaround times — hours instead of days or weeks.

Equally noteworthy, deploying predictive scheduling maintenance software and tools can aid service personnel to cultivate specialized skills and harness data-driven insights to address issues before they escalate. Robotic Skies and Continuum Applied Technology are developing Corridor, a cloud-based MRO software tailored to manage hundreds of AAM repair stations.[12] Third-party players as well as OEMs need to invest to create availability, capacity, capability and proximity of MRO services.



Source: L&T Technology Services

12. Aviation Week Network, "Robotic Skies, Corridor Partner on MRO Software for AAM", Aug 2, 2022

Infrastructure Harmonization

Common public infrastructures for AAM, such as vertiports and charging stations, should be harmonized to increase utilization and acceptance among all users. The automotive electric vehicle (EV) industry provides a clear lesson: because electric chargers were not standardized from the get-go, the work and cost of constructing charging stations to support all EVs were massively increased. By aligning interests and pooling resources, industry and participants should pursue interoperability and compatibility across different platforms, fostering overall ecosystem growth.

Preparing for the AAM Future

While the AAM sector presents numerous challenges across the value chain, collaborative solutions from a range of industries can be leveraged to overcome them. In our experience, both current AAM players and those not yet in the sector need to be asking fundamental questions to be ready to address the opportunities and challenges that AAM generates. For suppliers, OEMs and infrastructure providers, here are four key considerations to guide AAM strategy:

1. **Investment Strategy:** How should you diversify your portfolio? Where should you invest, when should you act, which capabilities should you prioritize and what volume should you project?
2. **Capital Needs:** How much investment will be required and is warranted to scale operations at pace and deliver the projected production volumes? What is the financing strategy to support this?
3. **Manufacturing Footprint Configuration:** Given the rapidly changing AAM environment, how are you flexibly configuring your physical infrastructure and manufacturing capabilities?
4. **Business Process Adaptation:** What business processes and product development methodologies are you implementing to ensure responsiveness and adaptability?

With operations starting, a wave of certifications tantalizingly close, launch operations identified, and financial stresses showing, the AAM sector is posed to enter a phase of rapid development and maturation.

Authors

James Marceau
Managing Director
Boston, MA
jmarceau@alvarezandmarsal.com

Lou Peluso
Managing Director
New York, NY
lpeluso@alvarezandmarsal.com

Pablo Wangermann
Managing Director
Dallas, TX
pwangermann@alvarezandmarsal.com

Nick Bowman
Senior Director
Tampa, FL
nbowman@alvarezandmarsal.com

Ars-Vita Alamsyah
Senior Associate
New York, NY
aalamsyah@alvarezandmarsal.com

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