KPMG

Aviation 2030

Passenger use cases in the Advanced Air Mobility revolution

> "
> Within this decade passenger AAM offers quieter and perhaps safer alternatives to helicopter and general aviation, and onward airport shuttle. It is not until meaningful automation - of pilot and airspace - that the cost advantage kicks in. And it is not until this that new use cases really take off. As such, our projections will not happen without that automation. With automation, however, the passenger AAM market will be preferable to less flexible and more expensive infrastructure investment in road and rail.
>
> **CHRIS BROWN, PARTNER,**
> **KPMG IN IRELAND**
> "

> "
> AAM has the potential to unlock demand and new route patterns for air carriers, it will be critical for AAM companies to work with existing air transportation networks to build out capability and trust over time while creating a time-saving alternative that can get passengers from curbside to inside of security and to their destination curbside faster than alternatives.
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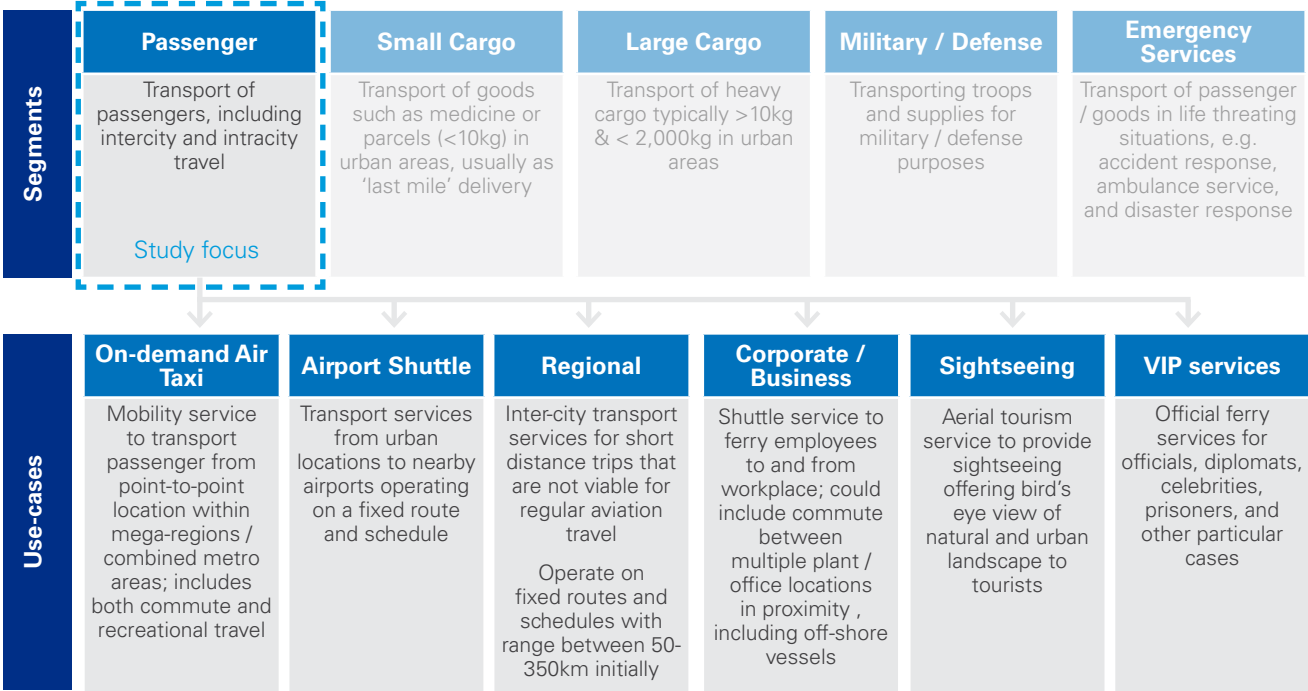> **JONO ANDERSON, PRINCIPAL,**
> **KPMG IN THE US**
> "

An idea whose time has come

Advanced Air Mobility (AAM) covers a range of new technologies and use cases to move people and cargo between places underserved to date. Several of these use cases have the potential to become the largest and most exciting new markets of the 4th industrial revolution.

This is driven by a perfect storm of city congestion, environmental concerns, technological disruption and rising customer expectations. But with long development lead times for both technology and regulation, all interested parties need a farsighted approach if that potential is to be realized, and the sector's future winners have much to gain by engaging regulatory stakeholders now.

KPMG's 'Aviation 2030' series has already considered readiness issues for 'Air Taxis' by geography, or the implications of Vertiports for traditional aviation. Its sister series 'Mobility 2030' has considered the opportunities and challenges presented by key disruptors such as Mobility as a Service (MaaS) and Autonomous Vehicles (AV). This paper looks specifically at some of the larger short and vertical take-off and landing (S/VTOL) passenger-carrying market opportunities and associated ecosystems that will evolve. It is informed by client projects, supplemented by inputs from across our network, and includes rounded projections from our latest market model. Like any model, it aims to serve future planning purposes without claiming certainty about the future.

Advanced Air Mobility use cases

	Passenger	Small Cargo	Large Cargo	Military / Defense	Emergency Services
Segments	Transport of passengers, including intercity and intracity travel Study focus	Transport of goods such as medicine or parcels (<10kg) in urban areas, usually as 'last mile' delivery	Transport of heavy cargo typically >10kg & < 2,000kg in urban areas	Transporting troops and supplies for military / defense purposes	Transport of passenger / goods in life threating situations, e.g. accident response, ambulance service, and disaster response

	On-demand Air Taxi	Airport Shuttle	Regional	Corporate / Business	Sightseeing	VIP services
Use-cases	Mobility service to transport passenger from point-to-point location within mega-regions / combined metro areas; includes both commute and recreational travel	Transport services from urban locations to nearby airports operating on a fixed route and schedule	Inter-city transport services for short distance trips that are not viable for regular aviation travel Operate on fixed routes and schedules with range between 50-350km initially	Shuttle service to ferry employees to and from workplace; could include commute between multiple plant / office locations in proximity , including off-shore vessels	Aerial tourism service to provide sightseeing offering bird's eye view of natural and urban landscape to tourists	Official ferry services for officials, diplomats, celebrities, prisoners, and other particular cases

> **Around 20% of the general population has a disability, seen or unseen. In traditional commercial aviation, designing for accessibility has often been an afterthought. This new generation of AAM aircraft and vertiports presents an opportunity to consider practical modifications that don't exclude a material proportion of the population. By introducing accessibility into the DNA of these aircraft and structures now, the industry will be well placed to genuinely change the lives of everybody, whatever the impairment or ability into the future.**
> **MIKE MILLER-SMITH MBE, CEO, AEROBILITY**

Passenger AAM is an idea whose time has finally come, underpinned by a range of technological advances and driven by huge economic opportunity attached to overcoming urban congestion and infrastructure deficits, as well as realising sustainability gains.

Key technological enablers of AAM

Key Enabler	Why is this important	Current state / What has been accomplished?	Future state requirements
Vehicle Safety	Obtaining regulatory approval and public acceptance	Existing fail-safe mechanisms such as fly-by-wire and navigation systems are being leveraged to support AAM	Development of fully autonomous systems / vehicles to mitigate risk of pilot error
Noise Reduction	Obtaining regulatory approval and public acceptance	Adoption of distributed electrical propulsion system and bladeless propellers have significantly reduced noise	Further noise reduction (max of 62 dB at 500 feet) required to enable high density operations
Battery Technology	Achieving technical feasibility and economic / financial viability	Advancement in Lithium-ion battery technology has enabled sufficient battery density (~250 Wh/kg) to support primarily low-range AAM applications	Higher battery density (350-400 Wh/kg) for broader / high-range applications – likely requiring shift to alternate technologies (Lithium air or solid sate) (Note those OEMs prioritizing range and/or capacity will more likely favor hydrogen as its options develop)
Infrastructure & Ecosystem	Development of operational capabilities to support long-term growth. In order to ensure operation in a safe and smooth way, 5G coverage is a key enabler	Existing heliports are being leveraged for near-term operations with some investment in dedicated vertiports	Investment in dedicated vertiports and telecom infrastructure to support autonomous vehicles longer term
Air Traffic Management	Achieving airspace operational feasibility	Initial low density AAM operations to leverage existing air traffic management (ATM) system	Dedicated ATM system addressing key gaps with UTM (Unmanned Traffic Management)

This has prompted something of a gold rush. The nascent sector has seen around USD8bn in investment from early-mover companies eagerly seeking to establish themselves in a lucrative growth market.[1]

Our model projects that the global passenger AAM Target Addressable Market (TAM) will grow to ~USD120bn annually by 2040.

[1] Pitchbook; Crunchbase; UAM investor presentations; VTOL news

> **The speed at which remotely piloted or autonomously flown aircraft reach commercial scale around the world completely depends on the regulators and public acceptance in each territory. It is our job to accelerate that as much as possible so AAM can scale to serve public demand safely and affordably.**
>
> **DAVID ROTTBLATT, VICE PRESIDENT, BUSINESS DEVELOPMENT, EVE URBAN AIR MOBILITY**

> **It's going to be tough to pick the winners. There are so many companies in this space. An aircraft is a very complex piece of engineering. You need to invest a lot of money to get it to market. I would be very careful with all the hype, it needs research to figure out who has the more realistic market ambitions.**
>
> **EREZ HENIG, SPECIAL ADVISOR, AEROSPACE & DEFENSE, KPMG IN ISRAEL**

A varied market

In its early incarnations, with higher costs and volumes limited by technological constraints, AAM will penetrate the corporate travel and airport shuttle sectors, but as costs reduce, greater automation comes onstream and volumes increase, expect AAM to become a viable alternative to ground-based taxis, buses and rail options.

To get and keep this variety of services airborne, the AAM revolution will likely support a diverse ecosystem.

Possible evolution of the passenger proposition

Range of Mode Choices	
Intra-city	**Inter-city**

Urban Air Mobility

Airport Shuttle

Air Taxi, Sightseeing

Corporate / Business

Regional Air Travel

Rural connectivity (susidized rural connectivity / special event access)
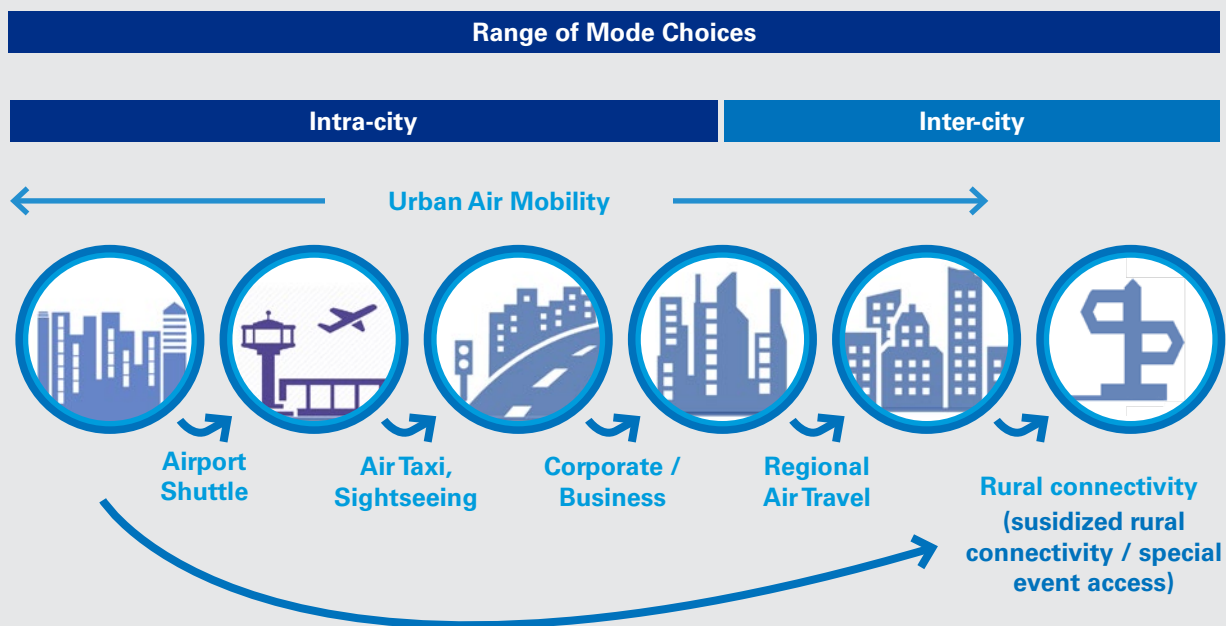
> "There's a lot of demand for understanding and envisioning how we are going to use the airspace now and in the future. That will require collaboration between multiple stakeholders from public and private sectors. Currently the ecosystem is quite fragmented. Bringing the different stakeholders together would make sense and bring clarity.
>
> **NADER LABIB,**
> **INNOVATION TECHNOLOGY LEAD,**
> **KPMG IN LUXEMBOURG**

> "Large helicopter operators are already ordering 100s of VTOL units – direct replacement for their existing helicopter fleets; for them it's an easy choice on noise, operating cost and environmental story. That's how this market will start and gain acceptance before automation of airspace brings about new air taxi type opportunities in future decades.
>
> **JOHN ARBUCKLE,**
> **PARTNER & HEAD OF AVIATION,**
> **GERALD EVE LLP**

Ways to play

Whilst hi-tech flying machines are of course the most visible and sexy aspect of the AAM revolution, vehicle sales are only a small part of the overall opportunity.

The market breaks down into four clear segments:
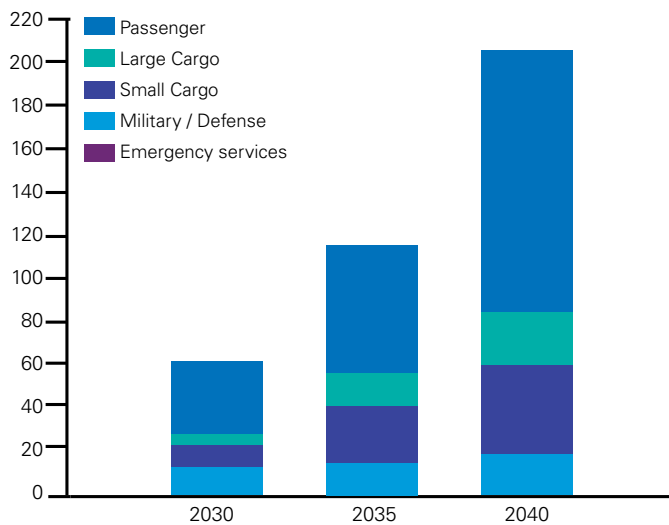
Service ecosystem
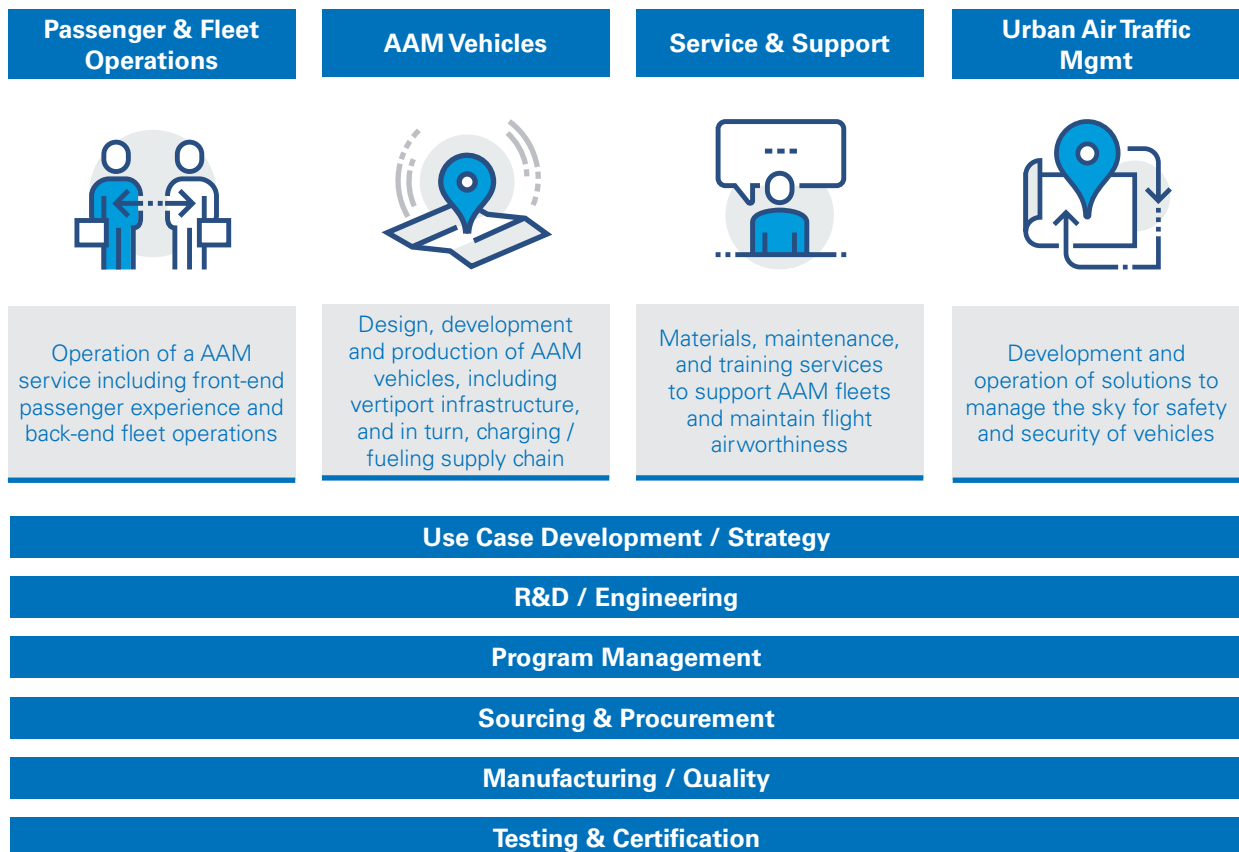
Passenger & Fleet Operations	AAM Vehicles	Service & Support	Urban Air Traffic Mgmt
Operation of a AAM service including front-end passenger experience and back-end fleet operations	Design, development and production of AAM vehicles, including vertiport infrastructure, and in turn, charging / fueling supply chain	Materials, maintenance, and training services to support AAM fleets and maintain flight airworthiness	Development and operation of solutions to manage the sky for safety and security of vehicles

Use Case Development / Strategy

R&D / Engineering

Program Management

Sourcing & Procurement

Manufacturing / Quality
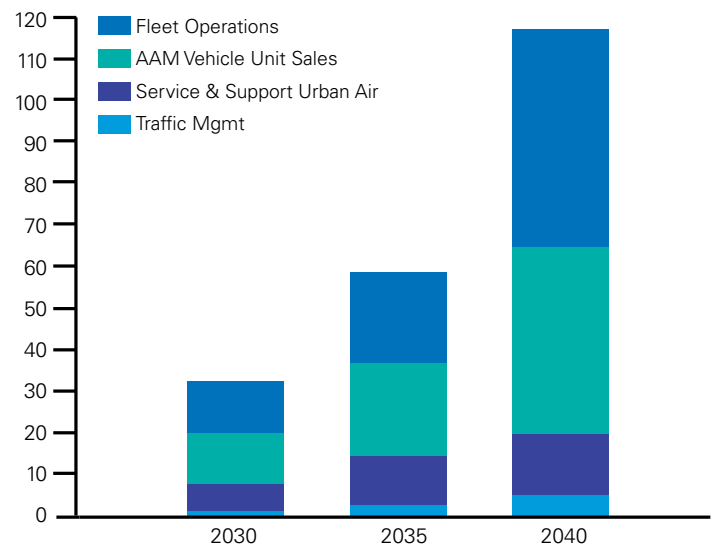
Testing & Certification

Figure 1: AAM market projections

Global AAM Economy (USDbn)

AAM Passenger Total Addressable Market (USDbn)

We model that vehicle unit sales only account for ~40% of the market by 2040. Of the USD120bn by 2040 TAM for passengers that we model, ~USD50bn is accounted for by vehicle unit sales, with fleet operations accounting for almost the same, service and support at over USD15bn and urban air traffic management at over USD5bn.

We assess these four opportunities in turn:

Passenger and Fleet Operations

Passenger and fleet ops are two distinct sets of activities managed by AAM service providers:
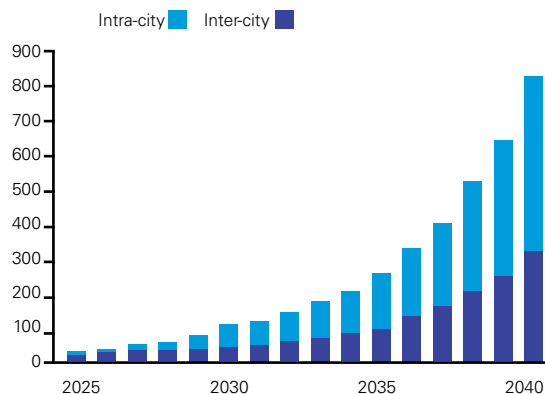
Passenger & Fleet Operations			
Passenger Experience		**Fleet Operations**	
Customer Experience, Booking & Ticketing	**Back-End Technology & Oversight**	**Fleet Management**	**Flight Operations**
■ Customer interface app ■ Booking & managing of tickets, cancelations ■ Pricing / revenue management functions (e.g., dynamic pricing)	■ Integration of back end data with front end customer facing technology ■ Vertiport and charging mgmt ■ Partner services & booking ■ Health & maintenance data	■ Aircraft deployment, tracking and storage ■ Inventory management (spare parts) ■ Facilities management ■ Maintenance & repair ■ Battery charging / battery swapping / fueling (for hydrogen and SAF designs, for example)	■ Route planning ■ Flight scheduling & cancelations ■ Customer on & offboarding ■ Ground operations
Customer Management	**Infrastructure Setup**	**Crew Management**	**Safety**
■ Customer support team ■ Customer experience staff	■ Terminal land-side & air-side facilities ■ Lounge network ■ Gates	■ Crew acquisition and retention ■ Management of crew training & licenses ■ Crew deployment & optimization	■ Adherence to maintenance schedule ■ Controls to ensure compliance & safety ■ Compliance with regulatory / reporting requirements

Figure 2: Passenger and related revenue projections (excludes rural)
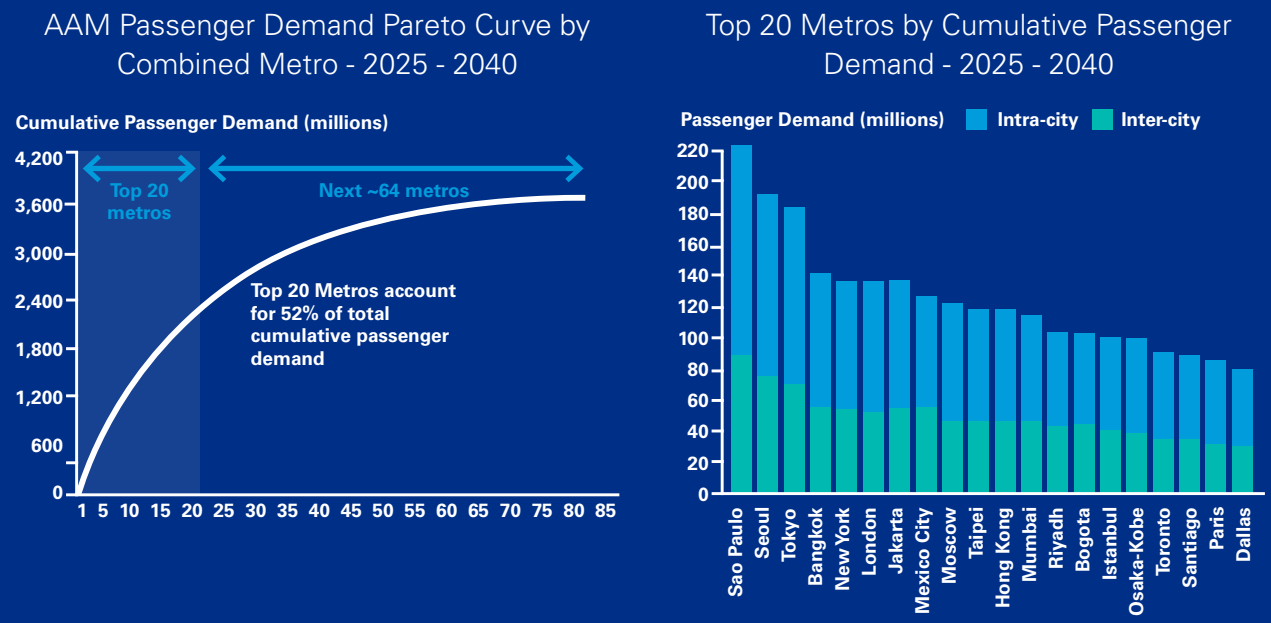
Global Forecasted Passenger Demand (millions)

Global Passenger & Fleet Operations Forecasted Revenue (USDbn)
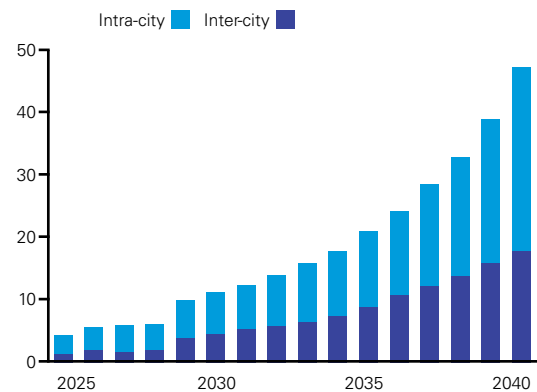
By 2040, the AAM passenger and fleet ops market could grow to over 800m passengers annually, with more than half of the estimated 2040 passenger demand concentrated in 20 combined metros. Note this assumes supply-side constraints around regulations and infrastructure (e.g. 5G, cyber security standards, UATM and vertiport infrastructure) are overcome, with our Air Taxi Readiness Index paper highlighting the relative geographic maturity with regard to obstacles, in contrast to this demand-led view.

Figure 3: Largest markets

AAM Passenger Demand Pareto Curve by Combined Metro - 2025 - 2040

Cumulative Passenger Demand (millions)

Top 20 metros

Next ~64 metros

Top 20 Metros account for 52% of total cumulative passenger demand

Top 20 Metros by Cumulative Passenger Demand - 2025 - 2040

Passenger Demand (millions)   ■ Intra-city   ■ Inter-city

Sao Paulo, Seoul, Tokyo, Bangkok, New York, London, Jakarta, Mexico City, Moscow, Taipei, Hong Kong, Mumbai, Riyadh, Bogota, Istanbul, Osaka-Kobe, Toronto, Santiago, Paris, Dallas

> " One thing that I feel some startups struggle with, is trying to tackle a whole bunch of these challenges at once. They would more likely succeed by focusing on tackling one at a time.
>
> **NADER LABIB, INNOVATION TECHNOLOGY LEAD, KPMG IN LUXEMBOURG** "

Depending on their roles, AAM companies seeking to enter this market can adopt one of two main strategies: city-by-city or partner-by-partner. Many existing airline service providers have relationships with municipalities and infrastructure required for AAM services, decreasing the time required for AAM fleet operators to go to market. The partner-by-partner strategy therefore allows AAM fleet operators to achieve scale at an accelerated speed compared to the city-by-city approach, at the expense of the partner's share in the takings.

Go-to-Market Approaches for Passenger & Fleet Operations

Ways to Play	Go-to-Market Strategy	Description	Example Companies	Advantages	Disadvantages
AAM Service Provider Role	City-by-city	■ Responsible for activities under passenger experience & fleet operations with wider range of oversight ■ Set up AAM service and operations from the ground up on a city-by-city basis	■ e.g. Volocopter, Joby, Lilium, Archer	■ Additional margin capture ■ Enhanced experience: greater control over end-to-end customer experience ■ Brand development: opportunity to establish own brand (e.g., become the "Uber" of AAM)	■ Significant upfront investments ■ Low speed to market: time needed to select city, engage stakeholders, plan routes, and obtain city approval / agreement
Fleet Operator Role	Partner-by-partner	Partner with 3rd party AAM service providers to operate their fleets in the cities they plan to enter	■ e.g. Eve	■ High speed to market: ability to grow cities and scale operations faster ■ Operational benefits: ability to leverage partner assets & capabilities (e.g., vertiports, crew, etc.) ■ Accelerated customer adoption: ability to leverage and extend value proposition of known brands	■ Potential legacy constraints: challenges from partnering with existing airlines that tend to move slow and drive high costs

> "
> **One of the biggest challenges is on vertiport development. Using existing airfields and helipads will be prominent at first, followed with redevelopment of existing ground transport hubs, but doesn't help with the 'point-to-point' promise of mobility-as-a-service. A practical challenge for many cities will be that where the affluent live tends to be already well developed with few large brownfield opportunities. If you take London, for example, early adopters of AAM may be concentrated around Kensington and Mayfair – but where are the major land spaces for vertiport opportunities there? And that's before you consider planning obstacles like privacy. Meanwhile the east of London offers much more opportunity for integrated vertiport thinking in new real estate development. In practice then, for both space and existing helicopter flight path reasons, we might see more development of floating vertiports along the river.**
> **JOHN ARBUCKLE, PARTNER & HEAD OF AVIATION, GERALD EVE LLP**

Pilots

In the early phase of growth, over 19,000 AAM pilots may be required (by 2030) to fulfil projected global passenger demand, implying a looming pilot shortage driven by declining student population, ageing pilots and expired licenses. Sourcing, qualifying and deploying crew will therefore be one of the key opportunities of this sector of the market.

Figure 4: Forecasted AAM Pilot Demand ('000s)
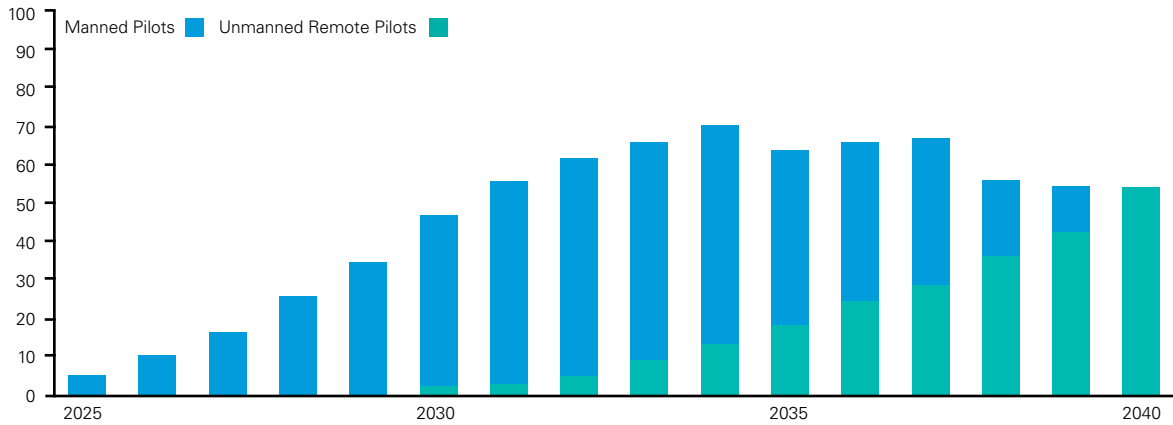
Crew Availability Requirements

Key Enabler	Why is this important	Current state / What has been accomplished?	Future state requirements
Effectively Identify and Source High Quality Pilots	Fulfill significant pilot demand: over 19,000 AAM pilots may be required by 2030 to fulfill projected global passenger / aircraft demand	Looming pilot shortage driven by declining student population, aging pilots to retirement and expired licenses due to lack of flying hours as a result of COVID	Identify new pools of talent instead of relying on existing pilot pipeline

Provide industry-leading compensation package and incentives to attract pilot talent |
| **Optimize Pilot Deployment** | Improve operational efficiency & customer experience: having the right pilots, at the right place, at the right time is critical to avoiding delays, minimizing idle time and optimizing utilization | Different certification required for each vehicle; available pilots and vehicle type may not always match

Challenged pilot reserve driven by unexpected situations such as health or personal issues or the weather conditions | Leverage integrated resource planning tools to optimize pilot deployment

Track pilot utilization and build resourcing plan to ensure continuous pilot coverage |
| **Ensure Retention of Pilots** | Mitigate disruption to operations & high turnover cost: turnover rate as a % of pilot pool can be as high as 30%, which can be costly for operators | Long hours, lower pay, limited professional growth, and challenging management practices are the biggest factors contributing to lower job satisfaction | Build transparent / open management culture with clear internal career trajectory while offering a balanced compensation package between hours & pay |

> AAM is not yet a large topic in real estate and property development circles, because it's unproven. With education and time, there is the opportunity for owners of nonprime land to integrate vertiport thinking and thereby drive a step change in the attractiveness of their real estate.
>
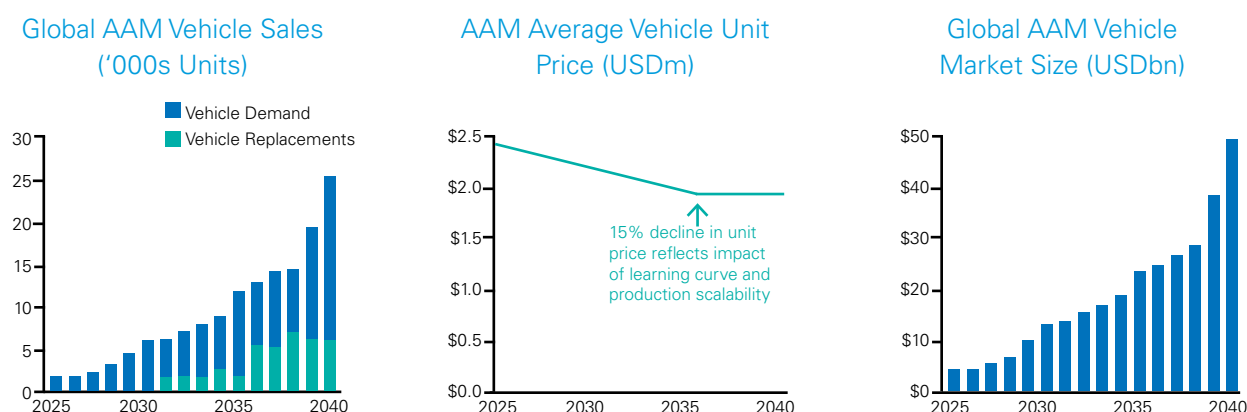> **JOHN ARBUCKLE, PARTNER & HEAD OF AVIATION, GERALD EVE LLP**

Vehicle Unit Sales

Global vehicle unit sales are modelled to reach 25,000, with revenue CAGR of 18% from 2025 to 2040.

Figure 5: Vehicle projections

Global AAM Vehicle Sales ('000s Units)

- Vehicle Demand
- Vehicle Replacements

AAM Average Vehicle Unit Price (USDm)

15% decline in unit price reflects impact of learning curve and production scalability

Global AAM Vehicle Market Size (USDbn)

Building S/VTOL vehicles usually involves a number of key technologies, namely:

- multiple **rotors** powered by distributed electric propulsion to improve safety and noise
- **batteries** weighing 200-500kg, many using li-ion or li-metal technology (we assume the vast majority of S/VTOL are electric – though hydrogen and sustainable aviation fuel will have their niches). Among electric, battery swap capability enables faster turnaround times once vehicle capacities grow and hence higher vehicle utilization compared with conventional electric charging)
- **avionics** responsible for flight management, communication and navigation system
- **sensing systems** to provide space awareness and detect and avoid in-flight collisions

There are four distinct capabilities that will differentiate OEMs in this market, each with distinctive success criteria as we outline below:

	Proficiency in vehicle certification	Design for flexibility	Competitive operating cost	Production scalability
Description	■ Obtaining type/design, airworthiness, and production certifications	■ Designing vehicle to operate in different use cases ■ Leveraging market-leading technologies for batteries & electrical systems to optimize performance	■ Designing vehicles with low operating costs per seat mile	■ Ability to manufacture S/VTOLs to meet market / customer demand
Success criteria	■ Strong relationships with aviation authorities ■ Proven track record of certification success	■ Maximization of KPIs including range, speed and load capacity ■ Relationships / partnerships with leading suppliers	■ Vehicle design ■ Seat configuration ■ Fewer critical parts ■ Autonomous capabilities	■ Ability to mass produce S/VTOLs efficiently at scale while meeting rigorous aviation quality standards
Anonymized industry view	"You need the relevant authority to answer any questions you have throughout the process so having certification experience certainly helps"	"Mission adaptability is key here. Vehicles need to be able to meet different range and payload requirements for trips "	"The 4 seat passenger configuration is the ideal combination because you are maximizing the space within a vehicle and the # of passengers carried" "For airport connections, we will need some luggage capacity, reconfigurable seating for separate cargo runs and/or a supporting ground transport infrastructure for checked bags"	"I think the cross juncture of aerospace and automotive manufacturing capability is the sweet spot to scale up."

> " Whilst safety definitely needs to be proven in order to win over a still-sceptical public, the lack of a regulatory framework also forms a barrier to the kind of experimentation and innovation that will ultimately enhance AAM's safety to the standard required for mass adoption. Regulatory sandboxes are needed - where innovators, regulators and early adopting clients can collaborate on rapid iteration. Pilots will also play a key role in such sandboxes.
>
> **ÖZTÜRK TASPINAR, PARTNER, ADVISORY, KPMG IN BELGIUM** "

> " Since 2017, Volocopter has collaborated hand in hand with EASA to develop the first specification category for eVTOL air taxi aircraft from the ground up. This process has been phenomenal in that EASA has continuously been open to our input and cooperation, and I am impressed with their strong will to embrace the sustainable transportation mode of the future. Though the certification process is time-consuming, EASA is aware of Volocopter's commercial timeline of 2024, and we are mutually working hard to achieve that goal. Nevertheless, all safety-related aspects need to be fully taken into account.
>
> **FLORIAN REUTER, CEO, VOLOCOPTER** "

Service and Support

Service and Support consists of three primary capabilities:

Maintenance Services

- Maintenance and technical services to preserve the airworthiness of S/VTOLs
- Services may be diagnostics, preventative maintenance, repair, or tech upgrades
- Services offered on site or at external service centers – provided by OEMs or 3rd party providers

Material Services

- Material Services ensure the availability of S/VTOL spare parts
- Services include scheduled exchange and unscheduled replacement
- Unlike traditional vehicles, batteries will be a key component for material services
- Services may include forecasting consumption / repair cycle of S/VTOL parts
- Services can be offered on-site, in service centres, and distribution centers

Training & Simulation (T&S)

- T&S is the process by which pilots and crew learn to operate and technicians learn to maintain a vehicle
- Comprehensive programs deliver training through in-air, classroom, and simulated environments
- T&S is required for pilot, crew, and technician certification
- T&S is offered at training / simulation facilities and flight schools

The service and support market is forecast to reach an estimated USD16bn annually by 2040. Material services are modelled to comprise the biggest share, at 64%, followed by maintenance services and finally training and simulation, which is expected to decrease in importance as automation becomes more widespread.

Figure 6: Global Service and Support Forecasted Revenue (USDbn)
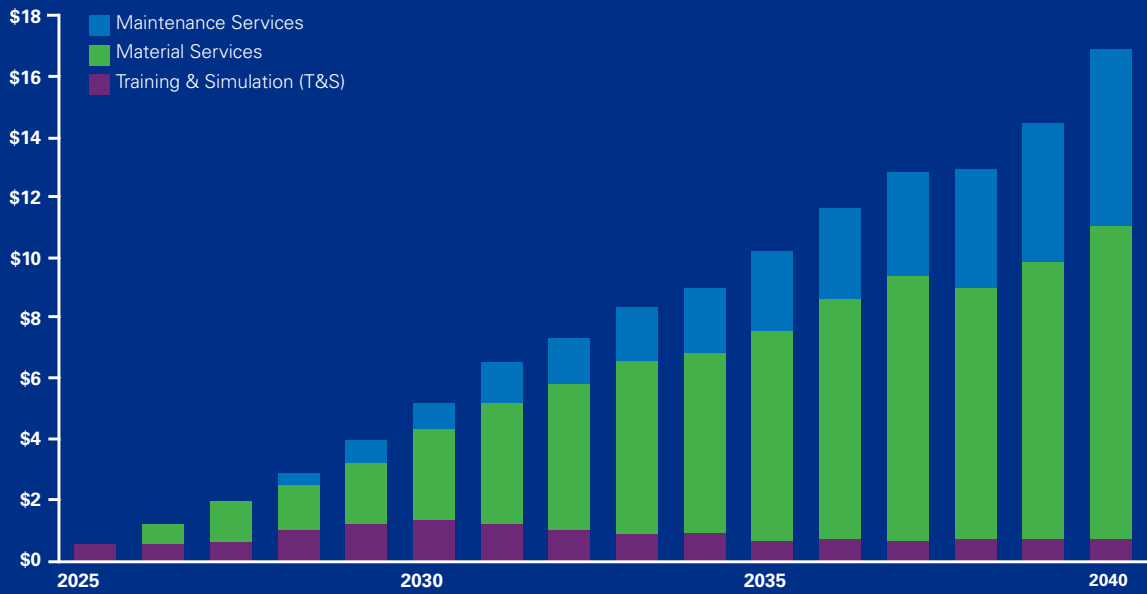
This ecosystem will evolve significantly over time, driven by total vehicles in operation, regulatory evolution, and the transition to autonomy.

Providers will need to execute in four key areas, each again demanding its own success criteria as below:

Service & Support Capabilities and Differentiation

	Service Network	Maintenance Strategy	Technician Availability	Training & Simulation (T&S)
Description	■ A maintenance network is a system of support service stations ■ The network provides routine checks and non-routine maintenance	■ A maintenance strategy details approach for upkeep and modification ■ The strategy is essential to ensuring comprehensive lifecycle services and availability of components	■ Technicians inspect, repair, and maintain airframes, and avionics ■ Technicians ensure safety, support performance, and extend vehicle life	■ T&S informs pilots, crew, and ground operators to operate vehicle ■ As VTOLs represent a new segment, T&S is table stakes for operations
Success Criteria	■ A distributed maintenance network at or near high-AAM traffic centers ■ Rapid response via scheduled or on-call requests at service centers or on-site	■ Development and execution of a comprehensive maintenance strategy ■ Data collection & analytics to enable maintenance strategy decisions	■ Hiring, retention, and training of a pool of qualified (i.e., certified) technicians	■ Development and execution of a comprehensive T&S program
Anonymized industry views	■ "Service centers will be within flight range to minimize battery cycles and downtime" ■ "Current aerospace MRO service providers will extend their businesses to include S/VTOLs"	■ "We expect frequent touchpoints from new technology and element exposure at low altitudes" ■ "While OEMs will want to maintain control, full vertical integration will be difficult. Partnerships are inevitable"	■ "Vehicle OEMs already have technicians, which may translate into an advantage" ■ "Technicians will require training and certification for high-voltage systems"	■ "Specialized pilot training in both training vehicles and simulators will result in a whole new subsector"

> " **Unmanned aerial mobility's safe operation will require a transformation of traditional traffic management systems to a more complex cyber-physical system that will need to handle a large volume and variety of data. This means that cyber security challenges cannot be bypassed.**
>
> **NADER LABIB, INNOVATION TECHNOLOGY LEAD, KPMG IN LUXEMBOURG** "

> " **Our dedicated AAM team work across a number of the integrated systems challenges that the sector faces. One challenge not yet getting much attention is interoperability – whether that's landing space requirements, vertiport digital infrastructure, certification harmonization, or charging and/or battery swap needs.**
>
> **JIA XU, SR. DIRECTOR STRATEGIC PLANNING, URBAN AIR MOBILITY, HONEYWELL** "

> **"**
>
> **The biggest barrier to mass adoption of AAM right now is safety, because all the aviation solutions based on automation are very, very strictly designed in terms of safety operations. There still needs to be another supporting system, a contingency plan in case something goes wrong.**
>
> **MARCIN WILKOWSKI, SENIOR MANAGER, IT CONSULTING, KPMG IN POLAND,**
>
> **"**

Urban Air Traffic Management

The associated Air Traffic Management market is by some measure the smallest of the four that compose the AAM ecosystem, modelled to remain just under USD6bn by 2040. This market includes stakeholders and providers for software / data management, data providers, regulatory fees, and cyber security.

The ATM ecosystem's evolution will be driven by S/VTOL density in airspace and the transition toward autonomous flight, but AAM presents unique challenges not fully addressed by prevailing regulations, software or infrastructure, such as:

- Integration of low-level airspace for manned and unmanned passenger flight
- Greater operational complexity compared to existing services increases difficulty of meeting stringent regulatory standards
- Underdeveloped digital infrastructure to address new AAM missions, vehicle and ecosystem
- Insufficient scale of supporting physical infrastructure
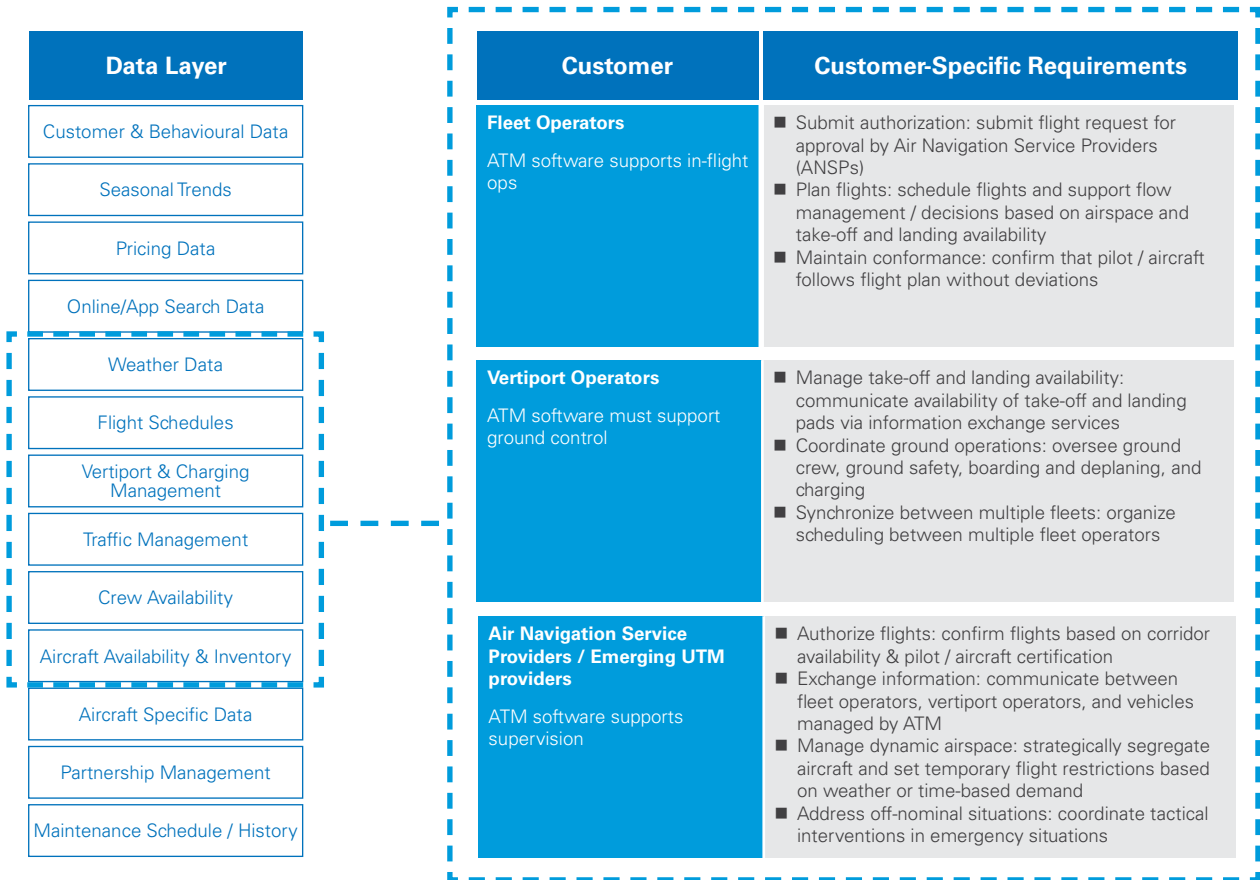- Public acceptance (noise, safety)

Figure 7: Global ATM Forecasted Revenue (USDbn)
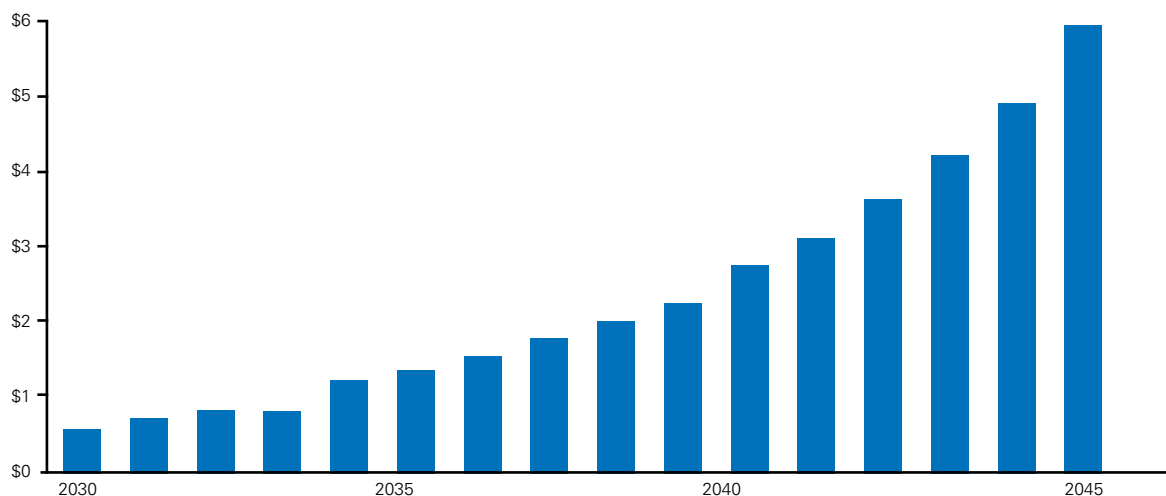
As a result, agencies worldwide are developing concepts of operations for ATM to support and scale AAM, in discussion with the private sector. For ATM software solutions providers, there are three customer groups with distinct needs:

Key Customer Group Requirements

Data Layer
Customer & Behavioural Data
Seasonal Trends
Pricing Data
Online/App Search Data
Weather Data
Flight Schedules
Vertiport & Charging Management
Traffic Management
Crew Availability
Aircraft Availability & Inventory
Aircraft Specific Data
Partnership Management
Maintenance Schedule / History

Customer	Customer-Specific Requirements
Fleet Operators ATM software supports in-flight ops	■ Submit authorization: submit flight request for approval by Air Navigation Service Providers (ANSPs) ■ Plan flights: schedule flights and support flow management / decisions based on airspace and take-off and landing availability ■ Maintain conformance: confirm that pilot / aircraft follows flight plan without deviations
Vertiport Operators ATM software must support ground control	■ Manage take-off and landing availability: communicate availability of take-off and landing pads via information exchange services ■ Coordinate ground operations: oversee ground crew, ground safety, boarding and deplaning, and charging ■ Synchronize between multiple fleets: organize scheduling between multiple fleet operators
Air Navigation Service Providers / Emerging UTM providers ATM software supports supervision	■ Authorize flights: confirm flights based on corridor availability & pilot / aircraft certification ■ Exchange information: communicate between fleet operators, vertiport operators, and vehicles managed by ATM ■ Manage dynamic airspace: strategically segregate aircraft and set temporary flight restrictions based on weather or time-based demand ■ Address off-nominal situations: coordinate tactical interventions in emergency situations

> " The emergence of an entirely new digital Air Traffic Management solution is the true bottleneck in achieving a viable business model for Advanced Air Mobility. Until then, only very few aircraft will be allowed over cities, following existing helicopter routes or applying for complex exemptions through existing Civil Aviation approvals. Only automated and demonstrably safe UTM systems will allow the density of aircraft required for viable and sustainable passenger services.
>
> **JOE TAYLOR, MANAGER, INFRASTRUCTURE ADVISORY GROUP, KPMG IN THE UK** "

Concluding thoughts

The AAM revolution will only thrive in a complex ecosystem of services, presenting commercial opportunities for a spectrum of players. To conclude, we consider some implications by player type, building on thoughts previously aired in our 2021 Air Taxi Readiness Index.

OEMs & supply chain

- The currently crowded field is highly likely to consolidate within the next 5-10 years
- With many 'national champions' playing in this space, we expect some countries to unofficially have preferred manufacturers from the outset
- OEMs will need to decide between targeting solutions that are operator-specific (supporting operators' participation in the wider ecosystem) or ecosystem-wide (extending services beyond single operators, distributing data broadly across operators)
- Much of the aerospace supply chain has had a disruptive reminder during the pandemic of its concentration risk with 1-2 OEMs. S/VTOLs offer a once-in-a-generation opportunity at revenue diversification. However, since many of today's OEMs won't survive a future consolidation, cultivate multiple relationships while managing the time spent on any one particular OEM without firm income streams in place

Investors & lessors

- Some tempting markets, such as India, will require a long-term perspective on returns; investors need to look carefully and comprehensively at readiness of target markets, not only size. Our Air Taxi Readiness Index builds on this further
- We foresee a new cohort of S/VTOL only lessors drawn to this growing market – a mix of private capital and institutional sub-brands. The question is whether or not existing lessors want to be part of the AAM value chain, with a customer base spanning tech giants, reimagined automotive brands, transport companies and local government
- Exposure to S/VTOL as an asset class not only defends traditional aviation lessors from long-term cannibalization of regional and short-haul narrowbody aircraft, but with a vehicle size much more compatible with the limitations of battery technology, electric S/VTOLs offer an opportunity for lessors to 'green' their portfolio – monetising a shift to sustainability as opposed to seeing CSR as just costs and risk management

Fleet and ops providers

- With infrastructure costs being substantially lower than road and rail, S/VTOL mobility has the potential to seriously disrupt existing urban and regional transport plans

- Joint ventures are likely needed between ground mobility / tech companies and OEMs looking to bridge the expertise and skills gap between urban mobility and air travel

- Startups need to develop and nurture relationships with aviation authorities essential for vehicle certification

- Consider advantages and disadvantages of city-by-city or partner-by-partner expansion strategies

- Take steps well in advance to effectively identify and source high-quality pilots

- Actively plan for atrophy of pilot requirements over the longer term as unmanned mobility goes mainstream

Infrastructure providers

- Given the likely regulatory restrictions around S/VTOL mobility in the urban environment, mass adoption will require extensive bespoke vertiport and short take-off infrastructure. Existing infrastructure providers (including airports, coach terminals, railway stations) have an opportunity to partner with S/VTOL players to service that need

- Much of the maintenance opportunity may be on the vertiport side, with high frequency turnarounds and urban operating environments meaning more intensive maintenance and repair budgets

- Future proofing new landmark commercial, residential, and mixed-use developments with landing sites for S/VTOLs will be in the interests of major developers in many cities

- Opportunities exist to retrofit S/VTOL-compatible landing areas into the urban landscape, which will enable operators to continue concept proving whilst widening accessibility to AAM beyond existing public transport hubs. This is particularly the case for STOLs which, with longer range, can do more stops requiring little more than 50-100m of a suitable surface

- A new market in asset repurposing is likely, as prime-located existing infrastructure (e.g. car parks) is repurposed to support vertiport operations

National policy makers

- Policy makers will have widely different degrees of public acceptance and knowledge to contend with and will in many cases need to actively promote public acceptance if they wish to facilitate AAM adoption. This will involve assuaging concerns around noise and environmental impact

- ANSPs or new bodies will require investment to build suitable air traffic management infrastructure (see below)

- Best practice will be available through international fora such as the World Economic Forum's recent 'Seven principles of the urban sky'

- Policymakers who wish to accelerate the roll out of air taxis in their geography need to first know which pillars of readiness are holding them back and address them accordingly. Our Air Taxi Readiness Index provides relevant commentary. For some countries, our proxy approach suggests it is particular areas that bring down the overall average, and depending on which metrics those are, materially different strategies should be adopted. If, for example, cyber security scores poor nationally, this is, in relative terms, something that can be 'bought in' from a geopolitical ally at reasonable cost. If public attitudes to change or technology score low, a thoughtful and sustained communications campaign may help

- Geographies with limited existing infrastructure may have an opportunity to leapfrog expensive ground-based infrastructure programmes. Whether state-led or merely state-enabled, here is an opportunity to get more 'bang for buck' than high-speed rail, hyperloops, bridges or tunnels. This applies within developed economies as well as in emerging markets – who doesn't pay lip service to economic prosperity that is inclusive of rural areas? Yet even the wealthier countries of the world often struggle to justify the economic case for remote bridges, rail and highways. Much as rural bus services are often supported by the state today, subsidized S/VTOL routes provide rural connectivity at a fraction of the cost (and carbon footprint) of major road upgrades

- Policymakers should consider targeted funding and financing to support early stage R&D, for areas of ecosystem which are essential but less easily monetized in the short term (e.g. UTM)

- Governments should encourage the development of regulatory sandboxes, convening innovators to test use cases in a safe environment to prove emerging concepts

- Provide government-backed funding in the form of grants, to catalyse the development of emerging concepts towards operational and commercial viability
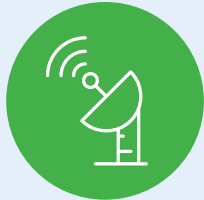
ANSPs & regulators

- AAM presents unique challenges not fully addressed by prevailing regulations or infrastructure, especially in the integration of low-level airspace for manned and unmanned passenger flight. Innovative concepts of operations are required for ATM to support and scale AAM

- The need for regulators to engage is urgent in many jurisdictions to avoid unplanned deployment and the PR setbacks likely attendant on that

- We can expect new players from tech, independent start-ups and space agencies entering the Unmanned Aircraft System Traffic Management (UTM) market

- There will be new revenue opportunities from the provision of training, licensing and consultancy work in the area of airspace designs, systems integration and operations set-up, as well as ATM services to S/VTOL operators

- ANSPs need to establish the costs of monetizing this opportunity. Leading ANSPs would like to increasingly digitize their offering this decade, with increased use of AI. But upgrading core systems at scale is tough – would it be better to trial automation in air traffic control first on UAVs, then passenger S/VTOLs? Once the system works, concepts from lower airspace can be translated into existing upper airspace operations

- Regulators will probably require bespoke frameworks around noise and designated rights of way in urban environments, as well as vertiport positioning and specs

- Shifts in regulation will be a key accelerator in enabling and driving another wave of rapid innovation in drone-enabling technologies, including but not limited to autonomy enablers, sense-and-avoid response systems, imaging and sensor capabilities, and IoT platform integration

- Regulation continues to lag technology advancements, slowing enterprise adoption, depressing startup funding, and limiting further use cases for commercial users. Regulators need to anticipate and lead innovation, not merely follow it

Local government, airports & public transport bodies

- Engage in public-private partnership. In a heavily regulated field, local governments will collaborate with private innovators to find pragmatic solutions specific to the geography

- Existing major airports will need substantial additional vertiport assets to service the anticipated demand for local and regional AAM. Newbuild terminals can start incorporating vertiport design today, while existing operations will need to factor in the required build work to minimize disruption

- The choice of VTOL and/or STOL will be influenced by local geographic characteristics. Is the priority rural-to-rural and small town connectivity (which may suit STOL) or does the route network involve downtown routes where landing space is at a premium (VTOL)? Many regions will realistically need to consider a mix

- Given the small size of VTOLs, in particular, heavy luggage for onward travel is impractical. Therefore, expect the roll-out of integrated, door-to-door luggage services (ground or AAM cargo based)

- The workforce will need to be upskilled and their processes redesigned to manage S/VTOL maintenance in airports and vertiports, with increased volumes and faster turnarounds

- Given the urgency of congestion issues in some geographies and their proven deleterious effects on public health, a strong case can be made for public subsidies in AAM-relevant infrastructure and journeys. Whether that means starting subsidies now, or in several years after winning technologies become clearer, will be down to local strategic preferences, but is akin to the existing subsidisation that many governments in effect give to rail and bus networks today

Service and maintenance providers

- Actively seek potential AAM partners in your area of operations, whether established or startup operators, or lease / operators

- Understand high-AAM traffic centres and consider building maintenance networks focused on them, to facilitate rapid response to on call-requests

- Depth of data collection and analytics will be ever-more critical to enable timely and effective maintenance decision making

- Development and execution of comprehensive T&S programmes for AAM provide a major new revenue opportunity
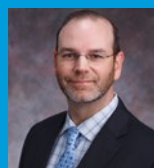
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