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Malaysian Industry-Government Group for High Technology

ADVANCED AIR MOBILITY (AAM)
INDUSTRY REPORT
Envisioning Future of AAM in Malaysia

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PREFACE

Welcome to a new era of mobility. Envision a future when people are transported to their destinations with unparalleled speed efficiency by means of urban air taxis that smoothly traverse over urban landscapes. Imagine cargo drones navigating rough terrain and congested roadways to deliver essential medical supplies to isolated locations. This scenario is exemplified by Advanced Air Mobility (AAM), a relatively new and expanding sector of the aviation industry. AAM aircraft are characterised by their revolutionary design, embedded new and upcoming technologies, ability to take off and land, sustainability through electric propulsion systems, and new business model. Generally, they operate in low-level airspace.

AAM market
projected to reach
$137.11 billion
by 2035

Projections by Grand View Research indicate that the global AAM market could reach USD 137.11 billion by 2035, expanding at a compound annual growth rate (CAGR) of 24.6% from 2023 onward. This underscores the transformative potential of AAM to reshape economies, societies, and the environment. Beyond contributing to GDP growth, Malaysia can tap into this immense opportunity by improving transport connectivity, especially between rural and urban areas. Such advancements lower emissions, noise, and congestion, bolster emergency response capabilities, and create new commercial prospects for local startups and SMEs.

While the potential is enticing, difficulties persist. Local stakeholders must work together to address obstacles such as funding and other incentives, institutional and infrastructure issues, regulatory and policy concerns, skills and talent requirements, technology and innovation expansion, and regulatory matters. This will create a strong ecosystem to support AAM industry development. For this purpose, this MIGHT and FUTURISE collaboration provides an overview of AAM initiatives in Malaysia, examines the challenges faced in growing the AAM sector, presents foresight on the next 20 year industry scenario, and offers recommendations for incorporation into future national development agenda.

FOREWORD

The Prime Minister of Malaysia

The government has set the path for Malaysia's economic growth moving forward, guided by the Economy MADANI framework. It aims at higher value-added activities as well as greater competitiveness and sustainability, while ensuring economic prosperity which translates into a better quality of life and standard of living for the rakyat.

In this context, promoting the development of Advanced Air Mobility (AAM) poses a significant impact on the two key pillars of the framework: "raise the ceiling" and "raise the floor". In terms of economic impact and competitiveness, this report projects that the AAM industry would bring RM70 billion in additional revenue, contributing RM34 billion to GDP in the next 20 years. In addition, sustainable mobility as one of the key features promoted by AAM, is set to help the country achieve its target of net-zero greenhouse gas emissions by 2050.

The second pillar, "raise the floor", aims at the creation of high-quality jobs, which is projected to add RM14 billion to worker salaries. In terms of social development, one key feature of AAM is the creation of a mode of transportation that enables ease of reach to areas with geographical challenges. This is expected to improve accessibility of healthcare, education, supplies, and other services to rural communities. Considering AAM has a huge upside potential, I believe it is imperative for the government to provide the necessary support and position AAM as the next engine of national economic growth.

YAB DATO' SERI ANWAR IBRAHIM

Prime Minister, Malaysia

FOREWORD

The Minister of Science, Technology and Innovation

Technology has been a key factor that brought changes in the way we live, work, and play, as it creates new opportunities as well as disruptive impact. Nevertheless, it is imperative that we embrace it with new perspectives by capitalising on its advantages for the better. The Ministry of Science, Technology, and Innovation (MOSTI) has been responsible for identifying and catalysing new and emerging technologies on the horizon and directing their benefits towards national economic development, improving quality of life, and contributing to sustainability goals.

The importance of focussing on advancing local technology development is being emphasised in the Economy MADANI framework as well as in the National Science, Technology, and Innovation Policy (NSTIP 2021–2030). NSTIP states the need to strengthen the development and use of advanced technology, setting the goal to transform industry and society from technology users to technology developers by leveraging existing resources.

Advanced Air Mobility (AAM) is the country's focus area as it is laden with new and emerging technologies ranging from aircraft design, electric propulsion systems, and autonomous flight and navigation systems to advanced green materials. I believe the convergence of more new technologies in AAM in the future will fuel the need for more research, development, and innovation programs in the country. Collaboration between local research institutions and industry players in this area will further enhance research outputs and commercialisation rates. I look forward to supporting further progress in the AAM's development in Malaysia.

YB CHANG LIH KANG

Minister of Science, Technology and Innovation

FOREWORD

from FUTURISE and MIGHT

The Advanced Air Mobility (AAM) report marks a successful initial step in the partnership between FUTURISE and MIGHT to proactively stimulate new and emerging topics into mainstream conversations at the national level of air transportation. Horizon scanning activities have resulted in a number of signals and trends that have yet to be ascertained in terms of their degree of impact and implications for current policies, business models, and social norms.

Therefore, a preliminary study was conducted to identify potential opportunities and limitations in the current setting, particularly in and around urban areas and less connected regions. Besides deepening understanding of the topics and visioning the future state, focus is also given to the impact on the current ecosystem support in terms of financial & incentives, infrastructure & institutions, regulatory & policies, skills & talent, and technology & innovation aspects.

This study will uncover new perspectives, encourage receptiveness to new ideas, and prompt actions from decision-makers and industry leaders to position Malaysia ahead to reap the benefits and with the potential to reshape and complement the existing transportation network.

Rushdi Abdul Rahim

President & CEO
Malaysian Industry-Government Group for High Technology (MIGHT)

Shafinaz Salim

Acting Chief Executive Officer
FUTURISE

CHAPTER 1

ONBOARDING FLIGHT

INTRODUCTION

Background of the Initiative

This report, co-developed by the Malaysian Industry-Government Group for High Technology (MIGHT) and FUTURISE, explores new and emerging technologies and industries that could profoundly impact Malaysia in the future. The highlights include:

a. Strategic engagement to explore the potentials of selected technology and the ecosystem in stimulating economic growth,
b. Ecosystem and technology assessment to identify areas impacted by the technology,
c. Foresight into industry trends and outlook, including potential future opportunities and vulnerabilities, and
d. Recommendations for driving the industry forward through progressive anticipatory regulatory intervention.

The topic of Advanced Air Mobility (AAM) has been gaining traction within Malaysian aviation communities. However, it has yet to reach the mainstream agenda of Government policy development, which makes it imperative to position AAM as a future engine of economic growth in Malaysia.

Objectives of the Study

The study aims to:

a. Establish the current state of AAM industry players and its ecosystem support in the areas of funding and incentives, infrastructure and institutions, regulation and policy, skills and talent, and technology and innovation,
b. Identify issues and challenges, as well as gaps in developing AAM in Malaysia,
c. Articulate the future scenarios of successful AAM industry development,
d. Project the potential for spill-over of AAM industry development on Malaysia's economic growth including GDP, employment, and wages and salary.
e. Propose recommendations for the way forward.

METHODOLOGY AND APPROACH

The study aims to address the following guiding questions:

Where Are We?

- Where does Malaysia stand in AAM development?
- What are the socio-economic implications of AAM development in Malaysia?
- Does Malaysia have the necessary ecosystem support to catalyse AAM development?

Where Do We Want To Be?

- What are the factors that will accelerate AAM growth in the future?
- What future images depict successful AAM development in Malaysia?
- What are the opportunities and risks?

How Can We Get There?

- What are the crucial issues, challenges, and gaps hindering AAM development?
- What recommendations can pave the way forward for AAM development in Malaysia?

While AAM is a relatively new topic in Malaysia, awareness is increasing. Consequently, a substantial amount of information will still rely on secondary data and global perspectives.

The study employed the following tools, approaches, and modalities.

1. **Desktop Research:** Various keywords were utilized in the search for AAM-related publications, articles and writeups, including:
    a. AAM - Advanced Air Mobility
    b. AAM - Advanced Aerial Mobility
    c. UAM - Urban Air Mobility
    d. RAM - Regional Air Mobility
    e. LAM - Low Altitude Mobility
    f. LAAT – Low Altitude Air Transportation
    g. eVTOL – electric Vertical Take-off and Landing
    h. UAV – Unmanned Aerial Vehicle
    i. ROV – Remotely Operated Aircraft
    j. PAV – Personal Aerial Vehicle
    k. AAV – Autonomous Aerial Vehicle
    l. RPA – Remotely Piloted Aircraft
    m. pUAM - passenger Urban Air Mobility

2. **Stakeholders' Engagement:** To date, only a handful of local players are involved in this segment. To gather input for the development of the local AAM industry outlook, a series of engagements were conducted:
    - **Workshop:** A workshop was held on 11th July 2023, gathering approximately fifty stakeholders representing various Malaysian ministries and agencies, industry players and academia involved directly and indirectly in the AAM industry to map local AAM players and capabilities, existing ecosystem support, and stakeholders' aspiration for the local AAM industry. Subsequently, the second stakeholders' engagement workshop was conducted on 29th January 2024 with the objective of exploring potential developmental opportunities and vulnerabilities arising from bridging the gaps between the current state and desired future state. Based on the views, recommendations were suggested by the stakeholders on the way forward.
    - **Interviews:** For more in-depth understanding of the local AAM industry development, one-to-one interviews were held with selected stakeholders such as Aerodyne Group, National Aerospace Industry Corporation (NAICO), Northern Corridor Economic Region (NCER), respectively. Additionally, a predetermined set of questions were shared via email and answered by several companies including Airasia Drone Sdn Bhd, Selangor Aviation & Technology Innovation (SELATI), Drone Academy Asia, etc.

3. **MIGHT's F.I.R.S.T® Matrix:** The in-house developed matrix serves as a comprehensive tool outlining all the elements that a government or industry must provide or need to facilitate the successful implementation of an initiative.
    a. F – Financial & Incentives
    b. I – Infrastructure & Institutional
    c. R – Regulatory & Policies
    d. S – Skills & Talents
    e. T – Technology & Innovation

4. **Foresight:** Various tools for anticipating futures are employed, including Opportunities/Threats/Products & Services (OTPS) and Future Wheels.

OVERVIEW OF ADVANCED AIR MOBILITY (AAM)

Definition

Multiple definitions describe Advanced Air Mobility (AAM) including:

a. An air transport system concept that integrates new transformational aircraft designs and flight technologies into existing and modified airspace operations (BAE Systems Incorporation, 2023).
b. The emerging aviation ecosystem which leverages revolutionary new aircraft and a broad array of innovative technologies to safely, quickly, affordably, and sustainably move people and goods among local destinations to connect communities underserved by existing modes of transportation (Advanced Air Mobility Institute, 2023).
c. A rapidly emerging new sector of the aerospace industry which aims to integrate highly automated aircraft safely and efficiently into the National Airspace System (NAS). AAM is not a single technology, but rather a collection of new and emerging technologies being applied to the aviation transportation system, particularly in new aircraft types. Notional AAM use-cases include Urban Air Mobility (UAM), Regional Air Mobility (RAM), public services, large cargo delivery, and private or recreational vehicles (Federal Aviation Administration, 2023).
d. A new concept of air transportation using electric vertical take-off and landing (eVTOL) aircraft to move people and cargo between places not currently or easily served by surface transportation or existing aviation modes. eVTOL aircraft may be powered by hybrid electric systems, batteries, or potentially hydrogen fuel cells (National Business Aviation Association, 2023).
e. The convergence of new technologies such as electric propulsion and autonomy, as well as new business models, such as mobile application-based ride sharing and network-enabled on-demand services, are generating the potential for new aviation markets to emerge. These new aviation markets are becoming collectively known as AAM (Garrow, et al., 2022).

Drawing from these definitions, the study identifies the following key characteristics of AAM:

- **Transformational Aircraft Designs**

  Incorporates innovative configurations such as wingless multicopters, electric helicopters, and novel autogyros.
- **Integration of Emerging Technologies**

  Utilises advanced technologies including information-enabled platforms (e.g. ride-hailing apps), next-generation batteries, distributed propulsion systems, airspace integration, and shared autonomous vehicles.
- **Electric Vertical Take-Off and Landing (eVTOL)**

  Enabled by battery-powered distributed propulsion, offering improved safety, lower noise, and reduced operating costs compared to conventional VTOL aircraft.
- **New Aviation Ecosystem**

  Enhances connectivity for underserved areas, especially rural and suburban communities, improving access to urban centres and key destinations.
- **Sustainable Operations**

  Produces zero in-use emissions and minimal lifecycle emissions, supporting environmental goals.
- **New Business Models**

  Emphasises accessibility and sustainability through models like Mobility-as-a-Service (MaaS), which integrate transport planning and payment via digital platforms, reducing car ownership and enhancing mobility, particularly for transport-disadvantaged populations.

Syndication with the Civil Aviation Authority Malaysia (CAAM) reveals the absence of a specific definition of AAM for Malaysia. For this study, a working definition adopted from NASA's paper on"A Proposed Taxonomy for Advanced Air Mobility" is utilised.

"NASA defines AAM as safe, sustainable, affordable, and accessible aviation for transformational local and intraregional missions."

- ***Safe, sustainable, affordable and accessible***

  AAM will enable more people to practically utilize aviation that ever before and to make aviation a more common part of individuals' regular experiences
- ***Transformational***

  Must be a substantive change to aviation's role such as the cost to perform the mission, the locations from which the aircraft takes off or lands, the number of flight operations observed, the ease of use, and so forth.
- ***Local and intraregional***

  Mission covers relatively short ranges.

Major Components of AAM

Expanding from the AAM definition, NASA further divided AAM into three (3) major segments:

a. **Urban Air Mobility (UAM)**

   UAM is defined as manned or unmanned, safe, quiet and efficient air traffic operations for passenger mobility, cargo delivery, and emergency management in a metropolitan area (Cohen & Shaheen, 2021). UAM employs aircraft with eVTOL capabilities.

b. **Regional Air Mobility (RAM)**

   RAM refers to air transportation vehicles operating within specific regional distances, typically ranging from 100 km to 300 km. It bridges the gap between short urban flights and longer regional journeys. RAM operations are categorized into:

   - **RAM short distance:** Covering air transportation vehicles with ranges of more than 100 km but less than 300 km
   - **RAM long-distance:** Encompassing air transportation vehicles with ranges greater than 300 km but a capacity of equal to or less than 19 passengers (Hader & Baur, 2022). RAM utilizes aircraft with eSTOL (electric Short Take-off Landing) capabilities.

c. **Low Altitude Mobility (LAM)**

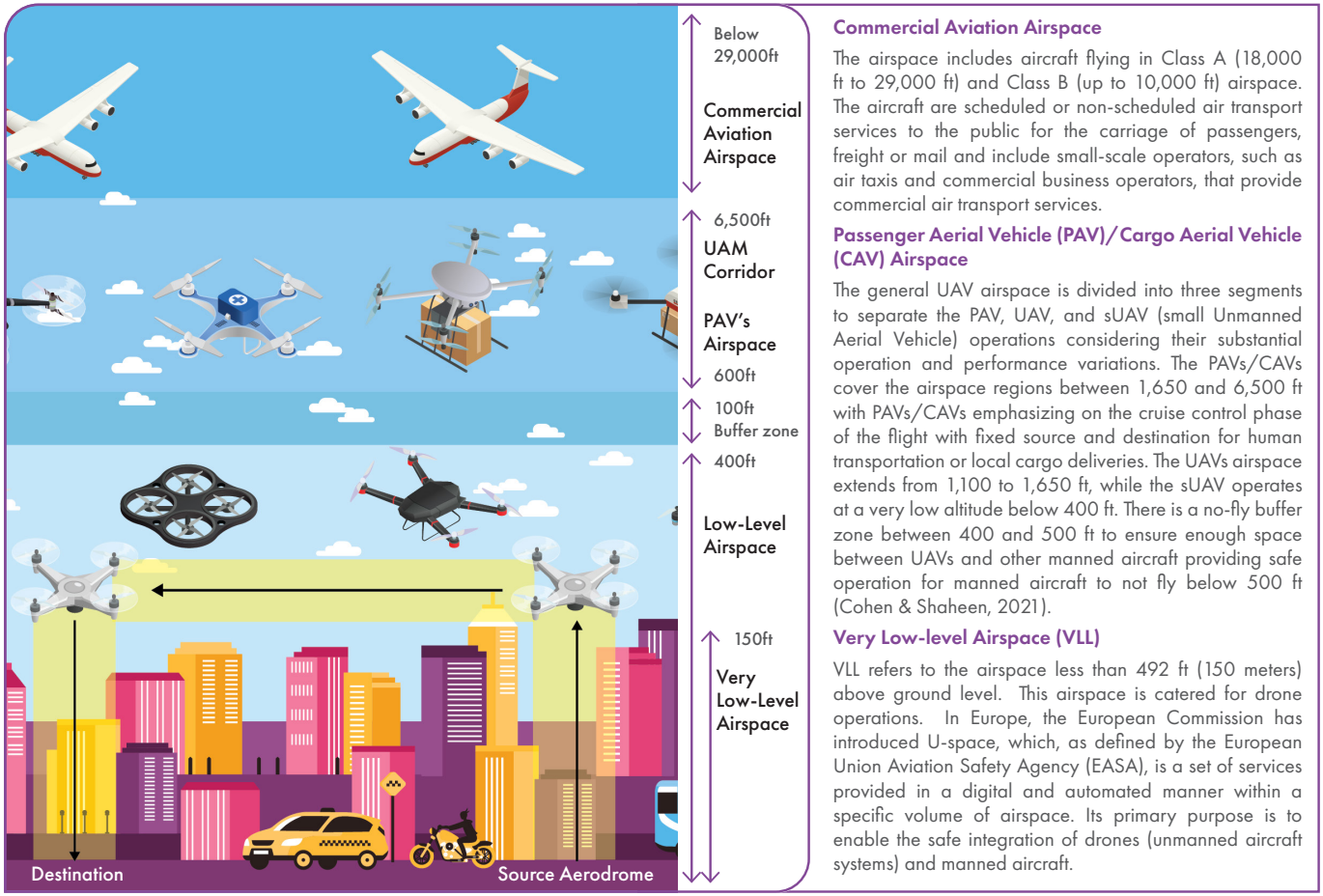
   LAM, also known as small UAS (sUAS) operations, is a newly proposed term for very low-altitude operations, typically below 400 ft above ground level within the Unmanned Aircraft System (UAS) Traffic Management (UTM) environment involving aircraft weighing less than 55 lb. Commonly used aircraft in LAM include drones that perform activities such as videography, small package delivery, and medical supply transfers.

Demarcation of AAM Operation in Overall Aviation Activities

AAM like other conventional aircrafts, utilizes airspace; however, it operates at a lower level. Figure 1 illustrates the different operating levels of AAM aircraft based on altitude compared to commercial aircraft.

Figure 1 depicts the demarcation of aviation operation according to altitude and airspace for AAM aircraft operation.

Figure 1 Low Altitude Airspace Management



Commercial Aviation Airspace

The airspace includes aircraft flying in Class A (18,000 ft to 29,000 ft) and Class B (up to 10,000 ft) airspace. The aircraft are scheduled or non-scheduled air transport services to the public for the carriage of passengers, freight or mail and include small-scale operators, such as air taxis and commercial business operators, that provide commercial air transport services.

Passenger Aerial Vehicle (PAV)/Cargo Aerial Vehicle (CAV) Airspace

The general UAV airspace is divided into three segments to separate the PAV, UAV, and sUAV (small Unmanned Aerial Vehicle) operations considering their substantial operation and performance variations. The PAVs/CAVs cover the airspace regions between 1,650 and 6,500 ft with PAVs/CAVs emphasizing on the cruise control phase of the flight with fixed source and destination for human transportation or local cargo deliveries. The UAVs airspace extends from 1,100 to 1,650 ft, while the sUAV operates at a very low altitude below 400 ft. There is a no-fly buffer zone between 400 and 500 ft to ensure enough space between UAVs and other manned aircraft providing safe operation for manned aircraft to not fly below 500 ft (Cohen & Shaheen, 2021).

Very Low-level Airspace (VLL)

VLL refers to the airspace less than 492 ft (150 meters) above ground level. This airspace is catered for drone operations. In Europe, the European Commission has introduced U-space, which, as defined by the European Union Aviation Safety Agency (EASA), is a set of services provided in a digital and automated manner within a specific volume of airspace. Its primary purpose is to enable the safe integration of drones (unmanned aircraft systems) and manned aircraft.

Not to scale

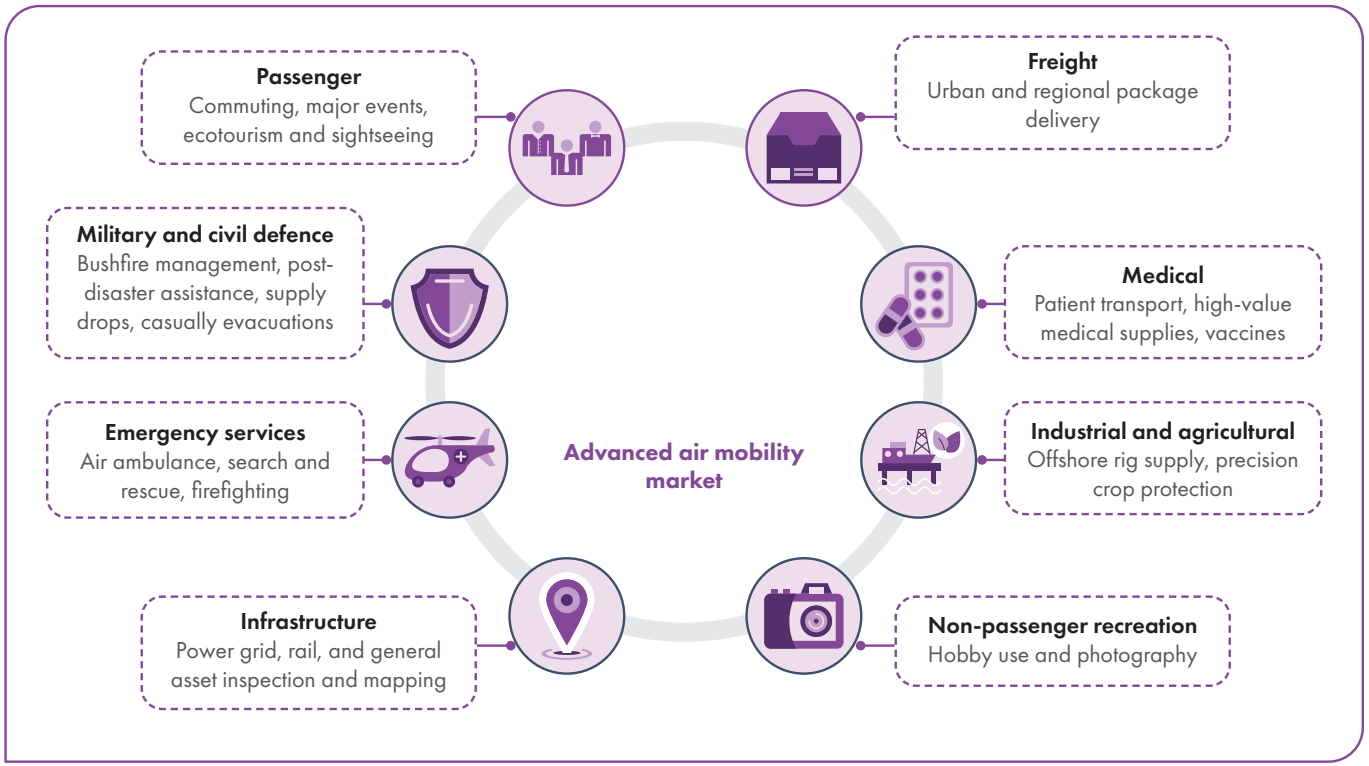
Source: A Survey on Operation Concept, Advancements, and Challenging Issues of Urban Air Traffic Management, Frontiers in Future Transportation, 2021.

PURPOSE AND APPLICABILITY OF AAM

AAM vehicles operate at designated levels of airspace, featuring vertical take-off and landing, smaller aircraft sizes, and sustainability making them suitable for various important missions. Figure 2 illustrates general AAM applications involving the transportation of passengers and goods.

Figure 2 illustrates the diverse purposes and applications of AAM on a global scale.

Figure 2 Purposes and Applications of AAM on a Global Scale



Source: AAM Potential Market, L.E.K Consulting, 2021

Movement of Passengers/People

AAM aims to revolutionise passenger transportation, particularly in urban and regional areas:

a. **Urban Air Mobility (UAM)**

AAM enables urban air mobility, providing efficient and sustainable transportation options for urban commuters. eVTOL aircraft transport passengers between vertiports located in urban centres, suburbs, and airports, bypassing ground congestion and reducing travel times.

b. **Interregional Connectivity**

AAM enhances connectivity between regions by providing efficient and direct air travel, options bridging gaps between urban centres and remote or underserved areas for business, leisure, or emergency purposes.

c. **Commuter and Regional Flights**

AAM offers short-haul regional flights connecting cities and towns within a few hundred kilometres, providing alternatives to road or rail transportation, reducing travel times, and enhancing connectivity.

d. **Air Taxi Services**

AAM envisions on-demand air taxi services, where passengers book flights through mobile applications. This flexible and personalised mode offers convenience and time savings for business travellers, tourists, and individuals seeking quick and direct point-to-point transportation.

e. **Tourism and Sightseeing**

AAM contributes to the tourism industry by offering unique aerial experiences, including scenic flights, aerial tours and access to landmarks, national parks, and tourist destinations.

Source: Airport-Centric Advanced Air Mobility Market Study, National Academies of Sciences, Engineering, and Medicine, 2023

Movement of Goods/Cargo

The AAM industry envisions utilising electric vertical take-off and landing (eVTOL) aircraft for goods transportation applications:

a. **Cargo Delivery**

AAM facilitates the efficient and swift delivery of goods, including packages, medical supplies, spare parts, and other time-sensitive or high-value items. eVTOL aircraft access areas with limited ground infrastructure, bypassing traffic congestion, and providing faster delivery times, particularly for last-mile and urban logistics.

b. **Supply Chain Operations**

AAM optimises supply chain operations by enabling faster and more flexible transport of goods, supporting just-in-time inventory management, reducing lead times, and enhancing the overall responsiveness and resilience of supply chains.

c. **Humanitarian Aid**

AAM plays a crucial role in disaster response, providing rapid delivery of relief supplies, medical equipment, and personnel to affected areas, even in challenging or remote locations.

d. **Environmental Monitoring**

AAM is utilised for environmental monitoring missions, carrying specialised equipment for data collection on air quality, climate, biodiversity, or other environmental parameters allowing efficient and timely data collection in areas difficult to access by ground.

e. **Air Ambulance and Medical Services**

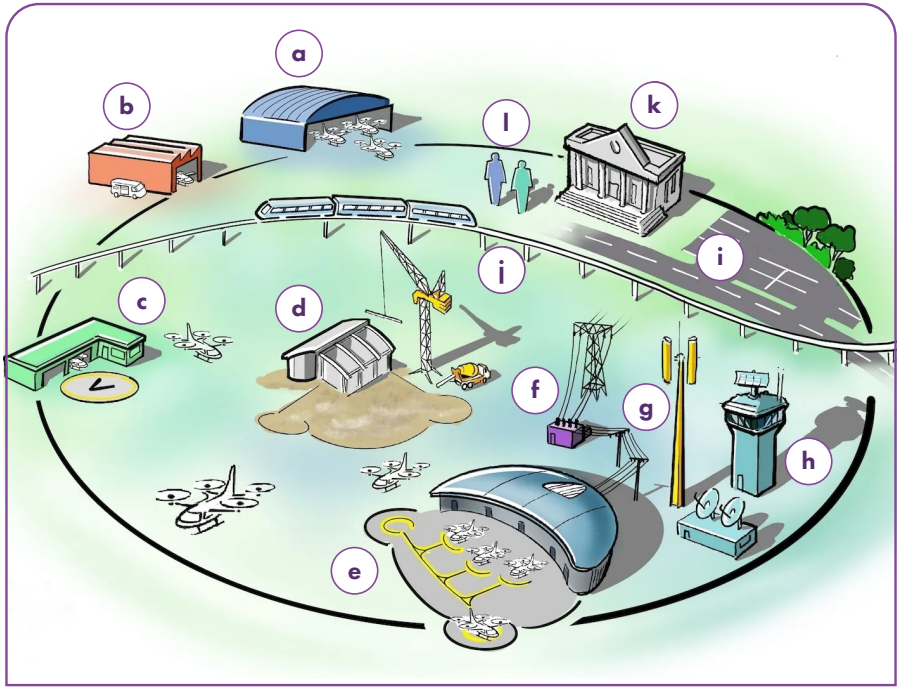
AAM supports medical services with air ambulance capabilities and rapid transportation of medical personnel, organs for transplants, or emergency medical supplies prioritising speed, access, and efficient healthcare delivery.

Source: Airport-Centric Advanced Air Mobility Market Study, National Academies of Sciences, Engineering, and Medicine, 2023

AAM PROFILES & ECOSYSTEM

Supporting AAM operations involves an ecosystem of activities similar to conventional aviation but with distinct requirements. Figure 3 depicts the various actors within the AAM ecosystem.

Figure 3 Advanced Air Mobility Ecosystem



Source: Advanced Air Mobility Insights, SMG Consulting, 2023.

AAM industry eco-system comprises the players that are involved in production, operation, maintenance and other support activities such as:

a. **Original Equipment Manufacturers (OEMs)**
   Drive AAM progress through technology innovations, vehicle design, infrastructure development and ongoing maintenance for sustained efficiency.
b. **Maintenance, Repair, and Overhaul (MRO)**
   Provide routine and unscheduled maintenance services.
c. **Operators**
   Develop technologies and competencies necessary for strategic applications.
d. **Infrastructure General Contractor**
   Develop a range of urban and suburban sites, including rooftops, water facilities, car parks, transport hubs, and purpose-built independent facilities.
e. **Vertiport Operators**
   Ensure infrastructure and AAM facilities are effectively managed to support safe and efficient operations.
f. **Utilities**
   Provide power grids for eVTOL charging, airspace management, communication systems, and data analytics.
g. **Communication**
   Facilitate secure and reliable communication between AAM vehicles, vertiports, air traffic control, and other relevant stakeholders for coordinated and safe operations.
h. **Unmanned Aircraft System Traffic Management (UASTM)**
   Manage the integration of diverse unmanned aerial vehicles, including passenger drones and air taxis, operating autonomously or remotely, within low-altitude airspace.

i. **Real Estate**

Focus on noise reduction, structural reinforcement for AAM landings, energy infrastructure, and firefighting services.

j. **Multimodal Transportation**

Integrate diverse ground transport modes—long-distance rail, bus, metro, tram, and taxis—to streamline urban journeys.

k. **Regulator/Government**

Establish regulatory frameworks for technology development, aircraft standards, air traffic control integration, test flights, autonomous flight certification, and personal air mobility incentives.

l. **Users**

Potential client companies involved in defining services to fulfil mobility incentives.

The overall AAM industry can be looked at from supply and demand perspectives as follows:

Supply Side

The supply side perspectives outline the key components supporting AAM activities across operations, infrastructure, and airspace management.

a. **Aircraft Operationalisation**

AAM adopts electric propulsion systems to improve efficiency and sustainability. Operations may be piloted or autonomous, with aircraft optimised for short field performance, requiring only 152 metres (500 feet) for take off and landing.

b. **Vehicle and Supporting Technology Development**

AAM platforms incorporate advanced technologies such as next generation batteries, artificial intelligence, and 5G. Supporting systems include MRO services, electric charging, intermodal integration, and on demand applications, enabling a connected and resilient aviation ecosystem.

c. **Infrastructure Development**

Infrastructure includes upgraded and purpose built facilities that meet technical requirements. It comprises physical components like vertiports and mobility hubs, alongside digital systems for connectivity, autonomous operations, and weather monitoring.

d. **Airspace Design**

AAM airspace design defines operational zones and altitude bands to support safe integration into existing frameworks. It prioritises structure and risk mitigation to enable safe and scalable implementation.

e. **Traffic and Operations**

Traffic and operations involve air traffic coordination through authorised service providers. Resilient operations are essential to ensure service continuity. Licensing and certification remain critical to meet safety and regulatory standards.

f. **Vehicle Operations Management**

Vehicle operations cover autonomous and digital flight, pilot licensing, and flight procedures to ensure safety, including over populated areas. MRO, weather resilience, certification, and continuous airworthiness are key to maintaining reliability and efficiency.

Demand Side

The demand for AAM can be attributed to the following:

a. **Potential Users.**

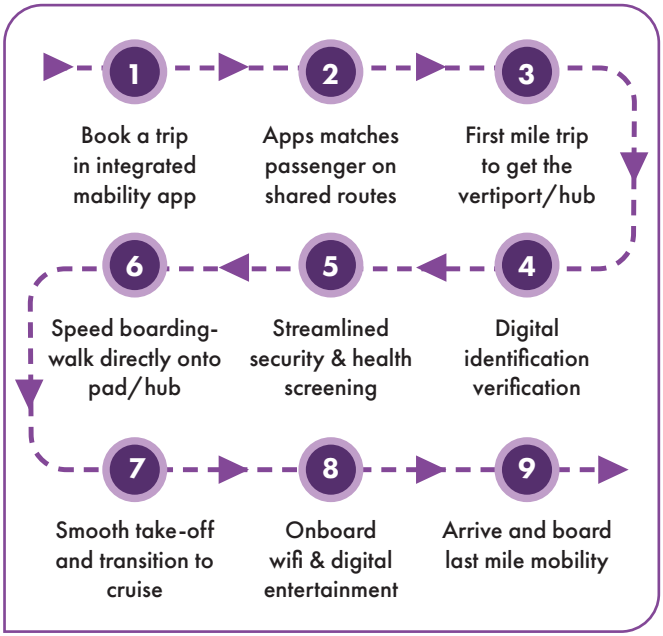
Similar to conventional air transportation, users of AAM demand uncompromised safety, security, and comfort. AAM introduces an additional value proposition of travel time saving (TTS) derived from the reduced travel time, including both waiting and actual travel periods. Nevertheless, achieving public acceptance hinges on addressing concerns such as privacy, noise and visual disruption, and environmental impact.

b. **Trip Profiles.**

User preferences in AAM services are associated with specific trip characteristics. AAM trips are expected to deliver shorter door-to-door travel times, minimising the overall journey duration. The travel experience should be direct and efficient to reduce transfers and stop points for a streamlined and time-effective travel experience. The effective trip cost should involve both operating costs and the overall trip cost for an economically viable solution. High levels of reliability in departure and arrival times are crucial, ensuring a seamless and predictable travel experience for users. A cost-efficient business model, encompassing factors such as risk allocation and impact on the supply/value chain, plays a pivotal role in shaping the attractiveness of AAM for users.

The following picture envisions a multimodal and seamless journey of AAM for users (Figure 4).

Figure 4 Multimodal and Seamless Journey of AAM for Users



ADVANCEMENTS OF TECHNOLOGIES IN AAM ECOSYSTEM

AAM incorporates new and emerging technologies segmented into three (3) main areas: aircraft vehicles technologies, ecosystem support and communication infrastructure.

Aircraft vehicle technologies

Aircraft Design

There are six (6) aircraft architectures of AAM vehicles as depicted in Figure 5

i. **Highly distributed propulsion concepts (multi-copter):** These vehicles have multiple propellers or rotors distributed across the airframe, often in a multi-copter configuration allowing vertical take-off and landing (VTOL) capabilities and enhanced manoeuvrability.

ii. **Quadcopters:** A specific type of multi-copter with four rotors. They are known for their simplicity, stability, and ease of control and are commonly used in various drone applications.

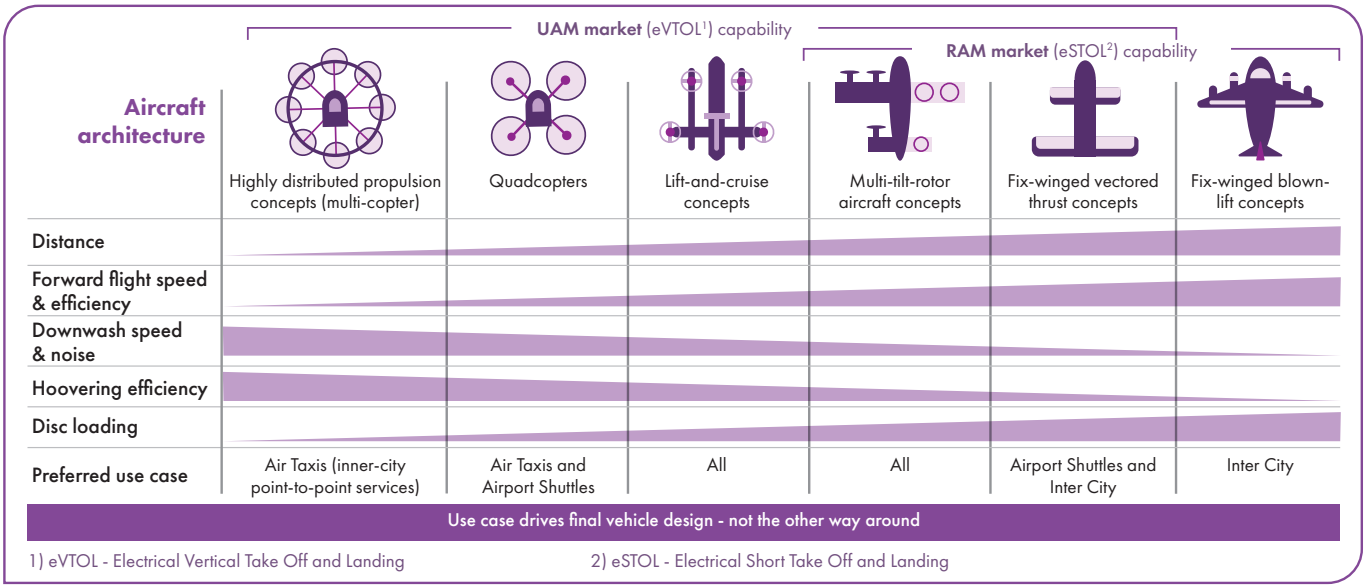
iii. **Lift and cruise concepts:** This architecture combines vertical take-off and landing capabilities with efficient forward flight. It typically involves transitioning from vertical to horizontal flight to maximise the aircraft's range and speed.

iv. **Multi-tilt-rotor aircraft concepts:** These aircraft have rotors that can tilt to transition from vertical to horizontal flight. Tilt-rotor designs provide the flexibility of helicopters for vertical operations and the speed of fixed-wing aircraft during forward flight.

v. **Fix-winged thrust concepts:** Aircraft with fixed wings that use additional thrust mechanisms, such as ducted fans or jet engines, to enable vertical take-off and landing. These designs aim to combine the efficiency of fixed-wing flight with VTOL capabilities.

vi. **Fix-winged blown-lift concepts:** In this architecture, the air is blown over the wings to provide additional lift during take-off and landing. This allows for shorter take-off and landing distances while still maintaining the benefits of fixed-wing flight during cruise.

Figure 3 Advanced Air Mobility Ecosystem



Source: The Advanced Air Mobility Market Isn't Far from Realization, Roland Berger, 2023

eVTOL aircrafts have various applications including passenger transport which encompasses intra-city scenarios such as tourism and urban taxi services. The prospects extend to airport shuttles and transportation between cities in the same region as well as applications in agriculture, construction, energy, emergency medical services, and air freight. Notably, eVTOL possesses diverse applications with varying requirements for range and payload. For instance, agricultural applications might necessitate a 100-250kg payload with a 50-80 km range, while air freight applications could demand a payload exceeding 500kg and a range surpassing 250 km.

Six different aircraft architectures with varied characteristics suitable for different use cases are tabulated in Table 1 (Al-Rubaye, Tsourdos, & Namuduri, 2023)

Table 1: Technologies in AAM Aircraft Vehicles

AIRCRAFT TECHNOLOGIES	**Autonomy**	System resiliency
		GPS-denied technology
		Vehicle autonomy and conflict resolution
		Verification and validation methods
		Detect and avoid
	Sensing	Weather detection
		Flight and health management
		Image sensing
		Sensing system capabilities
		Lidar
	Propulsion	Electric
		Hybrid
	Energy storage	High-specific energy batteries
	Controls	Adaptative controls
		Guidance and control software
		Command, control and communications
		Active noise control
	Certification	Airworthiness standards
	Operations	Ridesharing technologies
		Unmanned Aircraft System Traffic Management (UTM)

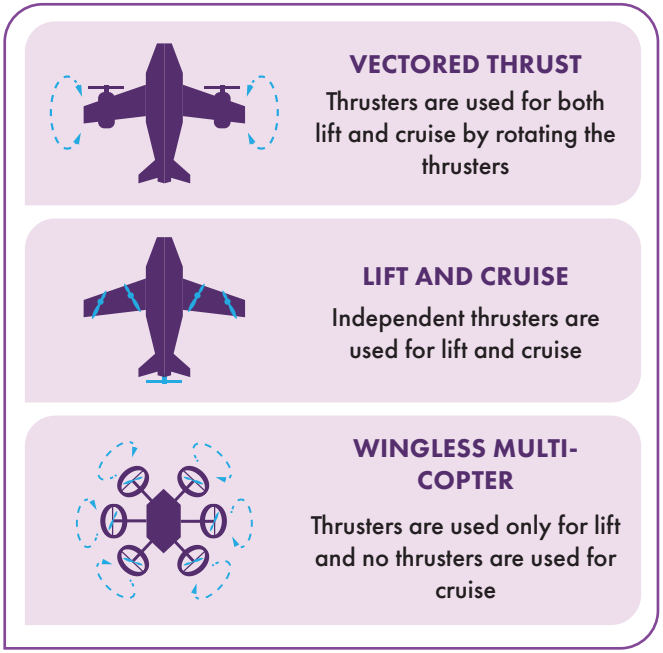
Source: Advanced Air Mobility Operation and Infrastructure for Sustainable Connected eVTOL Vehicle, Drones, 2023.

AAM aircraft can also be classified by the type of propulsion system, the take-off and landing style, and the type of operator.

Propulsion

Figure 6 shows the most common AAM propulsion configurations:

Figure 6: Most Common AAM Propulsion Configurations



Source: Airport-Centric Advanced Air Mobility Market Study, National Academies of Sciences, Engineering, and Medicine, 2023.

Energy Storage

Fuel types under development for AAM aircraft generally include the following:

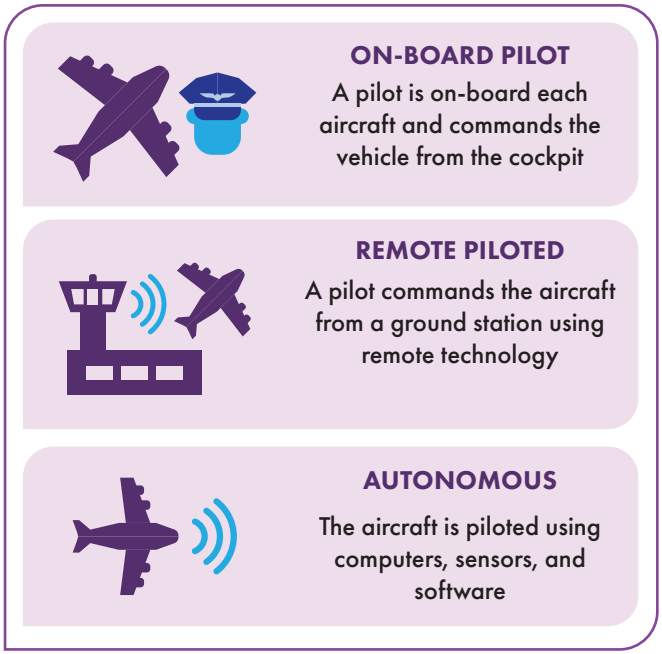
- **Battery-electric:** On-board batteries store energy to power flight. The batteries are charged at ground stations using direct-current fast chargers (DCFC) with recharging times between 15 and 90 minutes. In some cases, these systems are similar to those used to charge electric ground vehicles.
- **Hybrid-electric:** On-board batteries are combined with a liquid fuel-powered generator to charge the batteries in-flight and provide extended travel range. The batteries are charged on the ground at DCFC stations.
- **Hydrogen fuel cell:** A hydrogen fuel cell is used to generate electricity to power flight. These systems are in the initial stages of development.

Most AAM aircraft in advanced stages of development utilises lithium-ion batteries as the primary energy source.

Autonomy

Figure 7 shows the different operator types for AAM aircrafts

Figure 7 AAM Autonomy and its Operator Types



Source: Airport-Centric Advanced Air Mobility Market Study, National Academies of Sciences, Engineering, and Medicine, 2023.

AAM Ecosystem Support

Ecosystem support technologies can be categorised into six (6) categories; infrastructure, cybersecurity, navigation, safety, surveillance and UAM Vehicles as outlined in Table 2.

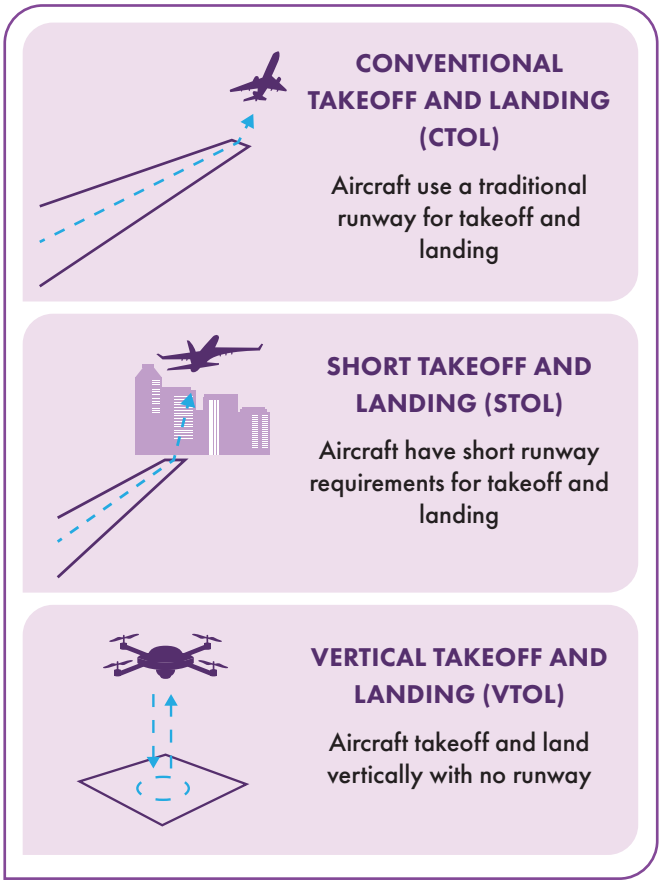
Table 2: Technologies supporting AAM ecosystem

TECHNOLOGIES SUPPORTING AAM ECOSYSTEM	Infrastructure	Vertiports technologies
		Energy grid infrastructure
		Vehicle charging technologies
	Cybersecurity	Cyber-physical detection
	Navigation	GPS, GNSS
	Safety	Advanced vehicle safety systems
		Crashworthiness and survivability
	Surveillance	Cooperative surveillance
		Non-cooperative surveillance, ADS
	UAM Vehicles	Unmanned vehicles
		Manned vehicles -pilot training

Infrastructure.
At its most basic level, the infrastructure necessary to support AAM operations at an airport or vertiport includes

- A designated surface for take-off, landing, and movement of aircraft with appropriate markings. Figure 8 depicts different types of take-off and landing styles,
- Air traffic management (either towered airspace or an appropriate communications channel),
- Vehicle charging and battery conditioning equipment,
- Facilities to support passenger and/or cargo operations,
- Safety equipment,
- Navigational aids,
- Lighting.

Figure 8 AAM Aircraft Different Types of Take-off and Landing Styles



Source: Airport-Centric Advanced Air Mobility Market Study, National Academies of Sciences, Engineering, and Medicine, 2023.

Communication Infrastructure

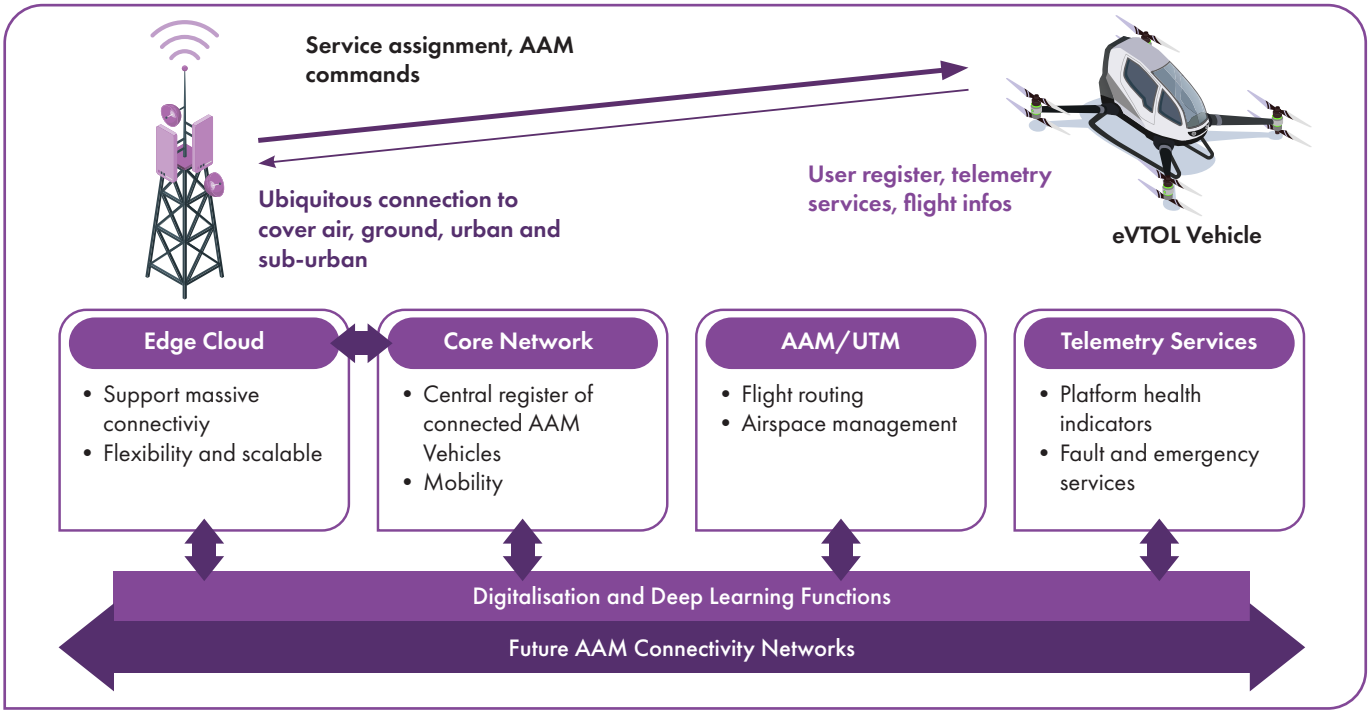
Communication infrastructure includes aircraft-to-ground communication, aircraft-to-aircraft communication, satellite and terrestrial link technologies and terrestrial network 4G/5G/6G. An effective communication infrastructure requires the integration of a diverse range of communication technologies and protocols encompassing voice, data, and video communications as depicted in Figure 9. AAM vehicles may leverage satellite-based communications, cellular networks, or dedicated communication networks to transmit information, connecting with ground operators and other vehicles.

The high-bandwidth, low-latency connectivity is crucial for facilitating real-time communication and data exchange, essential for the safe and efficient operation of eVTOL aircraft.

Communication infrastructure also hinges on the implementation of UTM systems. These systems play a pivotal role in tracking and managing eVTOL aircraft in urban airspace, mitigating collision risks, and ensuring overall operational safety. They rely on real-time data from eVTOL aircraft and integrate information from ground-based sensors and other relevant sources.

Telecommunications providers are the main backbone for eVTOL services due to their network reliability, low latency, and high-bandwidth services they provide to ensure safe and efficient flight management and robust connectivity with other aircraft. Based on the functionalities and performance, the advanced communication system can be divided into edge cloud, core network, AAM-UTM, and telemetry services.

Figure 9 Overview of Advanced Air Mobility Connected System



Source: Airport-Centric Advanced Air Mobility Market Study, National Academies of Sciences, Engineering, and Medicine, 2023.

GLOBAL AAM INITIATIVES

Harnessing the potential of AAM applications, a new market segment is created, and substantial efforts are made by OEMs to promote the use of AAM vehicles worldwide. Table 3 tabulates the dynamic range of AAM options for global innovative urban air mobility solutions. The AAM Reality Index (ARI) indicates the readiness and progress of the country's OEMs in the AAM.

Table 3: Readiness and progress of OEMs in the AAM by Countries

Country	OEM (stock ticker)	ARI	Funding ($M)	Use Case	Vehicle Type	Propulsion	Operation	Vehicle	First Flight	EIS
Brazil	Eve Air Mobility (NYSE: EVEX)	7.2	$377.40	Air Taxi	Lift + Cruise	Electric	Piloted	Eve	2024	2026
China	Ehang (NASDAQ: EH)	8	$160.40	Tourism, EMS, Firefighting	Multicopter/Lift + Cruise	Electric	Autonomous	EH216-S / VT-30	2018 / 2021	2023 / -
	AutoFlight	6.9	$200.00	Air Taxi	Lift + Cruise	Electric	Piloted	Prosperity I	2022	2026
	Aerofugia	6.8	$38.00	Air Taxi, Cargo, Tourism	Vectored Thrust	Electric	Piloted	AE200	2023	2026
France	Airbus	6.5	Corporate backed	EMS, Tourism, Air Taxi	Lift + Cruise	Electric	Piloted	CityAirbus NextGen	2024	-
	Ascendance Flight Technologies	6.2	$71.30	Regional, Cargo	Lift + Cruise	Hybrid	Piloted	Atea	2024	2027
Germany	Volocopter	8.3	$761.0	Air Taxi	Multicopter / Lift + Cruise	Electric	Piloted	VoloCity / VoloRegion	2021 / 2022	2024 / 2026
	Lilium (NASDAQ: LILM)	6.7	$1,342.30	Regional, Cargo, Biz Av	Vectored Thrust	Electric	Piloted	Jet	2024	2026
	Volkswagen	3.7	Corporate backed	Air Taxi	Lift + Cruise	Electric	Autonomous	V.MO	2023	-
Japan	SkyDrive	6.4	$249.8	Air Taxi, Tourism, EMS	Multicopter	Electric	Piloted	SKYDRIVE	2024	2026
	Honda Motor Company	5.5	Corporate backed	Air Taxi	Lift + Cruise	Hybrid	Piloted	-	2023	2030
South Korea	Supernal	6.5	Corporate backed	Air Taxi	Vectored Thrust	Electric	Piloted	S-A1	2024	2028
Sweden	Heart Aerospace	5.1	$85.00	Regional	Conventional	Electric/ Hybrid	Piloted	ES-30	2026	2028
Switzerland	Dufour Aerospace	5.7	$11.0	EMS, Regional	Vectored Thrust	Hybrid	Piloted	Aero3	-	-
UK	Vertical Aerospace (NYSE: EVTL)	7.1	$347.80	Air Taxi, Cargo, EMS	Vectored Thrust	Electric	Piloted	VX4	2023	2027

Country	OEM (stock ticker)	ARI	Funding ($M)	Use Case	Vehicle Type	Propulsion	Operation	Vehicle	First Flight	EIS
USA	Joby Aviation (NYSE: JOBY)	8	$2,251.30	Air Taxi	Vectored Thrust	Electric	Piloted	-	2018	2025
	Beta Technologies	8	$796.0	Cargo, Regional, Air Taxi	Conventional / Lift + Cruise	Electric	Piloted	CX300 / Alia-250	2020 / 2022	2025 / 2026
	Archer (NYSE: ACHR)	7.9	$1,096.30	Air Taxi	Vectored Thrust	Electric	Piloted	Midnight	2023	2025
	Wisk (Boeing)	7.4	Corporate backed	Air Taxi	Vectored Thrust	Electric	Autonomous	Generation 6	-	-
	Pipistrel (Textron)	7	Corporate backed	Cargo	Lift + Cruise	Hybrid	Autonomous	Nuuva V300	2024	2025
	Elroy Air	6.8	$90.00	Cargo	Lift + Cruise	Hybrid	Autonomous	Chaparral C1	2023	2024
	Alaka'i Technologies	6.3	$60.00	Air Taxi, Cargo, EMS	Multicopter	H2 Fuel Cell	Piloted	Skai	2022	2024
	Eviation	6.2	$200.00	Regional, Cargo, Biz Av	Conventional	Electric	Piloted	Alice	2022	2027
	Overair	6.2	$170.00	Air Taxi, Cargo, EMS, Tourism	Vectored Thrust	Electric	Piloted	Butterfly	2023	2027
	REGENT	6.1	$90.0	Regional	Augmented Lift	Electric	Piloted	Viceroy	2024	2025
	eAviation (Textron)	5.9	Corporate backed	EMS, Air Taxi, Cargo	Vectored Thrust	Electric	Piloted	Nexus	2024	2030
	Electra	5.2	$134.00	Regional, Cargo	Augmented Lift	Hybrid	Piloted	EL-2 Goldfinch	2023	2028
	Jaunt Air Mobility	4.4	$3.10	Air Taxi,Cargo	Lift + Cruise	Electric	Piloted	Journey	2025	2028

Note:
The ARI is a rating tool, based on a proprietary formula that uses publicly available information as well as expert knowledge. It helps assess the industry entrants' progress toward the delivery of a certified product at mass-scale production. The ARI is based on five elements: the funding received by the company, the team that leads the company, the technology readiness of their vehicles, the certification progress of their vehicles, and the production readiness towards full-scale manufacturing.
A value of 0 on the ARI tool represents a company just considering the market with little to no financing. A 10 on the ARI tool represents a company with a commercial product that is produced in thousands of units per year. No company at present would be able to achieve a 10, as no one in Aerospace is capable of producing thousands of vehicles per year.
EIS - entry into the service
Countries are arranged in alphabetical order.

Source: AAM Reality Index, SMG Consulting, 2023.

The AAM infrastructure requirements extend beyond aircraft, emphasising infrastructure development as crucial for the overall industry. AAM's diverse needs include a sophisticated ecosystem comprising landing infrastructure, zoning, permits, airspace management, diverse power sources (electrical, hydrogen), digital infrastructure/cybersecurity, multimodal operations, ground equipment, and emergency response tools. Adequate development in these areas is essential for the initiation of commercial AAM services. Table 4 uses the Advanced Air Mobility Infrastructure Readiness Index (AIR) to rank countries that are initiating AAM.

Table 4: Ranking of Countries Initiating AAM using the Advanced Air Mobility Infrastructure Readiness Index (AIR)

Country	Company	ARi	Funding ($M)	Use Case	OEM Partners	EIS Cities	Vertiport Prototype	Vertiport EIS
Australia	Skyportz	2.2	$1.10	Regional, Air Taxi	Electra, Dufour Aerospace	Sydney, Melbourne, Brisbane	-	2024
France	Groupe ADP	6.9	Corporate backed	Air Taxi	Volocopter	Paris (5 locations)	2022	2024
Germany	Munich Airport International	5.9	Corporate backed	Regional, Air Taxi	Airbus, Lilium	Bavaria locations	-	2026
Italy	UrbanV	6.8	Corporate backed	Air Taxi, Tourism, Cargo	Volocopter, Lilium, Ascendance Flight Technologies	Rome, Cote Azur, Venice, Bologna	2022	2024
Japan	SkyScape	2.7	$0.50	Cargo, Air Taxi	Plana	-	2023	2025
Netherlands	Ferrovial	6.3	Corporate backed	Regional, Air Taxi	Lilium, Vertical Aerospace, Eve Holding	West Palm Beach, Orlando	-	2024
Spain	BlueNest	5.8	Corporate backed	Tourism, Air Taxi	Ehang, Eve Holding, Plana	Zaragoza, Qatar, Costa Rica	2023	2024
Sweden	Kookiejar	2.1	$1.10	Tourism	-	Norrkoping, Dubai	2023	2024
UK	Skyports	6.9	$40.00	Air Taxi, Cargo	Volocopter, Eve Holding, Wisk, Joby Aviation, Vertical Aerospace	Paris, Dubai	2019	2024
	Urban-Air Port	6.3	$38.10	Air Taxi, Cargo	Supernal	Los Angeles, Stephenville (NL)	2022	2024
USA	Beta Technologies	6.3	$796.00	Regional, Cargo	Beta Technologies	South Burlington, Plattsburgh	2019	2022
	Volatus Infrastructure	5.6	TBD	Air Taxi, Cargo, EMS	SkyDrive, AIR, Plana, Eve Holding	Oshkosh, Bellefonte	-	2024
	Skyway	4.7	$1.50	Air Taxi, Regional, Cargo	Eve Holding. Traverse Aero	Costa Rica	-	2024

Note:
The (Advanced Air Mobility Infrastructure Readiness Index) AIR Index is based on five completely unique elements with infrastructure-tailored specific milestones: the funding received by the company, the team that leads the company, the partnerships the company has established to complete its ecosystem, the regulatory progress achieved by the company and the deployment progress of their vertiport networks.
The formula scores each entrant on a 0 to 10 scale. A 0 on the AIR Index represents a company just considering the market with little to no financing. A 10 on the AIR Index represents a company with several vertiports networks across the world in commercial operation.
EIS - entry into the service

Highlights of China AAM Initiative: Low Altitude Economy

Source: China's Low-Altitude Economy: Why its Investment Outlook is Bright

With a population exceeding 1.4 billion and several cities ranking among the world's top 20 for highest density, China faces an urgent need for easier movement of people, goods, and services. In order address these needs, the country has identified AAM industry as a next engine of economic growth or refer to as "Low-Altitude Economy". The term is referring to a spectrum of economic activities occurring within low altitude airspace, defined as the space 1,000 meters above ground. This includes various activities and industries centred around civil-manned and unmanned aerial vehicles, such as passenger transport, cargo delivery, manufacturing, low-altitude flight operations, and integrated services.

Currently, this new economy segment has experienced rapid growth, witnessing an increase in both low-altitude aircraft and enterprises. With vast potential, it is projected to contribute up to US$700 billion (RMB 5 trillion) to the country's economy by 2025, as indicated by a white paper published in 2023 by the International Digital Economy Academy in Shenzhen. The growth is backed by advanced technology, rising domestic demand, and government support. China's robust industrial base, particularly strong in cutting-edge technologies, has become a magnet for enterprises specialising in innovative aviation solutions like manned electric vertical take-off and landing (eVTOL) aircraft. Furthermore, the low-altitude economy is also closely linked with the artificial intelligence (AI) and power battery industries.

The growth of the industry is being supported by the government through intensification efforts to support a batch of leading companies to engage in R&D to develop drone logistics and generate more low-altitude airspace resources. In 2020, the Civil Aviation Administration of China (CAAC) sanctioned 13 national pilot zones in development zones, two of which focused on drone logistics and three on drone delivery in cities. In February 2021, the low-altitude economy was formally written into the national development plan for the first time. Subsequently, in 2022, the CAAC established an additional 4 civil unmanned aerial test zones and 3 civil unmanned test bases. By 2023, 16 provinces had integrated concepts related to the low-altitude economy and general aviation into their government work reports. Most recently, in January 2024, the Interim Regulations on the Management of Unmanned Aircraft Flights was implemented, marking a further step for the orderly development of the sector.

HIGHLIGHTS OF USE CASES FROM OTHER COUNTRIES

Global momentum for AAM is rising with rapidly evolving use cases. A 2018 study identified 36 potential markets across 16 categories, including passenger, cargo, corporate, healthcare, research, maintenance and inspection, security, construction, public services, and agriculture (Reiche, et al. 2018) (see Table 5). The list was then refined to three passenger transport-focused markets: airport shuttle, air taxi, and air ambulance. In addition to the passenger transport-focused markets outlined; the air cargo market can also be included. It encounters fewer obstacles to initial implementation when compared to passenger and RAM services connecting urban or rural areas.

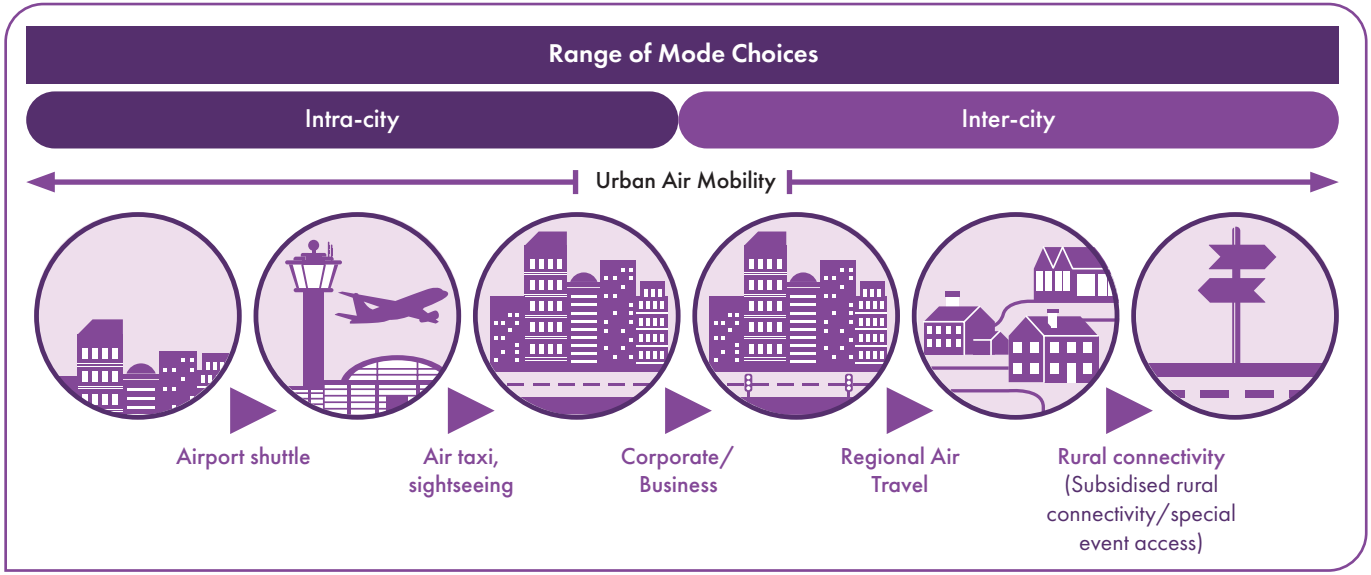
Passenger Transport

Given the growing congestion on urban land routes, commuters require fast and comfortable air mobility both for professional purposes such as commuting to work and private needs like airport shuffles as depicted in Figure 10.

Table 5: A Case of Potential Market of AAM (Passenger)

Use Case	Enabling convenient and efficient point-to-point transportation for passengers, especially in urban areas.
Example of Application	Urban Air Taxis: eVTOL aircraft providing on-demand air taxi services for short-distance travel within cities.
Countries	United States, Germany, Singapore, Japan, and many other developed and emerging economies are actively exploring or piloting urban air mobility solutions for passenger transport.

Figure 10 Possible Evolution of the Passenger Proposition



Source: Aviation 2030 Passenger use cases in the Advanced Air Mobility revolution, KPMG, 2022

Cargo Transport

Manufacturers are exploring aerial goods delivery without human intervention, to optimize resources and services.

Table 6: A Case of Potential Market of AAM (Cargo Transport)

Use Case	Facilitating quick and reliable transportation of goods, with a focus on last-mile delivery or urgent shipments.
Example of Application	Cargo Drones: Unmanned aerial vehicles used for transporting small packages, medical supplies, or other time-sensitive cargo.
Countries	Rwanda and Ghana: • Zipline, a California-based company has operated a system of medical drones throughout Rwanda since October 2016; and • A similar system in Ghana since April 2019. Zipline reported that it had flown 25,094 "lifesaving operations by drone" by December 2019 and that its deliveries account for nearly two-thirds of blood-product deliveries in Rwanda outside the capital city (Graboyes, Bryan, & Coglianese, 2020). Additionally, countries like the United States, China, and several European nations are actively exploring cargo drone applications.

Data Collection

Flying vehicles, particularly drones, are increasingly employed for data collection across various sectors due to their autonomy and speed, and the capability to provide new information through aerial views.

Table 7: A Case of Potential Market of AAM (Data Collection)

Use Case	Employing aerial vehicles for collecting various types of data, such as environmental monitoring, surveillance, or mapping.
Example of Application	Surveillance Drones: Drones equipped with cameras or sensors used for monitoring and collecting data in areas that might be difficult or dangerous for human to access.
Countries	Israel, known for its advanced drone technology, has extensively used drones for surveillance purposes. Similarly, the United States, China, and various European countries deploy drones for data collection in diverse fields such as agriculture, forestry, and environmental monitoring.

These use cases demonstrate the versatility of AAM across sectors and applications, with various countries exploring and implementing these technologies to address specific transportation and data collection needs. The adoption of such technologies is often influenced by regulatory frameworks, infrastructure development, and public acceptance. It is important to highlight that the advancement of AAM initiatives highly depends upon regulatory approvals, infrastructure development, public acceptance, and technological advancements. The AAM landscape is dynamic with new use cases and projects are emerging over time.

Table 8: Potential use case markets for AAM vehicles

Market Category	Potential UAM Market	Definition
Air Commute	Airport Shuttle	Comprises establishments primarily engaged in transporting passengers to, from, or between airports over fixed routes
	Air Taxi	Providing point-to-point passenger transportation and are not operated on regular schedules or routes
	Train	Providing concentrated point-to-point travel along network infrastructure (like trains/ subway)
	Bus	Replacing public transportation routes & charter lines such as Greyhound & BestBus
First Response (Public Services)	Air Ambulance	Travel to/from the hospital for emergencies and potentially hospital visits
	Police – Local, State, and Federal	Law enforcement individuals enabled by air support for daily tasks and events management
	Firefighter – Private, Municipal, and Federal	Quick response firefighting enabled by air mobility travel
	Natural Disaster and Armed Conflict Response – Local, State, and Federal	Air support for aiding humanitarian workers and for evacuation efforts, in addition to the police, ambulance, and firefighting professionals during a natural disaster and armed conflicts
Corporations	Company Shuttle	Shuttle to and from a company headquarters to other offices or employee services
	Office-to-Office Travel	Travel to and from specific offices in adjacent skyscrapers
	Inter-office / Client Delivery	Deliver legal/business documents, replacing inter-office mail and traditional courier services
Events	Major Events	Pick up and drop off for events with a capacity greater than 25K people
	Minor Events	Pick up and drop off for events greater than 100 people but less than 25K
Entertainment and Media	Amusement Parks / Extreme Sporting	Thrill ride (i.e., trackless roller coaster), aerial acrobatics platform, bungee jump/parachuting platform
	Photography	Aerial Photography
	Film/TV/Radio Stations	Filming, Traffic and News Reporting
	Tourism	Aerial Sightseeing Tours
Logistics and Goods Delivery	Aerial Delivery	UAM aircraft and drones to deliver mails, food, humanitarian aid, shopping items etc.
	Aerial Warehousing	Using aerial craft to facilitate goods delivery, warehousing, and logistics management

Market Category	Potential UAM Market	Definition
Real Estate and Construction	Aerial Showcasing, Inspections, and Survey – Property Inspection and Real Estate Showcasing	Building, house, or land inspection and survey by certified inspectors, surveyors or private owners for repair and maintenance Realtors showing prospective client neighborhoods, parcels, and even attending an open house or broker's open house
Security	Aerial Security	Video footage or pictures from the sky to identify security weaknesses in various events
Rentals	Car Rentals – Corporation and Franchise	Replacing daily car rentals
Asset/Building Maintenance	Building Maintenance	Servicing building exteriors, such as painting and window washing, to replace current access methods such as pulley platforms that occasionally result in injury/death
	Utilities Asset Maintenance	Servicing electrical wires, smart poles, and certain meter types, to replace current access practices such as pole climbing that occasionally result in injury/death
Healthcare Providers	Remote Visits	Pickup and drop-off of provider or patient for patients living in remote areas
	Medical Equipment Delivery	Delivery of urgently needed medical items; for expensive diagnostic tools, establish sharing program where delivery to next user is scheduled immediately after use at the first location
Scientific Research	Aerospace Travel/Colony Pilot Studies	Study effects of long-term space travel, life above terrain, new types of aviation technology/process, etc. using potentially less expensive and safer-context UAMs
	Other Applications	Conducting scientific research using other applications elucidated in this list (deforestation, migration patterns, etc.)
Urban Planning	Small Houses/ Emergency Shelter	Modifications to UAMs to create permanently air-parked shelters in crowded environments, crime-prone locations, attached to owner home, etc.
Security	Storage	Modifications to UAMs to create temporary storage space where building permanent addition may not be feasible
Public Services (Non-First Response)	Snowplow & Salt Trucks	Replacing winter snowplow and salt trucks
	Trash Collection	Replacing for trash trucks, hazardous waste disposal, etc.
	School Buses	Replacing public school buses
Agriculture	Flock Tending	Reaching remote flocks for herding, medical care
	Harvesting	Reaching less-accessible farmland for planting, harvesting, potable water
	Landscaping	Replacing ladders and tree-climbing assists with UAMs for tree limb removal

Source: Urban Air Mobility Market Study, National Aeronautics and Space Administration, 2018.

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CHAPTER 2

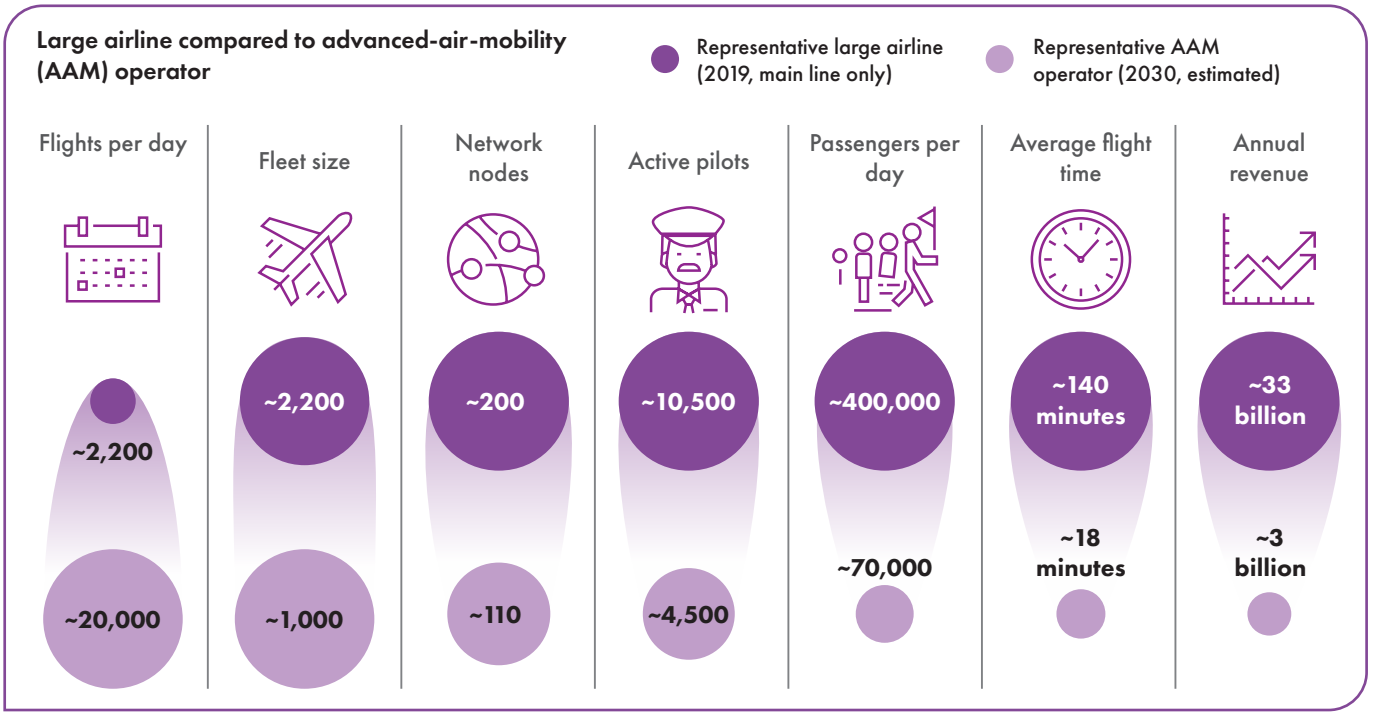
EXPLORING NEW SKIES

GLOBAL AAM OUTLOOK

The AAM industry is witnessing increased investment and interest from companies, venture capitalists, and governments, indicating a growing market with significant economic potential. The development, manufacturing, and operation of AAM vehicles and supporting infrastructure are expected to create new job opportunities in engineering, maintenance, operations, and urban planning. AAM has the potential to disrupt traditional transportation models, leading to new business opportunities and revenue streams.

Studies project robust growth for AAM. In terms of global AAM aircraft size, McKinsey reported that passenger AAM operators could surpass today's largest airlines in 2030. Figure 11 shows a comparison between large airlines (based figure of 2019) and AAM operation in the future. Although large airlines will maintain higher passengers, AAM operation could significantly impact flights per day and fleet size due to shorter, more frequent flights and diverse missions. It is anticipated that AAM could create ten times more flights than large airlines per (averaging only 18 minutes), with fewer passengers on board. In addition to relatively short distance and high-frequency flights, AAM aircraft will be used in undertaking more diverse missions and therefore, size of aircraft could be larger compared to large airlines.

Figure 11: Comparison large airlines and AAM operation in the future

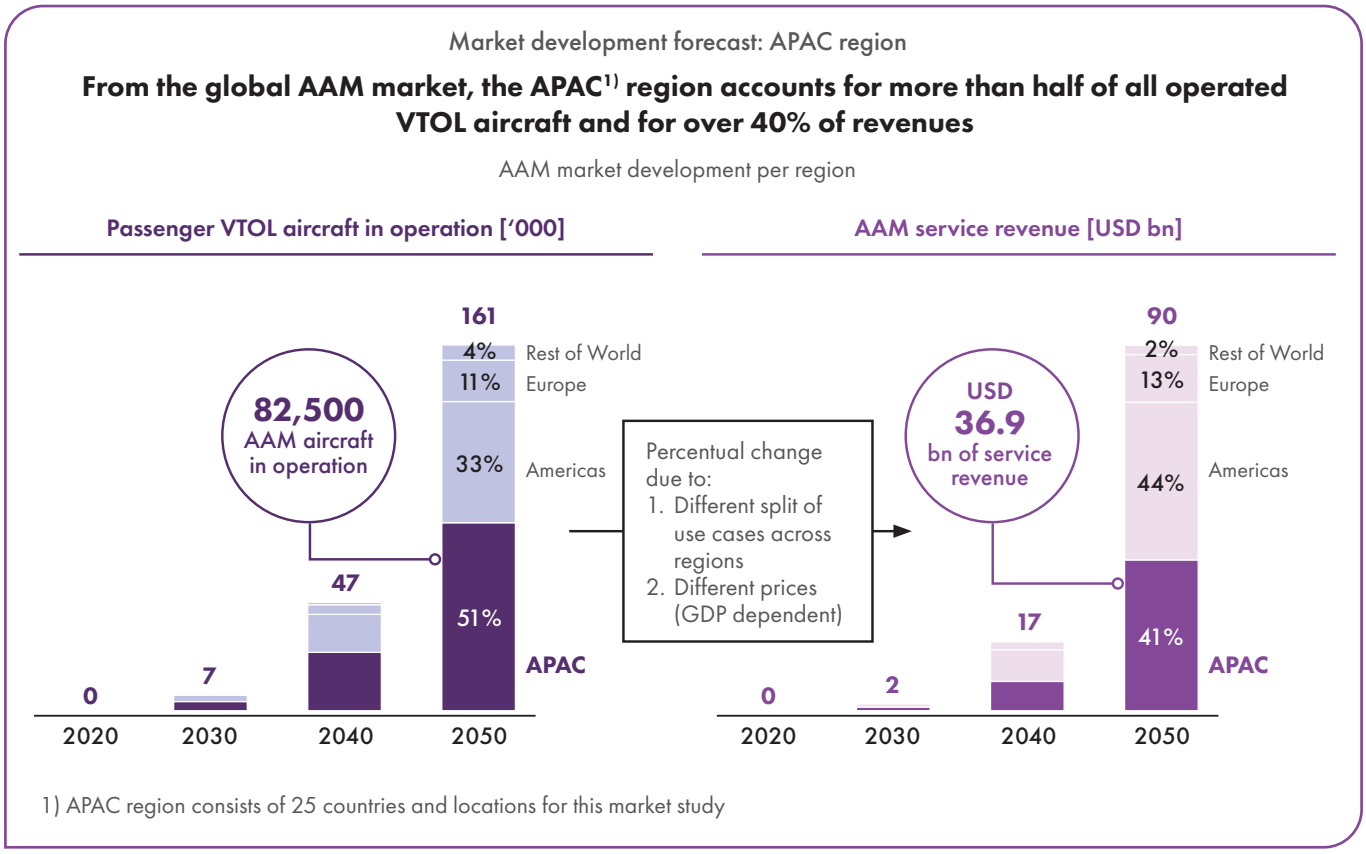


Source: Cirium; investor presentations; US Bureau of Tranportation Statistics; McKinsey analysis.

AAM Market Growth

A vibrant future for AAM will boost demand for its ecosystem, including aircraft parts, components, equipment, and related services. Some studies attempt to forecast the global AAM market in the future. Herman et al. estimated a market potential of USD 318 billion across 74 global cities by 2040. Grand View Research projects the global AAM market to reach USD 137.11 billion by 2035, growing at a CAGR of 24.6%. According to Roland Berger, by 2050, the APAC region could account for over half of all operated VTOL aircraft globally, generating significant revenue.

Figure 12: Global AAM market 2020 - 2050



Source: Roland Berger

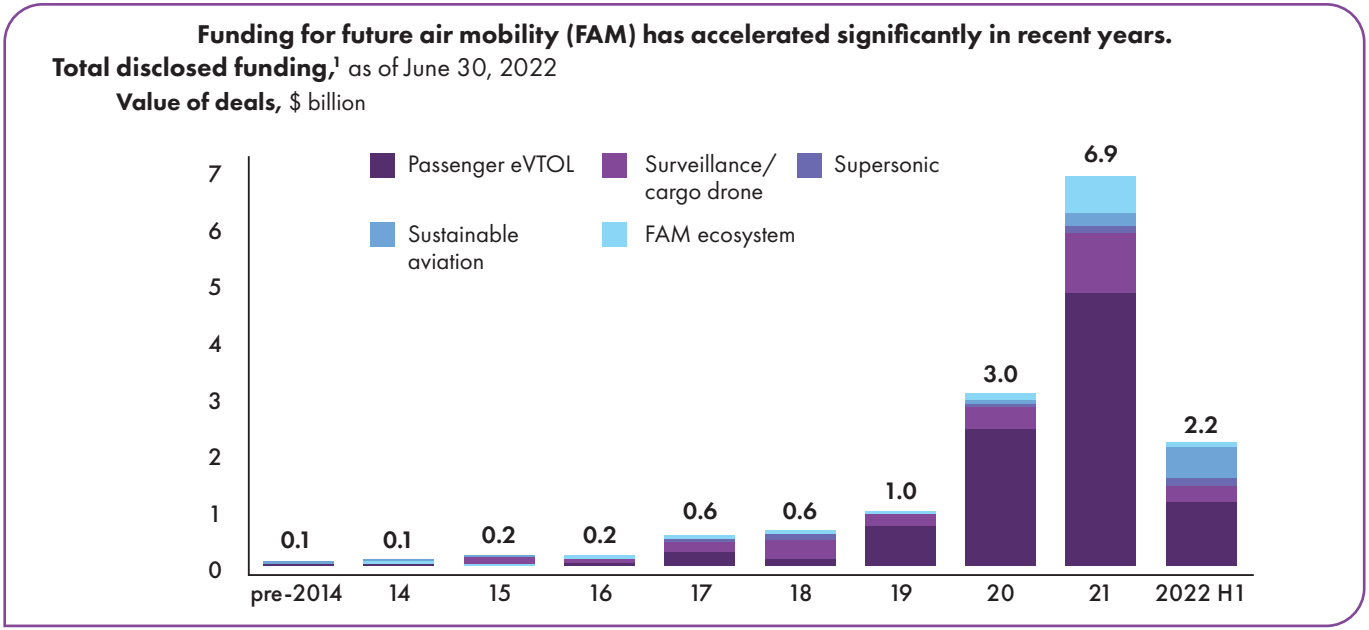
Investment in AAM

The future growth of AAM is strongly tied to increased investment, driven by global efforts to reduce carbon emissions. Total funding has grown exponentially since 2014, as shown in Figure 13, although a decline was recorded in 2022, with USD 3 billion invested—down from USD 7 billion in 2021, but consistent with 2020 levels.

Despite the dip, momentum is expected to continue, supported by a rising volume of orders, prototype development, and vertiport construction in cities such as Paris and Rome. According to McKinsey, approximately 6,700 AAM aircraft orders were placed in 2022, valued at around USD 45 billion. The majority of these came from airlines (25 percent), aircraft charter operators (16 percent), and leasing companies (14 percent).

The year also marked a shift from early-stage concepts and mock-ups to functional prototypes and initial manufacturing efforts, although most remain subscale and pre-certification. The sector has further gained traction through the growing involvement of established aerospace players. By the end of 2022, 72 percent of the top 25 aerospace OEMs and 64 percent of major suppliers were actively engaged in AAM initiatives—up from 60 percent and 48 percent, respectively, in the previous year.

Figure 13: Exponential Growth of Total Funding Committed by Interested Parties from 2014 to 2021



Source: S&P Global Market Intelligence, McKinsey analysis.

TRENDS SHAPING THE FUTURE OF AAM DEVELOPMENT

In addition to the economic outlook, the future of AAM industry development could be attributed to social, environmental, technological and political trends. These trends might have a direct or indirect impact on the demand and operational aspects of AAM development.

TREND 1: Accessibility And Equitability

What is it?

Governments are under increasing pressure to create a more inclusive and just society by addressing systemic inequalities and providing equal access for all individuals to participate in socio-economic activities. Corporations are focusing on extending their reach to marginalized and underserved communities, enhancing social responsibility and equitable business practices.

A well-connected transport network enhances efficiency, significantly reducing travel times and unlocking new possibilities for work, education, and leisure. In the United Kingdom, the population of individuals aged 65 and above in rural areas is projected to increase by around 50% by 2043, while the population of 16–24-year-olds is expected to see almost no growth. This seems to indicate that factors like mobility and increased isolation could gradually contribute to the decline of rural communities over time. A report by the UK Government revealed that two in three people thought that improved transport links would have a positive impact on people's ability to access job opportunities hence promoting rural revitalization (Handley, 2022).

AAM could bring potential socioeconomic benefits, such as economic growth, reduced rural-urban disparities, increased agricultural productivity, access to healthcare, education, and public services, regional development, population retention, and overall economic resilience.

How it drives the growth of AAM?

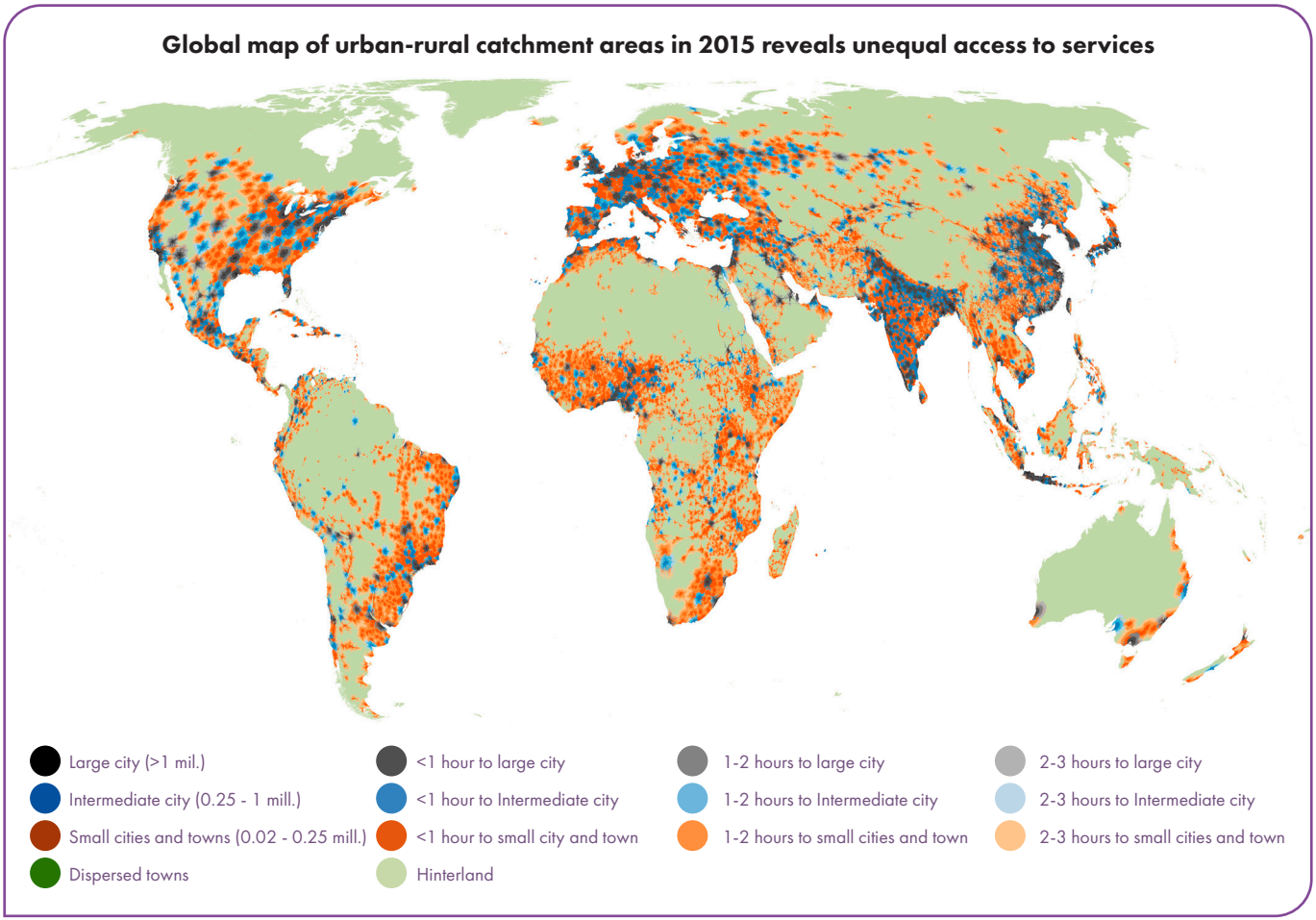
AAM complements and completes existing transportation networks, facilitating connectivity and accessibility. It can level up and bridge the gap between diverse populations, mitigating the impact of distance and ensuring the delivery of essential supplies and services to currently underserved regions.

In 2021, the share of the global population living in rural areas was approximately 41% but the untapped land areas classified as rural is still vast and could be potential opportunities for the utilisation of AAM as shown in Figure 14.

Table 9: Comparison of Travel Time for Selected Hard-to-reach Destinations in Malaysia

From	To	Duration (by river/land)	Duration (by flight)
Kuching	Sibu	6 hours 30 minutes (by road) 4 hours 30 minutes (by express boat)	45 minutes
Marudi	Bario	4 days (by logging trail)	40 minutes
Kota Kinabalu	Sandakan	6 hours 30 minutes	45 minutes
Kota Kinabalu	Lahad Datu	7 hours 30 minutes	1 hour

Figure 14: Accessibility to Service Globally by Urban-rural Catchment Areas



Source: Global Map of URCAs in 2015, The Proceedings of the National Academy of Sciences, 2021.

TREND 2: Convenience Consumer

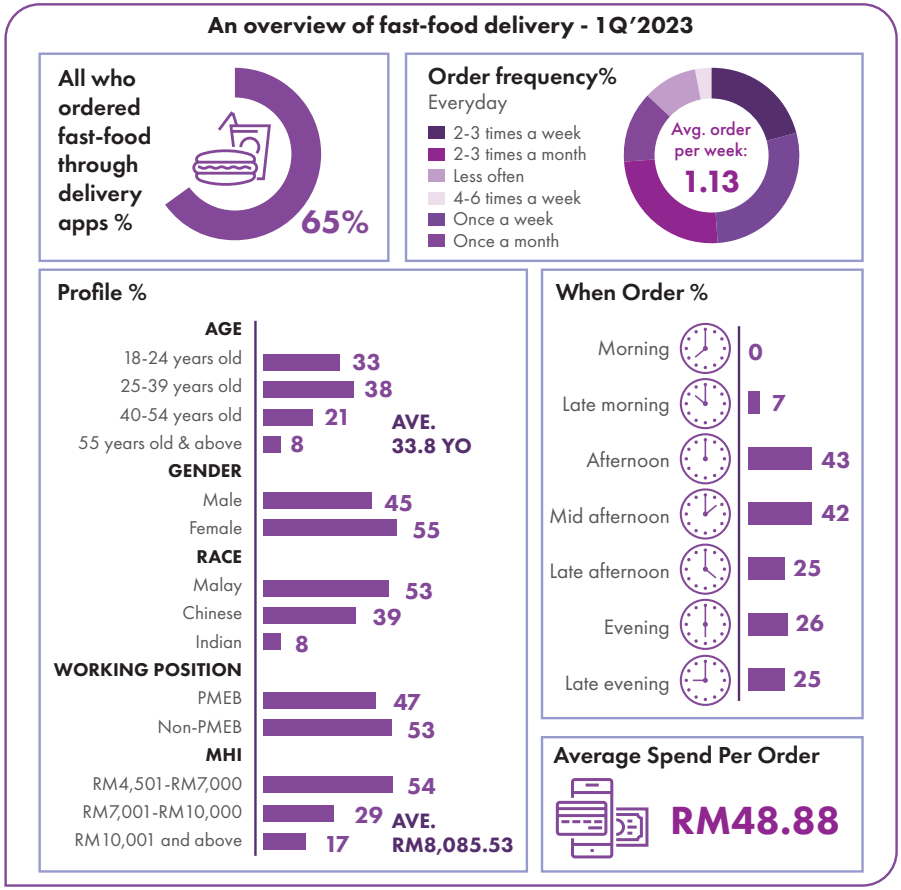
What is it?

Consumer behaviour has shifted with the rise of door-to-door delivery, e-commerce and personalised services coupled with increased income and lifestyle changes. Consumers now prioritise convenience experience and are willing to pay for a seamless experience, valuing time efficiency, on-demand access, automation, smart technology, and mobile and digital as shown in Figures 16 and 17.

How it drives the growth of AAM?

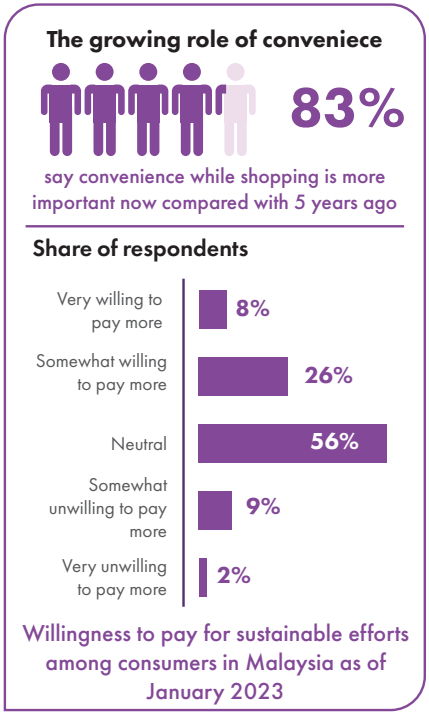
Increasing population density leads to rising market demand for solutions to traffic congestion, limited land availability in densely populated cities, and the need for connectivity and accessibility in underserved areas. AAM's Vertical Take-off and Landing (VTOL) capabilities are suitable for these conditions, providing efficient transportation options.

Figure 16: Overview of Fast-food Delivery in Q1, 2023



Source: Overview of Fast-Food Delivery, Oppotus, 2023

Figure 17: The Growing Role of Convenience



Source: Convenience is driving e-commerce growth and influencing consumer decisions, Smart Insights, January 28, 2020 and Willingness to pay for sustainable efforts among consumers in Malaysia as of January 2023, Statista, 2023

TREND 3: Electrification of Mobility

What is it?

There is a growing adoption of electric vehicles (EVs) and a transition from internal combustion engine (ICE) vehicles to electric powertrains. This trend is driven by the need to reduce greenhouse gas emissions, improve air quality, and decrease reliance on fossil fuels. Electrically-powered AAM vehicles are also gaining traction due to environmental benefits, lower operating costs, and quieter operations.

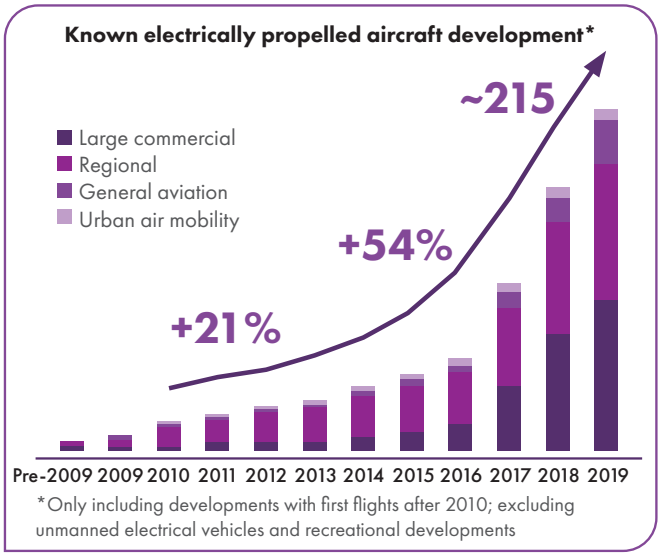
The development of electrically propelled aircraft has accelerated in recent years, driven by the global push for sustainable and low-emission aviation. As of 2022, over 100 electric aircraft projects were under development worldwide, with urban air taxis representing a substantial share of activity (WSP, 2022). The global electric aircraft market was valued at approximately USD 8.89 billion in 2022 and is projected to grow to USD 54.36 billion by 2032, reflecting a compound annual growth rate of 19.8 percent (Emergen Research, 2023). While the sector was initially led by smaller developers focused on regional and urban mobility, recent years have witnessed increased participation from major aerospace and automotive players. Airbus and Rolls-Royce have launched hybrid-electric development initiatives (Lux Research, 2023), while Toyota has significantly expanded its investment in Joby Aviation, contributing nearly USD 900 million to support certification and commercial production of electric air taxis (Reuters, 2024). These developments reflect growing confidence in electric aviation as a core enabler of future air mobility.

In Malaysia, the electrification of mobility is currently limited to ground transport with increased efforts to attract investments in EVs and achieving the national target of 15% of the total industry volume for EVs and hybrids by 2030. This is in support of Malaysia's pledge to become a net-zero GHG emissions nation by 2050, as outlined in the 12th Malaysia Plan.

How it drives the growth of AAM?

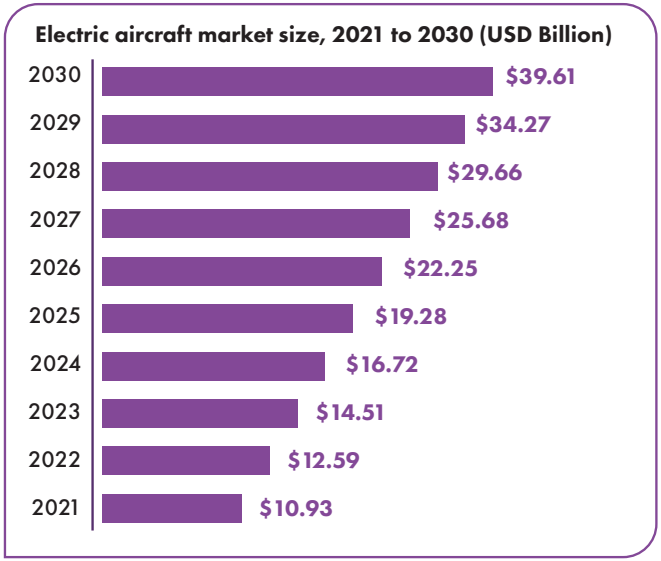
The global electric aircraft market is expected to exceed USD 85 billion by 2027, driven by demand for eco-friendly aviation solutions. Existing aerospace players are developing electric fleets, and potential government and consumer support for electrification of aviation further drive the growth of AAM.

Figure 18: Development of Electrically Propelled Aircraft



Source: Electric Propulsion is Finally on the Map, Roland Berger, 2018

Figure 19: Electric Aircraft Market Size



Source: Electric Aircraft Market Size, 2021 to 2030, Precedence Research, 2022

TREND 4: Stakeholder's Acceptance and Trust

What is it?

The viability of AAM depends on regulatory approval and public acceptance. Governments are developing regulations and standards to govern AAM operations, ensuring safety, managing airspace, and addressing privacy and security concerns. Temporary operating licenses or type certifications are in the plans or have been issued in the US, EU, UAE, and Singapore through regulatory frameworks and sandboxes.

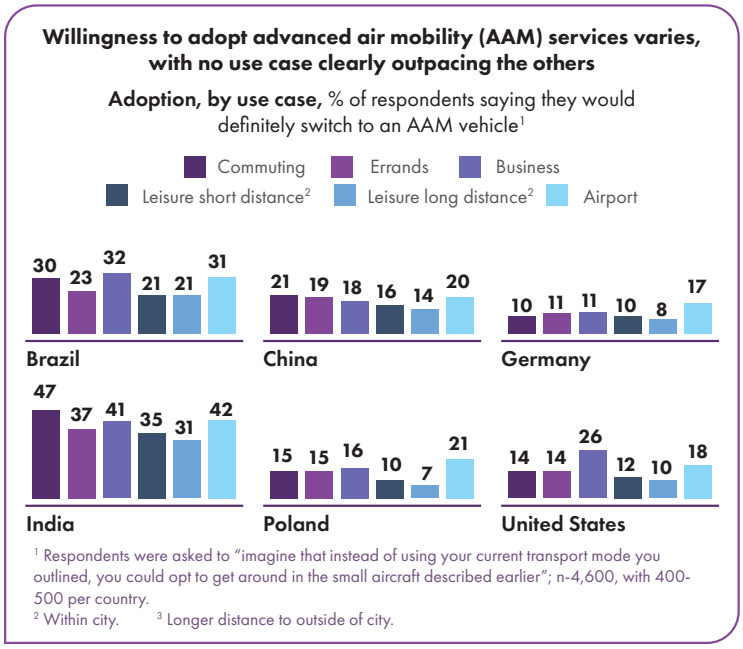
Building public trust and acceptance for AAM will be crucial for its successful integration into existing transportation systems, requiring effective communication and stakeholder engagement. Not only to potential users but also those impacted by it as public protests could place pressure on the government to prevent the operation of air taxis, and unmanned passenger, and cargo drones.

Additionally, to enable intra-regional connectivity, collaboration between countries and regulatory bodies is essential to establish harmonized standards and enable cross-border AAM operations.

How it drives the growth of AAM?

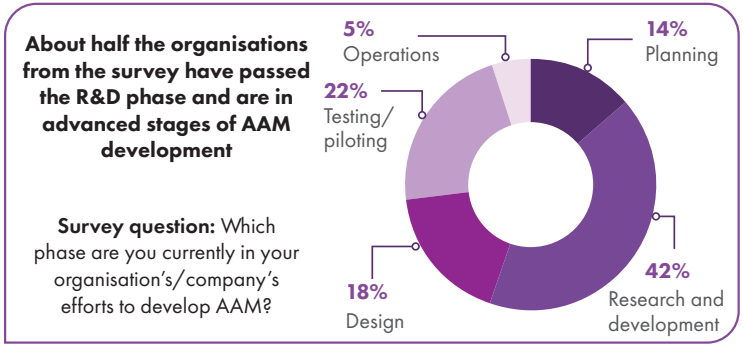
The Federal Aviation Administration (FAA) in the United States is actively working on regulations for AAM operations, including certification, airspace management, and pilot training. Similarly, the European Union Aviation Safety Agency (EASA) collaborates with other regulatory bodies to develop common standards. Engagement with regulators and the public will facilitate the integration of AAM into existing transportation systems. NASA's Advanced Air Mobility National Campaign focuses on community engagement to build trust and gather feedback, which is crucial for the successful adoption of AAM technologies.

Figure 20: Survey Question on Consumers' Willingness to Adopt AAM



Source: Up in the Air: How Do Consumers View Advanced Air mobility, McKinsey & Company, June 1, 2021.

Figure 21: Survey Question in which Phase of Developing AAM



Source: Advanced Air Mobility, McKinsey & Company, June 1, 2021.

TREND 5: Sustainability and Decarbonisation

What is it?

By 2050, the world must achieve climate stabilisation through net-zero emissions and limit global warming to 2°C. As nations work to fulfil their climate commitments, a variety of low-carbon technologies will need to be rapidly scaled up.

The transportation sector in Malaysia accounts for 28.8% of total fossil fuel combustion emissions, well above the global average of 24.5% (International Energy Agency, 2019). CO2 emissions from transportation in Malaysia increased from 4 metric tons in 1972 to 55 metric tons in 2021 growing at an average annual rate of 5.67% (Knoema, 2022).

Figure 22: Lower-carbon Footprint Mobility Solution

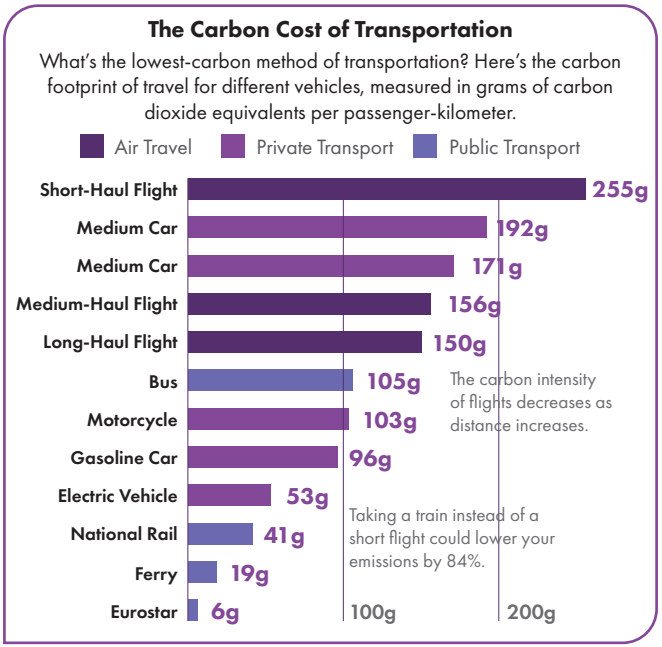
Industry
Transformative electrochemical processes, electrification of industrial heat, and the use of green hydrogen as a feedstock and fuel.
Agriculture
Direct and disruptive options to simultaneously satisfy the demand for reduced environmental impact, food diversification, and food security.
Buildings
Shifting from procuring zero-carbon electricity to on-site generation and storage of zero-carbon energy for electricity, heating, and cooling.
Transport
A combination of electrification via next-generation batteries, hydrogen fuel cells, and synthetic fuels to meet various demands and transportation modes.
Energy Production
Novel energy production working in harmony with incumbent wind and solar, enabling faster decarbonizations rates for electricity, heat, and hydrogen.
GHG Abatement
Point-source GHG capture and negative emissions technologies addressing Scope 1, Scope 2, and Scope 3 emissions.

Source: Advanced Air Mobility Inquiry for MIGHT, Lux Research, April 18, 2023.

How it drives the growth of AAM?

AAM provides a lower-carbon footprint solution, significantly reducing emissions compared to traditional aviation. By integrating renewable energy into operations, AAM enhances sustainability, making it appealing to environmentally conscious consumers. Electric aircraft designed for short-haul flights, such as regional commuter planes or air taxis, can achieve substantial emission reductions, as they are zero-emission during operation, significantly improving air quality. These aircraft can reduce CO_2 emissions by 49% to 88% compared to fossil-fuelled counterparts. Additionally, AAM is projected to be 2.1 to 3.2 times more energy-efficient in operation. When compared to aircraft using e-kerosene, a sustainable alternative to fossil jet fuel, electric aircraft could be 4.5 to 6.9 times more energy-efficient.

Figure 23: The Carbon Cost of Transportation



Source: Comparing the Carbon Footprint of Transportation Options, Visual Capitalist, February 15, 2022.

TREND 6: Technological Advancement

What is it?

The concept of vertical take-off and landing aircraft has been experimented with since the 1900s. However, significant technological advancements have been made since then namely in the following:

- **Electric Propulsion:**

  A shift towards electrically powered AAM vehicles is gaining traction due to their environmental benefits, lower operating costs, and quieter operations.
- **Autonomy and Automation:**

  Advancements in autonomous flight technology and artificial intelligence enable greater automation in AAM operations, enhancing safety and efficiency.
- **Vehicle Design and Infrastructure:**

  Innovations in aircraft design, such as vertical take-off and landing capabilities, enable AAM vehicles to operate in urban environments and utilise vertiports as landing and charging stations.
- **Next-Gen Battery Capital:**

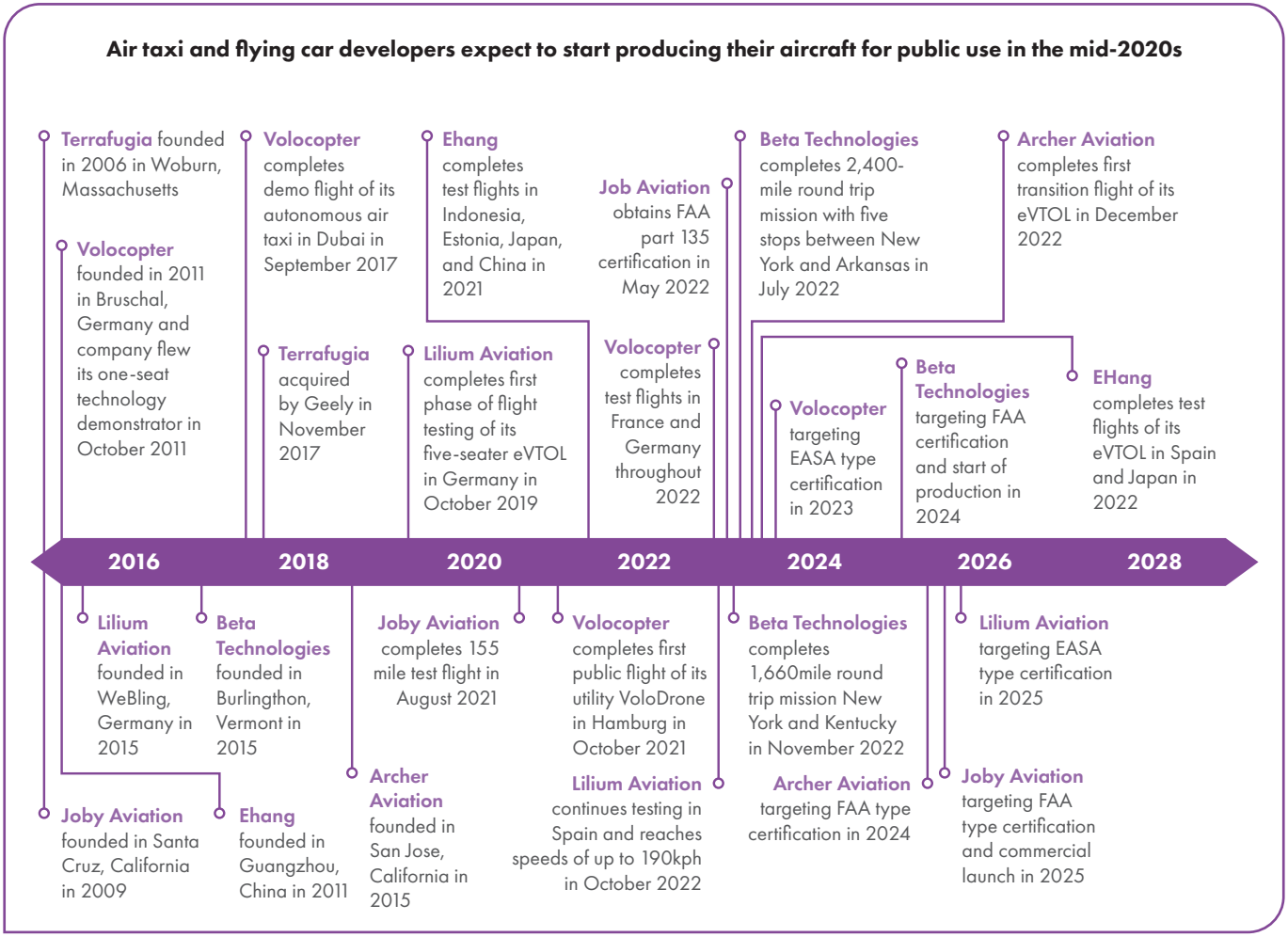
  Battery technology has been undergoing continuous improvements in energy density, allowing batteries to store more energy in a smaller and lighter package. Higher energy density batteries enable AAM vehicles to carry larger loads, extend flight range, and enhance overall performance. Ongoing research and development in lithium-ion technology have led to performance enhancements, cost reductions, and increased safety, making them a popular choice for AAM applications. Solid-state batteries are emerging as a potential future technology for AAM vehicles. These batteries offer higher energy density, improved safety, and faster charging capabilities compared to traditional lithium-ion batteries.
- **Fast Charging Solutions:**

  AAM operators are exploring and developing fast-charging solutions to reduce downtime and increase operational efficiency. Fast-charging infrastructure can enable quick turnaround times between flights, making AAM vehicles more viable for on-demand transportation services.

How it drives the growth of AAM?

Technological innovations support the development of efficient and safe AAM operations. Companies like eHang and Joby Aviation are actively developing autonomous AAM vehicles, showcasing advancements that will drive market growth. Companies like Archer and Lilium are designing AAM vehicles with vertical take-off and landing capabilities, while infrastructure providers like Skyports are developing vertiports to support AAM operations.

Figure 24: Air Taxi and Flying Cars Developers Expect to Start Producing Aircraft for Public Use



Source: Advanced Air Mobility Inquiry for MIGHT, Lux Research, 2023

TREND 7: Urbanisation and Rise of Megacities

What is it?

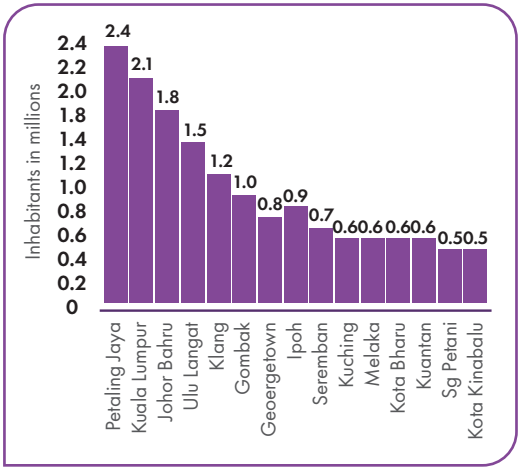
Urbanisation in Malaysia has nearly tripled, rising from 28.4% in 1970 to 78.7% in 2023. By 2050, the population is projected to reach 40.7 million, with an anticipated urbanisation rate of between 85% and 90% (World Bank, O'Neill, 2023).

Mass migration from rural areas to urban centres gives rise to megacities which are defined as cities housing more than 10 million people. These megacities create a new urban dynamic, as supersized cities are seen as the new engine of the global economy, connecting the flow of goods. Currently, there are 32 megacities in the world, housing 545 million people.

How it drives the growth of AAM?

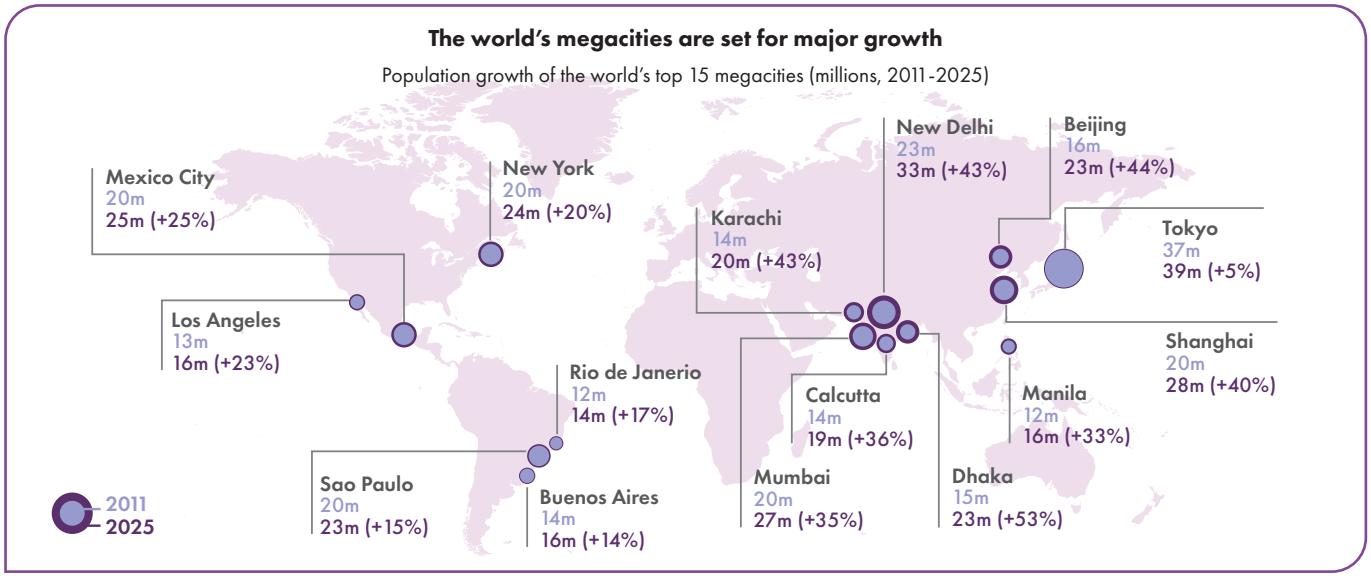
AAM offers practical solutions for urban mobility, addressing traffic congestion and providing efficient transport options in densely populated areas. Its VTOL capabilities are ideal for cities with limited space, supporting sustainable urban development and connectivity.

Figure 26: Largest Cities in Malaysia by Population in 2024



Source: DOSM, 2024

Figure 25: These will be the World's Next Megacities



Source: The world's megacities are set for major growth, Deloitte, January 29, 2014.

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CHAPTER 3

NAVIGATING THE FUTURE

HISTORICAL CONTEXT

Malaysia's commitment to further advance the aerospace industry development started with the launch of the National Aerospace Blueprint: Piloting the Industry Take-off in 1997 (National Aerospace Blueprint, 1997). It set the aspiration and charted the direction for Malaysia's success as a regional centre for aerospace activities by the year 2015. This is achieved through the implementation of 45 key recommendations by the Malaysian Aerospace Council (MAC). This has driven the country to develop its capabilities from performing maintenance of aircraft to venturing into a higher value activities through the manufacturing of small aircrafts both fully metal (SME MD-3 Aerotiga) and fully composite (Eagle 150B). However,Malaysia becoming a prominent player in the small aircraftproduction market was an uphill task due to intense competitionwith other global players. Realising this, MAC sets the wayforward in achieving the national aspiration through four (4)focus areas:

i. Maintenance, Repair and Overhaul (MRO),
ii. Parts & Components Manufacturing,
iii. Avionics and Systems Integration, and
iv. Centre of Excellence for aerospace education and training.

To help support the growth of the four (4) focus areas, MAC in 2005 agreed to bolster the development of the general aviation industry serving as a catalyst to the national aerospace industry. General aviation, as defined by the General Aviation Manufacturers Association (GAMA), encompasses the manufacture and operation of any aircraft issued an airworthiness certificate by the aviation authority, excluding those used for scheduled commercial air service or by the military. Activities within this industry cover flying training, helicopter operations, aerial photography, air charter, medical and evacuation, air taxi and pest control, amongst others. Importantly, these diverse activities can also be undertaken by an AAM aircraft.

The second edition of the Malaysian Aerospace Industry Blueprint, published in 2015, aimed to reaffirm the national commitment with a renewed aspiration: "By 2030, Malaysia will be the number 1 aerospace nation in Southeast Asia and be an integral part of the global market" (Zainal, Abu Talib, & Hack, 2015). A notable addition to the focus areas was Engineering and Design Services. The new aspiration was aimed to be realised through the following objectives and targets:

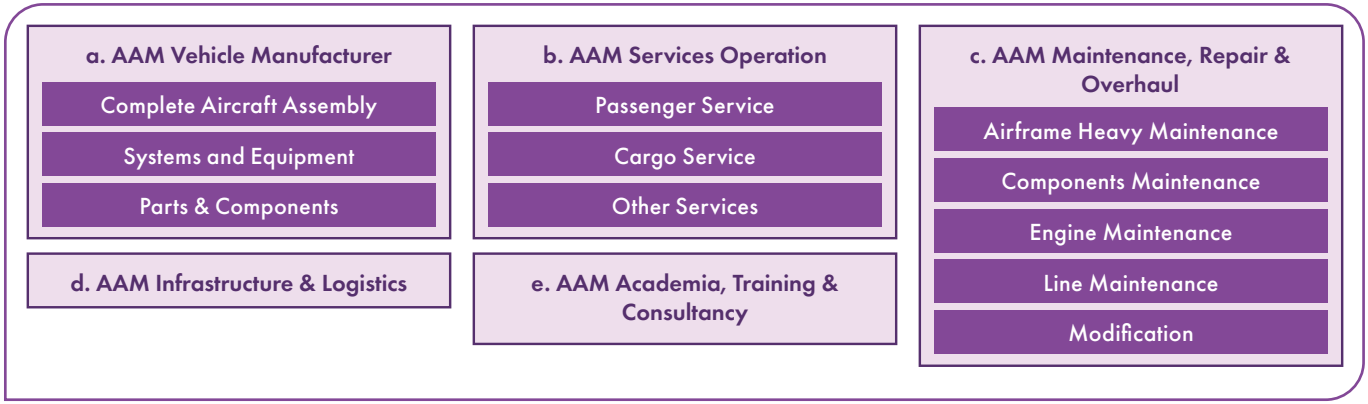
a. Maintenance, Repair and Overhaul (MRO) – to capture at least 5 percent of global market share.
b. Aero-Manufacturing – to be ranked first in Southeast Asia for aerospace parts and components sourcing by targeting to be a large sub-assembly, Tier-1 and Risk Sharing Partner (RSP).
c. Systems Integration – Self-reliant (at least 70 percent local content) in integration and upgrading of strategic assets.
d. Engineering and Design Services – to capture at least 3.5 percent of the global market share.
e. Education and Training – to become number 1 in Southeast Asia in supplying a competent workforce.

Given that AAM shares a similar nature of applications of general aviation, promoting the growth of AAM in Malaysia is aligned with the direction set in both aerospace blueprints. However, a review of the current blueprint to include more AAM development initiatives is needed as it has not been explicitly stated in the blueprint. Therefore, this report will provide input to the future aerospace industry development planning and related policies in Malaysia.

MALAYSIAN AAM PLAYERS AND STAKEHOLDERS

AAM initiative in Malaysia is relatively at the infancy stage which mostly involves drone activities. Nevertheless, new and existing players, are already exploring new business models using AAM aircraft to provide passenger transportation services. Figure 27 shows major industry activities involved in the aviation sector that comprise manufacturing, service operation, MRO, infrastructure & logistics, and training and consultancy.

Figure 27: Major components of AAM industry



AAM Manufacturing

Sixty companies are currently involved in the AAM manufacturing supply chain, spanning complete aircraft assembly, systems and equipment, and parts and components. As shown in Figure 28, these include both international and local firms, with contributions from AAM-specific and cross-industry players, reflecting a diverse and growing ecosystem.

Figure 28: Numbers of AAM vehicle manufacturers segregated by type of company both local and international

	Companies		Industry	
AAM Vehicle Manufacturer	**International**	**Locally established**	**Specific AAM**	**Cross-industry**
Complete Aircraft Assembly	14	8	17	5
Syatems & Equipment	1	18	10	8
Parts & Components	9	10	6	14

Source: AAM Stakeholder's Engagement Workshop Series, 2023.

Complete Aircraft Assembly

The AAM vehicle manufacturer refers to a company or entity which specialises in the design, development, production, and assembly of AAM vehicles. These vehicles are typically electric or hybrid-electric vertical take-off and landing (eVTOL) aircraft designed for various applications, including urban air mobility, aerial transportation, cargo delivery, and other aerial services. Findings of the stakeholders' engagement as depicted in Figure 29 shows 22 companies involved in activities of producing a complete AAM aircraft, comprising 14 international players, and eight (8) locally established companies.

Figure 29: Complete Aircraft Assembly: Numbers of International and Local Companies of Complete Aircraft

Source: AAM Stakeholder's Engagement Workshop Series, 2023.

Figure 30 segregates players identified as specific AAM companies that primarily operate within the AAM sector, developing and providing solutions directly related to AAM, such as manufacturing electric or hybrid eVTOL aircraft, developing flight control systems, providing aerial services, and other AAM-specific activities. For example, startups like Etienne are making progress in the design and development of eVTOL aircraft.

The cross-industry businesses in the AAM domain refer to companies that are involved in various industries and may act as systems integrators, that provide comprehensive solutions that incorporate AAM technologies along with their expertise in other fields. For example, they might offer integration services that combine AAM capabilities with technologies like data analytics, the Internet of Things (IoT), or artificial intelligence (AI) for comprehensive urban mobility solutions.

Figure 30: Specific AAM and Cross-Industry Businesses

Source: AAM Stakeholder's Engagement Workshop Series, 2023.
**Specific AAM - a dedicated focus and specialised expertise in the complete aircraft assembly of the AAM industry*
**Cross-industry - involved in a broader range of businesses beyond AAM*

Systems and Equipment

Systems and equipment for AAM encompass a diverse range of advanced technological devices that are specifically designed and utilised to support and enhance AAM solutions. These essential systems and equipment play a pivotal role in ensuring the seamless operation, precise navigation, heightened safety, and optimal efficiency of electric or hybrid eVTOL aircraft, as well as other related AAM services.

The stakeholders' engagement session highlights the presence of locally established companies in this segment, with growing interest and capabilities of domestic industries in advancing AAM technology. These local companies encompasses start-ups and well-established players from diverse backgrounds, such as system integrators, aerospace, and the automotive sector. However, there was only one international player i.e. T-Motor of China. There are a total of 18 companies within the segment. One aspect worth noting is the dominance of locally established companies, with 17 out of 18 entities being homegrown.

Figure 31: Numbers of Specific and Cross Industry Companies Involved in System and Equipment

Source: AAM Stakeholder's Engagement Workshop Series, 2023.
**Specific AAM - those that have a dedicated focus and specialized expertise in the systems and equipment of the AAM industry*
**Cross-industry - involve in a broader range of businesses beyond AAM*

Figure 31 above highlights industry players in systems and equipment that belong to the specific AAM companies. Among these companies, 10 are specific AAM players, primarily operating within the AAM sector and are actively involved in developing and providing solutions directly related to AAM. Their offerings include manufacturing electric or hybrid eVTOL aircraft, developing advanced flight control systems, providing aerial services, and engaging in other AAM-specific activities.

There are also eight (8) companies from cross-industry sectors involved in systems and equipment, playing a significant role as system integrators. These companies combine AAM technologies with their expertise from various fields. They offer comprehensive solutions that incorporate AAM capabilities alongside other cutting-edge technologies such as data analytics, IoT, and AI. By blending these diverse capabilities, they contribute to the creation of integrated urban mobility solutions that go beyond conventional AAM applications. These cross-industry players are instrumental in advancing AAM technology by exploring innovative ways to embed AAM solutions into broader industry contexts.

An ecosystem for AAM systems and equipment has emerged, comprising a mix of startups and established companies. This balanced presence has led to a diverse combination of firms from various backgrounds, including system integrators and aerospace specialists. Together, these companies have the potential to form a robust ecosystem that fosters innovation and collaboration in developing cutting-edge systems and equipment for AAM solutions.

Parts & Components

There are a total of 20 companies identified were involved in the parts and components segment of the AAM industry. Of these, 10 are locally established companies with a strong presence in diverse industries such as information technology, aerospace, automotive, and oil and gas. The remaining 10 are foreign multinational companies that either have interests in the local market or work through local partners.

During the stakeholders' engagement session, 19 of these companies were identified and reviewed. Among them, six were specifically focused on AAM, while the rest were cross-industry companies engaged in related sectors like aerospace and systems integration. This highlights the growing role of cross-industry players in strengthening the AAM parts and components ecosystem.

Figure 32: International and Locally Established Companies

Source: AAM Stakeholder's Engagement Workshop Series, 2023.

AAM Services

In the AAM services industry, it's observed that a wide range of companies participate in providing support to the manufacturing and operation of AAM-related activities. The study categorised these companies into specific segments, although the challenge was that these companies provide services that extend beyond the primary focus of the AAM sector. Nevertheless, the AAM-related services segments were clustered as follows: Services Operation - Passenger Service, Services Operation - Cargo Services, Services Operation – Other services, Infrastructure & Logistics, and Academia, Training & Consultancy. This investigation will encompass both local players and international companies operating within these segments.

Services Operation - Passenger Service

The presence of the AAM passenger segment which involves the transportation of passengers using advanced aerial vehicles, is currently marked by an absence of notable activity or substantial development. Efforts to establish a robust AAM passenger sector are in their infancy, and substantial growth and establishment are necessary to transform this almost non-existent presence into a viable aspect of the broader AAM landscape. To gain a comprehensive understanding of the current state and potential growth of this segment, further analysis and data collection from a wider range of operators will be crucial.

The stakeholders' engagement sessions brought together a diverse mix of companies in this segment, including well-established "traditional" players from the aerospace industry such as Air Asia, Hornbill Skyways, MHS Aviation, and Malaysia Airlines, all expressing their involvement in the AAM sector. Additionally, the session featured emerging technology players like DG and Aerodyne, contributing to the industry's innovative advancements.

Still others include another key player Aerotree, a 100% local Malaysian-bumiputra-owned company specializing in aeronautical engineering, aerospace technology development, aerial flight training, and the introduction of new products and services within Malaysia's defence aviation industry.

Services Operation - Cargo Services

There have been some notable developments in the cargo service segment within the AAM industry in Malaysia. For instance, DHL Express Malaysia and PETRONAS have partnered with Aerodyne Group to explore drone services, which signal potential advancements in cargo transportation efficiency. Additionally, AirAsia and Swoop Aero have received recognition from JUPEM, though the relevance of this to cargo services in AAM remains unclear and warrants further clarification. While a list of users—including DHL, Berjaya, Amazon, Poslaju, and Edaran—has been identified as operators, their exact involvement and collaborations within the cargo service segment remain to be clarified.

Innovative startups have the potential to significantly transform the cargo service sector by introducing new possibilities and fostering healthy competition. The Malaysia UAV Alliance Association (MUVA), a collective of UAS enthusiasts from various industries, government agencies, and academic institutions, focuses on four main areas: Beyond Visual Line of Sight (BVLOS) flight, regulatory frameworks, precision agriculture, and Urban Air Mobility (UAM). Pen Aviation, a key player in the niche aviation sector, offers a wide range of services—from consulting and project management to service delivery, manufacturing, infrastructure development, aircraft sales, acquisition, and charter concierge.

Maintenance, Repair, and Overhaul (MRO)

General segments of MRO can be divided into engine maintenance, component maintenance, modification, airframe heavy maintenance, and line maintenance. MRO is essential to ensure the safety and reliability of AAM vehicles through essential upkeep and repairs. Currently, local players' capabilities are strong in all segments to support local and international aviation activities. However, the stakeholder engagement sessions indicated that 14 companies have expanded their service to support AAM.

Figure 33: Number of MRO Companies Participated in the Workshop

Source: AAM Stakeholder's Engagement Workshop Series, 2023.

Academia, Training & Consultancy

In the dynamic landscape of AAM, academia, training, and consultancy are pivotal in cultivating a proficient workforce. Expertise is paramount for the AAM sector's success, encompassing research, development, operation, and maintenance. Academic institutions, training providers, and consultancies contribute significantly to nurturing capable professionals, empowering them to navigate the sector's challenges and prospects.

Figure 34: Organisations Involved in Academia, Training, and Consultancy Services to Support the AAM Sector

Source: AAM Stakeholder's Engagement Workshop Series, 2023.

Through academic programs and courses specifically designed to cater to AAM and aerospace-related fields, universities and polytechnics play a fundamental role in educating and training future professionals. These institutions offer a comprehensive range of courses at various levels, from undergraduate to postgraduate, providing a well-rounded education that encompasses the technical, regulatory, and operational aspects of AAM.

During the stakeholders' engagement session, over 50 organisations directly or indirectly involved in academia, training, and consultancy services to support the AAM sector were identified. Notably, there are 31 universities and polytechnics from both public and private entities offering AAM, aerospace-related and engineering courses at various levels.

Infrastructure & Logistics

Companies providing infrastructure and logistics services are essential players in the support services for AAM. This segment includes construction companies with the capability to develop AAM infrastructure, including vertiports and other critical facilities. Malaysia Airports Holdings Berhad (MAHB) is a significant stakeholder in this segment due to its role as an airport operator with a direct interest in this domain. In July 2021, Malaysia Airports Holdings Berhad (MAHB) signed an MoU with Skyport (the world-leading designer and operator of vertiport infrastructure for electric air taxis) and Volocopter (the pioneer of Urban Air Mobility) to conduct a feasibility study for vertiport deployment in Malaysia (Malaysia Arirports, 2021). The collaboration forms part of the five-year Sultan Abdul Aziz Shah Airport, Subang (LTSAAS) Regeneration plan. It will explore the deployment of revolutionary electric air taxi services at LTSAAS as well as other locations throughout Malaysia, putting the country amongst the leaders in the region in terms of progress in the implementation of UAM.

Notably, some state governments, like Perbadanan Kemajuan Ekonomi Negeri Perlis (PKENPs), have shown keen interest in advancing the AAM industry by investing in the development of AAM infrastructure. This commitment reflects the growing recognition of AAM's potential benefits in enhancing transportation and mobility options.

During the recent stakeholders' engagement session, a total of 18 companies were identified in the AAM infrastructure and logistics services segment (Figure 35). Out of these, five are foreign entities, indicating potential international interest in Malaysia's AAM market. However, the degree of local collaboration for these foreign companies remains undisclosed.

Figure 35: Companies Engaged in AAM Infrastructure and Logistics Services

Source: AAM Stakeholder Engagement Workshop Series, 2023.

Services Operation – Other services

Companies involved in providing other services for the AAM industry play crucial roles in primary system integration, surveillance, air navigation services, data security, and secondary services such as insurance, financing, and research and development (R&D). These services collectively support the AAM industry's operations and growth. A diverse profile of companies is identified under this category, with each offering a range of services not only specific to the AAM industry but also catering to various other industries.

Figure 36: Companies in AAM Industry

Source: AAM Stakeholder's Engagement Workshop Series, 2023.

Primary system integration, surveillance, and air navigation services are essential for ensuring the safe and efficient operation of AAM vehicles. Meanwhile, companies offering data security solutions address the critical need to protect sensitive information and maintain the trust of customers and stakeholders.

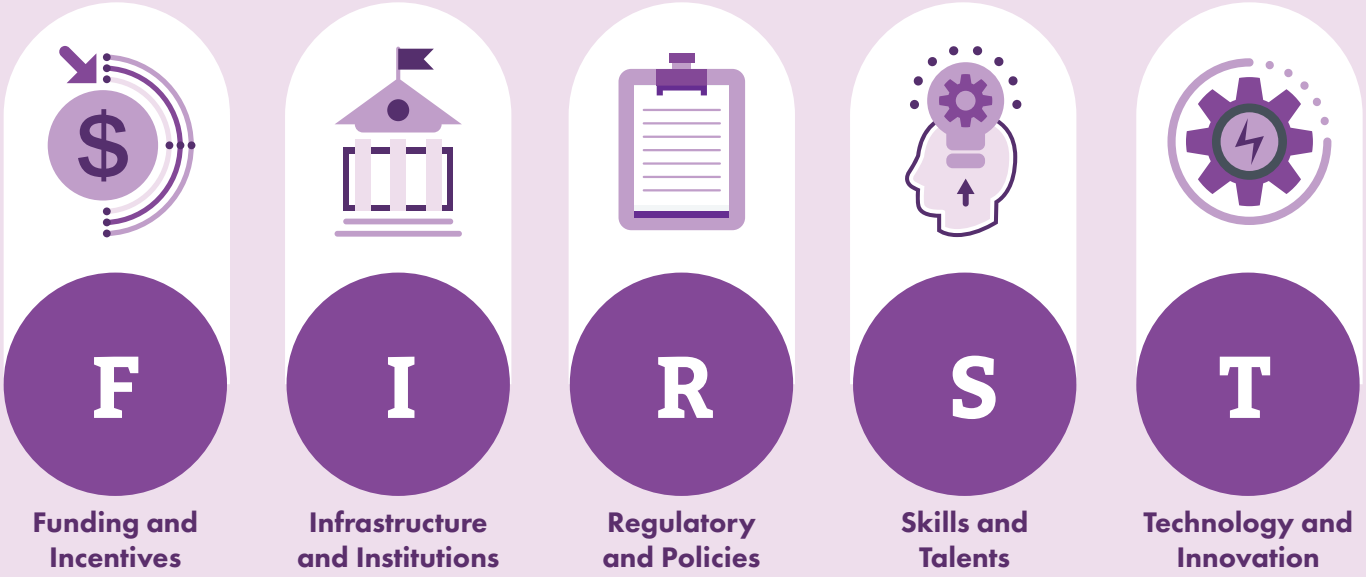
In addition to these core services, the AAM industry benefits from a variety of secondary services. Insurance providers offer coverage tailored to the unique risks associated with AAM operations while financing companies assist in securing the necessary capital for industry players to scale their operations. Research and development firms contribute to technological advancements, driving innovation within the AAM sector.

While some companies in this category may serve multiple industries, it is noteworthy that they also offer services that fulfil the specific requirements of the AAM industry. These companies play a crucial role in supporting the growth and development of the AAM ecosystem, enabling the industry to thrive and mature.

Overall, the workshop output serves as a starting point for understanding Malaysia's AAM ecosystem. While it offers initial insights into the presence of local and international players and the potential for cross-industry collaborations, it is crucial to recognize the need for further research and analysis to draw more conclusive and comprehensive insights. The workshop output should be viewed as a preliminary assessment, guiding further investigations to gain a deeper understanding of Malaysia's position in the global AAM.

LOCAL AAM ECOSYSTEM SUPPORT

Creating a conducive ecosystem support is catalytic to the development of the AAM industry in Malaysia. With this support, local and international players are motivated to expand and advance their AAM activities through investment, research, development and innovation (RDI), and employment of local talent. MIGHT's F.I.R.S.T® perspectives outlines five elements, providing a comprehensive framework for successful AAM implementation; which are Financial & Incentives(F), Infrastructure & Institutions (I), Regulatory & Policies (R), Skills & Talents (S) as well as Technology & Innovation(T). These elements are Government enablers or instruments for the promotion and expansion of new and existing industrial activities. The stakeholder engagement sessions provided insights into the current state, as well as issues and challenges in every aspect of eco-system support for AAM industry development in Malaysia as follows:



Funding and Incentives

Ease of access to funding and financial resources is critical in sustaining and expanding the AAM industry. It is an essential component for industry players to pursue investments in research and development, alongside building infrastructure and production facilities. The funding and financial landscape discussed highlights the diversified sources of support, ranging from government grants and incentives to international collaborations and public-private partnerships, reflecting the need for a comprehensive approach to fund and fuel the growth of the AAM industry in Malaysia.

At present, the Ministry of Science, Technology and Innovation (MOSTI) serves as a funding source specifically for R&D projects with a substantial budget, showcasing a commitment to supporting advanced research initiatives. An agency under MOSTI, MRANTI, offers Strategic Research Fund (SRF), a funding programme within *DANA PEMACU MOSTI* specifically to fund strategic research and top-down initiatives based on priority areas and in line with *Dasar Sains, Teknologi dan Inovasi Negara* (DSTIN), 10-10 MySTIE and MOSTI's technology roadmap. Leveraging the SRF programme, MRANTI provides an opportunity for more experimental R&D projects crossing the Technological Valley of Death (from Proof-of-Concept stage to Testing in Real Environment stage) specifically in 3 areas: Healthtech, Dronetech and Agritech, indicating government support for innovation and technology projects, aligning with the Ministry's role in fostering economic growth through technology (Strategic Research Fund, 2020).

Cradle Fund Sdn. Bhd. (Cradle), a focal point agency for Malaysia's early-stage startups, incorporated under the Ministry of Finance Malaysia (MOF) in 2003 with a mandate to fund potential and high-calibre tech startups through its Cradle Investment Programme (CIP). Cradle is presently administered by MOSTI. The inclusion of CRADLE in the funding ecosystem indicates a focus on nurturing and supporting early-stage startups and fostering innovation and entrepreneurship (Cradle Fund, 2022).

Jelawang Capital, formed through the consolidation of MAVCAP and Penjana Kapital under Khazanah Nasional Berhad in 2024, represents a strategic initiative to strengthen Malaysia's venture capital ecosystem. While it does not currently focus on AAM-specific investments, Jelawang Capital contributes to the broader funding landscape through fund-of-funds mechanisms and partnerships with venture capital managers. Its mandate aligns with national policy initiatives such as the Malaysia Venture Capital Roadmap 2024–2030 and KL20, both of which aim to position Malaysia as a regional hub for innovation. Jelawang's role in enabling early and growth-stage technology ventures could, over time, support adjacent industries relevant to AAM, including green mobility, advanced manufacturing, and digital platforms.

VentureTECH, initiated in 2009 by the Malaysian government, operates as an investment company aimed at boosting local Malaysian firms' involvement in high-value and high-tech industries. Collaborating with key entities, it strives to enhance technology-based companies in targeted growth areas, addressing critical funding gaps through customized investment strategies. Positioned as a catalyst for economic transformation, VentureTECH aligns with governmental goals while emphasising impact investments for socio-economic benefits and community growth. One notable success story of an investment company by VentureTECH is Aerodyne, a Malaysian-headquartered company ranked third globally by Drone Industry Insights in its 2019 Drone Service Provider Ranking. In five years, Aerodyne has expanded its presence to 25 countries, providing AI-driven, drone-based enterprise-integrated managed solutions to industries such as Oil & Gas, Power, Telecoms, Renewables, Construction, Agriculture, and Infrastructure. VentureTECH operates as a wholly owned subsidiary of the Malaysian Industry-Government Group for High Technology (MIGHT).

MITI's involvement in funding suggests a strategic alignment with the ministry's role in promoting trade and industry development. Under MITI, the Malaysian Investment Development Authority (MIDA) indicates a link between financial incentives and investment promotion for AAM-related ventures.

The reference to the Public Private Partnership/ Private Finance Initiative (PPP/PFI) signifies a funding model characterised by cooperation between the public and private sectors, demonstrating a synergistic approach to financial backing. Presently, instances of partnerships like the one between PETRONAS and AERODYNE underscore the significance of strategic collaborations and shared ventures in securing both funding and expertise for AAM initiatives (Petroliam Nasional Berhad, 2023). In a strategic collaboration, PETRONAS Technology Ventures Sdn Bhd (PTVSB), the technology commercialisation arm of PETRONAS, joined forces with Aerodyne Oil and Gas Sdn Bhd, a subsidiary of Aerodyne Group.

Issues and Challenges

At present, securing support and investment from the government and financial institutions poses challenges due to the perceived high risk of AAM. One stakeholder concern is the general current limited access to funding , let alone the provision of specific funding for AAM. Compounding the issue is the lack of specific incentives for AAM. One contributing factor is the low awareness within financial institutions regarding industry requirements and potential, which hinders investment. Nevertheless, continuous effort to raise awareness has been initiated by small communities of interest such as MUVA and MAIA, which have yet to find their way to the mainstream public.

Infrastructure and Institutions

Infrastructure includes buildings, facilities, labs, datacentre and systems while an institution refers to organisations dedicated or tasked to manage, implement and oversee development. Technology testing and development centres, such as MRANTI's Area 57 and Malaysia's first Drone Testing Zone (DTZ), established on 1st July 2019 play a crucial role in advancing drone technology. The DTZ serves as a platform for drone players to test their innovations in a safe and controlled environment, fostering long-term growth for the drone industry. Notable testing activities at the DTZ include a drone food delivery demonstration by a local entity during the 2019 MyDroneX event. In August 2020, Poladrone launched its Oryctes drone, the world's first spot precision spraying drone for oil palm, marking a significant advancement in the agricultural drone market. More recently, in March 2021, AirAsia Group, through its logistics arm Teleport, showcased its urb**an drone delivery services. These dedicated spaces for testing and refining drone technologies ensure that innovations are practical, safe, and meet regulatory standards before deployment. They provide integrated infrastructure and facilities to UAS innovators, developers, and manufacturers.

Startups focusing on AAM contribute to innovation and technological development. Incubators and accelerators are important in supporting these startups, fostering an entrepreneurial culture and providing resources for the development of new technologies. For example, the Perlis air space has been identified as suitable for an AAM sandbox. Perlis is a state with lower air traffic, lower density and fewer airspace restrictions which provides a more conducive environment for testing and certifying UAM operations, especially for heavy payload drones. Other examples include UNISEL Bestari Jaya Bernam River Airfield and Drone and Robotic Zone, IRDA, Johor.

Issues and Challenges

ChallengesThere is a need to address the lack of certified landing pads or helipads to provide initial infrastructure to begin with. As an alternative, stakeholders are of the view that there are opportunities to convert abandoned airstrips into vertiports. However, issues related to land and space fees and tax rate are complicated and interventions by related Governments and authorities are required.

In addition, the integration of infrastructure to support AAM development encounters challenges such as preparing landing and security infrastructure, charging stations, communication management and navigation systems. The challenges attributed to the absence of Non-connected Visual Flight Rules (VFR) and low-level airspace corridors add to this complexity. Additionally, there is a current lack of UAS Traffic Management System for airspace governance along with other infrastructure gaps such as communication systems including 4G/5G satellite communications for seamless operations, hydrogen or e-fuel hubs for aviation industry suppliers and air traffic service in uncontrolled airspace.

In terms of required facilities, there is a need for extensive testing activities considering that AAM is very new and largely developing. Despite institutions such as FUTURISE's involvement in testing activities through the "sandbox" concept, the provision of new regulations has been challenging as it is subjected to airspace regulations under Civil Aviation Authority of Malaysia (CAAM). Testing areas are limited for comprehensive tests, especially for Visual Line of Sight (VLOS) and Beyond Visual Line of Sight (BVLOS).

Regulatory and Policies

Regulatory and policies required for the operationalisation of AAM in Malaysia are crucial to ensure the highest level of safety and security compliance in the deployment of AAM-related systems. It aims to address various aspects of AAM, including safety standards, airspace management, pilot licensing, privacy concerns, environmental impact, and integration with existing air traffic.

A robust regulatory and policy framework is essential for ensuring the safe, efficient, and standardized operations of aerial mobility services. Several key entities contribute to shaping and enforcing these regulations. Among these, Futurise serves as a public policy advisor mandated to conduclatory interventions for new technologies through collaborations between industries and the government. The Civil Aviation Authority of Malaysia (CAAM) plays a pivotal role by overseeing licensing requirements, pilot certifications, and adherence to Civil Aviation Regulations 2016. Collaboration with international aviation bodies such as the Federal Aviation Administration (FAA), the European Union Aviation Safety Agency (EASA), and the International Civil Aviation Organization (ICAO) ensures alignment with global standards. At the state level, the Ministry of Transport Sarawak (MOTS) and Unit Keselamatan dan Penguatkuasaan Sarawak (UKPS) contribute to the localized regulatory landscape, emphasizing safety measures in AAM operations.

Issues and Challenges

The regulatory landscape for Advanced Air Mobility (AAM) remains under active development globally, and Malaysia is no exception. From the stakeholders' perspective, regulatory readiness is a top priority that must be addressed to enable industry progress. Authorities are under increasing pressure to respond to growing demand from industry players and investors, particularly in establishing frameworks to govern the design, operation, and integration of AAM systems within national airspace.

At present, Malaysia does not have specific regulations dedicated to AAM. While regulatory frameworks exist for commercial and military aviation, provisions for operations within low level airspace (below 20,000 feet) remain limited. Stakeholders highlighted the absence of designated flight routes, policy guidelines for vertiports, and procedures for managing low altitude operations. There is also a lack of clarity in the approval process for Flight Procedure Designers, alongside gaps in air traffic control guidance for AAM across various corridors including urban to urban, urban to rural, and rural to rural operations.

On airworthiness, the absence of standards for vertical take off and landing (VTOL) aircraft and electric propulsion systems within Malaysia's civil aviation framework prevents certification and operational approvals. Although the International Civil Aviation Organization (ICAO) has mandated the inclusion of Remotely Piloted Aircraft Systems (RPAS) in Annex 8 from November 2026 (for non passenger use), equivalent provisions for passenger carrying AAM platforms are still unavailable. Without Type Certificates or Certificates of Airworthiness, AAM services cannot legally operate for commercial purposes. Furthermore, the lack of recognised technology certification, including standards for using locally produced materials, restricts opportunities for Malaysian companies to participate in manufacturing or component development for AAM.

Public awareness and acceptance present another challenge. Current public understanding of AAM remains limited, with safety, privacy, noise, and visual intrusion cited as major concerns. Without targeted awareness campaigns and effective communication, public apprehension may constrain the roll out of AAM, particularly in urban environments where other modes of transport are already established, affordable, and reliable.

Stakeholders also pointed to constraints in institutional capacity, including limited expertise and technical resources within agencies responsible for AAM policy and regulation. The novelty and complexity of AAM technologies create additional difficulties in developing forward looking and practical guidelines. A lack of effective consultation among key stakeholders, combined with limited coordination between approving authorities, may further delay regulatory progress.

To support the development of a coherent regulatory ecosystem, Malaysia should consider adapting international frameworks such as the United States Federal Aviation Administration's AAM regulatory model and the European Union Aviation Safety Agency's approach to Design and Production Organisation Approvals. These could serve as references in developing a regulatory sandbox tailored to Malaysia's context, ensuring consistency with international standards and facilitating global interoperability.

Skills and Talents

A skilled and sufficient talent pool is essential for the sustainable growth of the AAM industry. Talent shortages in aviation are a global challenge, and addressing them requires coordinated efforts among industry players, educational institutions, and policymakers to identify and develop the right capabilities in a rapidly evolving landscape.

	Competency Required					
	Design & Certification	**Manufacturing & Production**	**Operation & Support (Air Traffic Mgt, Vertiport, Ground Handling)**	**Airworthiness Mgt.**	**MRO**	**Training**
Certification	CAAM CAD Part 21 – Subpart J (DOA)	CAAM CAD Part 21 – Subpart G (POA)	Air Service Permit/ License AOC	CAAM Part M – Subpart G (CAMO)	CAAM Part 145 – Approved Maintenance Org. (AMO)	CAAM Part 147 – Approved training Org. (ATO)/Part 66 Syllabus
Outputs	Type Certification (TC)	Certificate of Airworthiness (Initial)	Operation Approval	Certificate of Airworthiness (Renewal)	Airworthiness Release Certificate	License / Certificate of Recognition/ Type Approval

There are some institutions offering training programmes that equip pilots and aviation personnel with relevant skills for AAM. In particular, remote pilot training is critical for operators of unmanned aerial vehicles, which form a core component of AAM. Universities and training bodies such as UPM, UTM, and certified Remote Pilot Training Organisations (RPTO UAS) contribute to building competency in this area.

Institutions of higher learning including UniKL, UPM, and UTM also offer academic programmes in engineering, aviation, and related disciplines, supporting the development of a future ready workforce. Specialised centres such as the Centre of Excellence for UAS at UNIMAP provide focused research, development, and training in unmanned aerial systems, strengthening the talent pipeline for AAM.

CAAM also plays a role in enabling human capital development through approved organisations such as the Approved Flight Procedure Design Organisation (CAAM-AFDO-003), which could support the creation of safe and efficienf procedures for AAM operations based on their experience with manned flight operations.

These initial efforts reflect a comprehensive and collaborative approach to skills development, spanning pilot training, remote operations, and technical ground roles. However, gaps remain in promoting awareness and incentivising participation, particularly through outreach programmes that highlight future career pathways in the AAM industry.

Issues and Challenges

The shortage of skilled talent in the field of AAM in Malaysia is a significant challenge. For example, there is a shortage of Flight Procedure Design Officers (FPDO) in Malaysia, responsible for creating routes and procedures for flying vehicles at low altitude airspace utilised for AAM operation. Furthermore, low salaries and wages pose a significant concern for skilled professionals in fields like AAM and Urban Air Mobility (UAM) which demand specialized expertise. Many talented individuals are seeking better opportunities and support abroad often due to more competitive wages, improved work conditions, and better career prospects.

Further exacerbated by the issue of shortage is talent mismatch. This occurs when skills acquired by workers do not align with the demands of the AAM industry. As a result, Malaysia's AAM sector will continue to rely on foreign experts to fill the skill gaps. On this matter, the stakeholders highlighted an example of the requirements for training remote pilots, as stipulated by the CAAM, reportedly do not align with the training provided by the Department of Skills Development (JPK). This misalignment hinders effective pilot training for new transportation modes.

In addition, for existing training, it is a necessity to acquire an air transport pilot license for operating air taxis and possess drone pilot license certifications to operate in Malaysia. The demand for a rigorous two-year on-site training program for operators seeking certification adding the complexity to the overall processes. These challenges are compounded by insufficient funding, which plays a pivotal role in establishing comprehensive training, attracting skilled professionals, and ensuring the safe growth of AAM in Malaysia.

Technology and Innovation

InnovationTechnology and innovation are key drivers that drive the advancement of the AAM industry, which are achieved through research and development, technology acquisition, and applications. It offers the potential to enhance efficiency, reduce operational costs, and elevate the overall quality and safety of the services.

Local capacity and capabilities related to technology development and innovation largely performed by academia and research institutions. Institutions such as UPM, UTM, and UNIMAP are crucial components of the ecosystem. They serve as hubs for research and development (R&D) activities, contributing to technological advancement through studies related to drone technologies, urban air mobility, and other relevant fields.

In addition, technology and innovation activities related to AAM are also carried out by several key organizations under the ministry. For example, the Malaysian Research Accelerator for Technology & Innovation (MRANTI) under the Ministry of Science, Technology, and Innovation (MOSTI) and the government-led initiative FUTURISE under the Ministry of Finance. Recognizing the importance of intellectual property in fostering innovation, the Malaysian government, through agencies like MOSTI and the MRANTI, can actively support AAM on related patent activities. Another significant contributor is MIGHT, which facilitates collaboration between the government, industry, and academia to advance high-technology initiatives.

Other than Government-related organisations, industry players such as Aerodyne and Drone Asia, are actively engaged in technology acquisition, bringing in cutting-edge solutions and expertise in drone technologies, and fostering innovation through collaboration with global industry players. Startup companies focusing on AAM can contribute to innovation and technology development. Incubators and accelerators may play a role in supporting these startups. Government regulators such as the CAAM establish regulations that ensure the safety and reliability of AAM technologies. Compliance with these regulations is essential for technology deployment. SIRIM's involvement in standardization and quality assurance contributes to creating a conducive environment for the adoption of innovative technologies.

Issues and Challenges

The current understanding of AAM technology primarily resides at the user level, with a lack of comprehensive grasp of the technical and developmental aspects. This situation is exacerbated by the nation's heavy reliance on foreign Original Equipment Manufacturers (OEMs) for expertise and technology infusion.

The maturity level of AAM technology in Malaysia remains relatively low, reflected by a limited understanding and adoption of this new area of innovation. At present, challenges in AAM innovation arise from limited funding for technology development which partly contributes to discouraging AAM-focused research conducted by universities and industries. Other common concerns by research institutions are outdated research facilities, and challenges in transitioning from research to commercialisation. This is true as the process of acquiring patents to support innovation in AAM is lengthy and intricate given the rigorous evaluation required by patent offices. The extended timeframe for securing patents can potentially hinder the rapid development and deployment of AAM innovations, thereby delaying their entry into the market.

From the industry's perspective, the complexity of AAM technologies and limited manufacturing capacity and capability will restrict the local production volume of AAM parts and products. Malaysia AAM industry will be highly dependent on foreign suppliers and technology providers considering limited local capabilities and capacity such as in battery technology to meet AAM's long-range requirements, restricted utilisation of 3D printing for crafting lightweight AAM components, the slow adoption of next-gen fuels, and the absence of a dedicated test ground for operations like BVLOS and VLOS operations. The impact of these challenges will also create a negative perception of local products and services due to the absence of consumer trust and prevailing scepticism among potential users regarding the reliability, safety, and effectiveness of AAM solutions.

POLICY DIRECTION

Given issues and challenges in the eco-system support, the Government through its ministries and agencies have to be mobilised to address it effectively. However, there is a need for a clear direction on the way forward to develop the AAM industry in Malaysia. The dedicated policy that sets direction and recommendations which is related to the AAM industry is the Malaysian Aerospace Industry Blueprint 2030 (MAIB 2030). It outlines seven (7) key strategies to achieve set objectives and realize the aspirations (Zainal, Abu Talib, & Hack, 2015). The following are the strategies of MAIB 2030:

Strategy 1: Apply Policies that will Impact the Future Landscape of the Industry.

This strategy promotes the use of policy instruments and guidelines to unlock opportunities for industry development. Several initiatives under this strategy are directly applicable to AAM:

Initiative 1.3 encourages capable local design, engineering, and systems integration companies to participate in upgrade and modification contracts. AAM offers high potential in this area due to its reliance on advanced technologies, complex systems, and customisation for various missions.

Initiative 1.4 advocates for acquiring systems developed by local industry, such as UAVs, simulators, and ground systems. As AAM operations are expected to eventually exceed the volume of conventional aircraft operations, local capabilities in these areas will be critical.

Initiative 1.5 promotes participation in international aircraft development programmes as risk sharing partners. This could enable Malaysian firms to secure work packages in AAM design and manufacturing through collaboration with global industry leaders.

Initiative 1.6 suggests using Industry Collaboration Programmes (ICP) as a platform for market access and technology transfer. This approach can support local AAM companies in building strategic capabilities and entering international markets.

Strategy 2: Enhance the Effectiveness of Institutions that have Direct Influence on the Growth of the Industry

This strategy calls on government ministries and agencies to play an active role in accelerating the aerospace sector.

Initiative 2.1 highlights the need to raise awareness among procuring ministries about the aerospace industry's potential. In the context of AAM, awareness within government remains limited, and mainstream discussions often focus only on drones. Wider institutional understanding is necessary to support policy formulation and programme implementation.

Initiative 2.2 proposes the corporatisation of the Department of Civil Aviation (now CAAM) into a Malaysian Aviation Authority. This would enhance its capability to certify aircraft parts within the European Union Aviation Safety Agency (EASA) framework. Such transformation is crucial as CAAM's current scope does not yet fully address AAM certification and operational needs.

Strategy 3: Improve Airworthiness and Space Regulations and Promote Green Practices.

Although this strategy includes three initiatives, it does not yet cover the specific regulatory needs of AAM operations such as low altitude air traffic management or the establishment of a regulatory sandbox for pilot projects. However, Initiative 3.3, which promotes sustainable practices, aligns with AAM's environmentally friendly design.

This initiative calls for the introduction of regulations to ensure that disposal activities adhere to green standards, including the promotion of MS ISO 50001 certification to improve energy efficiency. As highlighted in earlier sections of this report, AAM platforms powered by electric propulsion are designed with sustainability in mind and present opportunities for reducing carbon emissions in urban transport.

Strategy 4: Invest in R&T to Develop New Capabilities and Enhance Industry Competitiveness

This strategy introduces seven initiatives aimed at strengthening research and technology in aerospace through collaboration with local universities and research institutions. These efforts are expected to expand local capabilities and improve industry competitiveness.

As highlighted earlier, challenges related to limited technology capabilities, insufficient knowledge in developing AAM platforms and systems, and difficulties in securing intellectual property rights can be addressed through Initiatives 4.1 to 4.3.

Initiative 4.1 calls for the development of a National Aerospace Research and Technology Roadmap, prioritising industry led collaborative research to address stakeholder concerns and build strategic direction.

Initiative 4.2 promotes applied research and development in key areas including improvements in maintenance, repair and overhaul processes, aircraft structural integrity, advanced manufacturing techniques such as robotics and additive manufacturing, as well as systems related to UAV payloads, mission applications, and dual use civil and defence technologies.

Initiative 4.3 supports investment in capabilities development across avionics, mission systems, sensor integration, electronic warfare, ground systems, and propulsion technologies.

Stakeholders have also expressed concerns regarding low confidence in locally developed AAM products, citing issues of safety, reliability, and limited manufacturing capacity due to the complexity of the technologies involved.

Initiative 4.6 proposes the establishment of a National Composite Centre as a Centre of Excellence to advance composite research in areas such as thermoplastics, green composites, and new production technologies.

Initiative 4.7 encourages greater investment in automation to enhance productivity and reduce labour intensity in parts and components manufacturing, improving cost efficiency and global competitiveness.

Strategy 5: Promote Aerospace Investment through Incentives and Matching Funding

To drive growth in the aerospace sector, this strategy outlines four initiatives aimed at increasing investment through government support, incentives, and funding schemes.

Initiative 5.1 recommends maintaining maintenance, repair and overhaul and aero manufacturing as priority areas for investment promotion beyond 2020.

As highlighted by AAM stakeholders mentioned earlier, there is currently no dedicated provision for AAM-specific incentives or funding. This gap could be addressed by:

Initiative 5.2, which supports the growth of aerospace small and medium enterprises through matching grants for capital equipment purchases, certification programmes such as AS9100 and NADCAP, original equipment manufacturer approvals, and participation in international trade exhibitions.

Initiative 5.3 promotes both domestic and foreign direct investment in strategic areas including component maintenance, supplemental type certificate development, aero manufacturing, engine module assembly, and the development of new aerospace products. These areas are highly relevant to the AAM ecosystem, which is characterised by advanced systems and integrated technologies.

Initiative 5.4 encourages foreign investment from raw material suppliers to establish regional warehousing facilities in Malaysia. This would enhance supply chain resilience and unlock new sourcing opportunities from local producers.

Strategy 6: Attract and Prepare the Workforce of Tomorrow for Malaysia and the Region

This strategy underscores the importance of building a skilled and future ready workforce to support the growth of the aerospace and AAM sectors. Eight initiatives are proposed to address talent gaps and better align training with industry needs:

Initiative 6.1: Establish a Centre for Learning, Skill and Employment to coordinate education, qualifications, continuing professional development, and job placement across industry and academia.

Initiative 6.2: Prepare a sufficient number of design engineers with signatory status for future aerospace projects. The scope should be expanded to include critical AAM roles such as Flight Procedure Design Officers and Flight Procedure Designers.

Initiative 6.3: Develop structured training programmes and encourage investment by institutions in aero-structure manufacturing and large format machining, with a focus on enhancing productivity among technical personnel.

Initiative 6.4: Expand aviation training curricula and equip institutions with relevant tools and technologies to support the production, operation, and maintenance of AAM-related systems.

Initiative 6.5: Strengthen existing training centres by upgrading course content and infrastructure in line with evolving AAM requirements.

Initiative 6.6: Encourage investment in the B2 Avionics Licensed Aircraft Engineer (LAE) programme to support the electrical and sensor-driven systems in next generation AAM aircraft.

Initiative 6.7: Develop a structured programme to transition retired military personnel into the civil aviation sector through targeted reskilling and upskilling efforts.

Initiative 6.8: Leverage Independent Aircraft Engineering Assessors (IAEA) appointed by CAAM to recognise prior working experience and expedite licensing processes for aircraft maintenance engineers.

Strategy 7: Capture New Markets and Strengthen Local Supply Chain

This strategy aims to position Malaysia as a regional leader in aerospace while expanding its role in the global supply chain. Seven initiatives are proposed to open new markets and strengthen the domestic industrial base:

Initiative 7.1: Leverage bilateral relationships to expand market access, including opportunities for cross-border AAM operations such as Johor–Singapore, Perlis–Thailand, and Sabah–Kalimantan corridors.

Initiative 7.2: Offer fleet technical management and Part 21 design services, through CAAM-approved organisations, to support both local and regional operators and aircraft owners.

Initiative 7.3: Attract original equipment manufacturers (OEMs) to Asia Aerospace City (AAC) to establish regional engineering and service centres, building on the early presence of AAM players such as Volar Air Mobility and EHang.

Initiative 7.4: Explore remanufacturing and end-of-life disposal markets for AAM aircraft, incorporating circular economy practices such as material recycling, resource optimisation, and sustainable disposal processes.

Initiative 7.5: Increase the number of certified Tier 3 and 4 small and medium enterprises (SMEs) involved in detailed parts manufacturing, tooling, and jig production, including companies transitioning from non-aerospace sectors.

Initiative 7.6: Establish a central secondary processing facility to support the growing number of metal-based Tier 3 and 4 suppliers, helping to reduce production costs and strengthen supply chain integration.

Initiative 7.7: Expand the role of the Malaysia International Aerospace Centre (MIAC) in Subang into a preferred integrated hub for aviation services and intra city AAM operations. Similar development models can be extended to Senai and Melaka.

VISIONING THE FUTURE OF AAM IN MALAYSIA

As Malaysia continues its trajectory into the future, the landscape of transportation undergoes a radical transformation with the integration of AAM technologies. Envisioning the year 2040 unveils a possible future where AAM seamlessly weaves into the fabric of everyday life, revolutionizing urban, rural, and regional connectivity. The emergence of aerial solutions is not merely a futuristic dream but a tangible reality reshaping how Malaysians commute, interact, and address critical challenges. The infographic provides a compelling glimpse into Malaysia's AAM landscape in 2040 across various domains. The envisioned utilisation of AAM technology in Malaysia by 2040 encapsulates a paradigm shift in transportation infrastructure, fostering its integration into urban, rural, urban-rural, and intra-regional activities.

URBAN

Across urban landscapes, AAM's utilisation primarily manifests in the form of air taxis and drone services, significantly reducing commute times, addressing traffic congestion, and providing swift delivery of goods and emergency medical supplies. Some of the envisioned potential uses of AAM include:

Kuala Lumpur
Use of air taxis alleviate rush hour traffic from 53 minutes to a meagre 10-minutes commute at an affordable fee.

Subang Skyport Shuttle
Use of air taxis connect Klang Valley's major transportation hubs between KL Sentral, KLIA, Subang and key city centers.

Temerloh
Man suffering from life-threatening cardiac arrest saved thanks to AED drone (drone-delivered defibrillator).

Penang
Development of vertiports in land-limited Penang and use of air taxis addresses the issue of lack of extensive public transport system and connection between Penang Island and Mainland.

Melaka
AAM technology used for smart city infrastructure monitoring and assessment including preservation of vulnerable heritage infrastructure.

Iskandar Puteri
The use of drone-based traffic monitoring help authorities manage traffic flow and make informed decisions about road infrastructure improvements.

Cyberjaya
Food and parcel delivery services using drones from door-to-door delivering hot piping food and undamaged parcels.

URBAN - RURAL

The intersection of urban and rural areas witnesses connectivity, tourism, and accessibility, bridging th Some of the envisioned potential uses of AAM inclu

Kelantan
AAM deployed in search and rescue missions in Malaysia's annual monsoon season floods rescuing 150 people from rooftops and monitoring early warning signals in water levels.

Kedah
Semiconductor wafers transported seamlessly from Kulim Hi-Tech Park to Penang International Airport on a tracked air traffic control UAV enabling the expansion of Malaysia Free Industrial Zone (FIZ).

Cameron Highlands
From farm to fork with vegetables delivery within an hour from harvest.

Kuala Terengganu
Malaysian Maritime Enforcement Agency prevents illegal fishing boats from entering Malaysian waters.

INTRA-REGIONAL

Furthermore, its application in intra- border commuting, bolsters security showcasing the versatility and wide domains of Malaysian society. Some include:

Johor
Establishment of Johor-Singapore AAM Causeway using mobile app approval enables smooth commute for the 350,000 people crossing the Malaysia-Singapore border daily.

s the convergence of AAM technology, enhancing
e gap between remote areas and urban centres.
de:

Tioman Island
eVTOL used to ferry tourists and necessities between Johor, Pahang, Kuala Lumpur and Singapore.

Langkawi
Air taxi utilized for unique and captivating scenic aerial tours of Langkawi's 99 islands.

Kuching
Rural-urban connectivity enhanced with eVTOL transporting residents commuting between Kampung Sebuyau Besar taking only 30 minutes.

Subang
Subang Aerotech Park becomes largest AAM maintenance, repair and overhaul centre in ASEAN.

-regional activities revolutionises cross-
measures, and aids in law enforcement,
espread impact of AAM across diverse
of the envisioned potential use of AAM

RURAL

Meanwhile, in rural regions, AAM technology serves as a crucial lifeline by enabling rapid response in emergencies, facilitating efficient logistics for agriculture, and supporting conservation efforts through aerial surveys. Some of the envisioned potential uses of AAM include:

Mount Kinabalu
Climber rescued after a 48-hours search and rescue mission upon getting lost and injured at Lows Peak Circuit.

Long Unai, Sarawak
eVTOL ferries doctor and epinephrine from Belaga Clinic to anaphylactic shock child within 25 minutes.

Pahang
AAM technology used for aerial surveys and exploration in Pahang's mining regions assist in assessing mineral deposits, environmental impacts, and resource extraction activities.

Taman Negara
Drones and AAM platforms deployed for wildlife monitoring and conservation efforts.

Sabanalang Pitas
High-Attitude Platform System (HAPS) deployed to provide various communication services including internet, voice and data reducing digital divide in rural Malaysia.

Perlis
RPAS used to enhance Malaysia-Thailand border security and successfully prevents multiple cases of smuggling activities.

Malacca Strait
UAV surveillance rescues passengers from capsized boat believed to be involved in human trafficking activities and will be deported to Sumatra once recovered.

Source: MIGHT Analytics, 2023.

In addition, local players shared their vision on desired eco-system support that shall be in place to realize the above AAM landscape in 2040. Based on input gathered, local AAM players envisage the following:

By year 2040,

a. In terms of Financial & Incentives:

An escalated funding commitment to Research and Development (R&D) shapes Malaysia's future AAM landscape, fostering adaptation and innovation within AAM technology. Strategic funding initiatives drive the development of vertiports, serving as pivotal nodes enabling a wide spectrum of activities across urban, rural, and intra-regional domains.

b. For AAM Infrastructure & Institutions:

The backbone of the envisioned eco-system rests on the establishment of a comprehensive Air Traffic Management (ATM) system, orchestrating the safe and efficient movement of AAM vehicles. Intricate elements like UAS Traffic Management (UTM), real-time surveillance, weather monitoring, and emergency response plans fortify this infrastructure. A specialised AAM Council ensures meticulous regulation, while vertiports boast sophisticated infrastructure and services, designed for safety, compliance, and passenger comfort. Interconnected AAM corridors optimize routes, integrating seamlessly with existing transport modes for holistic connectivity.

c. Regulatory and Policy Aspects:

Stringent yet supportive Regulatory & Policies frameworks, including designated Flight Information Zones (FIZ) for AAM vehicles, emphasize safety protocols and operational separation. Certification processes for airworthiness, piloting, and maintenance underscore the ecosystem's compliance and safety standards. Distinctive separation between traditional airspace management and the automated traffic management system in AAM technologies ensures a harmonized yet distinct operational framework.

d. For Skills & Talents:

A synchronised alignment between educational curricula and industry demands cultivates a skilled workforce. Defined career pathways, particularly in AAM manufacturing and related services, ensure a robust talent pool. Specialised expertise in AAM MRO (Maintenance, Repair, and Overhaul) amplifies the ecosystem's competency.

e. Catalysing Technology & Innovation:

The envisioned landscape champions locally developed electric aircraft, collaboration with local and international experts to propel technological advancements, and the realisation of Level 5 autonomous AAM vehicles. Innovative ventures like swarm drones for rapid sea Search and Rescue (SAR), hydrogen powered AAM vehicles, and high-tech sonar for sea scanning underscore the ecosystem's commitment to technological breakthroughs, redefining the future of air mobility in Malaysia.

This could result in a potential AAM eco-system support that appears as such:

Funding & Incentives	Infrastructure & Institutions	Regulatory & Policies	Skills & Talents	Technology & Innovation
Increased funding for R&D in adapting and developing AAM technology.	Establishment of Air Traffic Management (ATM) system to manage the safe and efficient movement of AAM vehicles and ensure the integration of AAM operations into existing airspace traffic management units. • UTM • Traffic Separation and Coordination • Digital Airspace Management • Real-time Surveillance and Tracking • Weather Monitoring and Alerts • Communication Infrastructure • Emergency Response and Contingency Plans • Integration with Existing ATM	Establishment of Flight Information Zone (FIZ) where AAM vehicles such as eVTOLs and air taxis operate, complete with vertical, longitudinal and horizontal separation and search and rescue (SAR) operation.	Syllabus match with industry requirement and demands.	Locally developed, assembled and certified aircraft for urban and regional air mobility.
Funding to promote the development of vertiports in strategic locations to enable AAM services between intra- and inter-urban, urban-rural, intra- and inter-rural as well as intra-regional.	Establishment of an AAM Council or AAM Agency specifically and only for regulating AAM operations and to support CAAM.	Airworthiness certificate for AAM vehicles and vertiports.	Job opportunities are well-defined career pathway in AAM manufacturing, manufacturing-related services and services industry.	Local and international expertise to collaborate in developing the necessary AAM technology for advancement of air mobility.
	Proper vertiport infrastructure equipped with: • Safety measures • Charging and fueling infrastructure • Ground control centre • Weather protection • Security • Passenger amenities • Regulatory compliance	Everything Autonomous System which comply with safety requirements.	Strong AAM MRO skills and talents.	AAM vehicles with Level 5 autonomous heavy-load cargo.
	Proper vertiport services equipped with: • Ground-based housing remote pilot station. • UTM service provider (USP) - UAS Traffic Management Service (UTM) for unmanned. • Aerodrome Flight Information Service (AFIS) for manned aircraft.	License and certification specified for piloting (manned and unmanned), MRO service providers and AAM replacement parts.		Swarm drone for rapid sea SAR and high-tech sonar for sea scanning.
	Establishment of AAM corridor for designated routes where AAM operations are concentrated. The AAM corridor is designed to optimize routes for AAM vehicles, enhancing connectivity and efficiency in urban and regional transportation. AAM corridors include dedicated vertiports or landing sites along the route.	Separation between traditional airspace management and the automated traffic management system used in AAM technologies.		Hydrogen-powered AAM vehicles.
	AAM infrastructure is connected with existing transport infrastructure via seamless first, road, air, water) to ensure first, mid, and last mile connectivity.			

Source: MIGHT Analytics, 2023.

ECONOMIC IMPACT AND IMPLICATIONS

Estimating the demand and growth potential of AAM is essential for three key reasons. First, it provides critical insights for private sector investment in electric vertical take off and landing (eVTOL) aircraft and supporting infrastructure. Second, it informs public sector planning, policy formulation, and strategic decision making. Third, it enables both public and private stakeholders to anticipate the scale of externalities such as environmental, economic, and social impacts associated with widespread adoption of AAM.

ASSESSING THE ECONOMIC IMPACT OF ADVANCED AIR MOBILITY (AAM) IN MALAYSIA

Key Highlights

The AAM sector has a positive economic multiplier to the Malaysian economy

- AAM has the potential to drive Malaysian economy in line with the New Industrial Masterplan (NIMP) that aims to transform Malaysia into a high-income, sustainable, and globally competitive economy. In particular, AAM fits into the objective of NIMP 2030 in which it allows economic diversification and resilience by diversifying the economic base of the country and via promotion of wide range of industries, including high-tech manufacturing, a wide range digital economy, green technologies, and services, including AAM.
- By developing and supporting AAM in both the supply and demand sides, a wide range of economic activities are stimulated. On the supply side, jobs are created in manufacturing and construction, and new technologies developed. On the demand side, these technologies improve efficiency and productivity in various industries, from transportation to agriculture, leading to broader economic growth and innovation.

Supply-Side:

Activities such as manufacturing eVTOL vehicles and installing electrical systems and charging stations in preparation for AAM operations have strong potential to stimulate economic activity across related sectors.

Demand Side:

AAM-related activities such as movement of passengers for scheduled and non-scheduled flights, monitoring livestock, herding, and managing their health, and aerial monitoring and management of hatcheries have high influence on the rest of economic activities.

Advanced Air Mobility (AAM) has the potential to significantly enhance the Malaysian economy across multiple dimensions, including income, economic growth, and employment

Revenue	GDP	Employment (Salaries)
AAM is projected to generate an additional RM70 billion for the Malaysian economy. This increase represents a 1.9% uplift in total economic revenues. This revenue growth comes from various AAM activities such as manufacturing eVTOL (electric Vertical Take-Off and Landing) vehicles, developing and installing the necessary infrastructure like charging stations, and providing new transportation and logistical services.	The introduction and expansion of AAM are expected to add RM34 billion in value to Malaysia's GDP. This contribution accounts for an additional 2.3% to the nation's GDP, reflecting the creation of high-value industries and services associated with AAM. This includes the development of advanced manufacturing sectors, enhancements in logistics and transportation efficiency, and the stimulation of innovation and technological advancements.	AAM is also anticipated to significantly boost income levels for Malaysian workers. The sector is expected to contribute an additional RM14 billion in salaries, which amounts to a 2.3% increase in total salaries across the economy. This rise in income will stem from the creation of high-paying jobs in the engineering, manufacturing, and technology sectors, as well as new employment opportunities in the operation and maintenance of AAM infrastructure and services.

The advent of Advanced Air Mobility in Malaysia promises significant economic benefits, including substantial increases in revenue, GDP, and worker salaries. By generating RM70 billion in additional revenue, contributing RM34 billion to GDP, and adding RM14 billion to worker salaries, AAM will not only drive economic growth but also foster technological innovation, create high-quality jobs, and promote sustainable development. These positive impacts will help propel Malaysia towards a more prosperous, resilient, and forward-looking economy.

Objective And Methodology

Objectives

1. To measure the economic impact of Advanced Air Mobility (AAM) in Malaysia
2. Conduct linkage analysis for AAM-related industries.
3. Estimate the contribution of AAM to Malaysia's revenue (output), value-added (GDP, and wages resulting from AAM infrastructure development and operation.

Methodology

Input-Output modelling (2021-2040)

- This study deploys an input-output modelling in measuring the economic impact of AAM to Malaysia.
- The adopted method is consistent and in line with best practices by other countries such as by the Canadian government, and the state of Ohio and Virginia in United States. There are not many economic impact analysis done by other countries on this sector, except in the countries mentioned above.

Table 9: Methodologies Employed by Other Institutions

Institutions	Country	Year	Method	Period (reference year)
Canadian Advanced Air Mobility (CAAM) Consortium1	Vancouver, Canada	2020	Input-output modelling	2020-2040
UAM Geomatics2	Ohio, USA	2021	Input-output modelling	2021-2045
NEXA Advisors3	Virginia, USA	2023	Input-output modelling	2023-2045

[1] CAAM. 2020. Economic Impacts of Advanced Air Mobility. AAM white paper series part II.
[2] UAM Geomatics. 2021. Advanced Air Mobility Business Case Assessment: State of Ohio.
[3] VIPC. 2023. Virginia's AAM Future: AAM's Economic Benefit for the Commonwealth.

In this study, the main data source used for the analysis is from the Department of Statistics, Malaysia, namely the Input Output Transaction Table 2021.

Findings

AAM has the potential to drive the Malaysian economy in line with the New Industrial Masterplan (NIMP) that aims to transform Malaysia into a high-income, sustainable, and globally competitive economy.

AAM fits into the objective of NIMP 2030 where it allows economic diversification and resilience by diversifying the economic base of the country and via promotion of wide range of industries, including high-tech manufacturing, digital economy, green technologies, and services, including AAM.

Key Expected Outcomes from Advancing AAM

- Stimulate broad economic activity through multiplier effects during both infrastructure development (supply side) and operational phases (demand side). Infrastructure development will increase demand for manufacturing, construction, and technological innovation. Once operational, AAM services can enhance efficiency and productivity across multiple sectors, including transport, agriculture, and logistics, driving wider economic growth and innovation.
- Increase income levels, contribute to GDP growth, and generate additional wages through the creation of new jobs and higher value economic activity, particularly in high skill and technology-driven segments.

The impact on the economy is consistent with other countries' experiences where GDP is expected to expand between nearly RM10bil to about RM58bil or 1.4% to 2.1% of GDP.

Country	Study Period	Duration	Additional GDP	Percentage increment on GDP	Agency/Institutions
Vancouver, Canada	2021-2040	20 years	RM9.2 billion (USD2.2 billion)	1.4%	Canadian Advanced Air Mobility (CAAM) Consortium[1]
Ohio, USA	2021-2045	25 years	RM47.2 billion (USD12.9 billion)	1.5%	UAM Geomatics[2]
Virginia, USA	2023-2045	23 years	RM57.5 billion (USD12.6 billion)	2.1%	NEXA Advisors[3]
Malaysia	2021-2040	20 years	RM34 billion	2.3%	MIGHT (This study)

Note: Conversion from Dollar to MYR using "Average for period" rate published by Bank Negara Malaysia
[1] CAAM. 2020. Economic Impacts of Advanced Air Mobility. AAM white paper series part II.
[2] UAM Geomatics. 2021. Advanced Air Mobility Business Case Assessment: State of Ohio; Federal Reserve Bank St. Louis. 2023. Gross Domestic Product: All Industry Total in Ohio (Million of Dollars)
[3] VIPC. 2023. Virginia's AAM Future: AAM's Economic Benefit for the Commonwealth; Federal Reserve Bank St. Louis. 2023. Gross Domestic Product: All Industry Total in Virginia (Million of Dollars)

AAM will represent a significant portion (11%) of Aerospace revenue in 2030.

Figure 1: 2030 Projected Revenue, Malaysia (RM billion)

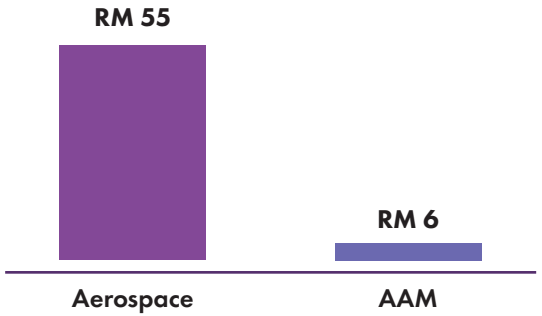
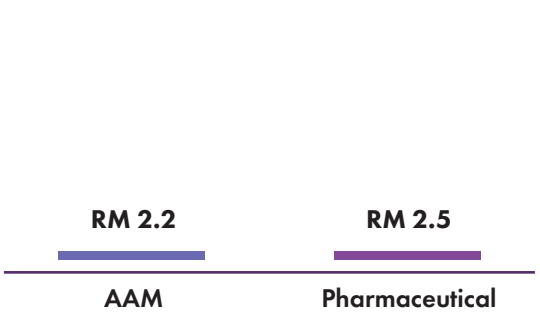


Figure 2: 2030 Projected GDP by Selected Key Industry, Malaysia (RM billion)



Source: MITI. 2023. New Industrial Master Plan (NIMP) 2030
Pharmaceutical industry is considered as priority sectors under NIMP 2030. There are only five priority sectors under NIMP 2030. The other four sectors are: Aerospace, Chemical, Medical Devices, and Electrical & Electronics (E&E).

Advanced Air Mobility (AAM) has a strong influence on economic activities.

Forward and Backward Linkages

Infrastructure development (Installing electrical systems & charging stations) Forward and Backward Linkages

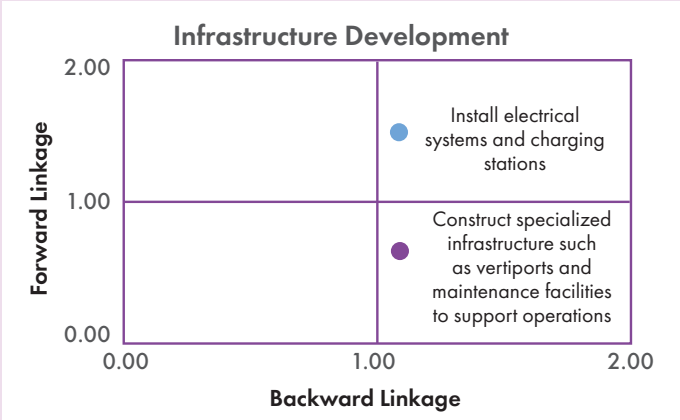
Aircraft operationalization (Maintenance, repair, & overhaul (MRO) services).

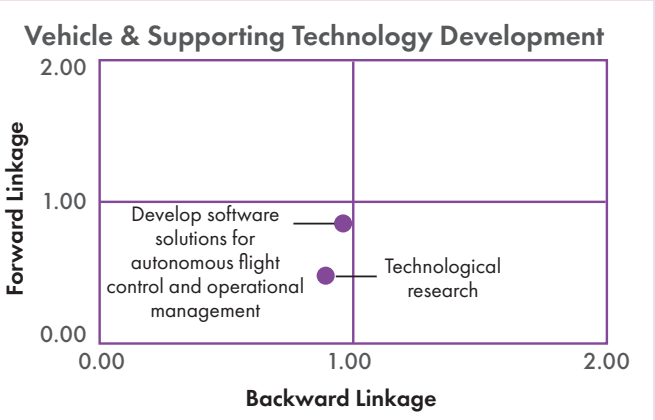
Backward Linkages

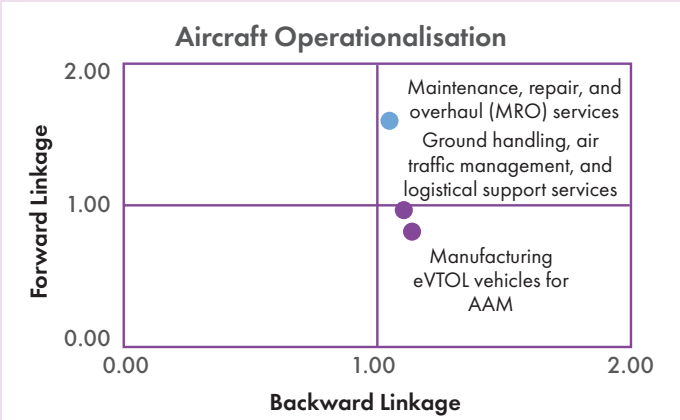
Aircraft operationalization (Manufacturing eVTOL vehicles for AAM): Ability to utilized inputs from various industries

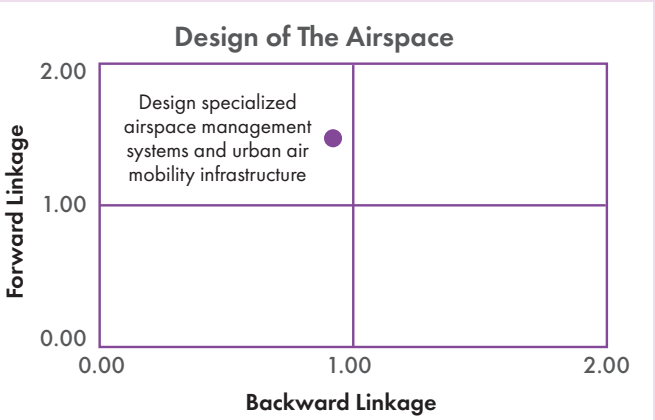
Forward Linkages

Design of the airspace (Design air mobility infrastructure): Ability to extensively contribute output to overall industry









Note:
Linkages analysis is a tool used to measure the importance of economic sectors that produce goods and services in the economy. It examines the interdependence of supply and demand within the sectors.

Key sector: Recorded an index value exceeding one for both backward and forward linkages. This signifies that these sectors are potential key sectors of the Malaysian economy. Key sectors utilised inputs from various industries (Backward linkage) and extensively contributed output to the overall industry (Forward linkage).

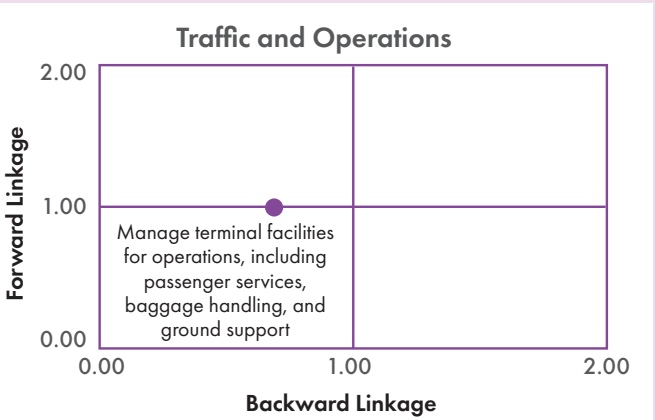


Table 10: Linkages during AAM's infrastructure development

There is potential for AAM to drive economic activities once it starts to operate.

Forward and Backward Linkages

Key sectors that have strong ability to influence economic activities in other sectors from both backward and forward linkage direction are:

Movement of passengers
(Movement of passengers for scheduled and non-scheduled flights)

Infrastructure maintenance
(Aerial mapping, environmental monitoring, and infrastructure inspection)

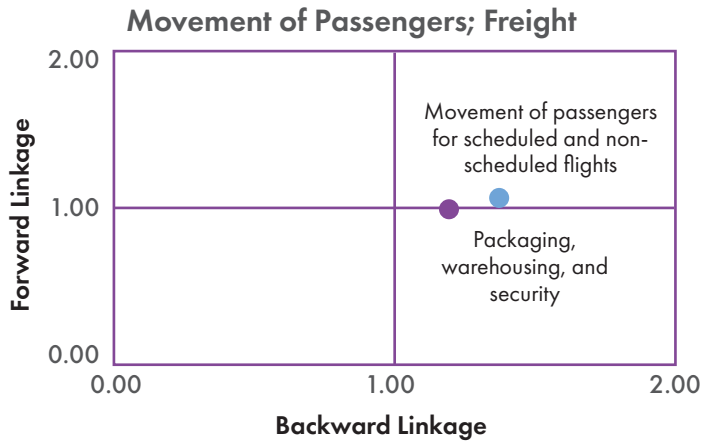
Industrial & agriculture
(Monitor livestock, herding, and managing their health).

Backward Linkages

Freight
(Packaging, warehousing, and security) – ability to utilize inputs from various industries

Forward Linkages

Industrial & agriculture
(Monitor crops, irrigation, and pest control) - ability to extensively contribute output to overall industry



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See Appendix for more description on the linkages

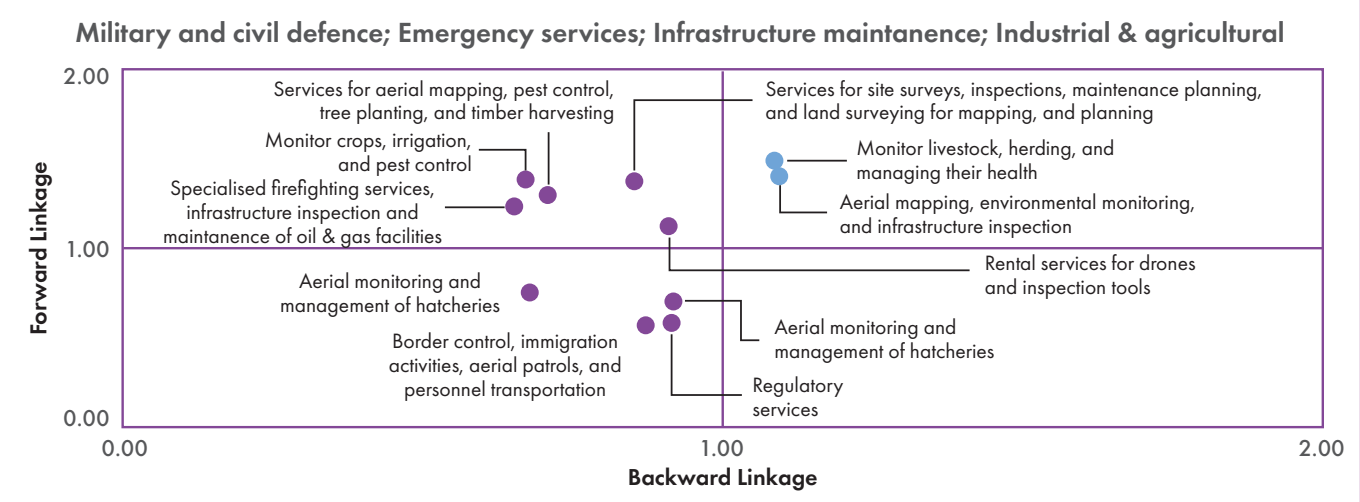
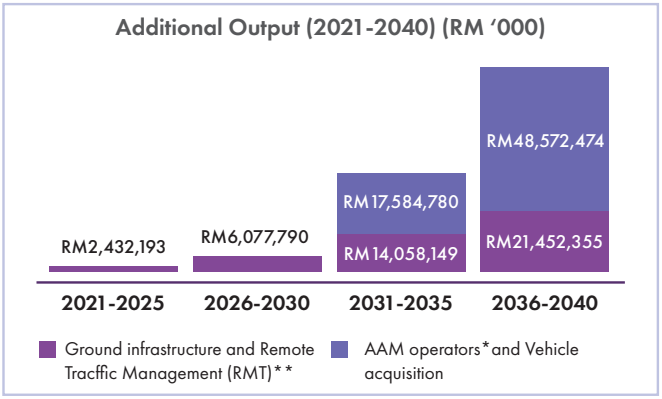


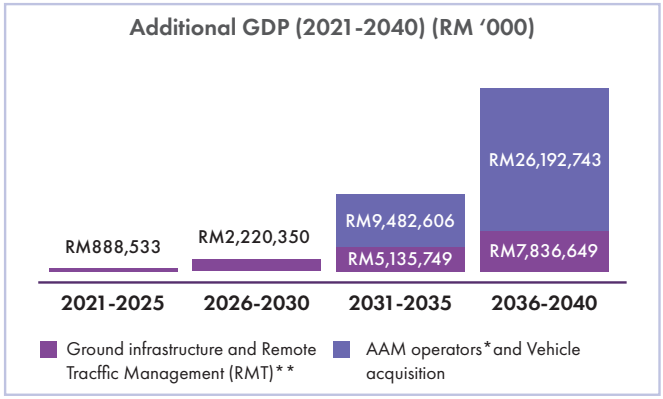
Table 11: Linkage Analysis (Demand-side)

The introduction of Advanced Air Mobility (AAM) is projected to generate RM70 billion in additional revenues, which would account for an extra 1.9% of the total revenue in the Malaysian economy.



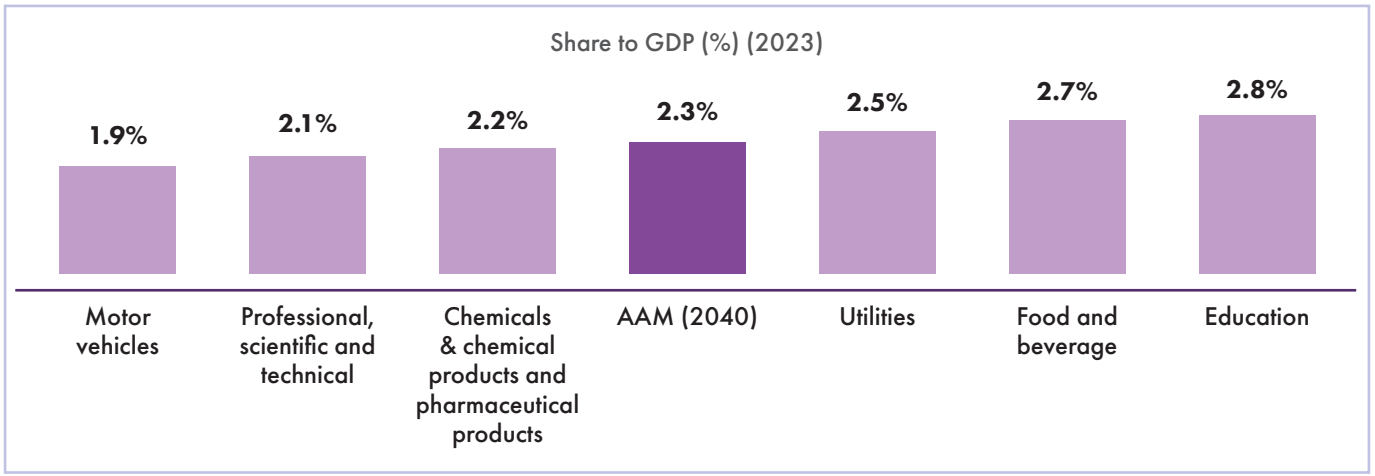
For more details on the input structure, see Appendix
** Including operators' revenues, medical and emergency medical services) and Vehicle acquisition*
*** Including both OPEX and CAPEX*
Note:
- *Exclude existing drone activities.*
- *Does not take into account potential negative impact on other conventional transportation activities i.e., logistics and air transport.*

Value-added contribution to the economy will also grow. AAM is expected to add 2.3% to the national GDP, amounting to an additional RM34 billion over the 2021-2040 period.



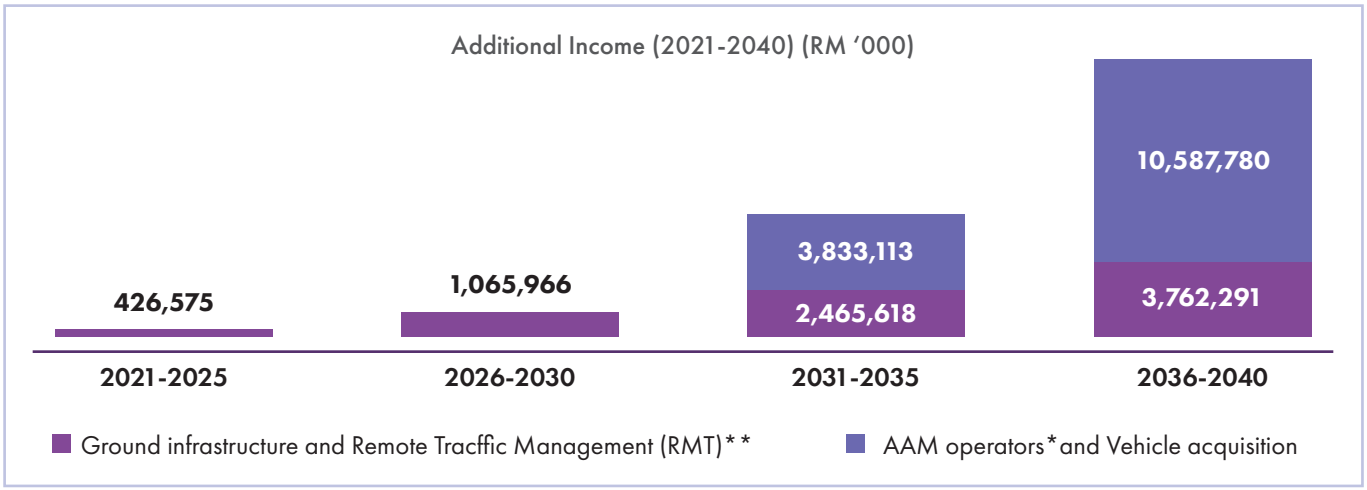
For more details on the input structure, see Appendix
** Including operators' revenues, medical and emergency medical services) and Vehicle acquisition*
*** Including both OPEX and CAPEX*
Note:
- *Exclude existing drone activities.*
- *Does not take into account potential negative impact on other conventional transportation activities i.e., Logistics and Air Transport.*

The projected GDP contribution is similar to the current size of Professional, Chemical, F&B, and Education sector.



Source: DOSM. 2024. National Accounts: Gross domestic products (2015-2023).

As part of building AAM infrastructure and operation, there will be additional income generated in the economy. AAM will contribute 2.3% of total salaries during the 2021-2040 period, equivalent to RM14 billion.



** Including operators' revenues, medical and emergency medical services) and Vehicle acquisition*
*** Including both OPEX and CAPEX*
Note:
- *Exclude existing drone activities.*
- *Does not take into account potential negative impact on other conventional transportation activities i.e., Logistics and Air Transport.*

In Conclusion

This study assesses the economic impact of Advanced Air Mobility (AAM) in Malaysia, drawing on input output modelling and official data from the Department of Statistics Malaysia's Input Output Transaction Table 2021. The findings highlight AAM's significant potential to drive economic growth well beyond its immediate industry boundaries.

AAM is projected to generate a disproportionately large economic influence, particularly in sectors such as electrical system and charging infrastructure installation, maintenance and repair, passenger movement, livestock monitoring, and aerial mapping. These activities are expected to stimulate both upstream and downstream economic activities across multiple industries.

Over the period from 2021 to 2040, the introduction of AAM is estimated to contribute an additional RM70 billion in revenue, equivalent to 1.9 percent of the national total. The sector is also expected to add RM34 billion in value to the economy, contributing 2.3 percent to national GDP. In terms of income generation, AAM activities could inject an additional RM14 billion in wages, representing 2.3 percent of total national income, particularly benefiting workers involved in infrastructure development and operations.

These findings underline AAM's potential as a catalyst for new economic value, enhanced productivity, and high quality employment. As Malaysia moves forward in shaping its future mobility landscape, the integration of AAM offers not only innovation in transport, but also tangible economic returns that support national development objectives.

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CHAPTER 4

READY FOR TAKE-OFF

RECOMMENDATIONS

Drawing from stakeholders' vision or aspiration as well as projection of potential economic impact, Malaysia is presents a huge potential to cultivate a thriving advanced air mobility (AAM) industry. Although intensified AAM activities are driven by supply and demand but more importantly a conducive eco-system support will become a catalyst for sustainable growth of the industry. Therefore, the report proposed six (6) mission-based recommendations to prepare Malaysia's eco-system support in embracing AAM. For every mission, context was proposes from future opportunities that can be leveraged **(There is a need for ...),** and considerations **(There is a future concern on...)** that could downplay the mission. Therefore, based on the context, proposed actions represent a list of interventions required to act upon collectively by all parties, the government, industry players, associations and academia.

6 MISSIONS

32 PROPOSED ACTIONS

MISSION 1:
Building A Robust Financial Ecosystem For A Thriving AAM Ecosystem In Malaysia.

There is a future need for...

1. Active participation of financial institutions in providing financial support to AAM industry initiatives. Attract private investors, including banks and venture capitalists, by identifying and engaging stakeholders with strategic interests in AAM to foster diverse funding streams and drive AAM development.
2. A comprehensive AAM funding ecosystem with targeted grant programs, R&D incentives, early-stage funding mechanisms, and dedicated support for AAM green technologies. This approach will stimulate innovation, accelerate development, and attract diverse investors committed to a sustainable future.

There is a future concern on...

1. Technology immaturity, high initial investment, and uncertain ROI. The relatively new AAM technology presents a risk due to its immaturity, high initial investment, and uncertain ROI. This discourages traditional investors and burdens the government with infrastructure and technology costs.
2. Public perception and acceptance. Negative public perception poses a risk to AAM adoption due to potential concerns regarding safety, noise pollution, and environmental impact. These anxieties could dissuade potential users and limit AAM's economic viability.
3. Competitive landscape with limited resources. This includes competition for existing funding, lack of dedicated AAM programs, regional competition, and restricted university R&D funding.

Proposed Actions

1. A platform such as a dedicated technical working group can be established with the purpose of providing in-depth explanations of AAM technologies and its alignment with sustainability goals. In addition, the platform can be a medium to explore and improve funding options for AAM players by clearly defining the specific scope of AAM funding and outlining defining areas, to attract investors targetting specific industry segments. For example, The AAM Funding Program supports the development and commercialisation of electric vertical take-off and landing (eVTOL) aircraft for urban air mobility (UAM) applications.
2. Leveraging public-private partnerships (PPPs) for broad investment. Attract private investment and expertise to the AAM sector in Malaysia by demonstrating the economic and social benefits, the government can incentivise industry contributions and corporate social responsibility (CSR) initiatives from larger companies.
3. Implement targeted grant programs and incentives focused on AAM design, applications, and operational systems to stimulate innovation and accelerate the development of AAM technology. One approach is through revamping existing funding mechanisms e.g. Aerospace and Electrical & Electronic Investment Fund (AEEIF) including reducing grant requirements or criteria and streamlining access across the entire AAM value chain.
4. Establish dedicated early-stage funding mechanisms, such as seed funding for aircraft building, to facilitate proof-of-concept development and attract subsequent investments, fostering innovation and growth within the AAM startup ecosystem. The funding and incentives could also encourage participation of startups and universities in showcasing their innovative products in world-class airshows, fostering public awareness, industry exposure, and potential partnerships for AAM development.

MISSION 2:
Deployment Of AAM Infrastructure On Strategic Locations Nationwide For Effective AAM Mobility Networks

There is a future need for...

1. Preparing AAM infrastructure deployment. One is through retrofitting existing helipads and infrastructure to repurpose them for AAM operations, minimizing construction costs and accelerating deployment. By acquiring suitable land and enacting supportive regulatory frameworks, the government can streamline the development process, mitigate potential obstacles, and create an enabling environment for AAM industry growth.
2. Integrating with Public Transportation Stations. Integrating AAM infrastructure with existing public transportation stations, such as bus or train stations, enhances connectivity and accessibility for passengers. By co-locating AAM terminals with other modes of transport, it can offer seamless multimodal travel options, improving overall transportation efficiency and convenience. Integrated public stations provide passengers with convenient access to AAM services, facilitating first-mile, last-mile, and intermodal travel solutions, thereby enhancing mobility and reducing congestion in urban areas.

There is a future concern on...

1. Restricted adoption and deployment of AAM in certain areas due to land use restrictions. Land use restrictions pose a significant obstacle to the integration of aerial mobility solutions into urban and rural environments, potentially impeding the expansion of AAM infrastructure and services.

Proposed Actions:

1. Strategically located AAM terminals with other modes of transport. AAM terminal to be located near existing transportation hubs and connectivity feeders such as rail stations, bus terminals, and major roads. This integration with existing transportation networks enhances accessibility and facilitates seamless multimodal travel experiences for commuters. can offer seamless multimodal travel options, improving overall transportation efficiency and convenience. Integrated public stations provide passengers with convenient access to AAM services, facilitating first-mile, last-mile, and intermodal travel solutions, thereby enhancing mobility and reducing congestion in urban areas. Collaboration with transportation authorities and urban planners can help identify optimal locations for AAM terminals, ensuring efficient interconnectivity with other modes of transport.
2. Prioritize AAM infrastructure development to improve accessibility. By ensuring that AAM terminals are accessible and conveniently located, even in rural regions, residents can benefit from enhanced connectivity and mobility options. Therefore, Government incentives or subsidies could be provided to encourage private operators to establish AAM services in underserved areas, thereby addressing transportation inequalities and promoting inclusive development.
3. Efficient process and facilitation for infrastructure development. Clear land acquisition policies and regulatory guidelines provide certainty for investors and developers, encouraging investment and fostering sustainable AAM development.
4. Modernize communication infrastructure. Transitioning to advanced technologies like Real-Time Kinematic (RTK) devices represent a pivotal step towards enhancing the efficiency and reliability of AAM operations in Malaysia. This transition enables real-time data exchange and precise positioning, crucial for navigating complex airspace and ensuring safe and efficient AAM integration. By upgrading communication infrastructure, Malaysia can strengthen its capabilities to support the growing demands of AAM operations, fostering a safer and more resilient transportation ecosystem for the future.
5. Repurposing existing helipads for AAM operations can significantly reduce the need for extensive new construction, thereby streamlining deployment and minimizing costs.

MISSION 3:
Regulatory And Policy Development, And Enforcement Dedicated For AAM Operation

There is a future need for...

1. Efficient coordination of AAM initiatives in Malaysia. Collaborative effort ensures AAM activities are governed and regulated to facilitate smooth operations within Malaysia's airspace.
2. Accelerating provision regulations for AAM operation. Progress in provision for regulations made for AAM starting not from scratch but from the established rules and regulations implemented in conventional aviation activities.
3. Designated areas for AAM activities. AAM applications are undergoing development which provide huge opportunities for innovation. Therefore, a need for a designated area (s) to allow R&D and testing activities to be carried out for AAM developmental programs.
4. Regional partnerships and collaborations. Collaborations with neighbouring countries on AAM policies and air traffic management facilitate seamless border control, minimizing unauthorized crossings and promoting regional integration.

There is a future concern on...

1. Privacy issues. Privacy concerns emerge as drones equipped with cameras operate, particularly in residential areas, raising issues about surveillance and data privacy rights.
2. Ineffective AAM policy. Developing a comprehensive policy framework is hindered by limited expertise in Malaysia, presenting challenges in crafting regulations that effectively govern AAM operations. In addition, fragmentation of policies and regulations across various ministries and agencies further complicates regulatory efforts, creating inconsistencies and overlaps that undermine regulatory coherence and effectiveness.
3. Oversight in policy deployment and enforcement. The rapid growth of AAM technology outpaces the capacity of a rigid regulatory framework to adapt, leading to potential gaps in oversight and enforcement.
4. Restricted adoption and deployment of AAM in certain areas due to land use restrictions. Land use restrictions pose a significant obstacle to the integration of aerial mobility solutions into urban and rural environments, potentially impeding the expansion of AAM infrastructure and services.
5. Increased safety & airspace integrity risks. Increased safety risks associated with low flying altitude, necessitating robust measures to mitigate potential accidents and incidents. In addition, affordability and accessibility giving rise to unlicensed drone operators which further compound regulatory challenges.
6. Air clearance limitation in high-density populated areas. High-density populated areas pose challenges for AAM operations due to airspace congestion and air clearance limitations. There must develop effective airspace management strategies, traffic control systems, and urban planning measures to address these challenges and ensure safe and efficient AAM operations in urban environments. By coordinating with relevant stakeholders, implementing airspace regulations, and leveraging advanced technology solutions, Malaysia can optimize airspace usage and mitigate the risks associated with air clearance limitations in densely populated areas.
7. Passenger Hop-in and Hop-out Security. Implementing passenger hop-in and hop-out operations in AAM introduces security challenges that need to be addressed effectively to ensure passenger safety and confidence. Stakeholders opined that authorities must develop robust security protocols, passenger screening procedures, and onboard safety features to mitigate potential risks associated with AAM operations. By prioritizing passenger security and adopting best practices from other transportation modes, Malaysia can build trust and acceptance of AAM technology among passengers and the general public.

8. Data privacy, cybersecurity, and protection. As AAM operations rely heavily on data collection, processing, and transmission, raising concerns about personal information. Breaches or misuse of sensitive data could lead to legal liabilities, reputational damage, and regulatory penalties, underscoring the importance of robust data protection measures and compliance with privacy regulations.

Proposed Actions:

1. Develop and implement a holistic AAM Regulatory Framework tailored to the unique needs of Advanced Air Mobility (AAM) in Malaysia. The regulatory framework will define a clear guideline within the specific boundary for AAM operations such as establish altitude and weight regulations (>10 kg, >400 ft altitude) tailored for AAM operations. It should also align with international standards, such as the United States Federal Aviation Administration (FAA) and International Aviation Safety Assessment (IASA) program.
2. Explore mechanism to merge manned and unmanned aerial vehicle (UAV) regulation requirements is presents a strategic avenue for streamlining regulatory processes and enhancing integration efforts in Malaysia's airspace. By acknowledging the similarities between manned and unmanned aircraft operations, regulators can simplify compliance requirements and facilitate a more cohesive regulatory framework.
3. A dedicated organisation for AAM development. There is a need for a dedicated entity to be established not only to regulate AAM through a comprehensive policy framework, but also integrating relevant other policies, and collaboration with various government agencies. Functions also include low-altitude air traffic policing to monitor drone-related activities in public and commercial spaces. such as streamlined licensing and approval processes.
4. Designated areas or space for AAM operations and supervised by regulator. To spur more interest and activities on AAM through designated drone-friendly zones for hobbyists and educational areas to promote drone-related interests research.
5. Strengthen AAM community of interest to promote and sustain AAM activities. Further intensified and drive AAM movement in Malaysia through establishment a working group for AAM to drive industry development agenda, incorporating industry, government, and technology partners. In addition, industry players are encouraged to join an AAM association and nominate a non-government association as the primary representative for the AAM community. Networks developed through local with international communities could stimulate demand for AAM services and further enhance Malaysia's presence in the international AAM ecosystem.
6. Raising public awareness and acceptance. Fostering public acceptance by demonstrating the technology through public events and testing platforms to create a more receptive market for potential users and investors. Additionally, highlighting specific AAM applications like medical services in rural areas can address connectivity needs and potentially overcome public acceptance challenges. Promoting insurance solutions for AAM can further enhance public confidence and pave the way for broader adoption. These awareness-raising initiatives can play a crucial role in attracting resources and fostering a supportive environment for AAM development in Malaysia.
7. Adapting emergency response similar to helicopters. The opportunity to adopt emergency response protocols similar to those for helicopters presents a crucial strategy for ensuring the safety and effectiveness of AAM operations in Malaysia. This initiative will involve training exercises and simulations to test emergency response plans and enhance readiness as well as to establish communication channels and coordination mechanisms between AAM operators and emergency services to ensure timely and effective response.
8. Develop a comprehensive insurance solution for the AAM industry that addresses its specific safety requirements and offers a range of coverage options comparable to those available for existing air transportation solutions like helicopters and airbuses.

MISSION 4:
Sufficient Pool Of Skilled And Knowledge Workforce To Support The Growth The AAM Industry In Malaysia

There is a future need for...

1. Capabilities development in all aspects of the AAM eco-system. Malaysia has sufficient and ready talent to meet the demands of the AAM industry if there are trainers or mentors available to train new talents for the sector.
2. Development of Certification and Standards for Workforce involved in AAM industry. There are existing certifications and standards for ongoing talent development, however, it requires alignment and adoption from international authorities for AAM industry.
3. Collaboration with institutional authorities on training, and capacity building. The opportunity for local universities to collaborate with the Civil Aviation Authority of Malaysia (CAAM) holds immense potential for advancing the integration of AAM in the country. By partnering with CAAM, universities can play a pivotal role in fulfilling regulatory and training requirements essential for AAM operations.

There is a future concern on...

1. Low demand for highly skilled and knowledge workers. Malaysia is considered a small market, which implies less demand to produce in-house products for the entire AAM value chain. Instead, some products, such as batteries and motors for AAM vehicles, can be imported rather than being locally manufactured and designed, which would be more costly for local players. This diminishes the focus on talent development in the design and manufacturing sectors.
2. Talent retention and brain drain. Talent retention may pose a challenge, as other countries like Singapore offer better career prospects and competitive remuneration packages. Additionally, the weak currency makes it difficult to retain talent locally.

Proposed Actions

1. Embedded AAM skills training in current training systems. AAM skills module to be added into Malaysia's Technical and Vocational Education and Training (TVET) curriculum as well as current National Occupational Skills Standard (NOSS) / Standard Kemahiran Pekerjaan Kebangsaan. The module can be developed by emulating training modules of pioneering countries or have flourishing AAM industry and customised to Malaysian context. Therefore, AAM stakeholders should be actively involved in providing input on the type of skills needed for AAM market development.
2. Recognising AAM related subject as a priority in existing courses (aerospace and aviation). Prioritise funding for scholarships, HR development programs, and postgraduate/graduate R&D in AAM-related fields to nurture a robust talent pool with targeted educational opportunities, professional development, and attracting talented researchers and future AAM designers and pilots.
3. Chart Career path for AAM talent in the pipeline. Malaysia has sufficient and ready talent to meet the demands of the AAM industry by attracting and building a career path for youth towards higher level of skilled and knowledge AAM workforce. This opportunity should be extended to marginalized communities in Malaysia by providing incentives, easy access to training, and other relevant supports.

4. Equip local talent pool with latest technologies of AAM. Promote emerging technologies with existing talent pool using different applications and platforms such as develop programs to expose talent pool to AAM technologies and skills such as through Hackathon programs, or competitions such as problem solving, drone war, etc. At higher institution learning, advanced degree in UASM/AAM such as drone design, however, for undergraduate degree program, may use existing programs that need to update syllabus accordingly for AAM knowledge and skills needed, such as include AAM in existing civil aviation education program.
5. Increase accessibility to related knowledge and skills to support AAM activities. Utilizing existing Malaysia Digital Economy Corporation (MDEC) programs, such as Digital Initiatives, which offer short courses to address in-demand digital skills, ensures Malaysian talents remain relevant and competitive in the workforce. By leveraging this platform and supplementing it with additional programs, we can create a comprehensive catalogue of training programs to meet the skill requirements of the AAM industry.
6. Provision of Standards and Certifications dedicated for AAM. Digitalization of trainings and assessments (hosted on digital platform as a learning centre) should align with the standards and criteria set by the Civil Aviation Authority of Malaysia (CAAM) and the Department of Skills Development (JPK) under the Ministry of Human Resources. In addition, a certification body, similar to the Board of Engineers Malaysia (BEM), should oversee talent in the AAM industry to ensure compliance and quality assurance.

MISSION 5:
Establishing Regulatory And Technology Sandboxes For Fostering Innovation, Undertake Comprehensive Testing And Enabling The Safe Integration Of AAM Technologies Into The Aviation Ecosystem.

There is a future need for...

1. Secured Testing Environment. A secured testing environment allows stakeholders to explore and refine innovative solutions for long-range AAM operations, accelerating progress and fostering collaboration within the industry.
2. Standards development. Contribute to or adopt global standards for AAM, as seen in collaborative efforts by the International Civil Aviation Organization (ICAO) and other international bodies.

There is a future concern on...

1. Limited support for AAM aircraft technologies. There appears to be strong support for physical infrastructure such as the building and operation of Vertiports, but limited enthusiasm for developing, adopting, adapting and operationalising AAM aircraft technology.
2. Disruption of existing technologies and infrastructure. Potential frequency interference with critical existing technologies.
3. Funding accessibility hindered by non-adaptive requirements for tech startups. While funding is accessible, the requirements to obtain the fundings do not align with future market needs. Tech startups encounter obstacles such as the requirement for established customers and difficulties in testing new technology due to strict criteria.
4. Risk of regulations being influenced by profit motives. While the inclusion of the private sector is essential in the development of new regulations and standards, it is essential that the regulatory framework remains impartial and in the best interest of the nation.

Proposed Actions:

1. Identify suitable areas for the establishment of regulatory and technology sandboxes where researchers, innovators, and companies can test AAM technologies and business models within a controlled environment. This will enable regulators to evaluate the safety, operational feasibility, and regulatory implications of AAM technologies development and deployment effectively. Each of the areas chosen could be focused on testing particular parameters, applications or operating conditions including the allocation of a dedicated frequency/channel for AAM operations testing. For instance, the Drone Testing Zone (DTZ) established by Futurise serves as providing a controlled environment for testing and developing drone technologies. This initiative offers various benefits, including research and development opportunities and facilitation of regulatory compliance.
2. Identify low-risk zones across Malaysia suitable for regulatory and technology sandbox initiatives. These zones should prioritize safety considerations such as being situated over water, away from densely populated areas, and minimizing the risk and impact with soft crashes over agricultural lands like paddy fields. Potential areas for such sandboxes could include regions like Langkawi-Perlis, Sabah, Sarawak, and others with similar characteristics.
3. Facilitate collaboration through a working group between regulators and industry players. This collaboration will assist in the formulation of supportive regulations that will enable the development and operations of AAM technologies.
4. Establish a centralised AAM administrative sandbox centre. This centre would serve as a centralised administrative hub for managing and overseeing the various AAM technology and regulatory sandboxes, across Malaysia. By streamlining administrative processes and coordination efforts, this would facilitate smoother collaboration between stakeholders, expedite regulatory approvals, and ensure compliance with regulatory requirements. Ultimately, such an administrative sandbox centre would provide a cohesive framework for advancing AAM technology development while effectively managing regulatory complexities, thus enhancing Malaysia's competitiveness in the global AAM market.

MISSION 6:
Establishing A Robust And Supportive Research, Development, Commercialisation And Innovation (RDCI) Ecosystem For Spurring Local Innovation Of AAM Technologies

There is a future need for...

1. Optimising existing research initiatives. Utilise existing patents and research especially in related areas such as aerospace performed by local universities or research institutes to drive AAM innovation and prototype development.
2. Leverage on ongoing and future technology transfer programmes. Promote the transfer of technology through partnerships with international aerospace companies to enhance the capabilities of Malaysian firms.
3. Consolidate Malaysia's current capabilities and expertise from various industries. These relevant local industries could accelerate AAM technology development, such as aerospace, ICT and electronics and electrical.
4. Collaboration with international/global players. Collaborating with international or global players presents an opportunity for Malaysia to leverage external expertise, technology, and investment to accelerate the development of its Advance Air Mobility (AAM) industry.
5. Dedicated testing areas for AAM. Dedicated testing areas further support R&D efforts, offering controlled environments for the exploration and validation of AAM technologies.
6. Exploring green technologies for AAM development such as electric propulsion technology. Learning from countries like Norway and Sweden that promote electric propulsion technology for AAM, aligning with global efforts to reduce the environmental impact of aviation.
7. Harnessing Malaysia's abundant natural resources and government support to enhance value-added manufacturing. Exploration of Rare Earth Materials (REM) and advanced materials such as Carbon Fiber Reinforced Polymer (CFRP) and Titanium (Ti) for manufacturing of AAM aircraft and infrastructure components.

There is a future concern on...

1. Protection of national interests by ensuring that collaboration with international or global players does not compromise Malaysia's national interests, sovereignty, or security. Safeguarding sensitive information and technologies is critical in international partnerships.
2. Lack of Monitoring & Evaluating Impact. Evaluate the terms of technology transfer agreements to ensure that local companies benefit from access to cutting-edge technologies and expertise.
3. Lack of support for local R&D. Although local universities are actively engaged in drone research, they lack adequate support for ongoing research and global patent maintenance. Additionally, there is limited interest from companies in commercialising these research findings.
4. Intellectual property rights. Currently, grant funding and research, development, and commercialization (R,D&C) activities at university business arms are bound by the policies of the parent university. Sometimes, business arms are discouraged from engaging in R,D&C activities in emerging technology areas due to uncertainties surrounding intellectual property rights.
5. Technology Acquisition. The stagnation of the Nation State in technology adoption, often assuming the role of a "User Nation," may pose a risk. Acquiring new and emerging technologies involve high cost that poses a challenge for businesses to venture into AAM market.

6. Dependence on imported technologies. Malaysia's aerospace manufacturers are primarily assemblers, lacking innovation and heavily reliant on technology transfer from the US, hindering local innovation capacity. Furthermore, Malaysian technology operators have limited ownership of the technology, possessing only the knowledge, not the proprietary technology itself.
7. Approval hurdles. Complex approval process for technology testing, involving multiple agencies such as CAAM, JUPEM, MINDEF, MCMC, and SIRIM.
8. Market Uncertainty. Rapid technological advancements and shifting market demands may pose challenges in anticipating future trends and requirements for AAM technologies.
9. Competition from incumbent global players. Malaysia's existing strengths may face competition from established global players in the AAM market, necessitating strategic positioning and differentiation to remain competitive.
10. Technological Obsolescence. Rapid advancements in AAM technology may render existing strengths obsolete if efforts are not made to continuously innovate and adapt to evolving industry trends.

Proposed Actions:

1. Establish innovation hubs. These collaborative spaces will drive RDCI activities as they serve as focal points for knowledge exchange and resource pooling among researchers, startups, and industry players, fostering a vibrant ecosystem for AAM innovation.
2. Enhance Public-Private Partnerships (PPP) and establishment of industry collaboration platforms. By fostering partnerships among government agencies, academia, research institutions, and private companies, these platforms facilitate knowledge sharing, best practices, and resource pooling for AAM R&D and innovation. They leverage diverse strengths, accelerate progress in developing and implementing AAM technologies, and enhance competitiveness within the industry. Introducing PPP-funded grants, subsidies, and research funding programs targeted at AAM technology development incentivizes innovation and provides vital financial support, ultimately driving growth and competitiveness in the sector.
3. Regulatory reform to enable AAM technological development. Working with regulatory bodies to develop agile and adaptive regulations that support innovation while ensuring safety and compliance in AAM technology development fosters an enabling regulatory environment. This regulatory reform streamlines processes and encourages experimentation, driving innovation and growth in the AAM industry.

CONCLUSIONS

The report acknowledges that Malaysia possesses essential components to hasten the advancement of AAM. While some AAM activities in Malaysia primarily involve drone operations, the eco-system already has established the capabilities of local players, including those in manufacturing, MRO, training and education, operation services, infrastructure, and logistics, that are directly and indirectly required to support AAM. During the visioning exercise, the stakeholders articulated their aspirations for AAM's future in Malaysia, expressing their convictions about the potential market that AAM could grow into over the next 10 to 20 years. In order to quantify this, the study projected that the introduction and expansion of AAM would contribute RM34 billion to Malaysia's GDP. This contribution accounts for an additional 2.3% of the nation's GDP, reflecting the creation of high-value industries and services associated with AAM. This includes the development of advanced manufacturing sectors, improvements in logistics and transportation efficiency, as well as the stimulation of innovation and technological advancements.

However, realising the aforementioned aspirations and potential economic impact will not be possible without the support of a conducive eco-system, which includes funding and incentives, infrastructure and institutional structure, regulation and policy, skills and talent, and technology and innovation. Resolving a number of issues and challenges is necessary to accelerate the growth of the AAM industry in Malaysia. In terms of funding and incentives, financial institutions' perception and willingness to accept risks associated with a new and emerging industry necessitates a relentless campaign to create awareness and buy-ins. One of the main features of AAM is the need for dedicated infrastructure, such as Vertiport and its complimentary support, but land acquisition matters could potentially impede progress. On top of that, the current shortage of talent is already a glaring challenge for most high-technology industries in Malaysia, and it will become an uphill task to attract the young generation to pursue their career path in the AAM industry. It is inevitable for Malaysia to initially rely on foreign technologies; however, over time, it must shift away from a high reliance on imports by developing its own indigenous technology and innovative products. Above all, regulation and policy aspects dominate most of the conversations throughout the study. In general, stakeholders' concerns revolved around the unclear regulatory framework that governs AAM activities in Malaysia. The lack of regulatory requirements delays the launch of new initiatives for AAM activities beyond drone services, including urban and regional air mobility. Also, cross-ministerial agencies like CAAM (which is part of the Ministry of Transport), MCMC (which is part of the Ministry of Communications), and the Ministry of Investment, Trade, and Industry (MITI), among others, need to work together, so a good coordination body or platform needs to be set up.

Given that AAM in Malaysia has not yet gained widespread attention, particularly in the context of government policy-making agendas, this report aims to provide an overview of the current state of the AAM industry in Malaysia, along with suggested measures to address the various opportunities and vulnerabilities identified by local AAM stakeholders. Advancing from this point, there is a need to develop a detailed document such as the AAM industry roadmap that provides more information regarding each mission to a certain level and includes refined actions, programmes, projects, timelines (short-term, medium-term, and long-term), and responsible organisations. Therefore, a wider stakeholder's engagement is required for this purpose. A higher-level national platform, like the Malaysian Aerospace Council (MAC), must present and endorse the roadmap or white paper. The Minister of MITI currently chairs the MAC, with high-level officials from relevant ministries and agencies, industry captains, and higher education institutions representing its members.

Although Malaysia has a long road ahead, every wonderful journey begins with a single step. Every successful industry, such as aerospace, automotive, and biotechnology, began as a new industry. Realising the potential, AAM could be one of the new engines of growth for the national economy, enhance the social well-being of the rakyat, and contribute to Malaysia's targets to achieve net zero by 2050.

ABBREVIATIONS

AAM	Advanced Aerial Mobility
AAM	Advanced Air Mobility
AAV	Autonomous Aerial Vehicle
AFPD	Approval of Flight Procedure Designers
AI	Artificial Intelligence
AIR	AAM Infrastructure Readiness Index
ARI	AAM Reality Index
ATC	Air Traffic Control
ATM	Air Traffic Management
BVLOS	Beyond Visual Line of Sight
CAAM	Civil Aviation Authority Malaysia
CPD	Continuing Professional Development
CSR	Corporate Social Responsibility
DCFC	Direct-Current Fast Chargers
DOA	Design Organization Approval
EASA	European Union Aviation Safety Agency
EIS	Entry Into The Service
eSTOL	Electrical Short Take Off and Landing
EV	Electric Vehicle
eVTOL	Electric Vertical Take-Off And Landing
FAA	Federal Aviation Administration
FIZ	Flight Information Zones
FPD	Flight Procedure Designers
IAEA	Independent Aircraft Engineering Assessors
ICAO	International Civil Aviation Organization
ICP	Industry Collaboration Program
IoT	Internet of Things
ITU	International Telecommunication Union
LAAT	Low Altitude Air Transportation
LAE	Licensed Aircraft Engineer
LAM	Low Altitude Mobility
LLA	Low-Level Airspace
MaaS	Mobility-as-a-Service
MRO	Maintenance, Repair And Overhaul
MSAF	Minimum Safe Altitude Floor
MUVA	Malaysia UAV Alliance Association
OEMs	Original Equipment Manufacturer
OTPS	Opportunities/Threats/Products & Services
PAV	Personal Aerial Vehicle
POA	Production Organization Approval
pUAM	Passenger Urban Air Mobility
RAM	Regional Air Mobility
ROV	Remotely Operated Aircraft
RPA	Remotely Piloted Aircraft
RPTO	Remote Pilot Training Organisation
SRF	Strategic Research Fund
TTS	Travel Time Saving
UAM	Urban Air Mobility
UAV	Unmanned Aerial Vehicle
UTM	Unmanned Traffic Management
VFR	Visual Flight Rules
VLOS	Visual Line of Sight
VTOL	Vertical Take-Off And Landing