Advanced Air Mobility: Market study for APAC

Manfred Hader, Global Head of Aerospace & Defense, Roland Berger

The Roland Berger Center for Smart Mobility

PIONEERS OF POWER

SINGAPORE AIRSHOW 2022 15–20 Feb

February 16, 2022

Content

This study was commissioned by Rolls-Royce plc and written by Roland Berger

A. Market development forecast

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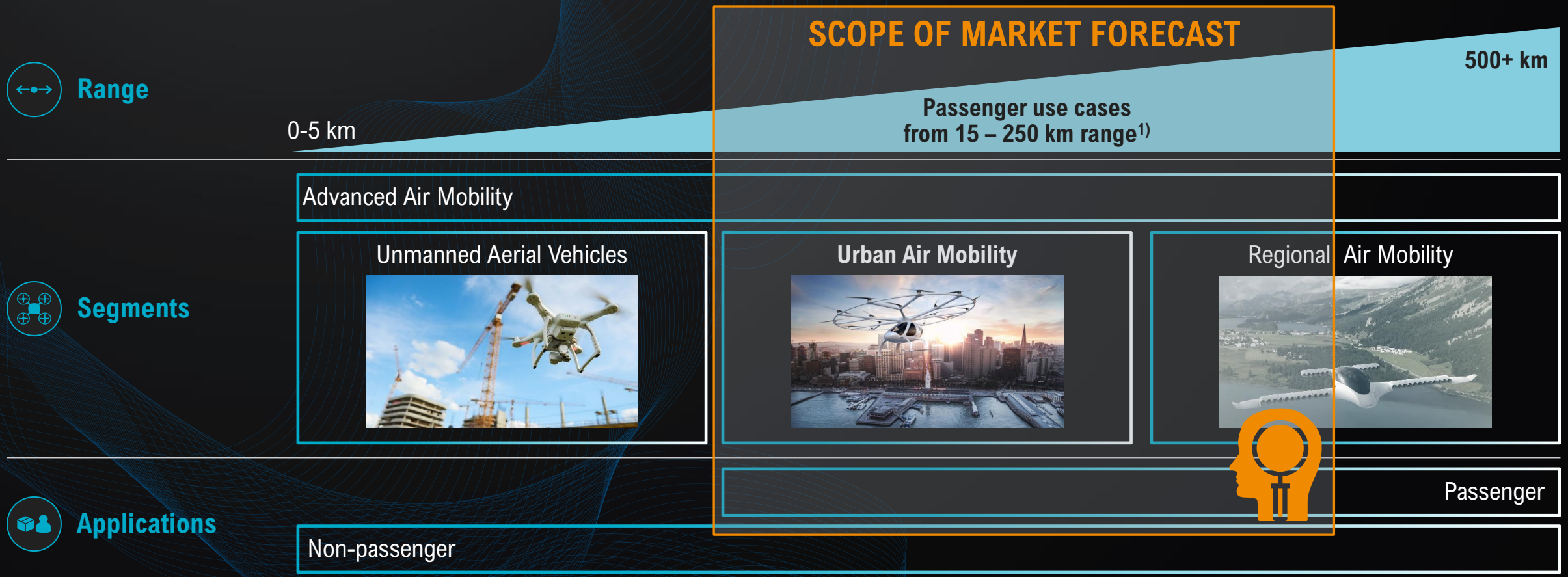
Advanced Air Mobility can be divided into passenger and non-passenger transport as well as into RAM, UAM and UAVs

Definitions and market overview



1) Realistic useful range of battery-electric Vertical Take-Off and Landing aircraft

Source: Roland Berger

Three passenger use cases covered in market development forecast: City Taxi and Airport Shuttle fly up to 50 km, Inter City flights cover up to 250 km

AAM passenger use cases

Urban Air Mobility

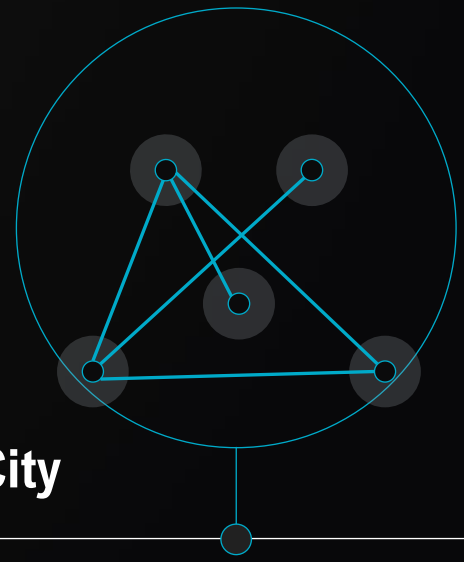
1 City Taxi

On-demand flights between any available landing station
(15-50 km)

2 Airport Shuttle

Scheduled flights on defined routes between the airport and surrounding landing stations
(15-50 km)

Regional Air Mobility



3 Inter City

Scheduled flights on defined routes
(50-250 km)

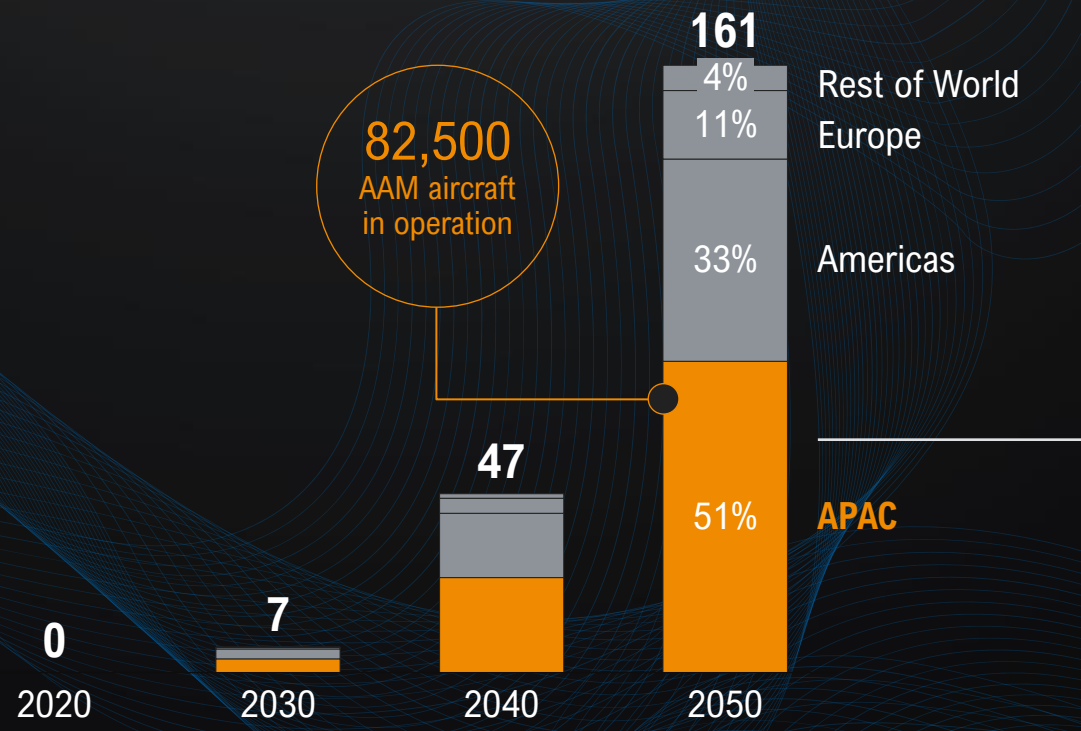
AAM landing site — Scheduled service ····· On demand service — Metropolitan area

Source: Roland Berger

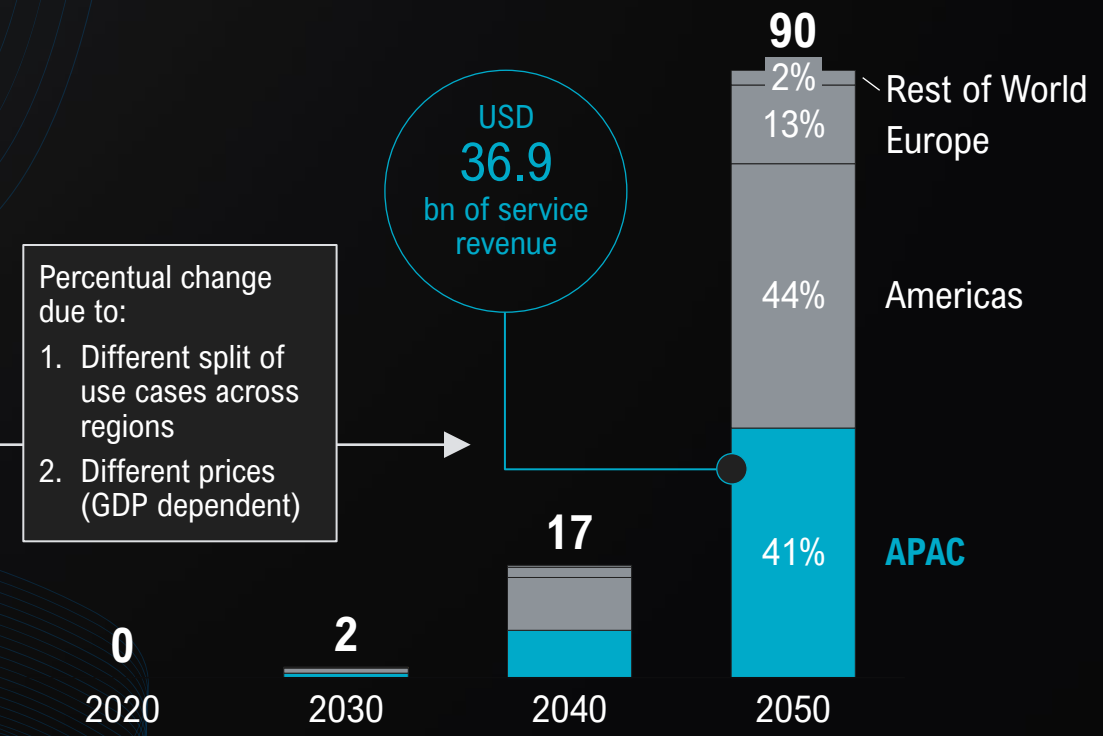
From the global AAM market, the APAC[1)] region accounts for more than half of all operated VTOL aircraft and for over 40% of revenues

AAM market development per region

Passenger VTOL aircraft in operation ['000]



AAM service revenue [USD bn]

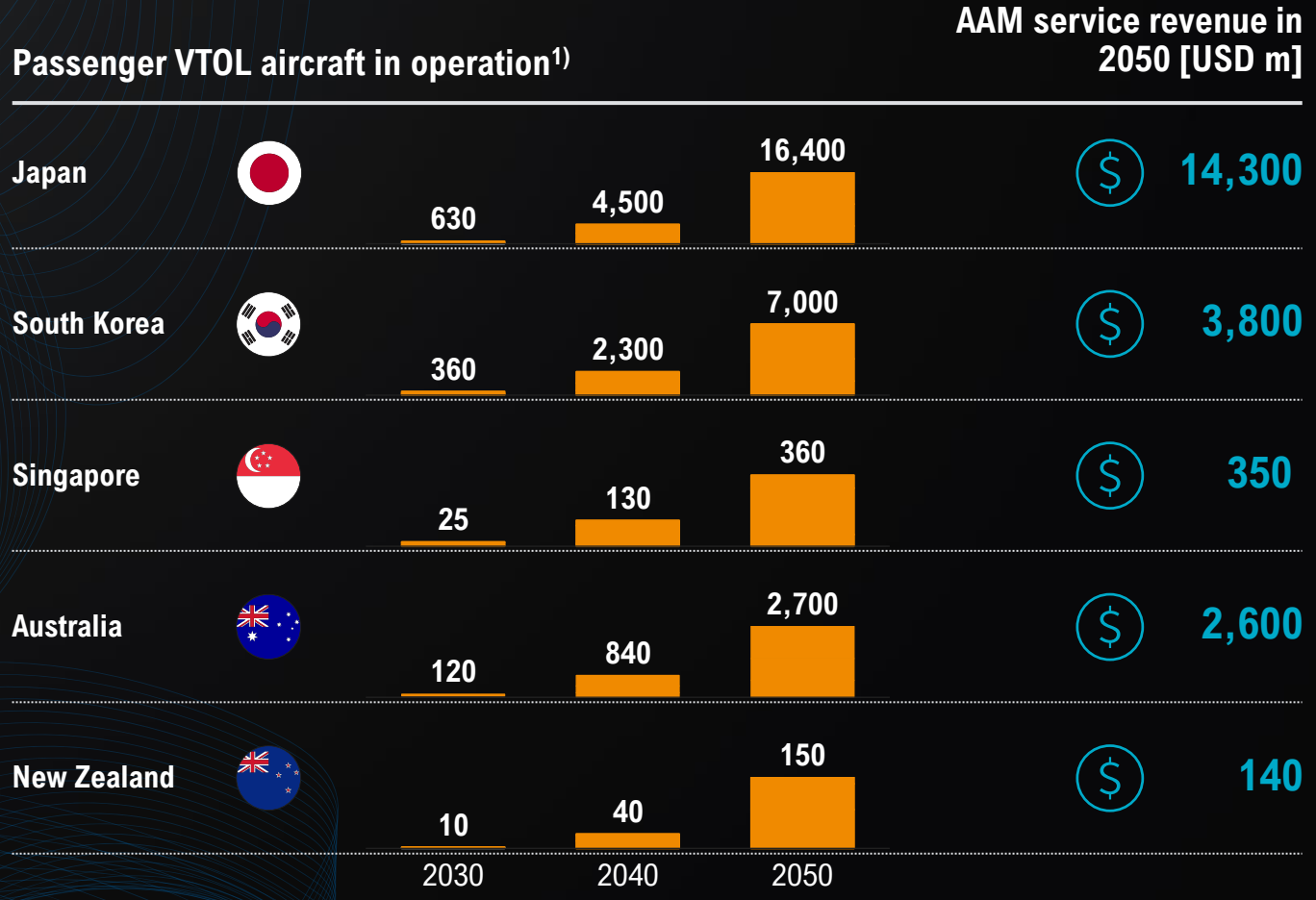


1) APAC region consists of 25 countries and locations for this market study

Source: Roland Berger

Market forecast shows APAC countries implementing AAM services before 2030 with potential of up to several thousand aircraft

APAC region: Country-specific development of AAM



1) Top 5 countries in APAC with highest Human Development Index (HDI)

Source: Roland Berger

B. AAM implementation on city-level

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Advantages of AAM are appealing to cities as AAM will offer a whole new travel experience: Fast and easy to use with zero emissions

Key promises of AAM passenger use cases

Transportation

1 Time-saving

AAM services complement transport options on **high-volume** ground route and geographically challenging to reach locations

Fly above traffic jams

2 Intermodal

AAM services integrate **with existing** private and public **ground transport** to offer inter-modal journeys

With the UBER to the vertiport

3 Convenient

AAM services offer attractive **scheduled and on-demand flights** from and to **attractive and useful locations**

Commuting by aircraft – what else?

Sustainability

4 Green

AAM services have **zero emissions** and are more sustainable compared to existing urban air travel options

Greener flights for a greener city

5 Silent

AAM services operate close to communities but thanks to novel rotors and electric motors with **minimum noise footprints**

It's a bird, it's a plane, it's… I cannot hear it?

6 Safe & reliable

AAM services adhere to the high **certification standards** of **commercial aviation** ensuring safe and reliably operations at any time

From 'have a safe flight' to 'have a nice flight'!

Source: Roland Berger

AAM implementation: Overview of frontrunner cities

AAM is already becoming reality in the APAC region with interesting partnerships and airline activities announced in frontrunner cities

Frontrunner cities of AAM development in the APAC region

TOKYO

- Marubeni Corporation ordered up to 200 aircraft from Vertical Aerospace
- JAL leases Vertical Aerospace eVTOLs from Avolon
- JAL partnered with Volocopter to explore AAM

VERTICAL

JAPAN AIRLINES

AVOLON

VOLOCOPTER

SEOUL

- Hyundai's Supernal plans AAM implementation in 2025
- Korean Air has signed agreement with Incheon Airport and Hyundai for joint AAM development
- SK Telecom and Joby announced strategic collaboration

HYUNDAI

supernal

KOREAN AIR

Incheon Airport

Joby

SK telecom

SINGAPORE

- Volocopter commits to launch AAM services in Singapore
- Airbus and CAAS co-llaborate to enable AAM
- First successful trial UTM system in 2021
- Ascent Flights ordered up to 100 EVE AAM aircraft for their route network

VOLOCOPTER

AIRBUS

CAAS

OneSky

ASCENT

EVE

MOBILITY REIMAGINED

AAM frontrunner cities …

1 … have an above-average level of AAM initiatives already ongoing

2 … have shown high engagement from both local governments and industry to make AAM a reality

3 … have already tested AAM in a real-life environment with first use cases

Source: Press research, company information, Roland Berger

AAM implementation: Overview of frontrunner cities

Passenger AAM services will offer time-saving, inter-modal and convenient travel options – Use cases dependent on city structure

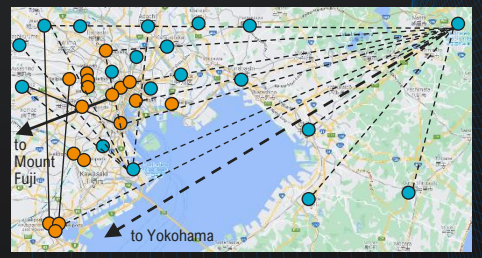
City deep-dives: Summary of AAM passenger use cases in frontrunner cities

Illustrative

TOKYO

Planned AAM launch date:

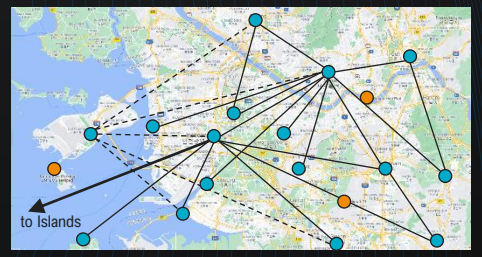
2025



SEOUL

Planned AAM launch date:

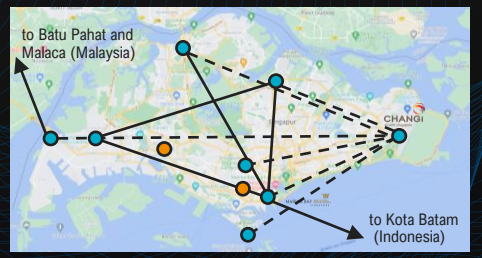
2025



SINGAPORE

Planned AAM launch date:

2024



Key insights from the AAM route networks

1. **Airport Shuttle:** Benefit from fast travel options from the airport to the city center and suburbs
2. **Scenic tourist flights:** Enhance your experience as traveler (or local) and enjoy breathtaking views of cities and landscapes while you travel along the coastline, to nearby islands or surrounding areas
3. **City Taxi:** Reduce significantly your daily commuting time or travel through the city faster – City Taxis bring suburban and urban areas closer together
4. **Inter City:** Even cities in neighboring countries and rural points of interests become within minutes in reach

Existing heliport · New AAM port · Potential AAM route · Potential AAM Airport Shuttle

Source: Roland Berger

C. Ecosystem requirements

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To enable the use cases and make AAM a reality a whole new ecosystem needs to be put in place greenfield

Until AAM aircraft are ready for commercial operations, the AAM ecosystem (infrastructure, charging, flight operations, airspace mgmt., MRO etc.) needs to be created

BUT HOW ?

Source: Roland Berger

AAM industry must proof its technical and commercial viability to be economically successful: Certification as necessary requirement

Key deliverables of the AAM industry

1 Technical proof of concept

Responsible: **Regulators** and **aircraft OEMs**

Required building blocks:
- Commercial certification
- Production ramp-up

Only achievement of technical proof **enables commercial operations**

2 Commercial proof of concept

Responsible: Supporting ecosystem of **infrastructure providers** and **operators**

Required building blocks[1)]

Customer	Public acceptance	Booking platforms	Customer experience
Operations	Aircraft handling & charging	Flight operations	Maintenance, Repair, Overhaul
Infrastructure	Vertiports	Air traffic mgmt. system	Connectivity & communication

Only the **efficient alignment** of all ecosystem building blocks create superior **customer value** and the **fastest** travel option at **lowest cost** possible

1) Selection of building blocks

Source: Roland Berger


Roland Berger
D. Recommendations to industry stakeholders
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Best practice example of AAM initiatives shows ecosystem-wide partner-ships and sandbox approach to test AAM in real-life urban areas

Key learnings from AAM initiatives – Example: 'Re.Invent Air Mobility' in Paris

Re.Invent Air Mobility

GROUPE ADP · RATP · CHOOSE PARIS REGION

- Goal of showcasing AAM operations at the **Paris Olympics 2024**
- Assistance in **scaling up** operations **until 2030**
- **Testing ground** Cergy-Pontoise airfield in Paris

Key partners

dgac · EASA European Aviation Safety Agency · EUROCONTROL

Vehicle development

VOLOCOPTER · AIRBUS · VERTICAL · CHANG I亿航 · PIPISTREL · ASCENDANCE FLIGHT TECHNOLOGIES

Ground infrastructure

Skyports · greenmotion · H3Dynamics · LEOSPHERE A VAISALA COMPANY

Airspace integration

Internest · m3 systems · ENAC ECOLE NATIONALE DE L'AVIATION CIVILE · THALES

Operations

CAE · AIRFRANCE · HELIPASS · DASSAULT FALCON SERVICE A Dassault Aviation Company · HELIFIRST

Public acceptance

BRUITPARIF · INSTITUT POLYTECHNIQUE DE PARIS · Berkeley UNIVERSITY OF CALIFORNIA · nlr · envirosuite

Key learnings

- Role as an **aggregator** and **orchestrator** of activities **across** the **ecosystem**
- **Multi-OEM approach** to test interoperability of ecosystem
- Real-life **test environment** as '**sandbox**' for flight trials and **public showcasing** opportunity
- Necessity of **public-private** partnerships
- **Long-term** approach with time horizon of 3+ years working towards a **joint vision**

Note: Selection of partnerships; in total 30 partner companies have been selected

Source: Re.Invent Air Mobility, company information, press research, Roland Berger

Frontrunner cities should take on the role as 'orchestrator' by integrating and managing all ongoing activities in a streamlined way

Recommendations to frontrunner cities for successful AAM implementation

1. **Establish your AAM vision:** How do you foresee AAM to improve people's lives and the overall city – by when shall this vision be reached?
2. **Build long-term partnerships and multi-OEM partnerships:** Partner up with these industry-leading and innovative companies who share your AAM vision
3. **Take on or appoint orchestrator role:** Necessity to manage all partnership activities in a streamlined way towards the AAM vision
4. **Create sandbox for physical tests:** Ensure an open regulatory environment for safe and secure trials with initial infrastructure, aircrafts and supporting systems

Source: Roland Berger

Your contact

Manfred Hader

Senior Partner
Global Head of
Aerospace & Defense

Tel.: +49 40 37631-4327
manfred.hader@rolandberger.com

Roland Berger

Roland Berger

Sederanger 1
80538 Munich
Germany

Roland Berger

The Roland Berger
Center for Smart Mobility

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