SIAPARTNERS

Urban Air Mobility Observatory

First edition

Pierre ROBIN
Senior manager, Brussels
pierre.robin@sia-partners.com

Vincent HEURTEUR
Senior consultant, Paris
vincent.heurteur@sia-partners.com

Contacts

Pierre ROBIN
Senior manager
Lead team mobility

Vincent HEURTEUR
Senior consultant
Lead UAM Observatory

Thomas RORTEAU
Consultant
Transport & Tourism

Azer CHANDOUL
Consultant
Transport & Tourism

Adrien PROVOST
Consultant
Transport & Tourism

Summary

1

Introduction to urban air mobility

The concept of urban air mobility has been tested in the past, but its initial attempts were unsuccessful

Attempts were already made in the 1960s, as illustrated by **Pan Am's case, which offered more than twenty daily flights** between its tower and JFK Airport terminal.

Why did it fail ?

Technological and regulatory maturity too low (multiple accidents)

High operating costs

Significant societal and environmental impacts

Since then, the concept has evolved significantly, **becoming a true competitive mobility opportunity in complex urban environments...**

Current urban development challenges require to rethink the mobility of tomorrow

Urban congestion

*Urban road congestion **reduces overall quality of life.***

In 2023, the **annual time lost per person in traffic** jams represented:

104 hours or **11 working days** [1]
+3% average congestion per year (since 2018)

This congestion is also evident in the usage of other **land infrastructures (airports, train stations, etc.)**, whose capacities are expected to reach saturation in the next decade. At the same time, the possibilities for expansion are sometimes limited, as well as being costly.

CO2 emissions

*The **transportation sector** in transformation must adapt to **ecological challenges.***

More than 45% of passenger transport emissions in Europe come from **road transport** (cars and motorcycles) [2].

+240 kg of CO2 per vehicle on a daily trip due to traffic jams [3].This represents a **double challenge** given the increase in urban congestion.

For comparison, this surplus of CO2 emissions accounts for nearly **3%** of what an average European emitted in 2021 (EU27) [4].

Territorial network

Increasing flows of **people and goods.**
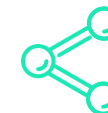
83.7% urbanization in Europe projected by 2050 (compared to 76% in 2024) [5].

Including **7%** of the territory in built-up areas by 2030 to accommodate growing populations (compared to 3% in 2015) [5].

It is therefore essential to address this transformation through a network that enables **economic and social cohesion** :
- **Enhance intermodal solutions** to quickly connect people to economic hubs (e.g., Grand Paris Express, Crossrail in London…).
- Provide relevant mobility solutions that meet the **needs of more isolated areas** (healthcare, education…).

[1] TomTom traffic index : dans 19 megacities mondiales (>8 millions d'habitants), pour une voiture essence, considérant un trajet quotidien de 10km aux heures de pointes.
[2] Parlement européen : émissions de CO2 des voitures : faits et chiffres (infographie) 2023.
[3] TomTom traffic index : Mesuré en 2023 à New York pour des trajets quotidiens de 10km aller-retour avec une voiture essence sur les heures de pointe en jours ouvrés
[4] Ministère de la transition écologique et de la cohésion des territoires : émission moyenne en Europe en 2023
[5] Commission européenne : urbanisation en Europe, 2020.

Urban air mobility has thus become an opportunity to meet the challenges of urban areas transformations

Stakes

A new generation of aircraft (eVTOL*)

- Increase accessibility to restricted or isolated areas through enhanced **maneuverability**.
- Reducing environmental impact and noise pollution compared to traditional helicopters through **electric propulsion and smart design.**
- Aligning to evolving **certification** standards, with maturity levels varying across geographic regions.

Advanced air traffic management

- Enabling eVTOLs to **integrate into an aerial ecosystem** that already accommodates multiple classes of aircraft, through advancements in Air Traffic Management (ATM/UTM) systems.
- Developing opportunities for the integration of **autonomous flights** (partial or full automation).
- Ensuring airspace safety and operational flexibility (planning, routing, etc.) through **real-time automated communications**.

Infrastructure development in cohesion with the territories

- Responsibly developing vertiports to maximize opportunities for **leveraging existing infrastructure** (buildings, train stations, etc.).
- Enhancing **intermodality** with existing mobility solutions and improving territorial connectivity (access to economic hubs, education, healthcare services, etc.).

Emerging business models

- Ensuring the viability of new business models emerging from these fields, which are highly sensitive to the surrounding challenges.

Focus in the next slides

SIAPARTNERS confidential

Key use cases for emerging passenger and cargo markets…

Domains

Passenger transport

Passenger transport to city centres, suburban areas or other cities.

Zoom on use cases

Emergency transport

Transport of passengers or goods
- Hospital services (EMS) : patients, medical staff, equipment…
- Disaster assistance : food supplies, evacuation of people, assistance in clearing debris…

Cargo transport

Cargo activities for :
- One-off last-mile deliveries (parcels, etc…)
- Heavier deliveries planned at regular intervals (supplies, etc…)

Use cases

Airport shuttle

Service with fixed times and routes from an urban area to an airport.

Regional shuttle

Service with fixed times and routes to suburban or regional destinations not viable for a traditional airline (isolated areas, short distances, etc.).

Corporate transport

Scheduled service with fixed routes for business trips:
- To business hubs,
- Intra-company for employees, to different offices, factories...

On-demand taxi

Enhanced offers connected to other urban transport modes, supported by a well-developed operating network to ensure a minimum level of service..

Leisure & Tourism

- Visits to tourist sites from the air.
- Transport service between hotels (seaside areas, islands, etc.).

…supported by multiple eVTOL vehicle configurations

	Multicopter	**Lift & Cruise**	**Vectorial thrust**	**Tilt wing**
Description	Multiple fixed rotors to generate both lift and propulsion	Dedicated rotors for the take-off/landing and cuise phases, transition between vertical and horizontal flight is made without tilting the rotors or wings	Rotors or turbines capable of directing their thrust, enabling the aircraft to go from vertical to horizontal flight without changing the wings position.	Equipped with wings that can tilt from a vertical configuration for take-off and landing to a horizontal configuration for cruising.
Prefered use case	**Use case :** in-demand taxi, EMS **Perimeter :** inner city	**Use case :** in-demand taxi, shuttle, logistics **Perimeter :** suburb, inter-city	**Use case :** shuttle, logistics **Perimeter :** inter-city	**Use case :** shuttle, logistics **Perimeter :** inter-city
Sample of manufacturers	Volocopter, Skydrive…	Eve mobility, Airbus…	Lilium, Joby Aviation, Archer…	Dufour aerospace, Transcend Air…

	Multicopter	**Lift & Cruise**	**Vectorial thrust**	**Tilt wing**
Passengers*	1 to 2	4 to 6	4 to 6	4 to 6
Cruise speed*	90-110 km/h	120-200 km/h	200-300 km/h	300+ km/h
Range*	~40 km	~80 to 100 km	~150 to 180 km	~200+ km
Energy efficiency	■ ■ ▢ ▢	■ ■ ■ ■	■ ■ ■ ▢	■ ■ ■ ▢
Hovering efficiency	■ ■ ■ ■	■ ■ ■ ▢	■ ▢ ▢ ▢	■ ■ ▢ ▢
Simplicity of design and construction	■ ■ ■ ■	■ ■ ■ ▢	■ ■ ▢ ▢	■ ▢ ▢ ▢
Acoustic comfort	■ ▢ ▢ ▢	■ ■ ▢ ▢	■ ■ ■ ▢	■ ■ ■ ▢

Air traffic management needs to take on a new dimension, to harmonize urban skies with low-altitude operations

Specific challenges for the UAM

Increased traffic density at low altitude
eVTOLs will operate mainly in urban areas at low altitude, adding a significant volume of traffic to areas sometimes already saturated by helicopters, drones and other aircraft.

Coordination with traditional aviation
eVTOLs must integrate into existing airspace without disrupting the operations of commercial aircraft.

Safety and fluidity
Traffic management must ensure that there are no collisions, particularly in dense urban environments with complex trajectories.

3 technological levers to respond

UTM* systems
- Management systems specifically designed for vehicles operating at low altitude.
- Automated coordination using artificial intelligence algorithms to optimize trajectories, avoid conflicts and manage priorities in real time.

Real-time data flows
- Using 5G and satellite systems to transmit data instantly between aircraft, vertiports and traffic managers.

Autonomous detection and avoidance systems
- On-board sensors in eVTOLs to automatically identify and avoid obstacles in flight.

Public-private partnerships to accelerate research and innovation in the digitalization of airspace

Federal Aviation Administration
NextGEN

SESAR
JOINT UNDERTAKING

The UAM offers opportunities to optimize existing infrastructures and innovate in the design of new dedicated spaces

Vertiport concepts are emerging all over the world, these are based on 5 principles :

Modern architectures
Combining modularity (based on estimated traffic levels) and ease of integration into different environments (on rooftops, water…).

Opportunities for integrating sustainable solutions into their design and operation
- Reduction of noise and visual pollution, particularly in dense urban areas, through optimization of flight paths and operating hours, use of quieter aircraft, siting to minimize impact on surrounding ecosystems...
- Eco-responsible operations through: the use of solar panels and sustainable materials, optimized resource management...
- Integration of electric recharging infrastructures to meet the needs of eVTOLs.
- Multimodal connectivity to provide seamless travel and maximize passenger benefits.

An enhanced passenger experience
- A smoother passenger journey with tailor-made facilities.
- An enhanced passenger experience: applications or platforms for flight booking, check-in and boarding guidance, etc. loyalty programs coupled with e-commerce and click & collect services...

Specific safety standards
- Dedicated certifications to authorize eVTOL operations and their interaction with other means of transport
- Integration with urban air traffic management (UTM) systems to coordinate eVTOL operations with the rest of the airspace.

Optimized operations with digitalization
- Automated management of flows and planning of landings / take-offs according to the possible flow of operations...
- Systems for monitoring the condition of assets and essential components (charging stations, etc.)

Helicopter vs. eVTOL: what are the differences ?

Features	Helicopter – Bell 407*	eVTOL	
Propulsion	Thermal (Fossil fuels)	Electric (Lithium-ion)	
Noise level	87 dB in flight	65 dB in flight** (Volocity)	**x4** human perception
Range	Approx 600 km	20 to 200km	
Maximum capacity	6 passengers	1 à 6 passengers	
Cruise speed	246 km/h	90 to 300+ km/h	
Urban accessibility	Limited	High	
Operating costs	High	Reduction opportunities	

Fuel prices
Maintenance of numerous moving parts...

Electricity prices
Simplified design and mechanics
Predictive maintenance
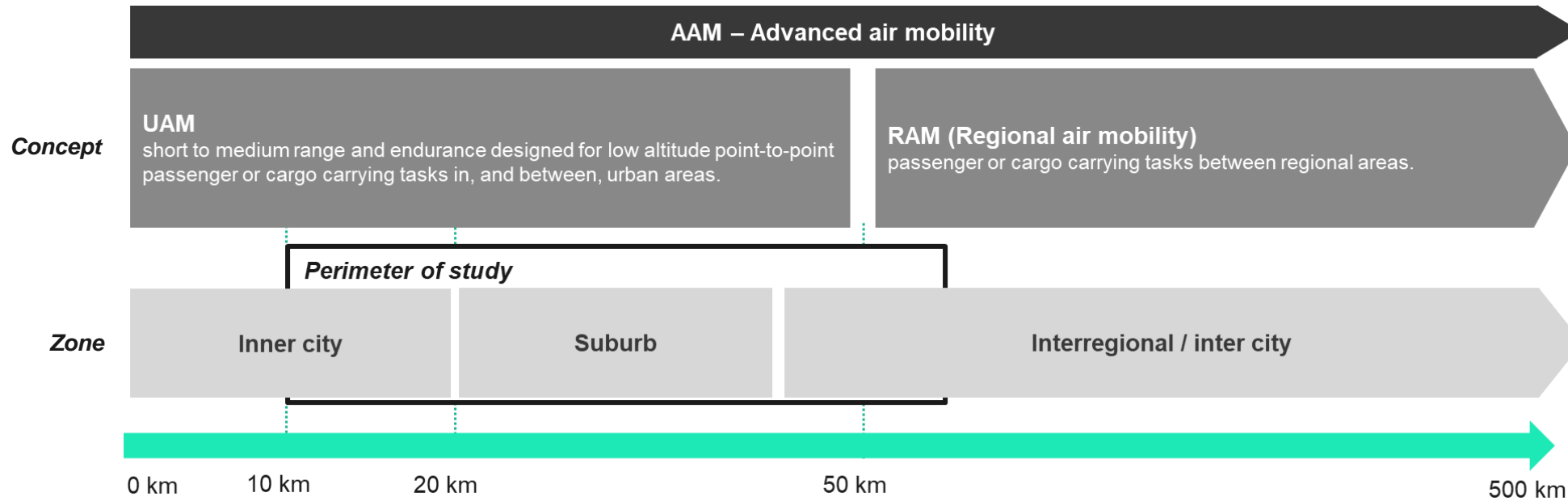Automation and higher flight frequency...

Key points

Although the use cases for helicopters and eVTOLs are similar, particularly for transporting people or moving quickly over short distances, eVTOLs are better suited to urban environments.

- Quieter flights for the overflown areas,
- **Opportunities to reduce operating costs,** particularly for large-scale mobility services,
- Opportunities for evolutions (batteries, etc.) and **digital integration,** making it easier to manage operations, optimize journeys and connect with other modes of transport...

Our observatory is part of a broader perspective, that of advanced air mobility

AAM – Advanced air mobility

Concept

UAM
short to medium range and endurance designed for low altitude point-to-point passenger or cargo carrying tasks in, and between, urban areas.

RAM (Regional air mobility)
passenger or cargo carrying tasks between regional areas.

Perimeter of study

Zone

Inner city	Suburb		Interregional / inter city

0 km   10 km   20 km   50 km   500 km

We therefore focus on the **UAM domain, also integrating certain aspects of RAM** , taking into account the assimilations made between the two domains according to the geographical contexts.

Furthermore, our focus for the moment is on players who are mainly focused on **passenger transport,** the relevance of which is generally revealed from distances of around 10 km.

Note : As this is the first edition, the results are not entirely exhaustive; however, we plan to further enhance our approach in future editions.

Our objectives

IN THREE STEPS

1
- Conduct a comprehensive analysis of the UAM ecosystem to gain a global overview of the key pure players.
- Assess the activities of these players to identify industry leaders.
- Examine the distinct characteristics of each major market to monitor their evolution and track progress over time.

2
- Map the ongoing initiatives of selected UAM players to track their progress (6 actors selected)
- Conduct a multi-criteria analysis of these initiatives to identify key trends
- Gain deeper insights into the strategies employed by UAM players and the challenges they face.

3
- Assess the UAM regulatory maturity of geographical areas (eVTOL certifications, etc.).
- Identify mechanisms for collaboration between civil aviation authorities and/or UAM players in order to accelerate the adoption of UAM.
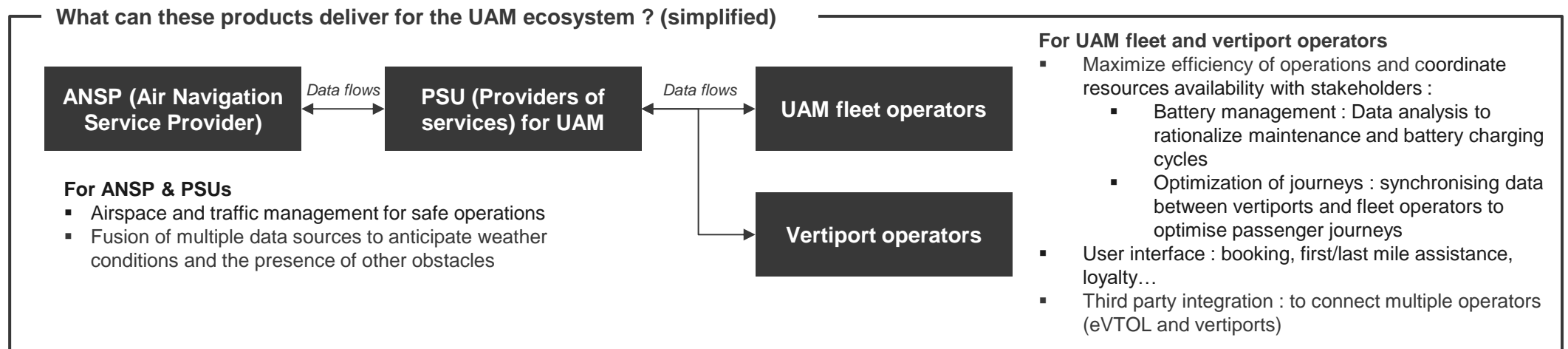
1. EXPLORE
GLOBAL UAM
MARKET PLAYERS

2. IDENTIFY
CURRENT INITIATIVES &
ASSOCIATED TRENDS

SIAPARTNERS

UAM OBSERVATORY

3. REVIEW
UAM REGULATORY
MATURITY

2

Our observatory

The UAM Pure Player activity has a <u>three-tier</u> structure

1 **Aircraft or physical infrastructure manufacturers**
Design and production of VTOL vehicles and physical infrastructure (vertiports, etc.)

2 **Digital product provider (integrated operating systems, platforms…)**
A complete portfolio of product addressing operations, Urban Traffic Management and passenger journey.

What can these products deliver for the UAM ecosystem ? (simplified)

ANSP (Air Navigation Service Provider) — *Data flows* — **PSU (Providers of services) for UAM** — *Data flows* — **UAM fleet operators**

Vertiport operators

For ANSP & PSUs
- Airspace and traffic management for safe operations
- Fusion of multiple data sources to anticipate weather conditions and the presence of other obstacles

For UAM fleet and vertiport operators
- Maximize efficiency of operations and coordinate resources availability with stakeholders :
  - Battery management : Data analysis to rationalize maintenance and battery charging cycles
  - Optimization of journeys : synchronising data between vertiports and fleet operators to optimise passenger journeys
- User interface : booking, first/last mile assistance, loyalty…
- Third party integration : to connect multiple operators (eVTOL and vertiports)

3 **Service providers for eVTOL & vertiports**
- MRO services
- Ground handling
- Training services : piloting, MRO
- Integration of services : development of infrastructure and electric reloading network
- Exploitation of services : air taxi, medical…

What is the situation worldwide ? ▶

Europe and North America defend their pioneering positions in UAM, as APAC gains momentum

Legend: eVTOL conception & production · Physical infrastructures conception & production · Digital products development · Aircraft & infrastructure services

Global overview

Activities

Within the 43 identified actors, **vehicle manufacturing leads**

10 · 12 · 6 · 36

Volume of activities
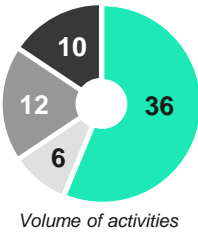
Geographic repartition

Global leadership from North America…

of **UAM actors**

of **eVTOL manufacturers**

…EU & APAC remain in the race and are **consolidating their position across all areas.**

Market

Global UAM market size projection

2023
2024
2025
2030

0 · 5 · 10 · 15 · 20 · 25

Sia Partners estimations

Value (Billion USD)

North American market expected to represent more than 1/3 of global UAM market in 2030.

North America
Volume of activities
15 Actors
Notable leaders — ARCHER, Joby

Europe
Volume of activities
12 Actors
Notable leaders — VOLOCOPTER, LILIUM

Latin America
Volume of activities
1 Actor
Notable leader — EVE MOBILITY REIMAGINED

Middle East
4 Actors
Volume of activities

APAC
Volume of activities
11 Actors
Notable leader — EHANG

17
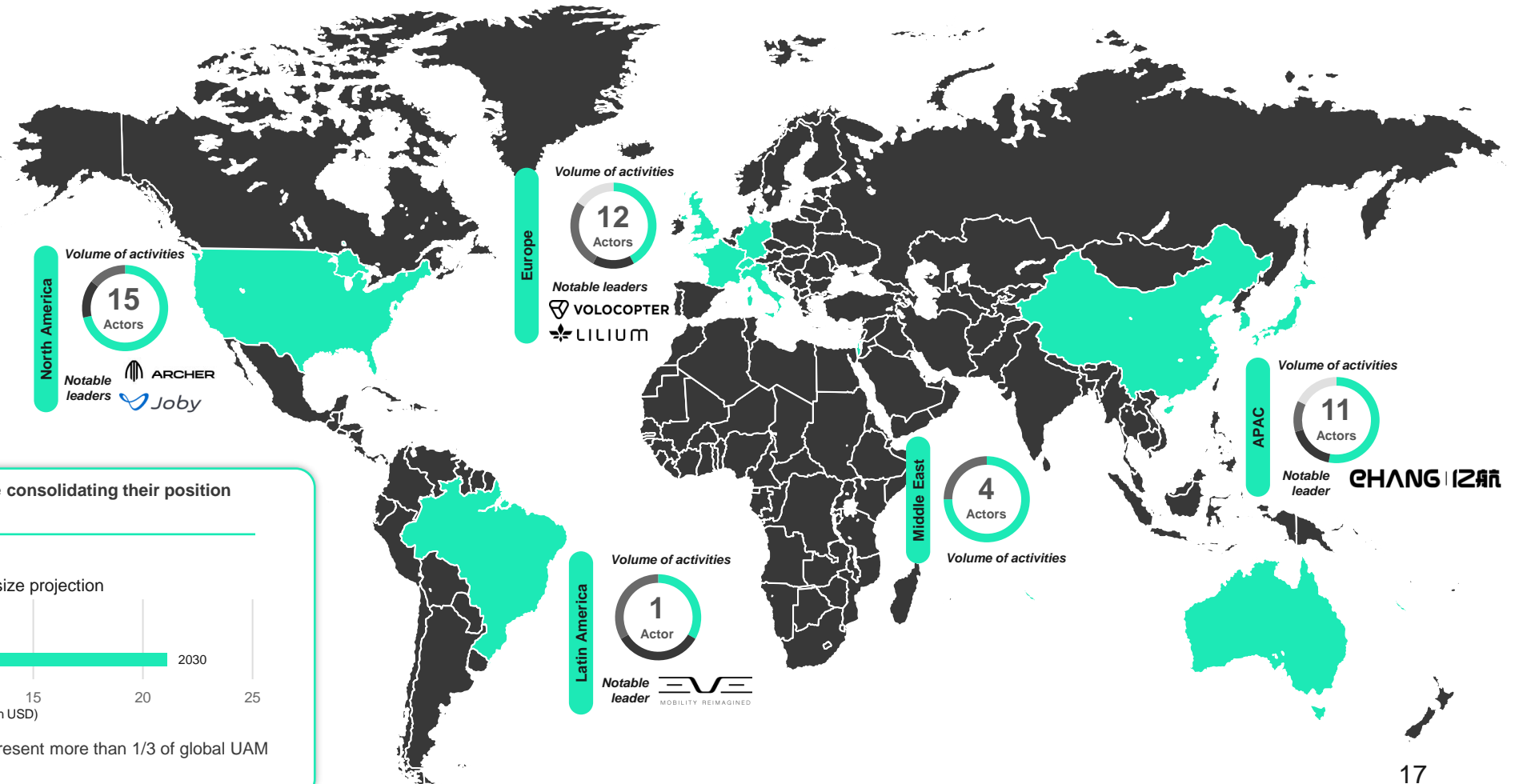
A market mainly made up of start-ups is expected to evolve significantly over the next few years

The UAM market is still young, and the players are mainly small structures…

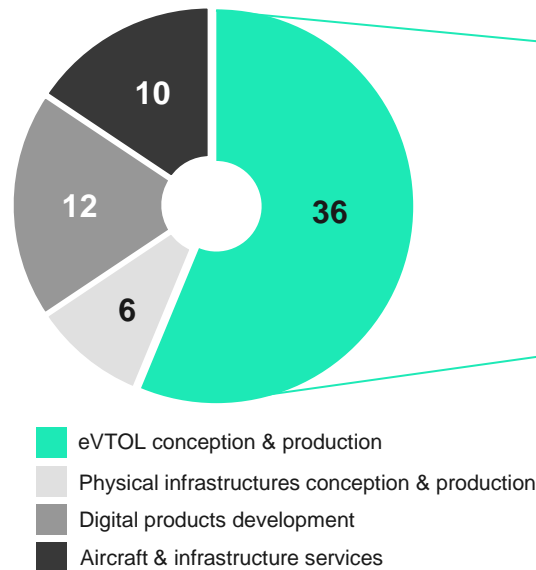Breakdown of UAM players by number of employees:
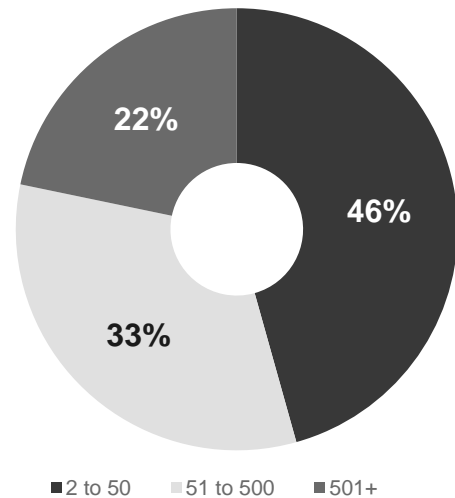
78%

of players in the scope have **less than 500 employees.**

- ■ 2 to 50
- ■ 51 to 500
- ■ 501+

…focused on creating viable eVTOL prototypes.

55%
Of activity is dedicated to **eVTOL design/production**

37%
Only of them has gone **beyond the design phase**

Breakdown per activity :

Breakdown per maturity for eVTOL manufacturers:
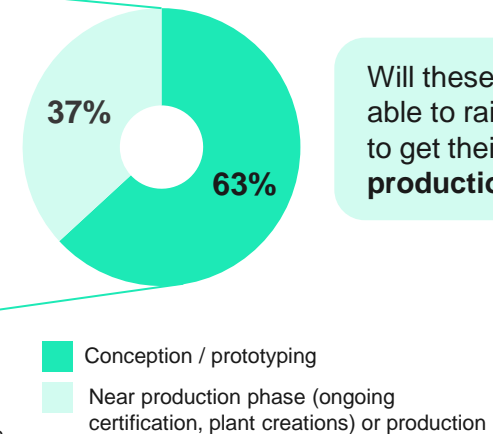
Will these companies be able to raise enough capital to get their prototypes **to the production stage ?**

- ■ eVTOL conception & production
- ■ Physical infrastructures conception & production
- ■ Digital products development
- ■ Aircraft & infrastructure services

- ■ Conception / prototyping
- ■ Near production phase (ongoing certification, plant creations) or production

Nearly a quarter of these eVTOL manufacturers have an integrated approach, notably through the development of digital products

Selection of three solutions

Macro functions

VOLOIQ by Volocopter	POWER-ON by Lilium	Vector by EVE Mobility
Flight booking and passenger interface		
●●●	●●○	○○○
▪ Dedicated passenger interface for booking, tracking flights and preferences. ▪ Integration of end-to-end services with the option of continuing the journey by other means of transport.	▪ Interface between reservation systems and ground infrastructures. ▪ Partnership with Amadeus to integrate their airport solutions (reservation and distribution system, check-in, security control, etc.).	▪ Not taken into account for the moment, solution focused on traffic management services, and not on the passenger interface or reservations.
Vehicle fleet and land infrastructure management		
●●○	●●●	●○○
▪ Optimised management of vertiports and recharging facilities, with real-time data collection via device sensors. ▪ Advanced security thanks to a partnership with Microsoft Azure. ▪ Proactive management of maintenance requirements thanks to AI, guaranteeing the reliability and durability of devices.	▪ Integrated digital suite for flight planning, ground activity management and an AI-powered customer portal to improve workflows and provide access to technical documents. ▪ Collection and analysis of data on battery management, vertiports, aircraft condition monitoring, etc. ▪ Proprietary algorithms to improve the management of aircraft energy and propulsion systems.	▪ Integration of vertiport availability and management of alternative landings. No centralization of aircraft technical data.
Air traffic management		
●●○	●●○	●●●
▪ Connectivity to automate and orchestrate network operations (route optimization, infrastructure availability, etc.), ▪ Flight data collection to ensure coordination with the planning of other operators in the ecosystem...	▪ Flight operations management, including planning. ▪ Includes flight data monitoring via GE Aerospace's event management system. ▪ An approach to optimising the performance and reliability of flight operations.	▪ Ensures coordination between eVTOL fleets and vertiport operators. ▪ Proposes alternative flight plans and assesses the impact of any delays. ▪ Integrates meteorological data to ensure the compliance and safety of flight operations.

●●● : depth of functionality

2

Our observatory

2.1 Exploration of UAM actors at the global level

We have identified 4 key areas of value creation and 10 business models

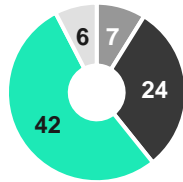| 4 domains	10 business models	Details*
eVTOL aircrafts	Conception & manufacturing	▪ Creation of production sites/lines and management of vehicle orders ▪ Partnerships with specialist technology players (batteries, propulsion, etc.)…
	MRO trainings & services	▪ General inspections, software updates, hardware repairs, predictive maintenance…
Physical infrastructures	Terminal infrastructure conception & manufacturing	▪ Design and building vertiports & other airfield installations…
	MRO services for infrastructures	▪ Recharging stations ▪ Storage facilities (hangar for vehicles and spare parts, etc.)…
Digital infrastructures	Marketplace & passenger guidance	▪ First contact point with UAM service users (ticket booking, first/last mile guidance, digital check-in, loyalty program, etc.)…
	Operations, planning & navigation	▪ Aircraft health & performance monitoring, engineering support… ▪ Flight planning, coordination with UTM, monitoring of the operating network…
	Urban Traffic Management (UTM) services	▪ Interoperability & synchronization between other UAM operators, link with civil aviation authorities for mission approvals…
Ground & flight operations	Flight & ground operations trainings	▪ Formations in piloting, ground handling…
	UAM service integration & exploitation	▪ Piloting eVTOL vehicles for multiple use cases : air taxi (shuttle or on-demand), EMS, disaster assistance, leisure & tourism, delivery of goods)
	Ground handling services	▪ Aircraft turnarounds (cabin preparation, battery recharging, storage, etc.) ▪ Passenger routing at vertiports…

50% of initiatives concern eVTOL operations, with Europe and the United States remaining the most attractive territories
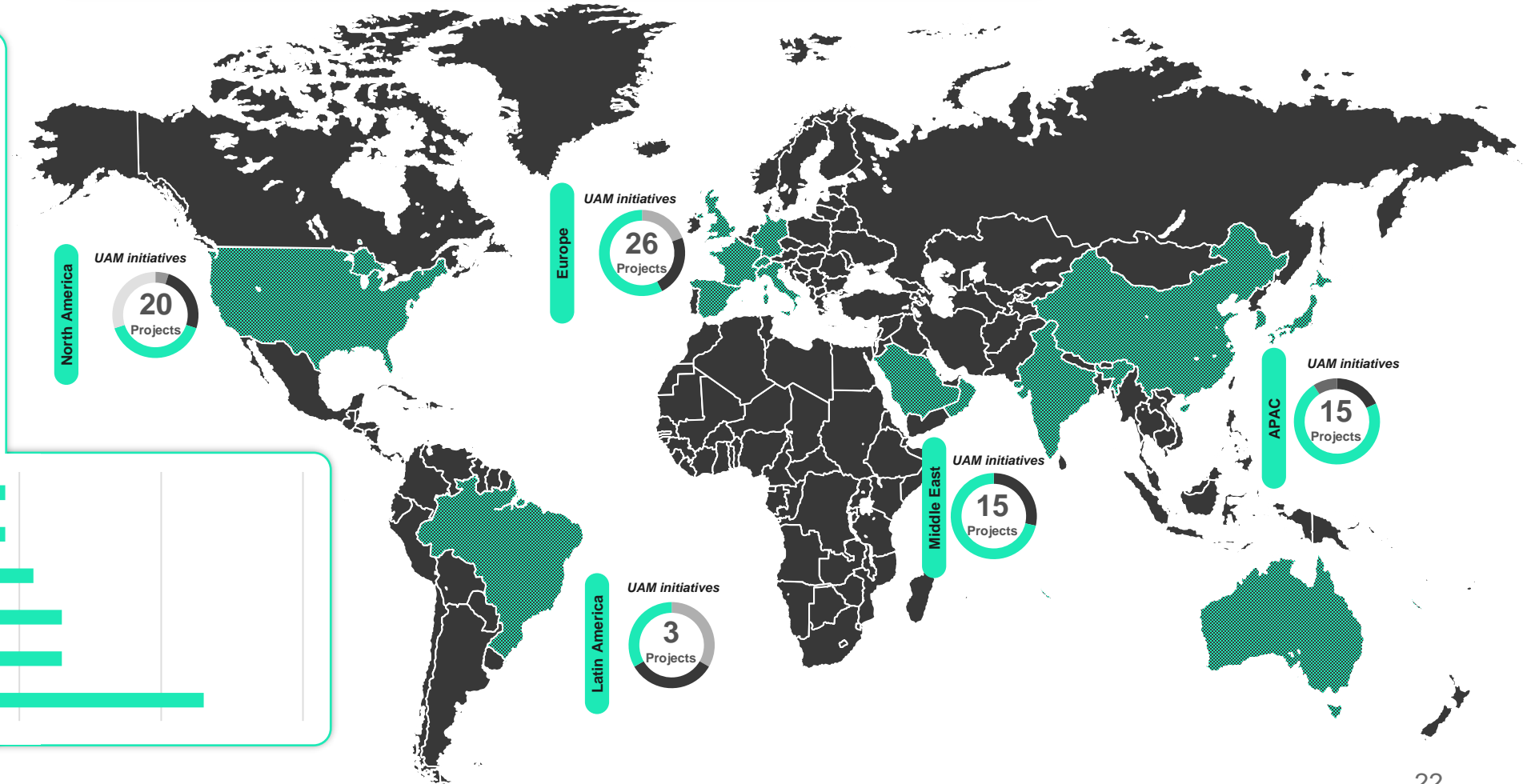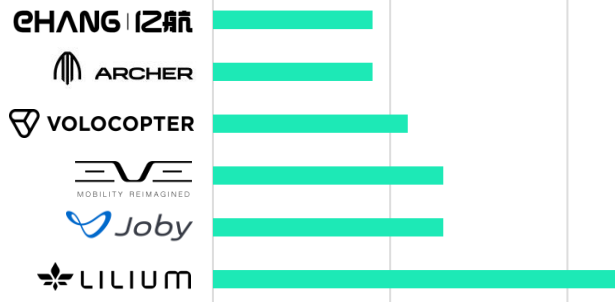

Legend: Ground & flight operations | Physical infrastructure | Digital infrastructures | eVTOL aircrafts

Global overview

Type of initiative

Within the 79 identified initiatives, **Ground and flight operations leads**

Donut values: 42, 24, 6, 7

Projects observed among 6 key UAM players

EHANG | 亿航
ARCHER
VOLOCOPTER
EVE MOBILITY REIMAGINED
Joby
LILIUM

North America — UAM initiatives — 20 Projects

Europe — UAM initiatives — 26 Projects

APAC — UAM initiatives — 15 Projects

Middle East — UAM initiatives — 15 Projects

Latin America — UAM initiatives — 3 Projects

North America

Overview

Projects distribution per domain
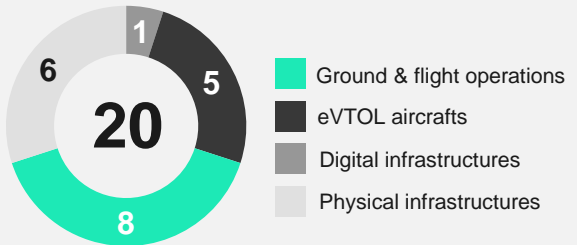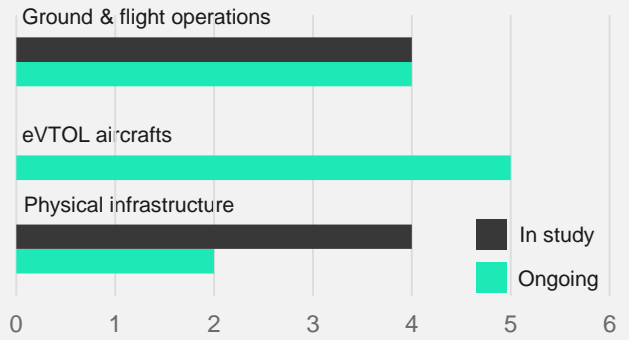
20

- 1
- 5
- 4 (8)
- 6

- 🟩 Ground & flight operations
- ⬛ eVTOL aircrafts
- ⬜ Digital infrastructures
- ⬜ Physical infrastructures

Progress of these projects

Ground & flight operations

eVTOL aircrafts

Physical infrastructure

- ⬛ In study
- 🟩 Ongoing

0 1 2 3 4 5 6

In study : MoU, opportunity and feasibility studies…
Ongoing : near production phase, eVTOL purchases, tests campaigns, digital product developed…

Ground & flight operations
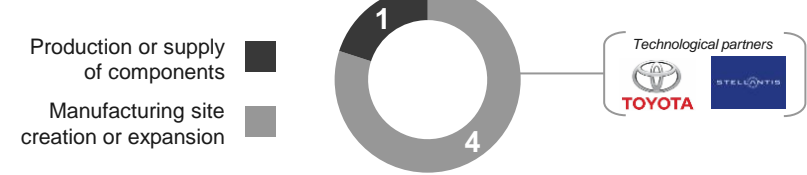### *Focus on UAM service integration & exploitation*
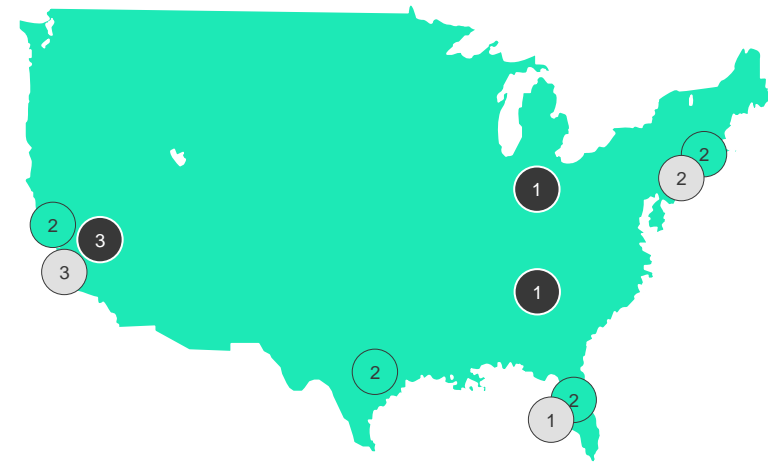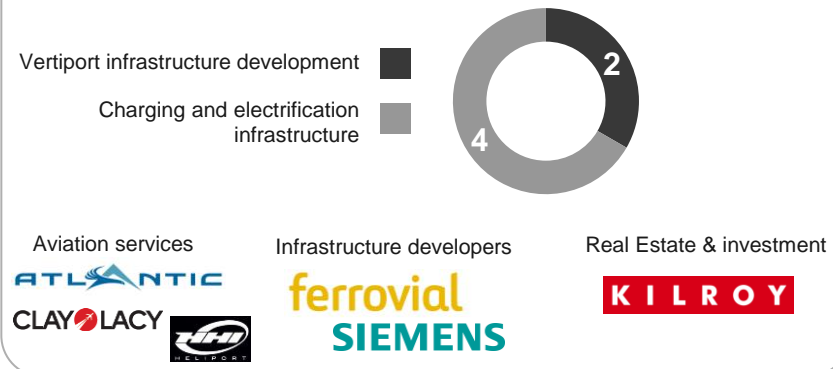
Distribution of actors within projects

- ⬛ Infrastructure manager
- ⬛ Operating service provider
- ⬜ Technological partner

1 / 5 / 4

NASA BETA TECHNOLOGIES

Signature AVIATION   GREATER ORLANDO AVIATION AUTHORITY   EWR   O'HARE

U.S. AIR FORCE   Delta AIR LINES   Bristow   Southwest   UNITED AIRLINES

eVTOL aircrafts
Focus on conception & manufacturing

Type of initiatives

- ⬛ Production or supply of components
- ⬛ Manufacturing site creation or expansion

1 / 4

Technological partners
TOYOTA   STELLANTIS

Physical infrastructures

- ⬛ Vertiport infrastructure development
- ⬛ Charging and electrification infrastructure

2 / 4

Aviation services
ATLANTIC
CLAY LACY   HELIPORT

Infrastructure developers
ferrovial
SIEMENS

Real Estate & investment
KILROY

23

North America

3 key elements to bear in mind

1. **The eVTOL production sector in the USA is well advanced,** with companies like Archer and Joby already having their prototype development facilities as well as large-scale manufacturing plants in the country.

2. **eVTOL initiatives are evenly distributed across the United States**, with future use cases expected to vary and adapt to the specific needs and characteristics of each region, partly thanks to collaborations with local authorities.

3. **The USA is relatively advanced in terms of physical infrastructure initiatives for eVTOLs,** thanks in part to a well-established culture of air mobility.
This topic will be explored further in the next slide.

An accelerated development of eVTOL infrastructure in the United States

Well-established urban air mobility culture

The United States has a well-established network of heliports, often located in business centers, which are strategic hubs for Urban Air Mobility (UAM). The challenge is to successfully transition to vertiports by overcoming the related challenges (regulation, infrastructure sizing, energy logistics, and limited experience with UAM operations).

eVTOL manufacturers are directly involved in projects to create business centers to facilitate the integration of infrastructure dedicated to UAM operations. This is the case with **Archer** in collaboration with the real estate company **Kilroy**, which aims to provide this service to their clients.

Electrification of existing infrastructures

The development of UAM infrastructures in the USA is supported by a well-established culture and infrastructure undergoing electrification, a challenge that only the USA is considering on a large scale. The country benefits from a solid ecosystem, with strategic partnerships in energy and aeronautics, facilitating the deployment of charging networks. **Their experience in infrastructure standardization (as for electric cars) strengthens their ability to install interoperable charging stations** between different eVTOL brands, accelerating the transition to sustainable aviation.

Diversity of transport scale

The United States is taking advantage of the diversity of its transportation needs to develop appropriate UAM infrastructures. In major cities like New York and Los Angeles, vertiports serve short intra-urban trips, while in regions like Texas and Southern California, they facilitate longer-distance intercity travel.
The development of eVTOLs in the United States is driven by this **ability to meet the country's diverse needs**, from rapid transit in urban centers to transport infrastructures supporting more isolated areas.

Public-Private Partnerships

Public-private partnerships in the United States play a crucial role in the development of eVTOL infrastructures, particularly for the integration of vertiports in urban environments. These collaborations between private companies and public authorities (state governments, municipalities, ministries and economic development agencies) facilitate the development of infrastructure tailored to the needs of cities and their residents. By pooling resources and expertise, these partnerships accelerate the electrification of local infrastructures and the adoption of advanced air mobility solutions.
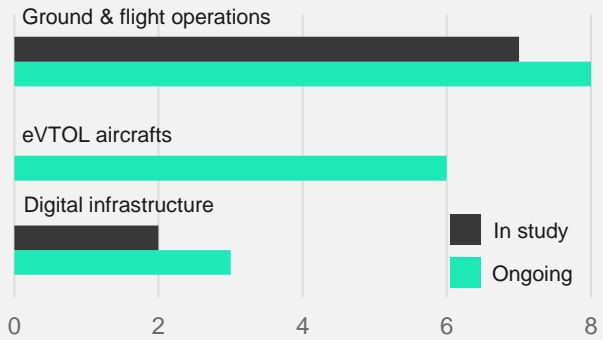
Western Europe

Overview

Projects distribution per domain
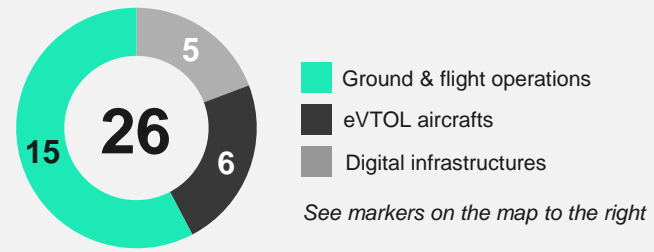
26
- 15
- 5
- 6

- 🟩 Ground & flight operations
- ⬛ eVTOL aircrafts
- ⬜ Digital infrastructures

See markers on the map to the right

Progress of these projects

Ground & flight operations

eVTOL aircrafts

Digital infrastructure

- ⬛ In study
- 🟩 Ongoing

0 2 4 6 8

In study : MoU, opportunity and feasibility studies…
Ongoing : near production phase, eVTOL purchases, tests campaigns, digital product developed…

Ground & flight operations
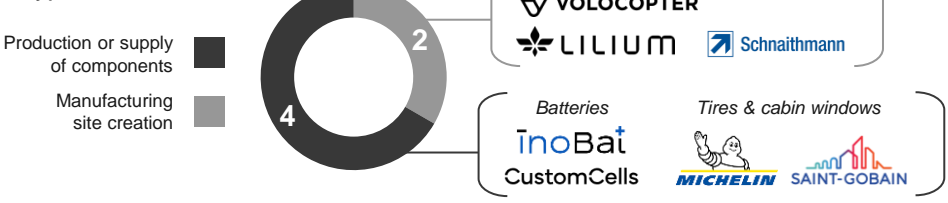### *Focus on UAM service integration & exploitation*

Distribution of actors within projects

- 6
- 4
- 8

- ⬛ Infrastructure manager
- ⬛ Operating service provider
- ⬜ Vertiport partner

ADAC · eVOLARE LUFTHANSA GROUP · ASL GROUP · AIR-DINAMIC ANYWHERE.ANYTIME · Bristow

Skyports INFRASTRUCTURE · URBAN-V

GROUPE ADP · RATP GROUP · AEROPORT NICE CÔTE D'AZUR · Fraport · SAVE GRUPPO SAVE · SEA · Milan Airports · Aeroports de Catalunya

eVTOL aircrafts
Focus on conception & manufacturing

Type of initiatives

- 2
- 4

- ⬛ Production or supply of components
- ⬛ Manufacturing site creation

VOLOCOPTER · LILIUM · Schnaithmann

Batteries
InoBat · CustomCells

Tires & cabin windows
MICHELIN · SAINT-GOBAIN

Digital infrastructures
Focus on technological partners

Distribution of developed features

- 2
- 5
- 3

- ⬛ Operations, planning & navigation
- ⬛ UTM
- ⬜ Passenger journey

Expertise in connectivity
Telefónica

Expertise in IT
Microsoft · amadeus · SITA

Expertise in certified aviation processes
Lufthansa Industry Solutions · GE Aerospace · esa
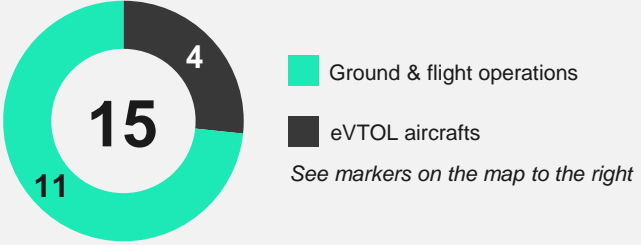

26
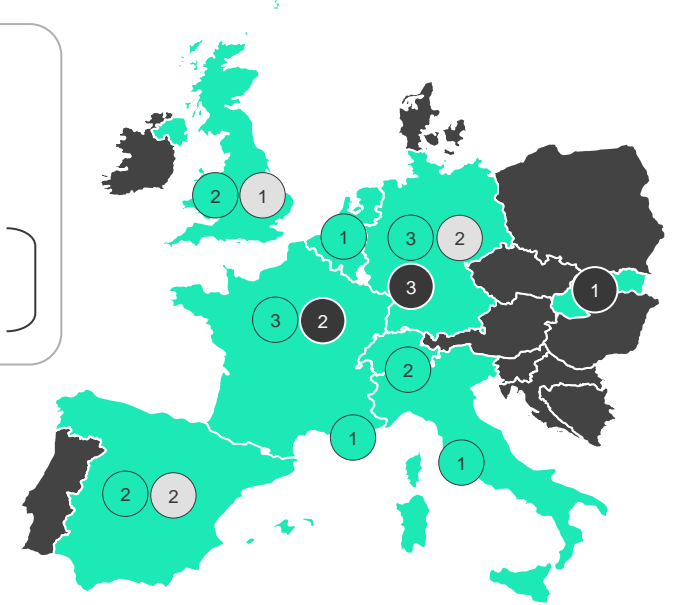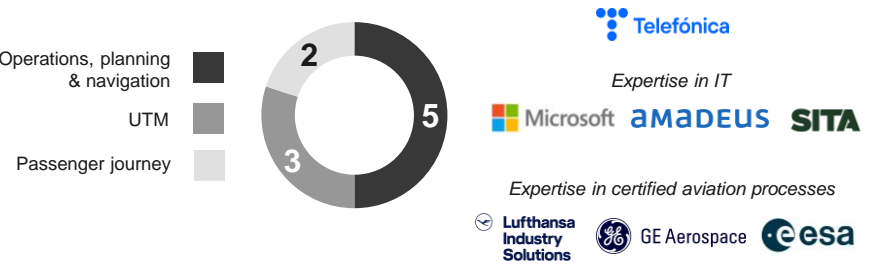
Western Europe

3 key elements to bear in mind

1. **Strong involvement of France and Germany** in the UAM sector. **Germany is home to Volocopter & Lilium**, two of the most important players, who have also centralized their production sites there.

2. **Expansion of the industrial base and innovation in electric batteries** to support future mass production and remain competitive in the performance of eVTOL designed.

3. **Greater airport coverage and population density**, favorable to the creation of **vertiport networks** in collaboration between airports and local authorities.
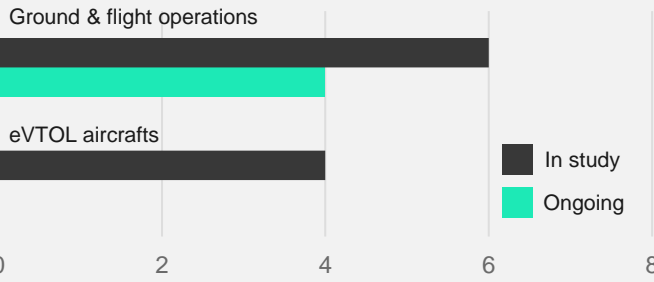
Middle East

Overview

Projects distribution per domain

15

4 — Ground & flight operations
11 — eVTOL aircrafts

See markers on the map to the right

Progress of these projects

Ground & flight operations
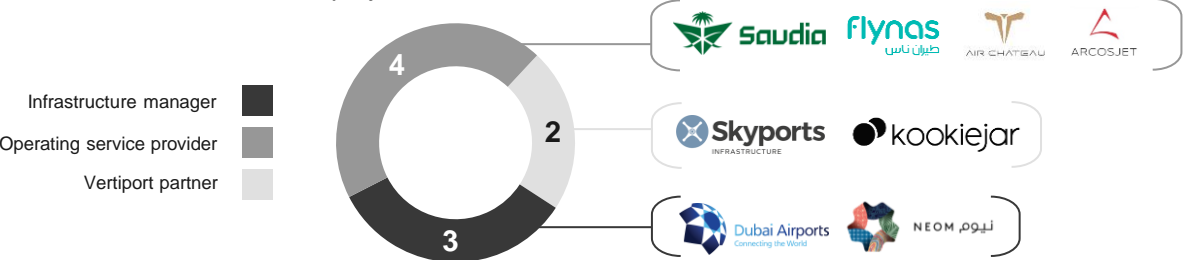
eVTOL aircrafts

- In study
- Ongoing

0 2 4 6 8

In study : MoU, opportunity and feasibility studies…
Ongoing : near production phase, eVTOL purchases, tests campaigns, digital product developed…

Ground & flight operations
Focus on UAM service integration & exploitation

Distribution of actors within projects

- Infrastructure manager
- Operating service provider
- Vertiport partner

4 — Saudia, flynas, AIR CHATEAU, ARCOSJET
2 — Skyports INFRASTRUCTURE, kookiejar
3 — Dubai Airports Connecting the World, NEOM نيوم

eVTOL aircrafts
Focus on conception & manufacturing

Type of initiatives

- MRO training services
- Manufacturing site creation

2 — ARCHER, Joby
2 — Saudia Technic, AIR CHATEAU, FALCON AVIATION SERVICES, GAL AMMROC

Public investments
UAM as a catalyst for local economic development

Financial support   **Visions**

PIF
- Localize promising manufacturing industries,
- Improve local and regional connectivity of transport network.

Abu Dhabi
- Plan Abu Dhabi 2030 : Urban Structure Framework Plan
- Abu Dhabi Industrial Strategy
- Smart and autonomous vehicles industry cluster (SAVI)

ABU DHABI INVESTMENT OFFICE مكتب أبوظبي للاستثمار

Dubai
- Dubai commercial transport strategy 2030
- Dubai 2040 urban master plan
- Dubai industrial strategy 2030

RTA هيئة الطرق والمواصلات ROADS & TRANSPORT AUTHORITY

Dubai — 3
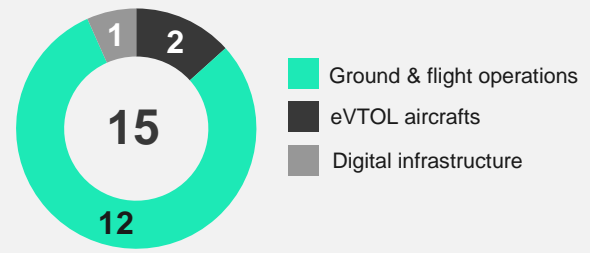Abu Dhabi — 3, 3
Saudi Arabia — 5, 1

28
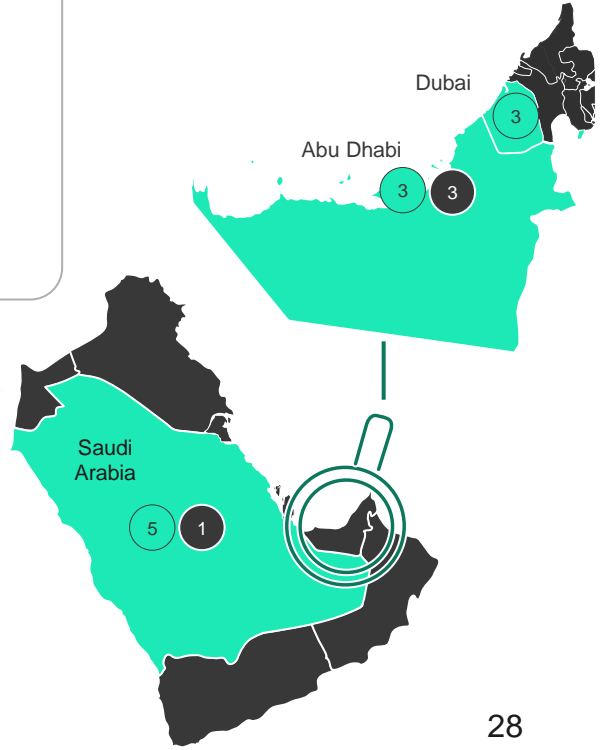
Middle East

3 key elements to bear in mind

1. **Strategy of attracting UAM pure players through multilateral partnerships** with local players and public investments to develop the local economic base (in country manufacturing, trainings, etc.).

2. **Joint working groups** between UAM pure players and civil aviation authorities (notably in KSA and UAE) to **develop and implement UAM regulatory frameworks**.

3. UAM service initiatives are generally associated with the more global ambitions of **smart cities and the expansion of transport infrastructures**.
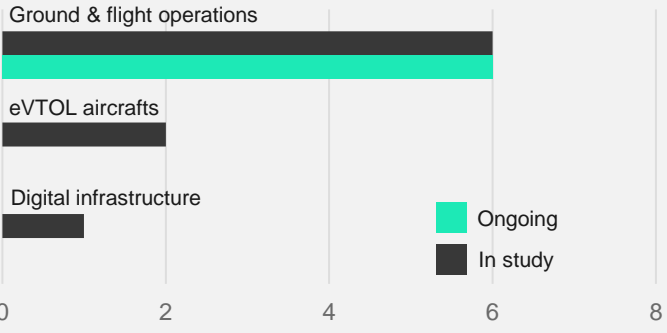
APAC

Overview

Projects distribution per domain

15

- Ground & flight operations
- eVTOL aircrafts
- Digital infrastructure

Progress of these projects

Ground & flight operations

eVTOL aircrafts

Digital infrastructure

- Ongoing
- In study

In study : MoU, opportunity and feasibility studies…
Ongoing : near production phase, eVTOL purchases, tests campaigns, digital product developed…

Ground & flight operations
Focus on UAM service integration & exploitation

Distribution of actors within projects

- Infrastructure manager
- Operating service provider
- Vertiport partner

7 1 1

JAPAN AIRLINES · 中信海直 COHC · kakao mobility · INTERGLOBE · ANA · JEJUair

SkyScape

NOMURA REAL ESTATE HOLDINGS

eVTOL aircrafts
Focus on conception & manufacturing

Type of initiatives

- eVTOL production
- R&D

1 1

VOLOCOPTER

EHANG 亿航 · 巨湾技研 GREATER BAY TECHNOLOGY

Public authorities
Strong involvement of local authorities in project monitoring and aircraft certification

Certification bodies

MINISTRY OF TRANSPORT CONNECTING SINGAPORE
- Supervise the introduction of UAM services on tourist routes
- Participate in freight transport feasibility studies

中国民航 CAAC
- Certify aircraft and issue authorizations for commercial operation
- Coordinate the main Chinese UAM players

- Coordinate all players for EXPO2025
- Issuing test authorizations around vertiports

30
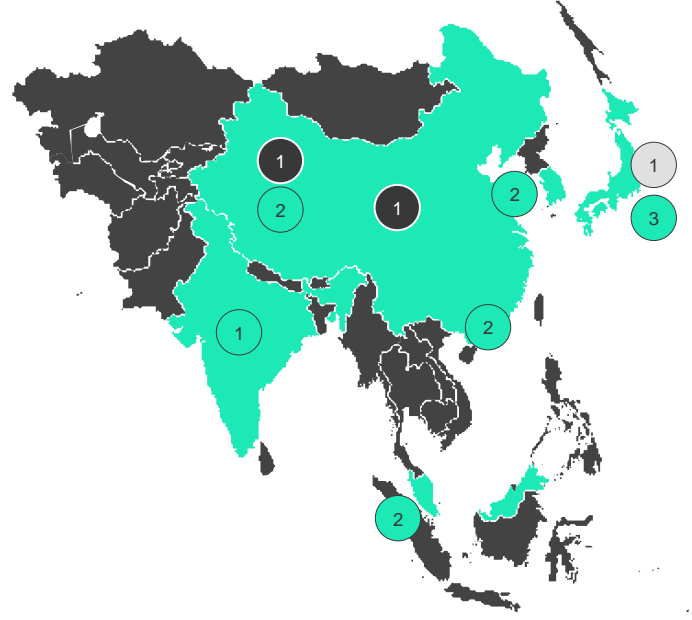
APAC

3 key elements to bear in mind

1. UAM initiatives are mainly driven by **integrated pure players with minimal involvement** from technological partners (e.g E-hang).

2. **Collaboration** between UAM pure players and civil aviation authorities (notably in China) to **develop and implement eVTOL regulatory frameworks** which accelerates flight certification.

3. UAM initiatives encompasses a **broader spectrum of applications** than in other world regions, such as **overflights of recreation venues,** or solution for **urban high-rise firefighting.**

Airports have a key role to play and must anticipate an increase in requests from UAM players

Airports can be essential in dealing with the challenges of integrating and operating UAM services

Extract of subjects that can be supported by airports

☆ **Infrastructure availability**	Reducing the footprint of vertiports in dense urban areas	Integrating with existing transport infrastructure	Maintenance and recharging of equipment (turnaround time)
☆ **UAM network operations**	Flight planning (vertiport network capacity, etc.)	Optimising air routes and integration into the existing ecosystem	Fleet monitoring and predictive maintenance
☆ **Air traffic management (ATC* services)**	Optimizing operational throughput with ATC service capacity	Low-level airspace management	
Acceptance by surrounding communities	Assessing the acceptability to local residents (noise and visual pollution)		
Certifications	Certification of eVTOL prototypes for commercial flights		
Economic viability	Limiting the cost of launching the UAM service		

Key facts about the relevance of airports

- **Essential air transport infrastructures** already in place and proven expertise in their management.
- **Air traffic control** (ATC) services with which airports are familiar.
- Possible synergies via the many **partnerships with traditional airlines** (optimised use of runways, enhanced mobility offers, improved freight management, etc.).
- Increasingly developed **intermodal connections** (train, metro, etc.)

Training initiatives are emerging and will need to quickly address the growing demand for skill development

Three major stakes

Avoid staff shortage

674.000 pilots   **716.000** technicians

Required by 2043 according to Boeing* for commercial aviation. Demand for UAM is not considered within the same timeframe, given that fully autonomous flights will only begin to democratize in the medium to long term.

→ UAM stakeholders will need to anticipate recruitment needs and quickly train their operators.

Ensure regulatory compliance

Regulatory requirements are currently being established by regulators (e.g., Special Condition for Vertical Take-Off and Landing by EASA).
These strict frameworks will necessitate specific training for operators and pilots, compared to traditionnal training requirements for helicopters.

→ Therefore, investments in training to meet these standards will need to increase.

Adopt new technologies of the sector

UAM relies heavily on technological innovations such as the automation of operations and air traffic management.

→ Specialized training will need to be provided to ensure the successful scaling of UAM.

The ecosystem is preparing by engaging with experts

Meanwhile, some UAM players are working on the **possibility of providing training themselves**, pending the acquisition of the appropriate certification (e.g., ATO – Approved Training Organization).

Extract of partnerships

UAM actor	Piloting	MRO
LILIUM	FlightSafety International / Lufthansa Aviation Training	FlightSafety International / Lufthansa Aviation Training
VOLOCOPTER	Via Volocopter Air Services	Via Volocopter Air Services
EVE MOBILITY REIMAGINED	Via services portfolio	Saudia Technic

UAM actor	Piloting	MRO
Joby	Government of Abu Dhabi	Government of Abu Dhabi
ARCHER	Etihad Aviation Training / Interglobe	Saudia Technic / Interglobe
EHANG		HAECO

2

Our observatory

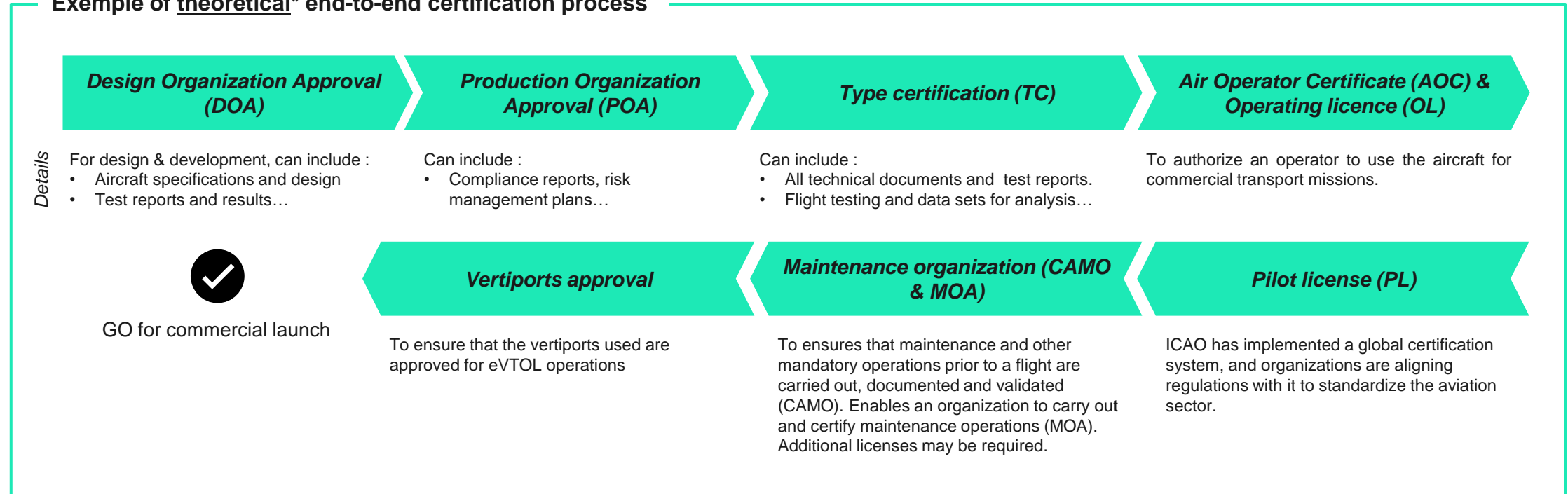**2.1** Exploration of UAM actors at the global level

2.2 Identification of ongoing initiatives and large-scale trends

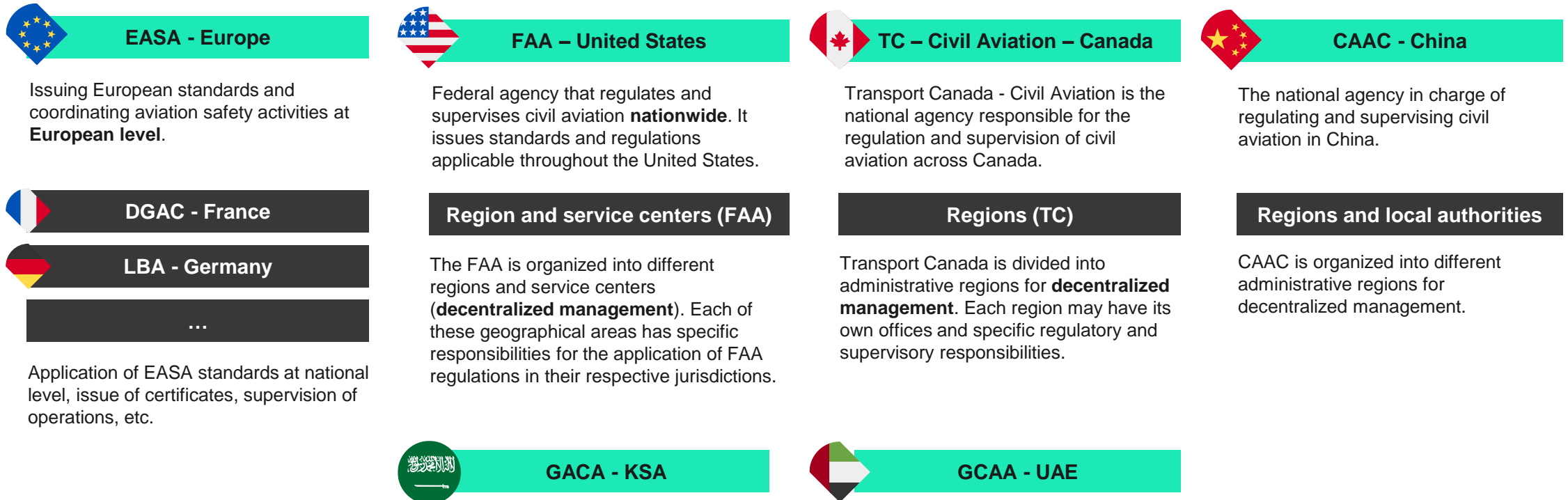**2.3 Review of the regulatory maturity of the ecosystem**

The certification of eVTOL vehicles is currently the most complex stage in the commercial launch process

The launch of commercial operations for a UAM service is governed by the civil aviation authorities issuing the relevant certifications.
Depending on the location chosen for a UAM project, certification frameworks may not be sufficiently mature, potentially leading to significant delays.

Exemple of <u>theoretical</u>* end-to-end certification process

Design Organization Approval (DOA) → **Production Organization Approval (POA)** → **Type certification (TC)** → **Air Operator Certificate (AOC) & Operating licence (OL)**

Details

For design & development, can include :
- Aircraft specifications and design
- Test reports and results…

Can include :
- Compliance reports, risk management plans…

Can include :
- All technical documents and test reports.
- Flight testing and data sets for analysis…

To authorize an operator to use the aircraft for commercial transport missions.

✔ GO for commercial launch

Vertiports approval → **Maintenance organization (CAMO & MOA)** → **Pilot license (PL)**

To ensure that the vertiports used are approved for eVTOL operations

To ensures that maintenance and other mandatory operations prior to a flight are carried out, documented and validated (CAMO). Enables an organization to carry out and certify maintenance operations (MOA). Additional licenses may be required.

ICAO has implemented a global certification system, and organizations are aligning regulations with it to standardize the aviation sector.

Top-down dynamics should be leveraged to take advantage of inter-country and regional coordination

EASA - Europe

Issuing European standards and coordinating aviation safety activities at **European level**.

DGAC - France
LBA - Germany
…

Application of EASA standards at national level, issue of certificates, supervision of operations, etc.

FAA – United States

Federal agency that regulates and supervises civil aviation **nationwide**. It issues standards and regulations applicable throughout the United States.

Region and service centers (FAA)

The FAA is organized into different regions and service centers (**decentralized management**). Each of these geographical areas has specific responsibilities for the application of FAA regulations in their respective jurisdictions.

GACA - KSA

TC – Civil Aviation – Canada

Transport Canada - Civil Aviation is the national agency responsible for the regulation and supervision of civil aviation across Canada.

Regions (TC)

Transport Canada is divided into administrative regions for **decentralized management**. Each region may have its own offices and specific regulatory and supervisory responsibilities.

GCAA - UAE

CAAC - China

The national agency in charge of regulating and supervising civil aviation in China.

Regions and local authorities

CAAC is organized into different administrative regions for decentralized management.

Multiple geographic areas are currently emerging and represent relevant market opportunities

Not started **Initial** **In development** **Emergence**

Global overview

Six levels of maturity for certifying organizations

Not started : The civil aviation authority (CAA) has not launched an initiative to understand eVTOL technologies and regulatory needs

Initial : The CAA is in the early stages of understanding eVTOL technologies and regulatory needs

In development : The CAA is actively developing specific standards and regulations for eVTOL projects

Emergence : The CAA has established specific regulations for eVTOL projects, but these may need to be adjusted as few or no certifications have been issued to date

Including two that we expect to meet in the mid-term

Advanced development : The CAA has expertise in the certification of eVTOL projects regulations are regularly updated.

High maturity : The CAA has high expertise in the certification of eVTOL projects and is recognised internationally for its leadership (multiple UAM service certified, international partnerships are established, the authority plays an active role in the development of global standards…)

Note
Macro analysis, maturity levels may vary at local level (e.g. for EASA, each member country is governed by a local authority which influences the maturity of the UAM ecosystem at its scale).

EASA members

■ : Not studied

37
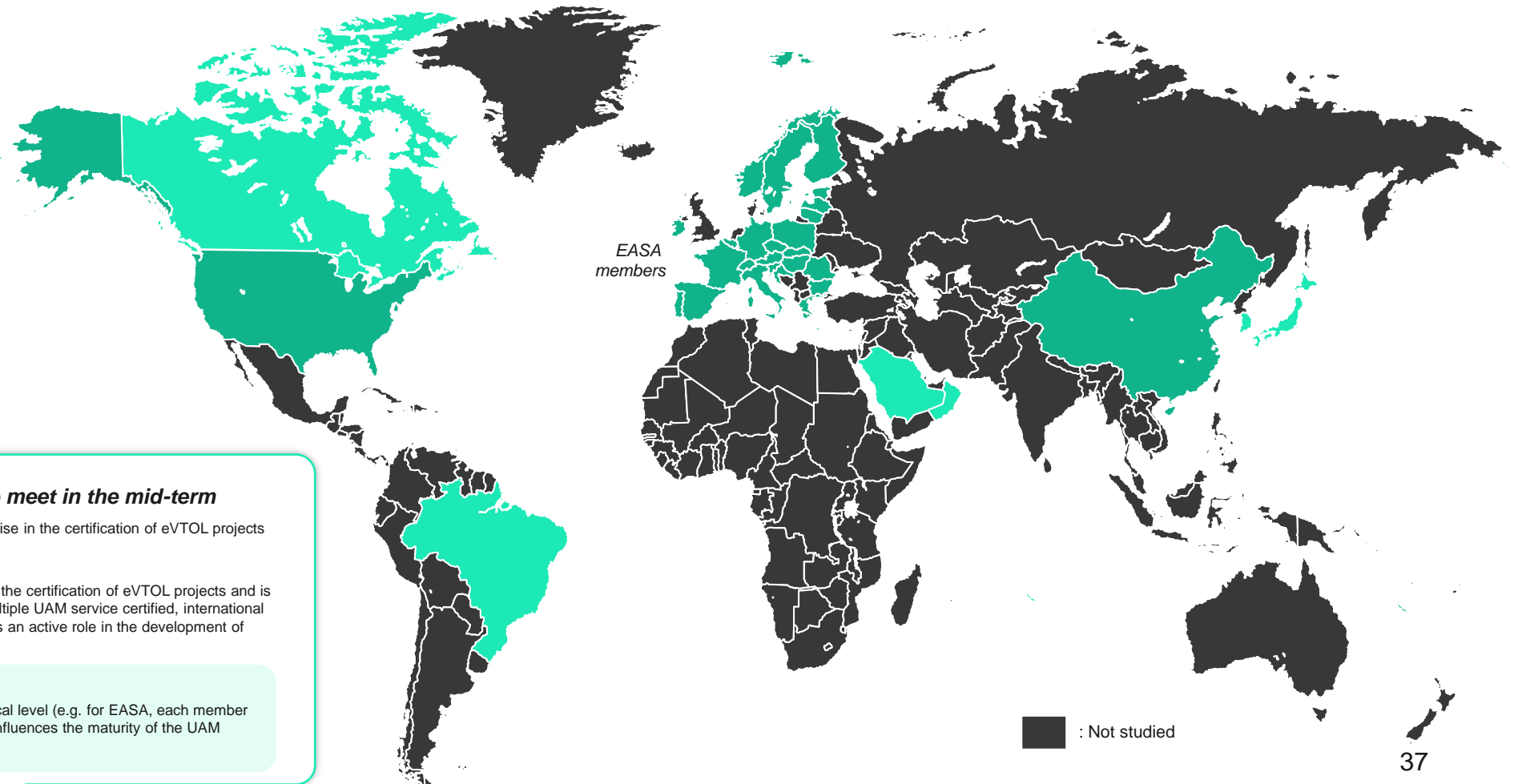
3

Our offers on the subject

Sia Partners offers multiple services to support the UAM ecosystem

Stakeholders

Local & regional entities	Government authorities	Mobility operators	Infrastructure managers	Aerospace industry	Technological & industrial partners	Service providers (maintenance, trainings…)	Distributors & resellers

Strategy & business model

- Market analysis and identification of opportunities for UAM: market sizing, competitive landscape, value chain…

- Development of differentiated UAM business models: geographic areas, customer needs & segments, positioning...

- Evaluation of financial viability for various scenarios: long-term cost and revenue projections...

- Identification of potential sources of fundings and investors...

- Establishment of strategic public-private partnerships: manufacturers, infrastructure, local authorities, operators...

- Formalization of innovation strategies: transition to autonomous systems, energy efficiency, connected infrastructure...

Operational support

- eVTOL production chains: Industry 4.0, master production planning...

- Design of vertiport networks: locations, capacities, supply chain development, etc.

- Definition of air routes: compliance with current regulatory zones, route optimization...

- Support for the development of innovative tools and processes for operational management: ConOps, air traffic, ground operations management...

- Service commercialization : value proposition, service pricing, marketing communications, distribution channels…

Educational support

- Support for the creation and facilitation of UAM awareness programs for stakeholders.

- Development of educational communication campaigns to familiarize the general public.

Our Transport department brings together over 350 consultants across 10 countries, providing expertise across the entire mobility value chain.

Specific needs for each player in the UAM value chain

	Example of actors	Strategy & business model	Operational support	Educational support
Local & regional entities	Cities & regions Local economic development agencies	Definition of territorial strategy for the implementation of vertiports and UAM services based on local needs.	Integration plan for vertiports within the urban space, optimizing zoning and accessibility while ensuring connectivity with ground transportation infrastructures.	Creation and facilitation of awareness programs on UAM issues to promote community engagement.
Government authorities	Civil aviation authorities Government agencies	Benchmark of eVTOL vehicle certification policies to support the development of a regulatory framework for UAM.	Support in the implementation of Urban Traffic Management (UTM) systems, ensuring their interoperability with existing systems, etc.	Support in the development of awareness modules on new regulations and safety standards (workshops, seminars, etc.).
Infrastructure managers	Airports Ports, train stations Property asset manager	Development of a business model for the establishment and operation of vertiports. Impact analysis on passenger / logistics flow and profitability.	Operational plan and optimization of vertiport maintenance, passenger flow, and associated sub-services...	Development of a sharing network among infrastructure managers promoting UAM, to provide recommendations for other stakeholders.
Mobility operators	Airlines Private aviation operators Ground transport managers	Development of a partnership strategy with other actors (metro, bus, ridesharing) to create an integrated multimodal offering, while optimizing flow management and pricing.	Optimization of eVTOL fleet management: predictive maintenance, flight scheduling, rotation optimization…	Development of a sharing network among operators promoting UAM, to provide recommendations for other stakeholders.
Aerospace industry	eVTOL manufacturers Vertiport manufacturers Aeronautics OEM	Definition of a business model for production and commercialization, taking into account R&D costs, certification cycles, and market opportunities…	Optimization of supply and production chains (leveraging Industry 4.0, operational excellence, etc.).	Creation of educational workshops and training programs for employees to anticipate technical and regulatory developments.
Technological & industrial partners	IT, connectivity, aviation specialists... Specialist suppliers	Benchmark and technological monitoring. Definition of a roadmap for the development of specific UAM solutions by integrating stakeholder needs.	Deployment of digital solutions dedicated to UAM operations (passenger journey management, operations control, etc.).	Creation of educational communication campaigns to raise awareness among the general public and stakeholders about technological innovations specific to UAM.
Service providers (maintenance, trainings…)	Aeronautical maintenance companies Training organisations	Development of a business model for services specific to the UAM ecosystem.	Support for the launch of associated service offerings.	Creation of educational workshops and training programs for employees related to the associated service.
Distributors & resellers	Aircraft retailers, brokers	Development of marketing and distribution strategies for eVTOLs, considering market trends and the needs of targeted customers.	*To be defined depending on specific needs.*	Creation of educational workshops and training programs for employees to familiarize them with the specifics of eVTOLs.

SIAPARTNERS

Sia Partners is a next-generation management consulting firm.

We offer a unique blend of AI and design capabilities, augmenting traditional consulting to deliver superior value to our clients. With expertise in more than 30 sectors and services, we optimize client projects worldwide. Through our *Consulting for Good* approach, we strive for next-level impact by developing innovative CSR solutions for our clients, making sustainability a lever for profitable transformation.

Follow us on **LinkedIn** and **Twitter @SiaPartners**

sia-partners.com