Focus

Roland Berger

Urban Air Mobility | USD 90 billion of potential: How to capture a share of the passenger drone market

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The Roland Berger Center for Smart Mobility

Urban Air Mobility / *USD 90 billion of potential: How to capture a share of the passenger drone market*

Our updated market analysis and Global Urban Air Mobility Radar show that the passenger Urban Air Mobility (UAM) market is set to soar. The number of UAM projects continues to rise, barriers to progress – such as regulation and public acceptance – are increasingly being overcome and the coronavirus crisis shows no sign of causing serious delays.

By 2050, we estimate that the passenger UAM industry will generate revenues of almost USD 90 billion a year, with 160,000 commercial passenger drones plying the skies.

This potential is driving the emergence of an integrated ecosystem in the nascent UAM industry, consisting of five major building blocks: eVTOL vehicles; maintenance, repair and overhaul services; flight operations; physical infrastructure; and digital infrastructure. First collaborations are forming across this ecosystem.

Yet among the many disparate market players, no dominant passenger UAM player or business model has emerged yet. Instead, companies are tending towards four business model archetypes: system providers, who are involved across the value chain, and service providers, hardware providers and ticket brokers, who focus on distinct areas. Most players are currently positioning themselves as system providers to gain as much industry knowledge as possible, and we believe this trend will continue. A shake out and consolidation are likely in the coming years.

Despite the lack of a proven business model, investors are strongly backing the passenger UAM industry. Investment in startups hit USD 907 million in the first half of 2020 – almost 20 times the level in the whole of 2016. Growing public acceptance of the technology, successful progress beyond developmental stages and favorable changes in regulation are driving funding, which is only likely to increase.

To successfully participate in the market and secure a slice of the USD 90 billion prize, choosing the right business model and forming collaborations will be crucial, whether you are an OEM, startup or supplier.

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Cover photo Chesky_W/iStock

Introduction

Having successfully achieved take-off, the passenger Urban Air Mobility (UAM) market is now set to soar. In just a few years it has gone from "pie in the sky" concepts to a bustling industry with a multitude of passenger drones, air taxis and longer-range jets in development or undergoing trials. The market's flight trajectory is clearly only going one way. But this rapid progress has left UAM players unsure about how the industry will develop.

Roland Berger's first report on UAM analyzed the nascent market, outlined what it may look like in the future and highlighted key success factors, such as choosing the right use case. Our predictions were broadly correct, but much has changed since then. This second report describes the flurry of activity in the market since our first report, and how an integrated ecosystem is now emerging from the jumble of UAM ideas and pilot projects. We predict that the market is set to grow rapidly from 2030, with revenues of around USD 90 billion a year in 2050.

HOW TO CAPTURE A SHARE OF THE PRIZE

With such a big prize at stake but few proven business models, this report focuses on how to operationalize and participate in the market – and capture a slice of this opportunity whether you are an established aerospace or automotive OEM, startup or supplier. First, we review the current state of the UAM industry and emerging ecosystem, and provide an update on UAM market potential based on our market model. This includes giving figures on industry revenues and future drone numbers. Next, we describe five building blocks that will form the backbone of the ecosystem – from production of UAM vehicles to the physical and digital infrastructure behind them.

How should OEMs, startups and suppliers position themselves in this ecosystem? In the key part of this report, we identify four emerging business model archetypes that will likely become standards in the market. These comprise system providers, who are involved across the value chain, and service providers, hardware providers and ticket brokers, who focus on distinct areas. To give an idea of what the future might hold, we also draw lessons from the experiences of the auto industry. We go on to look at how confidence in the market is driving record levels of financing, despite the coronavirus crisis and lack of proven business models, and ask how players can attract investment. Finally, we derive recommendations for OEMs, startups and suppliers, including what to focus on now, possible headwinds and how to overcome barriers and accelerate progress.

1 / Status report

THE PASSENGER UAM INDUSTRY CONTINUES TO DEVELOP RAPIDLY AND SHOULD BE READY FOR TAKE-OFF IN 2025

/// **Our Global Urban Air Mobility Radar has identified ~110 passenger UAM projects worldwide, and our Aircraft Electrical Propulsion Radar 95 projects**

/// **Barriers to UAM, such as regulation and public acceptance, are easing**

/// **The coronavirus crisis will have only a minor impact on UAM growth**

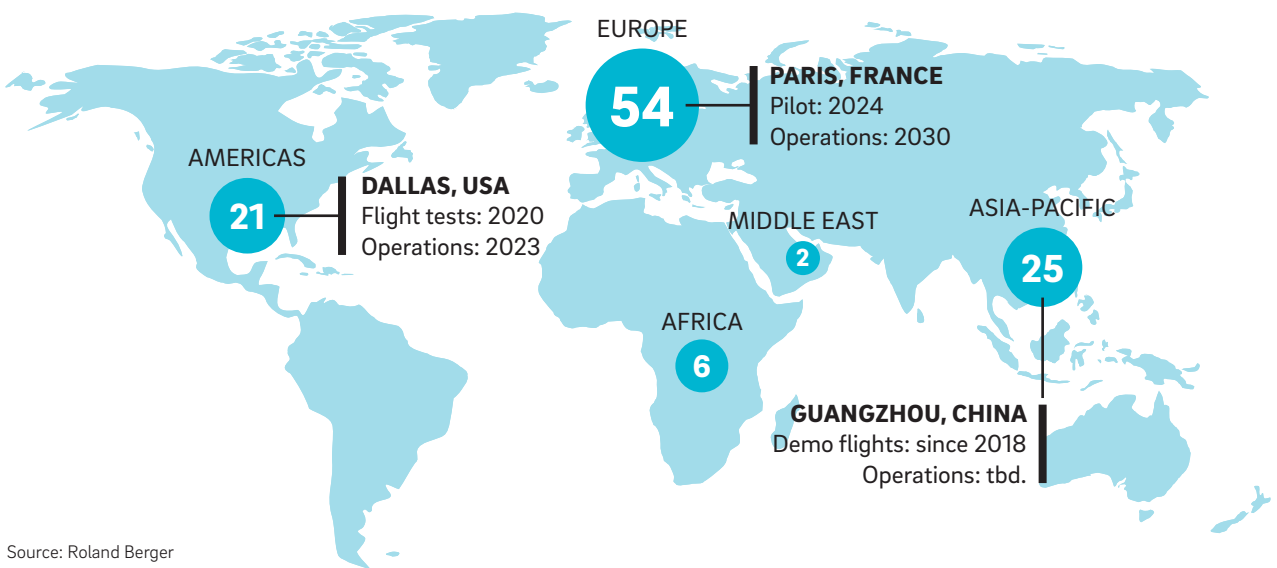
The past two years have seen tremendous activity in Urban Air Mobility. While the industry is still in its early stages, new players continue to enter the market and the number of UAM pilot projects – involving conventional helicopter or aircraft types as well as electric vertical take-off and landing (eVTOL) aircraft – continues to rise. Until now, almost all vehicles designed specifically for UAM rely totally or at least partly on electric propulsion. Our new Global Urban Air Mobility Radar tracks the current status and progress of UAM projects around the world, and had identified more than 110 city projects as of February 2020. → A Our Global Electric Propulsion Radar also shows significant growth, with 95 of the approximately 230 electric aircraft projects around the world currently focused on the development of UAM passenger drones. → B

THE GLOBAL URBAN AIR MOBILITY RADAR

Following the publication of our first UAM report, we began building an interactive map to track the progress of all relevant autonomous UAM projects around the world. The Radar is based on extensive research of cities, companies, press coverage, data bases and governmental sources and classifies projects according to use case, flight areas, region and progress. It was first published in March 2019, is regularly updated and includes passenger, delivery/cargo and medical supply projects.

→ **rb.digital/Mapping_autonomous_urban_air_mobility's_progress**

A: The Global Urban Air Mobility Radar
Distribution of the more than 100 projects, with example cities



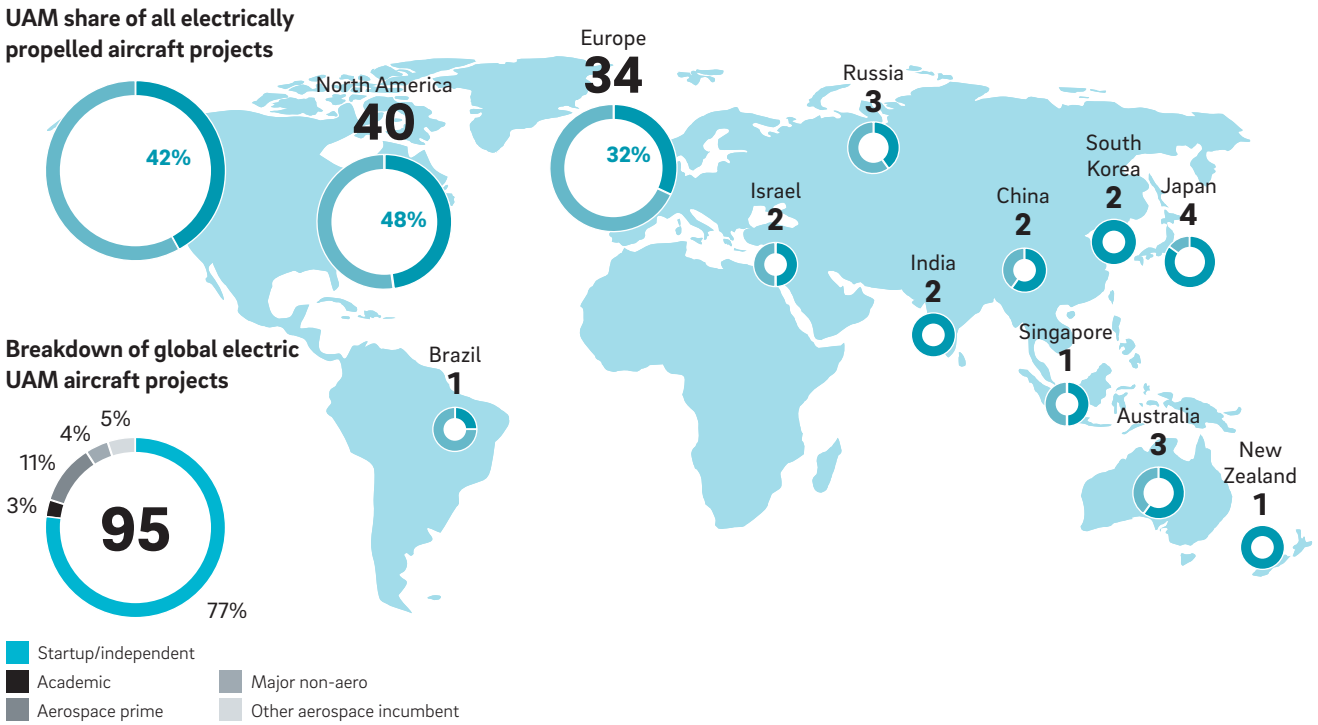
Source: Roland Berger

THE GLOBAL ELECTRIC PROPULSION RADAR

Following the publication of our "Aircraft Electrical Propulsion – Onwards and Upwards" report in July 2018, we created the Global Electric Propulsion Radar to track and map developments in this field. These have increased rapidly since 2016, driven by strong growth in regional (89% CAGR) and UAM (78% CAGR) developments. This is attributable to demonstrable technological progress spurring on investment in promising projects. The radar is regularly updated.

→ rb.digital/Electric_propulsion_is_finally_on_the_map

B: The Global Electric Propulsion Radar
Distribution of the 95 known electric UAM aircraft projects[1]



1 Only including current and ongoing projects with first flights after 2010 and major electric concepts; excludes UAVs and purely recreational developments

Source: Roland Berger

CONFIDENCE IS RISING

As more and more operational UAM use cases take to the skies and publicity increases, we see confidence rising and a higher probability that developers will meet their announced targets. As such, we predict that the first commercial UAM passenger routes will be operational by 2025. They may even start earlier. EHang, a Chinese autonomous aerial vehicle developer, is already operating sightseeing flights, for example, and has received approval from the Chinese authorities for piloted cargo operations. Indeed, the first production facilities and supply chains are already being built. EHang delivered about 60 eVTOL vehicles in 2019, but due to the coronavirus crisis only 20 by mid-2020. It aims to expand production facilities to produce 600 vehicles per year. Also, Joby Aviation, a US eVTOL maker, is building a production site in California with the help of the Japanese auto giant Toyota, which invested in the startup in early 2020.

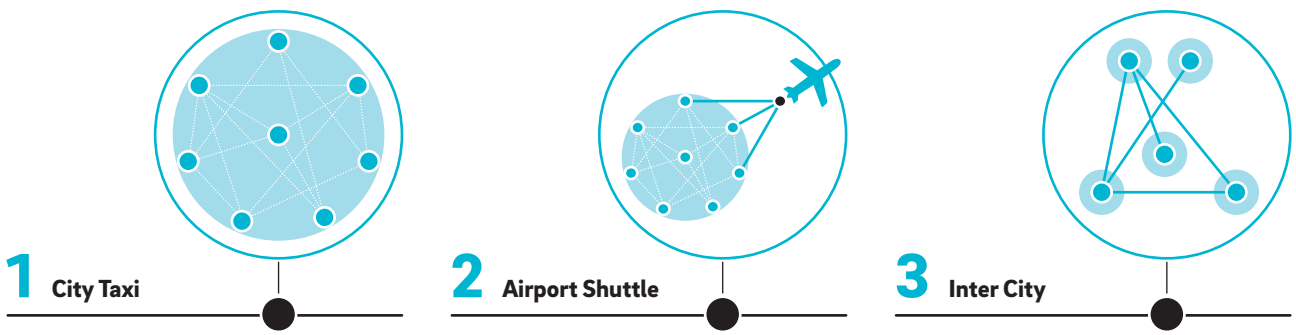
A GROWING MARKETPLACE

The increase in the number of eVTOL producers entering the market has led to an increase in the number of passenger eVTOL designs. Most new models are designed to serve a particular purpose, and they still fit the categorization we developed in our first study: City Taxis will fly within densely populated urban areas, covering distances from 15 to 50km; Airport Shuttles will transfer passengers from transport hubs or points of interest to airports between 15 and 50km away; and Inter City flights will ply commuter routes of up to 250km between major cities. The five-seater eVTOL jet made by German firm Lilium, for example, is aimed at building regional networks and has an advertised target range of 300km. → C

This categorization highlights the importance of designing the right aircraft for the right job. Some OEMs are gaining operational experience here by testing cargo drones before developing more complex passenger vehicles.

C: Passenger UAM use cases

The future market will be dominated by three main use cases



Source: Roland Berger

It's not just drone makers that are surging ahead. More and more players have entered the wider passenger UAM industry, from parts suppliers to air traffic management providers, infrastructure suppliers and software producers. This is creating a UAM ecosystem, with a varied value chain. Collaborations are becoming an increasingly important part of it. As we predicted, "going it alone" is simply not an option for any player as strong collaboration between manufactures, operators and infrastructure providers is proving a key success factor. Regulatory authorities must also be involved.

PUBLIC ACCEPTANCE AND REGULATORY ENVIRONMENT IMPROVE

Overall, we expect the growth path of passenger urban air mobility to continue in the longer term, based on two key developments. First, public acceptance, one of the key stumbling blocks in UAM, is on the rise. While it is not yet totally overcome, eVTOL aircraft are no longer viewed as a risk due in part to the success of passenger and cargo drone trials, and because they will operate with a pilot at first. For example, Volocopter demonstrated unmanned drones in Dubai in 2017 and has partnered with UK-based Skyports to showcase prototype "vertiports" in Singapore. As more passenger drones take to the skies either in demonstrations or actual service, the public is able to see beyond the hype and accept that the technology is real and here to stay.

Drone developers are now also better able to gauge public thinking, thanks to the publication of major studies into perceptions of UAM vehicles. For example, a paper entitled "Factors affecting the adoption and use of urban air mobility" by researchers at the Technical University Munich, University College London and Bauhaus Luftfahrt e.V. found that safety and trust, data concerns and socio-demographics were important factors for adoption.

Second, regulation is no longer viewed as a major industry barrier. Aviation authorities around the world, such as the European Union Aviation Safety Agency and the US Federal Aviation Administration (FAA), are now working with eVTOL manufacturers and other players to define and implement workable regulations. The FAA, for example, is set to certify eVTOL under existing regulations with special conditions.

CORONAVIRUS IMPACT

While the coronavirus crisis has hit the conventional aerospace industry hard, we do not expect that it will severely impact upcoming market introductions or the expected post-2025 growth in the UAM market. The major drivers of the market, such as congestion, urbanization and people's desire to save time, are not going to be dissipated by the pandemic. Indeed, UAM may even benefit, as passenger drones offer increased opportunities for social distancing compared to mass transportation systems.

However, there may be some short-term effects, such as delays to certification as a result of restrictions on business travel, slowed technology development due to workplace limits and funding problems or budget freezes at startups and OEMs. Overall delays are only expected to run to about six months and are more likely to delay UAM launches than jeopardize the implementation of UAM as a whole.

None of this, however, takes away from the fact that the UAM industry is still in the very early stages of development. It could become a game changer for mobility, but there are still many open questions about how it will develop.

2 / Passenger UAM market forecast

160,000 PASSENGER DRONES WILL BE IN SERVICE BY 2050 GENERATING REVENUES OF USD 90 BILLION A YEAR

/// **We modelled future UAM usage and revenue potential based on data from 1,200 cities**

/// **In 2050, drone numbers will be split equally between the three use cases**

/// **Airport Shuttle and Inter City services will generate 90% of revenues**

In our first report, we built a comprehensive market model to estimate the future number of passenger UAM vehicles in operation. For this report, we expanded and improved the model to refine our drone number prediction and forecast future global service revenue. This is the potential income from ticket sales and therefore includes the cost of drone operation and associated services, such as maintenance, and infrastructure.

WHAT WE DID

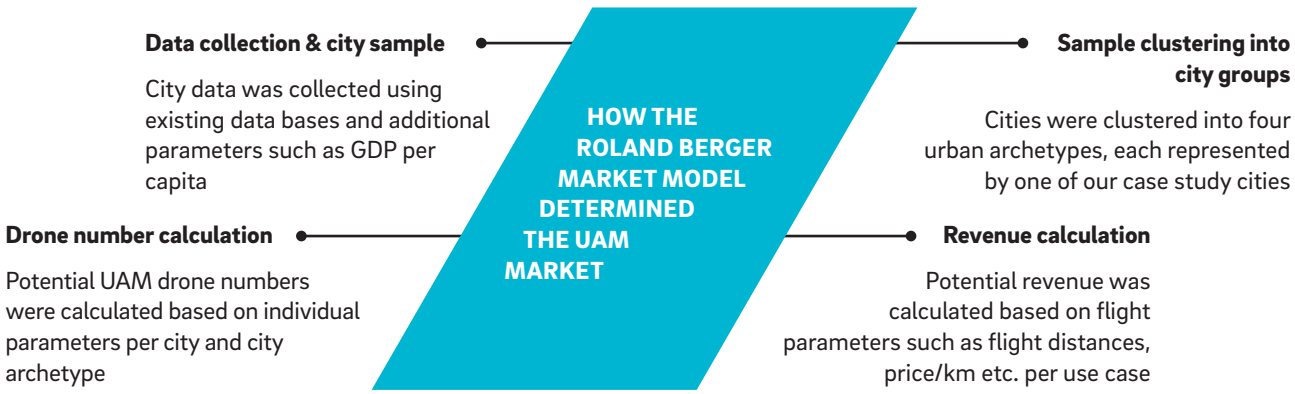
The new model uses data from 1,200 relevant cities with more than 100,000 inhabitants around the world to forecast potential UAM drone numbers and revenues to 2050. As before, the cities were grouped into four clusters based on area and population density. A reference city was chosen to represent each cluster: Singapore, Munich, Los Angeles and Sao Paulo. The number of drones in service in 2030, 2040 and 2050 was then estimated based on commuter, air passenger and public transportation data for each representative city. This included mapping potential launch sites and routes and modelling the likelihood of passengers switching to UAM. The reference city findings were extrapolated for all 1,200 cities to determine an overall global figure for drone numbers, categorized into the three use cases City Taxi, Airport Shuttle and Inter City.

The projected service revenue figure was not calculated in the previous report. It is based on calculations of flight distances, prices per km and flights per day using the drone number estimate.

The model was improved in several other ways: The quality and consistency of city data was enhanced by using better data bases; the sensitivity of drone number calculations was increased by adding new parameters such as GDP per capita, implementation speed and degree of penetration; and we consulted with UAM experts to validate our assumptions and parameter settings. → D

D: UAM market model

Based on data from 1,200 cities, as well as estimates of implementation potential



Source: Roland Berger

WHAT WE FOUND

In 2050, we estimate that there will be 160,000 commercial passenger drones in operation around the world. These will be split almost equally between the three use cases of City Taxis (36%), Airport Shuttles (35%) and Inter City services (29%). As reference, global passenger car sales were in 2019 around 65 million cars[1], while global commercial helicopter sales were 657 units in 2019, with a ten-year production volume of around 7,500 units[2]. Our passenger drone projections can be related to an up-scaled helicopter production. Based on the number of drones, flights and flight distances we further calculated that passenger drones will travel around 18.8 bn kilometers (approximately 11.7 bn statute miles), which translates to approximately 117.000 kilometers (approximately 73.000 statute miles) per drone in one year. For comparison, today's car taxi travels approximately up to 90.000 kilometers per year. → E

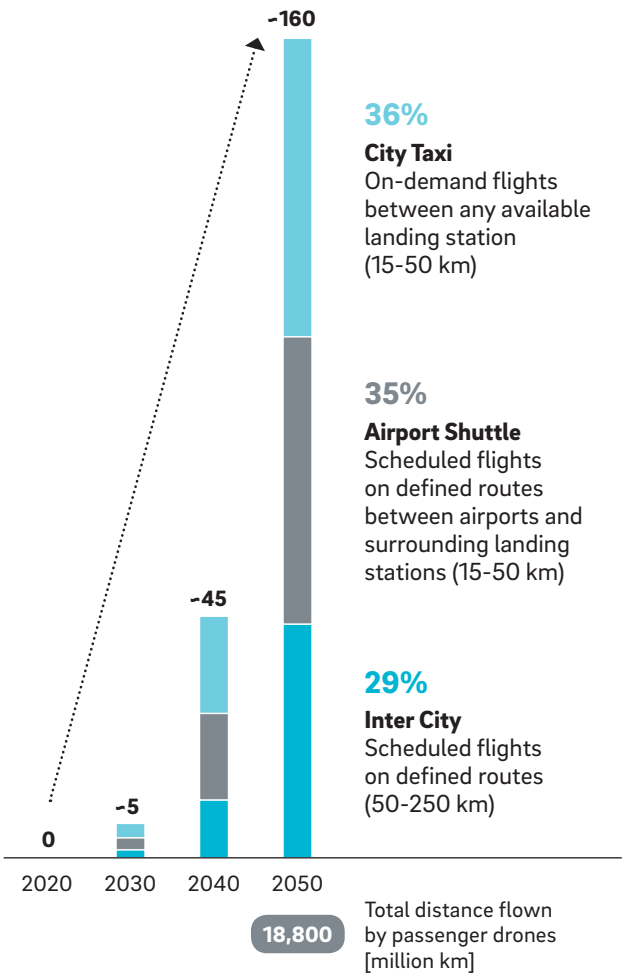
Our prediction in the first report was 100,000 drones. The difference is mostly due to the increase in city sample size (it was 98 in the first report) based on the overall industry projection, that much more cities will eventually implement UAM operations. Further changes include updates to the criteria and relevance for Inter City services, improvements to the methodology and addition of new parameters which influence UAM implementation.

We expect that the passenger UAM market will grow to USD 90 billion by 2050, from around USD 1 billion in 2030. For comparison, the global taxi market is expected to be worth around USD 300 billion in 2030 and global public transportation around USD 1,100 billion in 2025, while total revenues of the global commercial airliner market have been USD 840 bn in 2019[3].

[1] Source: OICA
[2] Source: TEAL
[3] Source: Statista, forecast for commercial airliner market in years 2025-2030 difficult due to uncertain recovery from COVID-19

E: Passenger UAM drone numbers
More than 160,000 drones will be in operation in 2050, with nearly equal distribution across the three use cases

OPERATING UAM PASSENGER DRONES
['000]



Source: Roland Berger

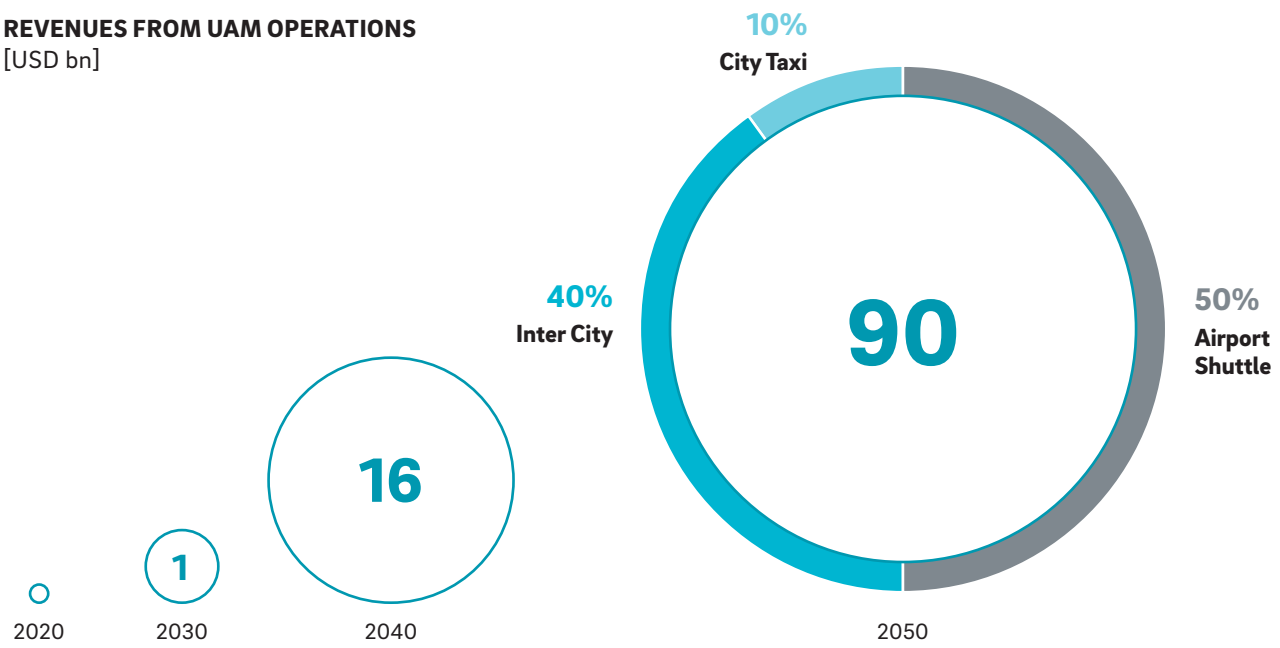
By 2050, Airport Shuttle and Inter City services will provide 90% of revenues, with City Taxis making up the rest. Inter City services will have a lower number of overall flights, but will cover longer distances, generating more revenue per flight and with higher utilization. Medium-distance Airport Shuttle services will be appealing to the business market, enabling them to charge a premium compared to City Taxis. → F

Our results indicate that UAM services will be introduced step-by-step. In the first few years after 2020, volumes will be small and costs high. This means services will be exclusive and mostly attract executive users looking for convenience and to save time, much like premium ride-hailing or limousine taxi services today. But as scale and experience increase, we expect a transition to a premium public transportation model, where UAM services become more and more like today's taxi services.

Public acceptance of UAM will be crucial to this transition and the market's future success. It can only be achieved if the industry is quick to follow the learning and price curve.

F: Passenger UAM revenues

Expected to grow to USD 90 billion in 2050, with Airport Shuttle and Inter City services providing the lion's share



Source: Roland Berger

3 / UAM ecosystem

NOT JUST DRONES – THE MARKET IS EXPANDING TO COVER SERVICES FROM FLIGHT OPERATIONS TO TICKETING AND REPAIRS

/// **The UAM market is becoming an ecosystem of integrated building blocks**
/// **These include eVTOL vehicles, MRO services, flight operations and physical and digital infrastructure**
/// **Partnerships and collaborations are being formed across this ecosystem**

It's not just about drones – the UAM market is expanding to cover services from flight operations to ticket brokering and repairs as well as covers a whole ecosystem of urban eVTOL operations, from infrastructure to drone control and regulations. This system of systems needs to be built from scratch, and is now beginning to take shape.

ECOSYSTEM COMPONENTS

We see five major building blocks of the passenger UAM ecosystem. Each must be compliant with overarching specifications and integrated with the others to function successfully.

eVTOL vehicles

Drones must be specifically designed and built for a target market, whether inter- or intra-city travel.

MRO services

eVTOL vehicles require maintenance, repair and overhaul (MRO) work on demand and at scheduled service intervals.

Flight operations

These involve all ticket distribution and passenger operations, piloting of manned/unmanned drone flights and ground handling activities, such as charging and storage.

Physical infrastructure

This comprises flight infrastructure (take-off/landing sites and passenger hubs), MRO infrastructure (such as hangars) and connected infrastructure, or nodes of transportation that bring passengers to UAM sites.

Digital infrastructure

There are three main components: the Drone Control Center (systems for remote surveillance); Air Traffic Management and Unmanned Aircraft System Traffic Management; and navigation aids, such as 5G networks.

ECOSYSTEM ACTIVITY

As the passenger UAM ecosystem has started to develop, activity in each building block has increased:

eVTOL vehicles

To date, our Electric Propulsion Radar has mapped 95 eVTOL aircraft projects worldwide. Our first study observed that all projects could be classified under five technological concepts, an observation that holds today: highly distributed propulsion concepts (multicopters); quadcopters; hybrid concepts; tilt-wing/convertible aircraft concepts; and fixed-wing vectored thrust concepts. This is typical for an early-stage industry where no dominant design or use case has yet evolved. Supply chains are also yet to be fully formed, although first partnerships are forming. For example, Lilium and Japanese materials company Toray have agreed a supply deal for carbon fiber composites, and German avionics specialist Diehl Aerospace will supply flight control computers to Volocopter. We assume there will be a rapid shake out or consolidation in the industry once it has matured.

MRO services

No OEM-independent MRO service provider, such as SR Technics in the airline industry, has yet emerged in the UAM industry. This is unsurprising given its nascency. We believe that OEMs themselves will provide vehicle-specific MRO services until a dominant design emerges or a specific maturity level of the industry has emerged.

Flight operations

Here we expect a platform approach from providers, especially when it comes to ticketing and passenger operations. Uber Elevate is a good example. It is

building an intermodal booking platform that will allow customers to book seamless door-to-door trips. Users will be collected by an Uber car and taken to a vertiport. They will then fly on an Uber drone to a vertiport near their destination. There, another Uber car will be waiting to drive the final leg. Such intermodal platforms will also likely be adopted by public transport providers, enabling mixed mode journeys and tickets. But also other companies, such as for example Hyundai Urban Air Mobility are targeting this approach by providing also transportation for the first and last mile.

Physical infrastructure

Drone producers have already presented their first ideas of what vertiports may look like, and more recently dedicated providers, such as Skyports, have emerged. Real estate and property developers are also showing an increasing interest in vertiports. We believe ancillary services such as cleaning and charging will be carried out by the eVTOL company itself to begin with, and later vertiport operators or airport service companies.

Digital infrastructure

Again, eVTOL manufacturers will be a major driving force. EHang, for example is planning its own drone operation center. Communication infrastructure is also in development, with telecoms firm Vodafone collaborating with EHang in Germany, to supply mobile SIM-cards to EHang's drones. Public agencies are also becoming involved to ensure safe operations. Germany's air traffic controller Deutsche Flugsicherung has formed a joint venture with Deutsche Telekom, called Droniq, to ensure the safe and reliable integration of manned and unmanned drones into its airspace. And the FAA and NASA have developed, with industry players, a UAM Concept of Operations (ConOps 1.0) to introduce piloted vehicles in "UAM corridors".

"It's not just about drones – the UAM market is expanding and a whole ecosystem from ticket brokering, to drone-specific infrastructure, regulations and MRO services is adjacent to UAM flight operations."

Manfred Hader,
Senior Partner

4 / Business models

FOUR ARCHETYPES ARE EMERGING IN THE UAM MARKET, WITH PLAYERS CURRENTLY FAVORING ONE IN PARTICULAR

/// **The nascent ecosystem consists of many players with disparate models**

/// **Four key archetypes are emerging, offering overarching or distinct services**

/// **The 'system provider' archetype is preferred as it allows players to comprehensively control the market**

As in any industry, passenger UAM players need a clear and convincing business case to demonstrate that their plans are commercially viable and to attract investment. But with so many unanswered questions in the industry, this is a particularly tricky task.

BUSINESS MODEL ARCHETYPES

We observe a great number of players across the building blocks of the UAM ecosystem. They offer a disparate array of value propositions and business models. But our analysis shows one trend is clear: most industry players are positioning themselves as system providers, with an overarching business model archetype that spans the five building blocks. From this model, three other distinct archetypes are emerging, with a varying degree of integration in the UAM value chain: service providers, hardware providers and ticket brokers. Below we look at the value proposition and business model of each archetype. → G

System provider: Both passenger UAM incumbents and startups currently favor this archetype, which focuses on a mixed B2B/B2C business model. Its value proposition lies in integrating all five building blocks and offering holistic solutions. System providers conduct R&D in all verticals to gain an understanding of the entire UAM ecosystem, but venture only into those that fit their existing value proposition. Armed with a holistic understanding, they can specify overall UAM requirements while operating with superior knowledge in their chosen areas of the ecosystem.

The business model can be further broken down into two sub-models. First, vertically integrated system providers that design or engineer the whole system, but which also provide, directly or via suppliers and partners, most elements needed to set up and operate the ecosystem. This includes a lot of startups. For example, Joby Aviation will not only be an OEM, but has also registered with the FAA as an operator, and Lilium is planning what it calls a "branded service". EHang is another example. But it's not just startups – automaker Hyundai, which entered the UAM race in 2019, also occupies this space.

Second, established aerospace players such as Airbus or Boeing. These companies are systematically building knowledge of the whole ecosystem, and test different elements of the ecosystem through pilot and demonstrator projects to better understand them. They do not develop all of these concepts into products or services. These players have not yet decided on their final positioning in the UAM market but rather are keeping all options open for the future. However, in the midst of the coronavirus crisis, both OEMs may need to critically evaluate their UAM activities and either put them on hold or "pull the plug".

Our analysis shows that most companies are currently positioning their business model as a system provider for three key reasons. One, it allows them to understand the whole ecosystem and the integration of the different parts. Two, because the industry situation is still dynamic, the knowledge and vertical integration gained as a system provider allows players to react quickly to developments. Three, supply chains are not yet fully established.

Service provider: Service providers focus on a B2B business model and are strongly integrated in the UAM value chain. They offer either a lone service or multiple services related to the building blocks of MRO services, flight operations and digital infrastructure. Their value proposition lies in offering standardized and optimized processes with a national or global footprint. Companies in this field include SkyGrid, which has developed a software platform that integrates passenger drones into airspace, Vodafone in Germany and the Deutsche Telekom/Deutsche Flugsicherung joint venture Droniq.

Hardware provider: Hardware providers focus on a B2B business model and are partly integrated in the UAM value chain. They design and manufacture eVTOL vehicles or

G: The four business model archetypes

UAM players are currently tending towards the system provider model

UAM ECOSYSTEM BUILDING BLOCKS		System provider	Service provider	Hardware provider	Ticket broker
eVTOL vehicles	Design	■	□	■	□
	Manufacturing	■	□	■	□
MRO[1] services	Maintenance	■	■	□	□
	Repair	■	■	□	□
	Overhaul	■	■	□	□
Flight operations	Ticket distribution	■	■	□	■
	Piloting	■	■	□	□
	Ground handling[2]	■	■	□	□
Physical infrastructure	Flight infrastructure	■	□	■	□
	MRO infrastructure	■	□	■	□
	Connected infrastructure	■	□	■	□
Digital infrastructure	Drone Control Center	■	■	□	□
	ATM[3] and UTM[4]	■	■	□	□
	Navigation infrastructure	■	■	□	□

[1] Maintenance, Repair and Overhaul [2] Including cleaning, charging and storing of vehicles [3] Air Traffic Management [4] Unmanned Aircraft System Traffic

Source: Roland Berger ■ Part of the value proposition □ Not part of the value proposition

components as well as physical infrastructure. In addition, they may also provide necessary hardware components for digital infrastructure. Their value proposition is delivering the best technically feasible and economical product that can be integrated in the overall UAM ecosystem. The aero engine manufacturer Rolls-Royce, for example, is working on an all-electric propulsion system for passenger drones and put it already in test flight mode within the CityAirbus Demonstrator. Skyports is developing vertiports and Diehl Aviation has formed a partnership with Volocopter to supply flight control computers.

Ticket broker: Ticket brokers focus on a B2C business model and are generally little integrated in the UAM value chain. They commoditize the existing product and service, opening up the market to a broader target group. This is done by mapping and pooling available flights (currently using helicopters) to reduce prices. The value proposition of ticket brokers is the connection between back-end operations and the front-end user interface. Uber Elevate is leading the way in this field with its seamless intermodal solution but others, including the US app-based flight sharing

service Blade, will also be involved. Although this position along the value chain seems to be limited in focus, it has its advantages: Operating a booking and ticketing platform guarantees asset-light operations and nearly endless scalability for reasonable additional costs. Further, as integration of UAM into other public transport networks is required to enhance the overall network value, these platforms are the central node to enable a seamless travel experience and can be therefore of strategic value.

AND THE WINNER IS…

While passenger UAM companies are currently tending towards the system provider archetype, it is not clear which archetype will dominate in the future. The system provider archetype is the natural choice in a nascent industry, but as the industry matures, other archetypes will grow in significance. Despite this, based on what happened in the automotive industry (see box) we believe the system provider archetype will win through, albeit in a less vertically integrated form than today.

LESSONS FROM THE AUTOMOTIVE INDUSTRY

The six-phase evolution of the 150-year-old automotive industry offers insight into how the UAM market may develop, with many clear parallels and assumed conclusions.

A whistle-stop history

Experimental phase – The internal combustion engine (ICE) emerged as the dominant automotive technology in the early 1900s, fending off challenges from electric and steam-powered cars.

Emergence of a market – The automakers that formed around the ICE started life as hardware producers that made all their own parts.

Mass production – Suppliers emerged after the introduction of mass production by Ford in 1913, but contributed fewer than 20% of parts for many years.

Industry overhaul – Efficiency drives, tighter regulation and consolidation marked the period up to the 1980s.

System integration – Between 1990 and 2009, the supplier share in an average car's value creation rose from 60% to almost 80%. This signified OEMs' shift from hardware producers to system integrators.

MADE – Since 2009, the industry has shifted again, with OEMs becoming service providers driven by the MADE trends (mobility, autonomous driving, digitization and electrification).

CONCLUSIONS FOR THE UAM INDUSTRY

- The first two phases in the automotive development timeline took place over the past five years in the UAM industry, so we expect the whole UAM timeline to be condensed into the next 25 to 30 years.

- Even if a breakthrough passenger UAM technology has already been invented, we can assume alternative technologies will be around for several years before it becomes dominant.

- Once a breakthrough technology has emerged, additional players are likely to enter the market. They will fight for market share until dominant players win through, sparking a wave of consolidation and market exits

.

- Value creation will change as the UAM market develops. In the beginning, most firms will produce their own parts, but as volumes increase suppliers will emerge and produce more components.

- Low eVTOL vehicle production numbers will at first keep the cost of UAM services high, with only the most affluent customers using them. This model was not profitable for carmakers, so we believe the best route for UAM OEMs will be to partner with service providers while focusing on scaling up production of eVTOL vehicles.

5 / Funding

INVESTMENT IN PASSENGER UAM STARTUPS[4] HIT USD 907 MILLION IN THE FIRST HALF OF 2020 – MORE ALMOST THAN 20X THE LEVEL IN 2016

/// **Even without revenue-earning products, investors are strongly backing UAM**

/// **Funding rose from just USD 40 m in 2016, thanks mainly to the market entry of strategic investors**

/// **Growing trust, UAM maturity and lighter regulation are driving investment**

One of our latest Roland Berger Aerospace and Defense Radar surveys shows a majority of industry executives believe commercial UAM services will be operational between 2025 and 2030. This reflects current activities in the industry. Startups, whose funding depends on an aggressive timeline, are unsurprisingly bullish and have ambitions to launch services before 2025. On the other hand, legacy aerospace companies are more cautious and predict service entry in the late 2020s or early 2030s, perhaps reflecting their desire to learn from the experience of first movers before taking the plunge or based on their experience with certification timelines. However, neither timeline factors in two key challenges facing the industry: No UAM company is yet generating steady revenues and business models remain unproven.

INVESTMENT SOARS DESPITE CHALLENGES

Proof of financial concept is hard to achieve in a nascent industry such as passenger UAM, yet it is critical to securing funding. And only through investment can players quickly scale up and position as a first or second mover in the UAM ecosystem value chain. A successful proof of concept could therefore unlock the funding floodgates and quickly drive forward the industry, making it the next major milestone.

Despite these challenges, and the coronavirus crisis, funding activities in the industry are already astonishing. Even without a proof of concept, financial and strategic investors have tremendous confidence in passenger UAM. Our analysis shows that funding in startups leapt from USD 40 million in the whole of 2016 to USD 907 million in the first half of 2020 alone, almost 20 times the amount.

Funding has been raised in three distinct rounds. The first ran from 2013 to 2017, with mainly venture capitalists (such as GP Capital and Capricorn Investment Group) providing seed funding. During this period, it seems that established industry players did not have enough trust in the concept of UAM to make significant investments. From 2017, strategic investors entered the race, especially from the automotive and digital industries (Daimler, Tencent, Intel). In 2020, a third round began (backed by the likes of Geely and Toyota), largely to enable startups to ramp up testing and certification efforts and to start industrialization.

A BRIGHT INVESTMENT FUTURE

Investor faith in passenger UAM reflects a maturing of the industry and rising confidence in the technologies being developed. But it also reflects positive regulatory developments. As mentioned above, strict legal controls on drone flights were a major stumbling block in allowing first passenger flights. But regulations books are increasingly being adapted to assist UAM development. For example, Volocopter is expecting certification from EASA by 2022 and Joby Aviation is working towards certification from the FAA by 2023. Joby's USD 590 funding round in January 2020 will be used to pay for its certification push.

With development schedules on track and milestones such as test flights continuing to be ticked off, we expect that faith in the industry will only grow, with investors set to continue to increase their funding in the future.

[4] Startups considered: Aeromobil, EHang, Joby, Lilium, Volocopter.
Source: Crunchbase, company websites

6 / Recommendations

COLLABORATIONS AND THE RIGHT BUSINESS MODEL ARE THE KEYS TO SUCCESS IN ALL UAM INDUSTRY SECTORS

/// **OEMs should stabilize core business and find a best-fit UAM model**
/// **Startups need to focus on public acceptance and proof of concept**
/// **Suppliers and hardware providers should select value chain targets**

Based on our analysis of the passenger UAM industry, we would make the following sector-based recommendations to enable players to take a slice of the future USD 90 billion market:

OEMS (AEROSPACE & DEFENCE AS WELL AS AUTOMOTIVE)

We advise carefully balancing a two-pronged strategy. First, stabilize your traditional core aerospace and defense or automotive business to secure revenue streams and profit pools, especially in the aftermath of the coronavirus crisis. This will enable you to continue investments in UAM areas. Focus on luring talent from other companies to build strong UAM capabilities and ensure readiness of an eVTOL product and UAM ecosystem value proposition as soon the market is ready. Second, even though the UAM industry is still nascent, start to think about which business model to enter the UAM market with. Remember that whether as an eVTOL manufacturer or system provider, there is no "one approach fits it all" model – collaborations will be key. Consider a first mover versus second mover approach.

STARTUPS

If you have secured funding, focus on demonstration flights to gain more operational knowledge. Public demonstrations will help to build public acceptance of, and confidence in, passenger UAM flight, as will the successful role out of cargo drone services. In addition, as passenger UAM operations have higher regulatory and certification requirements, develop less complex use cases, such as cargo drone operations (medical delivery, cargo delivery, intralogistics), to prove your concept and secure first revenue streams. If you have not yet secured funding, focus all efforts into proving your chosen business model with a minimum viable product to convince investors. Build collaborations if necessary, as together you will be stronger.

SUPPLIERS AND HARDWARE PROVIDERS

Start to think about which parts of the value chain to cover and on which subsystems to focus. In particular, consider generic areas that are independent of specific drone designs or ecosystem requirements. These could be within your area of expertise or current business model or – especially relevant in light of expected industry shifts in the wake of the coronavirus crisis and A&D industry downturn – outside your normal operations. The latter could form part of your future growth strategy. But if you do venture into new territory, note that it is important to engage early in collaborations with OEMs and/or eVTOL startups. Supply chains are yet to be fully formed and securing one small contract now could be very lucrative in the long-term.

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ABOUT ROLAND BERGER AND OUR WORK ON UAM

Roland Berger is one of the leading global management consultancies, the only one of European origin. Our Aerospace & Defence practice has dedicated teams in all major A&D hubs around the world. We serve primes and their supply chain, start-ups, investors, governments as well as institutions in the fields of strategy development, transformation and performance improvement.

The "Roland Berger Center for Smart Mobility" has built considerable mobility project experience across ecosystems and along the entire mobility value chain. It also provided early support to the nascent Urban Air Mobility industry.

Three pillars are key to our work within Urban Air Mobility:

- First, our "Roland Berger Center for Smart Mobility" brings vast project experience along the entire mobility solutions value chain
- Second, we continuously develop leading market intelligence in the field of UAM, such as market models, studies, articles and our Urban Air Mobility Radar
- Third but not least, we leverage a strong global network within the UAM ecosystem in our work, for example with eVTOL manufacturers, infrastructure providers, operators, cities, investors, etc.

The Roland Berger
Center for Smart Mobility

We welcome your questions, comments and suggestions

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