Executive Insights

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Aerial Ride-Sharing Within the Next 5 Years. Fact or Fiction?

How soon do you think e-air taxis will begin to fly over our cities? Talking about air taxis and flying cars may evoke memories of "The Jetsons," a cartoon show set in 2062 with flying cars throughout the skies. Many companies believe air taxis will be flying around much sooner than 2062, and have commercial launch expectations within the next five years.

- Uber recently hosted their third Elevate Summit and announced that their third launch city, the first outside the U.S., would be Melbourne in 2023[1].
- Lilium has completed their first vertical test flight of a full-scale, all-electric five-seater aircraft and hopes to launch their fully operational flying taxi service by 2025.
- Airbus is working with the French Civil Aviation Authority and Aeroports de Paris to achieve their goal of offering piloted airborne taxis between airports and sporting venues at the Paris 2024 Olympics[2].

Whilst at face value these projections seem aggressive, these proposed deployment times are not that dissimilar to many others in the industry. The timeline below (see Figure 1) shows several companies' expected trial and commercial launch dates. It also highlights the breadth of flight development tests currently taking place, with full-scale operational testing scheduled to finish in the next few years.

This paper examines whether the timelines of companies such as Uber, Lilium and Airbus are realistic, by exploring the critical barriers they will need to overcome, not only for their initial launch but also to become scalable businesses.

E-air taxis: Ride-sharing services provided in small, eVTOL (electric vertical take-off and landing) aircraft, both piloted and autonomous.

Urban air mobility (UAM): The safe and efficient operation of both passenger-carrying and non-passenger-carrying (e.g. drones) aircraft systems in a metropolitan area.

Critical barriers

We believe there are seven key barriers, as articulated in the diagram below (see Figure 2). We will consider each in turn.

Regulation

Regulation remains the primary challenge for the e-air taxi market, presenting barriers from commercial launch, to scaling and ultimately full viability.

However, regulators and politicians are warming to trialling the technology, despite safety being their main concern. At Uber Elevate's June 2019 summit, acting U.S. Federal Aviation Administration (FAA) Chief Daniel Elwell indicated support for trials but also emphasised the importance of safety, alluding to the limits this might place on initial deployments. In particular, he supported trials in remote areas and emphasised the challenges in transitioning to dense urban settings[3]. Similarly, at the same event, the Victorian Government's Treasurer, Tim Pallas, welcomed Uber's Melbourne trials, while a spokesperson for the Australian Civil Aviation Safety Authority (CASA) pointed out that Uber Air still has many challenges to overcome[4].

Aerial Ride-Sharing Within the Next 5 Years. Fact or Fiction? was written by **George Woods**, Partner, and **Natasha Santha**, Principal, L.E.K. Consulting, and Eric Schneider, Consultant. George is based in Sydney, and Natasha is based in Melbourne.

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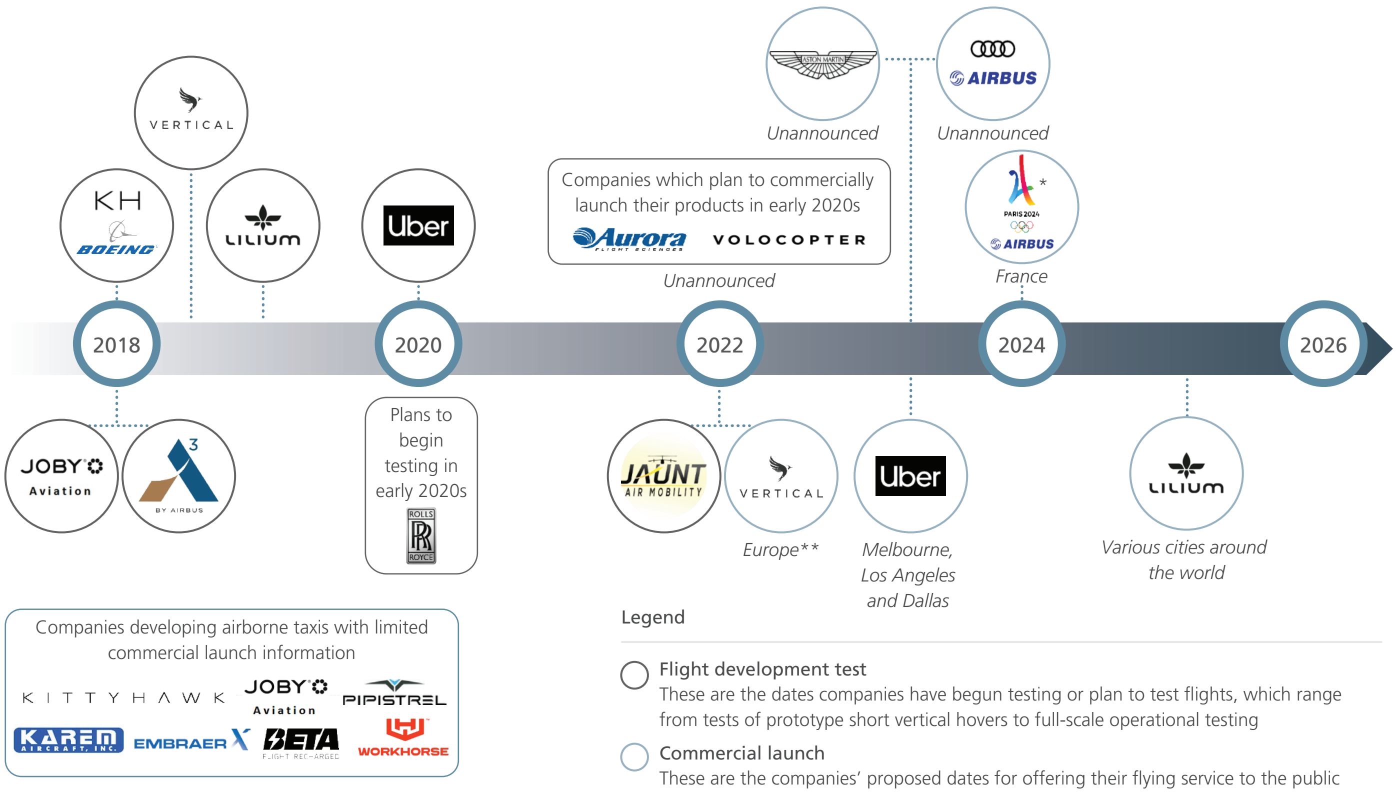
Figure 1
Aerial ride-sharing timeline as at July 2019



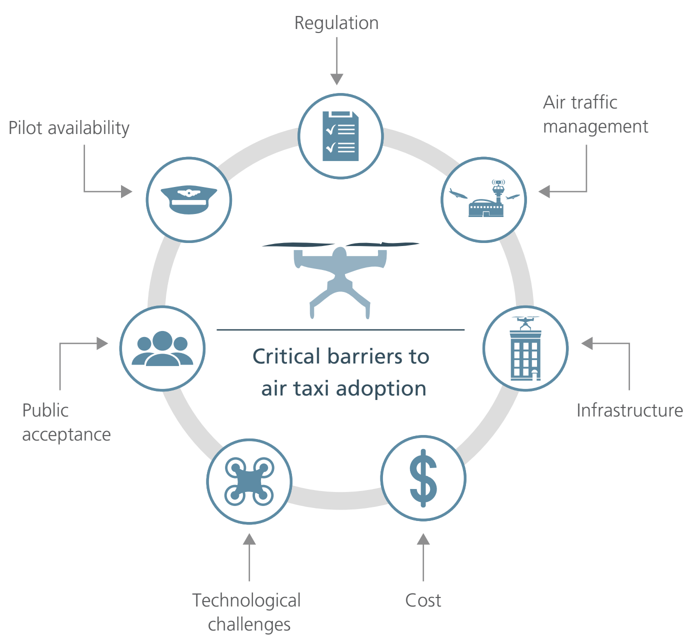
Note: * Various stakeholders (incl. Airbus and Groupe Aeroports de Paris) are working together to offer spectators airborne transport between airports and sporting venues.
** While Vertical Aerospace haven't confirmed a location for their intercity launch, they are working with the Europe Aviation Safety Agency to secure certification by 2022.
Source: L.E.K. research and analysis, press, company websites

Regulatory progress is being made in some jurisdictions. For example, the European Union Air Safety Agency (EASA) recently published their "special condition" regarding the development and certification process for eVTOL (electric vertical take-off and landing) aircraft. This creates a clear set of rules directly addressing the certification process for eVTOL aircraft, providing guidance for manufacturers, investors and the public[5]. These special conditions also suggest genuine intent to provide timely oversight and support for market progress.

Air traffic management

Today, most air traffic is monitored by human controllers, who talk directly with pilots in their designated sector. This manual approach is barely sustainable as commercial air traffic continues to grow, and will certainly not be sufficient to handle the mass uptake of air taxis or drones. Unmanned aircraft system traffic management has been proposed as a more scalable, digital management system to overcome the limitations of current practices. While the specifics are still being determined and may vary per geography, a digital system able to efficiently monitor all aircraft in the sky will be vital to the launch and scalability of unmanned aerial vehicles. Multiple parties are working to produce a system, with NASA leading the charge in the United States and Single European Sky ATM Research in Europe.

Figure 2
Critical barriers to air taxi adoption



Infrastructure

While current infrastructure may be able to support initial trials, it is unlikely to be able to accommodate these businesses at scale. One solution is to create initial "skyports" (e.g. take-off and landing zones) by sharing existing helipads. In the U.S., there are 5,664 helipads, with all but 66 for private use[6]. Most of this infrastructure lies unused through large parts of the day. However, at scale, other solutions will be required. For a recent Uber design competition, submissions were asked to design skyports able to support the transport of over 4,000 passengers per hour within a three-acre footprint, while meeting noise and environmental requirements and mitigating impact on nearby communities (see Figure 3).

Achieving 4,000-passengers-per-hour throughput is no small feat and will require custom-built, large-scale infrastructure. While this may be technically feasible, these larger structures would require prime real estate in densely populated urban environments, large-scale grid capacity in a concentrated location and would create visual disruption.

Figure 3
Visualisation of a "skyport" from Uber and Humphreys & Partners Architects[7]

Sources: https://www.theverge.com/2018/5/9/17337680/uber-flying-car-skyport-design-concept; https://humphreys.com/project/uber-elevate-2018/

Cost

Uber estimates the cost of an Uber Air trip upon launch will be $5.73 per passenger mile, about the same as an Uber Black ride currently. With scale manufacturing techniques, autonomy and pool usage, Uber says aerial taxis could be cheaper than car ownership today, at $0.44 per passenger mile[8].

While this cost level appears to make aerial ride-sharing a viable transportation mode for more travellers than just wealthy individuals and executives, is this realistic?

Our analysis broadly aligns with Uber's; cost estimates suggest that these price levels are theoretically possible. However, to meet these projections, our modelling requires a heavily utilised model, at scale, with relatively modest infrastructure investment.

Our research identified four key aspects to mass-market pricing:

- **Rapid turnarounds:** Maximise utilisation by minimising the time it takes to load and unload passengers. We believe a maximum time for this would need to be c.8-10 minutes.
- **Ride-sharing:** High load factors will be essential. Retaining an average passenger capacity per trip of at least ~2-2.5 passengers (including both maximum capacity constraints and usage per trip) will likely be needed.
- **Minimising fixed network costs:** Upon launch, existing infrastructure will need to be used to keep initial capital costs below c.$5-10 million per skyport. This suggests capital will be required from property investors to meet the shortfall.
- **Efficient manufacture:** Vehicle cost estimates will need to be in the $1-2.5 million range, which we think is reasonable upon launch.

Technological challenges

Two of the most notable technical challenges with e-air taxis are battery energy density and noise.

Batteries are heavy. While a conventional jet engine burns fuel and becomes lighter, eVTOLs will carry a constant battery weight throughout a flight. Moreover, current battery technology has only 1/60th of the energy density of kerosene[9]. Although this energy density is not sufficient to fly several hundred kilometres at a time, it appears that ranges up to 100 kilometres will likely be available upon launch.

eVTOLs are quieter than helicopters but could still cause noise disruption. The electric motors of eVTOLs emit much less noise than the piston engines and fast rotors of helicopters. While noise is not expected to delay initial low-volume commercial launch, with mass adoption, noise may become a significant factor[10].

Public acceptance

Trust in any technology is critical to scalability. On their initial launch, there will be plenty of early adopters willing to try eVTOLs, especially since flights will be piloted. However, with scale, and particularly when autonomous aircraft are introduced, considerable work will be needed to drive customer acceptance.

In a recent NASA urban aerial mobility market survey of more than 2,500 consumers, c.25% reported comfort with unmanned aerial technology, with c.25% reporting they would not use unmanned services and c.50% potentially using the technology[11].

Past experience suggests that consumer acceptance will come, only so long as there is trust in safety.

Pilot availability

Air taxis will be piloted upon launch and for the medium term until autonomy is accepted by regulators and the public. While we think that the current pilot shortage will not delay commercial launch, it could act as a brake until either more pilots are trained or autonomous eVTOLs become accepted.

One possible solution for pilot shortages is to make it easier to certify pilots. Bell Helicopter is engineering their air taxi (Bell Nexus) for simplified operation by "minimally trained" pilots, finding a route around today's growing shortage[12].

Conclusion

We are on the cusp of a mobility revolution. Although the timelines may seem futuristic at first glance, we believe a commercial piloted launch by 2023 is aggressive but technically and operationally feasible. Regulation will likely prove the largest bottleneck. Regulators could push launch time frames out, despite the service being technologically and operationally ready.

Delivering a fully autonomous solution will take several years and will be contingent on millions of incident-free flying kilometres to match the safety standards of other passenger aircraft.

The delay to autonomy and the infrastructure needed will make mass adoption difficult in the medium term. We believe substantial uptake will not occur within the next c.10-15 years. Rather, the 2020s will be characterised by rollout in new cities and regulatory regimes, new use cases, and technological improvements. But the Jetsons are not as far-fetched in this area as you may think. These issues are very likely to be resolved well before 2062.

Endnotes

1 https://www.uber.com/en-AU/newsroom/uberelevatemelbourne/
2 https://www.electrive.com/2019/06/25/paris-may-offer-flying-cabs-by-airbus-at-2024-olympics/
3 https://www.faa.gov/news/speeches/news_story.cfm?newsId=23794
4 https://ia.acs.org.au/article/2019/uber-to-fly-taxis-in-melbourne-by-2023.html
5 https://transportup.com/headlines-breaking-news/easa-releases-its-special-condition-for-vtol-development/
6 https://www.nextbigfuture.com/2019/01/flying-cars-and-skyports-versus-tunnels-and-self-driving-electric-cars.html
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11 https://www.nasa.gov/sites/default/files/atoms/files/uam-market-study-executive-summary-v2.pdf
12 https://www.wired.com/story/bell-nexus-air-taxi-flying-car/

About the Authors

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George Woods leads L.E.K. Consulting's Asia-Pacific Airports practice. George has advised airport clients for over 20 years. Much of his current work concerns helping airports deliver the next wave of major airfield and terminal investments, resolving issues of timing, airline and government strategy, congestion management, and commercial models. George holds a Master of Business Administration with distinction from INSEAD, France.

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