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Flying-cab drivers wanted

Air taxis are coming. Until they can fly autonomously, this nascent industry will need many pilots.

by Uri Pelli and Robin Riedel

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Flying cabs may smack of science fiction, if not of science fantasy. Yet many mobility experts envision a future of small, car-like vehicles that avoid the congested streets of our cities by zipping through the skies above them. More than 250 businesses of all forms and sizes are preparing to manufacture, build, or operate these air taxis in the next five years. These will mostly be multi-rotor or multi-winged electric vehicles that take off and land vertically, seat two to six passengers, and have a 30-to-300-mile range. While some might personally own such vehicles, we expect the vast majority to be operated in a shared fashion. When this urban air mobility (UAM) market reaches scale and its full potential, our latest estimates suggest, the global opportunity will be on the order of hundreds of billions of dollars a year.[1]

But the flight path from here to there is uncertain. UAM needs to overcome a number of challenges—from technology to regulatory to public acceptance to air traffic management to physical infrastructure—to name a few. In addition, it needs to resolve a pilot challenge. These vehicles will eventually fly autonomously, but that could take a decade or more because of technology issues, regulatory concerns, and the need to gain public acceptance. Until autonomous flight of hundreds or thousands of vehicles above cities across the globe becomes a reality, the industry must recruit, train, and deploy thousands of pilots—an important but much less visible challenge than other issues associated with UAM.

Pilots will help the public recognize the value proposition for UAM. Before taking flight, however, they must gain experience with this new mode of transport and help compile data about it. Pilots must also understand broader operational issues and help build confidence in the industry's safety and reliability among regulators and the public.

Although neither the length nor the nature of this transition to autonomy is obvious, we have identified four key phases:

— no automation or human assistance (current capabilities, where computer systems may assist human pilots by reducing workload and providing safety protections)

— partial and conditional automation, in which pilots provide some control from the ground but onboard automation systems control the majority of activities

— high automation with remote supervised vehicles (one supervisor on the ground monitoring multiple aircraft)

— full automation[2]

UAM providers may be able to leapfrog some stages, or some stages could overlap.

Four major headwinds

The industry will have to recruit, train, and pay thousands of pilots during the next decade or so, before it reaches full autonomy. That reality will beget a range of challenges for businesses eagerly anticipating their automated future.

The cost challenge

Pilots increase costs and the complexity of operation. Our models (using reasonable assumptions about key inputs, such as energy prices, the cost and utilization of vehicles, landing fees, and pilots' salaries) suggest that the cost per passenger-seat-kilometer of a piloted UAM flight could be up to twice the cost of an autonomous one (Exhibit 1).

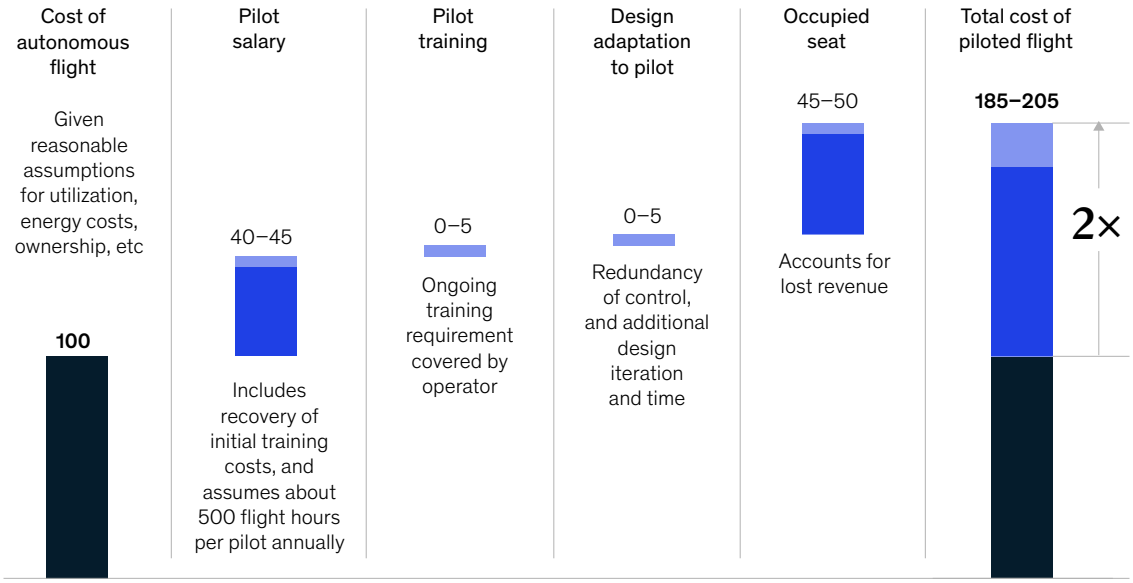
The higher cost will dampen demand for air taxis and reduce the profits of their operators, which might have to accept losing money while they develop their networks, platforms, and customer base. Although this situation may be challenging, operators can hope to recover their losses when autonomy at last arrives.

[1] All financial values are stated in constant 2019 US dollars.
[2] This classification resembles the autonomous-ground-vehicle vision of the Society of Automotive Engineers.

Exhibit 1

The cost per passenger-seat-kilometer of a piloted urban-air-mobility flight could be up to twice the cost of an autonomous one.

Piloted urban air mobility (UAM), cost per passenger-seat-kilometer,[1] %



[1] Constant 2019 US dollars, not adjusted for inflation.

Source: McKinsey analysis

The pilot-sourcing challenge

Finding, training, and retaining enough pilots will be another big challenge. Before COVID-19 brought global aviation to nearly a standstill, operators of smaller aircraft were already having difficulty finding qualified pilots. Projections from before the crisis suggest that already-tight supply of commercial pilots would become even tighter in the future: at that time, current commercial operations were expected to require 320,000 newly trained aviators over the next ten years.[3] The COVID-19 crisis will defer the need for these pilots by a few years and potentially even lower the number required if commercial aviation does not return to its original trajectory. That said, there will still be a need for most of those new pilots toward the end of the decade. Pilots for UAM would come on top of that.

Before the pandemic, several promising and well-funded players announced that they were aiming to start UAM operation by 2023. Of course, the COVID-19 crisis might slow a few players down and shift the start dates by a year or two. But our modeling, based on announced launch dates and expected delays, success rates, production ramp ups, and market constraints, suggests the industry could require about 60,000 pilots by 2028, roughly 17 percent of the total number of commercial pilots in 2018 (Exhibit 2).

Some efforts to reduce the requirements for UAM pilots,[4] and consequently the training burden, are now under way. Approved programs seem many years distant, however. Until then, prospective UAM pilots will have to take today's training

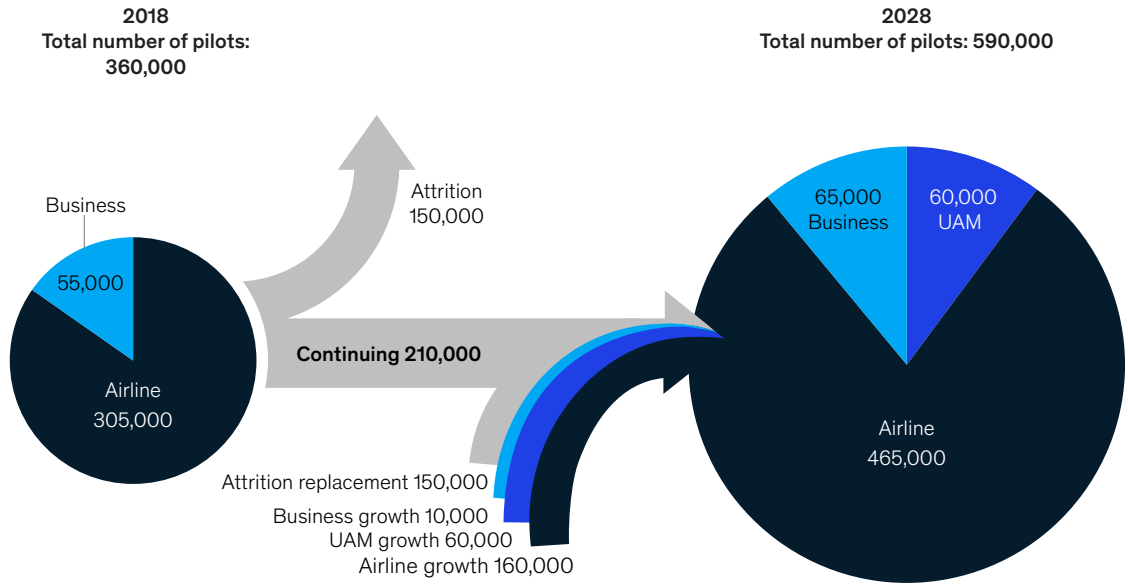
[3] "Airline and business jet pilot demand outlook: 10-year view, 2018 update," CAE, cae.com.

[4] For example, through the concept of Simplified Vehicle Operations (SVO), now being explored by, among others, the US National Aeronautics and Space Administration (NASA), the US Federal Aviation Authority (FAA), and the General Aviation Manufacturers Association (GAMA).

Exhibit 2

Urban air mobility (UAM) will accelerate demand for pilots.

Number of pilots required to fulfill urban-air-mobility (UAM) need in next decade



Note: Numbers are rounded.

Source: McKinsey Flight Crew Model, CAE Airline and Business Jet Pilot Demand Outlook, 10-year view, 2018 Update

programs. Given current training costs, it will take about $4 billion to $6 billion to train 60,000 new UAM pilots. If these aspiring aviators, like the majority today, pay for the training themselves, financial institutions must step in to overcome the tight supply of financing.

Another important challenge will involve creating a value proposition that will encourage people to embrace careers as UAM pilots despite the expense of basic flight training, the 12- to 24-month training period, and—most critically—an uncertain future. The UAM industry is quite vocal about the need to automate, potentially limiting the career of an UAM pilot to a few years. The net present value of a five-year UAM career could be quite low or even negative, given the upfront training cost and the opportunity cost of training time without income, even if compensation levels were in line with current early career pilots (around $40,000 to $60,000 per year). Further, UAM piloting skills and experience may not be transferrable either within or beyond the aviation industry. Many people might therefore believe it would be better to pursue other professions.

Most aspiring UAM operators now focus on technology, employ few if any pilots, and lack experience managing a large operational workforce—whether employed or contracted. All these things will also interfere with sourcing pilots.

The customer-experience challenge

A pilot's presence in a small capsule without a separate flight deck will surely affect the customer's experience of the ride and perceptions of its safety—potentially both positively and negatively—much as experiences with taxi or rideshare drivers do today. In turn, the pilot's presence will influence the willingness of consumers to embrace a new mode of transport. No one quite knows which protocols for customer–pilot interactions will create the safest and most comfortable environment. Will pilots be allowed or even encouraged to converse with passengers? Should they help customers who

feel airsick? How will they balance these tasks with safely operating the aircraft? And what kind of behavior by pilots will give passengers confidence in the safety of the flight? Operators will have to find answers to these questions.

The aircraft-design challenge

A pilot's presence further has implications for the design of UAM vehicles. In addition to the pilot's seat, it will be necessary to design controls and interfaces between the pilot and the aircraft. Industry players will need capabilities (for instance, in human factors) that will be superfluous on autonomous vehicles, and the transition from piloted to autonomous vehicles will require significant redesign of the vehicles. The point is not that piloted vehicles will be harder to design or more complex than autonomous ones but rather that they will be quite different. After spending some years designing and producing one kind of air taxi, their manufacturers will have to switch to designing and producing another.

Piloting the transition to autonomy: Four key initiatives

To address the challenge of recruiting, training, and certifying UAM pilots during the early years of UAM, the industry should pursue four key initiatives. All will require collaboration across a range of stakeholders, including vehicle manufacturers, technology players, operators, regulators, and flight schools.

Streamlining the training and certification of pilots

The industry and its regulators must develop a new kind of certification for UAM pilots because the current standard simply does not make economic sense for them or the industry. Certification and training requirements for today's commercial pilots are complex, lengthy, and expensive—an investment, in both money and time, that UAM pilots might not recoup before automation takes over. Therefore, it is essential to redesign the training—without compromising safety, of course. Such new programs would not only streamline training but also increase the pipeline by opening the business to people who lack traditional credentials or want new kinds of jobs late in their careers.

One important area that has to change is the curriculum. For example, commercial pilots study such topics as high-altitude aerodynamics and the technical details of high-bypass jet engines, neither of which will be relevant for UAM. The new industry's pilot-training programs should also expand the scope of digital instruction, both for ground school and practical flying lessons. Relatively low-cost simulators, for instance, could replace a significant portion of the time currently needed for flight training in real aircraft, or artificial intelligence algorithms could help adapt training to the needs of individual students in real time—for instance, by identifying areas where they require remedial training.

To ensure an ample supply of pilots, operators must offer them an attractive career path. Otherwise, high pilot churn might break their business case.

Developing an attractive value proposition for prospective pilots

To ensure an ample supply of pilots, operators must offer them an attractive career path. Otherwise, high pilot churn might break their business case. The career path might, in some cases, extend beyond operating UAM vehicles for a few years. The options could include serving in nonpilot roles within the operators' scope (for example, as remote operators), reskilling for a future outside aviation, or a transition to piloting commercial jets. The latter option would require flow-through agreements with airlines and financing for type-rating training. Operators could also subsidize the cost of basic flight training to improve the economics of a UAM pilot's short career and make it easier to enter.

Managing the pilot workforce

As we have noted, none of the aspiring UAM operators have strong, rigorous employee-management functions to recruit, retain, and direct employees. They will have to develop these capabilities when they scale up. They will also have to build the capabilities specific to managing pilots, such as those required to optimize schedules, ensure regulatory compliance, create an effective safety culture, and manage organized-labor contracts.

Leveraging pilots to provide an excellent experience and increase UAM's public acceptance

Although the need for pilots will increase the costs and complexity of the UAM business, it may improve customers' experience of the ride, as well as perceptions of its safety. This, in turn, will influence the willingness of potential customers to embrace an exotic new mode of transport.

Operators should design their businesses with pilots in mind and use them to improve the customer experience. A pilot, for example, could not only instill confidence among passengers but also greet them and help them load and unload luggage. As we have already noted, only experience will show which protocols for customer–pilot interactions would create the safest, most comfortable environment.

In any case, pilots on board will gradually promote public acceptance of UAM itself. Our research shows that while most people are neutral or positive about the basic idea, they prefer flying in piloted vehicles, and the very notion of a remotely piloted one will deter some potential customers, at least for now. As the need for human controls progressively declines, the market will gradually come to accept full autonomy.

While UAM's long-term future will be autonomous, the industry must initially recruit, train, certify, and manage tens of thousands of pilots. This will likely only be the case for a few years—a problem in its own right, since pilots might not recoup their training investment, including forgone income, during their careers. Stakeholders across the spectrum—manufacturers, operators, flight schools, regulators, and employment agencies—must collaborate to tackle the significant challenges the piloted ramp-up period is certain to pose. They do not have a lot of time to prevent the supply of pilots from becoming the bottleneck that stalls this new industry's development.

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