December 2019

Travel beyond 2020 Autonomous vehicles

Key themes

- Autonomous (self-driving) vehicles, which can take some of the strain out of short road journeys, are already being trialed.
- Ride-hailing companies are early adopters of autonomous road vehicles.
- Backing from global automotive companies will support widespread adoption of autonomous technology.
- With widespread deployment not far away, it's time to think about the implications for travel policy and duty of care.
- The next traffic congestion-busting revolution has already started, as companies develop flying taxis, with some operating autonomously from the outset.

Getting smoothly around a city can be just as important to business travelers as flying between cities. New business models, such as ride-hailing, are already changing the way we travel around on the ground. Technological innovations including electrification, connectivity and autonomy are poised to further transform the way we travel in and between towns and cities.¹ Autonomous, or driverless, vehicles are most likely to be adopted in larger metropolitan areas like Los Angeles or Greater London in the U.K., where commuters rely on cars for daily commutes. Combined with dedicated road space and demand-driven congestion charges, self-driving cars could help to reduce the congestion that costs Los Angeles an estimated US\$23 billion per year.²

¹<u>McKinsey</u>, An integrated perspective on the future of mobility, Oct. 2016 ²INRIX National Traffic Scorecard Annual Report, 2013

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Productive, stress-free travel

Autonomous cars can remove much of the strain for road travelers, especially when facing a long-distance drive or the challenges of navigating congested and often unfamiliar streets. They also allow travelers to spend their time as passengers being productive between meetings or relaxing after a work trip. And if using a black car, taxi or ride-hailing service, there'll be no need to employ a driver.

Fully-autonomous road vehicles are not yet available in meaningful numbers.³ And the concept has some way to go before it appeals to city planners—in its 2015 study "*City of the future: Technology and mobility*", the National League of Cities found just 6% of the 68 largest U.S. municipalities were considering the effect of driverless technology.⁴

Today, established automotive technology companies, as well as startups like Zoox, are testing self-driving capabilities, with the aim of providing door-to-door travel without a human controlling the vehicle.

The reality is almost here

Mass adoption of autonomous vehicles may soon be a reality. According to McKinsey, by 2030 up to 35% of private journeys could be made in fully autonomous vehicles; that's up from the 15% the consultancy predicted back in 2016.⁵⁶ Many companies are developing self-driving cars, and the technology has shown real promise. Initially, it will most likely be applied to ride-hailing, with a human backup driver as safety support, and will serve short trips before heading intercity.⁷

California has awarded permits to test driverless vehicles to 62 companies.⁸ Alphabet Inc's business unit Waymo is perhaps the best established. In October 2018, it became the first company allowed by California to test driverless vehicles without a backup driver in the front seat. At the end of 2018, it launched a fare-paying autonomous ride-hailing service in Arizona. According to 2018 data from the California Department of Motor Vehicles (DMV), autonomous Waymo cars drove on average 11,254 miles before needing human intervention.

³<u>McKinsey</u>, The road to seamless urban mobility, Jan. 2019
 ⁴<u>PR Newswire</u>, Nov. 6, 2015
 ⁵<u>McKinsey</u>, The road to seamless urban mobility, Jan. 2019
 ⁶<u>McKinsey</u>, Self-driving cars and the future of the auto sector, Aug. 2016
 ⁷<u>Travelandmobility.tech.</u>, Oct. 10,2019
 ⁸Reuters, Dec. 21, 2018

Autonomous ride-hailing

A number of autonomous ride-hailing pilots are under way around the U.S., including Cruise in San Francisco and Voyage in Florida.

In what may be the first commercial robot taxi service in the U.S., Lyft and self-driving technology company Aptiv have operated a small fleet of autonomous cars since the beginning of 2018.⁹ Aptiv, an offshoot of global auto parts supplier Delphi, plans to expand the operation from the Las Vegas Strip to other downtown destinations.

Waymo has followed Aptiv in trialing a fare-paying service. It's also working with Lyft, whose riders in Phoenix can now choose to hail a ride with a Waymo self-driving minivan.¹⁰ As a precaution, a driver must still be present in the vehicle. Waymo will use the arrangement with Lyft to collect feedback and improve the customer experience.

Waymo has also teamed up with Groupe Renault to test autonomous vehicle airport transfers.¹¹ It plans to run a service from Paris Charles de Gaulle Airport and La Defense, a key business hub in the French capital city. Waymo hopes to have the service up and running in time for the 2024 Summer Olympic Games in Paris.

Uber has also actively engaged with autonomous technology; although its self-driving car program came close to closure after one of its vehicles was involved in the 2018 death of a pedestrian.¹² It recently announced a third-generation version of its self-driving car, developed in partnership with Volvo. Designed from the start primarily as a driverless car, the new Volvo XC90 SUV stands out from the conventional vehicles currently being adapted for autonomous operation. Including multiple redundant backup systems that will radically improve safety when operated autonomously, the XC90 may offer the confidence customers are looking for in driverless technology. Uber will start public road tests in 2020.



(Photo by Sundry Photography/Shutterstock.com)

Beyond ride-hailing

Aptiv is already looking beyond ride-hailing to mass vehicle adoption of its autonomous driving technology. It has formed a joint venture with South Korean automaker Hyundai to develop Level 4 and Level 5 production-ready self-driving systems for robot taxi and fleet operators, as well as other carmakers, by 2022.¹³ The backing of a global company like Hyundai will enable Aptiv to deliver self-driving cars at scale.

Zoox is taking a different road to promoting mass-adoption. Rather than retrofitting existing human-driven vehicles with autonomous technology, it is creating an entirely new autonomous vehicle targeted at the robot taxi market. In December 2018, Zoox became the first company to be approved for California's self-driving public transport services program.¹⁴ It's an important step in Zoox's drive to launch commercial services by the end of 2020.

⁹<u>The Verge</u>, Aug. 21, 2018 ¹⁰<u>The Verge</u>, May 7, 2019 ¹¹<u>Phocuswire</u>, Oct. 14, 2019 ¹²<u>The Verge</u>, June 12, 2019 ¹³<u>Techcrunch</u>, Sep. 23, 2019 ¹⁴<u>Reuters</u>, Dec. 21, 2018

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Autonomous cars have their drawbacks

Autonomous cars can take some of the stress out of driving and may improve traveler safety—but unless they are allotted their own dedicated road space, people who use them will encounter the same traffic congestion as those traveling in mannedcars. Traffic is getting worse in most of the world's major cities. Between 2010 and 2016, congestion in London rose by 14%; in Los Angeles by 36%; in New York City by 30%; in Beijing and Paris by 9%.

Ironically, the attractions of a self-driving car, particularly when electric-powered, may put even more cars on the road, potentially making congestion even worse. Congestion can result in productivity and financial losses. It can increase traveler stress and also impact their health by increasing their exposure to air pollution—at least until electric-powered vehicles dominate road transportation.

In a recent simple experiment conducted in the U.K. city of Sheffield, the BBC found car drivers were more exposed to air pollution than either pedestrians or cyclists (Figure 1).¹⁵



Figure 1: Driver exposure to PM2 pollution

Source: BBC, October 2019



Let the plane take the strain

The best way to avoid congestion on the roads may simply be to take to the skies. Boeing, Bell Flight, Volocopter and Sabrewing are among the companies developing electric vertical takeoff and landing (eVTOL) urban air mobility (UAM) solutions. Bell this year unveiled its first flying taxi model—the Bell Nexus—designed to carry four passengers as part of Uber's planned air taxi service, Uber Air. It doesn't expect the Bell Nexus to be fully operational until 2025 at the earliest.¹⁶ Joby Aviation is another company designing a flying taxi for Uber Air. Its backers include Intel, JetBlue and Toyota.

With the support of major automotive and aerospace companies, UAM has a realistic chance of playing a key role in dealing with increasing traffic problems in the world's major cities.

Backed by Daimler AG and Zhejiang Geely Holding—Chinese owner of Volvo—Germany's Volocopter is developing a congestion-busting solution that's autonomous, too. Propelled by 18 electrically-powered rotors, the 2X can carry two adults and a small amount of luggage. While it has a short range of just 17 miles before recharging, this will increase with more advanced designs.

Volocopter is in talks with major cities to get public trials of its planned flying taxi service.¹⁷ It has already successfully completed its first manned flight over Singapore, covering 1.5 km in a two-minute flight at a cruising height of 40m.¹⁸

Volocopter doesn't plan for its vehicles to drive on public roads. It will use its vertical takeoff and landing capabilities to offer short trips between key hubs in some of the world's busiest cities, cutting hour-long car journeys down to just a few minutes. Working with partner Skyports, Volocopter has already unveiled its first full-scale VoloPort air taxi vertiport in Singapore.

Hyundai Motor Group is another automotive company investing in air taxi technology, this year launching its Urban Air Mobility (UAM) division.^{19 20} It aims to develop smart mobility products for the aviation industry.

Chinese-owned Terrafugia is taking a more traditional approach to getting car travelers into the air for short trips. It plans to start selling its Transition car-plane hybrid in 2019. The Transition is essentially a flying car, with four wheels, folding wings and a rear-mounted hybrid-electric engine. It may struggle to compete with UAMs under development because it needs a runway for takeoffs and landings and is unlikely to operate autonomously.



(Photo by flowgraph/Shutterstock.com) Figure 2: Volocopter's X2

- ¹⁷<u>Motor Authority</u>, *Oct. 1, 2019*
- ¹⁸Future Travel Experience, Oct., 2019
 ¹⁹NBC News, Oct. 12, 2018

²⁰Avionics International, Oct. 2, 2019

Disrupting UAM

Even at this early stage, two companies, Metro Hop and FLUTR, are taking disruptive approaches to UAM.²¹ Metro Hop is proposing a short takeoff and landing (STOL) electric aircraft to move goods from warehouses to city center locations. As a conventional airplane, it will travel faster than a rotary aircraft and have a higher payload and longer range, but it would need 200 feet of runway. Metro Hop is also planning a passengercarrying air taxi version.

Munich-based FLUTR Motors aims to create true door-to-door flight through a personal air mobility future unconstrained by landing infrastructure. FLUTR's UAM solution (Figure 3) will require some infrastructure and regulatory approval for vertiports or heliports. Its vision: A bio-diesel-powered personal aircraft capable of flying above the traffic for 125 miles at a top speed of 155 mph. While not quite a door-to-door service, it's close enough, requiring a circular area 26 feet in diameter to land, such as a parking lot or low-traffic street. While this might be a challenge in city centers, it's clearly possible in less dense areas offices, factories, airports. FLUTR's UAM carries a high price tag of \$199,999, although it will offer \$4 by-the-minute rentals. Flights would be largely automated, with passengers selecting the flight path and landing spot. The company expects to have a finished protype capable of flight ready within 18 to 24 months.



Figure 3: FLUTR's UAM

Flight-hailing

In its quest to become the ultimate transportation company, Uber plans to launch an air taxi service in 2023, starting in Dallas, Texas, and Los Angeles. It also plans to offer Uber Air rides from lower Manhattan to John F. Kennedy International Airport.

In order to make Uber Air a reality, Uber needs companies to develop electric vertical takeoff and landing (eVTOL) vehicles. As well as Bell Helicopters, Uber has so far worked with more than five partners, including Boeing and Embraer. Its latest partner is Jaunt Air Mobility.²²

Uber Air flying taxis will be able to seat four passengers with limited luggage. The latest interior mockup from Safran Cabin features space for a pilot, but autonomous operations shouldn't be discounted.

Mike Eggleton

Do you have questions or comments regarding this report? Please email <u>Mike Eggleton</u> to share your thoughts.



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²¹Avionics International, Oct. 8,2019
 ²²Techcrunch, June 11,2019