

The Role of Big Tech in AV Development: What Amazon, Apple, Google, and the Like are Doing to Advance the Industry

By Katelyn Magney

Two weeks ago, Amazon made headlines in the AV industry after reportedly buying AV company, Zoox, for \$1.2 billion. Upon first thought, one might think companies like Amazon have nothing to do with the automotive industry, let alone self-driving technology. The same could be said for the other tech giants including Apple and Alphabet (Google) even though it is well believed they are in a decent position to monetize the technologies behind self-driving cars.

Other tech giants are also worth pointing out. Microsoft is already in the space but largely as a cloud player, and although Microsoft may never venture into cars, they play a predominant role in supporting the DevOps side of the industry much like Amazon. But Amazon, on the other hand, appears to be going all-in with their acquisition of Zoox.

At the end of the day, automated driverless technology (and the greater business of mobility services) is too important to ignore for the big tech companies. Even Facebook has a shot at participating one way or another.

Nevertheless, all these tech giants are well-positioned to participate in the business of automated vehicles; they have access to massive amounts of capital, deep software expertise, and all have an anchor position in the greater technology ecosystem. This tech brief will decompose Amazon, Apple, Google, Microsoft, and Facebook's activities in the self-driving car space.

Amazon

Amazon's recent acquisition of Silicon Valley-based Zoox was one of the largest acquisitions in the company's history. Founded in 2014, Zoox has been working to develop an autonomous vehicle targeted primarily at the robo-taxi market. The company has been closely followed by industry analysts, and in 2018, Zoox became the first company [approved to provide self-driving transport services](#) to the public in California. Prior to its acquisition, Zoox had planned to start additional testing on public



roads in March, but the pandemic delayed those plans in addition to causing [massive layoffs](#). Talks about an Amazon acquisition was reported soon after these layoffs.



A Zoox Test Vehicle in San Francisco ([Source](#))

Amazon has made other significant investments in mobility. A year prior to the Zoox acquisition, it [invested in Aurora](#) as part of a \$530 million Series B funding round. Amazon has also appointed electric truck startup Rivian to get [100,000 delivery vans](#) onto the road by 2030, and was speculated to have been [transporting goods](#) on self-driving trucks with the startup [Embark](#). While Amazon has long relied on USPS for deliveries, they have also been working on developing in-house delivery solutions. Nearly ten years ago in 2012, Amazon bought a robotics company, [Kiva Systems](#), for \$777 million, and used that technology to apply robotics into its warehouse fulfillment centers. They are likely taking a similar approach now in leveraging autonomous technologies for delivery services, considering the cost savings and increase in efficiency they could provide.

In 2018, Amazon partnered with Toyota to launch the e-Palette, a self-driving initiative described as "'Automated Mobility as a Service' ([Autono-MaaS](#))." It was said that the e-Palette vehicles "will be controlled by an automated driving system capable of operating up to 20 kilometers per hour at SAE level 4, supported by an on-board safety operator." Though there has been limited press since the initial launch of the e-Palette, Amazon's involvement once again reinforces their interest in AV technologies. Later in 2018, Amazon submitted a patent application for personalization features in AVs which described AV systems that would identify unique passengers and tailor in-vehicle experiences to their preferences.

One of Amazon's most important connections to the AV/ADAS world is their AWS cloud service. In an [earlier tech brief](#), VSI analysts reported the following Amazon products are being widely used by many AV companies.

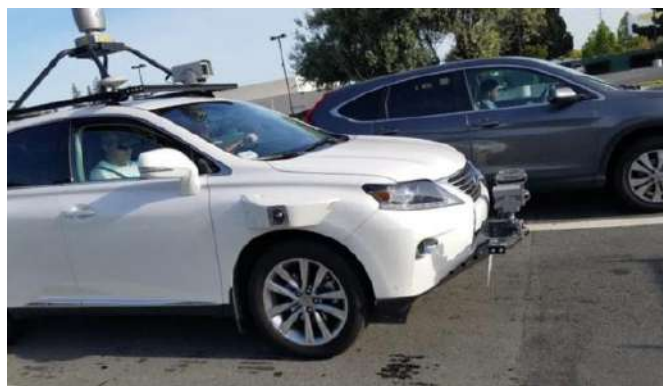
- *Amazon Snowball Edge: Petabyte-scale data transport with on-board storage and computing capabilities.*
- *Amazon EC2 P3: High-performance cloud computing with up to 8 NVIDIA V100 Tensor Core GPUs and up to 100 Gbps of networking throughput for machine learning and HPC applications.*
- *Amazon SageMaker: Fully managed service providing developers and data scientists with the ability to build, train, and deploy machine learning models.*
- *AWS Deep Learning AMIs: Infrastructure and tools to accelerate deep learning in the cloud. Amazon EC2 instances can be pre-installed with popular deep learning frameworks and interfaces.*

While by and large Amazon has been quiet about their involvement in the AV space, they're clearly looking to play a role in the industry. The company more than likely has the capital to continue doing so, and their spot in the market will only be further solidified with their new acquisition of Zoox.

Apple

Starting in 2014, Apple began working on "[Project Titan](#)," with 1,000+ employees developing an electric vehicle at a secret location near its headquarters. The project was largely shelved by 2016, and with new leadership, Apple was said to have transitioned to building an autonomous driving system rather than a full vehicle. In spite of this, [Apple analyst Ming-Chi Kuo](#) believes a vehicle is still in the works, and that it will become Apple's "next star product."

In early 2017, Apple was granted a permit to test self-driving vehicles on public roads in California, and began testing its software platform in several Lexus SUVs leased from Hertz. Many of these SUVs were spotted on the streets of Cupertino, outfitted with a host of sensors and cameras.



Apple Car Spotted on the Road in California ([Source](#))

That same year, Apple CEO Tim Cook [confirmed](#) that the company had been working on autonomous driving projects, stating, "We're focusing on autonomous systems. It's a core technology that we view as very important. We sort of see it as the mother of all AI projects. It's probably one of the most difficult AI projects actually to work on."

Two years later in June of 2019, Apple [bought self-driving car startup Drive.ai](#), supposedly saving the company from going under. More recently, Apple secured a [patent](#) just last month titled "Device, method, and graphical user interface for presenting vehicular notifications." The patent is designed to send vehicle warnings and alerts to a driver's mobile device.

Apple Insider reports the company has filed many other automotive patents, such as one from 2016 on a [path-finding method](#) for collision avoidance, as well as a ["confidence" system](#) to make data-driven driving decisions. Like Amazon, Apple has been relatively quiet regarding their AV development activity, though evidence suggests they are very active behind the scenes and it's possible we'll see a vehicle debuted in the next decade.

Google

Google has close ties to one of the most advanced AV technology in the market, Waymo. Now owned by Google's parent company, Alphabet, Waymo began as Project Chauffeur, an experimental project under Google's X lab for nearly 10 years. In 2016, Waymo spun out into a stand-alone company.



Google Self-Driving Car Prototype from 2009 ([Source](#))

Waymo is arguably the industry leader when it comes to industry advancement, particularly with regard to robotaxis. Earlier this year, the company announced it had driven over [20 million miles](#) on public roads since the company's inception.

In late 2018, Waymo launched a commercial self-driving ride-hailing service called [Waymo One](#). Though service is currently limited to the Phoenix area, Waymo's



launch made it the world's first commercial robotaxi service. Waymo Driver, the company's AV platform, has also been implemented in [Waymo Via](#), their autonomous delivery truck program.

Waymo also leads the industry when it comes to OEM partnerships. Just last week, Waymo announced a [partnership with Fiat Chrysler](#) (FCA) "to get self-driving cars, pickups and SUVs to market." FCA says it's working exclusively with Waymo on Level 4 driving tech for all of its brands. This news comes just one month after Waymo announced a [partnership with Volvo](#), in which they became Volvo's "exclusive global L4 partner." FCA and Volvo have helped Waymo build up a solid base of partnerships, joining existing OEM partners Jaguar Land Rover, and Renault Nissan Mitsubishi.

Facebook

While Facebook hasn't publicly announced any self-driving technology initiatives, speculation has been going around for years. Three years ago, Facebook's COO Sheryl Sandberg [made a surprise appearance](#) at the Frankfurt Motor Show, spurring rumors about their interest in the automotive sector. Sandberg made it clear that Facebook had no plans to make cars, in fact joking, "we're the only company in Silicon Valley that's not building a car." That said, it is entirely possible they're involved in developing self-driving software given the company's deep knowledge in artificial intelligence.



Facebook CEO Demonstrating their Oculus VR Headset ([Source](#))

A [2018 report by CB Insights](#) dives deeper into the AI approach, stating, "The company's work in virtual reality — specifically the Oculus — could also have potential use cases in the auto sector. A number of automakers are using VR at the dealership to allow buyers to test and customize different car features at the lot. VR is also relevant in the design and manufacturing process."

Last month, Facebook [acquired](#) Sweden-based Mapillary, which specializes in building immersive, up-to-date maps. Although Facebook said the acquired technology would be used in developing virtual reality products, mapping information has proven to be greatly useful in developing autonomous driving technology.

Facebook's role in the future of mobility remains to be seen, and VSI will continue to monitor their activity in the space. It's unlikely that the social networking company will build their own AV, but given their AI acumen, they could certainly make an impact on the industry.

Microsoft

Microsoft, while also not building an AV themselves, is supporting OEMs and other automotive tech companies with their massive cloud computing resources. As the largest software company in the world, Microsoft offers a [program for AV startup companies](#), as well as a [connected vehicle platform](#) powered by their Azure platform which competes with Amazon's AWS. Several OEMs and other industry companies including Renault Nissan, Volkswagen, Volvo, BMW, Ford, and Toyota are using Azure to further their AV development.



FEV Software, which uses Microsoft Azure ([Source](#))

Microsoft also offers AirSim, an open-source robotics simulation platform. AirSim, which comes with a model of detailed 3D urban environments, was launched on Unity in the fall of 2018. [Microsoft writes](#) that the goal of AirSim is to provide "a platform for AI research to experiment with deep learning, computer vision and reinforcement learning algorithms for autonomous vehicles. For this purpose, AirSim also exposes APIs to retrieve data and control vehicles in a platform-independent way."

Asked about their role in the industry, [Sanjay Ravi said](#), "Our automotive customers want and need to innovate faster than they've ever done before, and they understand that to achieve that, they need to co-create with partners, suppliers and customers via their own digital platforms." With this position, Microsoft is poised to play a huge role supporting other companies' AV developments.



In a [blog post](#) published in September 2019, Microsoft described their three-pronged automotive approach, highlighting the importance of industry partnerships, a customer-centric data approach, and a commitment to OEMs' relationships with their customers. With this approach driving their strategy, it's likely they will continue to heavily support OEMs and other automotive tech companies with their powerful software.

Conclusion

Regardless of how tight-lipped these tech giants may be about their AV involvement, all of them are no doubt investing in the technology. It is entirely possible these tech companies will pull ahead and gain momentum as startups and smaller companies struggle to stay afloat amidst COVID-19-related economic uncertainty.

We can also expect more acquisitions of start-ups that are running low on cash. Some of these may be considered acqui-hires for purposes of hiring talent, while other acquisitions may be for their patents on components, methods or systems.

Nevertheless, each company's strategy is markedly different even though some details remain behind closed doors. As the race to autonomy continues, one can only expect the tech giants to gain in their respective AV positions.

If VSI were to rank the big tech companies, not just those mentioned in this tech brief, we would surmise their order of importance to be something like this:

1. **Alphabet (Google/Waymo)** -- No company has more in the game than Google (Waymo) with massive fleets, deployments, investments and software expertise.
2. **Amazon** -- has the most to gain from AV technologies on the delivery front. They'll likely move into human mobility as well.
3. **UBER** -- On the human mobility front, we believe UBER (and Lyft to a lesser extent) to hold predominant positions in the race to automated mobility on demand. With this group, the question remains as to how much of the ecosystem they will consume.
4. **Microsoft** -- We believe MS will realize major value from AVs as their Azure cloud platform will be a common element to AV DevOps, but likely to no greater extent than Amazon in this space.
5. **Facebook** -- We believe FB is still a wild card in their space and sooner or later will monetize something from mobility services. That said, we don't know to what extent.



About VSI Labs

Established in 2014 by Phil Magney, VSI Labs is one of the industry's top advisors on AV technologies, supporting major automotive companies and suppliers worldwide. VSI's research and lab activities have fostered a comprehensive breakdown of the AV ecosystem through hands-on development of its own automated vehicle platform. VSI also conducts functional validation of critical enablers including sensors, domain controllers, and AV software development kits. Learn more about VSI Labs at <https://vsi-labs.com/>.

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