DXC.technology

White Paper

Racing to build autonomous cars

Traditional automakers must team with tech firms and computer science companies to manage challenging data, legal and marketing issues

Levels of driving automation

Here's the bottom line: You can expect to see semi-autonomous vehicles (i.e., some human intervention required) on the road in open highway areas by the early 2020s, followed by the first wave of semi-autonomous vehicles in urban areas a few years later. Most experts at the auto companies don't expect fully autonomous vehicles on the road until 2030.[2] It's also unclear when the transition will take place from drivers managing the vehicles to a fully autonomous system in which there are no more manual vehicles on the road — that may take decades.

A last bit of advice: Read carefully when you see articles on autonomous vehicles or advertising from the automakers. It will still take a few years to reach Level 4 in all regions and areas — and fully autonomous driving may be a decade or more away.

Imagine a vehicle that backs itself out of the driveway, waits for you at the curb, knows where you're going and the best roads to get there. You get into the car, but instead of driving, you're the passenger. Instead of navigating rush hour traffic, you spend your commute time eating breakfast, working, or watching a movie. When you reach your destination, the car lets you out at the curb and finds its own parking spot or continues on to serve its next passenger.

This futuristic scenario is fueled by the vision for fully autonomous vehicles, and behind the scenes there is a fierce race among automakers and technology companies to be the first to develop this capability to define the future of mobility. Some $80 billion had been poured into the development of autonomous vehicles through June 2017 by traditional automakers and a range of other interested parties, including the big tech companies, and competition among those involved is ferocious, according to The Brookings Institution.[1] While it remains to be seen who will win, all of the players face massive challenges in five core areas: artificial intelligence (AI), data management, the legal front, public safety and the ability to scale autonomous mobility technology.

Before digging deeper on those challenges, it's worth reviewing where we stand today.

Test cars from the likes of Google's Waymo, as well as Lyft and Uber, have traditional steering wheels and look and feel like a typical car. But the nearly autonomous vehicles that will appear by 2021 will offer passengers an experience more akin to riding on a commuter train. Instead of having two people in the front and two in the back, autonomous vehicles will likely accommodate four people facing each other over a work table. They might also offer spots where a person can sleep comfortably.

	L0	L1	L2	L3	L4	L5
	No Automation	**Driver Assistance**	**Partial Automation**	**Conditional Automation**	**High Automation**	**Full Automation**
DRIVER						
	In charge of all the driving	Must do all the driving, but with some basic help in some situations	Must stay fully alert even when vehicle assumes some basic driving tasks	Must be always ready to take over within a specified period of time when the self-driving systems are unable to continue	Can be a passenger who, with notice, can take over driving when the self-driving systems are unable to continue	No human driver required steering wheel optional – everyone can be a passenger in an L5 vehicle

Figure 1. Levels of driving automation[3]

In fact, we're moving to a time when owning a car may not be the best option for many people — and that puts tremendous stress on a business model that's existed for the automakers for more than 100 years. Especially in Europe, travelers may need a car for only a small piece of a multimodal journey that includes bus, rail and even a service such as Lyft or Uber.

The automakers look to pull ahead

While companies such as Tesla and Waymo have grabbed an early lead in driverless cars, the traditional automakers see the writing on the wall and have been investing heavily, lining up partners and pouring resources into development.

Every major automaker in the world wants to be an early mover, according to Brookings. And if they are not vying for early mover status, they strive to avoid competitive disadvantage. The automakers have been joined by leading automotive suppliers such as Bosch, Continental and Delphi Automotive.

But road tests and simulations create petabytes of data and result in massive data challenges. To cope, many automakers have leaned on computer science companies to solve these data issues.

The tech companies are also joining the race. Along with Waymo, Apple, Microsoft, Alibaba, Baidu and Tencent are increasingly in the mix, and other tech players such as Intel, NVIDIA and Qualcomm are investing big money to make the microprocessors needed for autonomous cars. Fleet operators are also investing, including rideshare and logistics companies that are likely to be the early adopters. These companies have a ready supply of vehicle miles to contribute data for machine learning applications that will change the future of mobility and transportation.

So, while there has been a lot of speculation about how the autonomous car development race will play out, the participants are still jockeying for position, and we can expect to see more deals and partnerships in 2019. Already, Toyota has invested $500 million into ridesharing company Uber to pilot an autonomous vehicle by 2021.[4] And Honda and General Motors announced a partnership to build autonomous cars together.[5] Other partnerships include Argo AI and Ford[6] and Waymo and Chrysler.[7]

The tech companies may claim they can build a better autonomous car, but to really produce cars at production-level scale, they'll have to partner with the automakers and the industry's vast network of suppliers and systems integrators.

The bottom line: It's unlikely that any one company will go it alone. The automakers may have production experience, but they'll also need AI and next-generation computer science and data management skills to build better autonomous cars more quickly.

Five challenges to master

Given the task at hand, here are five major challenges the autonomous driving industry must master to achieve success:

- **Artificial intelligence.** The automakers must look at AI as a new discipline and lean on systems integrators and the broader computer industry for expertise. They will need AI platforms to manage the flow of data at petabyte scale and AI experts to make sense of it all. This will require recruiting talent across the globe who can work in flexible and agile teams.

  They will also have to merge AI with internet of things (IoT) technologies and leverage that marriage going forward. Already, edge computing devices close to the testing action are being integrated into IoT environments to give AI the performance data required for continuous improvement in the near future. To obtain road approval for future innovation, AI technology and driver knowledge must be managed safely and traceably.

- **Data management and privacy.** Test fleets can generate petabytes of data per day around the globe. The automakers need to get the right datasets in front of the right research and development (R&D) teams for the right situations being tested. For example, an R&D team may be testing how vehicles react when pedestrians suddenly cross the road from the right side. The team needs only the videos for that specific situation, not the massive number of frames from the vehicles in all the other scenarios the cars are put through.

  Then there's the consumer data challenge. The new cars will track data on everything from the number of turns the car makes to where the car's passengers dine, where they shop and where they work and travel by car on vacation. Automakers need to figure out how to use this data to help consumers while grappling with the obvious privacy policy issues.

- **Political and legal implications.** Different countries will have to work out whether trade associations and independent standards groups will regulate the rules for autonomous cars, or if it will be done by government agencies. An entire new field of case law and automobile insurance will also develop when inevitable accidents and other product liability disputes arise as autonomous cars make their way into the market.

  In the United States, state governments have slowly been granting permits to test driverless vehicles. Waymo, for example, has been testing driverless vehicles in Phoenix, Arizona, and in October 2018 California gave Waymo the first permit to test driverless vehicles on public roads without a test driver present.[8] The company has begun testing in Los Angeles, Los Altos Hills, Palo Alto, Sunnyvale and Mountain View.

  In the summer of 2018, the Chinese government granted permission to Daimler to test driverless cars on public roads in Beijing. Daimler also has licenses in the United States and Germany, and plans to start offering an autonomous ridesharing service in California in late 2019.

- **Public support and safety.** When cell phones first emerged, signal coverage was poor. While that frustrated consumers, there's much more at stake with autonomous cars. As accidents involving autonomous vehicles occur, the industry will have to spend a great deal of effort to get the public to take the long view on the potential for this burgeoning technology: Over a decade or more, autonomous cars are expected to significantly reduce road fatalities and deliver more convenience to private citizens and business travelers alike.

  In many ways, this is an article of faith. Right now there are no studies, and the historical data does not exist to prove that autonomous cars will be safer in the long run. So the industry has to remain transparent and report to the public frequently about its progress with next-gen data and AI technology, and its testing of autonomous vehicles. As automakers prove they can build safe, reliable autonomous cars, the public should grow to trust and accept the vehicles.

- **Scale.** The issue of which companies will offer the first nearly autonomous cars may become clear during 2019, as both Tesla[9] and Waymo appear poised to make it happen. Of course, the traditional automakers are less concerned with which company gets on the road first, as opposed to which company can mass-produce autonomous vehicles at scale. Making that happen will require the automakers to move out of startup mode and into the next phase, where they identify the building blocks that can scale on an industrialized level. Data management will be critical. Building autonomous cars at scale will require standardized data-gathering methods and an open ecosystem for exchanging data and algorithms for verification and validation, so the automakers and their development network and partners can deliver continuous improvements as the technology for advances in autonomous driving development.

Teaming for success

The major automakers may be slightly behind, but they are confident they will have a profound story to tell and will prevail long-term. They certainly can't be ignored. The car industry has many interdependent suppliers and, as autonomous cars evolve, these relationships will become even more important. Traditional automakers and their suppliers can build cars at scale, and that will be critical if they hope to deliver autonomous cars at price points people can afford.

But the automotive industry must consider the big picture: How can all these complex automotive and computing skills be mastered on a production level so the industry can deliver better quality at less cost for consumers?

The tech companies, on the other hand, have to ask themselves whether they'll be able to keep up or if it would make more sense to forge strategic alliances with the automakers. The next-generation computer science companies and service providers play a crucial role in the autonomous car race because they have the necessary computing skills in their DNA to push automakers and their development partners to the next level of autonomous driving.

In the tech business, however, the trend for many years has been for a dominant player to emerge in each market — the Microsoft desktop, the Cisco router, the Google search engine. However, it's unlikely that the autonomous car market will be

dominated by one or two companies. There might be dominant regional players in the United States, Europe or Asia, but there is too much at stake and too many viable companies working on the issue to presume that only a few will survive.

Instead, it seems likely that there will be a meeting of the minds and skills as the autonomous car market evolves rapidly. The next few years promise to be very exciting. Expect to be amazed.

About the author

Matthias Bauhammer is head of the Analytics Automotive Center of Excellence (COE) at DXC Technology. He is responsible for the thematic development and strategic projects of DXC's Artificial Intelligence and Analytics programs in the automotive industry.

Learn more at www.dxc.technology/automotive

www.dxc.technology/roboticdrive

References

1. "Gauging investment in self-driving cars," Cameron Kerry and Jack Karsten, The Brookings Institution, October 2017
https://www.brookings.edu/research/gauging-investment-in-self-driving-cars/
2. "The Self-Driving Car Timeline — Predictions from the Top 11 Global Automakers," Jon Walker, Emerj, January 2019
https://emerj.com/ai-adoption-timelines/self-driving-car-timeline-themselves-top-11-automakers/
3. "Taxonomy and Definitions for Terms Related to Driving Automation Systems for On-Road Motor Vehicles," SAE International, June 2018
https://www.sae.org/standards/content/j3016_201806/
4. "Toyota invests $500 million in Uber, will partner to deliver self-driving cars by 2021," Nathan Bomey, USA Today, August 2018
https://www.usatoday.com/story/money/cars/2018/08/27/toyota-uber/1115405002/
5. "GM and Honda team up to build an autonomous vehicle; GM shares jump," Phil LeBeau, CNBC, October 2018
https://www.cnbc.com/2018/10/03/gm-and-honda-team-up-to-build-an-autonomous-vehicle.html
6. "Argo AI and getting Ford to Level 4 autonomy," Gary Vasilash, Autoblog, September 2018
https://www.autoblog.com/2018/09/08/argo-ai-ford-level-4-autonomy-self-driving-car/
7. "Waymo is launching a commercial autonomous service," Wes Raynal, Autoweek, November 2018
https://autoweek.com/article/autonomous-cars/waymo-launching-commercial-autonomous-service
8. "DMV OKs fully driverless vehicle testing on Silicon Valley streets," Megan V. Winslow, Los Altos Online, October 30, 2018.
https://www.losaltosonline.com/news/sections/news/297-news-features/58820-dmv-oks-driverless-vehicle-testing-on-local-streets
9. "Tesla Could Have Full Self-Driving Cars On The Road By 2019, Elon Musk Says," Jean Baptiste Su, Forbes, November 2018
https://www.forbes.com/sites/jeanbaptiste/2018/11/07/tesla-could-have-full-self-driving-cars-on-the-road-by-2019-elon-musk-says/#4a48d3e862ac

About DXC Technology

As the world's leading independent, end-to-end IT services company, DXC Technology (NYSE: DXC) leads digital transformations for clients by modernizing and integrating their mainstream IT, and by deploying digital solutions at scale to produce better business outcomes. The company's technology independence, global talent, and extensive partner network enable 6,000 private and public-sector clients in 70 countries to thrive on change. DXC is a recognized leader in corporate responsibility. For more information, visit **www.dxc.technology** and explore **thrive.dxc.technology**, DXC's digital destination for changemakers and innovators.