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Robotaxi Showdown

By Mark Costlow

Self-driving cars have been "coming soon" for a decade now. Many US states have passed some form of **Autonomous Vehicle (AV)** related legislation. Several cities now allow fully self-driving cars on the public roads. Some see this as the inevitable progression of transportation technology. Others are seriously **concerned about public safety**.

It's still difficult to gauge the effects of self-driving cars on public safety. The issues are complicated, which makes it easy to massage the data to support a given point of view. That's assuming the data is even available. The **government requires reporting** of AV-involved accidents but in many cases those **reports have redacted explanations**, under the guise of protecting proprietary information. Whether that is true or not, it makes people suspect things are being hidden.

It's likely the big-picture success or failure of self-driving cars will come down to how well they perform as robotaxis in several large-scale experiments now being performed in American cities.

Is THIS autonomy?

"Self-driving" and "Autonomous Vehicle" are terms that encompass a huge range of capabilities, from informational blind-spot-warnings to fully-automated trip planning and arbitrary road negotiation with no human involvement. That makes it hard to talk about, so the standards body **SAE defined 6 levels** of vehicle autonomy. Now car companies, marketers, journalists, lawmakers and the public can talk about these issues with clear definitions. **Detailed breakdowns are available online**, but here is a summary of the six levels, 0-5:

If your car has blind-spot monitors that alert you to problems, that is **Level 0**. Lane-keeping or smart braking is **Level 1**. **Tesla's "Full Self Driving" (FSD) system** is **Level 2**, in which the car controls steering and speed, but a human driver must be present and alert to take over if needed**.**

Level 3 is the same as Level 2, but the driver does not need to be alert (they can read or watch a movie). **Level 4** is truly driverless, with the car expected to handle any situation, as long as it is on pre-approved roadways (e.g. within city limits and not on freeways). Robotaxis have been testing at Levels 2 and 3 for years but are now deployed at Level 4 on public roads in a few cities.

Level 5 would be a fully automated vehicle, responsible for all tasks under all conditions on any roadways. Level 5 is a long way from reality.

A real AV future requires Level 4. Levels 2 and 3 seem just good enough to relax the "responsible human" into uselessness. We know that distracted driving can be as dangerous as drunk driving. Removing all of the active tasks for a driver seems certain to lead them to daydream, use their phone, or sleep. Emergencies happen FAST, and the context switch time can spell disaster. Level 2 FSD has been successfully marketed by **one car company**, mostly on the strength of personality of their head man, but most other carmakers have stayed away.

AV Needs Robotaxis

For AV to become the norm, the public must become comfortable with it. They must get used to hurtling down the highway in a box controlled by the same kind of machine that routinely mangles messages with auto-correct, deletes good emails while delivering spam, and suddenly stops working at inconvenient times to do updates. It’s hard to convince someone to risk a $50,000 car purchase on untested technology that nobody is sure of.

That's where **robotaxis** come in. Fleets of driverless ride-hailing cars will give people a taste of the technology with no commitment. Pay a few dollars for a ride to the airport, and you get to experience an AV and decide for yourself. It won't change minds overnight, but it may be the only way to give the public hands-on familiarity, and gather the safety statistics missing from debates.

There's no guarantee people will like it. If they start requesting only human drivers, AV projects may be dead on the street. After a decade of effort, this seems a good time to find out for sure if they are on the right track or if it should be abandoned.

Waymo vs Cybercab

The two robotaxi heavyweights are **Waymo** and **Tesla**. They've both been working the problem for over a decade and are starting to see their widespread deployment goals come into focus.

Waymo, a subsidiary of Google's parent Alphabet, started in 2009, based on a **robotic pizza delivery project for The Discovery Channel**. They've been testing and operating cars, with and without safety drivers, since the mid 2010s. The first tests without safety drivers were in Phoenix in 2017.

Waymo’s service is **live in 10 US metro areas, with almost 4,000 cars**. They provide 500,000 paid rides per week and have logged over 200 million fully autonomous miles.

Until recently, Waymo only retrofitted existing vehicles, such as the **Jaguar I-Pace**, with their cus-

tom package of sensors and driving controls. Their sixth-generation vehicle, called **Ojai**, hit the roads in 2025. **Made by Chinese car company Zeekr**, it is Level 4 and has no human driver. It does have an unnecessary steering wheel, but they may simply remove it in the future.

Tesla's robotaxi service has used their Model Y cars, first with Level 2 software, and now transitioning to Level 4. They recently **self-certified as SAE Level 4 capable in Texas**, on the day Texas enacted a law to allow self-certification. Their driverless cars have had remote supervisor support, in which a remote operator can take control when the car itself is unsure what to do next. It is unknown how involved the remote operators are, outside of when they are summoned.

Tesla's plan to scale rests on their **Cybercab**. This is a new purpose-built car model, not a retrofit. It is a 2-passenger sedan with butterfly doors and no steering wheel or pedals. Cybercabs are rolling off the **Gigafactory Texas** line in Spring 2026, but have not yet been added to the robotaxi fleet.

90% of all cab rides are only 1-2 people, so the 2-passenger vehicle may give Tesla a big ongoing cost advantage. The target production price is only $25,000 and it is smaller and lighter, thus uses smaller batteries and less electricity.

Tesla has racked up over 10 billion miles of supervised FSD (Level 2) driving, but no official miles at Level 4 yet. They argue those 10 billion miles of training data have made the neural networks embedded in their driving software the best available, and therefore they are ready for Level 4.

The cars are easy to tell apart. The Waymo Ojai is a boxy converted mini-van with obvious sensors and cameras sticking out all over. The Cybercab is a small, futuristic-looking golden sedan.

Can You See Me?

Waymo's and Tesla's AVs have a big philosophical difference: how to sense the outside world?

Waymo cars bristle with sensors: 13 cameras, 6 **Radar**, and 4 **Lidar** units. Cameras coupled with modern computer vision technology works well to detect objects in the path and flag unexpected events. But vision isn't everything. Waymo's Radar tracks the distance, speed, and size of objects, even in bad weather. Lidar does the same, generating 3D point clouds used to track the location and movement of everything in the environment. These 3 sensors all "visually" inspect the world. Cameras use reflected light, Radar bounces radio waves off everything, and Lidar uses reflected laser light. Together they can provide a complete picture, which **the driving software** uses to figure out the true situation moment to moment.

Waymo also has external microphones, to detect emergency vehicle sirens or trains.

By contrast, Tesla has committed to "Cameras + AI" as the only visual sensing technology. There are 7 external cameras, 1 in the cab, and one in the trunk (to notify you if you leave a bag behind). This issue is hotly debated, with many convinced that an FSD system with Radar and/or Lidar must be safer than one with only cameras. The robotaxi experiment may finally settle this debate, when we get numbers for accidents per road-mile for the two systems doing the same job on the same roads.

Waymo has been **in the news for robocar failures** the most of any of the contenders. They have blocked emergency vehicles, failed to negotiate construction zones, hit a child who ran out from behind a bus in a school zone, and driven into flooded areas. Each incident sparks an investigation and a temporary pause in some part of their service. In some cases, the initial fixes they deploy also failed, resulting in more pauses. This all amplifies the feeling that the general population are unwitting participants in someone else's experiment.

On the other hand, human drivers do all of those things every day. These are newsworthy because no human was behind the wheel. Waymo also has the largest fleet of Level 4 cars by a wide margin, so it is unsurprising that they are experiencing all the edge cases first among their peers.

Showdown in Austin

Austin may be the place where a lot of questions about which system is better will be answered. Waymo already operates hundreds of Level 4 cars there, and it's the obvious city for Tesla's first big level 4 roll-out (some have suggested that eventually new Cybercabs will drive out of the factory to pick up their first fare in the city).

The people of Austin may have a big influence on the future of self-driving cars. They will be spoiled for choice with Waymo, Tesla, Zoox and others operating there.

We may learn if robotic cars can really co-exist with the rest of us and whether they make the overall environment more safe or less. If they are viable, then is Waymo's market lead and experience enough to dominate, or will Tesla's economic advantages give them the edge? You can keep track on this **dashboard of Autonomous Vehicle incidents in Austin**.

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