



The State of Automated Driving: Year in Review

By Phil Magney

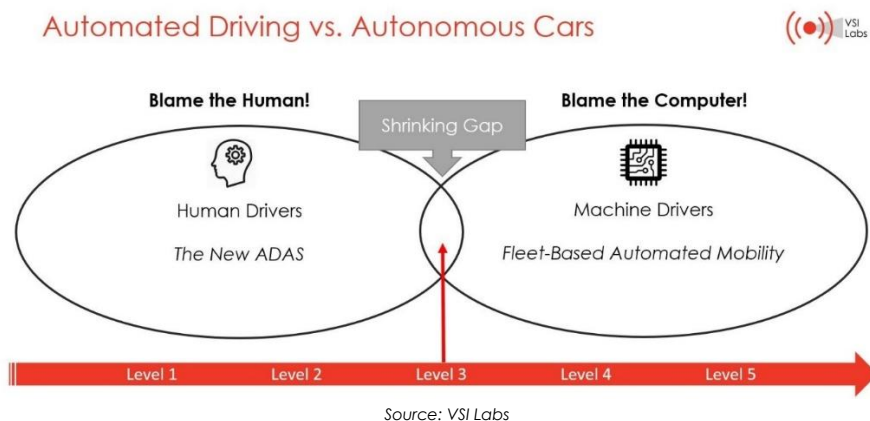
2019 is coming to an end and that means the decade is almost over. Marked by overzealous hype and bold predictions for AV deployment, the new reality has set in. Leading up to this point many AV developers had announced aggressive timelines and bold statements regarding AV deployment.

2019 is a year of the reality check when it comes to autonomous vehicles. Automated driving is a lot harder to do than the industry once thought, particularly at the higher levels. Anyone once promoting Level 3 (or higher) automation by the end of the decade has since scaled back their rollouts or removed them altogether.

The New Reality

The new reality is there are two kinds of AUTOMATED driving – one with a human in control, the other without. Levels 1 and 2 are merely capabilities of incremental automation, but the human is always in control ready to take over immediately. Levels 4 and 5 are robo-taxis, or driverless vehicles with no human intervention at all. Level 3 is forever a grey area that will continue to shrink until someone rewrites the SAE definitions.

This new reality is largely driven by legalities and regulation. Under current regulation, Level 3 is not legal because inattentive or distracted driving will earn you a citation. Level 3 is also sometimes referred to as “eyes off” operation because the car is supposed to navigate entirely on its own. Arguably the biggest reason we don't see Level 3 solutions today, is that the legal exposure is too great for most OEMs to assume.



VSI doesn't believe the two approaches are mutually exclusive as some suggest. Incremental automation is what Tesla is doing. You build up the fundamentals and collect as much data as you can. Eventually you will have gained enough knowhow to apply it to high levels of automation.

2019 was marked by the first commercial deployments of Level 4 "robo-taxis" although operation was only done so with safety drivers. Once driverless deployment starts for robo-taxis they will be done so in a highly constrained way. This likely means dedicated roads and lanes. Robo-taxis may have predetermined drop off and pick up locations. Some of these restrictions will be necessary if robo-taxis share roads with human drivers. If you could eliminate the human drivers from those roads the operational design domain (ODD) would widen in our opinion.

VSI believes low-speed shuttles are a Level 4 application that will do well. A low-speed shuttle is Level 4 by SAE definitions. As the name would suggest, a low-speed shuttle operates within a confined ODD as the reduced speed limits its exposure. More importantly, though, a low speed shuttle follows a pre-recorded path and rarely deviates from that path. Low speed shuttles operate on a "virtual rail" where positioning is determined through land-based infrastructure.

Meanwhile, the traditional sale of series production vehicles to consumers is not going away any time soon. Convenience and safety will be paramount (like today). Vehicles will be sold much like they are now, at least for the next twenty years or so.

Level 3 will happen but will have a hard time reaching SAE definitions. In other words, Level 3 features become increasingly available, but you will not be able to operate them without human supervision. This is essentially the law at present. In time these vehicles may be able to handle complete journeys, but the legal operation requires a driver to monitor operation and be prepared to take over manual operation.

Keep in mind SAE sets the standards but not the laws. Vehicle performance and safety requirements are established at the federal level while operational laws are done so at the state level in the US. In other words, the vehicle design and safety features are regulated by the Department of Transportation which is called Federal Motor Vehicle Safety Standards (FMVSS). Meanwhile, operational requirements are established at the state level. And while they are largely the same state by state, there is no state that allows drivers to operate vehicles without paying attention. Therefore Level 3 is illegal under the legal current system.

New ADAS for Series Production Vehicle – "ADAS 2.0"

An automated vehicle is a safer vehicle. If you drive a Tesla today, you will have more safety features than any other car on the road. During 2019 Tesla pushed out many ADAS features that substantially heighten the safety of their vehicles. Emergency Lane



Departure Avoidance and Conditional Speed Limits are among the latest Tesla software updates.

The fact is when you put that many sensors on the vehicles and create a 360-degree cocoon you have the potential for a safer vehicle. Tesla vehicles did not start out this way. Initially you had adaptive cruise control (ACC) and lane keeping, but in time, Tesla rolled out safety features that are active systems, reacting to situations that require intervention.

Automation Levels 1 and 2 are really the new ADAS as far as the industry is concerned. It is a collection of the incremental ADAS features that are largely sensor based and the springboard to full automation. This incremental approach has been developed and refined over the past 5+ years. This is not to suggest that the technologies are fully matured. They likely will never reach full maturity, just keep getting better.

2019 gave birth to Level 2+ automated solutions. Although Level 2+ has no formal definition, this generally means the vehicle has the capacity to overtake other vehicles and change lanes. Generally, Level 2+ automation relies on a high-definition map and more sensors.

Meanwhile, Level 3 is conditional automation where the vehicle has the capacity to handle stretches of driving on its own. Under these conditions the operator ceases control entirely to the automated driving system for periods of time. But the prospects of seeing Level 3 any time soon remains limited because of the legalities and current regulations.

Because of Level 3 challenges we are starting to see increasing level of performance coming from Level 2+. One example is Tesla's Navigate, a new Autopilot application where the vehicle has the capacity to change lanes, overtake slower vehicles, merge into traffic and even take off ramps without ever having to disengage. However, it is not currently labeled as Level 3 since by law this is not allowed. It is for this reason many of the newer systems entering the market are called Level 2+.

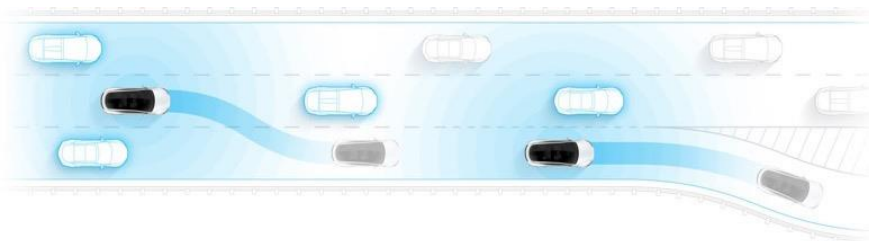


Image Source: [iPhone in Canada Blog](#)

Accordingly, these are functionalities designed for the convenience and safety of the driver and passengers. There are no scenarios in which the car should be blamed for anything. All supervision is the responsibility of the driver behind the wheel. This does not necessarily mean the driver must be physically active in the process. Some Level 2

solutions are also known as “hands-off” where the driver is being monitored through a camera-based system.

Level 3 was once thought to be a level of conditional automation where the driver could step out of the loop to the point where the vehicle would be held responsible if there was a crash. But we don't believe this is practical for a variety of reasons. First, we don't believe automakers will ever be able to take the financial responsibility of a Level 3 vehicle. The exposure is simply too great.

As mentioned earlier, L3 operation is not legal in most states. And while most states have no bills to address automated driving per se, state regulation require drivers to pay attention. In other words, it is illegal to drive and read the paper, put on makeup, or check text messages!

2019 Summary

- 2019 was a year that captured the reality of automated driving. OEMs and AV companies are toning down their aggressive plans and bold statements on autonomous vehicles by facing the hard truth of deploying safe automation. There are still many technological and legal challenges to deploy AVs. However, the AV industry will eventually overcome these challenges as AV is not a matter of if, but when.
- 2019 was a year that recognized the challenges of Level 3 automation. Too much grey area from a legal and regulation standpoint. The industry is settling into two kinds of automation – one where the human is responsible, and one where the computer is responsible.
- 2019 was marked by the realization that ADAS is where the money is at. Many component companies once targeting L4/L5 have repositioned themselves for lower levels of automation from L1 to L2+. The fact of the matter is targeting L4/L5 is going to result in a long time to profitability.
- 2019 was a year in which AI for ADAS and automation became legitimized. No longer is AI thrown out due to its lack of determinism. Rather, AI is now seen as the best approach due to the nature of artificial intelligence. As long as your system is well trained and proven safe enough then using AI is acceptable.
- 2019 was a year in which safety rose to the top. This is all on the premise that the only way to know if an AV is safe enough is to expose it to every scenario known to mankind. To address that, several companies have developed simulators where you can expose a single scenario to endless conditions for greater coverage.
- 2019 was a year for data and nowhere is this truer than in an automated vehicle. An automated vehicle with a diverse sensor package may collect up to a



terabyte of data per hour. Therefore, the industry has given rise to data annotation firms that can label data used for algorithm and system training. The year is also marked by the emergence of new tools for ingesting and managing these large volumes of data.

- 2019 was a year in which computing on the edge became practical and pragmatic. Traditionally, school of thought suggested you could process all the raw data in your central domain controller. But nowadays, many processing tasks get pushed to the edge for efficiency's sake.
 - 2019 was a year for OEMs and Tier Ones to announce a new commitment to ADAS which now includes all human driving application up to L2+. In other words, build solutions on the premise that cars will be sold for the next few decades as human operated machines that happen to be loaded with safety and convenience features including automation.
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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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