

Maintaining compliance amid changing regulations:

5 tools that accelerate vehicle validation

To keep up with the pace of evolving regulations, OEMs need a platform with five key features that speed up vehicle validation.

Automotive technology is changing fast. And regulation seems to be evolving even faster.

Regulators around the world are constantly updating the legal requirements for automotive manufacturers, particularly regarding safety and the environment. The advent of electric vehicles (EVs), advanced driver assistance systems (ADAS), and autonomous vehicles are driving the development of new standards and pose new challenges for OEMs. To keep up, manufacturers need new tools that can help them test and validate vehicles more quickly.

Key challenges for validation teams

If you ask vehicle validation teams about the most difficult challenges they face today, their answer usually involves one of three major trends: ADAS, electrification, and increasing regulation.

1. ADAS

Advanced driver assistance systems (ADAS) are among the most popular features in new vehicles. Researchers at McKinsey predict that by 2035, the passenger car market for ADAS and autonomous driving features could be worth between $300 billion and $400 billion. By 2025, forecasts suggest approximately 63% of vehicles sold will have Level 2 or higher ADAS features.

While ADAS represents exciting opportunities for manufacturers, it also presents difficult challenges. Most ADAS systems rely heavily on perception systems like cameras, radar, and lidar. These systems often don't work equally well in all environmental conditions. OEMs need to make sure that their ADAS features are improving safety in a wide range of circumstances, like night driving, fog, snowstorms, construction zones, bridges and overpasses, tunnels, and more. And that means they need to conduct a lot of test drives, which can take a long time.

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EVOLVING REGULATIONS AND STANDARDS

- Global NCAP
- US FMVSS
- NHTSA Standing General Order
- CAFE standards
- Advanced Clean Cars II
- Euro 7
- EU GSR
- UNECE DCAS
- PROCONVE L-8
- China 6b
- BS VI

Creating systems that work well in all conditions requires a lot of complex software. As issues arise during testing, software engineers need to tweak the software and then start the process of testing all over again. Relying more heavily on software also opens up the possibility of bad actors finding a way to hack into the systems, so companies have to maintain security as well.

Engineers also need to account for regional variations in roads and regulations. A speed limit sign in Germany does not look like a speed limit sign in Canada, which does not look like a speed limit sign in Saudi Arabia. That adds even more complexity to software development and testing. Taken all together, these factors drive up the time it takes to develop new systems and get them to market.

Electrification

The trend toward electric vehicles (EVs) is similar to the trend toward ADAS. Sales of EV cars increased 35% between 2022 and 2023, and they are expected to keep rising. Globally, about 18% of cars sold in 2023 were EVs, and in some regions, like China, Europe, and the United States, the percentage was much higher. For example, in Sweden 60% of new car sales are electric, and in Norway, EVs account for a full 95% of sales.

As with ADAS, this trend presents challenges as well as opportunities. Range anxiety is a real problem for customers, and the limited charging infrastructure heightens these concerns. That puts a lot of pressure on OEMs to increase the range of their vehicles and make sure they are accurately predicting how far vehicles can go before running out of charge.

Because EVs are so different from internal combustion engines, manufacturers also require new processes and systems for testing and validation. They need to understand how different charging levels affect battery health, and some of the same environmental variables that affect ADAS systems, particularly temperature and weather, can also affect EVs.

Regulation

The last key trend — regulation — overlaps with the ADAS and EV trends. As manufacturers develop new ADAS systems, government agencies are mandating new safety requirements that rely on the technology. They're requiring that some new features, like automatic emergency braking and intelligent speed assistance, be implemented into new vehicles. And they have requirements for performance and incident reporting.

The regulations around electric vehicles are even more intense. Some regions have EV quotas or have outlawed internal combustion engines altogether. Many areas have limits on exhaust and particle emissions, along with strict reporting requirements.

These rapidly evolving regulations place an even bigger burden on manufacturers. They often have very short timeframes for developing and implementing new technologies. They also need new systems and process for complying with reporting requirements. And if they don't comply, OEMs can get hit with costly fines and lawsuits, which can also lead to brand damage.

Accelerate validation to overcome challenges

To stay in compliance and take advantage of the opportunities afforded by ADAS and EVs, manufacturers need to speed up their development and testing processes. One way to do that is to implement a preproduction validation platform with five key characteristics:

1. Edge analytics

Some teams have vehicle data logging and analytics systems that are completely siloed from one another. The loggers in the vehicle simply collect the data and transmit it to the cloud for analysis. This two-step process always has some latency because it takes time to send the data, time to analyze it, and time to send any messages back to the device. These issues get compounded when vehicles are driving in places with spotty connectivity, such as mountains or proving grounds in remote areas.

While this latency isn't always a problem, it can slow down validation processes. In addition, many of the newer

vehicle regulations, such as the EU's Euro 7, require on-board monitoring (OBM). The vehicle needs to provide immediate alerts when a vehicle does not comply with environmental or safety standards.

Validation teams can speed up processes and improve compliance with OBM requirements by using an integrated data logging and analytics solution with the ability to do edge analytics. By analyzing data right in the vehicle instead of in the cloud, you avoid the latency of sending data back and forth. And you can get immediate alerts if you have an issue with your OBM system or any other systems in the vehicle. Importantly, you can still get some alerts even if the vehicle is not connected to a cell or Wi-Fi network. In addition, edge analytics streamlines validation of OBM systems by supporting champion/challenger methods used to improve models.

In short, edge analytics makes validation faster, allowing you to adjust quickly to changing regulations.



2. Event-based data collection

When engineers think about their vehicle data collection, they often think that they want to collect as much data as possible. After all, it seems like more data is better.

In reality, today's vehicles generate so much data that collecting and storing it becomes cost-prohibitive. In addition, it's very difficult to efficiently search through all that the data to find exactly what you need.

A better approach is to collect and analyze just the relevant data. Typically, this will be the data related to a particular event. For example, If you needed validate that a lane-keeping assist system (LKAS) complies with regulations, you'll need data from times when the LKAS steers the vehicle back into the lane and times when the LKAS disengages because it doesn't sense lane markings.

Collecting data during these specific events can help prevent data overload, allowing engineers to find the relevant information quickly. With the right solution in place, you can also receive alerts when these events happen so that if something unexpected or undesired is happening, teams can start troubleshooting right away. This approach also keeps costs low by making efficient use of engineers' time and minimizing the amount of data stored and transmitted.

Importantly, this approach also gives you the flexibility you need for compliance. If regulations or standards change, you can quickly change your event-based data collection to meet the new requirements.

3. Immediate OTA updates

Another key technique that helps improve flexibility is immediate over-the-air (OTA) updates. With some vehicle data collection solutions, engineers or technicians have to physically interact with the data logger in order to update the data collection strategy.

That doesn't work well in a fluid situation where requirements are changing quickly.

A better approach is to implement a solution that allows you to manage the OTA updates remotely. This eliminates the cost and expense of having personnel travel to the vehicle. And it opens up the possibility of running test

vehicles in locations far away from your engineering staff.

Immediate OTA capabilities also speed up the validation process. For example, imagine that your team discovers that a particular model of EV is experiencing issues with Level 2 charging. With OTA, you can immediately start collecting a wide range of signals during and after charging cycles so that you can begin troubleshooting without needing to visit the vehicle or be physically present during charging.

Similarly, you can immediately change how you collect data when new regulations are proposed or enacted to ensure compliance.

4. AI-enabled video

When validating ADAS and EVs, engineers often find it very helpful to have video of test drives so that they can see how objects and environmental conditions affected vehicle or system performance. For example, EV batteries may not perform as well in the snow, and automatic emergency braking needs to be tested around a wide range of vehicle types, such as cars, SUVs, emergency vehicles, bicycles, and motorbikes.

Unfortunately, analyzing that video often requires someone to watch thousands or even tens of thousands of hours of footage to tag what is happening in each frame.

Harnessing the power of AI dramatically cuts down on that manual work. For example, Aptiv offers Video Insights, which tags variables like road signs, tunnels, traffic jams, cars, trucks, buses, motorcycles, bridges, and more. That allows engineers to quickly spot objects or conditions that are consistently present when issues occur and to search for objects or conditions during other trips. It also makes it easier to ensure that you have completed the desired number of test cycles under different conditions.

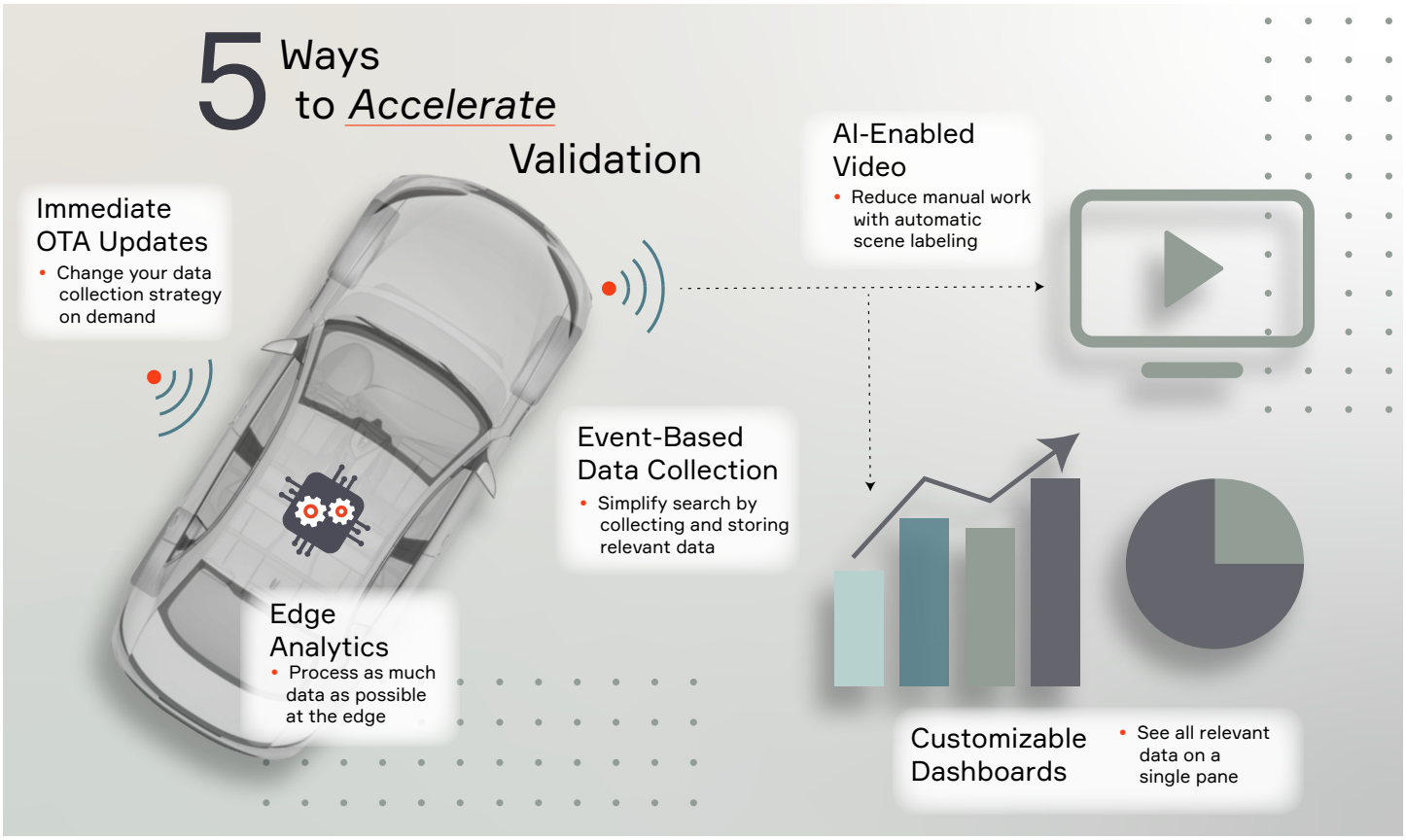
In addition, AI makes it easier to comply with privacy regulations. It can automatically blur license plates and faces so that your team appropriately safeguards the identity of bystanders captured in your videos.

And unlike human analysts, whose labels can vary, AI labels items the same way every time they appear in the video footage. That adds a greater degree of consistency and reliability to your data, making it suitable for higher levels of analysis.

5. Customizable dashboards

The final way to speed up validation to aid in compliance is with customizable dashboards. Dashboards provide visualizations that allow you to see key performance indicators (KPIs) on a single pane of glass. Those KPIs can include data vital for compliance. Instead of running a new report to see if your vehicles are in compliance with regulations, you can take a quick look at the dashboard.

Ideally, dashboards should also allow you to drill down into specifics of a particular incident for troubleshooting. For example, Aptiv Connect Qualifier has an optional in-use monitor performance ratio (IUMPR) dashboard that aids manufacturers in demonstrating their compliance with certain regulations. It counts how often monitors



run and tallies a compliance percentage. It also provides a table of raw data that highlights incidents of non-compliance, allowing engineers to quickly find details about the calibration and conditions that resulted in the lack of compliance.

When dashboards are customizable, like the dashboards in Qualifier, it makes it easy to update them as regulations evolve. That provides the flexibility teams need to adapt to new requirements and to changing market conditions.

Putting it all together

To understand how all five of these tools work together, consider an example of validating an automatic emergency braking (AEB) system that must comply with the EU's AEB requirement.

First, you would install an Aptiv EP-2000 vehicle data recorder and an Aptiv video system in the vehicle. This allows you to send an over-the-air update telling the EP-2000 to collect data whenever the AEB system activates. When that event occurs, the EP-2000 will use edge analytics to begin processing data in the vehicle and can even send alerts if you choose.

From the Qualifier web application, you can view a dashboard that provides an overview of total AEB occurrences and false positives — times the AEB system engaged without an object directly in front of the vehicle. To see what happened with a particular false positive, you can drill down and click a link that provides a visualization of the relevant data signals at the time of the event, as well as labeled video footage showing what happened.

That gives you all the information you need to quickly determine if the AEBS is functioning as intended or if you need to tweak your software to achieve compliance.

Aptiv Connect Qualifier provides a complete, end-to-end preproduction validation solution. It includes the five tools discussed in this paper that help simplify compliance.

Additional resources

To learn more about how Aptiv Connect Qualifier can help you speed up your validation processes and maintain compliance with evolving regulations, check out the following resources:

- Strategies for Maintaining Compliance Amid Changing Regulations presentation slides
- Is Your Validation Team Ready for EV? 4 Things You Need to Know
- Aptiv Connect Qualifier ADAS video
- Aptiv Connect Qualifier ADAS solution brief
- Aptiv Connect Qualifier Video Insights
- Environmental Insights integrated road and weather data
- Qualifier Overview Video

APTIV CONNECT QUALIFIER

Used by more than 70% of the world's leading vehicle manufacturers, Aptiv Connect Qualifier dramatically reduces the time it takes to find and fix vehicle problems, helping save millions of dollars. It includes Aptiv's Edge hardware that collects more signals in finer detail than any other solution and the Connect Edge software that begins analyzing that data right in the vehicle.

Qualifier transmits this pre-processed data to the cloud for additional processing before making it available in the Qualifier web application, which offers issue management, reporting, root-cause analysis, visualizations, and advanced analytics. Optional capabilities include AI-enabled video and integrated road and weather data. Qualifier can even ingest files captured with other data loggers, allowing you to perform comprehensive analysis on your vehicle data.

To set up a demo, contact Aptiv's sales team at sales@aptivcs.com.

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