

Competitive Landscape

There are three primary segments of competition for testing of connected and autonomous vehicles

| | Public roads | Privately-owned facilities | 3 rd Party-owned facilities |
|--------------------------|--|--|--|
| Definition | Public roadways (regulated by states) available to organizations testing CAV technology. Typically highways as driving conditions are simpler than urban environments. | Private test facilities available to OEMs and their suppliers (when allowed). Typically located near manufacturing facilities or extreme climates. | Facilities owned and operated by non-OEMs. Seek to supplement overall capacity and often offer specialized facilities or services, and often offer required certifications |
| Capacity | 4 million roadway miles / 2.3B acres (US only) | At least 30k acres in North America alone | Total acreage is doubling, but acreage for Smart City testing 40x by 2020 |
| Strengths | Free, real world simulation | Repeatable and confidential | Repeatable, shared costs and expertise, high utilization |
| Weaknesses | Risk of accidents, loss of confidentiality, least repeatable, highly regulated | Capital intensive and low utilization | Moderate cost, shared resource, low availability/accessibility |
| Use Cases | Validating semi-proven technology | Validate and fine-tune new & confidential technology, performance against benchmarks | Simulate / test specific scenarios, lacking in-house capability or capacity, certifications |
| Primary User Base | Tech Startups; eventually all players | Larger OEMs | Larger suppliers, Commercial Vehicle OEMs |

Source: Deloitte interviews and analysis; Bureau of Transportation Statistics

Sources of Demand

While total demand for testing is growing, this is not the case across all customer segments who are developing CAVs and related capabilities

| | Customer Segment | | | | | |
|--|--|---|--|--|--|---|
| | LV OEMs | CV OEMs | Traditional Suppliers | Non-Traditional Suppliers | Regulators | Infrastructure & Other |
| R&D and Testing Behavior | Most OEMs own large proving ground facilities with broad capabilities and a variety of lab-based testing facilities | Most CV OEMs have proving grounds with limited capabilities, and some lab based | Larger Tier 1s have own proving ground and both Tier 1 and 2 suppliers test components in lab-based facilities | Technology players test similarly to suppliers, and do a lot of lab-based testing before taking vehicles on public roads | Regulatory bodies need to conduct tests to set standards and certify vehicles | External entities such as infrastructure providers (e.g. AT&T, Verizon), engineering and testing companies (e.g. AVL, Defiance) |
| Need for additional 3rd Party Facilities | Minimal - OEMs will rarely use 3 rd party facilities for specific purposes (e.g. Mcity for city environment, TRC for high speed and emissions) | Strong - CV OEMs will often use third party facilities and public roads for tests that require more space than is available at their own proving grounds | Moderate - Most suppliers utilize 3 rd party facilities or OEMs' proving grounds | Moderate - They will sometimes use 3 rd party facilities as preliminary test grounds prior to putting new technology on public roads | Strong - Much of the federal testing is done at Ohio's TRC and may not face capacity constraints to justify establishing a new facility | Varies - Telecom companies are partnering with third party facilities to better understand how to support connectivity |
| Illustrative Companies | Ford, BMW, GM | PACCAR, Daimler, Cummins | Bosch, Delphi, Harman, Visteon | Uber, Lyft, National Instruments, RideCell, NVIDIA | NHTSA, USDOT, State DOTs | AT&T, Verizon, AVL, Ricardo |
| Expert Interview Comments (45+ total) | 0 of 40 experts said LV OEMs would need additional third party test facilities | 9 of 11 CV experts noted a desire for third-party test facilities for full-scale testing | 6 of 11 interviewees with supplier experience said there was a need for additional testing grounds | 5 of 9 interviewees said they could benefit from a controlled environment as opposed to public roads | 20 experts brought up the potential need for a third party facility to develop regulations for CAV technologies | 4 experts noted the need for third party facilities to work with Telecom companies to understand their role in CAVs |

Source: Deloitte interviews and secondary research



More 3rd Party Test Sites Needed for Commercial Vehicles

Nature of Demand

New capabilities and technologies being developed by transportation companies will require more and different capabilities from research and test facilities

| | Customer Needs | | |
|-----------------------------|--|--|---|
| | Physical Environment | Technological Environment | Intellectual Capital |
| Description | Assets that enable users to test vehicle performance and simulate various scenarios in a physical, controlled environment | Assets required for researching, developing, and testing vehicles, technologies, and systems in simulated environment | Staff, facilities and capabilities that provide support and specialized expertise to users of the facilities, and conduct research around emerging technologies |
| Value | The physical environment is primarily used to test and validate hardware durability and performance. Recently, CAV technologies have started being tested in cityscape test tracks and public roads | In a virtual/simulated environment, manufacturers can test vehicle performance in millions of specifically designed scenarios over a short period of time | CAV technologies are evolving rapidly, so in order to put a vehicle on the road, stakeholders need staff with expertise in the latest and greatest |
| Components (not exhaustive) | <ul style="list-style-type: none"> • Ovals and high speed tracks • Hills • Various surfaces • Cityscapes • Highway access • Extreme conditions | <ul style="list-style-type: none"> • Data collection infrastructure • Virtual Reality simulators • Lab space (e.g. Dynos, Wind tunnel) • Sensors • Wi-Fi/5G | <ul style="list-style-type: none"> • Staff engineers • Training programs • Data analysis • Computational/software acumen • Researchers (e.g. cybersecurity, powertrain) • Sponsors/alliances • Think tank/incubator • Government/regulator presence |

Source: Deloitte interviews and secondary research

Identifying Where to Play

There exists opportunity in the market for fully integrated and highly sophisticated 3rd party test & research facilities

