

Driving into the future: The fast-track to Software Defined Vehicles (SDV)

How HCLTech is helping car manufacturers /
OEMs innovate at speed with cloud-native,
AI-driven validation

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A quiet revolution is reshaping the automotive world. Today, performance is no longer measured by torque or horsepower, it's measured by processing power. Modern vehicles are now sophisticated data centers on wheels, running over 150 million lines of code. A number expected to double by 2030. As over-the-air (OTA) updates, autonomous driving and data-powered services become industry standards, vehicles are being redefined with every new software release.

However, as automotive software evolves rapidly, traditional validation methods haven't kept pace. Hardware-bound, sequential development cycles and overloaded test benches are no longer fit for the fast, flexible demands of the software-defined vehicle (SDV) era. The road ahead has changed and so must our approach. Car manufacturers now face a pivotal challenge: to rethink how vehicle software is developed, validated and deployed to stay ahead.

Why virtualization is the new standard

To meet this challenge, many car manufacturers are turning to virtualization as the new industry benchmark for validation. Virtual validation revolutionizes how vehicles are engineered by replacing physical prototypes with scalable, cloud-native simulations — dramatically accelerating delivery, enhancing safety and ensuring compliance from day one.

Key benefits include:



Speed to market

OTA-ready software releases move from months to days.



Expanded test coverage

Billions of edge cases, including rare fault and cyberattack scenarios, are validated long before hardware is available.



Regulatory confidence

Digital traceability supports ISO 26262 and UNECE R155/R156 compliance from the outset.



Continuous evolution

Persistent digital twins allow feature development and validation beyond vehicle launch.

Virtualization is not simply a shift in tools, it's a fundamental shift in mindset, enabling continuous innovation in a rapidly transforming landscape.

Engineering for the real world: HCLTech's virtualization framework

To fully realize the benefits of virtualization, automobile manufacturers need more than individual tools. They need a unified architecture. That's where HCLTech's virtualization framework comes in. Built on over three decades of automotive R&D expertise, it delivers a cloud-native, modular validation architecture that integrates seamlessly with existing ecosystems.

Our four-layer reference stack harmonizes Model-in-the-Loop (MiL), Software-in-the-Loop (SiL) and Hardware-in-the-Loop (HiL) environments, without costly rewrites or toolchain overhauls:



Simulation core: Ultra-precise mechanical systems simulate real-world dynamics, weather, tire behavior and sensor input.



Interface provider: Translates simulation data from OSI (Open Simulation Interface) into in-vehicle communication formats (CAN, FlexRay, Ethernet) to enable accurate rest-bus emulation.



Virtual ECUs (vECUs): Execute production-grade binaries or behavioral models across vehicle domains – and ADAS, body, powertrain and more.



Test framework: Automates execution, monitors system health and generates insights across regression, stress and scenario-based testing.



Every layer is open and tool-agnostic, allowing seamless integration with both commercial (e.g., CarMaker, VTD, ETAS, dSPACE) and open-source platforms (e.g., CARLA, SUMO), as well as consistent deployments across cloud providers like AWS, Azure and GCP.

TestSphere: Automating at scale

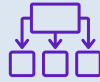
At the heart of HCLTech's virtualization solution lies TestSphere, our flagship AI-driven validation suite. TestSphere industrializes the testing process using Keyword-Driven Testing (KDT) aligned with ISO 29119-5 standards. By translating plain-language test logic into scalable, executable test scripts, TestSphere dramatically reduces manual effort while enhancing traceability and audit readiness.

Its core capabilities include:



Simple and composite keywords

Transform high-level test steps (e.g., SetSignal, ReadSignal) into standardized, reusable components.



Decomposer

Breaks down complex composite actions into detailed, executable steps.



Sequencer

Dynamically adjusts data stream, supports unit conversions and adapts test parameters.



Test case generator

Auto-generates test cases for tools like TPT, ECU-TEST and EXAM.



Reporter

Connects execution results to their originating keywords for full traceability.



Keyword database

Centralizes standardized test language across teams and projects.

With support for multi-platform execution, TestSphere bridges MiL, SiL and HiL environments — achieving up to 75% reduction in manual test design time while meeting global safety and compliance standards.



Real-world impact: From weeks to days

This approach isn't just theoretical, it's delivering results. A leading global OEM recently approached HCLTech with a bold goal: compress their Advanced Driver Assistance Systems (ADAS) regression testing cycle from several weeks to days.

To solve this, HCLTech implemented a series of strategic actions:

Modularization

Enabled plug-and-play simulations through a block-based architecture for rapid component swapping.

Tool migration

Transitioned simulation workloads to CarMaker within four weeks, unlocking advanced environment and sensor modeling.

Platform-agnostic deployment

Used Terraform and Packer to deploy hybrid simulation clusters on local VMs and cloud infrastructure.

KDT optimization

Condensed a 400-line test script into a streamlined, 16-line keyword-driven sequence - executed in parallel across SiL and HiL setups.



The outcome:

75% reduction
in test design
effort

Fully automated
testing from
implementation to
reporting

Complete
traceability from
requirements to
results

Validation
cycle reduced
from weeks to
just 24 hours

Beyond validation: A future built on self-optimizing vehicles

While virtualization is revolutionizing validation today, it's also paving the way for tomorrow. HCLTech is evolving the ecosystem further with AI-generated test scenarios, real-time digital twins and intelligent test benches, that learn and optimize themselves.

These emerging capabilities will empower:



Predictive
safety
patching



Adaptive
performance
tuning



Ongoing
regulatory
compliance

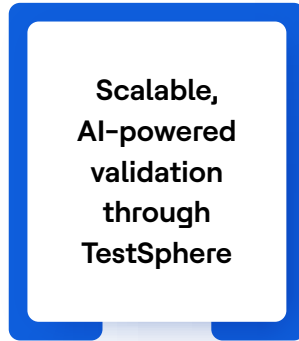
As we move from driver assistance to true vehicle autonomy, success will hinge on systems that continuously learn, adapt and self-correct in real time. That's not just agility, it's embedded intelligence.



Why partner with HCLTech?

The journey to software-defined vehicles demands more than cutting-edge tools. It requires a trusted partner with deep automotive expertise, proven digital capabilities and a record of delivering scalable innovation.

We offer:



Explore how HCLTech is empowering global OEMs to fast-track the shift to software-defined vehicles, through intelligent validation, cloud-scale simulation and future-ready innovation.

HCLTech | Supercharging Progress™

HCLTech is a global technology company, home to more than 223,000 people across 60 countries, delivering industry-leading capabilities centered around digital, engineering, cloud and AI, powered by a broad portfolio of technology services and products. We work with clients across all major verticals, providing industry solutions for Financial Services, Manufacturing, Life Sciences and Healthcare, High Tech, Semiconductor, Telecom and Media, Retail and CPG, and Public Services. Consolidated revenues as of 12 months ending March 2025 totaled \$13.8 billion. To learn how we can supercharge progress for you, visit hcltech.com.

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