



# SIL for Early Validation

FCA Accelerates Software Testing with Agile Practices and Virtualization

The Global Electrical Engineering and Software - Virtual Engineering Team (EE&SW VE Team) of Fiat Chrysler Automobiles (FCA) is implementing a new and improved software development and test platform that embraces agile technology practices and virtualization capabilities to enable early validation.



*Virtualization is a key concept when we talk about agility.*

By being able to quickly adapt to changes that can arise at any stage of the software development cycle, such as new requirements, code errors or integration issues, the new test platform will leave the EE&SW VE Team better positioned to secure optimal outcomes. "At FCA, we focus on best software development and testing practices," said Sangeeta Theru, Vehicle Modeling and Integration Lead, EE&SW VE, FCA US LLC. "Virtualization is a key concept

when we talk about agility in the controls and software development process." Some of the main benefits that are supported by virtualization include:

- A reduced number of costly iterations by frontloading tests
- Iterative development of complex new functions at an early stage
- Ability to perform development work on a laptop / computer without requiring the physical controller
- Reuse of plant models and test scenarios across xIL test platforms

[model-in-the-loop (MIL), software-in-the-loop (SIL) and hardware-in-the-loop (HIL)]

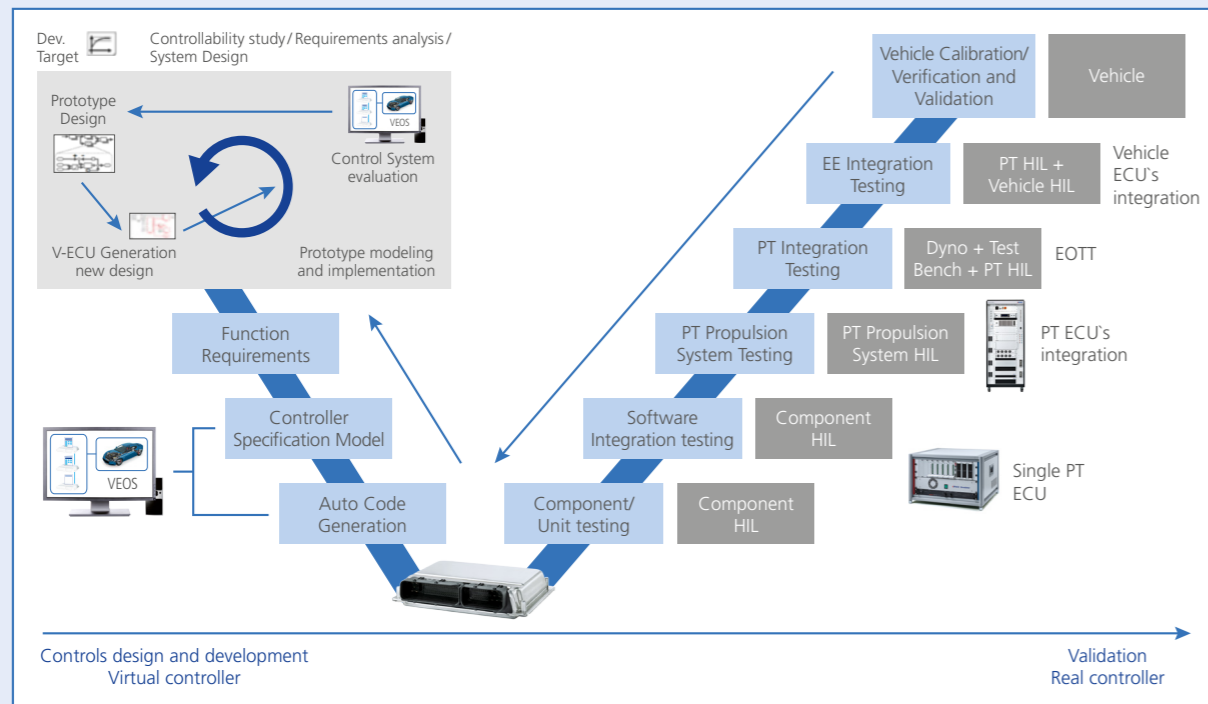
**Valuable Time and Costs Savings**  
A key incentive of the FCA virtual test platform is the capability to perform early software validation. This is made possible by creating a virtual version of the electronic control unit (ECU) under test. The virtual ECU is a physically-equivalent replica of the real ECU. By utilizing virtual ECUs in >>



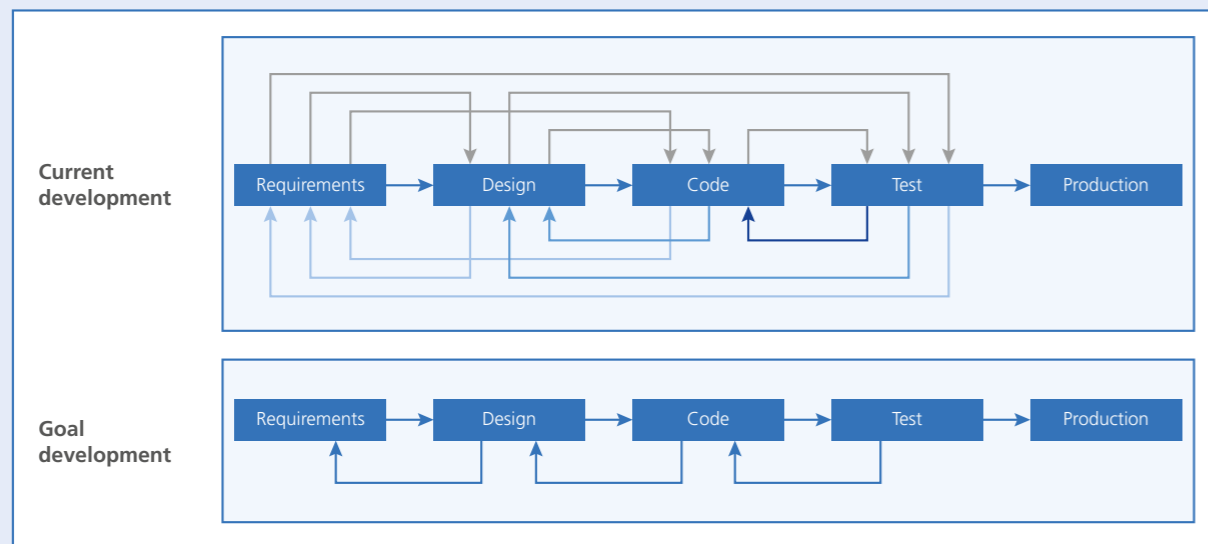
"Early validation at the software level significantly improves our test efficiency. To use it reliably, we rely on the PC-based simulation platform dSPACE VEOS, which integrates well into our test workflows."

Sangeeta Theru, Vehicle Modeling and Integration Lead, EE&SW VE, FCA US LLC.





Frontloading software validation and verification through SIL testing.



Development process optimization with agile methodology.

software-in-the-loop (SIL) testing, early and realistic ECU software validation can be performed – even before the first prototype becomes available. This process enables issues to be identified and debugged much earlier in the development process, saving valuable time and costs.

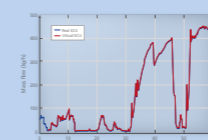
The EE&SW VE Team began its initiative to develop a virtual test platform in 2016 and has been working closely with dSPACE. Their test platform includes dSPACE VEOS, a PC-based simulation platform that enables virtual validation. VEOS makes it possible to simulate a wide range of different models,

such as function models, Functional Mock-up Units (FMUs), virtual ECUs (V-ECUs), and vehicle models, in the early development stages – independent of any specific simulation hardware. The latest version of VEOS supports the AUTOSAR Adaptive Platform for high-performance computing re-

**Key Points of VEOS**

**Realistic Simulation**

- Bus simulation
- Reproducible
- Benchmarks



**Consistent Workflow SIL to HIL**

- Models for all platforms
- Same sophisticated tools



**Support of all Relevant Standards/Formats**

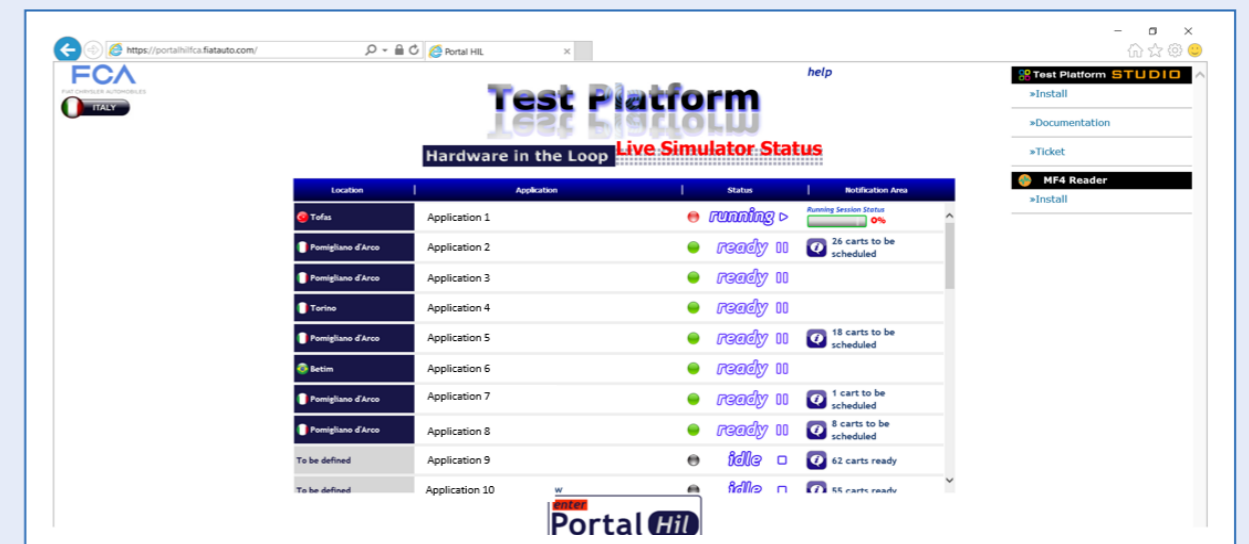


**Simulation for Each Situation**

- Virtual ECU network
- Sensor simulation
- Virtual vehicles



VEOS is a PC-based simulation platform for validating the software of electronic control units (ECUs) in early development process stages.



Screen shot of the FCA Virtual Test Platform showing the status of four virtual tests.

quirements, such as applications for autonomous driving. “Early validation reduces costly iterations due to issues or bugs identified very late in the vehicle program development timeline,” explains Giancarlo Di Mare, Head of Virtual Engineering, FCA Italy S.p.A.

Mr. Di Mare adds that VEOS and the virtual test platform technology integrate well into the overall model-based development and ECU testing workflow. The integrated workflow consists of database and workflow management to collaborate within different teams across different test

phases and xIL environments (MIL, SIL, HIL). FCA currently uses an internal, keyword-driven tool (VST) for test automation and traceability to requirements and test cases in IBM Rational Quality Manager (RQM), which enables remote global testing in all FCA test facilities.





“Early validation reduces costly iterations due to issues or bugs identified very late in the timeline of the vehicle program development. The simulation and validation solution from dSPACE efficiently accelerates their identification.”

*Giancarlo Di Mare,  
Head of Virtual Engineering, FCA Italy S.p.A.*

Additionally, FCA is using the dSPACE Test Solution Package (TSP). TSP is a product-bundle solution for performing efficient & automated ECU testing. It includes dSPACE SYNECT (data management and collaboration software), dSPACE AutomationDesk (test authoring and automation tool) and the dSPACE Test Authoring Framework (TAF). “Using TSP we are able to establish traceability with IBM RQM, handle variants of system tests and parameters, and perform optimized test authoring and synchronization of test steps into the RTC/RQM process,” summarizes Sisay Molla, Vehicle modeling and Integration, FCA US LLC.

**Improved Test Efficiency**

With the virtual testing platform technology in place, the EE&SW VE Team is working towards three significant goals: 1) reducing testing on HIL, 2) frontloading tests on software-in-the-

loop (SIL), and 3) synchronizing and managing requirements across the development stages and among various teams and suppliers. To date, the EE&SW VE Team has used this technology to successfully virtualize and implement a hybrid control processor (HCP) in a closed-loop virtual test platform and to virtualize and implement an engine controller in a closed-loop virtual test platform, based on AUTOSAR software architecture with production basic software. The team is also working on the integration of a virtual transmission controller, as well as the virtualization of legacy code.

**Global Team Effort**

The project team from FCA and dSPACE collaborated extensively to develop and implement the virtual test platform. The core group includes members of the EE&SW VE Team responsible for virtual ECU generation and integration

to the plant models to generate the closed-loop virtual test platform. The user group includes members from the FCA Controls Team Centers of Excellences (COEs) and software teams. This large team had quite an international footprint with various FCA contributors from FCA North America, Italy, Brazil, India, etc., as well as dSPACE team members from the USA and Germany. Together, the FCA and dSPACE teams took on several challenges, including the integration of AUTOSAR basic software from third-party commercial vendors, developing a new ECU with its own software architecture, and the virtualization of complex device drivers. According to FCA, the virtual test platform is currently utilized for controls development and software testing and is showing great promise for early validation. ■

*Courtesy of FCA US LLC*

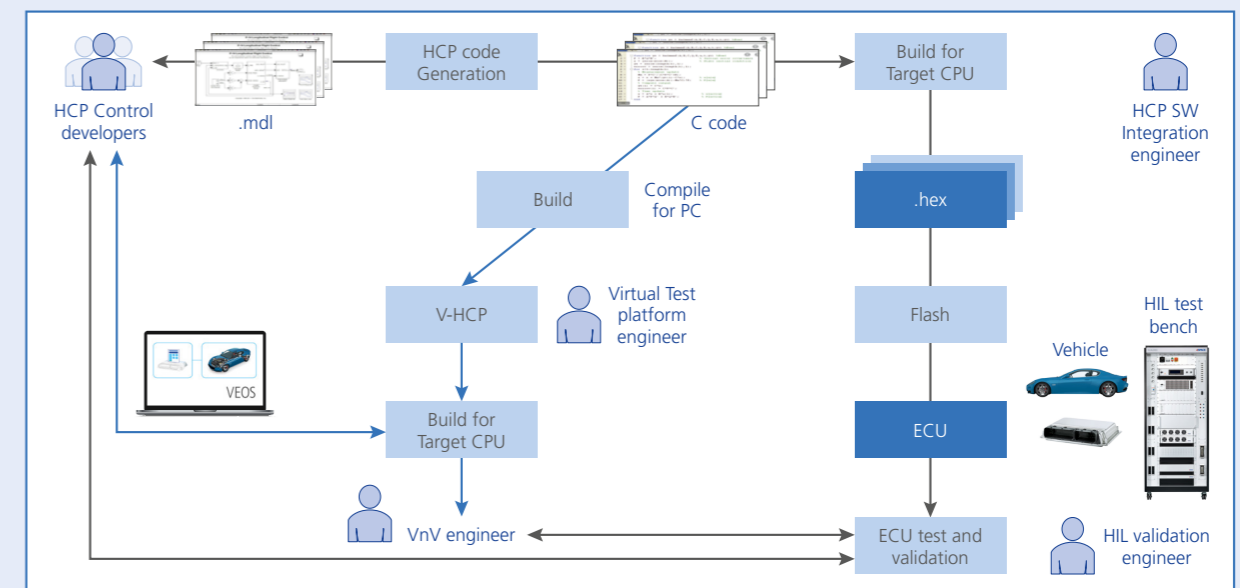


“The dSPACE Test Solution Package helps us to optimize tests and the test process.”

*Sisay Molla,  
Vehicle modeling and Integration, FCA US LLC.*



*SIL paves the way to efficiency.*



An example of a high-level workflow for hybrid controls development. Using virtual ECUs and the HCP Virtual Test Platform, the development team benefits from a more efficient build and time process and perform tests earlier.