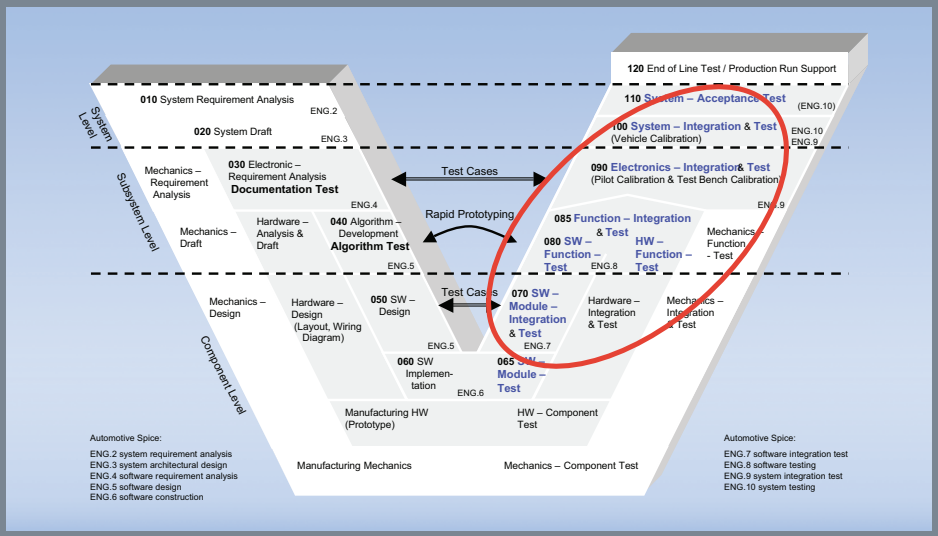
Engine Control Unit Validation

For Mass Production Alongside the Development Process

In automotive engineering, most innovations are realized through advances in electronics development.

New extensive algorithms must be produced with high product quality and lower costs, over a shorter period of time. To meet such demands in the development of engine control units, quality assurance measures, such as a start-to-finish test process, are integrated into the V-model development process.

The start-to-finish test process permits a very high error detection rate that is of crucial importance in relation to "safety-critical functions". Further advantages include early error detection and thus cost-efficient modification capabilities during the development as well as fewer recalls for vehicle manufacturers.



A start-to-finish tool chain is used in the control unit validation process. It allows information to be transferred without interface losses between individual development and test steps.

Automated testing (e.g. Testsuite and AutomationDesk) is used at all test stages to enhance efficiency and reduce cost.

A test management system (Quality Center™) is used for managing requirements, associated test cases and test results as well as for ensuring traceability. Although it is possible to apply the test units to hybrid drives, this involves adapting development methods, measuring techniques and measurement tools as well as additional integration and system testing on account of the distributed systems.

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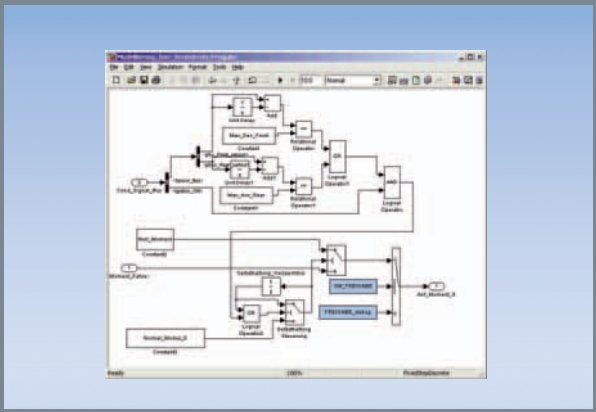
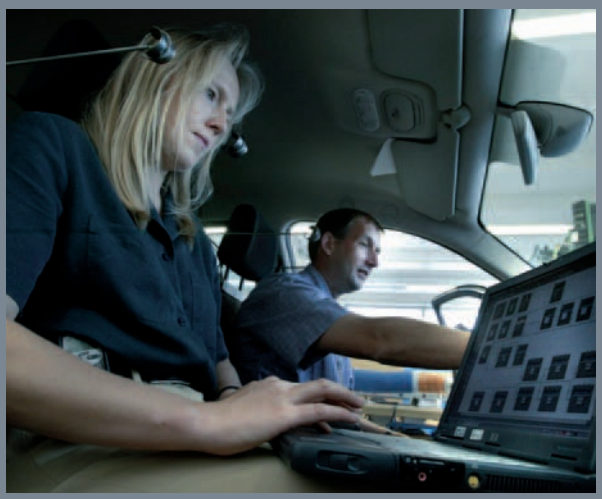


Software module test

Electronics integration test



System acceptance test

Test Steps:

The control unit functionalities are tested step by step in relation to the Automotive SPICE process description. This permits a continuous quantitative assessment of the degree of validation.

The first step is the **software module test**. This verifies whether the binary files compiled in the control unit/development board behave in the same way as the MATLAB®/Simulink® modules (function software). Most of the test vectors are generated automatically with IAV's MOTCase-X tool.

The **software module integration test** checks correct interaction between integrated software modules, including program flow and run-time behavior. Each connection, for example, is verified in relation to definition and value range.

The **software function test** verifies whether the function realized satisfies function requirements.

The **hardware function test** has the purpose of examining whether the hardware realized satisfies the hardware requirements (e.g. EMC, influence of temperature and short circuit).

The **function integration test** checks the integration of the sub-function models and determines whether functionality meets the overall function requirements. Furthermore, the connections between hardware, basic and application software are tested (e.g. in relation to value range and behavior over time).

The aim of the **electronics integration test** is to validate the control unit's complete functionality on the test bench in terms of meeting the requirements specification (e.g. testing of electronic diagnostics and tests with boundary samples).

The **system integration test** has the purpose of validating system behavior in the vehicle. This includes testing cold-start behavior as well as testing that can only be carried out in the vehicle environment (e.g. VVT temperature dependency).

Finally, the **system acceptance test** is carried out with the customer. Depending on customer wishes, this is where all major engine function modes can be demonstrated. The aim is to obtain customer acceptance for the system.

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