Safety, efficiency, and availability are the core requirements for commercial vehicles. Technology supplier WABCO has implemented a consistent process to optimize the development of safety-critical, reliable systems. It is based on a comprehensive tool chain in which SystemDesk and TargetLink pave the way to AUTOSAR- and ISO 26262-compliant development.
Efficient processes and methods for developing safety-critical driver assistance systems

Trucks and buses are more efficient and safer when they are in the correct lane at the right speed, have the appropriate tire pressure, and use the smartest collision avoidance systems. Driver assistance systems from WABCO make sure this is the case. The systems are integrated in the complex electrics/electronics (E/E) systems of commercial vehicles from a range of manufacturers. They support the driver by communicating with sensors and actuators in the vehicle. But developing and implementing safety-critical systems involves a number of challenges, which have to be considered when planning tool chain design and the development process. Compliance with important standards, such as ISO 26262 and AUTOSAR, is not the only crucial factor for developers. They also have to optimize development times and costs so that the products are as innovative as they are competitive. The tool chain therefore has to address the following criteria: continuity, traceability, automation, change management, and test front-loading. This is why WABCO uses a process designed like a double V-model (figure 1). It enables developers to quickly perform tests at any time during development.

Developing the AUTOSAR Structure

The development is based on requirements specified in PTC Integrity. Design guidelines ensure that the requirements are sufficiently detailed and formalized to export rudimentary AUTOSAR configuration files (ARXML files) from them with a custom plug-in. The configuration files are imported to the architecture tool dSPACE SystemDesk. This results in a software structure with the names of the structure components. In SystemDesk, the developers add implementation details, data types, and AUTOSAR communication mechanisms to the structure and pass it to the TargetLink Data Dictionary. TargetLink can then be used to generate the frame models for the AUTOSAR software components and the developers can insert function models (figure 2). These processes are directly linked and can be automated by means of a script to ensure more efficiency and prevent errors. The tool coupling makes it possible to trace requirements between requirements management and the development environment. Comments are even passed to the models. >>>
The code and model then pass back-to-back tests in BTC EmbeddedTester from BTC Embedded Systems to verify the code.

**Software Implementation**

The AUTOSAR software components that constitute the WABCO software are composed of several modules, which contain the individual functions. Incremental code generation in TargetLink is used to generate code for each model separately. This makes it possible to work in distributed development teams. It also ensures that the tested code of individual modules can be integrated in the AUTOSAR software component (SWC). Incremental code generation is particularly useful for complex SWCs because it is not necessary to generate the module code every time, which significantly reduces code generation times. After the assembled SWC is tested, it is integrated in the overall software for the electronic control unit (ECU).

**Efficient Software Verification**

A decisive factor for software quality is continuous testing throughout the development process. Early and comprehensive testing means that a high level of maturity is reached faster and more efficiently. WABCO developers use their own tools for consistency and plausibility checks to de-
Mission Accomplished: A Seamless Tool Chain

A tool chain becomes seamless through a direct exchange of data between successive development steps and tools. WABCO has achieved this with the following standard tools and its own automation scripts:

- Requirements management: PTC Integrity™
- Architecture design: dSPACE SystemDesk
- Control design: Simulink®/dSPACE TargetLink
- Code implementation: TargetLink
- Software verification: BTC EmbeddedTester, MES MXAM, MES MXRAY, own custom tools

The production code generator TargetLink is particularly valuable because it is certified for software development in line with the safety-relevant standards ISO 26262 and IEC 61508.”

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