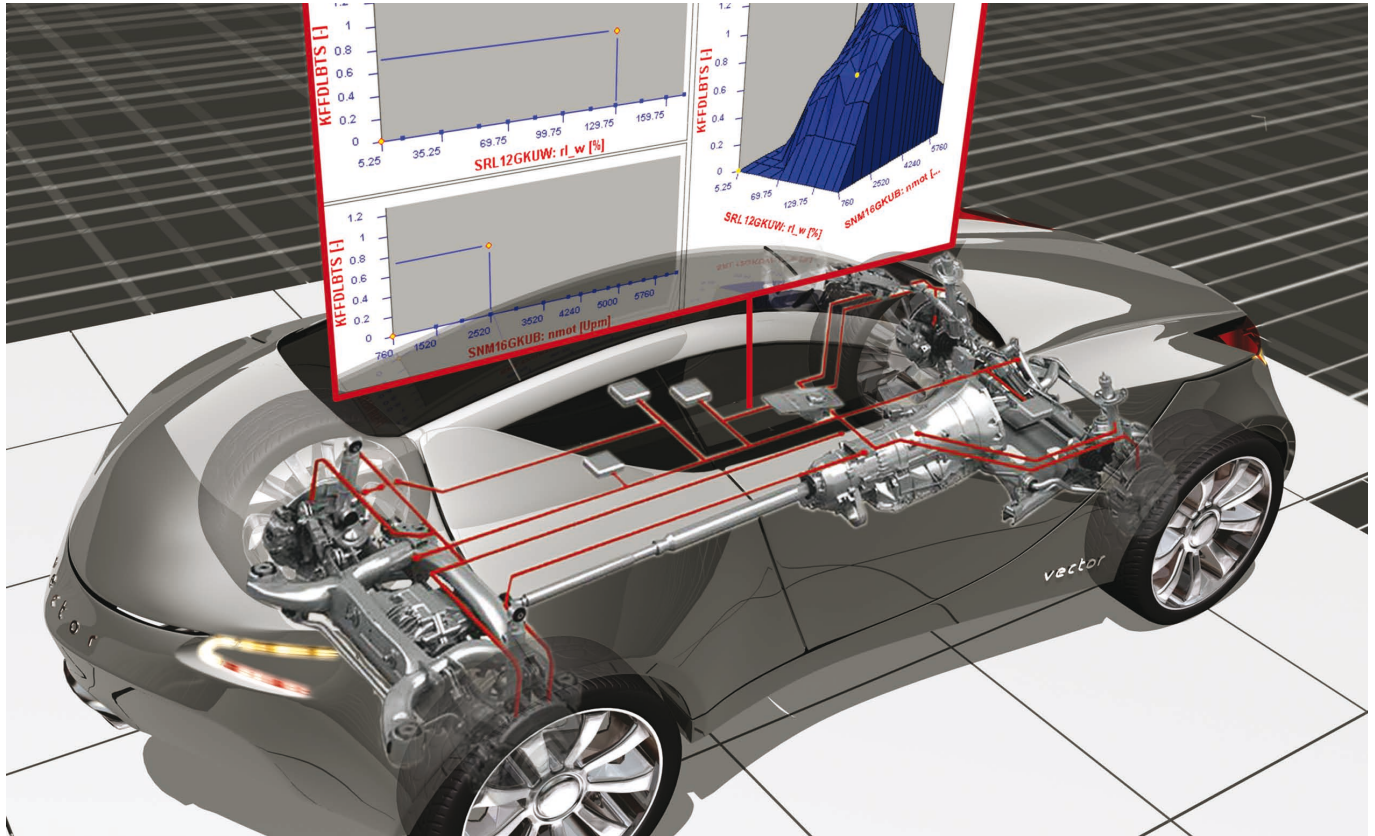


From Pilot Studies to Production Development

Efficiency and quality in calibrating transmissions



To soundly manage growth in the number of complex transmission calibration projects and their data at ZF Friedrichshafen AG, the company needed to introduce a new calibration data management system. Deciding factors for introducing the calibration data management system eASEE.cdm from Vector were the tool’s high functionality, flexibility and potential. Another crucial factor was the companies’ development partnership over many years with the goal of jointly meeting ZF targets for quality assurance and improved efficiency.

To be successful as a globally-active automotive supplier in a market characterized by innovation, competition and cost pressure, it is necessary to have products that meet the stringent technical and economical requirements of automotive OEMs.

Based on its comprehensive expertise, continuously optimized processes and process tools, ZF is able to position its products for powertrain and chassis systems very successfully in the market. In the powertrain area, ZF supplies transmissions for passenger cars, commercial vehicles, buses, rail vehicles, ships and helicopters. These areas are marked by a very high level of model diversity. This diversity in models and variants can be achieved by vehicle-specific parameterization (calibration) of the transmission. For example, ZF supplies the 6HP26 6-speed automatic transmission, which enables efficient gear shifting in different vehicles with vehicle-specific torque curves ranging from 300Nm to 800Nm; this is accomplished by individual parameterization (Figure 1). Short

shift times, smooth gear shifts, reduced fuel consumption and low emissions are other objectives that can be met by optimally adapting parameters to the vehicle.

Requirements of ZF Friedrichshafen AG

Even the first microcontroller-based transmission control electronics included parameters for adapting the electronics to the environment (e.g. transmission hardware, vehicle). Starting with just a few calibration parameters, the number of parameters continually rose in response to increasing functionality. A growing model diversity in transmission and powertrain systems – as well as a rising number of parallel projects – required functions for central, efficient and process-conformant management of the calibration data. The existing system for data management developed in-house at ZF had been stretched to its limits by the complexity of projects.

Objectives for the new calibration data management system were:

- > Uniform and corporate-wide system for central management of all ZF drive and chassis projects
- > Introduction of a modern, market-established Engineering Data Management system (EDM system) with a database orientation
- > Support and standardization of defined calibration processes
- > Integrated checking and test routines for quality assurance
- > Mass operations to improve efficiency
- > Flexibility of data storage – from simple addressing via variant-encoded groups for multiple systems or vehicles to complex data storage for many vehicles

Vector’s eASEE.cdm solution

To fulfill the requirements outlined by ZF, a tool was needed that integrates the functions of EDM systems, process tools and calibration tools in a comprehensive system solution. In deciding on eASEE.cdm from Vector, ZF chose a mature and market-established system.

The eASEE.cdm calibration data management system consists of a data management system for engineering artifacts and a graphic Parameter Editor; it also contains calibration-specific functions and automated sequences for managing all program and data sets occurring in the calibration process. As a modular component of the eASEE tool suite, it is also easy to integrate it with other process domains (Figure 2).

Functions of the eASEE base system include:

- > Functions for versioning, and for forming variants and configurations
- > Flexibly configurable data model for productive data and the meta-data that describes it

- > A workflow engine for process-conformant flow control
- > Multi-site operation for cooperation between distributed work teams
- > A differentiated roles and rights concept

Flexible configurability of the data model makes it easy to implement application-specific extensions – eASEE.cdm becomes the data backbone of calibration processes.

Calibration-specific functions support project leaders, data integrators and calibrators in all phases of a project. From project definition to data preparation to release of the integrated overall parameter sets, users benefit from calibration data management system functionality:

Project leaders at ZF are able to clearly structure complex calibration projects that have many variants by property-supported variants management. Data set variants are formed by combinations of variant-relevant attributes. Variant criteria are also utilized as filter criteria in releasing parameters (Figure 3).

ECU suppliers often perform calibration projects jointly with the OEM, and this requires flexible handling of data. Calibrators at ZF process and manage ECU parameters – either parameter-oriented, function-oriented, component-oriented or variant-coded, depending on the specific calibration process.

The CANape and INCA calibration tools that are used generate market-relevant data formats: both physical characteristic data formats (CDF, CSV, DCM, PaCo, PAR) and program formats (Intel Hex, Motorola-S) are supported.

The calibration area at ZF implements the graphic Parameter Editor for checking, adjustment and data integration (Figure 4). It offers extensive options for visualization (table-format, 2D and 3D) and offline editing of ECU programs and parameters. Changes are saved directly in the eASEE data backbone.

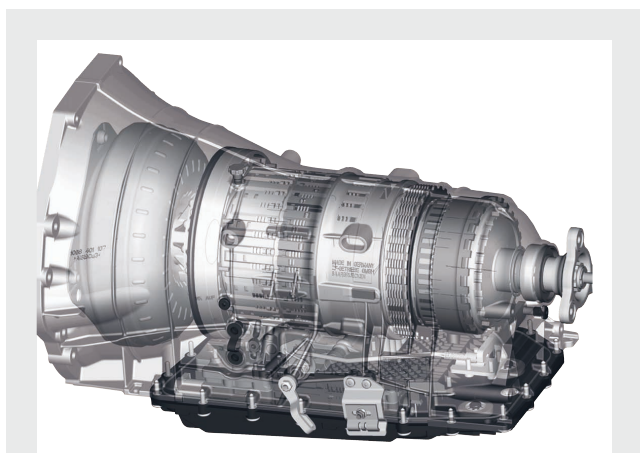


Figure 1:
The 6HP26 transmission from ZF

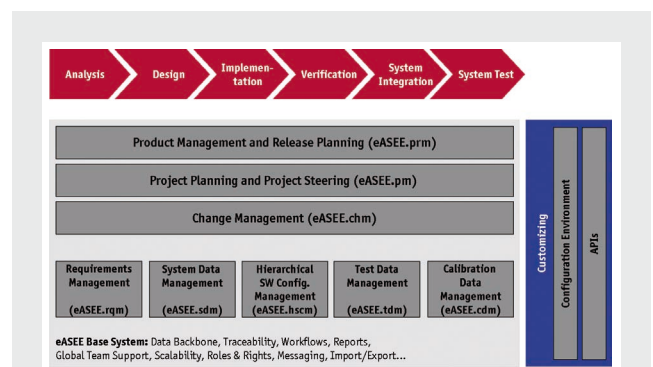


Figure 2:
The eASEE process tool suite

Data integrators make extensive use of algorithms to improve data consistency and integrity by checking for completeness, unambiguity and physical limits. Project leaders at ZF appreciate the added security offered by label-based rights management, which prevents parallel releases of overlapping data. Other important functions have been integrated in the calibration data management system, such as checksum generation and the ability to interface to signature tools for protecting ECU software.

Introduction of the system

The decision to implement eASEE.cdm as a corporate-wide solution at ZF was made in 2003. Before roll-out in the individual business areas, eASEE.cdm was first introduced and evaluated in two pilot projects. After successfully completing the pilot phase, the system was introduced to daily business operations in 2004. The first production projects were the ECOMAT (automatic transmission for city buses) and ASTRONIC (automatic transmission for trucks and buses) projects. Today, approx. 150 calibration engineers manage project and calibration data for 20 projects in different domains. This enables customer-specific separation of project data.

Implementation of ZF requirements was based on a multi-year development partnership. Close cooperation made it possible to meet targets in a timely way. The focus in implementing requirements was on general usability of the jointly developed functions.

Utility

Production calibration projects at ZF are performed using calibration processes that are defined area-wide. The processes are structured so that many process steps can be run in parallel and executed by an automated tool. All aspects of this calibration process at ZF are fully supported by eASEE.cdm. It ensures process-conformant execution of calibration projects in practice, and it supports of calibrators, developers and project leaders.

In their daily work, users benefit from the following functionalities:

- > Improved cooperation of calibration teams due to uniform and corporate-wide system
- > Data freeze time is reduced from one week to one day by automated checking and safeguarding functions
- > Reduced manual effort by automated generation of the data exchange containers
- > Reproducibility of data revision levels by automatic storage of test and signature configurations
- > Effective variants management reduces number of time-wasting and error-prone actions
- > Collision-free data integration by label-based rights management
- > Full traceability of the calibration process by thorough versioning of all relevant data and protocols
- > Reusability of calibration data by component library

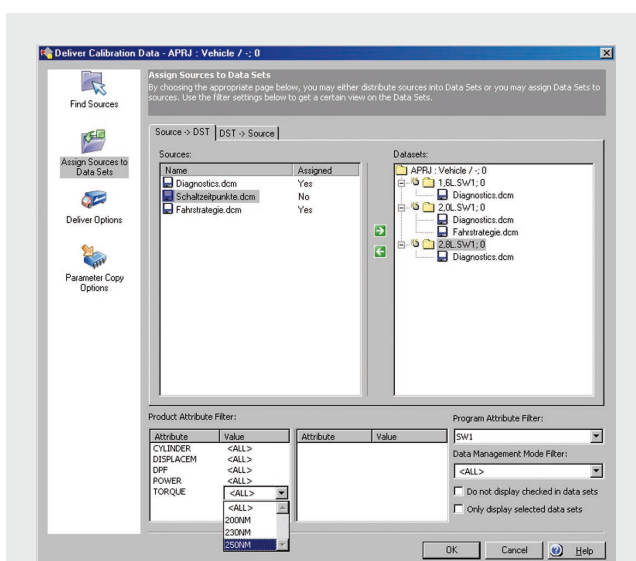


Figure 3:
Property supported variants management

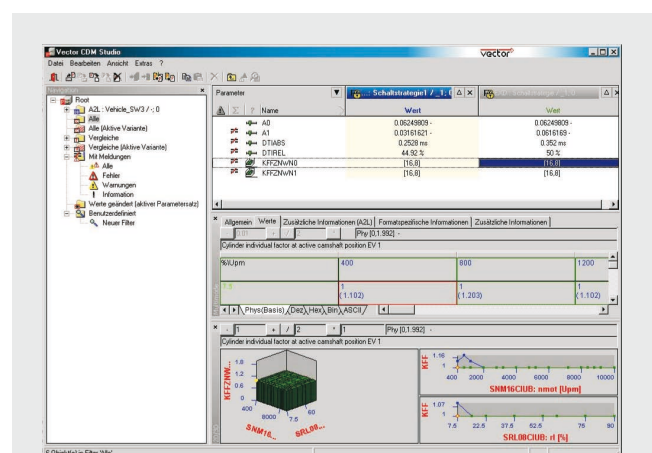


Figure 4:
Parameter Editor

Summary

The eASEE.cdm calibration data management system has been introduced corporate-wide at ZF, facilitating efficient, process-conformant data management while ensuring high data quality. Besides being used to support the business operations, the tool also serves as an important foundation in conducting (SPICE) assessments of ZF business processes in software development and calibration.

All of the objectives ZF sought to achieve were fully attained. Significant increases in efficiency of up to 90% were attained in safeguarding and signing-off data sets. Overall, eASEE.cdm is making an important contribution toward reducing costs in calibration.

Translation of a German publication in Automobil-Elektronik, 3/2008

Figure 1:
ZF Friedrichshafen AG

Links:

Homepage ZF Friedrichshafen AG : www.zf.com
 Homepage Vector: www.vector.com
 Product Information eASEE.cdm: www.vector.com/easee_cdm_en
 Product Information eASEE Tool Suite: www.vector.com/easee
 Product Information CANape: www.vector.com/canape



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