Tool-supported Data and Process Management at MAN Nutzfahrzeuge AG

At MAN Nutzfahrzeuge AG an integrated approach was applied to managing all engineering data generated in the E/E development process and its subprocesses. The goal is to further improve the efficiency and quality of development, despite the growing complexity of electronic systems. MAN Nutzfahrzeuge AG developed and introduced an integrated development database for this purpose, which is based on the eASEE Tool Suite from the Vector company:
The MAN Common Engineering Data Backbone.

1 Motivation and Goals

The development of vehicle functions, ECUs and ECU networks is becoming more and more complex. It is becoming increasingly important for MAN Nutzfahrzeuge AG to be able to master this complexity into the future. The primary objective is to increase development efficiency while further improving product quality.

2 Basic Ideas

Two factors led to the development of the MAN Common Engineering Data Backbone: First, it was clear to management very early on that quality could not simply be achieved afterwards by an extensive testing process. Rather a universal, well lived-out development process is necessary, which encompasses all areas of development. Second, management at MAN favored an integrated database solution that saves all data of the development process in a meta model (single source) [Figure 1] and thereby enables very efficient data usage and data universality. The ability to set relationships between data further increases efficiency. This database solution is referred to at MAN as the Common Engineering Data Backbone.

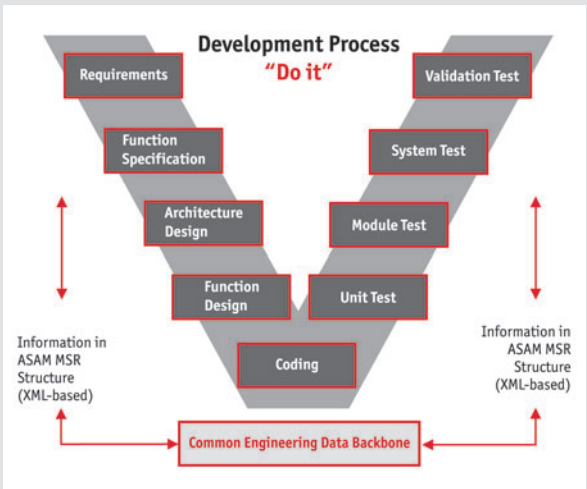

Figure 1:
Single-source principle for the development process

3 Implementation

The company was looking for a technical platform that lets users concentrate on the actual contents: The data structures and functionalities. The system already provides basic mechanisms such as user administration, version management and client-server architectures. That is why the choice was made to go with the eASEE Tool Suite from Vector.

3.1 eASEE as Technology Platform

eASEE is a process tool whose core consists of a hierarchical configuration management system for any desired data. This basic system includes:

> Functions for versioning and variant formation
> A user-configurable data model for user data and meta data
> A workflow engine
> Multi-site operation, and
> A differentiated roles and rights concept.

Overlaid on this basic system are modules specifically designed for various process areas. These modules cover the majority of key process functionalities that are needed in the automotive industry [Figure 2]. Programming interfaces are provided to allow for individual extensions. Besides being used at MAN, eASEE is also used at Bosch, General Motors, Daimler, ZF, Volvo, Porsche, VW, Audi and Getrag.

3.2 The MAN Common Engineering Data Backbone

Today, the MAN Common Engineering Data Backbone consists of eight domains. Its foundation is an Oracle database upon which the eASEE Tool Suite is placed [Figure 3].
The process model distinguishes between the actual development process ("Do it") [Figure 1] and the management process ("Control it") [Figure 4]. Analogously, in the MAN Common Engineering Data

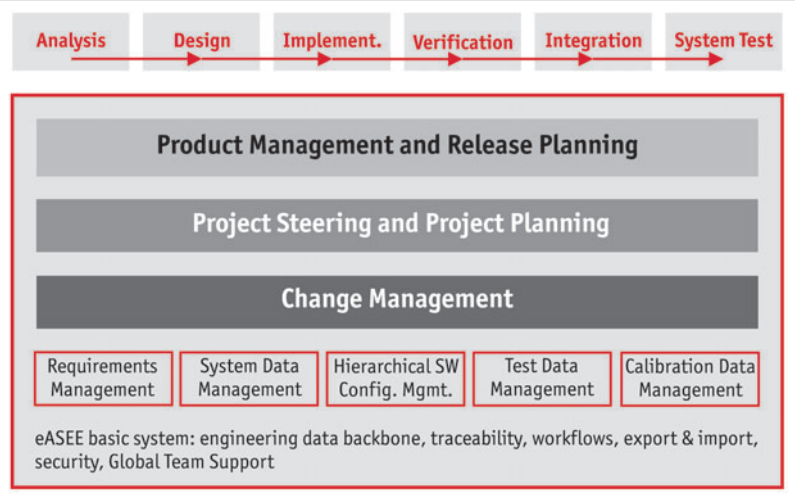

Figure 2:
The eASEE process tool suite

Backbone there are "Do it" data domains (FDM, TDM, CDM, etc.), and a "Control it" project management domain (PPM) [Figure 3]. The two areas are interlinked across all domains. Project schedules (Gantt Charts), for example, are automatically updated based on the states of the elements in the data domains. Thus, the project leader no longer needs to perform maintenance work on the states of work packets.

Function Data Management – FDM

The individual data domains are oriented directly toward the process. Function Data Management (FDM), for example, represents the left side of the V-Model. This domain contains a complete meta model used to describe all of the data of an electronic structure, including:

> Vehicle configurations
> ECUs
> Hardware (connectors/pins)
> Signals (e.g. CAN)
> Vehicle functions
> Functions
> Software architectures.

In addition, a classic requirements management system is represented.

Based on these data structures, the FDM offers many functionalities for the daily tasks of the engineer. These include:

> Various interfaces to expert tools, e.g. Matlab/Simulink/Target-Link as a development environment and XMetaL as an XML-based authoring environment for detailed specifications [Figure 5]
> The option of a virtual vehicle design/check,
> Signal path analysis
> Ability to generate DBC files to describe bus systems for analysis and test tools such as Vector's CANalyzer and CANoe.

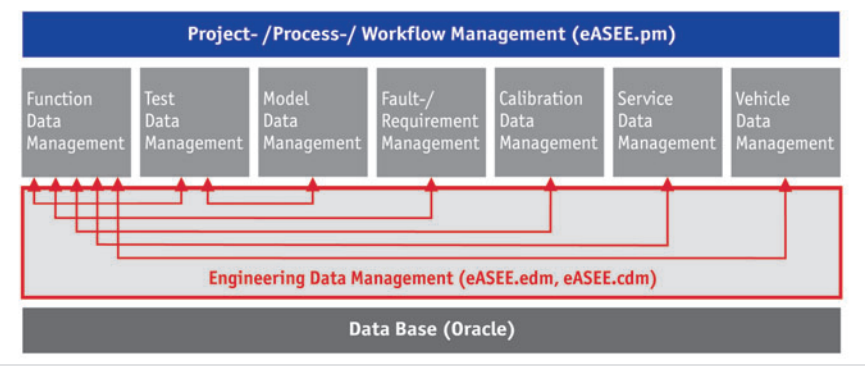

Figure 3:
MAN Common Engineering Data Backbone

Test Data Management – TDM

The right side of the V-Model is covereded by Test Data Management (TDM). In this domain it is possible to map entire test projects. Among other things, TDM manages the test specifications, test execution information for each test, test results, test environments and test methods. Test data in the TDM are directly linked to development data in the FDM. Since the system is used cross-departmental and over all test levels, it is possible and very easy to draw conclusions about test coverage – from component testing to validation testing.

Fault and Requirement Management – FRM

Fault and Requirement Management (FRM) contains a complete change management. This system can be used to input issues into the development process. The individual issues may be classified as errors or new requirements.

Errors are linked to both the test cycle in which the error was found, in the TDM, as well as to the function in which the error occurred. This makes it very easy for function developers to look in the FDM to see which issues are still open for them. The test engineer, in turn, sees very quickly which errors were corrected in a new function version, and what form of post-testing is necessary.

Calibration Data Management – CDM

Calibration Data Management (CDM) maps the data of the calibration process. Based on the data of the FDM, in calibration projects this system makes it possible to manage data records of ECUs via the ASAM MCD-2MC file. Data records from established calibration tools such as CANape, INCA or Caldesk – which have an ASAM MCD2MC interface and which support the CDF or DCM exchange format – may be read directly into the CDM. Completed and released parameter sets may be referenced in the FDM as initial data sets.

Service Data Management – SDM

Service Data Management (SDM) makes it possible to provide service-relevant data to the service area from the development area. Also represented in this system is a workflow mechanism that tracks the path from the released ECU to its production and use in series vehicles.

Traceability

Today, almost all data generated in the development process is saved in a meta model in the MAN Common Engineering Data Backbone. Integrated data storage in a database enables nearly perfect traceability of the data. For example, starting from a test cycle it is possible to determine which error was found with this test cycle and which requirement the test cycle covered.

Another potential use is to start with a CAN signal and have the system indicate which functions in an electronic structure utilize this signal. For example, it is possible to deduce whether a certain sensor can be omitted in the system.

3.3 Status of the MAN Common Engineering Data Backbone

The MAN Common Engineering Data Backbone has been in productive operation for several years and is currently utilized by about one hundred developers. Today it consists of the eight domains

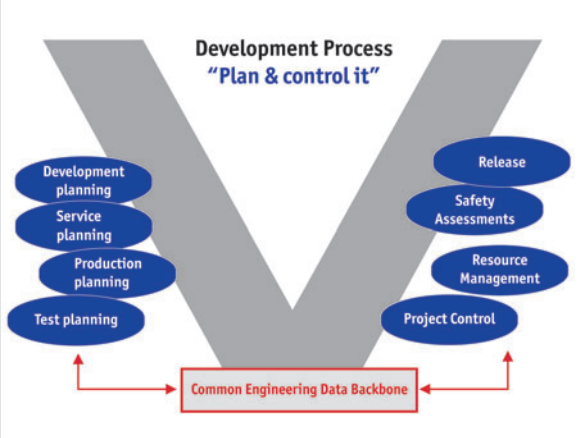

Figure 4:
Planning and control of the development process

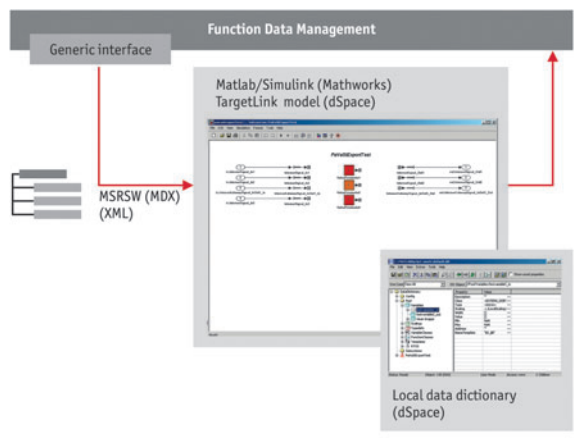

Figure 5:
FDM interface to Matlab/Simulink

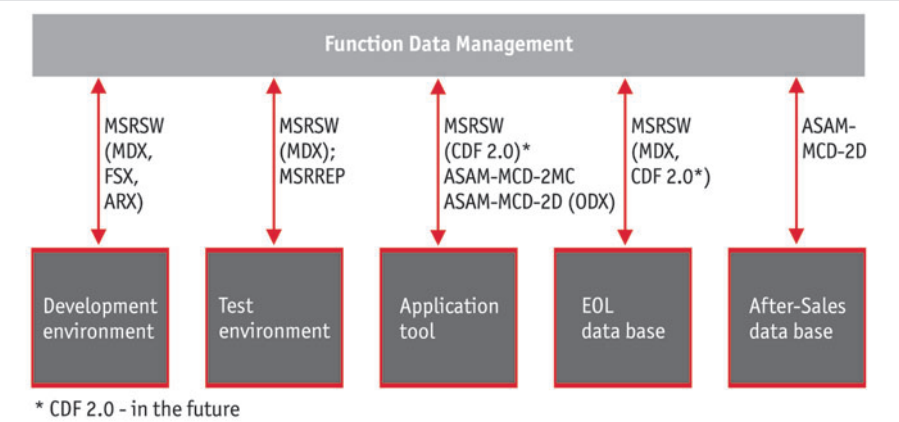

Figure 6:
FDM interfaces to authoring tools and external databases

described and various interfaces [Figure 6]. Since developers are actively supported by the backbone in their daily work, from the first requirement to the last test, the Common Engineering Data Backbone is very well accepted by developers. It has been shown that it is very important for developers to work within the system from the very first minute, and to single-source their data here. This eliminates an additional maintenance effort that would otherwise be perceived as rather disruptive.

4 Utility

After about three years of productive use by the Common Engineering Data Backbone, the initial objectives were realized. Efficiency gains were achieved due to redundancy-free data input and data storage and due to the many different options for supplying information and preparing data. Previously, an engineer would have to work through dozens of documents to predict the consequences of transferring a certain function from ECU A to ECU B. Today, it takes just a few mouse clicks and the relevant information is available at the latest revision level. Another advantage is reusability of engineering artifacts and data, which is made possible by Variant Management. Other positive effects are the considerably improved transparency for engineers involved in the development process and the ability to establish role-specific views for one and the same data content. Thus, the MAN Common Engineering Data Backbone offers very specific views of development status, e.g. for the project leader, system architect, function developer, integration manager and test engineer.

5 The Road Ahead

In implementing the MAN Common Engineering Data Backbone, special attention was given to exchange formats to ensure that established standards such as MSRSW and ASAM were used. Today, this is very beneficial especially at supplier interfaces. Therefore, MAN is following the development of the AUTOSAR standard very closely. If the advantages of the standard appear sufficiently great, the MAN Common Engineering Data Backbone would be adapted to the AUTOSAR standard and brought to a level of AUTOSAR compatibility. The interests of MAN and Vector overlap here too: The Stuttgart-based tool producer has set the goal of developing an eASEE module for AUTOSAR-compatible system data management, which combines the advantages of the standard with key functionalities of the Common Engineering Data Backbone.

Stefan Teuchert
(Graduate Engineer) manages the Software Development and Basic Technologies department at MAN Nutzfahrzeuge AG

Georg Zimmermann
(Graduate Engineer) manages the "Product Line Process Tools" department at Vector Informatik GmbH