The partners Daimler, Hella and Vector recognised the great potential of AUTOSAR very early on, and report on their experiences in introducing AUTOSAR development methodology. From several production projects, they have learned where benefits can be easily attained but also note the hurdles that had to be overcome, and they identified obstacles that must still be addressed today.

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For Daimler, the key drivers for introducing AUTOSAR were the large number of new functions and their progressive concentration in just a few ECUs. That has resulted in a high increase in communication requirements and made it necessary to use a FlexRay bus system. New basic software (BSW) and a new exchange format were necessary. To handle all bus systems uniformly, the course towards AUTOSAR was set. One of AUTOSAR’s greatest strengths lies in the fact that many new functions are available in a standardised form. This applies to the support of new bus systems – like Ethernet – and functions such as partial networking, functional safety, security and multicore support.

NEW METHODS AND EXCHANGE FORMATS

In AUTOSAR, the automotive industry has created a standard that places the development of ECU software on a new methodical foundation. This enables a significantly improved systematic approach to collaborative work between carmakers (OEM) and suppliers, which in turn makes it possible to combine functional contents from different sources in a process-assured way. The new method requires standardised data exchange formats and above all extended formats. While familiar exchange formats like DBC, LDF or Fibex are somewhat bus-specific and only describe the communication, the exchange format AUTOSAR System Description represents a significant extension. The application software is described by its software components (SWCs), the relationship between the SWCs and the networks (data mapping) and the use of service functions of the BSW (service mapping) is defined.

The SWC definition lets the OEM formally describe its own contents in the application software and transfer it to ECU suppliers (Tier 1) in a process-assured way. Daimler recognised this and still sees this as a significant step towards consistent implementation of a system- and function-oriented approach. Previously, the interfaces description for the application software was completed over the course of development and was the responsibility of the supplier. Now developers in the various technical departments at Daimler are faced with the task of distributing an ECU’s functional content to software components early in the development process and defining internal ECU interfaces. Formal description forces completeness and consistency very early on, and it shifts the effort in the development process forward – to the OEM. This is a good example of “frontloading”; however, this only brings the desired benefits after working through a learning curve.

For the Tier 1, early definition means a loss of flexibility at first, since local changes to the interfaces can no longer be performed so simply. These changes must be exchanged between the Tier 1 and OEM, . This indicated the need for high-performance difference, merging and report algorithms. Vector has invested heavily in this area and now offers mechanisms that significantly reduce effort and errors.

One clear advantage that Hella sees in integrating application software and configuring the BSW is that specifications are more precise. However, this advantage is only realised when the System Description is updated frequently enough in early development phases. This is the only way to assure consistency of the data on both the OEM and Tier 1 sides. Over the course of development, it has been found that clear release planning is needed for data exchange in both directions. Along with the ECU extract of System Description (subset of the System Description for an ECU) this also involves consistent exchange of the diagnostic parameterisation. Currently, the compatibility of architectural levels is still a largely unresolved problem: The Tier 1 develops its own software architecture to efficiently handle the different OEMs. In turn the OEM develops its own software content for all of its Tier 1 suppliers.

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AUTOSAR standardisation is desirable in this area but it runs into problems if it imposes limitations on competitive differentiation. If software components are also provided by third parties, synchronisation of the data becomes that much more important. Here too, the goal is to considerably simplify exchanges by formalised information – so that everyone is speaking the same language.

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The AUTOSAR System Description contains descriptions of the communication and other information on the software components and the basic software.
EFFICIENT DEVELOPMENT WORK

The tool producer is called upon to make the dramatically increasing number of configuration parameters manageable. The developer must be provided with as many algorithms as needed to correctly and automatically set dependent parameters and to recommend meaningful combinations. Both, the curse and the blessing of AUTOSAR are closely intertwined here: The high level of configurability of the BSW leads to the large number of parameters, but it also permits reuse in many projects. Therefore, the tools represent an important factor for success. A generic editor is insufficient here. The tool must offer specialised views and algorithms for maximum user support. For example, this makes it possible to edit dependent parameters consistently. Close coordination between the project partners has made a decisive contribution towards improving tools and processes. Although the work flow is roughly specified by AUTOSAR, only in practice does it become apparent which application cases occur and where the tools can be structured more efficiently by adding appropriate functions. All participants were faced with another challenge as well in the introductory phase of AUTOSAR: Over the course of the project, new requirements arose for the BSW modules and description formats. Sometimes it was necessary to switch over to new AUTOSAR minor or patch versions during development or even temporarily implement an extension to the AUTOSAR specification. At the same time, in-house tools that Daimler had used and extended for AUTOSAR were adapted to the tools from Vector. In addition, the application cases had to be considered from a Tier 1 perspective to permit an automatic transfer of the created configurations.

COORDINATED PROJECT HANDLING

In closing, it is necessary to examine the aspect of parallel work on an ECU project – a basic theme for the larger ECU developments that are typical at Hella. Central data storage makes it more difficult to work in parallel on an ECU project with multiple teams because everyone needs to access the data simultaneously. Arrangements between the teams which had previously pragmatic approaches of working together cannot simply be represented in the AUTOSAR description files. Therefore, it is advantageous to subdivide these files into elements, so that they can be stored separately in a configuration management system. Functions are also needed for representing differences and for consistent merging. The tools must relieve the user of as much manual work as possible. The quality of error messages and warnings proved to be very crucial here. Initially, too little attention was paid to this aspect. Now a significantly better level has been attained by intensive informational exchange between users and tool developers.

REVOLUTION OR EVOLUTION?

Today, all of the partners view the project in positive terms. For Daimler, the migration to the System Description was a logical and necessary step in mastering the increasing growth in the networking of vehicle functions. Combining the new AUTOSAR standard with multiple bus-specific configuration formats definitely would not have run nearly as smoothly. And with increasing experience consistently implementing this System Description step let all participants realise the full potential of AUTOSAR. Hella sees the greatest benefit in the improved and structured approach to collaborative work with OEMs. This method should be adapted on a broad scale, so that investments in AUTOSAR will lead to the anticipated gains in long-term efficiency and quality.