



## Software erosion protection for automotive embedded software

TRW uses the Axivion Bauhaus Suite to protect the UML-based architecture of its electric parking brake (EPB) – and the applications based on it – against erosion. This enables consistently fast development speeds to be achieved in the field of safety-critical control devices with consistently high levels of quality.

**THE CHALLENGE ++** The electric parking brake (EPB) from TRW has proved very successful in the market and is being used in more and more vehicle models. Today, the specific customer requirements and the necessary flexibility are mainly achieved and ensured by software. The growing customer base and the ever-increasing number of customer- and model-specific variants is therefore a major challenge for software development. For the OEM, perceptions of quality and flexibility are influenced directly by software development at TRW. Development speeds and adherence to deadlines for new variants are critical for TRW's success.

Software development based on ISO 26262 also places high demands on the components and associated documentation from the perspective of quality, which has to be consistently high. These include, in addition to requirements for the software architecture and its

documentation, the establishment of and compliance with coding guidelines such as MISRA-C.

TRW-EPB systematically relies on the implementation of a UML-based architecture when developing its electric parking brake (EPB). The major challenge here lies in keeping the UML models and the implementation continuously synchronised. Manual checking is not an option because of the large number of projects and variants.

**THE SOLUTION ++** The existing tool chain was extended to include the Axivion Bauhaus Suite, whose XMI interface is tailored to the popular CASE tools. The architecture of the UML models is now checked during the development phase itself. As a result, specific change requests for improving the quality are automatically triggered on an ongoing basis.

As soon as the implemented components differ from the models, the software

developers receive warning messages. In most cases, developers can quickly resolve the discrepancy themselves. Because the solution was easy to integrate into daily business and the individual developers could be included, it has made the architects' job easier, as they only have to intervene when changes to the architecture are actually required.

*“The Axivion Bauhaus Suite helps us implement our architectural concepts flawlessly. The seamless integration into our UML tool chain went without a hitch and it has made our everyday work easier.”*

Thomas Kremer, Teamleader Integration & Configuration, EPB Software System Development, TRW Automotive GmbH



*“Our innovations are increasingly dependent on software. At the same time, the customer and market requirements are changing faster and faster, and the number of different versions is increasing. This calls for fast response times and the Axivion Bauhaus Suite helps us significantly in this respect.”*

Gundolf Schmidt, Global Chief Engineer  
Braking Software, TRW Automotive GmbH

In a further step, the coding guidelines were revised with the assistance of Axivion and these are now likewise automatically checked during the development phase using the Axivion Bauhaus Suite.

**THE SUCCESS ++** The constant checking of the architecture specifications and modelling rules has made the entire development team more aware of architectural issues. The importance of the architecture and the architects in the project has grown and been generally accepted. Collaboration between architects and developers has been greatly improved and has become much smoother. Day-to-day tasks involve resolving discrepancies, sometimes in the implementation and sometimes in the architecture. Work is concentrated on finding the optimal solution in each individual case. As a result, not only are the requirements met in full, but lessons can also be learnt in the area of architectural design, thereby allowing overall architectures to be improved more and more.

Hence it has been possible to establish new architectures so that – for example – parts of the software are easier to integrate into third-party control units, as is increasingly being stipulated by OEMs. The perfect interaction and intermeshing of the UML models and the component implementations also enhanced the ability to reuse certain sub-components in several variants.

The automated checking of the coding guidelines in the background reduces the manual workload, increases acceptance

among the developers and is more conducive to learning, since there is immediate feedback.

The software erosion problems of the past were successfully eliminated right from the start of the EPB project at TRW by using the Axivion Bauhaus Suite.

The resulting overall increase in efficiency in development has made it possible to mitigate, to some extent, the impact of the much-quoted lack of skilled professionals and the associated shortage of personnel capacity.

**ABOUT TRW ++** With a turnover of 16.2 billion US dollars in 2011, TRW Automotive is one of the world’s leading suppliers to the automotive industry.

The company, with its headquarters in Livonia (Michigan, USA), has a global presence through its subsidiaries in 26 countries and employs approximately 60,000 people worldwide.

TRW Automotive’s product portfolio includes integrated vehicle control and driver assist systems, braking systems, steering systems, suspension systems, occupant safety systems (seat belts and airbags), electronics, engine components, fastening systems and aftermarket replacement parts and services.

**ABOUT AXIVION ++** Axivion, Stuttgart, Germany is a provider for complete solutions for protection from software erosion. The solutions include the development of innovative software tools – amongst others for static code analysis, architecture verification and clone management – as well as the development of methods,

training concepts, and service and consulting for the implementation of measures.

The core product of the company is the Axivion Bauhaus Suite, a tool suite for improvement of software quality and maintainability of software systems implemented in the programming languages Ada, C, C++, C#, and Java. Axivion’s customers are developers of technical software across different industries, e.g. in the field of automotive, railway, electronics, information and telecommunication, medical, avionics, mechanical engineering, and industrial automation. Axivion’s MISRA checker covers 100% of all automatically testable MISRA rules for the standards MISRA C:2004, MISRA C:2012, and MISRA C++:2008. Since its foundation in 2006, Axivion maintains close research links to the University of Stuttgart, Germany, and to the University of Bremen, Germany to keep up with the newest trends in programming and code analysis research.

More information is available at [www.axivion.com](http://www.axivion.com)

Sources of images: TRW Automotive

