



Architecture analysis for aerospace software

HENSOLDT Sensors (formerly Airbus DS Electronics and Border Security) has introduced a **product-line architecture** for its wide range of system variants. With its automatic architecture analysis, the Axivion Suite supports the **management of variants** and efficient further development of products.

THE CHALLENGE ++ HENSOLDT Sensors GmbH (formerly Airbus DS Electronics and Border Security) is a world leading provider of premium electronics for protection, reconnaissance and surveillance as well as situational awareness.

The Software Engineering – Operational Support Systems department is responsible for software development for operational planning and support systems for airborne weapon systems for all types of helicopters.

The department's portfolio of services ranges from modelling to development as well as validation and commissioning of operational support systems and provision of support for delivered systems. Operational support systems allow the customer to prepare for and implement deployments both tactically and technically. The Operational Support Systems department's international customers have highly individual requirements for

their operational support systems. These systems are only implemented and supplied as unique customer variants. This presents a **significant challenge for the variant management for the system, as the many individual versions result in a constantly growing number of variants**, which must be efficiently managed and further developed by the company.

HENSOLDT has introduced a product-line architecture for variant management.

Consistent compliance with this must be ensured. This concerns all product variants and the entire life cycle of each individual product. To this end, HENSOLDT opted for a sustainable approach, supported by a product-line architecture from the outset. To ensure systematic, uniform and correct implementation of the planned structures by the software, **compliance with the architecture must be checked** – a task which involves significant manual effort.

THE SOLUTION ++ Since 2008, these previously manual checks have been automated with the Axivion Suite. This enables a highly efficient and continuous complete review of the "as-is" architecture.

Continuous comparison of the product implementation in the source code with the specified product-line architecture means that deviations are immediately visible to the architects and developers and the relevant responsible persons are kept informed.

Continuous analysis during development

"With the Axivion Suite, we have significantly reduced our integration effort and integration risk."

Daniel Zimmermann, Head of OSS Software, HENSOLDT Sensors GmbH

"Integration with Enterprise Architect was perfect: Finally models can be enforced without intensive visual inspection!"

Heiko Stehli, Software Architect,
HENSOLDT Sensors GmbH

ensures that the architecture is implemented consistently and as planned. Whenever the Axivion Suite identifies deviations from the plan, it informs the architects and developers of the cause of the deviations in a targeted manner. This means that troubleshooting can be started immediately and either the developer can modify the code accordingly, or the architect can refine the architecture.

Hidden dependencies are completely eliminated from the development process and no longer cause planning and maintenance difficulties in later development phases.

Continual reviews are rid of repetitive bal- last, run considerably more efficiently and allow architects and developers to fully concentrate on the main, constructional aspects.

The "living" and continuously current architecture also increases flexibility in terms of development and allows HENSOLDT to respond quickly to change requests from customers. Thanks to architecture monitoring, the development team is now always in a position to make safe plans and can determine the necessary time frame for changes.

THE SUCCESS ++ With its architecture analysis, HENSOLDT has introduced a procedure that has been warmly welcomed by architects and developers. This is in part due to the fact that the architecture specifications and complex UML models are now more comprehensible with regard to their implementation as code: If the Axivion Suite detects a deviation, it issues targeted feedback immediately. This generates a learning effect for all developers in the form of a feedback loop, as all developers now know what the architects' models mean and how they are to be interpreted. The analysis imme-

diately detects misunderstandings.

Architects experience a similar learning effect: With the aid of the Axivion Suite, the architect gains knowledge and experience of how UML models can be better and more easily understood by the developers. He develops a sense of which modelling depth is reasonable and can precisely estimate impacts during implementation. This means it is possible to achieve an optimum balance between the modelling effort and benefit.

Another great success is the minimisation of the integration risk. During the integration phase, the products are created in the respective customer variants. This is performed at the very end of the process and in the past, this was also used as a safeguard to ensure that the customer variant precisely meets the specified requirements. Today, this safeguarding is already implemented during the architecture review and is therefore much earlier in the development process. This means any deviations can be corrected much more cost-effectively and with less of a risk to the deadline.

Beyond architecture analysis, the Axivion Suite is also used to record metrics. In addition, HENSOLDT's programming guidelines are also monitored with the Axivion Suite, in order to ensure that the software can be maintained, to minimise the probability of errors and to protect the code against further causes of software erosion. The results of the metrics and code tests are also used as KPIs in reviews and reporting.

HENSOLDT implemented the Axivion Suite on a large existing code base. The elimination of violations against specifications follows the strategy that all deviations must be eliminated from new code, and only violations with critical impacts need to be eliminated from existing code. Thus, previously validated system components do not have to undergo complete re-approval. This procedure has been made possible thanks to the differential delta analysis from Axivion, which only displays new deviations in comparison with the baseline.

Overall, HENSOLDT has significantly reduced the absolute overall effort for maintenance of product variants thanks to

the introduction of automatic architecture analysis through the Axivion Suite. This is especially remarkable since the team of developers has increased considerably since its introduction and the code volume for the systems has doubled in size.

ABOUT HENSOLDT ++ HENSOLDT is an independent and globally leading supplier of premium sensors for security and surveillance missions. The company is a global player in such areas as missile warning systems and submarine periscopes. Moreover, HENSOLDT is very active in the market for radar systems, optronics and electronic protection systems.

The company comprises the security and defence electronics activities of the Airbus Group, which were spun off from the group in 2017 and have now entered the market as a new sensor house under the brand name of HENSOLDT. HENSOLDT employs approximately 4,000 employees, generating annual revenues of about € 1 billion.

For further information on HENSOLDT go to www.hensoldt.net

ABOUT AXIVION ++ Axivion, based in Stuttgart, Germany, is a provider for innovative software solutions for static code analysis and for protection from software erosion. The core product of Axivion is the Axivion Suite, a tool suite for the improvement of software quality and maintainability of software systems implemented in the programming languages C, C++ and C#. In addition to static code analysis, the tool suite includes innovative software tools for architecture verification and clone management. Moreover, the tool suite detects software erosion factors such as cycles, dead code and violations of programming rules.

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. Furthermore, the AUTOSAR C++14 styleguide as well as the CERT® programming rules for secure software development are supported.

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