Automate Lifecycle Governance and Compliance for Automotive Software Systems

How To Accelerate Functional Safety in ISO 26262, SPICE, and CMMI

Innovation in the Automotive Industry continues to grow at a daunting pace. The integration of software into embedded systems represents great opportunities for differentiation and is the predominant accelerator of increased functionality and advancement. But the increasing complexity that comes along with it has already shown its toll, resulting in overstrained car development departments, product failures, and the associated cost explosion in terms of warranty costs and decrease in customer satisfaction.

In 2014, the industry is well on its way to shatter all previous records. Six- to seven-figure recalls have become the norm, with manufacturers worried about further regulation while still recovering from the aftershock of the $1.2-billion fine handed to Toyota in the wake of its unintended acceleration debacle.

According to the 2014 KPMG Global Automotive Executive Survey, the following global forces are shaping the sector:

- Environmental challenges
- Digitalization
- Changing customer behavior
- Growing urbanization
- Globalization

Introduction

Software in cars, while representing the single most important source of innovation, has also become the biggest source of challenges and complexity. The Boston Consulting Group expects that by 2015 about 60 percent of new cars will be connected—to the cloud, to users’ devices, to other cars, or to infrastructure. Other areas of innovation, such as assisted driving and driverless cars, are looming on the horizon and will add even more software to the development cycle.
Unlocking the value of these opportunities will require new kinds of thinking and collaboration—including a considerably higher degree of cooperation both among OEMs and Vehicle Manufacturers, as well as between the industry and regulators. Furthermore, labor shortages among skilled software developers will force manufacturers to staff their teams with subject matter experts from around the world. This will in turn require streamlined processes, transparency, and real-time information exchange on a global basis to avoid the kind of communication breakdowns that have been leading to an explosive number of defects and record level of recalls. As time goes on, product liability issues that come along with disparate teams working across continents will only become more challenging.

But we don’t even have to look to the future to realize that development organizations have to reinvent themselves and upgrade the tooling environment they use to stay on track. All we need to do is read the newspaper every morning and learn about yet another recall. The staggering amount of those is not as surprising when we consider the number of software-based functions in modern automobiles. Roughly 90 percent of the innovative features are software-driven. Today’s luxury class vehicles for instance contain as many as 80 software-based electronic control units (ECUs) that are networked together. This complex software development environment has been stretching development teams to the limit. Norms and processes have evolved over the past several years, such as ISO 26262 and CMMI (Capability Maturity Model Integration) as well as Automotive SPICE (Software-Process Improvement and Capability Determination), intended to ensure automotive safety and avoid the defects that lead to recalls in the first place.

Automotive manufacturers are investing increasing time and money in the development and improvement of their processes and process models to map to the new norms. To support those initiatives, leading organizations are looking for better tools to overcome the limitation of their legacy systems. Increasingly, they are discovering that Polarion Software’s solutions are a great choice to adapt to their specific environments while providing built-in expertise to retool quickly for the current challenges as well as get ready for the road ahead.

In this White Paper, we outline the industry-leading capabilities of Polarion’s Automotive Solutions, which are designed to unlock synergies across disparate development teams and empower all stakeholders with the capabilities and information they need to accelerate in the highly complex automotive ecosystem.

**Top 10 Benefits of Polarion’s Automotive Solutions**

- Capture and manage requirements and changes using one repository
- Leverage existing assets and tools, plus re-use requirements to increase overall efficiency
- Create broad and deep traceability across all key process artifacts
- Provide a common collaboration platform for all product lifecycle stakeholders
- Manage risk, recalls, and compliance guidelines centrally and transparently
- Track and manage product and process quality targets
- Provide real-time visibility on product status
- Build up requirement libraries to manage standards and variants of requirements
- Automate and standardize workflows, support distributed development
- Leverage risk management capabilities
Polarion Automotive Solutions

ISO 26262/IEC 61508 Qualification by TÜV NORD

Certification of the Polarion tool environment translates directly into minimal customer qualification efforts up to ASIL D/TCL 2, as only qualified tools support the development of products that conform to ISO 26262. Any non-trusted tool must be qualified individually.

Certified Compliance Functionality:
- Automated workflow control (fully customizable)
- Forensic-level traceability linking
- Comprehensive automated artifact history
- Process of defect and enhancement management
- PDF and other documentation outputs

Document Management

Polarion LiveDocs™

Creating, defining, and editing documents such as requirements, safety goals, and test cases is as easy as using Microsoft Word. Polarion’s patented online word processor enables you to write, edit, and format the content easily. The major difference, conceptually, is that some of your documents’ content can be marked as an artifact, enabling the team to take advantage of all workflow and project management features of Polarion, while document authors can continue to work with content from a document perspective. This approach provides the best of both worlds: office document usability and data-driven process and project management for the organization.

Another great benefit of Polarion is that team members can easily import and leverage existing assets using the rule-based Import Wizard. It recognizes artifacts like requirements, test cases, defects, etc. contained in Microsoft® Word or Excel® and quickly imports them to our modern, browser-based platform. Pre-import Preview prevents time consuming errors, while the “Round-trip” capabilities allow for exchange with outside stakeholders where changes made outside of Polarion can be imported back seamlessly keeping the original formatting and linking in place.
Work Item Concept

Work Items
A Work Item is the Polarion term for an artifact of your development process. A Work Item can be anything you want to track in your project. Polarion comes with several predefined Work Item types for requirements, activities, change requests and test cases. Custom Work Item types — for work products, safety goals, etc. can be defined as required.

Work Item Data Fields, Custom Fields
Each Work Item has a number of default data fields used to describe and categorize the item, assign it to someone, incorporate it into project planning and tracking, set its status, and so forth. Custom fields can be defined for any Work Item type, enabling tracking of and querying on any kind of information. The ASIL category of a requirement can be managed and tracked using a pre-defined Work Item custom field. For each Work Item, the look and feel is completely customizable.

Work Item Life Cycle/Workflow
Each Work Item type has its own life cycle or workflow definition. A workflow is a set of statuses and status transitions, transition conditions, and dependencies that a Work Item passes through in its life cycle. Each of its elements status, transitions, conditions, and dependencies can be customized. This means that you can customize workflow to support any process.

Link between Work Items, Link Attributes/Roles
Linking Work Items is the key to taking advantage of traceability and impact analysis features. Work Items can be linked inside one project, between different projects and even between different repositories. This allows you to relate Work Items to different products and/or product variants and to get traceability and impact information that is not limited by project scope.

The link between Work Items is defined and categorized by link roles. Link roles are distinguished by their names (relates to, implements, verifies, etc.). They can have different semantics if needed, and be customized to meet your specific needs. Using links, it’s easy to manage your complete requirement flow from the concept phase down to your hardware and software requirements and related activities, work products, risk items and/or test cases.

Tracking / Audit Trail
Every artifact change in Polarion is tracked and reported using the underlying configuration management system. You always have the complete audit trail (who, when, what, why, etc.) available. It is simply not possible to change anything in Polarion without leaving a trace. All configuration changes can be rolled back if needed.
Traceability and Impact Analysis

All traceability and impact analyses are based on the links between your Work Items. Polarion provides a number of different views, reports, and wiki pages representing the results of traceability and impact analysis.

The current state of every document is available online at all times. User permissions ensure that access is as open or as limited as needed. Polarion automatically maintains a history of each document. Every time you save the document, a new entry or revision is created in the history. You can easily review any revision, and you can compare any two revisions to understand what changes took place between the older and the newer revision.

You can share the document’s URL with other users and collaborate on the content. You can also use Polarion’s Word Round-trip feature to share the Document with external stakeholders who do not have access to the document in your Polarion portal.

Requirements Management

Defining and managing requirements with Polarion provides significant advantages over legacy approaches:

- **“Best of both worlds” support:** Those who are accustomed to a document-centric approach can continue to work with documents, and those who need data and tools to manage their work can take that approach.
- **Integration of requirements into the overall process:** Instead of struggling to stay on top of isolated office documents that are decoupled from the processes of implementation and testing. With Polarion, requirements are an integral component of the overall development process from start to finish.
- **Requirements based on standards or applicable across projects can be reused within different projects.**
- **More efficient and timely collaboration:** All stakeholders can have access to the same version of requirements at all times. Edits are reflected in real time - no delays waiting for emailed copies. The process is integrated and automated into project workflows, so that no steps are missed or skipped due to miscommunication, everyone can see the current status, and everyone is notified automatically as changes take place and requirements move forward in the process. Those responsible for approval and sign-off can do so electronically online.
- **Easier and more robust traceability:** Rigorous and thorough traceability has been tough to do with legacy approaches. Polarion makes deep and broad traceability easy to implement and totally transparent.
Test & Quality Management

Polarion offers integrated Test Management, which delivers these benefits:

- Specify and manage tests using Polarion LiveDocs and/or integrated tools.
- Easily create traceability down to defects, up to requirements.
- Link test codes to test cases ("where is the test code for this test case?").
- Manual or automatic test runs; optionally import results from external testing tools.
- Automatic test execution history with detailed statistics.
- Customizable test runs from ready-made templates.

Change & Configuration Management

Polarion offers integrated Change Management that provides the following benefits:

- Collect, manage, and track your change requests in one unified solution
- Use impact and traceability analysis to decide which project artifacts have to be checked, changed, or added
- Link your change requests with their related requirements
- Apply suspect management to assist in propagating a change
- Use audit trails (history) for Work Items and documents to show who changed what and when
- Collaborate via threaded comments, voting, and automated notification of implemented changes

Polarion is based on a configuration management system “Subversion.” Artifacts are versioned on each “Save.” Each revision is always available via history information of an artifact. Differences between artifact revisions - Work Items and documents - are shown using a graphical “diff.” You can visually compare any Work Items managed by Polarion… requirements, change requests, test cases, source code, activities, etc.
Baselines
Polarion supports the creation of Baselines. Typically, baselines are used to mark the current state of your project including all project artifacts (Work Items, documents, etc.) so that later on, team members can check the differences between different baselines or between a baseline and the current state of the project. By selecting less than two baselines for comparison, you can specify one or more repository revisions to compare against a single baseline.

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Audit Trail
It is not possible to change anything in the system without having the change tracked. You always have the complete audit trail (who, when, what, why, etc.) available.

Build & Release Management
Each artifact of your Polarion project can be linked to releases. Information can be retrieved using Polarion’s search and reporting features. Benefits include:

- Speed up compile and error recovery processes with mail notifications on build or test failures
- Quickly track down issues with complete audit trails of builds and releases
- Measure re-use of requirements, test cases, and other artifacts across projects

Collaboration

Team Collaboration
Stakeholders can collaborate and communicate on various levels. For discussions and collaboration at “higher” levels, Polarion features a built-in Wiki with default Wiki spaces and documents for the repository and each project. This provides a highly flexible communication medium accessible to everyone with access rights to the repository, project, or document.

More granular collaboration and communication takes place in comments on individual Work Items. Discussions on multiple threads can occur back and forth between two or more project team members, or among several. Comment visibility can be optionally controlled and limited. For example, some comments might be visible only to managers.
Interchange/Collaboration between OEM and Suppliers

• **Native RIF/ReqIF, MATLAB/Simulink Integration**
  Polarion offers an open platform which provides different options for OEM and suppliers to interchange data including native ReqIF round-trip, as well as data exchange via the MATLAB/Simulink integration, optimizing reviews, impact assessment and traceability.

**1.1 Interface Definition**

Fault-Tolerant Fuel Control System

- Sharing and reviewing documents/work products
  Polarion also enables data modification, including approval of requirements via Word documents. With Polarion’s unique “Word Round-trip,” documents containing managed artifacts can be exported to a Microsoft Word document, which can then be shared with and reviewed by people who don’t have access to Polarion. After changes (the type of which can be optionally restricted during export), the Word document can be re-imported to Polarion, where the changes it contains are incorporated into the online Document, and the Document history is updated.

• **Web based Collaboration**
  External partners can be invited to comment on Work Items or documents using Polarion’s pure Web 2.0 client interface, which requires only a late-model web browser and an internet connection.

With Polarion, OEMs and Suppliers can work and collaborate hand-in-hand without media barriers or loss of information and data.
**Risk Management**

Polarion can help product development teams manage risk at many levels, from ensuring that the latest requirements and specifications are available to all and are communicated clearly in a timely way, helping to spot resource bottlenecks before they reach critical mass, revealing the impact (and cost) of change before resources are committed, ensuring adherence to process and compliance with standards, and to providing visibility on what was changed, when, by whom, and why.

Taken all together, you have a solid basis for risk analysis and fulfillment of ISO 26262 in every project and across all projects.
About Polarion Software

Polarion Software is a leading provider of a 100% browser-based and unified platform for Requirements-, Quality-, and Application Lifecycle Management (ALM). The company helps global organizations in a wide range of industries from automotive to medical device and aerospace - creators of products that people trust – achieve agility, traceability and compliance for their complex products. More than 2.5 million users worldwide rely on Polarion to fuel collaboration; integrate ALM and Product Lifecycle Management (PLM); and more efficiently bring their high-quality products to market. For more information, visit www.polarion.com.

Additional Information

Polarion® ALM™

The Unified Application Lifecycle Management Solution.

Everything You Need to Accelerate Innovation.

Unlock synergies across all collaborators in complex product, software and embedded system development environments with bi-directional traceability and common processes, and gain project transparency through real-time aggregated management information.

Learn more @ www.polarion.com/alm

Polarion® REQUIREMENTS™

Complete Requirements Management Solution.

Everything You Need to Accelerate Collaboration.

Unlock synergies across disparate development teams and empower all collaborators with the capabilities and information they need to respond faster and with better quality to business opportunities and customer demands. Upgrading to the unified Application Lifecycle Management (ALM) solution is seamless.

Learn more @ www.polarion.com/rm

Polarion® QA™

Complete Test and Quality Management Solution.

Everything You Need to Accelerate Integrity.

Unlock synergies across disparate testing teams and empower all collaborators with the capabilities and information they need to plan for quality, catch issues, and analyze change much earlier and faster.

Upgrading to the unified Application Lifecycle Management (ALM) solution is seamless.

Learn more @ www.polarion.com/qa