

SIEMENS

Ingenuity for life

Automating lifecycle governance and compliance for automotive software systems

How to accelerate functional safety compliance with ISO 26262, SPICE and CMMI

This white paper outlines the industry-leading capabilities of Polarion™ automotive solutions from Siemens PLM Software, 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.

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Introduction

The automotive industry is well on its way to shatter all previous records. Six- to seven-figure recalls have become the norm, and manufacturers are concerned 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

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 indicates that in 2015 about 60 percent of new cars were 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, and 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 a 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 need 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 example, 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 the International Organization for Standardization (ISO) 26262 functional safety standard for electrical and electronic systems, as well as the Capability Maturity Model Integration (CMMI) and Automotive SPICE (Software-Process Improvement and Capability Determination) process assessment models, 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 limitations of their legacy systems. Increasingly, they are discovering that Siemens PLM Software's Polarion products are a great choice to adapt to their specific environments while providing built-in expertise to retool quickly for the current challenges and get ready for the road ahead.

This white paper outlines the industry-leading capabilities of Siemens PLM Software's Polarion 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 the Polarion automotive solutions

- Capture and manage requirements and changes using one repository
- Leverage existing assets and tools, and 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

The TÜV NORD safety validation association has certified Siemens PLM Software's Polarion solutions as capable tools within a safety development lifecycle according to the International Electrotechnical Commission (IEC) 61508 and ISO 26262 standards. The "Trusted Tools" certification of the Polarion product environment translates directly into minimal customer qualification efforts up to the most stringent Automotive Safety Integrity Level (ASIL) D, Tool Confidence Level (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

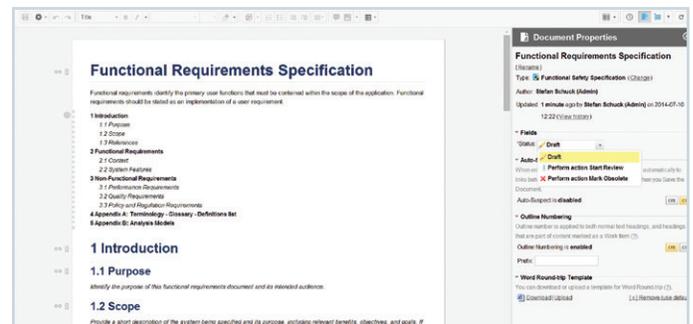
Document management

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 within 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.

Business analysts and requirements engineers who typically work with documents don't have to change their paradigms or sacrifice functionality and ease of use, while technical people can exploit the workflow and management capabilities of the data-driven user interface (UI) option. Executives and others responsible for compliance issues get the reports they need, and the organization as a whole benefits from improved efficiency, transparency and communication.

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, and others contained in Microsoft Word or Excel® and quickly imports them to the modern, browser-based Polarion platform. Pre-import previews prevent time-consuming errors, while the "round-trip" capabilities allow for exchange with outside stakeholders where changes made outside of the Polarion product can be imported back seamlessly while preserving the original formatting and linking.



Work item concept

“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. The solution comes with several pre-defined 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 lifecycle and workflow

Each work item type has its own lifecycle 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 lifecycle. Each of its elements’ status, transitions, conditions, and dependencies can be customized, enabling you to customize workflow to support any process.

Link between work items; link attributes and 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 capability enables you to relate work items to different products and/or product variants and to obtain traceability and impact information that is not limited by project scope.

The links between work items are defined and categorized by link roles. Link roles are distinguished by their names (relates to, implements, verifies, etc.). The roles can have different semantics if needed, and can be customized to meet your specific needs. Using links, it is easy to manage your complete requirement flow from the concept phase down to 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 work items. Polarion products provide 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. The product automatically maintains a history of each document. Each 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 revisions.

You can share the document's URL with other users and collaborate on the content. You can also use the Polarion round-trip for Word 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: Requirements captured using Polarion Requirements are an integral component of the overall development process from start to finish, so you don't struggle to manage isolated office documents that are decoupled from the processes of implementation and testing.
- Requirements based on standards or applicable across projects can be re-used within different projects.
- More efficient and timely collaboration: all stakeholders have access to the same version of requirements at all times. Edits are reflected in real time – there are 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 difficult with legacy approaches. Polarion makes deep and broad traceability easy to implement and totally transparent.

Test and quality management

Polarion offers integrated test management that delivers these capabilities:

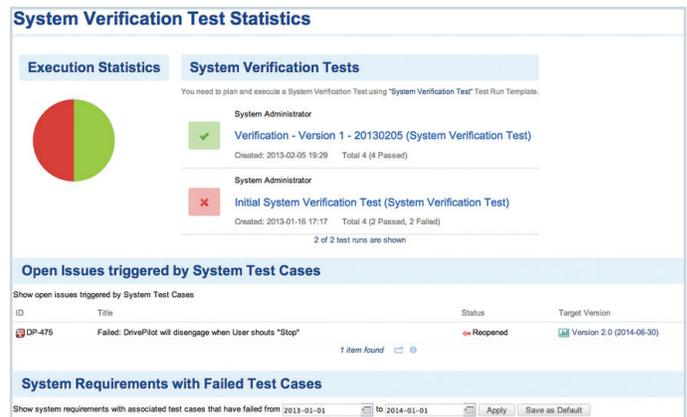
- Specify and manage tests using Polarion LiveDocs and/or integrated tools
- Easily create traceability down to defects, up to requirements
- Link test codes to test cases (“Where is the test code for this test case?”)
- Manual or automatic test runs; optionally import results from external testing tools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

Change and configuration management

Polarion offers integrated change management that provides the following functions:

- Collect, manage, and track your change requests in one unified solution
- Use impact and traceability analysis to decide which project artifacts must 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 the Subversion version control system. Artifacts are automatically versioned on each save. Each revision is always available via history information of an artifact. Differences between artifact revisions – work items and documents – can be displayed graphically, enabling visual comparisons of any work items managed by Polarion, including requirements, change requests, test cases, source code, activities and others.



Baselines

Polarion supports the creation of baselines, typically used to mark the current state of your project, including all project artifacts, so that 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.

Audit trail

With Polarion, 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.

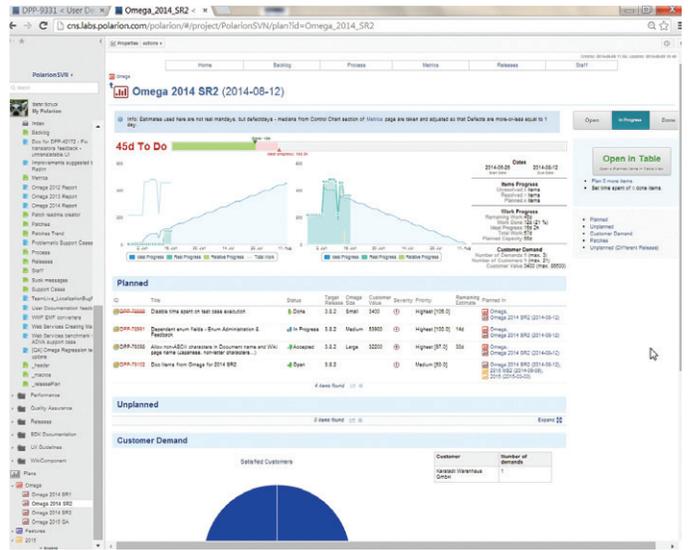
Each artifact of your Polarion project can be linked to releases.

Field	Removed	Added
Author: Stefan Schuck (Admin) , Date: 2014-03-27 17:04 , Revision: 8918		
Status	 Analysed	 In Progress
Operational Modes	driving	stationary
Author: Stefan Schuck (Admin) , Date: 2013-04-18 08:57 , Revision: 2703		
Description	Unintended activation of brake during drive and standing still	
Committed by: Stefan Schuck (Admin) , Date: 2013-04-10 10:45 , Revision: 2327 (created)		

Build and release management

Each artifact of your Polaron project can be linked to releases. Information can be retrieved using Polaron search and reporting features. Benefits include:

- Accelerate 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 among project team members. Comment visibility can be optionally controlled and limited; for example, some comments may be visible only to managers.

Interchange/collaboration between OEMs and suppliers

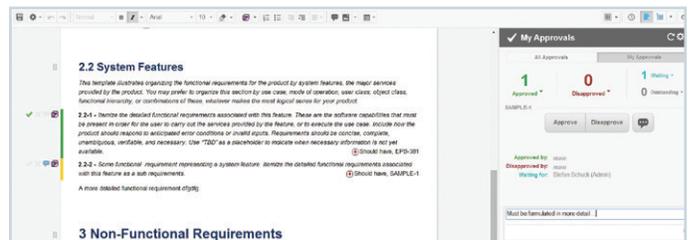
- **Native integrations with RIF/ReqIF, MATLAB® and Simulink®**
- Polarion offers an open platform that provides different options for OEMs and suppliers to interchange data, including native Requirements Interchange Format (ReqIF) round-trip and data exchange via the MATLAB/Simulink integration. These integrations help optimize reviews, impact assessment and traceability.

- **Sharing and reviewing documents/work products**

Polarion also enables data modification, including approval of requirements via Word documents. Using the Polarion unique Round-trip for Word capability, documents containing managed artifacts can be exported to a 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 the Polarion 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

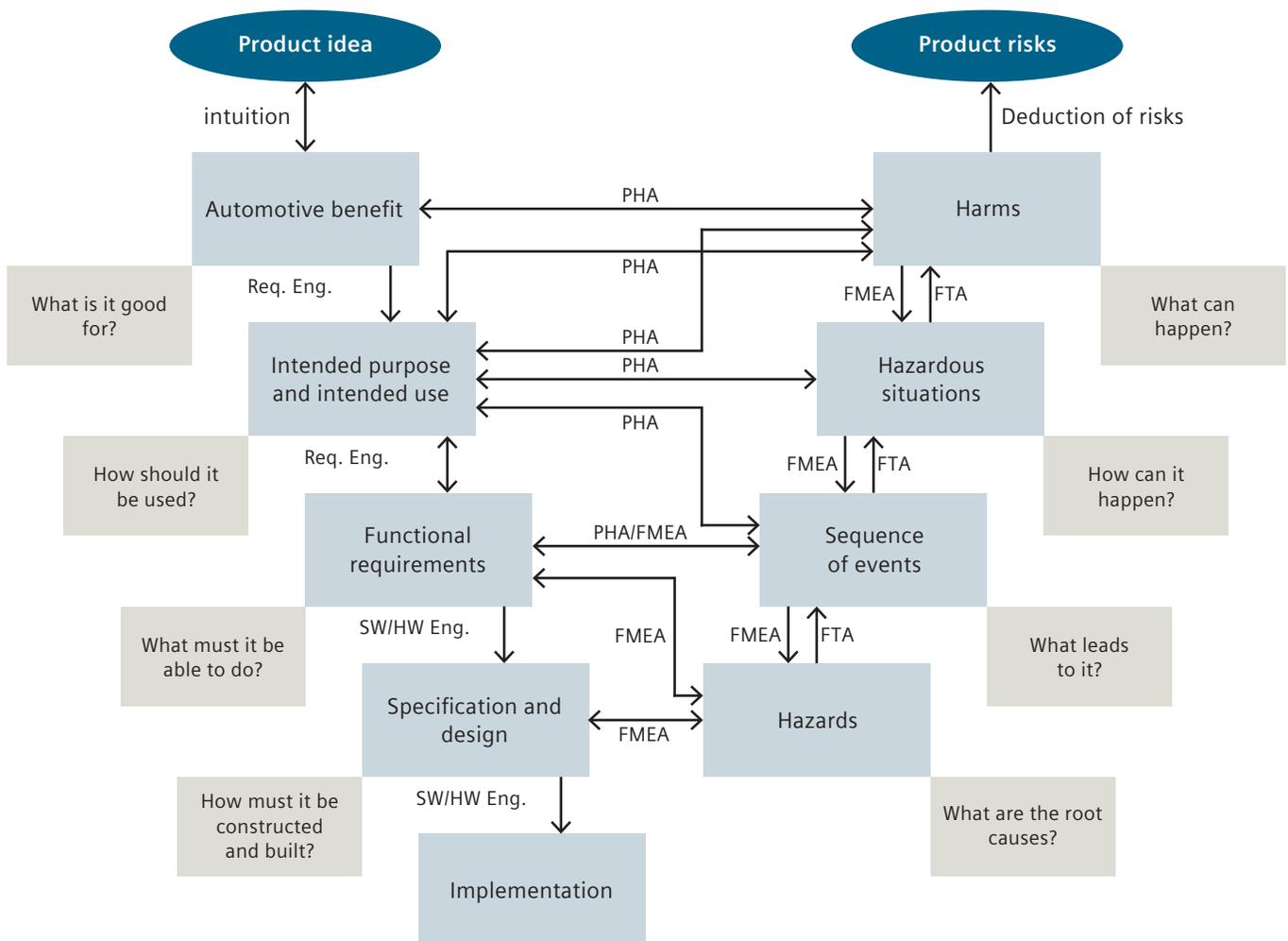
Polarion can help product development teams manage risk at many levels, including:

- 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
- Providing visibility on what was changed, when, by whom, and why

Taken all together, these capabilities provide a solid basis for risk analysis and fulfillment of ISO 26262 in every project and across all projects.

Relationship between product development and risk management



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About Siemens PLM Software

Siemens PLM Software, a business unit of the Siemens Digital Factory Division, is a leading global provider of product lifecycle management (PLM) and manufacturing operations management (MOM) software, systems and services with over 15 million licensed seats and more than 140,000 customers worldwide. Headquartered in Plano, Texas, Siemens PLM Software works collaboratively with its customers to provide industry software solutions that help companies everywhere achieve a sustainable competitive advantage by making real the innovations that matter. For more information on Siemens PLM Software products and services, visit www.siemens.com/plm.

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