Achieving software development agility in complex, regulated environments

Business best practices

Executive summary

Innovation has become an exercise of using software advancements in embedded systems to stay ahead in modern development environments. While opening up great new opportunities, constant updating of software and integration into mechatronics also presents unprecedented challenges to development and operations teams. As different software and hardware components must be seamlessly fused to ensure functional safety and compliance, teams working in silos suddenly must closely coordinate their development efforts in a dynamic ecosystem spanning the globe.

Most collaborators don't have the unified tools environment necessary to get them on the same page at the same time, however, and resulting disconnects have increasingly negative impact, disrupting industries with new records of regulatory warning letters, product failures, recalls, legal sanctions, loss in market position and associated cost explosions.

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Introduction

This paper discusses best practices of adopting Agile and hybrid methodologies in complex software engineering environments, and the benefits of collaborating in a unified, 100 percent browser-based online environment where a powerful rules engine can automate processes at the granular work item level, while multi-directional traceability minimizes the risk of project failure, increases efficiencies and automates the proof of regulatory compliance.

In the last decade, Agile software development methods have come of age and proven their worth in a wide range of industry settings, delivering faster time-to-market, more rapid innovation and increased productivity. However, these methods have not been as quickly embraced by highly regulated development environments for good reasons. Enterprises that have for a long time relied on sequential or waterfall methods have a harder time incorporating lean/Agile methodologies without jeopardizing quality and compliance. But even those organizations have started to embrace Agile or hybrid methodologies in order to achieve the next level of innovation and bring products to market faster.

In a recent Forrester Research report, "Increase Flexibility by Embracing Future Business and Technology Trends," analysts Jost Hoppermann, Paul D. Hamerman, and George Lawrie outline Forrester's vision for the future of business applications, stipulating that "many firms recognize that they can no longer satisfy their continuously changing and growing range of requirements."

Topping the list of challenges in the new world of software-driven innovation are the need for tight orchestration across disparate teams, growing regulatory demands and the increasing role of suppliers as innovation partners. Manufacturers that are able to shift gears to meet the growing complexity will be well positioned to secure new market opportunities.

It is clear that the old way of managing software development no longer suffices to address the wide range of challenges modern development teams face every day:

- Mounting speed in development and rising expectations for innovation

- Increasing use of software for innovation, multiplying technology, supply chain and portfolio complexity

- Seamless integration of complex software for embedded systems

- Growing proportion of development and production processes delegated to suppliers

- Cost reduction mandates and competitive pressures diametrically opposed to safety requirements

Individuals and interaction over processes and tools

Working software over comprehensive documentation

Customer collaboration over contract negotiation

Responding to change over following plan

That is, while there is value in the items on the right, we value the items on the left more.
Agile Manifesto, 2001

In the midst of all this pressure, the environment of the market has become highly consumer- and safety compliance-centric, which forces regulated industry to respond even faster with more innovative capabilities to capricious market demands, while also having to jump through more and more hoops to protect quality and compliance.

The purpose of this paper is to share best practices of Siemens Digital Industries Software's Polarion™ product customers who have already successfully adjusted to the new realities and established a highly collaborative, fully linked development environment that allows them to mitigate risk while applying Agile or hybrid development methodologies.

The following is a summary of what we found in our ongoing conversations with our customers, organized around the software-related challenges most worrisome to the managers in the trenches who are responsible for successful software development for embedded systems:

- Increased agility through real-time collaboration

- Advanced productivity through DevOps integration

- Proactive protection of quality and functional safety

- Smooth compliance with regulatory standards

- Integration of ALM and PLM – the road ahead

These challenges are all interrelated and in aggregate can have a tremendous impact on the success of any organization. Strategies for mastering

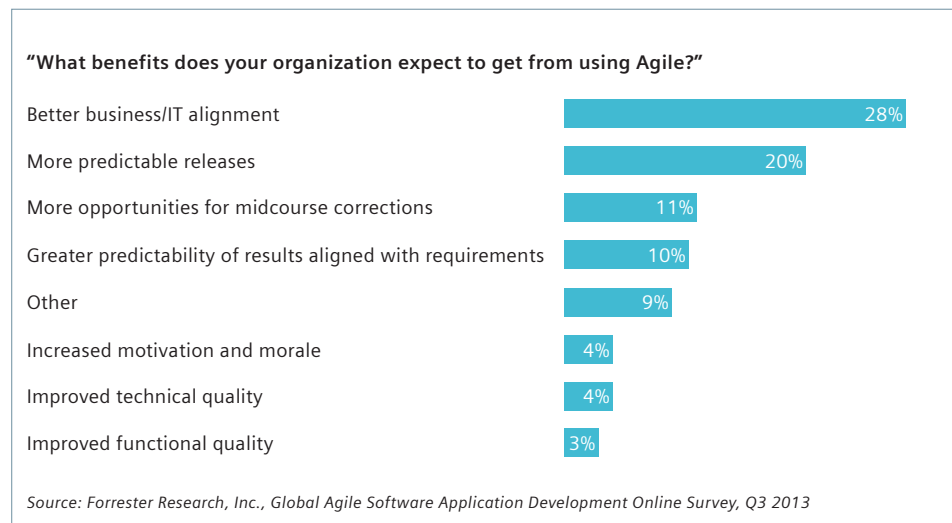# Increased agility through real-time collaboration

The days when organizations could release software only once a year are long gone. With faster time-to-market as a key success factor in today's competitive environment, real-time collaboration is a prerequisite to stay ahead. In many cases, Agile software development methods have replaced or augmented waterfall methods to release products more frequently. Adaptive discovery, design, development and testing in a time-boxed iterative approach support rapid response to change.

In Forrester Research analyst Diego Lo Giudice's report, "How Can You Scale Your Agile Adoption?," he outlines results from Forrester's Global Agile Software Application Development Online Survey, and presents the following benefits:

Siemens Digital Industries Software's Polarion products are ideally architected to help regulated industries succeed with Agile, lean or hybrid methodologies as it seamlessly adjusts to any preferred processes and workflows. In fact, it provides flexible support for Agile or lean, as well as traditional and hybrid environments, including any customized Scrum, Feature-Driven Development (FDD), Kanban, Extreme Programming (XP), or Rational Unified Process

(RUP) methodologies. Templates available for most common methodologies can be used out of the box, or rapidly configured to map to particular business scenarios, while process automation safeguards that no steps are missed or bypassed.

Innovative customers report that the ability to harness contributions from across the entire ecosystem has become a key factor for ongoing advancement, and the synchronization between the different engineering teams within their organizations and their suppliers around the globe has evolved into one of their main concerns. They point out the great value their disparate stakeholders derive from cross-functional collaboration in real time whenever questions arise, taking advantage of the Polarion product's 100 percent browser-based solution. No longer do they have to wait for email responses, or worse, meetings, to get answers to pressing questions. Instead, they can take advantage of the always-up-to-date online environment with live dashboards and wikis as well as access-controlled threaded commenting. Subscriptions for automated event monitoring and change notifications further enhance the rapid knowledge transfer.

"What benefits does your organization expect to get from using Agile?"

Benefit	Percentage
Better business/IT alignment	28%
More predictable releases	20%
More opportunities for midcourse corrections	11%
Greater predictability of results aligned with requirements	10%
Other	9%
Increased motivation and morale	4%
Improved technical quality	4%
Improved functional quality	3%

Source: Forrester Research, Inc., Global Agile Software Application Development Online Survey, Q3 2013

them Document-centric team members appreciate the fact that they can easily import existing work product into the online tool using Siemens Digital Industries Software's patented Polarion Import Wizard.

Once unfettered by the limitations of desktop application-based documentation, granular work items can be established and workflows can be kicked off individually, so team members can start working on them without having to wait for the full documentation to be completed.

Better yet, team members fond of the editing capabilities of the Microsoft® Office® suite don't have to worry about losing any of their productivity. Once online, they can enjoy Siemens Digital Industries Software's patented Polarion LiveDoc™ technology, which comes with much of the same user-friendly functionality, but without the distractions of bloated desktop tools. Customers relate that even die-hard users of traditional desktop applications have been surprisingly easy to convert.

As soon as their counterparts start reporting that document management almost seems easier in the online environment, while providing the power of contextual access to information, adoption hurdles quickly dissolve. This has proven to be of great help in migrating stakeholders that author and manage requirements into the online environment.
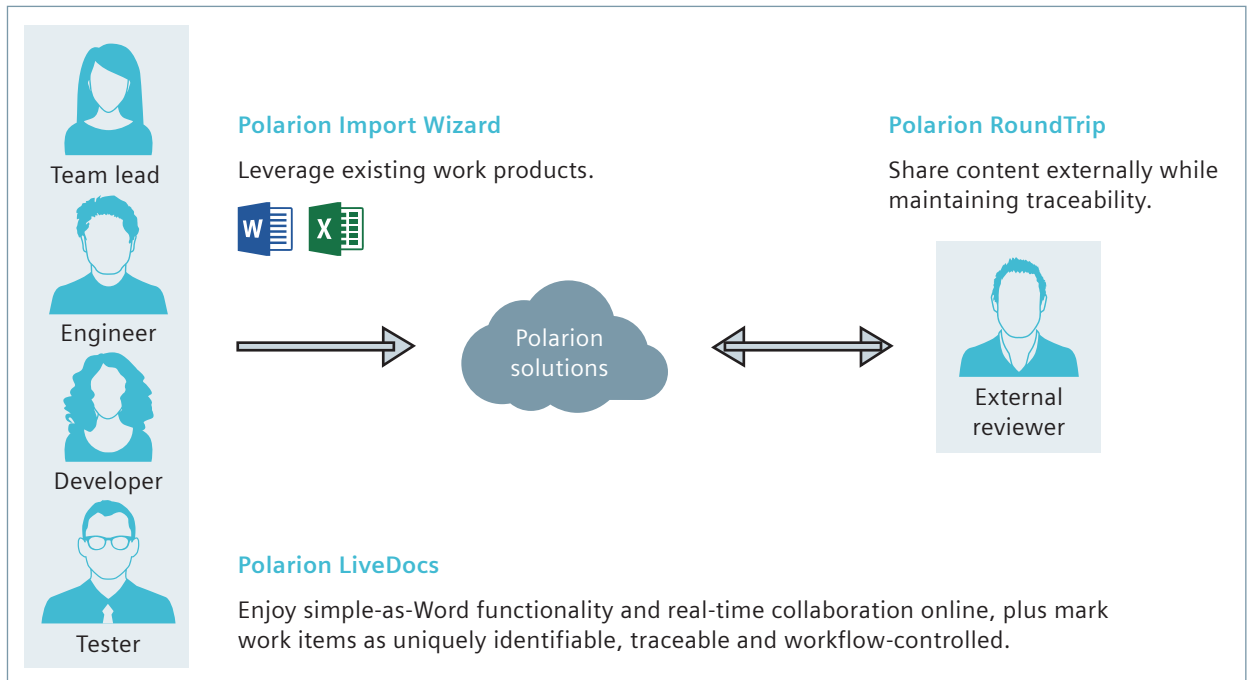
Besides contextual collaboration as a critical factor for shortened cycles and faster time-to-market, workflows also play a key role. Any time there are diverse groups within and outside the organization working together on a project (as is the case in complex ecosystems), the resulting complexity of the operation becomes a challenge. Governing the way the work gets done becomes imperative given all the tight regulations and the importance of functional safety. A sophisticated workflow engine with the ability to enforce business rules across company boundaries is essential to ensure team coordination and cooperation success.

" *Siemens Digital Industries Software's Polarion products presents the opportunity to allocate our complex and formal development rules via one state-of-the-art tool. The modularity and flexibility make the adjustment to our needs simple and effective. The traceability and workflow features are convincing and really assist the everyday activities.*"

Christian Kettl
MTU Aero Engines

Siemens Digital Industries Software customers using the Polarion products confirm that the ease with which streamlined workflows can be established at the work item level makes task-oriented information exchange between development, operations and quality assurance very easy. Templates for most common methodologies come with the tool that can be used out of the box to get teams started, and rapidly configured to map to specific business scenarios. At the same time, incorporated process automation and domain-specific templates are available to safeguard that no steps are missed or bypassed.

With one centralized repository at the core of all activities serving as the single source of truth, the capabilities have helped development teams transform how they collaborate regarding key processes like ideation, requirements management, detailed development and aftermarket support. In fact, the centralized nature of information exchange enables development teams sitting in different locations (or even in completely separate organizations) to effectively convey design ideas, intent and context much faster than the use of email, instant messaging and teleconference calls can achieve. And the functionality not only brings distributed teams closer digitally, but also fosters the healthy discussion of product concepts across business and domain areas that is so important for ongoing innovation.

Team lead

Engineer

Developer

Tester

Polarion Import Wizard

Leverage existing work products.

Polarion solutions

Polarion RoundTrip

Share content externally while maintaining traceability.

External reviewer

Polarion LiveDocs

Enjoy simple-as-Word functionality and real-time collaboration online, plus mark work items as uniquely identifiable, traceable and workflow-controlled.

Beyond that, comprehensive traceability allows developers to refer back to the requirements that underlie their assigned tasks, and also to reach out to the respective author when they have questions. The same applies to the testers that verify whether the requirements have been met. All activities and decisions are automatically tracked, with collaboration history available to reveal how decisions were made every step along the way. Formal approval processes with compliant electronic signatures complete the information exchange. All of this functionality contributes to a much more cohesive way of cooperation in today's complex ecosystem. Customers confirm that using the Polarion products has allowed their development and quality assurance teams to spend much more time and focus on the left side of the V-Model, and catch issues before they become problems.

Domain experts who want to stay in their familiar environments can do so and still be tied into the centralized repository. The Polarion product's native integration with MATLAB®, for example, enables customers to include Simulink® Model-Based Design workflows as an integral part of the application lifecycle. Bi-directional traceability facilitates navigation from Simulink model elements to associated work items in the Polarion products and vice versa. Versioning aids collaborative design, opening up the assets for easy re-use and variant management across an entire product portfolio. This goes back to the critical factor of being able to establish an effective way to bring tailor-made vehicles to market quickly.
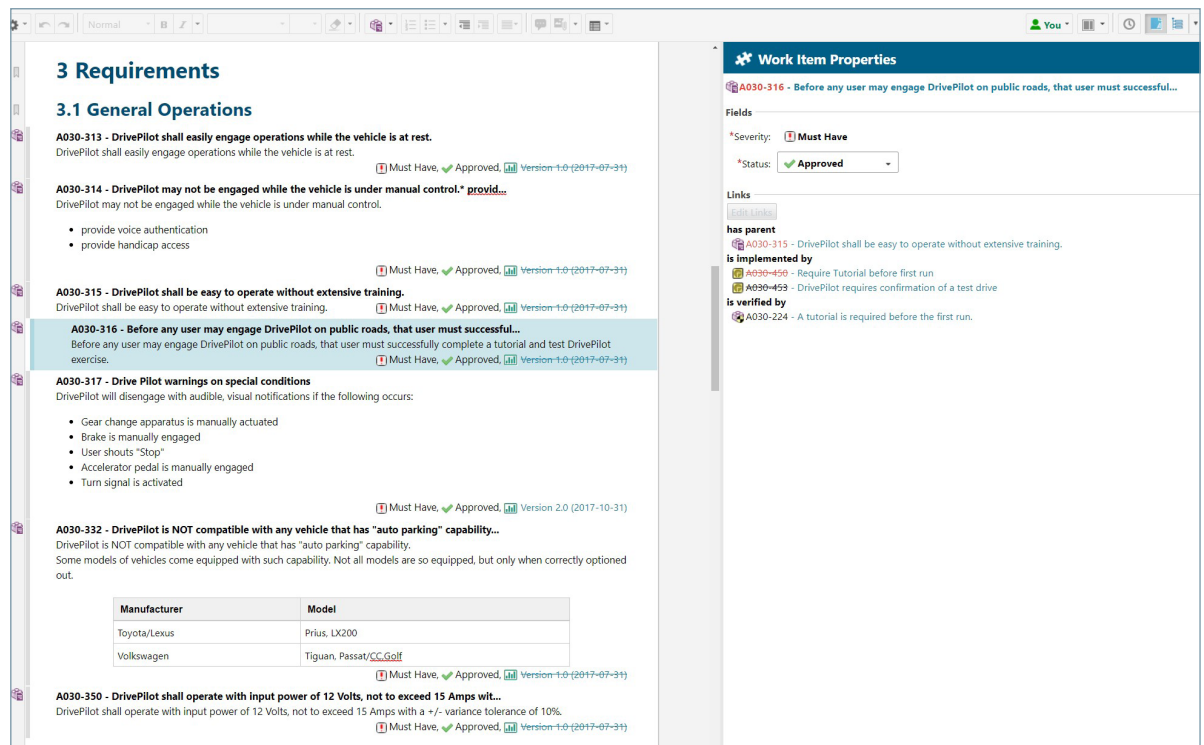
Another native integration that is popular among customers is the round-trip for Requirements Interchange Format (ReqIF) through which traceability across multiple documents or tools is maintained. The Object Management Group's (OMG's) standard for requirements exchange, a widely used Extensible Markup Language (XML) file format and workflow to support lossless exchange between partners, brings OEMs and their suppliers together around the globe. As suppliers are becoming increasingly involved in strategic development initiatives and provide mission-critical innovative functionality that must seamlessly fit into the overall development efforts, this is critical for successful collaboration.
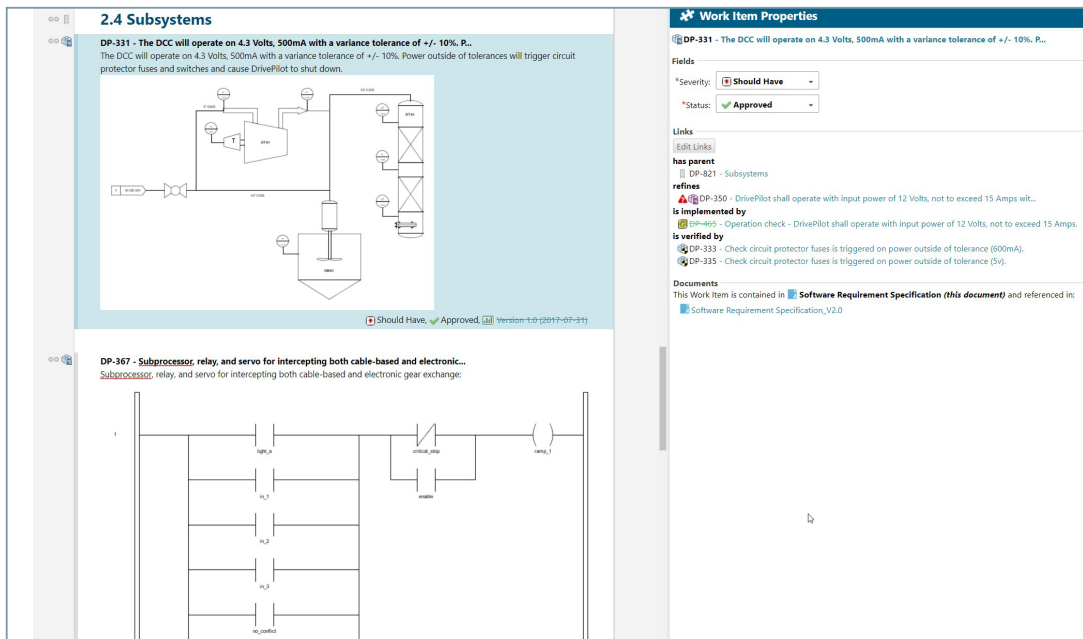
" *With Siemens Digital Industries Software's Polarion products, we found the solution to both of our biggest pain points: achieving SPICE compliance and enabling us to seamlessly fit into the OEM supply chain."*

Christian Posluschni
KÜSTER

Advanced productivity through
DevOps integration

Adoption of Agile methodologies has proven to be a great first step to support accelerating cycles, with a focus on optimized workflows and constant iteration. But in many cases, resulting improvements have been confined to development teams, while operations teams have been lagging behind. To further productivity, adjustments across the entire value chain are necessary, including process automation right at the intersection between development and operations.

DevOps emerged as the answer, allowing companies to advance to the next level of productivity. A large percentage of Siemens Digital Industries Software's Polarion customers

apply a combination of Agile and DevOps methodologies to streamline the interdependence between development and operations and to automate repetitive processes in their pursuit to improve productivity. Siemens Digital Industries Software's application lifecycle management (ALM) solution, Polarion ALM, is the perfect conduit to DevOps, allowing easy synchronization of development and delivery processes spanning requirements definition, feature development, quality testing, and maintenance. Issues anywhere in the process can be quickly traced back to the source in either direction, and the impact of changes can be directly assessed, while at the same time timelines can be adjusted in real time.

"Before, the company invested 20 to 25 percent of project time just managing the process with Excel and Word. With the Polarion product, the traceability is achieved by pressing a button and the time invested is reduced to five to 10 percent."

Uli Markert
Supervisor Software Services
Spansion

Proactive protection of quality
and functional safety

Troubleshooting issues along the development continuum can be a very time-consuming task, especially when traceability is not readily available in the software development process for each individual component. To this day, this can still be a cause for car manufacturers and their suppliers to either delay a release, or ship a car with a plan in place to issue very costly recalls once the defects surface.

Determining release readiness across the isolated groups and systems in today's global development ecosystem is time-consuming and error-prone. Also, the risks of making key decisions increase in direct proportion with the complexity, incompleteness and inaccuracy of data on which they are based.
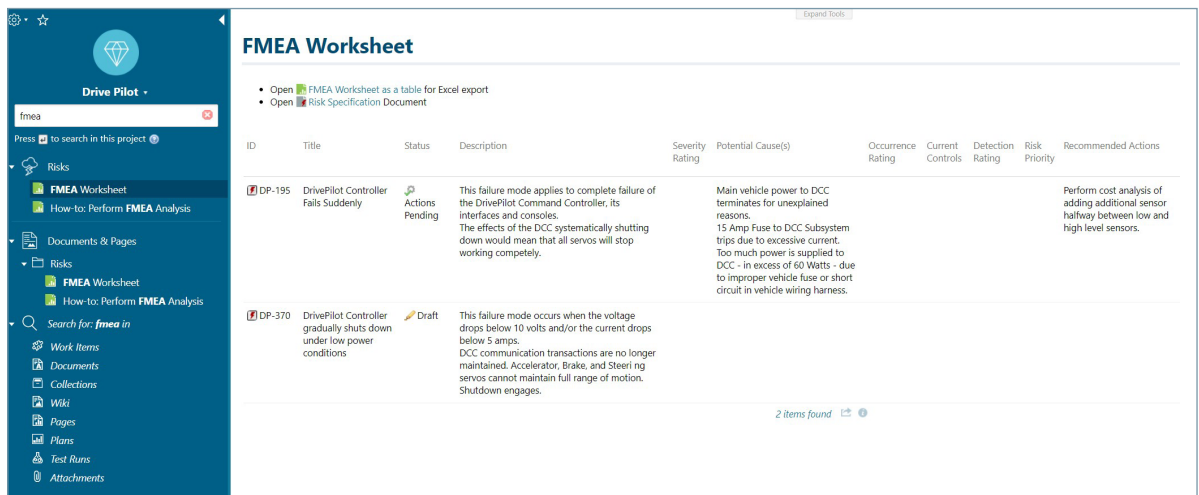
" *With the Polarion product, the entire spectrum of development activities is covered by one tool. This allows closer collaboration between software, hardware, mechanical, project management, test and requirements management.*"

Rainer Kirchner
ASK Industries

Siemens Digital Industries Software customers have been able to take advantage of this qualification and its underlying functionality to quickly comply with the new standard. They are using out-of-the-box features including a custom work item type called "risk," as well as Failure Mode and Effect Analysis (FMEA) templates and preconfigured work-flows that involve before and after Risk Priority Number (RPN) scoring based on user-defined values of severity, occurrence and detection. Additionally, Siemens Digital Industries Software's Polarion products have elevated risk analysis to a first-class citizen within the solution workflow.

This means that customers can easily achieve trace-ability starting from the granular risks identified in an FMEA, to mitigating requirements and subsystem designs, and from there outward to test cases that verify such requirements. From there, they can further trace those same risks through the results of the executed test cases, directly to the source code used for implementing the corrective software components.

Thanks to extensions such as the Polarion Connector for MATLAB Simulink, it is even possible to achieve traceability all the way into model elements. This has enabled Polarion customers to become much more proactive in their risk assessment and functional safety practices and in being able to prove compliance much faster.

Besides supporting the effective management of defects and risks, multi-directional traceability and change history tracking are essential for fast proof of compliance. Every artifact change in the Polarion product is tracked using the underlying configuration management system. The tool itself comes with the Subversion open-source version control system, but can also be easily tied in with any of the other configuration applications such as Git and Perforce. The automated tracking functionality makes it impossible to change anything without leaving a trace, and helps to further reduce the risk of defects and functional safety complaints. This proactive approach to ALM is a much more cost-effective business practice. Our customers confirm that their development teams can bring high-quality products to market much faster when they can find and fix issues before they become a problem. In fact, correcting errors long before final verification leads to tremendous overall savings in development time and project costs, and reduces the probability of expensive recalls and legal action due to bodily harm.

Integration of ALM and PLM
– the road ahead

As we have seen, in today's hyper-competitive environment, accelerating time-to-market for innovative products is critical for success. The source of the challenge associated with accelerated lifecycles is that most manufacturers still apply separate development processes and independently use ALM tools for software development while employing product lifecycle management (PLM) tools for hardware engineering. This is laden with inefficiencies and synchronization delays and their corresponding costs and risks.

The vital role systems and software play in product innovation intensifies this need for synchronization of both development efforts so the efficient use of people, processes, and tools can be achieved. Siemens Digital Industries Software believes that interoperability and data federation, at the core of the integration of software engineering processes into systems-driven product development (SDPD), help organizations make smarter decisions that lead to better products. Seeing the tremendous improvement opportunities, Siemens Digital Industries Software is working with its joint ALM and PLM customers to bring the advantages of such integration to bear.

ALM-PLM integration benefits include:

- Integrated processes make cross-discipline synchronization very easy.

- Access to product and software requirements supports comprehensive understanding of the product definition.

- Bi-directional linking enables cross-discipline lifecycle management and audit readiness.

- Change propagation and automatic notification enable comprehensive change impact analysis.

- Synchronized testing and reporting support cross-functional defect management.

- Linked, versioned data architecture without data duplication delivers closed-loop decision making.

- Integration makes holistic compliance reporting for every aspect of the manufacturing process a reality.

Orchestrating both lifecycle management disciplines unlocks tremendous synergies, helping organizations accelerate collaboration, integrity and innovation at the highest level. And as systems and software play an increasingly vital role in innovation and product value, the need for greater collaboration across design, development, testing and production of both software and product only intensifies.

" *Polarion ALM is the ideal Siemens Teamcenter companion to converge software and product development tools and talent to accelerate innovation.*"

Raj Khoshoo
Senior VP of Strategy Initiatives
Siemens Digital Industries Software

| Conclusion

The revolution in software development is happening, and the time to act is now. The chance to transform your processes is yours for the taking, so that you can harness the opportunities ahead. A unified approach to application lifecycle management and the integration with PLM is not a futuristic technology trend. It is here today, and the good news is that with Siemens Digital Industries Software as the right partner and technology you don't have to completely stop and reset, but can smoothly transition from getting the most out of your existing business processes to making your organization thrive in the future.

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About Siemens Digital Industries Software

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