



## TECHNOLOGY SPOTLIGHT

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# Digital Transformation Through a Product Innovation Platform

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### The Drivers for a Unified Product Innovation Platform

Manufacturers across industry, from medical device to automotive to high tech, are faced with multiple challenges and increased levels of complexity that make it a business imperative to digitally transform the way their product teams innovate, plan, collaborate, develop, and manufacture.

Challenges manufacturers face include:

- Product, demand, and supply complexity, driven by the increase in electronic and software content (particularly for automotive) and the Internet of Things (IoT)
- Global expansion and competition, with new market opportunities pursued by global and local players
- Mass customization and personalization of products, where customers expect their own unique "flavor" of product
- Value-chain expansion as suppliers and partners become design and innovation collaborators
- Enormous increase in the amount of data that can fuel innovation, which is both a blessing and an enormous challenge

In the world of product innovation, development, and manufacturing, 3rd Platform technology (cloud, mobile, analytics, social) and innovation accelerators (cognitive, robotics, 3D printing, and IoT) are being applied to better meet customer needs and for faster time to market and competitive differentiation. In short, innovation is complex and accelerated and hence requires a product innovation platform (product life-cycle management [PLM] extended across the value chain to other related systems, data, and processes) enabled by advanced technology that encompasses product, demand, and supply data and processes in a single view.

Tying application life-cycle management (ALM) and PLM together in a unified systems engineering framework is critical to achieving this view and ensuring ongoing product quality. The reality is that most software development teams want to work in their own ALM systems, and thus there is a strong need to ensure ease of integration with PLM and a seamless user experience. This 360-degree view of PLM, ALM, and quality management (QM) results in a harmonized process, where the team can log in to a single user interface (UI) with complete visibility, enabling smarter decisions on product, software, and quality data, as well as targeted, flexible quality management — whether the quality management is for overall product, hardware, software, or manufacturing processes.

Discrete products, from cars to planes to medical devices to smartphones, have an enormous (and increasing) amount of software within them to meet the functional requirements that customers demand. With this comes the need for integrating the software development process with the overall product development process, simulating products and manufacturing processes at the front end of innovation, as well as testing new and updated software in an already electronically rich, complex product.

In this new reality, quality management and application life-cycle management become even more critical, so manufacturers are looking to connect these processes more closely with product design, development, engineering (mechanical, electrical, software, systems), manufacturing, and service.

A unified product innovation platform enables product design, engineering (electrical, mechanical, software, firmware), manufacturing, operations, supply chain, and service to work closely together and have an ongoing, systems-level view of product, software, quality, and manufacturing information.

According to IDC Manufacturing Insights' *2015 Product and Service Innovation Survey*, quality is the top area of focus for manufacturers because of the aforementioned product, supply chain, and manufacturing complexities and the fight to gain and maintain customers with high-performing, constantly updated products. In fact, survey respondents said quality is the leading reason they purchase a PLM system.

## **Product Innovation Platform Key Elements: PLM, ALM, QM**

With complexity on many levels, manufacturers need a view of ongoing process and product quality across the value chain, which is why a single system that encompasses PLM, ALM, and QM is beneficial. In compliance-centric industries such as medical device and high tech, quality in particular is critically important — the quality group drives the product quality process and is a key partner in the design, development, and manufacturing process. In the medical device industry in particular, quality is paramount, so the quality group works closely with scientists, engineers, and product domain experts to ensure that innovations meet quality standards during manufacturing and usage.

IDC sees the strategic importance of quality increasing in other industries as well, where historically quality teams have existed separately from product design, development, R&D, and engineering. It's not that quality wasn't key in industries such as automotive, aerospace and defense (A&D), and machinery; it's just becoming more integrated into the development and ongoing optimization process of products — particularly in the automotive industry, where vehicles can contain up to 100 million lines of code that need to be updated consistently. This increasing software and connected product trend impacts high tech: High-tech suppliers are working more closely with automotive OEMs on developing in-vehicle systems and need to meet hardware and software requirements to ensure quality in the components and systems they are designing.

Manufacturers are increasingly taking a quality-first focus: design products right the first time and of the highest quality and avoid the scrap and rework costs of +20% versus the 5% costs for up-front parts and labor, for example. That's not to say that up-front sourcing strategy and resource allocation are not critical. However, quality closely ingrained in product design and development leads to fewer issues downstream. This is a whole product and software development discussion as well, where one needs to think about hardware, firmware, software interaction, and change impact. It requires hardware and software quality testing, ongoing hardware defect and software quality management, regression testing, and product simulation to be closely integrated with the product life cycle.

## Connecting to the IoT and IIoT for Faster Decision Making

Products that are connected through the IoT provide information about performance and usage, making it possible to improve quality on an ongoing basis. Manufacturing is instrumented through the IoT as well (the industrial IoT, or IIoT), so processes and issues with machines and lines can be detected quickly and — over time — predicted. With this smart manufacturing/Industry 4.0 approach, production of the aforementioned increasingly customized products can be achieved as products "communicate" their work instructions and tolerances to manufacturing machines and lines. IoT enables manufacturers to track product usage and performance more effectively and verify that the product can be manufactured as designed.

Also with this approach, it's critical to tie engineering and demand data, processes, and resources to manufacturing to meet the rapid, dynamic pace of customer needs and innovation. This is the reason IDC calls IoT an "innovation accelerator." Technically, to achieve innovation acceleration, PLM needs to be closely integrated with ALM, manufacturing execution systems (MES), and QM in the same system, closely integrated with data and processes visible via a single UI. A platform that combines engineering, manufacturing, service, and connected products in a single system, leveraging IoT in an industrial environment (IIoT), enables smart manufacturing/Industry 4.0 and can result in improved quality. One of the goals of tying these pieces together is to better enable dimensional tests on production lines and communicate results promptly to the engineer when a product defect is detected, for rapid change if necessary. For example, perhaps after the analysis, the engineer decides to tighten up tolerance on the shop floor to reduce recalls.

IoT has also made possible the delivery of product as a service, where the product has very little maintenance and low cost of serviceability, which can be managed in the cloud. One example is GE, which is in the process of transforming from an industrial company to a software company. GE sells hours and usage for its industrial products, as well as service and reliability. A feedback loop determines any failure modes, which can be combined with a historical view of quality by product, part, material, supplier, and manufacturing process, integrated with analytics.

When moving to this product-as-a-service approach, where quality and reliability are so important, manufacturers need to track how close in tolerance is the part that was built: Is it really +/- 5 or only 3? Determining the serviceability savings is critical, as is understanding how wide one can set the dimension tolerance while maintaining quality. This is why aligning manufacturing more closely with engineering and the service and repair team is so important.

## Critical Intersection of PLM Analytics, ALM, and Quality

Quality needs to be designed into the product, especially with the growth of connected products, and performance and engineering changes must be verified throughout the life cycle of the product. PLM analytics embedded within PLM systems enables the decision support required to maintain this high level of quality across the development and manufacturing process, supply chain, and service. When design, engineering, and service have access to relevant product quality data within their unique digital work environment — PLM, ALM, and service life-cycle management (SLM) — and not in a separate analytics tool, they can rectify any product issue more quickly. Essentially, product life-cycle analytics is the digital bridge between product, manufacturing, service, and back again.

Product quality information comes from multiple sources that need to be analyzed and presented in a unified fashion to a varied team of engineers across domains, including electrical, mechanical, firmware, and systems engineering. Sources of product quality information include:

- CAE (computer-aided engineering) — for form, fit, and function verification
- MES — to verify manufacturability and track process

- SLM — for product and service issues in the field
- ALM — for software development and tracking/mitigation of software bugs
- QMS (quality management system) — for overall product, process, and operational quality

It would certainly be inefficient, possibly ineffective, to have different bodies of quality information dispersed throughout the enterprise. Connected, "smart," software-rich products that change often require PLM to be integrated with these other systems if a high level of product quality is to be maintained. For ALM in particular, although software engineers typically prefer to work in a system separate from PLM (i.e., their native design system), they need to be able to check their work back in to the product record (usually existing in PLM) to keep it consistent and updated for the global team.

According to IDC Manufacturing Insights' *2015 Product and Service Innovation Survey*, respondents want their quality information available in a cloud environment. This is because of the need to respond quickly to quality issues (many of which will be software in nature due to connected/smart product growth) to stay competitive and meet customer demand, as well as meet dynamic compliance reporting requirements, particularly in highly regulated industries such as food and beverage and pharmaceutical. The performance and security of cloud infrastructure have improved, with increases in computing power and improvements in multifactor authentication, so manufacturers are more confident in their ability to support and expedite quality issue sensing, analysis, and communication to assist product/brand management, engineering and design/R&D, and manufacturing.

## Considering Arena Solutions

Manufacturers recognize the benefits of taking a unified product innovation platform approach to product design, development, and manufacturing, as well as the critical role product quality plays in the success of their business. Such an approach is required in a market that faces the following challenges:

- Complexity across product, demand, and value chain changes often — for example, complex electronics with a high mix of components.
- Manufacturing processes are elaborate as a result of the aforementioned complex products.
- Products are increasingly high tech, "electrified," and software intensive across industry.
- Customers expect customized products with a high mix of components delivered to market quickly.
- Supply chains and value chains are extended, where close collaboration and open innovation now take place.

Arena Solutions has evolved its set of offerings to support this reality by providing a single, 100% software-as-a-service (SaaS) platform that encompasses PLM, ALM, and QM for products and manufacturing in medical device, automotive high tech, and consumer high tech, as well as any vertical using embedded high-tech electronics. The company's ALM tool, Verify, supports embedded electronics and software product development through requirements creation and management by building a list of defects for the electrical designer during the early stages of design and new product development. This quality verification during the iterative design process enables manufacturers to achieve optimal quality and could be a nice complement to an ideation or customer needs management system.

Verify's capabilities include:

- Requirements management
- Defect management
- Bug management
- Integration with full ALM tools as required
- Part of the Arena cloud PLM platform

Other capabilities complementing Arena's quality management offering are as follows:

- **Analytics:** Through partnership with GoodData, a cloud-based business intelligence (BI) provider that enables in-context analysis within Arena Solutions on product development processes, data, and resources
  - Fully integrated into Arena's UI with an automated extraction, transformation, and loading (ETL) process between the two technologies
  - Customizable dashboards that can include key performance indicators (KPIs) such as cycle time, quality, and project performance
- **Manufacturing quality control:** Through partnership with 1factory
  - Provides "dimensional quality assurance" (i.e., Is a product being manufactured within the dimensions of the product design or the given tolerance?)
  - Factory floor test collection plan and process that flows into Arena PLM (When a product requires service or repair, information related to usage, performance, and failure mode is communicated to engineering for a fix and/or future innovation.)
  - QA in the factory for OEM- and supplier-made parts and products, where the actual measurements the line person is making for lot samples in a manufacturing line can be captured

### ***Meeting the Challenges Ahead***

Manufacturers are moving to a product innovation platform approach for design, development, engineering, and manufacturing. Many are shifting at least some key innovation processes, if not their entire PLM process, to the cloud, so Arena Solutions is well positioned. Quality in particular is a key focus for manufacturers across industry. One challenge is that in industries other than medical device and high tech, the quality group and quality systems are typically segmented from the rest of the organization, not tightly integrated with the rest of the organization. But no matter what the industry, software development and quality assurance are key and manufacturers are looking for a quality management solution that integrates ALM, analytics, and manufacturing quality control with the full product life cycle. This is a technical integration and organizational development challenge that Arena Solutions will need to be ready to meet.

The 1factory dimensional quality assurance partnership marks Arena's first foray into remediating issues on the manufacturing factory floor, a smart approach that doesn't go full-on into manufacturing process planning, manufacturing execution, or manufacturing operations management. The partnership essentially enables verification of product design and manufacturing capability, which is important in today's world of mass customization. The challenge will be the classic lack of collaboration between engineering and manufacturing; again, this challenge is technical and organizational in nature, mostly organizational.

PLM and ALM integration is a requirement for any manufacturer with connected products. Arena has taken the first step with Verify and in the short term needs to ensure easy integration with other software development systems. In the long term, the company must determine if development of an ALM tool that includes capabilities beyond requirements management, defect management, and software bug tracking is an endeavor it wishes to undertake.

## Conclusion

To achieve digital transformation, manufacturers need a single product innovation platform that includes PLM, ALM, and QM and enables collaboration between products, manufacturing, and supply chain to address multiple points of complexity across the various domains of engineering, manufacturing, and service.

IDC sees four benefits to tying PLM, ALM, and QM together in a product innovation platform, where there is a unified view of data, processes, and resources and hence better harmonization across cross-functional teams:

- **Improve product success rate by 25%** through continuous product improvement: Feedback loop of product performance information should be constant to learn from product failures and quality issues and improve future versions.
- **Minimize cost of poor quality by 25%:** Improving product success and reducing quality issues naturally will reduce costs. Any quality issues are sensed and acted upon more quickly.
- **Meet and exceed customer and regulatory compliance requirements:** Ensure initial and ongoing compliance.
- **Protect brand and reputation:** A single product quality issue can have a long-lasting negative impact on a brand.

The IoT provides a complementary feed of data into the quality management process, from products in use and from the manufacturing shop floor. With an analytics "digital bridge," manufacturers can be more proactive and predictive about quality issues — whether on the overall product, hardware, firmware, software, processes, supply chain, or manufacturing. To leverage this massive amount of data, the right organization has to be in place. In particular, design and engineering need to be closely tied to manufacturing to address quality issues during production so that any out-of-tolerance problems can be solved promptly.

IDC believes that a single product development platform, or a product innovation platform — one that encompasses PLM, ALM and QM — is the superior approach to address today's inherent complexities and quality demands. When engineering, quality, operations, manufacturing, and service are tied together, manufacturers achieve faster time to market, meet customer needs, and achieve higher product quality. IDC thinks Arena Solutions, as a pure SaaS cloud vendor, should be considered for complementing quality management in the high-tech space. Arena's expertise in the industry and capabilities in hardware defect management, requirements management, and software bug management, tied to the company's single PLM platform that encompasses ALM and QM, make Arena a viable option for any high-tech manufacturer or manufacturer with connected products that needs to manage an increasing amount of electronic and software content.

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