Configuration Management: Configuration Integrity is a Core Driver for Business Success

CIMdata Commentary

Key takeaways:

- *Configuration management is a fundamental capability requirement for any product produced in series and any complex machine.*
- *Poor configuration management guarantees business failure in the long-term and often in the short-term.*
- *Teamcenter supports lifecycle configuration management at scale from requirements through as-maintained serialized configurations. The Advanced Machine Engineering focuses on requirements through the as-designed state and is directly compatible with other lifecycle extensions including advanced simulation, manufacturing, and service.*

Introduction

The industrial machinery landscape remains incredibly complex. Domain and system requirements, changing assembly designs, third party components—all these facets and more must be managed beneath the umbrella of configuration management (CM). With more interdependencies driving machine configurations now than ever before, machine builders must prioritize doing things right the first time rather than doing them over and over, wasting valuable time and resources. To this end, Siemens' cloud-based, advanced machine engineering solutions supporting end-to-end product lifecycle development are critical to ensuring a company's success amid a competitive landscape.[1]

Regulatory Issues

Machine builders can face many different regulatory requirements often dependent on the industries of their customers and the uses of their machines. For highly regulated industries such as food processing and medical devices, the product configuration and manufacturing processes must be controlled. If the as-maintained configuration is not well documented and managed, often with serialized parts, regulatory violations may easily occur. The impact might be the inability of the customer, the machine's user, to continue manufacturing or selling their products. To readily produce compliant machines, machine builders can leverage Siemens' product lifecycle management tools. These tools provide a single, cloud-based environment for collaborating on projects, where regulatory documentation can be stored and aligned to each phase of the product development lifecycle. In this way, regulatory targets are met at every development phase and tightly controlled, driving down any potential risks or costs associated with violations.

Safety Issues

Even within low regulation industries, safety is always critical. OHSHA and other requirements must be validated and tracked for compliance. If a component has a known flaw, it must be corrected and the correction proven and traceable. Machinery is dangerous. Many hazards—physical, electrical, chemical, biological, and others—can injure or kill workers or bystanders. Evaluating safety issues that may occur in a machine may require ergonomic simulations and

[1] Research for this commentary was partially supported by Siemens Digital Industries Software.

analysis combined with machine operational analysis. Traceability, multi-disciplinary analysis, simulations, and other machine factors can be monitored via Siemens' comprehensive lifecycle management tools based in the cloud.

Customer Satisfaction Issues

A simple definition of customer satisfaction is that the customers come back and the products don't. Products that don't perform as expected quickly discourage customers. Delivering machines on time that work as specified when installed is the first step to a satisfied customer. Ensuring a machine works as planned is a fundamental component within a product lifecycle management solution. With its capabilities, a lifecycle management solution helps identify and resolve issues from anywhere, send and install the right replacement parts every time, and answer questions quickly so that customers are satisfied.

Cost Issues

In addition to pleasing customers, configuration costing is another important issue for machine builders. Poor CM leads to duplicate parts, overly complex products and product lines, excess inventory, more scrap, more rework, and incorrect machines and repair parts being shipped to customers—all items that have significant impact on margins. Without good solutions to support CM, more people are required to manage configuration data, adding cost, and inevitably increasing mistakes.

Machine CM can easily get out of control, leading to increased variations, lost innovation, and higher unit costs and inventory expenses, as new parts with new part numbers are created in lower volumes due to lack of data reuse which is critical for saving resources. Fortunately, there are tools companies can use to implement successful machine CM, for example, product lifecycle management solutions. Siemens' cloud solutions make it possible to find, source, duplicate, and reuse machine information and models at every phase of the product lifecycle, meaning, configurations can be better managed so that costs are controlled.

Cost of Late Changes

It is well understood that the cost of a change goes up by an order of magnitude as a product progresses through each phase of the product lifecycle. A change that costs $1,000 in the design phase, costs $10,000 in the manufacturing phase, and costs $100,000 in service.

During the early phases, most of the cost is in people's time. Once product manufacturing starts, investments in raw materials and tooling dwarf the early development costs. Field changes are worst because of the cost of travel to the machine's location, time to audit the current state of a machine in service, time to discover which parts and subsystems can be replaced or repaired, getting the parts and equipment to the location, and executing the repair. Furthermore, changes later in the product's design lifecycle impact delivery time which damages customer credibility and may negatively impact repeat business. Finally, late changes are usually rushed, which adds risk. This is why a product lifecycle management tool is essential: it can manage configurations and changes at any stage of development, so that errors are caught earlier, ensuring minimal expenditure. Saved time may also be reallocated to allow companies to complete even more projects that drive long-term profitability.

Managing the Digital Thread

To improve effectiveness and efficiency, industrial companies and PLM solution providers are collaborating to create a complete digital representation of products. This manifests itself in a

complete end-to-end virtual representation of the product's configuration and related information throughout its lifecycle. Siemens' Advanced Machine Engineering cloud-based approach provides machine builders with tangible benefits, from operational transparency to a shared collaborative space. Furthermore, this platform approach and synchronized tools ensure that the data from various lifecycle states e.g., as-designed, as-manufactured, and as-serviced, fully represent the product. An integrated product lifecycle and change management capability in the platform ensures that alterations are properly managed across the lifecycle. This digital representation of products is known as the digital thread, which allows the creation and maintenance of a digital twin of a product.

IoT, one of the recent technology additions to many machines provides machine builders with two fundamental digital thread capabilities. IoT enables improved product performance monitoring and support. Operational data can be used to support condition-based and predictive maintenance when combined with artificial intelligence or machine learning. Furthermore, operational data can be used to provide machine builders with insights that drive requirements to improve the next version of the product—closing the product lifecycle loop. As companies start to adopt new technologies like IoT, their need to have traceability and impact analysis further increases.

BOM integration has several different technical approaches but based on CIMdata research[2] the state-of-the-art approach is a multi-view BOM methodology. This usually requires a single PLM configuration management solution to manage the core BOM structures, but by doing this, common capabilities are used to maintain associativity among all of the BOMs and robust traceability can be established. With traceability, each item in the BOM is connected to its upstream and downstream item versions in the digital thread.

Impact Analysis

From an innovation viewpoint, impact analysis is perhaps the most useful capability enabled by the digital thread. Product improvements, retrofits, and new options are common strategies used to improve customer satisfaction, enhance product capabilities, and increase revenue. These strategies are all dependent on a clear understanding of existing configurations and what the impact of a change will be. Common impact analysis questions include:

- What are the cost and inventory impacts if a change is made?
- What population of in-service machines will this change be compatible (or incompatible) with?
- What technical documentation will be impacted?
- Are any requirements violated?
- What simulations will need to be re-run?
- How will this impact the manufacturing process?
- Do we need to notify any suppliers?

Change impact analysis is painful in most companies because data is not fully connected in a digital thread. This lack of connection forces the change team to search manually to identify issues and reduce risk, a time consuming and error prone process. Once a digit thread is created and a comprehensive digital twin is established, change processes improve

[2] https://www.cimdata.com/en/aerospace-and-defense#

dramatically in speed and quality. People are more confident that their decisions are accurate and won't have unintended consequences.

Configurators

In addition to variations brought about during the machine design process, there is also the need to support machine sales configurators in ETO and especially in CTO businesses. In the CTO case, the configuration needs to identify and manage all of the combinations of machine systems that can be built into a working solution for a customer—and exclude combinations that will not result in a valid, workable product. In these cases, the configurator has to be capable of managing a 150% BOM and the relationships that tell it how to create 100% BOMs for each desired configuration. In the case of ETO, a CTO baseline is often augmented with custom engineering to meet special requirements.

Siemens Solution

Siemens Advanced Machine Engineering (AME) is a subset of the Xcelerator portfolio that supports machine builders with three core capabilities—next generation machine design, effective delivery of complex products to market, and the digital twin of machinery and virtual commissioning. Siemens AME provides cloud-based product lifecycle management and configuration solutions, in addition to several other capabilities, such as simulation and computer-aided design. Through Siemens' integrated solutions, clients gain time, cost, and resource savings driven by cloud-based data sharing, which improves machine design and configuration processes. Many of CIMdata's industrial clients, including many machine building companies use Teamcenter to manage product configurations containing data from a wide variety of authoring solutions. The tightly integrated change management solution enables effective change impact analysis and ensures traceability and configuration integrity.

Conclusion

Properly configured product data is a gift that keeps on giving. When all the constructs necessary to describe the nuances of configurations are available and properly used, data reuse can be optimized, improving product quality, shortening design time, and shortening time to market. These same benefits are available for managing change. Strong CM enables faster and more confident decisions on what needs to change, when a change can be implemented, and how costs can be minimized. Machine builders looking to improve their business should explore Siemens' Advanced Machine Engineering solution. With Teamcenter and adjacent products, machine builders can use configuration and lifecycle management capabilities to drive greater efficiency and flexibility into their processes, engineering the machines of tomorrow, today.

For more information please see Siemens Digital Industries Software at:
siemens.com/plm/advancedmachinery

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