

Collaborative Manufacturing: Critical for Success in Today's Complex Heavy Equipment World

CIMdata Commentary

Key takeaways:

- *At the same time that overall product complexity is increasing, manufacturers must also produce custom product configurations, often in small quantities*
- *Better collaboration between engineering, process and product planning, and manufacturing is required to manage growing product and variant complexity*
- *Collaborative manufacturing provides a key solution for analyzing the product mix to understand its impact on production, allowing companies to optimize overall production throughput*
- *Siemens PLM Software is enhancing their PLM portfolio with focused solutions designed to help customers define, sell, and produce today's complex products more efficiently*

Introduction

Manufacturing enterprises face many challenges. Two that are causing extreme stress are the increasing complexity and variations of their products and the need to be able to simultaneously produce multiple product variations at different production plants distributed globally. For example, a piece of heavy machinery could have multiple equipment options, i.e., loading buckets, lift units, drive train components, and engines. Each option may be dependent on other options, e.g., a certain size bucket may require different attach points or hydraulics. Each of these options may require different build processes in different plants, for example, in Brazil one component may be purchased while in the United States that same component may be manufactured in-house as part of the build process.

Meeting global demand and responding to customer demands for “personalized” products is increasing the product and process complexity of both development and production. The need to support defining and managing these massive configuration alternatives is driving the requirement for improved collaboration between design engineering, process engineering, and production. Also, as-built information needs to be communicated with downstream service organizations. Companies need integrated information flows and processes that are highly flexible and can adapt to product and market changes. Those companies that implement business platforms to address these issues can achieve faster ramp-up to production, reduce their time to market, and better adapt to changes in their global and local markets.

CIMdata believes that companies that address these issues will position themselves to more quickly deliver the highly-configured-to-order products customers are demanding and make more efficient use of their distributed manufacturing facilities.

Efficiently Producing Complex Products

To efficiently realize global design and production, manufacturing enterprises must support, design, and produce multiple configurations and variants of a product family in a cost effective manner. Efficient global manufacturing requires improved planning and scheduling and that must start up front during engineering, not waiting until the design is completed and

transferred to manufacturing. Additionally, manufacturers must leverage and reuse their knowledge and lessons learned as well as ensure they are complying with company standards and applicable regulations. They need to have a closed loop process to manage changes between engineering and manufacturing and incorporate feedback from the shop floor. This early communication enables faster issue resolution that will help improve the quality of processes and products, and significantly reduce internal and external failure costs.

The reality of today's market is that complex configured-to-order product structures reflect customer demand for personalized products. Customers want to buy products tailored to their specific needs. Manufacturers must adapt their products to local markets, regardless of where they are produced. They need to define standard product modules and associated structures to efficiently support their downstream production planning processes and be able to quickly propagate changes to parts and assemblies. This will enable them to better support increasing numbers of product configurations and variants as their business grows.

Manufacturers must be able to effectively plan their production and supply strategy for a product "Lead Plant" and then be able to tailor and transfer that information to secondary plants. They need to have a consistent application of configuration and variability across design and planning to allow knowledge re-use and create a common set of best practices to support standardization. This will enable them to deliver production plans faster, improve their operational efficiency, and support plant specific production while increasing process standardization and shared best practices.

To meet the needs of individual plant production goals companies need to be able to distribute processes to the workstation level, perform line balancing, and assess utilization in real time. This has typically been done manually, however visual process planning and line balancing tools can help planners more easily understand the issues and determine appropriate solutions. This will ensure that the planned operations do not violate the workstation cycle time. They can also identify constraints between manufacturing processes to ensure that operations are distributed to workstations in the correct build sequence.

Another capability required is the ability to do up-front validation of manufacturing processes and leverage process information directly into the simulation environment to reduce errors and rework. The integration of analysis tools and processes will help companies develop right-the-first-time manufacturing plans and reduce the risk of errors in manufacturing, which will improve quality.

Manufacturers need to be able to establish closed loop change management between engineering and manufacturing to help them evaluate and assess the impact of a design change and perform assembly feasibility analyses. Establishing controlled manufacturing change collaboration and reconciliation can help improve time to market by ensuring manufacturing and engineering are aligned and issues are identified and resolved prior to physical production.

Companies need to have collaborative manufacturing capabilities so that they can analyze the product mix's impact on production to optimize overall production throughput. Such analysis helps identify and reduce non-value added work and optimize material flow and logistics. Manufacturers can also plan to better optimize equipment usage. They can more easily evaluate alternatives to validate early on how optimized throughput can be realized under typical mixed-model production scenarios.

To work more efficiently and be more competitive, companies need configured, intuitive and up-to-date information available on the shop floor via online electronic work packages. This

includes assembly sequences with visual data and animations as well as connectivity with MES and ERP. This information should be automatically created based on a plant-specific process definition. They also need to be able to report non-conformance issues in context of the work instruction. Having direct access from the production work context, with information about assembly station layouts, parts, and tools to be used helps provide immediate feedback from the shop floor on design or documentation issues and enables these to be resolved quickly.

Siemens PLM Software's Strategy for Collaborative Manufacturing

Siemens PLM Software has recognized the need for a collaborative manufacturing approach that addresses the issues described above so they can help their customers manage this increasing complexity. They have taken a holistic approach to how engineering and manufacturing need to collaborate to support the complexity of highly-configured products manufactured globally. Fundamental to their strategy is that companies need to be better able to deal with product complexity (highly-configured-to-order with increasing variations) and the complexity of their manufacturing environment (global sourcing and production with different processes at each plant).

Siemens PLM Software's Collaborative Manufacturing solutions are built on their Smart Innovation Portfolio. Characteristics of this platform are particularly pertinent to collaborative manufacturing. They are:

- Engaged Users—right information, right time, right context
- Realized Products—virtual product definition, real production environment, closed loop between product development and production
- Intelligent Models—accurately represent what is real, understand connectedness, always up to date
- Open System—optimize the value of business investments, easy deployment, future flexibility

Siemens PLM Software's new Collaborative Manufacturing solution includes product and process configuration, and variant management designed to support complex highly-configured-to-order products. These management capabilities are seamlessly integrated with a comprehensive, visual process planning solution that includes the ability to automate the creation of plant-specific manufacturing BOMs (MBOMs). Users can quickly see the changes needed and made across multiple MBOMs. This information supports production balancing across lines and plants to optimize production within and across production facilities as well as supporting throughput validation for mixed-model production.

Siemens PLM Software has developed a closed loop feedback system to manage change between engineering and manufacturing so that product and production changes are kept in sync and issues are identified and resolved earlier in the lifecycle. Working with Siemens Automation groups, they have also developed intelligent work instructions that can be automatically transmitted to manufacturing execution systems (MES) and individual workstations. These systems can then provide direct, immediate feedback from the shop floor to engineering and process planning users and systems.

To enable efficient collaborative manufacturing, Siemens PLM Software has developed and incorporated several new capabilities within their PLM solution portfolio:

Global Manufacturing BOM supports the ability to automatically author an MBOM from an Engineering BOM (EBOM) based on sourcing information. A plant-specific MBOM can be created from the EBOM or another existing plant-specific MBOM. The product configuration is automatically ported to the manufacturing structure during creation, with each plant getting a unique manufacturing structure. The solution maintains a link between the manufacturing structure and the product structure. This also enables the ability to automatically track and apply design changes over time. Siemens PLM Software's Teamcenter solution provides the capability to automatically create a manufacturing structure for each plant based on the product structure and the advised fabrication and supply strategy (e.g., supporting make/buy decisions).

Global Manufacturing BOM supports deviations for individual plants so that companies can leverage local low cost sourcing opportunities. It also helps companies reduce unique manufacturing part numbers per plant, which leads to simplified inventory. Using this tool to review and compare MBOMs from different plants helps companies derive and use global and local MBOM best practices, which supports continuous improvement to their manufacturing processes.

Global Process Planning (Enterprise Bill of Process (BOP)): This solution helps companies minimize the time required to introduce new models into production across their global manufacturing facilities. It supports the re-use of production methods and equipment across multiple plants and enables best practice propagation to relevant plants. It also supports process variations unique to each plant.

Change Tracker provides the ability to identify changes between project milestones. This includes tools that help users understand the changes as they are rolled in and also enables propagation of those changes to ERP and MES as appropriate.

Net Change enables the efficient data transfer of change and configuration information between PLM, ERP, and MES solutions. It is designed to only propagate what has changed, not retransmit the entire set of information. It then updates configurations and other appropriate data with the changes to ensure that they are complete, and valid. It also enables the capture of changes per Manufacturing Change Notice (MCN) and control changes per MCN.

Summary

Heavy equipment manufacturers are confronted with increasing complexity—complexity in their products and product variations, and complexity in global production. As a result, they need effective collaborative manufacturing capabilities so that they can better integrate their product and production processes, planning, and strategies.

Siemens PLM Software is addressing this need with new capabilities built on their Smart Innovation Portfolio designed to enable manufacturing enterprises to manage their highly complex, configured-to-order product variations so that they can plan and produce them as required to meet global, local, and specific customer requirements. This includes being able to create plant-specific MBOMs from a single EBOM, the ability to transfer intelligent work instructions directly to the shop floor, and a closed loop change process between engineering and manufacturing.

CIMdata believes that Siemens PLM Software's approach to and solutions for collaborative manufacturing are a solid step toward better, more effective, and more profitable manufacturing. These solutions should be able to help companies improve their overall

product engineering to production efficiency and improve their market competitiveness. Manufacturing enterprises facing these complexity challenges should include Siemens PLM Software in the evaluation of solutions for collaborative manufacturing.

About CIMdata

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