DIGITAL INDUSTRIES SOFTWARE

Leverage PLM to accelerate equipment design

Enhance efficiency by giving stakeholders immediate access to product and process information

Executive summary
Heavy equipment companies implement product lifecycle management (PLM) systems to provide various stakeholders across their global enterprises with access to a single source of product and process knowledge. Once a PLM system is in place, companies can leverage this knowledge to improve productivity, reduce design and engineering costs as well as operational expenses, facilitate global collaboration and provide the visibility needed for better business decision-making. This white paper identifies the best-practice capabilities that a PLM system should provide to support these fundamental business needs.

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Introduction

Whether in agriculture, construction, mining or material handling, companies across industries and around the globe are exploring innovative methods and technologies, aiming for unprecedented performance and addressing regulatory requirements that become increasingly stringent. As a heavy equipment company, your ability to keep up with this innovation wave or even lead it will determine your business success into the future. To survive, you will need to invest in research and development (R&D), upgrade your offerings and maybe even investigate new business models or redefine the scope of your activities. But while doing so, you must continue generating steady revenue by delivering current equipment quickly to secure your daily business.

This daily business is always under pressure. The margins are tight in heavy equipment because products require significant engineering effort and typically are produced in relatively low volumes. Oftentimes these products are time-sensitive because they are being ordered for specific construction or mining projects or for the harvest season. So time pressure on design is inherent to the business. However, a few trends are escalating the need for speed. First, as customers are exploring new ways of doing things, they require customized equipment. Second, various standards and regulations apply around the world, meaning during design you must understand all the differences and consider multiple requirements simultaneously. Finally, the advent of electrification and digital technologies is leading us to a new generation of machines, which will be much more complex to design and will touch many disciplines.

A PLM solution allows you to master the complexity of your heavy equipment lifecycle by bringing together all product information and processes into one centralized environment. The PLM system acts as the digital thread backbone that connects disjointed software tools to ensure accurate bill-of-materials (BOM) and configuration management, efficient supply chain management, robust change management and global scalability and extensibility. Globally distributed teams can work as one by accessing a single source of truth via the comprehensive digital twin model of the product maintained in the PLM system. Product information can be pulled as needed by stakeholders, including original equipment manufacturers (OEMs), their partners and suppliers.

Business agility is key to responding to market, regulatory and technological changes. PLM helps heavy equipment companies take full control of their product lifecycle by keeping all the information and processes in hand.

Product and process knowledge is recognized as a key resource in achieving business success. But even in today's digital age, most companies still struggle to utilize this knowledge as a manageable asset from one business opportunity to another.

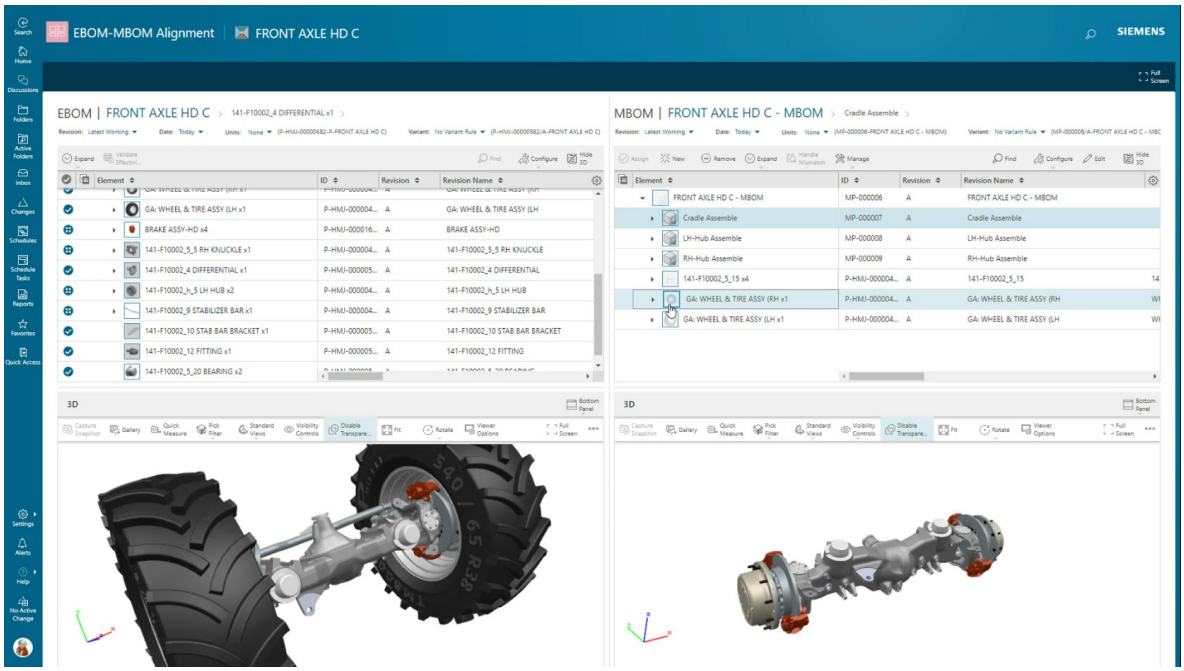
PLM enables heavy equipment companies to manage all their product and process-related knowledge in a single secure but accessible system that can be used with multiple applications and by teams across an organization. With a PLM system in place, product information assets can be coordinated and synchronized, enabling companies to:

- Improve productivity and reduce cycle time
- Reduce development errors and costs
- Facilitate collaboration with anyone, anywhere
- Improve value chain orchestration
- Provide greater visibility so people can make better business decisions

To deliver these advantages, companies need a PLM system that can support their business-specific needs. This system must be able to provide best-practice solutions for:

- Secure data management
- Process enablement
- Bill-of-materials management
- Requirements management
- Change management

Choosing the right PLM system provides companies with a solid foundation that can be easily expanded at their discretion into a full PLM platform.



Business challenges

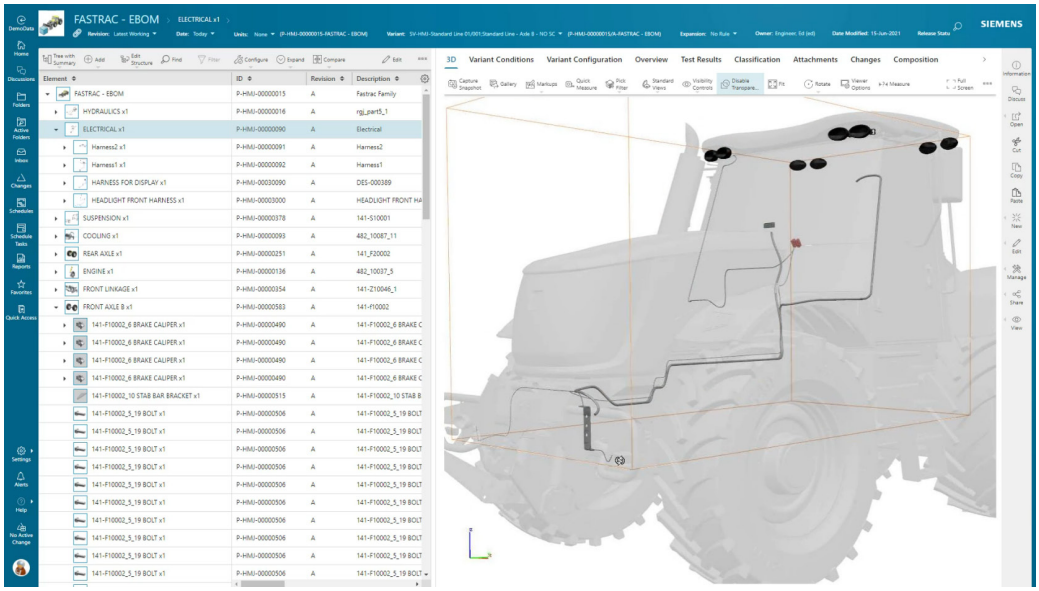
Accelerated equipment design is about successfully navigating a complex transition period in a market that is inherently traditional and competitive with tight margins. It's about securing daily business by timely delivery of what your customers want today and thereby creating the bandwidth to explore what they will need tomorrow. Our goal is to present you with a set of best practices that will help you achieve tremendous time savings while improving the quality of your products without the risk your reputation will be damaged.

Digitalization is key to managing complex project and product data throughout the product lifecycle.

Efficiently finding, updating and sharing information across all stakeholders keeps projects on track without delays or cost overruns. But current information handling processes, often based on spreadsheets, fail to provide the means to manage the complexity of today's heavy equipment projects. This poses the risk of unmanageable delays and lowered quality, causing penalties for late delivery, a drop in profits and possibly putting new orders at risk. While heavy equipment companies realize that change is needed, they abstain from adopting more complex solutions. So any new approach should be easy to implement across the complete organization.

Modern PLM solutions offer the flexibility, scalability and functionality required to move toward the digital enterprise. A centralized, easy-to-access data management system connects all product information to span the entire lifecycle, from requirements through design and manufacturing. When all product data is held in a single system, globally distributed teams can work with a common set of data, tools and processes. Further, customers, partners and suppliers can pull accurate and up-to-date information when and where they need it.

The outcome is a process that not only removes delays in communications or operations but also makes it easy to manage changes to projects and keeps timescales up to date, as well as re-use data for future projects, capture knowledge and define best practices.



Best practice solutions

As the following table indicates, a PLM system enables companies to address a variety of fundamental business needs.

Business needs addressed by a PLM system

Fundamental business needs	How a PLM system addresses these needs
Improve productivity and reduce design time	• Ensures that every participant has immediate access to the current requirements, specifications and feedback • Synchronizes product and process information across multiple organizations, linking an enterprise's silos and dramatically improving access to accurate and up-to-date data • Merges an enterprise's product and process knowledge into a single highly accessible and secure source that eliminates time-consuming information searches while facilitating information re-use and better decision-making
Reduce errors and costs	• Provides visibility into accurate, up-to-date information in a meaningful context, which reduces errors and lowers the cost of change • Enables enterprises to manage and reconcile multiple application systems more efficiently with a single secure source of knowledge • Eliminates the costly and error-prone process of manually duplicating information between different applications, reducing the number of iterations in the design and manufacturing phases
Facilitate collaboration with anyone, anywhere	• Ensures that product teams and their individual members are working with the right version of the right product information in a meaningful context, seamlessly connected by a digital backbone • Enables dispersed teams, departments, suppliers and partners to seamlessly share diverse types of knowledge without regard to geographic, organizational or technical boundaries

Improve value chain orchestration	• Provides enterprises with a way to consistently manage processes that involve the participation of both internal users and external partners or suppliers, as well as design and requirement changes that affect these participants • Enables companies to align the work of participants and reduce errors caused by miscommunications • Ensures regulatory compliance with traceability throughout development
Provide greater visibility to products and processes	• Enables enterprises to comprehensively manage their product and process data, including computer-aided design (CAD) data, parts information, documents, requirements, 2D and 3D data and other intellectual assets • Provides users throughout the enterprise with visibility into accurate, up-to-date information in a context that is meaningful to them, where the impact and status of design changes, requirements changes and other decisions can be clearly understood by everyone

Essentially, a PLM system can be used to manage product knowledge and development processes in local as well as global environments.

Of course, individual companies make their own unique PLM decisions about the applications they deploy, as well as whether they want to enable their workflow-driven processes to span all or only selected aspects of their value chain. Still, regardless of what decisions are made, the selected PLM system must be able to be used to provide best-practice solutions for the following five areas:

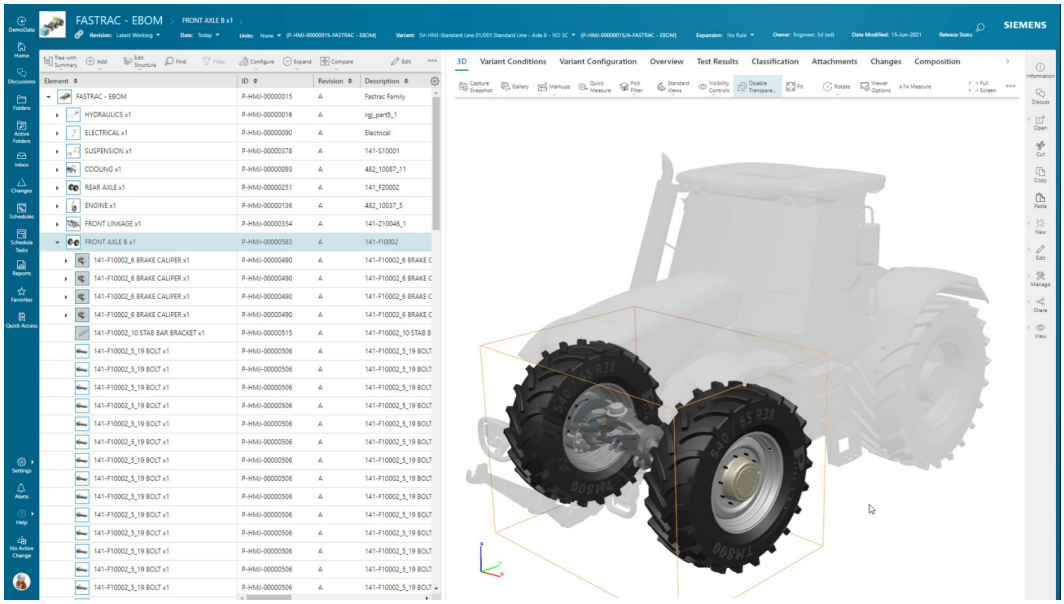
Secure data management, which enables the PLM system to address multiple end-user needs and experiences. A PLM system should be able to be used to capture and manage all the information required to design, develop and produce today's heavy equipment. Users across every stage of the product lifecycle need to be able to easily locate, understand and work with the information required to get their jobs done, including parts, documents, requirements, electrical drawings, manufacturing instructions and other meaningful data. This access must respect the entitlements that protect the intellectual property rights and security needs of the enterprise. The PLM system should facilitate the digital documentation of targets and requirements that companies need to guarantee regulatory compliance and auditability.

Process enablement, which provides the PLM system with workflow and process capabilities needed to enable both internal product teams and external partners and suppliers to participate in the product lifecycle. A PLM system should be used to ensure that all processes are consistently managed with best-practice rules and conventions.
A rules-based engine is especially valuable since it can be used to easily capture best practices and process knowledge and allow consistent execution with appropriate participants and data.

Bill-of-materials management, which enables the PLM system to manage product information from wherever it is created while allowing it to be used wherever it is needed. A PLM system should be able to be used to manage information across an entire product lifecycle and bridge the gap between the upstream stages of the lifecycle and its downstream phases, to offer data traceability from concept through production and handle future maintenance needs. The system also should enable participants in each stage to visualize and share information without requiring them to purchase or learn how to use special software. Just as importantly, the PLM system should provide complete BOM visibility, which includes being able to see the bill-of-materials before and after changes are made, as well as from different points of view, including promoting understanding by nontechnical users by enabling them to visualize the equipment and its components in 3D.

Requirements management, which enables the PLM system to easily capture, securely manage, accurately verify and reliably maintain requirements information. The PLM system should not be just about managing requirements. It should also connect requirements with people and processes to align them with equipment design, engineering and operation and provide all engineering decision-makers and stakeholders with a common understanding of the machine's characteristics and what they need to create.

Change management, which provides the PLM system with functionalities to support end-to-end, closed-loop execution from identifying the change driver, proposals and planning to physical implementation of the change.



Key capabilities

While the general requirements discussed in the preceding section are helpful in conceptualizing the best practice solutions needed by a PLM system, the following table describes detailed capabilities required by these solutions.

Best practice solution	Required capabilities
Secure data management	Provides the PLM system with key data management capabilities to capture, retain, communicate and validate up-to-date product information and ensure that the right information is delivered to the right users in the correct context. This single source of product and process knowledge can manage and provide seamless access to all of an enterprise's related designs, parts, documents and requirements. The PLM system also should facilitate: • Management of multiple CAD tools and formats • Authoring coordination (check-in, check-out) • Version and revision control

	• Document management that provides design and engineering teams with appropriate document templates, auto-rendering and markup capabilities, as well as support for desktop tools such as Microsoft Office • Search functionality that includes quick search, detailed search and graphical search capabilities for enabling widely dispersed and diverse users to access the PLM system's product and process knowledge anytime, anywhere • Security and administrative functionality that protects the intellectual property rights of all lifecycle participants through: • Role management • Program-based security • Access privileges
Process enablement	Provides the PLM system with key process management capabilities to ensure that product and process information is delivered to the right person at the right time, including: • Workflow capabilities that enable enterprises to establish, manage and execute automated and orchestrated workflow-driven processes that reflect company-specific best practices • A PLM system should also support other established processes, including phase-gate standards
Bill-of-materials management	Provides the PLM system with the visibility necessary for managing and presenting BOM information from wherever it is created to wherever it is needed. Key capabilities include: • BOM management that enables enterprises to accurately represent and efficiently manage a complete BOM in all of its lifecycle stages. The PLM system also needs to facilitate:

	• Complete, multi-domain BOM that can include mechanical, electrical, software and simulation parts, components and assemblies • Integrated configuration management and change management • Alignment and synchronization of all sources of BOM data, as well as all lifecycle phases, from the equipment's initial conception to production and beyond. • Open applications and systems integration with authoring tools and enterprise applications, including enterprise resource planning (ERP) and manufacturing execution system (MES)
Visualization	Enables lifecycle participants to share and visualize on-demand representations of the equipment and its underlying assemblies and parts in a secure portable format without the need for a CAD authoring tool. The PLM system also needs to provide: • Visualization capabilities to verify and validate the mechanical design, including virtual walkthroughs • Virtual prototyping of parts/components for design reviews • The JT™ data format support, the 3D language for PLM visualization

Requirements management	Provides the PLM system with the capability to capture, share and maintain requirements in a centralized place, helping ensure that everyone in the organization and across the supply chain has access to the latest, most accurate information. With requirements managed alongside the rest of the equipment data, companies can tie requirements to implementation. By allocating requirements to the various multi-domain design and analysis functions, they can ensure that implementation meets the initial requirements and that resources are available to address highest priority projects. Functional areas of the company can better establish verification plans and parameters, as well as provide the visibility needed to monitor the project status and quality.
Change management	Provides the PLM system with a single source of truth across domains and throughout the equipment's lifecycle. Project changes are recorded in real time to ensure all stakeholders have up to the minute access to the latest data, wherever they are. This boosts collaboration and helps drive smarter decisions. • Closed-loop change management across systems and processes offers: • Impact assessment to understand the overall impact of change to cost, process and schedules • Holistic control to manage the change process and leverage powerful project, workflow and schedule management capabilities to reduce the impact of complex change • Downstream interoperability with systems like ERP, material requirements planning (MRP) and manufacturing operations management (MOM) • The PLM system's change traceability allows stakeholders to easily:

	• Audit the change history, identify and share all changes including description, details, adds, removes, replaces and originating changes • Review sign-off reports to understand the change process execution including the various steps, participants & their involvement in completing the process flow • Monitor status and performance

Conclusion

To keep up with innovation and rapidly changing regulatory standards, heavy equipment companies need to implement PLM to provide a single source of product and process knowledge. This will enable them to improve productivity, reduce costs, facilitate collaboration and provide the visibility needed to optimize decision-making.

Siemens Digital Industries Software and our global network of partners have extensive experience helping companies like yours get started with PLM.

Teamcenter® software is the world's most widely used PLM software, available for delivery on-premises or on the cloud with our Teamcenter X software as a service (SaaS) subscription offering. Teamcenter is part of the Siemens Xcelerator portfolio, a portfolio of comprehensive software, hardware and services.

Take control of your product information and processes with PLM today, then grow to meet your needs tomorrow. We can help you achieve your strategic business goals.

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