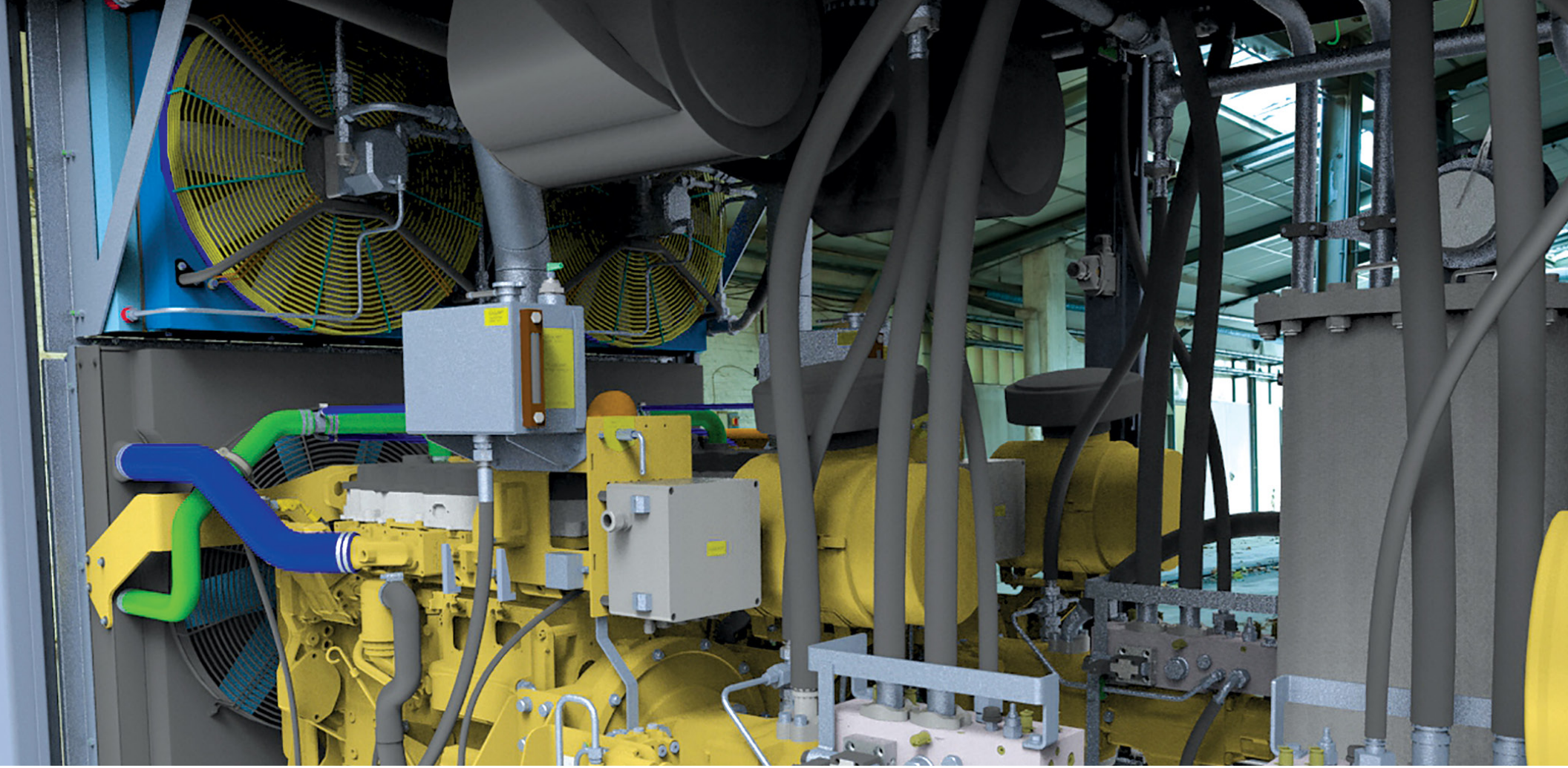

DIGITAL INDUSTRIES SOFTWARE

Streamlining heavy equipment design

Using a comprehensive digital twin to accelerate product development

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Industry trends

The challenges of the heavy equipment industry can be summarized in one word – complexity. This increase in complexity is compounded by product diversification, end-user customization requirements and the pressure to deliver reliable and highly efficent products faster and more cost effectively. These challenges are flattening existing revenue streams and eroding profit margins.

But the true disrupters in the heavy machinery industry won't be those trying to limit complexity. Businesses that succeed will be the ones that not only embrace this complexity, but harness it, turning it into a competitive advantage. Heavy equipment manufacturers that build and service the most reliable, efficient and adaptable products are the ones who will define the future.

Adopting a comprehensive digital twin can help you deliver innovative machinery and equipment to market faster. With the insights and data from a comprehensive digital twin, companies can accurately simulate the performance of their products, allowing them to build more flexible and connected equipment to handle a wider range of end-user needs and enabling quick responses as requirements change. Any part of the physical product or production environment that isn't represented in the digital twin can't be simulated, introducing risk into your business.

However, making data available isn't helpful if it's presented in a confusing or complex way. It must be personalized to the engineer and their task. Modern, adaptable, personalized solutions provide tools that are easy to use. They can pull information from many places and present that information in a way that is consumable for the task they are trying to complete.

Solid Edge® software, which is part of the Xcelerator portfolio, the comprehensive and integrated portfolio of software and services from Siemens Digital Industries Software, enables manufacturers to create a comprehensive digital twin of their products and includes solutions for mechanical design, electrical design, simulation, manufacturing and technical publications. It also includes solutions for data management for all the technical data that is created and consumed when supporting the comprehensive digital twin. It facilitates collaboration both within manufacturing companies and with external resources, including suppliers and customers. Solid Edge is an on-ramp to digital transformation.

The cornerstone of the Solid Edge portfolio is its innovative computer-aided design (CAD) application. Developed from the ground up to be an open and extensible tool, Solid Edge with synchronous technology provides you with the freedom to design naturally and iteratively, whether you are working on a new design or editing existing parts, assemblies or products. That's because synchronous technology contains built-in intelligence that interprets design intent regardless of where the design originated.

Using Solid Edge with synchronous technology also enables seamless collaboration. In today's open, highly connected digital design environment, interoperability is no longer just a nice feature to have – it is essential. For example, synchronous technology enables CAD models in a wide variety of formats to be opened and immediately edited in Solid Edge.

Using Solid Edge enables manufacturers to respond to major trends that are impacting the heavy machinery industry.

Major trends that are impacting heavy equipment manufacturers are:

- Competition from low-cost manufacturers resulting in pressure on product development and manufacturing costs
- Pressure to bring new, differentiated products to market faster than your competition
- Pressure to design equipment that is reliable and efficent and has low energy cosumption and emissions

Leveraging software to support innovation

To respond to these trends and succeed in competitive global markets, manufacturers will benefit from improving performance in key process areas.

Collaborate with customers and suppliers

- Simplifying and accelerating communication of designs with suppliers and customers reduces potential errors in design and manufacturing, and can help speed the complete product development process
- Easy-to-use, cloud-based collaboration tools can enable you to share design data that was created in different CAD formats
- Using Xcelerator Share cloud-based collaboration enables the user to securely share design data internally and externally and in a way that protects intellectual property (IP)

Manage projects and design changes

- The ability to easily and consistently manage data that is created and consumed throughout the product lifecycle can speed the introduction of new products
- Scalable data and process management solutions enable the fast and accurate completion of design projects and engineering changes
- Solid Edge provides built-in revision and release management capabilities and offers a growth path to Siemens' Teamcenter® software product lifecycle management (PLM) solutions

Ensure products meet requirements and comply with regulations

- Manufacturers must ensure that a delivered product meets customer requirements and complies with industry regulations
- Linking requirements directly to design projects and 3D CAD models provides easy accessibility to everyone involved in product development
- Solid Edge Requirements Management captures and tracks requirements and relevant industry regulations

Communicate design intent

- Manufacturers need to access and re-use legacy 2D CAD data, and to create engineering drawings to international standards
- Intelligent 2D schematics can be used to communicate design intent for electrical wiring, piping and piping and instrumentation diagrams (P&ID)
- Using Solid Edge enables you to create 2D drawings quickly and easily from 3D part and assembly models, allowing you to adhere to international standards

Accelerate mechanical design

- Comprehensive 3D computer-aided design (CAD) tools make design faster and more efficient
- Tools that can be used to directly open 3D models in common CAD formats can increase re-use of existing design data, ultimately speeding up design efforts
- Solid Edge includes superior migration capabilities that allow you to take data seamlessly from third-party CAD software and maintain it in the Solid Edge environment

Integrate 3D sheet metal models into electromechanical assembly designs

- Streamlined sheet metal design and manufacturing can reduce costs and speed delivery
- Solid Edge can be used to produce accurate flat patterns from 3D digital models and send the geometry directly to manufacturing
- Solid Edge includes integrated applications for nesting, cutting and bending of sheet metal components

Speed design of parts and assemblies

- A comprehensive assembly design environment should enable the creation and management of large assemblies without sacrificing performance
- Designing components in the context of an assembly to ensure fit and function can speed the product development process and reduce costs
- Solid Edge streamlines the process of finding 3D models of off-the-shelf components using integrated, cloud-based catalogs. Using more standard parts can speed product development and help reduce product costs.

Fabricate assemblies

- Frames and weldments are critical components in heavy equipment manufacturing
- Solid Edge can be used to create custom frames and cross sections, providing access to a library of standard sections for fast design of welded structures and automatically creating parts and cut lists
- Weld specifications can be accurately communicated to manufacturing

Configure new products quickly and accurately

- Capture insightful engineering knowledge using rules-based design processes
- An optimized process for designing products based on rules and experience can speed up the configuration of products
- Solid Edge Design Configurator provides product configuration capabilities built into Solid Edge, providing an easy-to-use solution that can be used by designers and sales engineers

Validate equipment designs before production

- Testing designs using virtual prototypes can help optimize performance prior to equipment being manufactured
- A multidiscplinary engineering approach ensures mechanical, electrical and automation engineers collaborate on mechatronic designs early in the design process
- Siemens' Mechatronics Concept Designer™ software can be easily integrated with Solid Edge

Streamline piping design

- Streamlined piping design and manufacturing reduces product development and manufacturing costs, minimizes errors and increases quality
- The design of complex hydraulic systems for heavy equipment requires 2D P&ID to accurately specify piping, hydraulic and pneumatic systems
- Solid Edge modular plant design tools include P&ID to create process and instrumentation diagrams and Piping Design to design complex 3D piping

Create model-based definitions

- Comprehensive product manufacturing information (PMI) improves communication among suppliers, manufacturing, inspection and service organizations
- Model-based definitions (MBD) can be used to publish complete 3D technical data packages and reduce the need to create and manage 2D drawings
- Solid Edge Model Based Definition can be used to publish production information using 3D PDFs based on company-specific templates

Leveraging software to support innovation *(continued)*

Heavy equipment manufacturers using Solid Edge are achieving significant benefits:

- Increase new product success by 300 percent
- Reduce errors by 95 percent
- Increase new equipment revenue by 50 percent
- Reduce design time by 40 percent
- Decrease manufacturing lead time by 30 percent
- Improved ability to respond quickly to market requirements
- Reduced design time for a custom order from three weeks to three days
- Replaced physical prototypes with virtual prototypes
- Achieved greater innovation across product lines

Share design intent between electrical and mechanical teams

- Simultaneous collaboration between electrical and mechanical domains can optimize product design
- Electromechanical collaboration software can provide fast creation of data-driven wiring schematics and wire harness designs
- Using Solid Edge Wiring & Harness Design enables you to seamlessly communicate design content between wiring schematics and electromechanical assemblies, providing a true co-design environment

Route electrical wiring in 3D

- Electrical routing in complex assemblies must meet compliance specifications
- Wire routing must be optimized to meet electrical system performance within mechanical constraints
- Solid Edge Electrical Routing enables you to route electrical wiring around complex assemblies and includes a unique connected mode for interactive mechanical computer-aided design/electrical computer-aided design (MCAD/ECAD) integration

Optimize kinematic and dynamic behavior

- Simulating all aspects of motion to understand the true dynamic function and performance of a design prior to producing physical hardware results in significant drop in costs and time-to-delivery
- Virtual prototyping aids in optimizing kinematic and dynamic behavior in addition to ensuring mechanical components and assemblies perform as required
- Solid Edge Simulation provides integrated analysis of kinematics and dynamics of mechanical assemblies

Evaluate structural performance

- Mechanical components and assemblies must be proven to work as required
- Integrated structural analysis can optimize component design, resolve problems before manufacturing and reduce the need to manufacture and test physical prototypes
- Solid Edge Simulation includes analysis of static loads, buckling, vibration and heat transfer

Analyze fluid flow and colling performance

- Computational fluid dynamics (CFD) analysis tools can move simulation earlier in the design process, allowing users to identify and fix problems earlier, saving time and money and enhancing productivity up to 40x
- Fully embedded, Simcenter™ FLOEFD™ for Solid Edge software extends the power of CAD environments to CFD analysis, optimizing product performance and reliability for fluid flow, heat transfer and electromagnetic effects
- Simcenter FLOEFD for Solid Edge provides intelligent automation, making it easy to use for the design engineer and powerful enough for the analysis specialist

Understand and optimize fluid flow in complex piping systems

- Heavy equipment manufacturers need to understand how design alterations, component size and operating conditions affect system performance accurately and quickly
- Conducting what-if analyses of complex systems leads to further understanding of fluid mechanics in complex piping systems

- Simcenter Flomaster™ for Solid Edge software is used to simulate system-wide pressure drop, pressure surge, temperature and fluid flow rates in a 1D environment

Manufacture accurately and efficiently

- Creating efficient machining toolpaths and simulations based on digital models results in reduced errors and rework in manufacturing
- Computer-aided manufacturing (CAM) solutions that are associative to a CAD model can maximize the value of your machine tools
- Using Solid Edge CAM Pro enables you to create accurate and efficient toolpaths and machine instructions

Take advantage of new additive manufacturing technologies

- Prepare and output component designs for additive manufacturing (AM) and 3D printing
- Flexibility of an additive manufacturing approach can reduce tooling costs, speed production of prototype parts and reduce the need to maintain inventories of rarely used spare parts
- Solid Edge enables you to output files in .STL and .3MF formats for additive manufacturing

Create clear technical documentation

- Clear technical documentation helps ensure products are manufactured, installed, used and maintained correctly to safeguard performance and reliability
- Producing top quality documents in-house can reduce the need for specialist technical authors or external services
- Solid Edge Technical Publications enable you to create interactive work instructions, installation guides, end-user guides and maintenance manuals

Produce attractive visualizations for sales and marketing

- Photorealistic imagery can communicate the unique value of innovative solutions
- You can use 3D digital models to easily create photorealistic images and animations of product design. Augmented reality (AR) tools can even show products in real-world environments
- Solid Edge includes KeyShot for photorealistic rendering and animations and provides AR capabilities

Benefits of using Solid Edge

Heavy equipment manufacturers are under pressure to deliver quality machinery and equipment faster and more cost effectively. Using Solid Edge, manufacturers can optimize both the performance of their product development process and the final product delivered to the customer. Solid Edge is a powerful, comprehensive and accessible product development solution for heavy equipment manufacturers.

The engine at the heart of the Solid Edge portfolio is Siemens' Parasolid® software, the most widely used computer-aided geometric modeling kernel in the industry. Parasolid enables the creation and modification of digital 3D models and delivers complete 3D model compatibility between product development applications such as design, simulation and manufacturing.

Flexible licensing lets users meet current needs with a straightforward growth path to meet future requirements. The Siemens Mechanical Design bundle offers flexiliby to access both Solid Edge and NX™ CAD software solutions with a low total cost of ownership. Siemens Digital Industries Software provides the appropriate mix of licensing options to suit your needs today and in the future.

To learn more about how Solid Edge enables heavy equipment manufacturers to be successful, please visit solidedge.com/heavy-equipment-manufacturing.

About Siemens Digital Industries Software

Siemens Digital Industries Software is driving transformation to enable a digital enterprise where engineering, manufacturing and electronics design meet tomorrow. Xcelerator, the comprehensive and integrated portfolio of software and services from Siemens Digital Industries Software, helps companies of all sizes create and leverage a comprehensive digital twin that provides organizations with new insights, opportunities and levels of automation to drive innovation. For more information on Siemens Digital Industries Software products and services, visit siemens.com/software or follow us on LinkedIn, Twitter, Facebook and Instagram. Siemens Digital Industries Software – Where today meets tomorrow.

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