Solving the Problems of Tomorrow, Today

How Siemens' software will play a significant role in the factory of the future

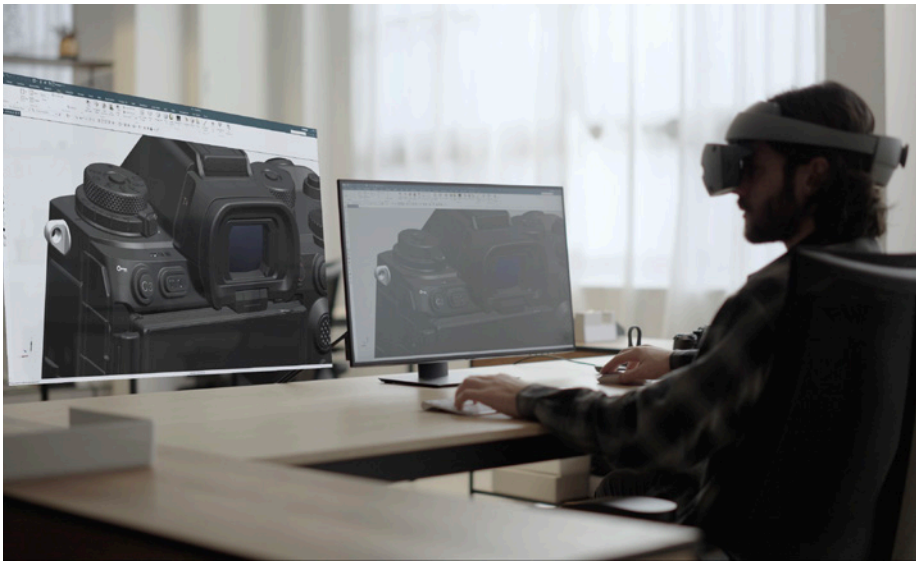
Matthew Jaster, Senior Editor

Siemens' annual event Realize LIVE Americas never fails to disappoint on the technology front. Automation, AI, IIoT, the Industrial Metaverse, additive manufacturing—you name the technology—Siemens has it covered. The factory of the future is no different. The company spends a great deal of time discussing smart manufacturing, analytics and services examining what a typical shop floor might look like in 15–20 years.

How does the factory of the future apply towards mechanical power transmission? This is the question we raised with Rahul Garg, vice president industrial machinery a, Siemens Digital Industries Software.

In the virtual realm, a comprehensive digital twin represents every aspect of a product's life, from design all the way to in-use performance, including the processes employed to manufacture the product. The comprehensive digital twin is used to simulate, predict and optimize the product and production system before investing in physical prototypes and assets. It provides valuable foresight prior to production as well as insights that drive continuous manufacturing improvements. Having an accurate digital twin of your complete manufacturing process is essential. It not only helps you produce higher quality products at a lower cost today, but also forms the backbone for manufacturing technologies that are just around the corner.

"One of the things we are doing is we are taking our applications to the cloud. By taking our applications to the cloud you get many benefits. First off, we are enabling customers to use the latest technology with minimal company resources like IT staff and server hardware. You have instant access to software updates. We are enabling very easy collaboration between engineers inside the company and outside the company—in a secure way. As a component manufacturer, like a gear manufacturer, if they are using Siemens *NX-X* for the design application, we have many built-in libraries that are easy to use," Garg said. "By utilizing these libraries and wizards, you can further improve your product design's timing and efficiency. Users are no longer alone at the computer. They have the Siemens backed catalog and many customers who are building and using similar designs. It becomes a lot more powerful when you have many customers that are feeding into these libraries and you're able to leverage those capabilities."



***Sony's XR head-mounted display is a fundamental part of the forthcoming* NX Immersive Designer.**

Optimizing Component Design

Siemens software such as *NX-X* and *Teamcenter-X* are updated regularly to improve component design, provide exceptional data and enhance Product Lifecycle Management (PLM). This analytical approach to product development is what the future of design will look like, according to Garg.

With *NX X* you can create, simulate, visualize and optimize 3D factory designs faster to improve factory logistics and material flow operations before full-volume production. Designers are planning and virtually simulating the smart factories of the future through digitalized processes. The virtual factory is created in 3D with layout and optimization tools, allowing us to design, layout and configure the factory environment and optimize factory operations. By allowing facility

planning and line design teams to see the outcome of plans virtually, costly expenses and wasted resources that occur when problems are discovered in actual, physical facilities can be easily avoided. During factory line design and planning the impact of equipment placement and access is difficult to realize using conventional factory layout tools. Understanding the throughput of individual lines of the factory is critical for manufacturers, as is understanding how material moves throughout the facility. Inefficiency can ripple throughout the factory and its production systems if you don't have the ability to optimize the factory layout based on the data obtained during the planning and analysis phases of production engineering. With *NX* solutions, you can quickly design and visualize production line layouts and associate them with manufacturing planning. You can easily optimize the process by specifying each production step down to managing a single manufacturing resource, such as a robot or fixture.

"As a company, Siemens is also a user of our own software applications in the design and manufacturing of the motors we sell to others," Garg added. "That's the most interesting part, where we not only sell the software applications to other companies, but we actually use these tools in-house for our own products.

"Our software applications are used all the way from the rotor design to the electromagnetic interference detections to the heat and thermal flow analysis and cost estimation" Garg said. "Our simulation applications can help design a motor effectively while also helping with the programming and evaluating the electrical power needs."

With these software tools, engineers can design the power input and output from the motors. They can also design the controls for the motor. They can help you get the maximum torque, define the speed-up/speed-down torque, etc. All this can be designed inside the software, which makes the process much more efficient.

"Siemens provides a whole set of sensors, gear and Industrial IoT applications that can help with gear noise reduction. The design application software—within *NX*—can help get manufacturers to the lowest possible fidelity of movement. This is where gear ratios and other challenges can be addressed.

"What's unique about *NX* is how the software can be used from the design phase all the way to the finished product," Garg said. "Kapp Niles, for example, uses *NX* to make the machine tool itself. Then, they use *NX* to design the gears on that very same machine. Every step of the gear manufacturing process involves *NX* software."

Garg noted that within a gearbox, there's typically a lot of change in motion. The whole purpose of the gearbox is to change this motion, either step it up, step it down, change the direction, etc. *Simcenter* helps with this analysis. It determines if the gearbox will perform efficiently or not.

"Not only will it provide simulation and analysis, but it will also help you do a lot of load analysis, time dependent stress analysis, heat transfer, and more," Garg said "What if you put a certain amount of load on the gear? What will happen in two hours? What will happen in two days? What will happen in 10 days? The software can also deep dive into friction analysis. What kind of friction are you generating and how can it be eliminated?"

If you've been paying attention to the markets, particularly consumer and industrial, you've noticed the consolidation of several vendors and suppliers. Post-COVID has laid the groundwork for "all–in–one" solutions. Software is no different.

The factory of the future demands that the design engineering process is streamlined and extremely focused. Modern industrial robotics systems play a crucial role in producing complex and smart products sought after by today's consumers, ranging from personal electronics to passenger vehicles. As advanced robotics, though adept at managing complex products, face hurdles in adoption due to the commissioning process.

Advanced robotics, especially with Virtual Commissioning will handle these changes without harming everyday operations. Technologies like AI and ML will modernize manufacturing so tasks can be optimized through advanced robotics. Businesses can leverage Virtual Commissioning for identifying issues during simulations, facilitating early validation and achieve informed decision-making. Shifting development and planning processes to an earlier stage allows problems to surface in the simulated environment rather than on the shop floor.

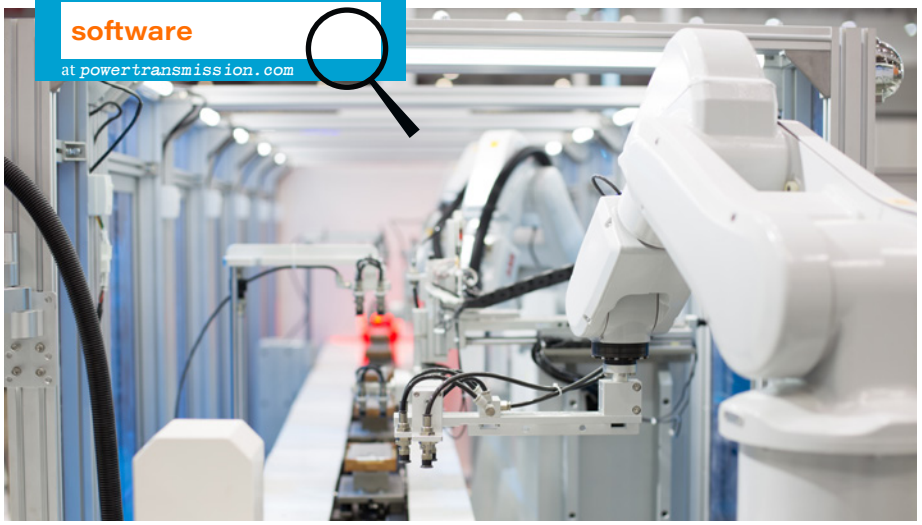
"You can have one application that does it all, eliminating the need for any data translation. Every time you do a translation, there is the possibility of losing accuracy and fidelity in that data," Garg said. "By using the same data, you are ensured and guaranteed—the analysis, design work, machining, production—all of it is working off the same data set enabling simulation to be done through the design process–Simulate early and simulate often. "By simulating the whole production line, we can identify defects and problems in the design to make necessary corrections before real production." Garg added.

This also ensures that if you make any changes anywhere in your process, that change is accounted for along the entire process chain.

"It's important and becomes a lot more seamless to use all the applications within the software suite," Garg said. "Track any changes as well. This is the biggest value that we see today whether you're designing a gearbox or an airplane. You need to have the ability to see the impact of changes. Siemens' MES allows us to spread process improvements and eliminate legacy tools. The dual benefit helps improve product quality and process efficiency, while also reducing operational risk and setting the stage for future shared improvements."

New Toys in the Toolbox

How would today's mechanical engineer want to conceptualize the products that they're trying to make—from the engineering phase to the manufacturing phase to the service, repair and maintenance? What's the best way to make sure that you're doing it in a sustainable way?



Simulate highly automated manufacturing processes in the digital twin before investing in expensive equipment. (Images courtesy of Siemens)

"For us, it's like the whole cradle to grave process of a product. This is where Siemens PLM software really shines. I think there are two important things that are coming into picture, two core technologies that have become more relevant today. One is Generative AI, and then the second is the Industrial Metaverse," Garg said.

Generative AI makes it very easy to leverage AI technologies to create and design new things without having the burden of starting from scratch, according to Garg. "It's much easier to take a piece of paper and edit versus writing anything from scratch, right? This can have a huge impact in terms of innovation and the speed of innovation. The testing, the validity, the various ways to attack a project, etc., now this can all be done using Generative AI tools."

The industrial metaverse is the concept of a digital world to mirror and simulate real machines and factories, buildings and cities, grids and transportation systems. By seamlessly integrating technologies like cloud and edge computing, industrial AI and digital twins, the industrial metaverse can optimize processes and drive sustainable practices, ultimately shaping the future beyond simulation.

The construction of the Industrial Metaverse relies on collaboration, openness, and strong ecosystems. Serving as a digital business platform, *Siemens Xcelerator* brings together a strong ecosystem of partners and offers solutions that work easier, faster, and at scale to use, helping customers to accelerate their digital transformation and enable the industrial metaverse.

Siemens Industrial Copilot opens the language models and gives engineers the ability to have human-like conversations with the equipment. Garg said the *Siemens Industrial Copilot* gives designers real-time access to non-proprietary information (manuals or guides, for example), proprietary product information and those language models.

"We're giving our customers the ability to access all three pieces of information through *Siemens Industrial Copilot*. If someone has made a new design in Brazil, they can share it in real time with the company or share it with customers around the world," Garg said. "Someone said it took the internet 20 years to become pervasive. I think it was on a podcast with the CIO from Google. Many believe Generative AI is going to do the same thing in five years' time. Keep an eye on the pace in the coming months, it's going to explode at a mind-boggling rate!"

At the show, Siemens also unveiled its collaboration with Sony's XR technology. Sony's XR head-mounted display is a fundamental part of the forthcoming *NX Immersive Designer,* an integrated solution that combines Siemens' *NX*, exclusively with Sony's breakthrough XR technology to deliver immersive design and collaborative product engineering capabilities. The head-mounted display and dedicated controllers let designers create more intuitively in a fully immersive environment, allowing you to move freely between the virtual and real worlds. It will allow designers to play around in the virtual environment without ever having to build a physical prototype. Siemens' *NX Immersive Designer* is expected to launch at the end of 2024.

"Lastly, we are looking at new ways to make our more accessible. Through a token-based approach and subscription models, small- and medium-size enterprises can now have easy access to applications that in the past were only in the reach of larger enterprises. "Instead of investing in a large upfront payment or managing a large IT system to support the software, there are many other options available. Now you can pay as you go, you can leave the application support to Siemens. There is much more flexibility," Garg added.

As a society, we take for granted how quickly technology is changing. Manufacturing production can slim down from months to weeks to days—even hours in certain circumstances. We can build things faster and more efficiently thanks to these new software tools.

Siemens Xcelerator is a comprehensive, integrated portfolio of software and services. It is designed to form a software foundation for digital business transformation—helping companies accelerate their evolution into digital enterprises, enabling them to be poised for ongoing success.

The factory of the future will allow designers to test, research and validate hundreds of "what-if scenarios" in real-time. They will no longer feel the restraints from budgets, time or resources. Creativity and innovation will play as big a role as the design execution itself in areas such as energy, e-mobility, packaging and aerospace.

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