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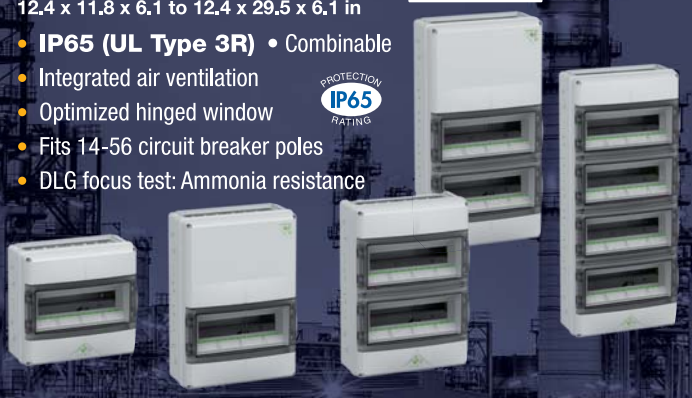

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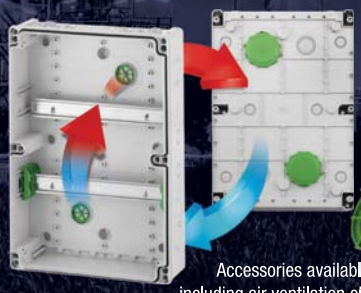

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From the Editor

By Rehana Begg, Editor-in-Chief

Design Engineering: View CAD from a Different Angle

The next generation of tools will allow designers to view 3D models from different angles before they're produced.

AN INTERESTING FACTOID about computer-aided design and computer-aided manufacturing is that 70% of all 3D mechanical CAD/CAM systems can trace their roots to CAD pioneer Patrick Hanratty's original code.

In the early '70s, Dr. Hanratty's company, Manufacturing and Consulting Service (MCS), produced a CAD/CAM drafting system which unleashed a new generation of design and manufacturing packages. Aptly named, ADAM (automated drafting and machining) was an independent software package built around a business strategy that would be licensed to other companies so they could sell it to end-users. These companies would also provide training and technical support. This operating model arguably has been the backbone for many successful resellers ever since.

By one estimate, the CAD and PLM software market is projected to reach $26.37 billion by 2030—a jump from $15.47 billion in 2023. Key players—including SAP SE, Siemens AG, Autodesk, Dassault Systèmes, PTC and Oracle Corp.—are scaling through cloud-based deployments. The public cloud market is on course to surpass $1 trillion in 2026, according to advisory firm Forrester. These developments drive the market forward and extend the ability for small and medium enterprises to purchase unified platform offerings.

Another association with Dr. Hanratty's work is that ADAM would form the basis for the first version of Unigraphics, a CAD/CAM/CAE/PLM suite. It should be no wonder ADAM's offspring leapt ahead once it was acquired by Siemens Digital Industries Software in 2007, and subsequently renamed Siemens NX.

That much was made clear at Realize Live 2024 in Las Vegas in May, where I made it my business to drill down into the comprehensive features of Siemens NX.

Designed for tighter integration of the hardware and software, the cloud-based platform enables reliability and scalability in ways never imagined. Siemens' NX Performance Predictor is a simulation application that empowers designers to iterate quickly and make informed decisions before designs proceed to final validation.

During a one-on-one session, Jeff Miller, product marketing director at Siemens Digital Industries Software, said that the full NX suite shifts simulation further left in the development process and brings simulation into the design phase.

An interesting example is Sony's new SRH-S1, an extended reality (XR) head-mounted display (HMD) with 4K OLED Microdisplays and a ring controller that allows users to intuitively manipulate 3D objects in virtual space. The HMD is a crucial part of Siemens' forthcoming NX Immersive Designer solution, featuring promising collaborative product engineering capabilities. Sony boasts that it improved design process productivity by 25%.

It's only a matter of time before the kinks—security, operating speed and Internet dependency—are worked out. The advantages of collaboration, advanced analysis and simulation, along with easy access ostensibly leads to faster innovation and time to market.

Look for us to keep that reporting going. Meanwhile, find much more on CAD/CAM/CAE development in this issue, as well as on *machinedesign.com*. ■

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TSN-Fueled Automation Amps up the EV Value Chain

A look at how future-oriented industrial automation and time-sensitive network technologies can help drive the successful electrification of the automotive industry.

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Featured Video

Video: Using Digital Processes to Enhance Safety and Quality

Explore quality control approaches in small to mid-size factories as well as the evolving role of technology in shaping the future of safety and reliability in manufacturing processes with Bryan Bauw, COO at Pico MES.

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Coast-to-Coast Expansions Supporting Supply Chain

New training centers, upgraded facilities and expanded portfolios support investment in local supply chains.

SOURCING MOTION CONTROL components and robotics solutions that meet basic design specs can be complicated even in the most favorable scenarios. For their part, design engineers are trading off variables such as cost and delivery time to balance functionality and performance.

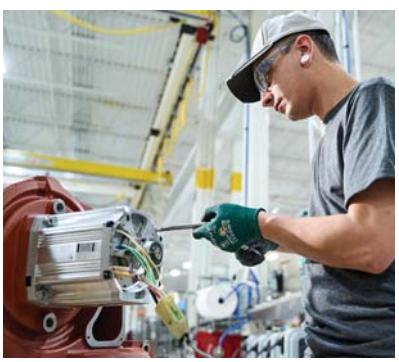
At the enterprise level, firms are responding by flexing strategic prowess in order to shape the direction of the supply chain while speeding up decision-making. A number of expansions across the nation support this narrative and call for long-term planning initiatives that will tighten the supply chain and address production delays head on.

U.S. Hub Develops and Manufactures AI-enabled Software and Hardware

ABB Robotics, for instance, announced a refitted U.S. robotics headquarters and manufacturing facility in Auburn Hills, Mich. in March 2024. The leader in electrification and automation said the expansion is part of a strategy to strengthen the company's local-for-local footprint. The new facility marks the third global robotics factory expansion in three years across China, Europe and the Americas.

ABB said the $20 million investment will enhance its ability to serve as the leading strategic robotics partner for its growing customer base. The new Customer Experience Center spotlights the company's hardware and software solutions, and is already pioneering the latest digital and AI-powered automation technologies for next generation robots.

"Robotics and AI are essential tools for companies in addressing critical labor shortages, localized supply chains and the need to operate more sustainably," noted Sami Atiya, president of ABB's Robotics and Discrete Automation Business Area. "The advances in AI-driven software and hardware make our robots more accessible to a wider range of businesses, enabling them to increase resilience and become more competitive."



ABB's expanded facility in Auburn Hills, Mich., is leveraging its engineering know-how and software, along with its partner ecosystem, to bolster a comprehensive AI-enabled product portfolio. *ABB Robotics*

Demonstration Lab Space Servicing OEI and OEM Partners

Heidenhain Corp. announced a new Silicon Valley headquarters in Fremont, Calif. The motion control technology leader said the 12,000-square-foot facility will serve double-duty for regional sales and support staff, as well as a 6,000-square-foot Manufacturing Innovation Hub.

The equipment demonstration lab space will be service collaborative projects with OEI/OEM partners seeking demonstration space in the Bay Area and focus on key market segments, including machine tool, semiconductor and automation equipment applications.

"As a foundation company, we promote the development of innovative applications within our core markets and we apply our motion control technologies to emerging high-growth application segments," said David Doyle, president and CEO, Heidenhain Corp. "We represent 10 brands of products from within the Heidenhain Corporate Group and each brand offers unique strengths."

Doyle noted the company will work closely with industry associations (including SEMI, AMT and A3) and will collaborate with industry partners in an effort to expand its involvement in workforce development across targeted industries.

"We hope to educate and train the future industry workforce in the use of linear, rotary and angle encoder technology, control electronics technology and related system integration," Doyle said. "Our CNC programming software and integrated digital manufacturing technology, sold in conjunction with our OEM partner systems to the machine tool industry, is critical for expanding 5 Axis machining applications and supporting a growing user-base at Silicon Valley companies, where precision and accuracy are in high demand."

Space, Medical Devices, Lab Automation, Digital Manufacturing and More

Beckhoff Automation has expanded its presence in the West Coast. The 4,100-square-foot office located in Greater Los Angeles will serve as a hub for events, seminars and customer meetings.

Located four miles from Los Angeles International Airport (LAX), the Beckhoff office in El Segundo opens opportunities for providing cutting-edge automation solutions to the region's high-tech industries.

"The Southern California territory has become one of the fastest growing areas for Beckhoff USA, with a five-year compound annual growth rate (CAGR) going from 22.5% to 69% in just the last two years," said Joe Martin, regional director, Sales & Strategy, Beckhoff Automation LLC. "The predominant markets of entertainment, space, medical devices, lab automation and digital manufacturing fit perfectly with Beckhoff's advanced automation technology. It was truly a no-brainer to open a new office in Los Angeles to keep accelerating our sales growth." ■

Protolabs Network's Advanced Software Integration Offers Streamlined Collaboration

PROTOLABS, A DIGITAL MANUFACTURER, has revamped its Protolabs Network service to leverage global manufacturing partners, providing enhanced capabilities and pricing options. This rebranded service integrates the company's internal digital factories with a network of more than 250 supply partners to cater to customer needs across the entire product life cycle—from innovation and prototyping to production and end-of-life support.

Addressing the question of specific software tools and systems used to facilitate collaboration within the Protolabs Network, Lucca Mazzei, strategic growth officer at Protolabs, said the company does not rely on commercial packaged software. Instead, Protolabs has developed proprietary software to automate various aspects of digital manufacturing. This homegrown software is streamlined to eliminate friction in the process and enable direct connections with customers for swift issue resolution.

Protolabs' network offering is integrated into its proprietary software, Mazzei says, which enables advanced tools and technologies to be used across the internal digital factories and the partner network. "The collaboration between both our factory and network technologies allows us to use the best solutions available in each across the larger business," he said.

For instance, Protolabs leverages its Design for Manufacturing (DfM) analysis tools from its digital factories for the network, while applying advanced geometry analysis to better match orders with manufacturing partners' capabilities, Mazzei explained. Artificial intelligence is also part of the network. "We are also able to use the network's advanced AI capabilities for our digital manufacturing process," Mazzei said.

As for the specific CAD/CAM/CAE software used by Protolabs, the company's website highlights the compatibility with a range of professional-level CAD software packages such as SolidWorks, PTC Creo, IronCAD and Siemens NX—all of which support a model-based definition (MBD) approach to product design. Protolabs facilitates the creation of 3D models through numerous CAD programs, allowing users to export files directly to the platform for manufacturing. Through a combination of proprietary software, industry-standard CAD tools and advanced technologies, Protolabs has been able to effectively utilize digital platforms and systems to enable collaboration between its digital factories and the global network of suppliers, helping to ensure an integrated and efficient manufacturing resource. ■

Kevin Strom

Off-Road Excellence:

A Case Study of Precision Machining and Craftsmanship

A luxury off-road truck design, machine and fabrication shop in Southern California blends traditional craftsmanship with modern technology to redefine truck-building excellence.

by Sharon Spielman, Technical Editor

IN THE HEART of SoCal's off-road haven, the Kibbetech workshop hums with the sounds of machinery, rock music and a group of skilled craftsmen doing what they do best—designing and fabricating custom truck builds and production parts.

Since its founding in 2006, Kibbetech has been challenging industry norms and setting new standards of excellence. The seeds of owner Ryan Kibbe's journey were sewn when he was dissatisfied with the practices of an off-road shop he previously worked for and decided to carve his own path.

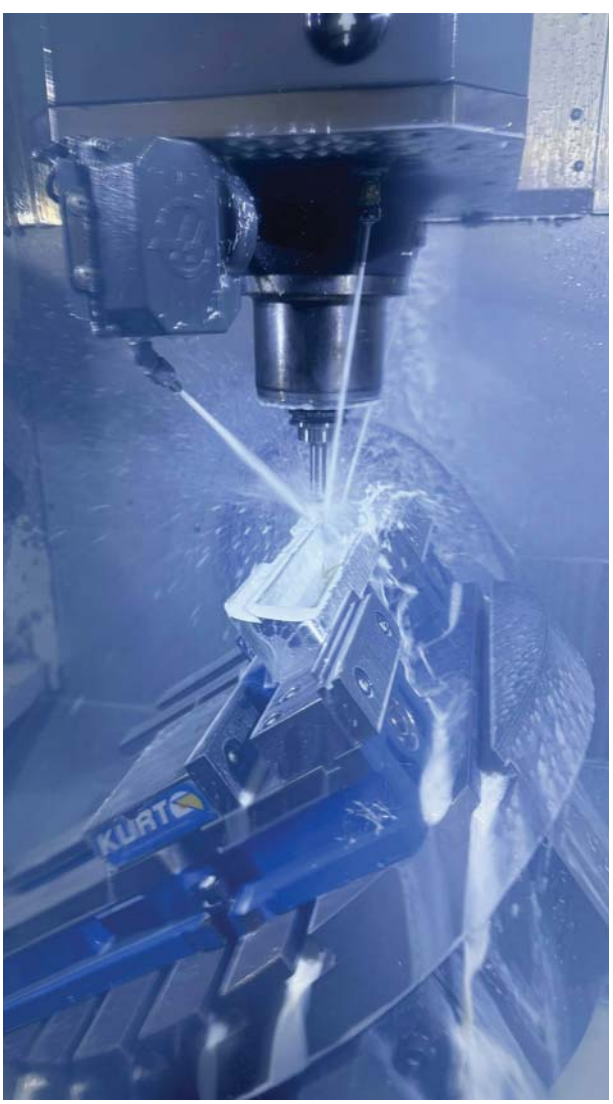
Setting up his beginnings under an E-Z Up canopy in the side yard at his father's end-unit sheet metal shop, Kibbe brought his vision to life. During the next 18 years, the shop—with its small and respected crew—has forged a name for itself in the industry. "One thing I hold close is our design and manufacturing," he told *Machine Design*. "With everyone outsourcing designs and [production], I keep everything under my roof right here, creating jobs and adding value to our products."

Phonexay Douangmala, design engineer at Kibbetech, shows the CAD drawing of a third brake light for a custom prerunner truck build. *Sharon Spielman and Kibbetech (inset)*

During a recent visit to the shop's Newbury Park location, Kevin Strom, CNC programmer/process engineer, showed *Machine Design* what Kibbetech has been up to lately. The company's mission is two-fold: One side of the business is custom fabrication and the other is product development and production. They offer a range of services—including design and hand fabrication such as sawing, grinding and welding—but the precision machining, laser cutting and forming is what gives the shop its edge.

The Role of Innovation

In the past 5-10 years there has been a significant shift toward utilizing advanced technologies such as computer numerical control (CNC) in the manufacturing process, Strom said. And Kibbetech is one of the fewer small shops to provide this service. While top podium race truck builders (think Mason Motorsports) have long been embracing CNC technology, its broader adoption in the market has been limited.



Kibbetech machines more third brake lights using its 5-axis HAAS UMC-1000 CNC machine after the successful installation on a prerunner build helped create the demand. *Kevin Strom*

The goal for many companies is to move away from traditional hand-fabricated methods toward computer-aided design (CAD) and manufacturing (CAM). This transition offers cost-effectiveness, higher quality and increased consistency in producing parts, Strom said, because each piece built adheres to the same quality of standards—independent of who worked on it—ensuring a standard level of excellence across all products.

Kibbetech uses Autodesk Fusion, an integrated CAD/CAM software, along with sophisticated machining equipment—including a 5-axis HAAS UMC-1000, 3-axis HAAS VF-4 and a HAAS ST-20 lathe—to achieve its high-end results.

While off-roading and race trucks dominate the West Coast market, there is also a demand for specialized builds like drift trucks; one of Kibbetech's most popular parts is its hydraulic brake handle.

Apart from custom fabrication, the company focuses on product development within the industry, offering aftermarket parts for popular truck models. While touring the machine shop, upper suspension control arms were being machined on the 5-axis machine, and a host of spindles and other parts were waiting in line for anodizing.

When asked about part design, Strom said the proper design of parts has all come from the vast experience of the owner. "Ryan has been in the industry essentially his whole life, and the ideas literally come from his brain. He then directs us how to design the part. There are critical dimensions that must be hit for the part to be a good part," Strom said.

Advantages of Rapid Prototyping

Collaboration within the team is critical for translating design concepts into manufacturable components. Technologies like 3D scanning, CAD and additive manufacturing play a vital role in this process, allowing them to iterate on designs and address potential manufacturing challenges effectively, Strom said.

When faced with the challenge of crafting a custom third brake light for a bespoke luxury prerunner truck build, the workshop's design engineer, Phonexay Douangmala, said, "We pulled out all the toys for this project," leveraging the synergies of CAD design, 3D scanning and 3D printing. Strom printed the prototype on a Bambu Labs X1C 3D printer, creating a part that is paving the way for a new era of customization.

While Strom was demonstrating the Autodesk Fusion software on his desktop, a co-worker had been checking the fit of the brake light prototype. He peeked his head around the corner and told Strom: "That brake light fits perfectly." From there, the part was machined on the 5-axis HAAS,

anodized and assembled, and now resides on the prerunner. And Kibbetech is in the process of machining more to meet a new product demand.

> *"Success is always a funny word for me. I still feel like I have a long way to go no matter where I or the company is at. I guess that is what keeps me pushing for more." — Ryan Kibbe, Owner, Kibbetech*

Driving Forward: Kibbetech's Vision for the Future

Kibbetech's use of precision machining techniques, advanced technologies and the integration of CAD/CAM software represents a progressive shift in manufacturing methodologies. The shop's reliance on automated processes ensures quality control and a uniformity of output that sets a high industry standard. Merging their expertise with the right tools, the shop has refined the art of customization to a precise level, achieving industry success.

So, what's the secret? "Success is always a funny word for me," Kibbe answered. "I still feel like I have a long way to go no matter where I or the company is at. I guess that is what keeps me pushing for more."

The prototype for a third brake for a prerunner truck build was printed using a Bambu Labs X1C 3D printer. *Sharon Spielman*

When asked what's next, Kibbe had this to say: "My goal is ever-changing. I would like to streamline our production parts and our custom truck builds so we can deliver a better product more efficiently. Also, it is my dream to have an in-house race truck so I can go racing and take all my guys out to the races to really enjoy the fruits of our labor!" ■

Editor's Nore: Be sure to check out Kibbetech's YouTube channel at https://www.youtube.com/@Kibbetech.

Dive into Software Solutions that Support Additive Manufacturing

Industry experts shed some light on the critical aspects of software for additive manufacturing. From advanced capabilities to the trends in the CAD/CAM/PDM/PLM market, get answers to help empower design and manufacturing processes.

by Sharon Spielman,
Technical Editor

IN THE QUICKLY EVOLVING LANDSCAPE of additive manufacturing (AM), the role of software is what drives improvements and efficiency. As companies look to optimize their processes and better their design capabilities, understanding the details of software solutions is necessary.

Machine Design reached out to two subject matter experts at PTC to help unravel the complexities and solutions that are paving the way for additive manufacturing excellence.

First, we'll take a look at the company's Creo software. In an interview with CAD Product Management Director Jose Coronado, we learn about the specific tools, integration with simulation and analysis, and the transition processes that this software offers. The spotlight falls on the built-in material libraries, design complexity challenges and geometric freedom that the platform provides.

Beyond specific software capabilities, a conversation with Dave Katzman, head of PTC's Velocity Group, expands to encompass the broader landscape of computer aided design (CAD), computer aided manufacturing (CAM), product data management (PDM) and product lifecycle management (PLM) solutions that shape the future of design. We gain insights into the shift toward cloud-native technologies, the integration of sustainability practices in design processes and the evolving roles of artificial intelligence (AI) and machine learning (ML) in reshaping design and manufacturing landscapes.

Below are abridged versions of both interviews. Questions and answers have been edited for clarity.

Jose Coronado, CAD product management director for PTC's Creo. *Images courtesy PTC*

5 Essential Questions about CAD/CAM Software for AM

From what tools or modules the software offers to support generative design to integration and simulation to the challenges of design complexity and freedom in AM, Coronado offers answers that relate to PTC's Creo product.

Machine Design: What specific tools or modules does Creo offer to support generative design?

Jose Coronado: Creo's journey into additive manufacturing began around 7-8 years ago, with a focus on integrating features like direct printer connections, lattice modeling and generative design seamlessly into the CAD system. These components within Creo work cohesively to enhance the AM workflow.

MD: How does Creo integrate with simulation and analysis tools to optimize designs?

JC: It provides users with a suite of simulation tools, including real-time simulation and extensive capabilities such as Creo Simulate based on Ansys solvers. This allows for in-depth analysis of designs prepared for AM, ensuring optimum performance and printability.

MD: Can Creo facilitate the seamless transition from CAD modeling to CAM tool path generation for AM equipment?

JC: It streamlines the transition process by enabling users to create, optimize and prepare 3D models for printing within the software itself. The user-friendly interface guides users through tasks such as adding support structures and generating printer-specific file formats, adding to the efficiency of the AM workflow.

MD: What about built-in material libraries and customization options?

JC: Creo empowers users to define and utilize material libraries with ease, sup-

porting simulations tailored to specific materials required for AM. By leveraging material data provided by printer manufacturers and integrating it seamlessly into the software, Creo ensures accurate and efficient simulation outcomes.

MD: How does Creo address the challenges of design complexity and geometric freedom in AM?

JC: Its full associativity and parametric capabilities set it apart in addressing design challenges. By maintaining a synchronized digital thread throughout the design process, Creo allows for quick and effortless adjustments to designs, supporting the evolving nature of AM without the need for extensive rework.

SaaS: The Concept of a Single Source of Truth

It is important to understand the intricacies of CAD, CAM, PDM and PLM—the technologies that form the backbone of modern design processes and enable engineers to innovate, collaborate and bring products to market with efficiency and precision. To help navigate this landscape of advancements and challenges, *Machine Design's* interview with Katzman helps shed some light on the subject.

MD: What current trends are you seeing in the CAD, CAM, PDM and PLM market, and how are they shaping the industry?

Dave Katzman, head of PTC's Velocity Group.

"The industry is witnessing a shift toward cloud-native and cloud-based technologies, which allow for collaboration within organizations of all sizes. From large enterprises to small companies, there is a growing adoption of technologies like PLM for global supply chains."

—Dave Katzman, Head of PTC Velocity Group

David Katzman: The industry is witnessing a shift toward cloud-native and cloud-based technologies, which allow for collaboration within organizations of all sizes. From large enterprises to small companies, there is a growing adoption of technologies like PLM for global supply chains.

MD: Why is cloud-native CAD and PDM becoming increasingly popular, and what benefits are offered over traditional systems?

DK: Cloud-native solutions offer a single source of truth, facilitating real-time collaboration on designs. This approach enables multiple stakeholders to work on the same design simultaneously, fostering efficiency and improved collaboration.

MD: How are companies expected to incorporate sustainability and eco-friendly practices into their design processes in the future?

DK: Sustainability is transitioning from a post-design consideration to an integral part of the design process. Engineers are now focusing on designing products with sustainability in mind, including material selection, production processes and overall environmental impact.

MD: How do you see the role of AI and ML evolving in CAD, CAM, PDM and PLM solutions and their impact on the design process?

DK: AI and ML are poised to revolutionize the design and manufacturing processes by offering features like generative design and design assistance. These technologies can enhance product innovation and streamline workflows, particularly when integrated with cloud-native solutions.

MD: What challenges do companies face when transitioning to collaborative design workflows, and how can they be effectively addressed?

DK: The main challenge lies in managing the cultural shift within engineering teams to embrace new technologies and collaborative workflows. Success lies in supporting employees through the change process and highlighting the benefits of enhanced collaboration and innovation.

MD: What factors should companies consider when selecting CAD, CAM, PDM and PLM solutions that align with their design and collaboration needs?

DK: Companies should prioritize improving their business processes and embracing change to enhance product design speed and quality. Selecting tools that foster collaboration, offer a single source of truth and enable data-driven decision making is key.

MD: How can companies leverage data analytics from these systems to optimize design processes, enhance product quality and improve time to market?

DK: Data analytics from these systems provide insights for proactive decision making, improving project timelines, resource allocation and overall design quality. It enables organizations to utilize real-time data to drive efficiency and innovation.

MD: What measures are taken to safeguard intellectual property when utilizing public datasets within these solutions?

DK: Public data sets are used for training AI models while maintaining confidentiality of personal information. Intellectual property of companies is protected, ensuring that data analysis focuses on metrics like activity duration and resource allocation without compromising proprietary information. ■

How PLM Can Improve Supply Chain and Design Synergy and Move Goods Faster

Interoperability is not a buzzword. There's a case to be made for integrating 3D CAD/CAM/CAE software to ERP and production planning.

by Jonathan Scott, Chief Architect, Razorleaf

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IN THESE CHALLENGING TIMES, product value can also be measured, beyond cost and function, by the ability of a manufacturer to quickly make and ship to a customer. With components and labor still not fully able to meet demand in a number of industries, manufacturers need to step up their use of digital automation software tools to achieve what's now become a critically important synergy between design and production. Improving this synergy will increase agility, reach across domains, and deliver higher performance in creating and making goods more quickly and reliably.

In fact, much of what manufacturers already do is digitalized; it's just not as centralized and interconnected as it could be. The domains that haven't been interconnected well enough are recognized by everyone—3D CAD/CAM/CAE—with most of what's "downstream." This includes Enterprise Resource Planning (ERP), Manufacturing Execution Systems (MES), Manufacturing Operations Management (MOM) and more. These mostly siloed entities must loop around to offer stakeholders and mission partners visibility and actionability into the whole of the process.

Is this possible today? It sure is. Is it easy? It's certainly a lot easier than coping with missing components, long delays and lost revenue. Platforms like Product Lifecycle Management (PLM), ERP and MES are evolving, yet mature in their capabilities. Interconnecting these software systems successfully is about recognizing the synergy possible by combining their individual capabilities to solve multi-domain problems. Whether you're a highly integrated manufacturer with design, production and shipping under one roof, or a firm that contracts out its product concepts, effectively leveraging your product data is important and key to realizing excellence, speed and profitability.

PLM and the Digital World

Today, improved and automated data interoperability packages in design, along with more open communication links upstream and downstream, allow for better execution of end-to-end processes for design and supply networks. Traditional supply chain models restrict the flow of information, causing it to be filtered and delayed as it travels to different parties. PLM, in contrast, can play a central role in managing the accuracy, visibility and robustness of information networks that run from design to the manufacturing floor, across multiple trading partners.

Every facet of the product realization process (already being done in silos) can be digitally captured and automated for optimal use. Not only does this create obvious efficiencies between disciplines, but it allows for predictive planning around risk (disruptions); better management and substitution of manufacturing assets (plants, machines, materials and suppliers); and forward optimization of the production process (simulating choices according to manufacturing/purchasing models and features and addressing bottlenecks).

Connecting design (CAD/CAM/CAE) to inventory and materials management (ERP) and then into production planning, analysis and monitoring (MES/MOM) seems imposing. Yet, these systems are in wide use and are often interconnected in ad hoc ways. The current, inelegant approach offers an opportunity for much better integration and improved efficiency.

Roles that PLM can Play

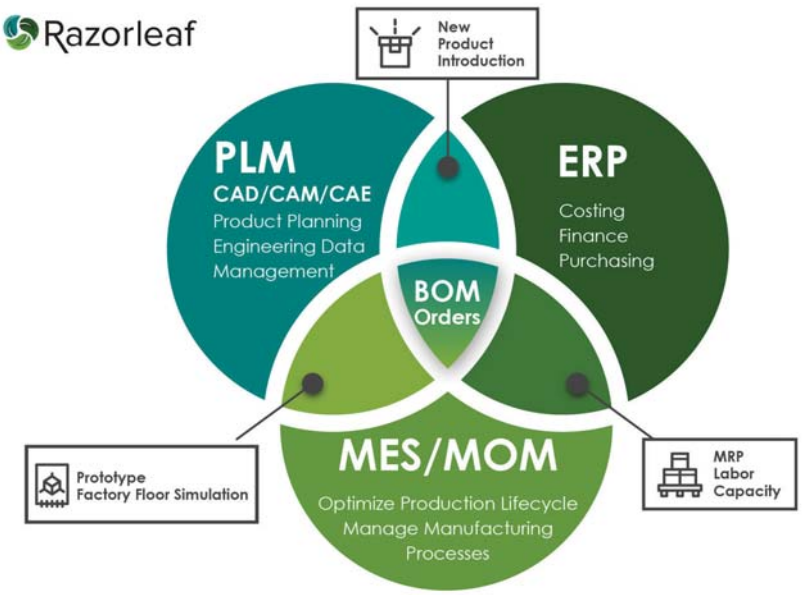
Design configuration and release management. PLM already manages designs and the various product versions needed by the marketplace. These capabilities are just starting points for achieving the manufacturing agility needed to cope with supply disruptions. Following what's been achieved with Sales Configuration Models for product customization, PLM could similarly take core designs, or modularized product families, and modify them to address supply shortfalls. We saw this to a degree during the pandemic with electronic chips being substituted or reprogrammed to shore up automotive production.

PLM's potential for integration with other management systems can help address many present and future supply chain questions. For instance: How many alternative parts and qualified suppliers could be organized to step in to fulfill demand? What are the process options for making parts? Can additive manufacturing provide direct-part replacement and flexibility? How about rapid tooling?

Digital automation and centralization make these decisions easier to explore and implement. The combination of PLM, ERP and MES/MOM can help map out crisis response scenarios that allow organizations to bypass market disruptions, if the resources are available. PLM is flexible enough to be implemented in stages where the return on investment is the strongest.

Factory floor simulation—planning and bottleneck reduction. Very few medium-to-large manufacturing companies operate without simulation these days. It's most often conducted in design but can also extend from how machines are selected and arranged on the factory floor to how products travel through handling and conveyor systems. How might better use of simulation serve to help throughput and reduce supply chain chokepoints?

The performance of handling equipment can be simulated to optimize how a product travels from receipt through assembly and back to shipping again. In an all-digital environment, feedback from simulations like this can also go upstream



PLM manages CAD/CAM/CAE product innovation and the simulation of production process plans in the earliest stages of design. By connecting the disciplines of ERP, MES and MOM with design, PLM allows manufacturers to adapt to unexpected supply chain pressures more quickly and effectively. *Razorleaf*

to inform product design about needed modifications that speed throughput, reduce cycle times and lower overall cost. This feedback can relate to product shape, weight or other factors. When every day and week counts in meeting delivery commitments, simulation can close important gaps.

Not only does factory floor simulation, planning and bottleneck reduction help move product to shipping more efficiently, but the information loop can reach any discipline in the organization tasked with efficiency and continuous improvement. PLM should serve as the digital management hub for all such product and process design and simulation data, enabling adjustments as market conditions, and therefore product requirements, shift.

PLM and Digital Twins—Virtual Twins to Factory Twins to Supply Models

A digital twin is a virtual representation of various engineering embodiments and final manufactured "instances" of a product. These manifestations can include design, simulation, process, quality, factory and field/service examples captured via scans or directly through authoring and test software. What makes integrated digital twins powerful in comparison to digital-but-siloed domains is the ability for whole communities—be they in-house or external partners—to view, understand and contribute to product value.

PLM, at the center and source of design decisions, can influence everything that follows downstream. It's the last word in product version control and configuration management. It holds the results, reasons and history of all the decisions made by multi-disciplinary teams (the core of the digital thread).

In a heartbeat, PLM can be used to open lines of collaboration for both problem solving and ongoing improvements. And if your team has that one intractable technical issue or seeks a fresh strategy, then others in the design/supply network might just be able to help—with the right access to your organized product information (in PLM).

PLM is a synergy tool. And more synergy and foresight might be just what we need to move goods faster and to overcome the truly historic challenges in our supply chains occurring right now. ■

CAD/CAM Roundup: Engineering Software Productivity Tools and Services

Overcome complicated processes with the use of agile, flexible CAD/CAM and PLM solutions that streamline workflow automation.

by Rehana Begg, Editor-in-Chief

TRUE OR FALSE? Automated processes and workflows are the bread-and-butter of the modern workflow.

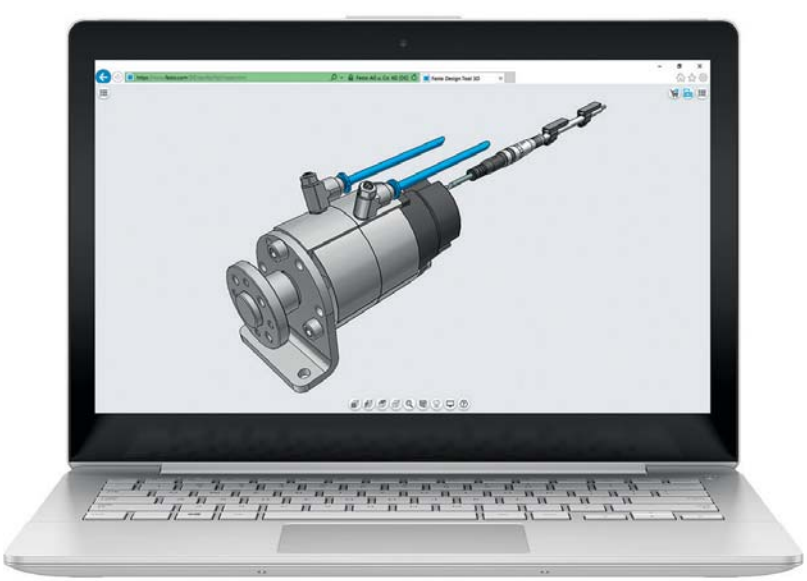
If workflow automation ensures busywork is handled by machines, then the answer varies depending on the software tool selected for improving the flow. The best productivity tech solutions affect the way that companies deliver on business goals. When choosing software, consider factors such as ease of use, customization options, ease of integration, scalability and pricing.

What we know is that flexible and adaptive software platforms that integrate with legacy equipment plonk the days of copy-and-paste in the rearview. Rest assured, functions such as setting up automated alerts and having greater visibility on how to avoid workflow bottlenecks will help today's multi-disciplinary design engineer focus on what really matters.

The following compilation of productivity tech not only provides intelligence on how to lower engineering and purchasing overhead, but also considers the demands of bringing machines to market faster and reducing operational risk.

Online 3D CAD Configurator for Pneumatic Actuators

Festo's latest design tool, a 3D CAD configurator supports pneumatic actuators and related accessories, including fittings, lengths of tubing and sensors. The tool supports the most common CAD formats and focuses exclusively on Festo's in-stock and quick-ship core range of pneumatic actuators and accessories.



The Festo 3D Design Tool enables OEMs to bring machines to market faster with an online 3D Configurator for pneumatic actuators and accessories. *Festo Corporation*

The single CAD file of the actuator/accessory assembly streamlines the design process by eliminating individual CAD files for the various components, noted the manufacturer of pneumatic and electromechanical systems and controls for process and industrial automation. The engineer simply selects the actuator from a choice of either cylinder, drive with guides or semi rotary drive, before clicking on accessory "hot spots" to identify and select each accessory. From there, the process configurator takes over to authorize and ensure compatibility between actuator and accessory and also validates the type code.

Subscription Services for 3D Fixture Modeling Software

Renishaw made available its FixtureBuilder 3D fixture-modeling software via a subscription service in January 2024. The software allows quick creation and documentation of advanced CAD-based metrology fixturing set-ups, with access to the full catalogue of Renishaw metrology fixturing components for designing and documenting modular fixturing setups.

Offered with the purchase of qualifying metrology fixturing products or bundles, the software offers full CAD compatibility and promises an intuitive interface, intelligent drag-and-drop functionality and an easy-to-use constraint mechanism. Renishaw noted the standout feature is

its "Build It" function, which automates the generation of work instructions and bill of materials for each fixture set-up.

CAE Workflows, Efficient CAE Analysis Simulation and Results Interpretation

A partnership between Visual Collaboration Technologies, Inc. (VCollab) and Novus Nexus empowers the design engineer and simulation specialist at every stage of the product development cycle. In this collaboration, VCollab brings its Rapid Results Review technology to Novus Nexus simulation automation users via its flagship product CAENexus, allowing users to review and share CAE analysis results without leaving their comfort zone in the CAE environment.

Bruce Webster, PhD, and Prasad Mandava—both CEOs and presidents of Novus Nexus and VCollab respectively—stated in a press release that having "VCollab's report generation capability baked into Novus Nexus' end-to-end simulation automation strategy" brings flexibility and power to design engineers and simulation specialists across the product development cycle.

Novus Nexus automatically handles simulations with complex CAD geometries, and with VCollab's interactive 3D report and Rapid Results Review capabilities, the solution enables high-fidelity and easy access failure investigations of whole assemblies. This is "a significant capability that has not previously been available with traditional automation and report generation approaches," Mandava said.

Webster best sums up the collaboration: "Simulation-ready CAD is the input, CAENexus the automation processor, and VCollab's performance visualization the output for live dynamic design review and decision making."

Cloud-based CAD-PLM Securely Shares Design Information

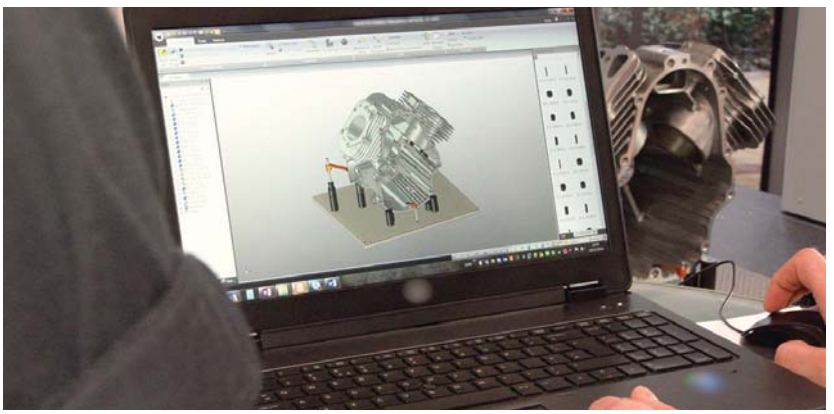
Nearly half or more of surveyed product design and manufacturing professionals rate their organization's operation efficiency (66%) and communication (48%) to be "very poor" to "average," according to a recent PTC survey. To accelerate product development, more companies are now transitioning to cloud-native and hybrid-cloud CAD and data management platforms.

To this end, OEMs looking for smoother transitions from the product's design phase to manufacturing can look to Onshape-Arena Connection. The solution is PTC's answer to seamlessly linking CAD, PDM and PLM in the cloud.

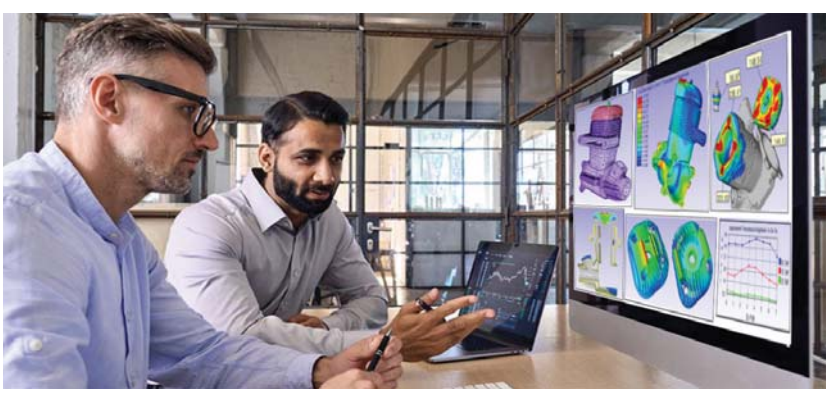
CAD-PLM integrations are notoriously complex and communication between the two typically requires an intermediary, known as PDM (product data management). Think of PDM as the translator between the CAD software and PLM system. PTC Onshape comes with built-in PDM capability. This allows for easy cloud-based adaptation with Arena PLM, which was developed for tracking and managing product design, engineering change and quality tracking across the product's lifespan.

During PTC's Q4 2023 earnings call last November, the company noted that PTC is taking share in different parts of the CAD market. PTC's latest CAD offering, Creo 3D CAD technology, enables the digital design, testing and modification of product models. Onshape Saas is a product development platform that connects computer-aided design with data management, collaboration tools and real-time analytics.

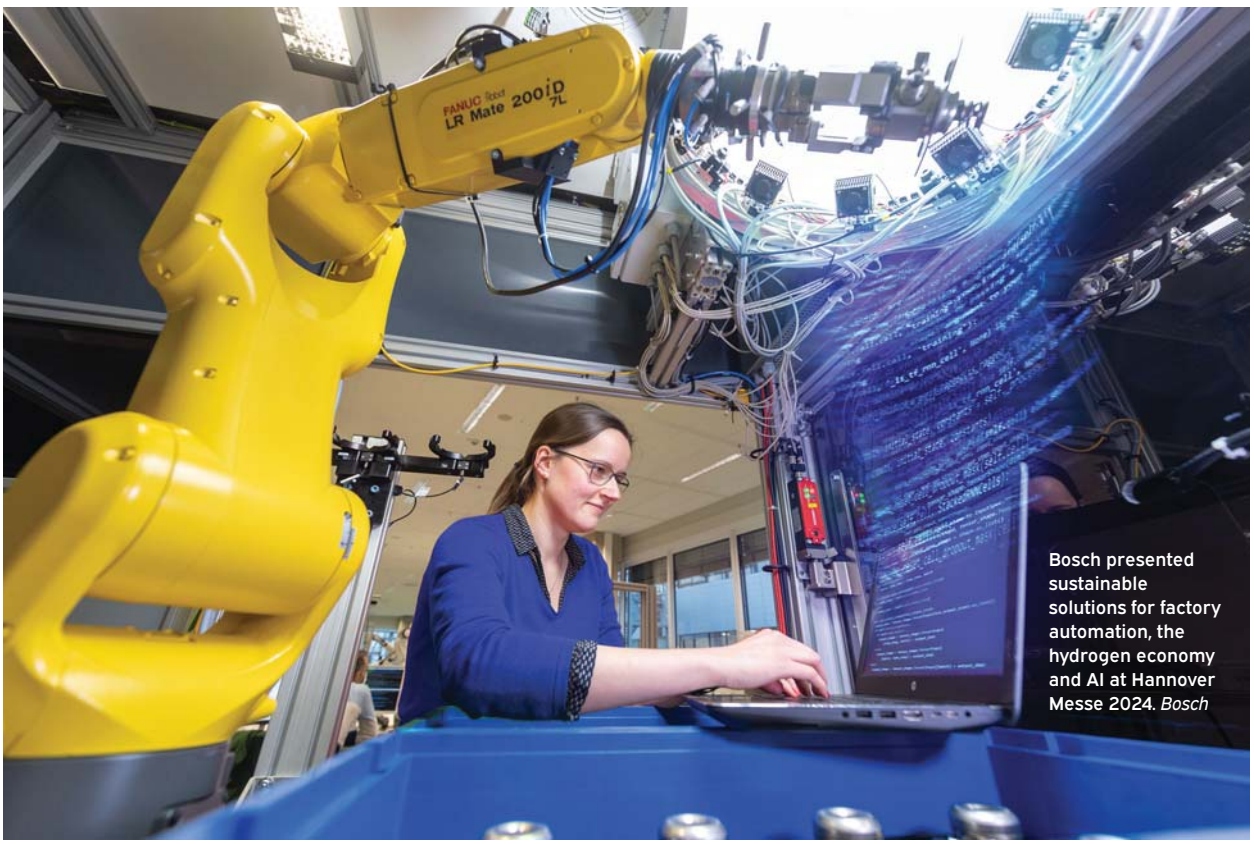
"Regarding Onshape, with NPS scores that lead the industry by a considerable margin and solid retention rates, we see good opportunities to take share in the part of the CAD market that Onshape focuses on," Matt Shimao, PTC's head of Investor Relations, said during the call. ■



FixtureBuilder 8.1 is the latest version of Renishaw's CAD-compatible software. It enables design of fixturing setups in seconds and then exports them to inspection programming software of choice, using popular file formats such as IGES, SAT and STEP. *Renishaw*



VCollab enables the creation of smart, interactive 3D CAE reports and delivers engineering performance data for live design review. *VCollab*



Bosch presented sustainable solutions for factory automation, the hydrogen economy and AI at Hannover Messe 2024. *Bosch*

Hannover Messe 2024: Open Ecosystems and Collaborations Steal the Show

With exhibits on digitization, cloud solutions, automation, engineering and more, this year's trade fair brought innovation to its peak.

by Rehana Begg, Editor-in-Chief

THINK RESILIENCE. Think sustainability. Think collaboration…

Call it big-picture thinking, but these were the topics of interest that core industrial companies across the globe impressed upon the 130,000 visitors from 150 nations, while trading ideas with some 4,000 exhibiting companies at Hannover Messe 2024.

Ranging from the efficient use of hydrogen in industry, help from software to reduce the carbon footprint, to verified use cases demonstrating ways to digitalize value chains, the business opportunities and tech solutions appeared to be boundless. This year's overarching theme, "Energizing a Sustainable Industry," elevated energy costs, the expansion of digital infrastructure, fast approval procedures and the call for qualified workers to the top of the agenda.

Setting Clear Objectives

The trade fair is a perennial site for economic policy delegations. More than 300 economic delegations visited the event, all intending to build capacity

and maintain competitiveness. A prime example of pan-European cooperation was a notable deal—signed, sealed and delivered—announcing this year's partner country, Norway, will export large volume hydrogen to Germany and will create necessary hydrogen infrastructure by 2030.

Open Ecosystems are Table Stakes in Manufacturing

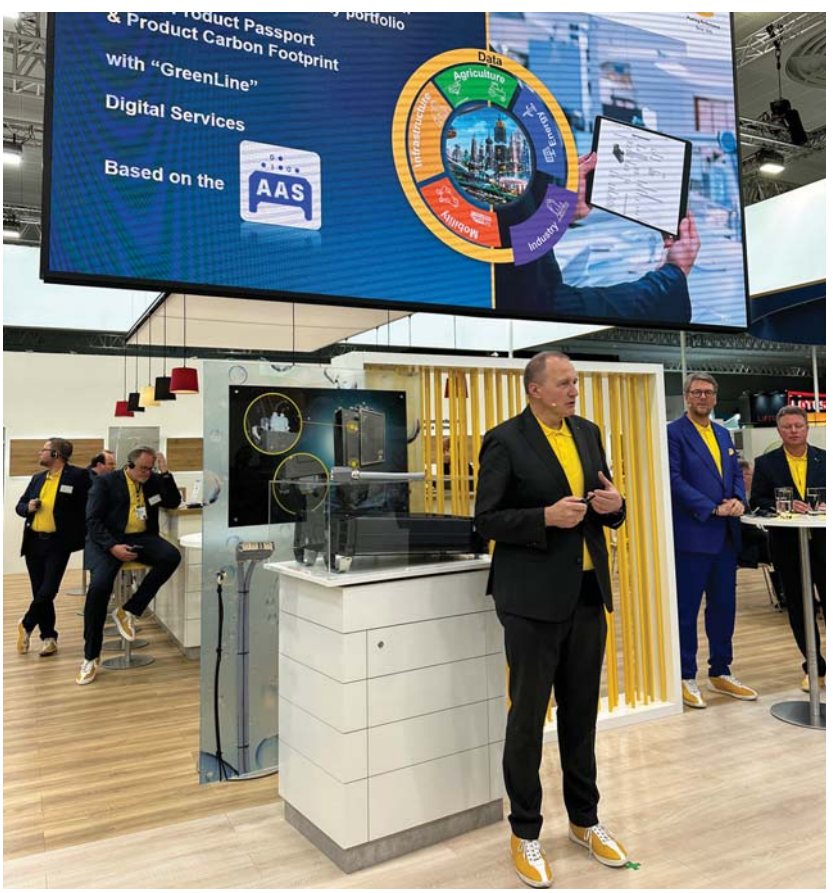
Bosch Rexroth responded to the theme by bringing automation solutions for battery production and hydraulic solutions as a practical contribution to the hydrogen economy. The drive and controls technologies supplier highlighted another prevalent trend in the factory automation section of their booth: shifting from closed supplier-related supply towardsopen ecosystems.

This is important in particular because innovation speed in factory automation is accelerating at speeds that are near to impossible to cope with, explained Thomas Fechner, member of the board of management and responsible for factory automation at Bosch Rexroth. "The reason behind the digitalization and high software content in the machines is because with this comes a differentiation," he said. "And no corporate alone can cope with the speed demands of our customers."

Fechner pointed to computer vision to illustrate his point. "With a stereo camera you are observing the materials; you check if quality is okay. There are hundreds of startups and a lot of venture capitalists invested in making source code and in making software to make the best out of it. So, utilizing artificial intelligence and generative AI. No big corporates can cope with this feat."

To this end, Bosch Rexroth can provide the base technology needed for automation through an open ecosystem, said Fechner. The company launched ctrlX Automation about three years ago, which is now marketed as building blocks for complete automation solutions—encompassing controllers and I/Os, IPCs, HMIs, drives and safety solutions, as well as comprehensive motion, PLC and IoT functions. "It's like a smartphone for automation," said Fechner. "The system allows you to optimize hardware independent from software."

Philip Harting, chairman of the Board, Harting Technology Group, presents his company's connectivity solutions to trade journalists at Hannover Messe 2024. *Harting*



Norbert Gemmeke, managing director, Harting Electric, outlined Harting's collaboration with Microsoft and Siemens. Through the partnership Harting can bring AI-enabled industrial devices to market. *Machine Design*

Bosch partners contribute the software. Out of 100 partner companies, a handful were invited to demonstrate the network of collaboration at Bosch Rexroth's ctrlX World showcase, including Arduino Pro by Arduino s.r.l., GEFAZ mbH, Intel Corporation and VMware by Broadcom, VEIL Energy BCorp, and XITASO GmbH, as well as ctrlX OS OEM partner Dell Technologies.

The partnership dynamic enables companies of various sizes to innovate faster than they could on their own. "We are making a joint value proposition," said Fechner. "If a customer buys such a solution, it is making business with us and with the software partner. So, it's a real partner ecosystem with a win-win situation or triple win because, in the end, the customer wins with the best and fastest innovation."

Data-Driven, AI-Powered Automation, Connectivity and Generative Engineering

Similarly, Harting Technology Group made clear that the company's goals to 2030 remain rooted in climate neutrality. The concept of an all-electric society is needed to solve the energy problems, with a focus on electricity, said Philip Harting, chairman of the Board, Harting. That would mean leaving behind fossil fuels and embracing new global energy sources such as wind, solar, water and, of course, Harting's products—cable solutions and connectivity, he said during a press conference. He also pinpointed digitization and automation as an opportunity,

The industrial connectivity solutions company takes a multifaceted approach to connectivity, extending beyond mechanical, to the cloud service, integrating software and IIoT connectivity. Norbert Gemmeke, managing director, Harting Electric, explained the relationship Harting has fostered with Microsoft and Siemens in an effort to bring AI to industrial products (such as AI-assisted connectors) to market.

Microsoft is using Azure OpenAI to provide recognition algorithms and contextual understanding for interpreting natural language inputs. This information adapts to specific requirements (such as environmental classes), and with the aid of Harting connectors can then create 3D models for CAD software, which is where Siemens fits in. To this end, Harting can boast of development process results that are sped up, customizable and resource efficient, Gemmeke said.

Data is Paramount: Why Make it Accessible to All?

Manufacturing is one of the most data-intensive industries, generating an average of 1.9 petabytes worldwide every year, according to McKinsey Global Institute. Yet, the ability to scale has remained a long-time bane due partly to the limited ability to unify OT and IT.

Microsoft's announcements of manufacturing data solutions in Microsoft Fabric—an end-to-end analytics software-as-a-service (SaaS) based platform—and copilot template for factory operations on Azure AI, are designed to help manufacturers scale, integrate and accelerate industrial transformation across operations. Azure IoT Operations leverages open standards and works with Microsoft Fabric to create a common data foundation for IT and OT collaboration.

The software giant brands itself as a co-innovation partner working with enterprises to unlock the potential of AI solutions. "Microsoft partners are critical to our success," said Kathleen Mitford, corporate vice president, Global Industry, during a private meeting with *Machine Design*. "In fact, here at HMI, we have over 24 different partners featured in our booth. And Siemens, Rockwell and Schneider are among many of the partners that are critical to Microsoft."

Kathleen Mitford, corporate vice president, Global Industry at Microsoft, explains the significance of Microsoft's partnerships at Hannover Messe 2024. *Machine Design*

Microsoft partners were in plain sight through branding and demonstrations across the fairgrounds. A partial list includes Accenture, Ansys, AVEVA, Blue Yonder, Bosch, CapGemini, Cognite, Connected Cars DK, DSA, HERE Technologies, Hexagon, Netstar, NVIDIA, PTC, Rockwell Automation, SAP, Schneider, Syntax, Sight Machine, Siemens, SymphonyAI, Tata Consultancy Services (TCS), ToolsGroup and Tulip Interfaces.

"The reason why we've chosen these partners is they have very deep solutions that our customers care about—engineering solutions, manufacturing solutions, service solutions," touted Mitford. "Our strategy is to meet our customers where they are, which means they're already using this technology... So how can we help our partners accelerate by using a combination of their existing technology, either on top of Microsoft technology or Microsoft technology incorporated into it?"

Hermes 2024 Award Goes to Schunk

Automation expert Schunk won this year's acclaimed Hermes prize for its 2D Grasping Kit. The award recognizes innovative products and solutions that demonstrate a high degree of technological innovation and provide benefits for industrial settings, the environment and society. Schunk's AI-supported 2D Grasping Kit was purposefully designed for automating repetitive sorting or randomly arranged objects or performing logistics tasks with little outlay. The kit consists of a camera with lens, an industrial PC, AI software and an application-specific gripper, enabling reliable handling of random parts on a conveyor belt, tray or supply table.

Siemens and Bosch Rexroth were both runners-up. Siemens submitted its SiGREEN CO2 management tool, a real-time, secure and scalable tool for managing product carbon footprint (PCF) data. The data capture platform is part of Siemen's Xcelerator portfolio. Bosch Rexroth submitted a system designed for unloading and dismantling battery modules from electric vehicles. Recycling allows up to 95% of the chemical elements to be returned to the production process, stated the company.

The winner of the 2024 Hermes Award, Schunk's 2D Grasping Kit is an intelligent solution for handling different non-position-oriented objects on a surface. *Schunk*

The coveted Hermes Startup Award was conferred upon to Archigas—a startup based in Rüsselsheim, Germany—for designing a compact, moisture-resistant sensor for fast, precise and reliable measurement of hydrogen content. The sensor was developed in cooperation with the RheinMain University of Applied Sciences. Archigas described the principle behind the sensor as an advanced thermal conductivity measurement function on a microchip. "In developing the sensor, Archigas is making a valuable contribution toward enabling the safe production, storage and use of hydrogen," stated the judges.

Hannover Messe 2025 runs from March 31 to April 4. Canada will be featured as the partner country. ■

Pairing of Slip Ring and Rotary Union Enable Automaker's Robot Arm to Turn Screws Precisely

A custom-designed robotic screwdriver turns plastic screws without stripping the fastener's threads and keeps pace with the vehicle production line.

by Bill Perry, Managing Partner, MARCH 24 Media LLC.

AN AUTOMOBILE, on average, has 3,500 fasteners consisting of nuts, bolts, clamps, screws and more. The material for these fasteners ranges from zinc-coated metal to vinyl. After reviewing its production process, an automaker's R&D department decided to automate how its workers used electric hand tools to turn plastic screws for fastening certain vehicle body parts.

Automating the process would bring consistency and efficiency, reduce errors and eliminate injuries from repetitive motion. To turn each plastic screw without stripping the fastener's threads and keep pace with the vehicle production line, the automaker's R&D team determined the car maker would need a robot with a tooling end that could rotate 360 deg., monitor torque continuously and communicate via PROFINET. The solution would have to offer seamless, continuous rotation at the joint of the robot's tool interface.

"There appeared to be no supplier on the market that could meet the requirements to enable the process," recalls Martin Assmann, marketing manager for Moog GAT in Geisenheim, Germany. "The R&D team then made an inquiry to us, and we made the process possible with an ultra-light combination slip ring and rotary union, which we call Rotokombi."

According to Assmann, the customized solution for the automaker required high-performance motion control, which called for a specific kind of technology. By way of background, a slip ring is an electro-mechanical device that allows the transmission of power and electrical signals from a stationary to a rotating structure. Inside the slip ring, brushes provide electrical contact between the rotating ring and the assembly's stationary parts. The brushes ride on the ring and the brush block assembly mounts on the stationary structure.

An 8-channel pneumatic Moog Rotokombi consisting of a Rotopack rotary union and Rotoflux slip ring used between a robot arm and tool for rotations of more than 360 deg. and precision clamping. *Images courtesy of Moog GAT GmbH*

The slip ring portion of the solution Moog GAT supplied is critical for not only the transmission of power but also monitoring torque, since there must be an unbroken exchange of data between the tool end of the robot arm and its control unit. Unlike the carbon brushes found in many slip rings, the slip ring Moog GAT chose for this application combines gold spring wire and gold-plated slip tracks. Assmann said this gold-gold technology extends the slip ring's service life, drastically reduces any maintenance and ensures high signal quality.

Paired with the slip ring is a Moog rotary union, which can accommodate up to eight channels. For this application, the rotary union includes two channels through which the automaker's robot can transmit air to create a vacuum up to 10 bar for holding and releasing the plastic screws. Moog GAT rotary unions can also transfer media such as oil, water and gas.

"About 85% of our solutions are customized with the client," Assmann adds. "Any application requiring 360-deg. rotation will need a slip ring and/or a rotary union."

A Universal Robots UR3e with the Rotokombi solution on the end of the robot arm.

As for choosing a robotic arm, the automaker's R&D team tapped Universal Robots' UR3e, the smallest industrial collaborative robot arm in the company's portfolio. The UR3e can lift no more than 3 kg., so Moog developed a Rotokombi weighing 1 kg. The UR3e robot arm, which has a reach of 500 millimeters, relies on the Rotokombi to guide each screw using a vacuum and a calibrated control loop that automatically halts the tightening process upon reaching the maximum torque, providing precision and control to the process.

According to Moog GAT's engineers, the customized solution is entirely new. Moog's team worked with Universal Robot and the automaker's R&D team to design and assemble the 1-kg rotary union and slip ring, which transmits power, signals and data to the tool end. The ultra-lightweight Rotokombi developed for the automaker's fastener-turning application stands in contrast to other such units that Moog GAT has developed for applications like sheet metal rolling and tunnel boring; for some of these applications, engineers have designed and manufactured Rotokombis weighing up to 4,000 kg.

Once the current test phase ends for the robotic screwdriver, the automaker's R&D department foresees using seven UR3e robots with lightweight Rotokombi. The robots will be affixed on automated trolleys for the induction loops of the production line to screw together various body parts. ■

A Universal Robots UR3e with the Rotokombi solution on the end of the robot arm.

DIY or Collaborate?
Navigating the Path to Optimal Linear Actuator Guidance

Stepper motor linear actuators provide thrust along a linear axis but cannot tolerate side loading. Supplemental guidance is needed to protect against external forces impacting the linear motion of the load. Here are some pointers.

by Matt Palmer, Product Manager—Linear Units, Thomas Industries, Inc.

WHEN MACHINE DESIGNERS need to translate motor torque into linear thrust, they often specify a stepper motor with an integrated lead screw and nut. Known as a stepper motor linear actuator (SMLA), this configuration can provide precise control, reliability and versatility along a linear path, but if there is potential for even a small moment or side load, it will be necessary to add additional linear guidance. A well-designed guidance mechanism can prevent any binding, bending, buckling or other dysfunction that side loading might introduce.

On the surface, adding guidance to an SMLA appears to be so easy that it may tempt experienced engineers to design it themselves, but given the complexity of calculations that may be involved, in even the smallest applications, the DIY strategy might not be worth the risk. Determining what is right for any application requires careful consideration of the motion profile, available time and budget, space considerations, integration and support.

Why SMLAs?

An SMLA typically consists of a stepper motor and an integrated lead screw that moves a load in a back-and-forth linear motion. SMLAs are highly reliable, economical workhorses that drive numerous applications in which precise stopping and starting and high programmability are desired, such as microscope stage adjustments, 3D printer head movement and pipetting *(Figure 1)*.

The Need for Guidance

An SMLA provides thrust along a linear axis but cannot tolerate side loading. Undesirable loading perpendicular to this axis can result from any of the following factors:

- Bending moment force from misaligned loads
- Vibration and shock loads, especially in environments with mechanical impacts or oscillations
- Thermal expansion differences among components
- Gravity

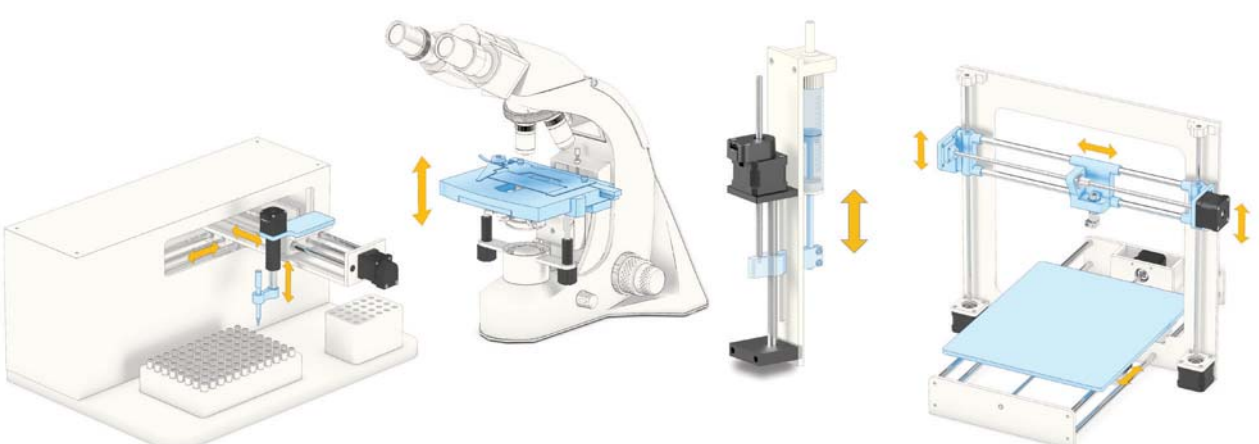


Figure 1: Top: All SMLAs have a stepper motor, integrated lead screw and a nut, but differ on whether they translate motion by rotating the lead screw, nut or lead screw that drives a traditional actuator-type rod. Bottom: Ideal SMLA applications include (l to r) pipetting, microscope stage adjustments, fluid pumping and 3D printing. *Courtesy Thomson Industries, Inc.*

Such forces, independently or in combination, can wear out or deform components. They can cause bending and buckling, premature failure and increased stress on bearings or lead screw nuts and threads. Misalignment, increased friction and material fatigue also contribute to overall performance degradation and shorter system life.

Avoiding the negative impact of moment or side loads requires supplemental guidance to protect against external forces impacting the linear motion of the load. Guidance often involves deploying additional round or square rails and bearings external to the lead screw. The challenge for either the user or OEM is to determine the most robust guidance, in the smallest space and at the lowest cost.

Adding the Guidance

The larger the load and the higher the speed, the more complicated it is to add guidance in an optimal way. The following steps are involved:

- Assessing the spacing, budget and delivery parameters
- Determining whether round rail, square rail or another guiding mechanism is best
- Running optimization calculations, which can take days
- Implementing the final design in CAD
- Assembly
- Testing

It is sometimes possible to put together a compact linear motion system from off-the-shelf components by yourself, integrating thrust and guide rails in a single, small-scale unit. However, an additional degree of expertise is usually needed to arrive at the optimal solution. Machine designers are left to choose between assembling a linear motion system themselves, potentially with unknown risks, or relying on a motion control manufacturer with decades of application expertise to create a highly configured solution, most often available with standard components.

Do it Yourself?

Designing a compact linear motion system by yourself can result in a more bespoke solution at a lower cost and could bring economies of scale in high-volume applications, but there are many potential downsides as well.

Machine designers who do not have extensive experience with system design may err on the side of caution and overengineer. While overengineering might reduce risk, it usually adds complexity as well. For example, oversizing the rails would add more support but would also add costs and eat up space. It is not uncommon for engineering projects to fail in their first iteration, which can entail going back to square one, adding further costs and delays.

Many, if not most, DIY projects integrate components from different vendors, which are less likely to work together optimally. If there is a problem, there may be finger-pointing among the component suppliers. Likewise, maintenance and support could be an issue, especially if the original in-house design team is no longer available to complete the project.

Partnering for Success

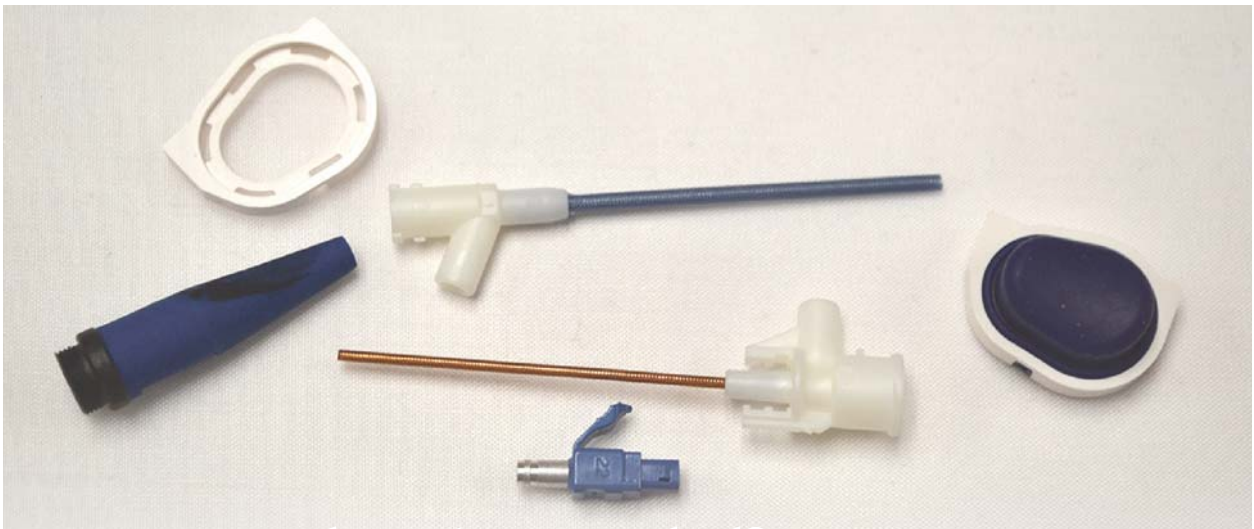
Working with a vendor who can configure the "just right" assembly of standard or slightly modified components will help to avoid such problems. Vendors are more likely to have extensive experience in customizing linear motion systems for diverse applications. Vendors may have developed configuration specifications, CAD models and online tools that facilitate the process, as well as physical tools that enable them to machine parts more efficiently. Vendors also may have pre-tested modules that can be adapted easily without major customization *(Figure 2)*. Modularity allows vendors to deliver highly configured standard products without the added cost normally associated with custom products. Vendors also take responsibility for the operation of the product—usually by issuing warranties. If integrated at the factory, the designer can be more confident that there will not be mismatches among components. Vendors will also have the experience to make maximum use of minimal space, producing a more compact linear motion system. Some suppliers provide customization services for free. The outcome of these vendor benefits and capabilities is less time, headaches and maintenance, a quicker solution and, most importantly, a lower total cost of ownership.

Figure 2: Motion engineers have myriad, standard configuration options for adding guidance to an SMLA. Depending on application requirements, and mounting and space considerations, for example, they might use a profile rail and lead screw positioned vertically (left) or horizontally (middle). Or they might use round rails on opposite sides of the lead screw (right) to help withstand higher moment loading.

The Safe Choice

If you need to customize a high-volume linear motion system project, have available time and expertise, and can tolerate some risk, you may be able to reduce the cost of having a guided system by building it yourself. Otherwise, working with an experienced vendor's engineering team to assemble a highly configured, compact linear motion system from standard components for your application may get you the optimized product you need faster and with less risk.

Although short-term, out-of-pocket costs may be higher, when you take all factors into account, working with an experienced linear motion supplier will result in a higher-quality, quicker solution with maximum ROI. ■



Courtesy C&J Industries

Two-Shot Molding:

The Advantages, Considerations and Real-World Applications

C&J Industries acquired a 220-ton Nissei two-shot press so they could accommodate the jobs they had been having to turn away.

by Sharon Spielman, Technical Editor

THE DECISION TO invest in a 220-ton Nissei two-shot press was a strategic move made by C&J Industries, Meadville, Pa., to expand its capabilities. The selection of this press was a deliberate internal project aimed at gaining experience in this specialized process. By matching the press with its two-shot coaster, the company addressed the growing demand for products that require two-shot capabilities.

Machine Design reached out to John Hanninen, senior engineer of new business development at C&J Industries, to learn about the process, its advantages and its challenges.

**Editor's note: Questions and responses have been edited for clarity.*

Machine Design: I understand that two-shot molding is something C&J Industries has recently taken on. Can you tell me about that decision, including how the company went about selecting its 220-ton Nissei two-shot press?

John Hanninen: Over the years we have had many instances of having to turn jobs away that required two-shot capabilities. To gain experience, management decided to pursue an internal project and after searching around, it was decided a good used press would be purchased. The Nissei was selected to match up with our two-shot coaster.

Going forward we will buy a unit(s) that fits the application we are awarded. There are various options depending on the program whether we buy another two-shot press or buy a side unit that can be used on our existing presses to do two-shot molding. Two-shot molding is very dependent on the part size and shot size required for each material and matching the part to the press size required.

MD: What are the primary advantages of utilizing a two-shot injection molding process?

JH: The primary advantage is cost savings from producing a completed two-shot or two-component product every machine cycle. You can usually get better quality with better adhesion between the two resins and better matching of the second core or cavity to the first part since it stays in the mold, so the aesthetics are improved. More than one color is possible.

Secondary assembly operations or separate over-molding or insert molding of the first part can be eliminated. It also reduces handling of parts like you would have with over molding, which increases WIP and potential of part damage or contamination that you avoid with two-shot molding.

MD: Can you explain the key considerations to keep in mind when designing parts for a two-shot injection molding process?

JH: The upfront tooling costs for two-shot molding can be significantly more than conventional molding, so an analysis of the return on investment (ROI) would be important. Does the product require a second resin? The part design must fit within one of the several methods used for two-shot molding, so before a design is started you need to know the difference between them. Are the resins compatible? Do you need them to bond together or are you creating an assembly? Depending on the resins you select, some resins chemically bond well together while other resins may require that mechanical bonds are designed in to better hold the two different resins together.

MD: Does the two-shot process enhance the quality and durability of the final product compared to other molding techniques? If so, how?

C&J Industries showcased its two-shot molding process at the recent IME West Show in Anaheim. The press has two barrels, and for this demo part, the dark blue rigid resin is molded first then rotates 180 deg. and finishes with the softer yellow resin while the blue is starting the next part. *Sharon Spielman*

JH: While the final quality of a two-shot part compared to an over-molded part can be similar, the benefit comes from scrap rates and machine capacity. You may run through more parts in the over-molding process to get the same amount of quality parts that you would get with two-shot molding.

MD: Tell me about the resin materials used in two-shot injection molding, and how does the selection of materials impact the overall product design?

JH: The initial resin or first shot is usually a rigid material such as ABS, polypropylene, nylon, etc. The second resin is usually soft resin like a thermoplastic elastomer or silicone-type material. Common items like hand tools with soft grips and even toothbrushes all take advantage of the two-shot process. It can also combine two rigid resins allowing multiple-colored parts like a headlight or taillight with opaque, clear and amber or red variations all in one component.

Various resin manufacturers have developed materials specifically for two-shot molding to achieve an adhesive or chemical bond between the rigid and soft resins. Working with them would be an important step for a successful design. If two resin are needed that are not meant to chemically bond to each other, then you must design in a mechanical bond feature to be able to mold a successful part.

MD: What challenges or limitations did you encounter when implementing a two-shot molding approach? How were these overcome?

JH: Our press uses parallel injection units and a rotary machine platen. Our design had to consider the part staying on the core and rotating 180 deg. over to the other side. The product design needed to allow gate locations that are on top of each other. The shut-off surfaces between the first-shot part and the second cavity had to be considered. The second cavity must squeeze an area of the first part with enough pressure to prevent the second shot resin from leaking out creating flash. That contact area can leave a visible mark on the part that needed to be considered.

Using the two-shot process, plastic can be molded on the inner or outer diameter of the metal component. *C&J Industries*

The compatibility of the two resins had some challenges due to their similar melting temperatures. They bonded well with each other, but the second resin could melt and blend into the first resin, leaving a marbled look which we did not want. Working with the resin manufacturers and adjusting the molding process we were able to overcome that. Another issue to keep in mind when matching a part to a two-shot press is considering barrel sizes. The amount of each resin must match the barrel size for each injection unit. This makes it hard to match multiple parts to the same press. This is a reason using a side unit with an existing press is sometimes more economical and gives you more options when trying to utilize your press capacity.

MD: Does the tooling and equipment setup differ for two-shot injection molding compared to conventional molding processes? Please explain.

JH: The tooling and equipment can be much more complex, so the setup takes longer. You are dealing with basically two molds with one side attached to a rotary platen. A robot will come in and pick and place the first shot into the second side. Does the mold have an internal core pull, a shuttle action or maybe a lift and rotate mechanism built in? Do you need air, hydraulics or servos tied into the press controls? The presses have the software built in to integrate the injection units together, so the actual injection setup is the same as a single component mold but with separate screens for each injection unit.

MD: Can you provide examples of real-world applications or case studies where this process resulted in significant improvements or innovations for your customer(s)?

JH: It has eliminated secondary assembly and bonding of the parts together, saving costs and improving the overall part quality. It has helped with part consolidation, resulting in reduced cost and lead time to market.

MD: In what ways does the two-shot injection molding process contribute to cost-efficiency and sustainability in manufacturing?

JH: Instead of paying for two separate injection molding processes run sequentially, you pay for two injection molding processes run in parallel. Each time the mold cycles you get a complete part, cutting the manufacturing process time nearly in half, saving man and machine hours.

MD: Is there anything else you want to mention?

JH: With so many variables in design and materials it is very important if you are thinking about designing a part that could potentially be molded as a two-shot part to have your molder in design discussions from the very beginning. ■

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Elevating Precision Manufacturing with CNC Micromachining

Micromachining is used to design and create small, delicate parts, especially in the electronics and medical device industries. The author lays out the main benefits and the best-suited micro-precision applications.

by Emily Newton, Technology and Industrial Journalist

PRECISION MANUFACTURING IS becoming increasingly crucial as products get smaller and quality standards rise. While there are many ways to achieve that precision, focusing on the micromachining process is one of the best strategies.

What is Micromachining?

Micromachining applies computer numerical control (CNC) machining on the microscale. In an engineering context, that generally means dealing with dimensions between 1 and 500 micrometers (µm).

Machining on this scale requires specialized equipment. A micrometer isn't visible to the naked eye and conventional CNC tools are too large to support that level of precision. However, newer tooling ends and automation make micromachining possible.

The equipment necessary for this kind of machining is becoming increasingly accessible as the market grows. While some manufacturers may hesitate to adopt these systems, they can yield several important advantages.

Benefits of the Micromachining Process

Understanding how this technology can improve your workflow is the first step to implementing it effectively. Here are some of the most important advantages of the micromachining process:

Higher Precision

The most obvious advantage of micromachining processes is that they're far more precise than conventional CNC milling. Standard machining tolerances hover around 0.005 in., more than 120 µm. A micro-capable mill will have a much

lower tolerance, as it needs to cut on the microscale with high repeatability.

That higher precision is beneficial for a few reasons. It lets you machine much smaller products, for starters. That's particularly advantageous for electronics producers amid ever-increasing demand for smaller components. Similarly, higher precision enables you to cut more complex designs.

Fewer Errors

Micromachining's precision also means production errors are less likely. CNC milling is already fairly error-resistant, as CNC spindles produce less vibration than other machining methods. Applying that advantage on a smaller scale makes you even less likely to damage the material you cut.

Because micro-capable CNC machines remove less material at once, it's harder to over-machine anything. Their size also means less resistance and less power, which further reduces vibrations and heat to preserve your material's structural integrity.

Material Versatility

A less obvious benefit of micromachining processes is that they can work with a greater range of materials. This versatility stems from the fact that it's a less intense process than conventional CNC machining.

Macro CNC mills may spin too fast, remove too much material, produce too much torque or get too hot to work with some delicate materials. Micromachining's smaller form factor mitigates these concerns. Consequently, you can use it to machine even the most brittle metals, plastics and ceramics.

Energy Efficiency

Micromachining is also more energy-efficient than conventional alternatives. Smaller tools naturally require less power to move. Taking less material off at a time also reduces friction and resistance, further minimizing your energy consumption.

This efficiency has two main advantages. First, it reduces your ongoing expenses by minimizing your electricity consumption. Secondly, it makes your manufacturing processes more sustainable, which is becoming increasingly important in today's market.

Less Waste

Similarly, micromachining processes produce less waste. One of the few downsides of CNC machining is that it's more wasteful than other methods because it removes material instead of shaping or adding it. Using a smaller, more precise scale minimizes that waste.

Smaller cutting allowances ensure you get the exact proportions you need without removing extra material. The precision will also prevent material loss from mistakes.

When and How to Apply Micromachining

It's hard to ignore the potential of micromachining for precision manufacturing. Still, these small-scale processes aren't ideal for every situation. Making the most of this technology is just as much about knowing when not to use it as knowing when it's best.

It's hard to ignore the potential of micromachining for precision manufacturing. Still, these small-scale processes aren't ideal for every situation. Making the most of this technology is just as much about knowing when not to use it as knowing when it's best.

Micromachining processes are best suited for complex or small-scale jobs. While they can perform larger tasks with higher precision, that accuracy comes at the price of efficiency at a certain point. Removing more material with a smaller mill will take longer, so opt for conventional machining when working with simple designs or larger components.

Because micromachining uses specialized equipment, it also requires special training. The manufacturing industry could be short 2.1 million jobs by 2030, so filling that talent gap could be difficult. Consequently, shops with smaller workforces may find it more economical to outsource micromachining tasks instead of buying and using this equipment in-house.

Micromachining can also be expensive. The resulting savings will make up for those costs over time if you use this equipment enough, but not every facility will. Precision-focused manufacturers—like those making electronics or medical devices—will benefit more from performing this work in-house, but more general-purpose companies may find outsourcing more effective.

Make the Most of the Micromachining Process

Micromachining offers several key advantages for precision manufacturing. Understanding these benefits and which situations they most apply to will help you make the most informed decision about implementing these processes.

Some manufacturers profit from micromachining more than others, but these benefits apply to many use cases today. Determine your needs and compare them to these advantages and applications to make the best decision. ■

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AutomationDirect Offers Lutze Superflex Control Cable

An addition to AutomationDirect's lineup, the Lutze Superflex control cable is available in sizes ranging from 21 AWG to 12 AWG with 3 to 34 unshielded conductors. Individual conductors are bare copper and stranded for flexibility with black PVC/TPE insulation and identification numbers for easy installation. An insulated ground conductor, green with a yellow stripe, is included in the conductor count of each cable. Designed for industrial applications, Lutze Superflex control cable is suitable for flexing in short to medium drag chains.

Made for stationery and flexing applications, the multi-conductor control cable is suitable for organizing and simplifying control wiring in machines and facilities. With a minimum length of 20 feet and cut-to-length options in 1-ft increments, the cable is designed to be a cost-effective and efficient way to meet industrial wiring needs.

AUTOMATION DIRECT, LUTZE

www.machinedesign.com/21285324

Ad Index

Master Bond's EP114 Advanced Nanosilica Epoxy System

Suitable for potting, coating and sealing applications, this two-part epoxy system can bond a range of substrates. Infused with nanosilica, this two-component epoxy system from Master Bond is suitable for potting, coating and sealing applications. EP114's nanoparticles are designed for dimensional stability, reducing shrinkage when cured. The epoxy system has a 100:80 mix ratio by weight with low viscosity and an extended open time of 2 to 4 days. EP114 does require oven curing, typically following a cure schedule of 2 to 3 hours at 250°F, 5 to 8 hours at 300°F and a post-cure at 350°F for at least 2 hours.

Targeting specialty OEM, electronic and optical sectors, EP114 is available in a range of sizes and units—including cans, pails and syringes—to accommodate users' needs.

MASTER BOND

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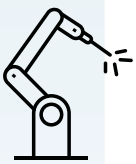
CAD/CAM Software Market Projected to Reach $51.87B by 2030

THE GLOBAL CAD/CAM MARKET by type and application is projected to reach nearly $52 billion by 2030, growing at a CAGR of 9.5% for the forecast period of 2023 to 2030, according to Cognitive Market Research's CAM & CAD Software Market Report 2024 (Global Edition).

Factors affecting this growth include:

- **Increasing need for industry automation**
- **Technological advancements**
- **Easy access to data**



ENGINEERING SOFTWARE MARKET FORECAST

(including CAD, CAM, CAE, AEC & EDA) based on a CAGR of 9.7%

2030	$64.90B
2029	$59.60B
2028	$54.70B
2027	$50.20B
2026	$46.10B
2025	$42.30B
2024	$38.80B
2023	$35.60B

Source: Grandview Research

CROSSWORD

Find puzzle answers here:
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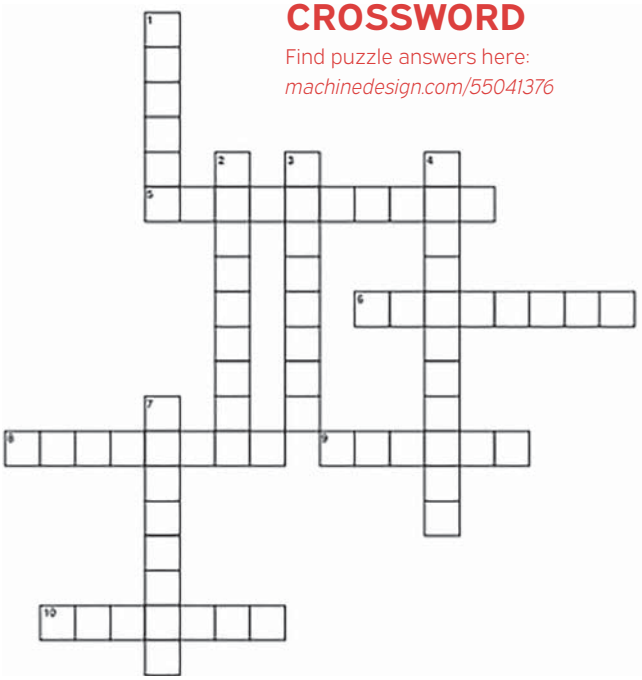


ACROSS

5. This Ivan created the CAD precursor Sketchpad in the 1960s

6. This Patrick is often considered the father of CAD/CAM

8. The C in CAM

9. The D in CAD

10. Pierre Bézier, an engineer at Renault, developed this first true CAD/CAM program.

DOWN

1. CAD tools create 2D and 3D (blank)

2. Type of process that refines designs based on feedback

3. This Jim was instrumental in developing Pro/ENGINEER (now known as PTC Creo)

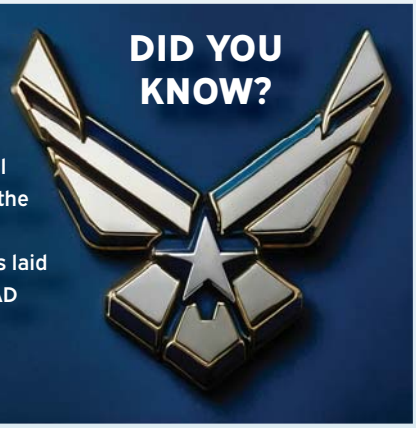
4. The E in CAE

7. Company that introduced AutoCAD software in 1982

DID YOU KNOW?

In the 1950s, a graphic defense system was developed for the U.S. Air Force, which involved 2-dimensional geometry to describe the width and height of measured objects. This laid the groundwork for CAD systems.

*Source: factfile.org



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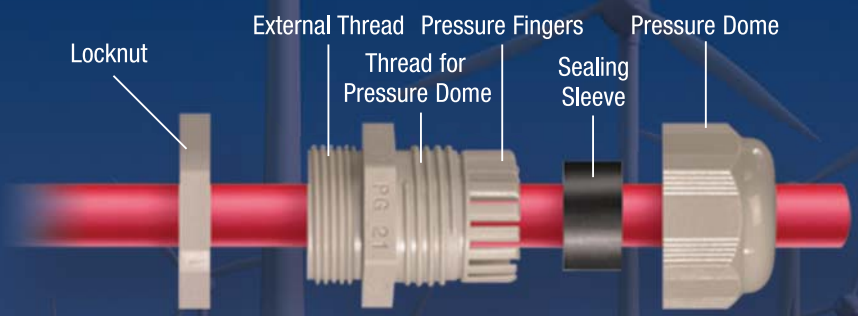

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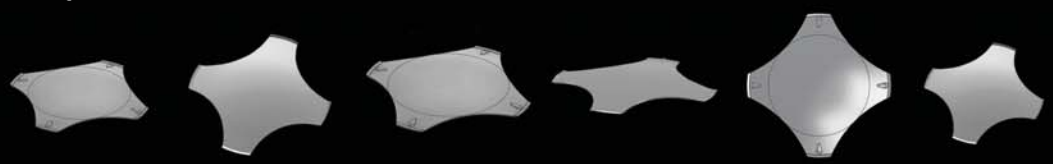
Refrigerator and freezer technologies have progressed far beyond just cold storage. Today's smart fridge and freezer units feature water & ice dispensers, user control panels & displays, Wi-Fi connectivity, voice recognition & control, and more.



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