motion world

Trends in CNC Automation

2016

MULTIVAC Sepp Haggenmüller SE & Co. KG

Multivac packaging machines use
the CAD/CAM-CNC process chain

Cover picture: Siemens AG

Digitalization?
Yes, and so much more!

The CNC machine tool's basic principles have remained unchanged for 50 years: a stable frame in a sealed enclosure with several axes, drives and an operator panel for the CNC. What does the machine tool need to meet the demands of an increasingly interconnected age and Industrie 4.0? Consistent software implementation and machine tool networking over the entire product lifecycle play an important role. To collect and analyze current data and implement networked production, machines require compatible interfaces.

As an industry-leading automation partner, Siemens offers machine manufacturers and manufacturing companies an integrated portfolio of industry software and automation technology to support them on their way to customized digital production. This reduces development time and time-to-market while increasing flexibility and efficiency in production.

As part of a holistic approach to the digitalization of machine tools, we are focusing on three key areas: the development and production of machine tools (BUILD), manufacturing with machine tools (OPERATE), and the optimization of machines and production (OPTIMIZE). However, digital concepts alone are not enough. A good machine tool requires the correct automation technology. With Sinumerik, Siemens offers the ideal platform for every imaginable machine tool solution. At the end of the day, what counts — including with digitalization — is the quality of the manufactured parts. And high-quality results are possible only with the right technological know-how. ■

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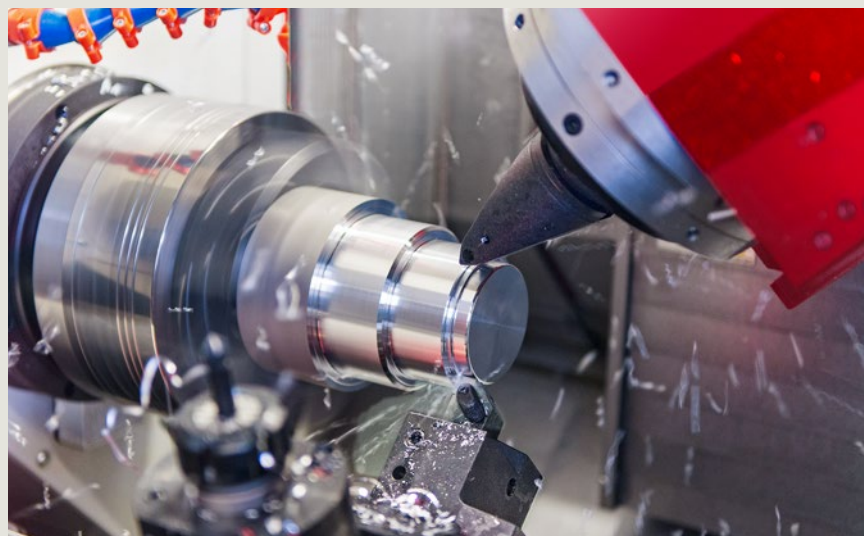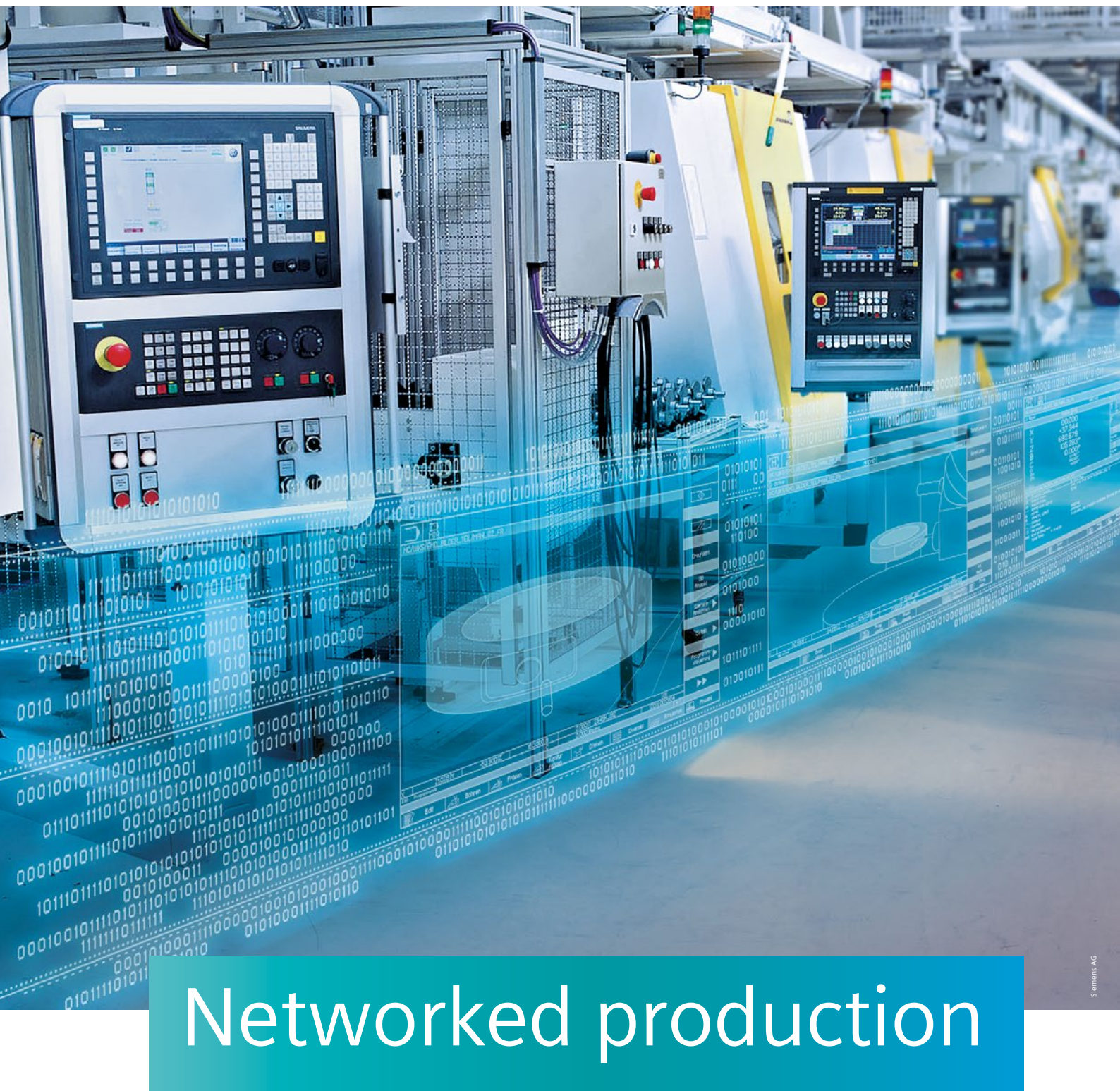
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Networked production

Digitalization: Siemens uses the close interaction of software and hardware to support both machine manufacturers and machine tool operators on their way to becoming a Digital Enterprise — providing a vital contribution to the advancement of machine tool digitalization.

A company's economic power, productivity and market success depend substantially on how intelligently and efficiently that company uses data produced in its operations — and what data are even available. The fourth industrial revolution, Industrie 4.0, can be described as the consistent and automated use of all available facts, data and forecasts to control the operational processes necessary for engaging in the market in the best possible way. Key objectives include taking advantage of upcoming market and business opportunities as quickly as possible, enhancing flexibility and increasing quality.

The product and process optimization methods are software driven and are mostly also supported by simulations. The transfer of simulation results to the real world, in turn, has effects on the processes in the company, which brings about its maturing into a Digital Enterprise. The current industry megatrend is therefore called the "digitalization of industry"; the concept applies not only to series production but also to shopfloor-oriented production companies.

Crucially, it is not a revolution — it is an evolution. Only through an evolutionary process supported by experience can the opportunities provided by digitalization be developed further — while also using successive innovations to keep risks within controllable economic and technical limits. That is why successful digitalization in production uses proven technology that is designed to be forward-thinking and used innovatively.

As a leading automation partner for industry, Siemens began very early on to drive forward the digitalization of its products, systems and solutions. Now an integrated portfolio of industry software and automation technology is available for discrete manufacturing with machine tools; machine manufacturers and manufacturing companies can use that portfolio to reduce time spent developing and bringing products to market,

while simultaneously increasing the flexibility and efficiency of their production. The portfolio is based on technology from a single source — with transparent data flows through every level, consistent data handling throughout a product's lifecycle, functions that are perfectly coordinated and unified operating philosophies.

Digitalization from development to commissioning

A crucial question for machine manufacturers is how machines can be developed more efficiently so that companies may react quickly and flexibly to market and customer requirements. To that end, they increasingly seek to visualize and parallelize the development phases for new machines. This requires consis-

tent implementation of all digitalization options — from the first idea through to the production machine's commissioning. Thanks to the digitalization of the development process, the machine manufacturer has access to all required data in the form of a virtual machine model very early on. This provides a digital twin for the machine, which makes it feasible for customer requests and new options to be tested and optimized simply and directly. Using integrated software and hardware solutions with a common data foundation in NX Mechatronics Concept Designer, Siemens also helps machine manufacturers shorten the machine development process considerably. Thanks to virtual machine commissioning, the real-life commissioning process ❯

Digitalization in Machine Tool Manufacturing
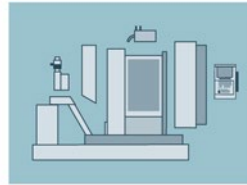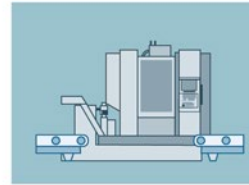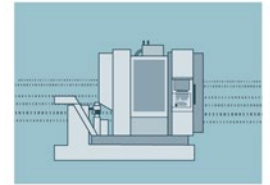
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can be made less capital intensive. The virtual machine model is also connected to Sinumerik, the actual control system. This allows one to test, and further optimize, the machine's functioning under near-real conditions. This procedure offers machine manufacturers maximum security, as companies can avoid potential damage to the real machine during commissioning and run-in.

Simple and efficient — from design to workpiece

Machine operators benefit considerably from having a virtual machine image in addition to the real machine. The virtual machine image offers a virtually identical work preparation area where all stages of production can be planned and optimized. For example, the machining strategy for a new workpiece can be inspected and run in using the virtual machine while the real machine is still producing other parts. This reduces set-up time and contributes to higher profitability for the business. Another advantage: machine operators can test their parts production programs early on under almost real conditions in a virtual environment. This shortens time-to-market and increases machine productivity.

Benefits at a glance

- Reduction in development time and time-to-market
- Higher productivity and efficiency of machine development
- Shorter machine set-up times
- Greater machine availability
- Increase in profitability of operation and machine
- Increase in flexibility and efficiency of production

"Smart operation" represents a pioneering package for job shops that wish to take the first step toward digitalization.

Optimized production planning

The virtualization process uses the original Sinumerik software, known as the Virtual NC Kernel (VNCK), which enables advance machining simulation under conditions almost identical to reality. This has advantages for machine operation: production planning and machine use can be optimized, while workpiece costs can be perfectly calculated over the computed primary processing time of the machine. Siemens thereby provides a solution that can considerably increase machine availability and raise profitability: the CAD/CAM-CNC sequence for production planning, including control system–specific, high-precision simulation. Processes from product development through to production can be designed efficiently and faultlessly. NC programs created in this way can be transferred directly to the machine and executed.

Networked production — also suitable for job shops

Sinumerik Integrate provides the industry with a comprehensive range of solutions for networking machines and connecting them to higher-level IT systems. This horizontal and vertical integration is combined with innovative solutions for cutting, connecting robots directly to the CNC and additive manufacturing.

Networked machines, innovative operating concepts with multi-touch displays, and production monitoring with mobile devices allow shop-floor-oriented businesses to optimize their production workflows, too. "Smart operation," which consists of applications for computer-based

production planning and promotes paperless manufacturing, represents a pioneering package for job shops that wish to take the first step toward digitalization. Operators use the machine to view directly many graphic formats, as well as PDF and DXF files. All the data required for production — including parts programs — can be accessed and executed by Sinumerik CNCs on the company network. Flexible machine and staff deployment enables monitoring of the current machine status using a smartphone or tablet via a protected web server.

The challenge of the Digital Enterprise

In the end, productivity and quality of parts produced are what count, and the field of digitalization is no exception. The contribution that the integrated portfolio of Siemens industrial software and automation solutions makes to the entire value added is as important as Siemens' expertise in the various technologies. Multi-tasking technologies such as mill-turning, turn-milling, or the combination of milling or turning with grinding technologies are a particularly good example of this. With this clear focus, digitalization in machine tool manufacturing from Siemens offers the complete solution for the manufacture of and production with machine tools: digitalization — automation — technology. ∎

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Bright prospects

Tool and mold making: In the milling of complex free-form surfaces, calculation tolerances in the CAD/CAM program can lead to irregularities in the surface. In such cases, Top Surface ensures that surfaces are as smooth as glass.

Wherever tools with complex geometries are produced — whether for mold and die parts, large parts for aerospace and power generation, or mass-produced parts — CAD/CAM programs must handle an extensive volume of data. Because many of these parts are highly intricate and are required to withstand enormous stress, the surface precision is held to an extremely high standard — a particular challenge for any CNC system.

Lower surface quality due to tolerances

The volume of data to be calculated is often very large, and calculation tolerances in the CAD/CAM system can therefore lead to variations in the generated milling path. These irregularities in the milling paths are then directly machined using the CNC and cause small reductions in speed and marks on the surface during the milling process. This means not only poorer surface quality but also lower machine productivity. In addition, the "jerking" movement increases mechanical wear on the machine.

Optimized CAD/CAM data for uniform surfaces ...

With Top Surface, the CNC is now able to eliminate the irregularities from the CAD/CAM data during machining for the first time. The innovative COMPSURF compressor optimizes the data from the CAD/CAM system for the subsequent Sinumerik path control, which results in a higher tolerance for inexact data. This ensures optimum surface quality. In addition, the smoothing of the milling paths is identical regardless of direction, which ensures greater uniformity across neighboring surface zones. Because the machine runs more smoothly when the Top Surface option is activated, less stress is placed on the machine's mechanics, wear is reduced and the milling machine's availability is increased.

... or structures

When the parts program is performing optimally, the user can use the high-speed setting cycle, Cycle832, to choose whether structures with the finest possible micrometer quality should also be machined, for example, engravings. For this, the user simply turns off the "smoothing" function. This option allows the user to choose when high surface quality is required and when the highest possible accuracy is also needed.

Simple operation

Top Surface is extremely easy to operate because — as always with Sinumerik Operate — all settings can be edited using graphical operating screens. For most NC programs, the standard settings are enough to achieve optimum surface quality. ∎

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Top Surface can be used primarily for complex parts such as turbines

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A path to success

Tool and mold making: The proud and once booming trade of toolmaking has struggled to find its place in a new century. Here's how one mold and die shop is using machine tool technology to invest in the future of its employees and grow its business.

The strategy for growth at True Die Inc., based in Zeeland, Michigan, may reflect the future of the mold and die trade itself. Tim Rietsma and his brother Mike started their mold and die shop in 2000 with a desire to continue their profession's proud heritage of skilled toolmaking. But evolving machine tool technology brought new ways of doing things, and soon the brothers faced an unexpected challenge to both their business and their ideals. The toolmaking profession had changed. Expert toolmakers were becoming scarce. While the trade had always been based on the development of skilled and well-rounded toolmakers, tech schools were beginning to turn out candidates for jobs in basic machine operation.

The owners recently changed the original name of the company, Contour Tool & Engineering, to True Die and accompanied this move with a new ownership investment, the addition of new round product tooling capabilities, and a renewed commitment to the toolmaking trade with the aim of fully leveraging the company's heritage. For True Die's leadership team, two alternatives emerged: invest in newer basic machines that give a machine operator the ability to cut a part, or invest in more capable machine/control packages that enable employees to build their skills, their careers, and the company.

Investing in the future

The leaders chose the latter direction, and with this commitment in mind, in 2014 the company bought its first Romi machine. The Romi D1000AP vertical machining center featured the Sinumerik 828D CNC and drives package. "We initially wanted higher speed and accuracy," Tim Rietsma recalls. "With the molds, you cut both halves of the tool; then the two halves need to fit tight to each other within 1/1,000 of an inch. If your machine can't do this, you need to spend a lot of time with a hand grinder on a bench." Doing away with bench grinding proved to be one of the immediate paybacks of the Romi/Siemens investment. The new technology eliminated any grinding-related variances in precision and surface quality, and the increased throughput capacity boosted the profitability of the business.

The Romi D1000AP vertical machining center also features integrated cooling during high-speed drilling. The coolant flows through the drill bit to flush the metal chips out and away from the flutes. Carbide drill bits last much longer, and drilling cycles have been reduced from five minutes to 30 seconds. Now the shop can drill a hole in one pass, rather than repeating up-and-down passes to clear metal chips from the hole and bit. This feature alone gives True Die the flexibility to increase the company's margins and to strategically price jobs to win new business.

Long-term benefits

The mold and die professionals at True Die are continuing to discover useful new features of the Sinumerik 828D CNC that drives their new Romi machining center. An important discovery was the ability to program the machine to minimize the time it takes to cut a part. A feature called Advanced Surface intelligent path control enables the shop to optimize mold-cutting velocity, accuracy and surface quality for the most efficient machining motion. "It's a feature that goes beyond any control I've ever seen," Rietsma says. "We can get the surface finish that the mold requires and the maximum speed of the machine all at the same time."

Just about every brand of CNC on the market claims to be easy to use, but seeing is believing. Rietsma confirms, "Siemens has definitely outdone its competitors. The CNC has full graphical support." That said, investing in an easier-to-use Siemens control that drives an advanced Romi machine was not the endgame for True Die. The greater goals were to broaden the capabilities of the shop's employees, to strengthen the business and to contribute to a toolmaking profession that was built on knowledge and skill development. The Romi/Siemens investment is

Siemens Industry, Inc.

> *»We purchased two more Romi machines — a C420 lathe that will be used strictly for the hard turning process, that can hold comparable surface finishes and tolerances to grinding, but more efficiently; as well as a smaller, D600 machine — both with the Sinumerik 828D CNC.«*

Brian Brown, owner and president, True Die Inc.

enabling the shop's employees to build their knowledge and skills. "We're still learning on the machine, learning every week. The sky's the limit with Sinumerik 828D," says Rietsma.

Looking ahead
Brian Brown, owner and president of True Die, is passionate about protecting and growing the trade through the adoption of more enabling technology and more robust education. "Our business is strengthened by companies like Siemens and Romi that understand the challenges of our industry," Brown points out. "In fact, to further enhance our market position and product offering, we purchased two more Romi machines — a C420 lathe that will be used strictly for the hard turning process, that can hold

comparable surface finishes and tolerances to grinding, but more efficiently; as well as a smaller, D600 machine — both with the Sinumerik 828D CNC."

The toolmaker's trade may have changed, but for True Die, the way forward includes investing in more open-ended technology that will build knowledge and skills, encourage inventive thinking and reward career-minded workers who bring new ideas to the shopfloor. ■

Watch the video: http://ow.ly/XPkhp

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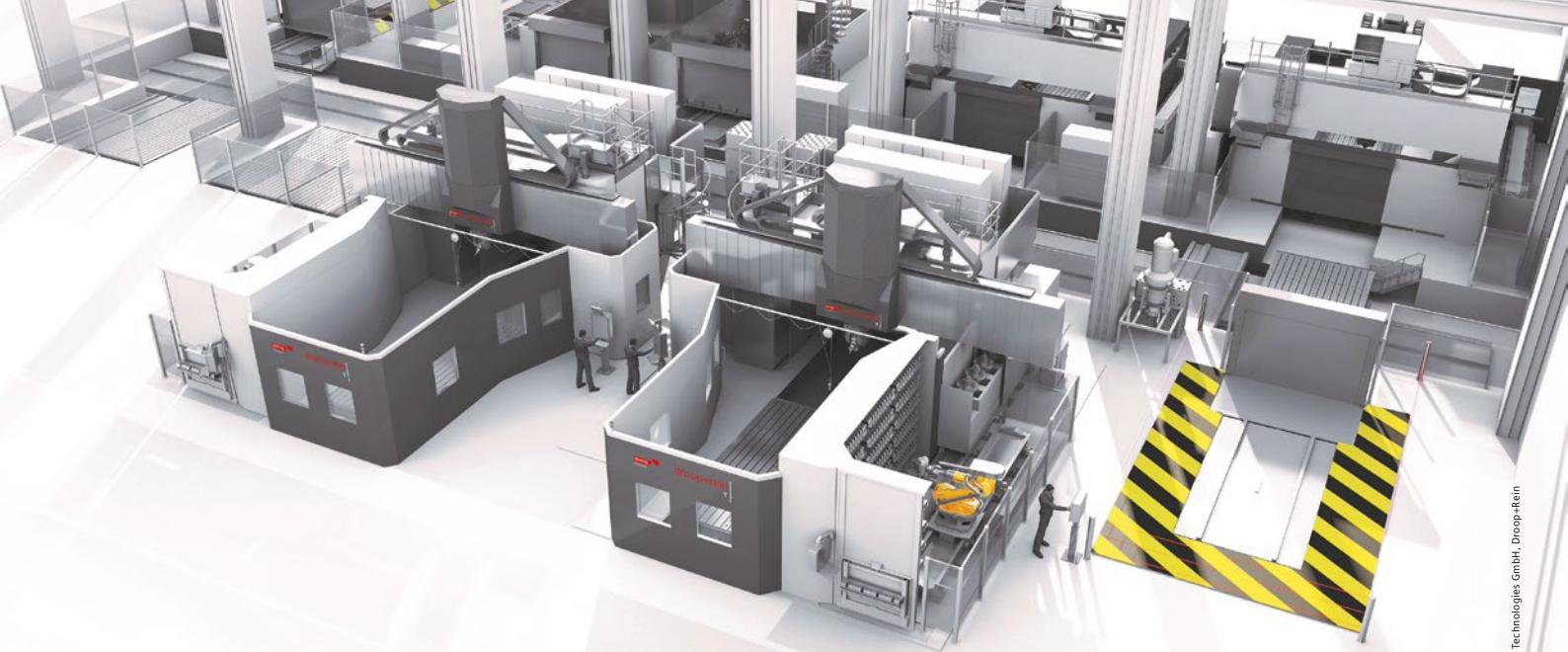
Model for innovation

Industry: Daimler AG has set up a new tool construction plant as part of the new TecFabrik Competence Center for innovative product technology from Mercedes-Benz. Experienced project partners Siemens and Droop+Rein were entrusted with providing the technical equipment and engineering.

To establish the new construction plant, Daimler AG expanded its high-tech location on Tübinger Allee in Sindelfingen, Germany. The result is "Manufacturing Cell 3" — a tryout center where sheet metal–forming tools to make the outer shells of cars can be both produced and tested. In addition to some fundamental require-ments — highest possible accuracy, secure processes, environmental protection and energy efficiency — Daimler set for itself a further deman-ding goal: the creation of exemplary technologies and concepts, whereby equipment construction takes on a key role by consolidating tool construction and plant engineering expertise.

The company Dörries Scharmann Technologie GmbH, which manu-factures large bespoke tool construc-tion machines with exchangeable milling heads under the name Droop+ Rein, was tasked with providing the plant equipment. Project planners decided to equip the machines with

Sinumerik 840D sl in order to com-pletely simulate the machining pro-cesses; these CNCs can be seamlessly integrated into the planned Siemens NX process chain, thereby contributing to process security.

Machining in a single clamping
The new plant consists of two portal machining centers and two multi-functional high-speed machining centers in gantry design. Comple-mented with, among other things, a pallet transport system for a work-piece weight of up to 40 tons and robot workstations, these interlinked large machines can machine the sheet metal–forming tools completely in a single clamping. The machining process for the cast blank parts begins at the portal machining center. Preci-sion machining and finishing at the tools' absorption areas, which make direct contact with the sheets of metal during pressing, takes place on the high gantry machines. Each of those machines is equipped with four auto-

matically replaceable milling heads, of which one is a fork head for different motor mill spindles. The process and technology are designed to ensure that the parts can move on to the next step in the tryout press with as little reworking as possible — or even no reworking at all. "We were able to achieve this while also reducing the machining time for the defined accep-tance part from 36 to 25 minutes," reports Ulrich Wiehagen, head of sales and plant manager at Droop+Rein. He explained further, "Sinumerik's surface features make an important contribu-tion to this."

Optimum machining results, simple handling
The machines in Manufacturing Cell 3 are equipped with the latest milling technology package — Sinumerik MDynamics; the package allows for improved path guidance, which ensures more surface accuracy and higher speed. The latest motion control highlights, such as mecha-

tronic engineered motion control (EMC), ensure improved surfaces and increased productivity. Sinumerik 840D sl also comes equipped with automatic kinematic measurement, which quickly and easily provides the necessary process security for particularly tricky or high-precision machining. With the help of the L9960 measuring cycle and CC_E996 downstream volumetric compensation, machine kinematics can be monitored at any time. This allows the machine operator to calibrate a milling head reproducibly with the standard touch probe and a high-precision ceramic calibration sphere.

The following will come as a relief for the machine operator: he or she can influence the tool orientation of the miller and its head during automatic processes and control it in jog mode. If the milling head is moved manually in the direction of the tool, distribution to the geometrical axes occurs — according to the orientation. Handling in the direction of tool orientation is also necessary during the automatic process. In the event that automatic

mode is interrupted and changed to manual operation, the milling head can simply be moved away from the contour in the tool direction and later returned to the starting position again — which may have been corrected (REPOS).

Well conceived from energy efficiency to servicing

Daimler set an ambitious goal for the project of reducing energy consumption by 40%, and the new plant meets that goal thanks to the project partners' collaboration. From LED lighting on the machines, to equipping the machines with high-efficiency, energy efficiency class IE3 asynchronous motors from Siemens, to reactive power compensation — everything was thought of. Additionally, Droop+Rein implemented a modern servicing-and-maintenance concept in the form of Analyze MyCondition condition monitoring from the Sinumerik Integrate software suite. This software solution monitors the status and quality of the machine tools, supports seamless machine operation and

keeps unplanned outages to a minimum — another important piece of the plant process reliability puzzle.

Successful collaboration

A month after Manufacturing Cell 3 began operation in July 2015, the plant was running three shifts. All those involved are proud of the result; they saw collaboration during the project as an uncomplicated and unbureaucratic exchange between partners. The proof of the endeavor's success can be seen in the Technology Factory on Tübinger Allee: a tool construction plant of model character. ∎

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Automatic kinematic measurement means operators may inspect machine kinematics at any time
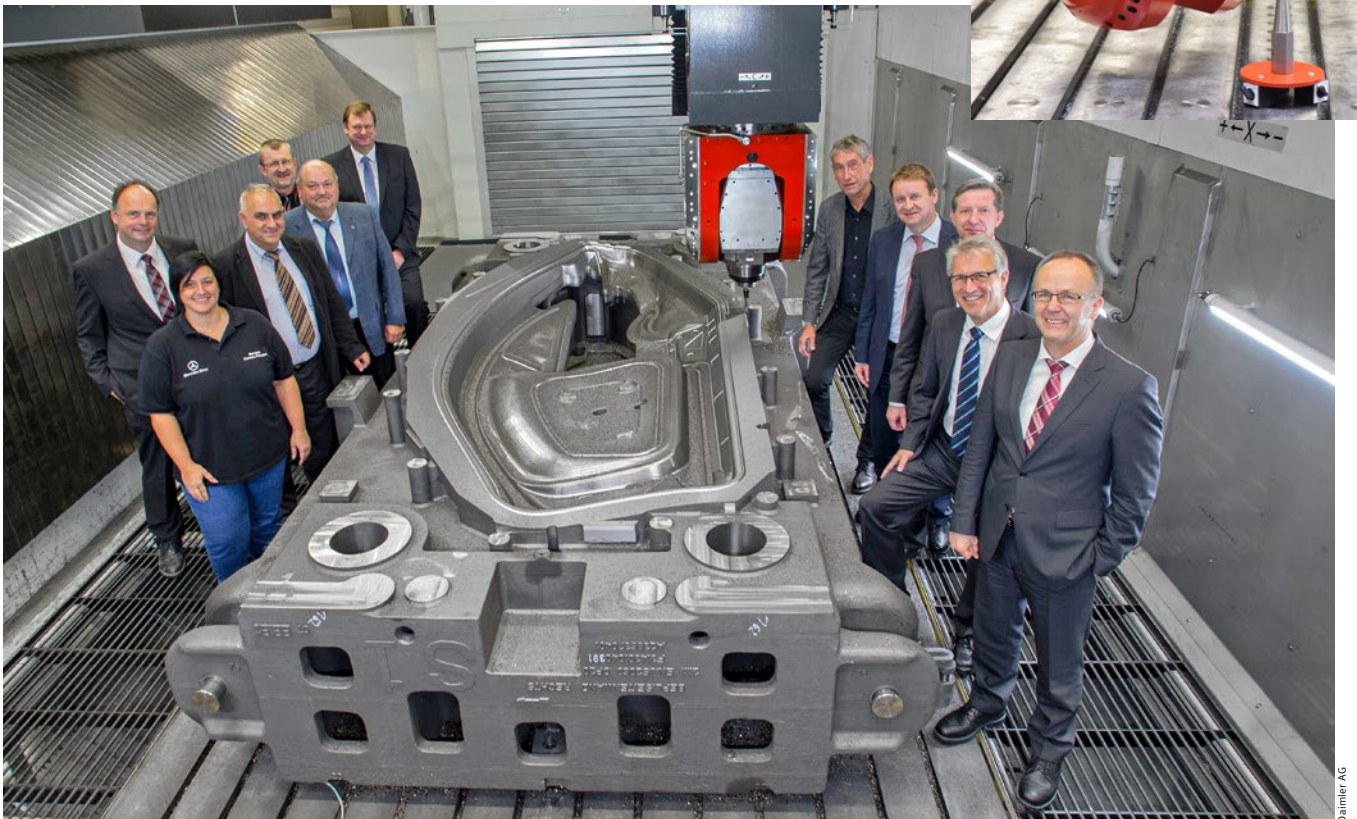
View of a manufacturing cell with sheet metal–forming tool

Series production for CFRP cars

Industry: The machine manufacturer Eima, in close cooperation with BMW, has developed the first machine capable of processing carbon fiber–reinforced polymers in high volumes — with an optimized machine and control system design.

Stable and economical series production of carbon fiber–reinforced polymer (CFRP) parts requires machines that are designed for this material, in terms of both the mechanics and the control system. BMW is already well acquainted with the material thanks to its experience with the i3 and i8 CFRP cars and was able to support the German machine manufacturer Eima in the construction of the Beta S machining center. Currently, 11 of these machines are being used to process parts for the BMW 7 and i8 in the BMW factories in Landshut and Dingolfing.

The challenge of a sophisticated material

CFRPs are attractive for many applications because of their special characteristics. The problem: CFRPs are significantly harder than equivalent-strength aluminum. Therefore, milling cutters and drills wear out comparatively quickly during machining, and the sealing strips of conventional vacuum mounts for the workpiece are incapable of delivering service life suitable for series production. Cost-sensitive high-volume processing of CFRP parts therefore requires machines whose basic design already takes the material's special characteristics into consideration.

Joint pretrials with machine operators at BMW showed that a significant proportion of the wear on the milling cutter was not due to the machining itself but was instead linked to the tool's creating splinters and "grinding" them. The project team therefore decided that workpieces would be positioned vertically in Eima's Beta S so that splinters would immediately fall away from the machining area. Additionally, there is a strong link between the vibration resistance and tool requirements for CFRP machining. The Beta S was therefore designed as a rigid traveling-column machine with short compensation paths. To ensure tool efficiency, the machine was also equipped with a very high-performance spindle and HSK-63 toolholders, which at first glance appear oversized. Both of these measures contribute to rigidity and low vibration, thereby reducing tool wear.

Complete tool utilization

To ensure optimum cutting tool utilization, the control system monitors the tools' load. For this, Eima uses Sinumerik 840D sl, which makes it possible to expand cycles and system programs using manufacturer-specific functions, such as synchronous actions. During the clean-edge machining of flat parts, which requires only part of the milling cutter, a manufacturer-specific control system cycle expansion causes the cutter to be axially offset, meaning that the full length of the blade is used and wear is distributed evenly. In this scenario, the CNC logs the area that is actually milled with the help of Sinumerik synchronous actions. Using the total dis-

The BMW i8 is a model for the use of CFRP in bodywork

BMW AG
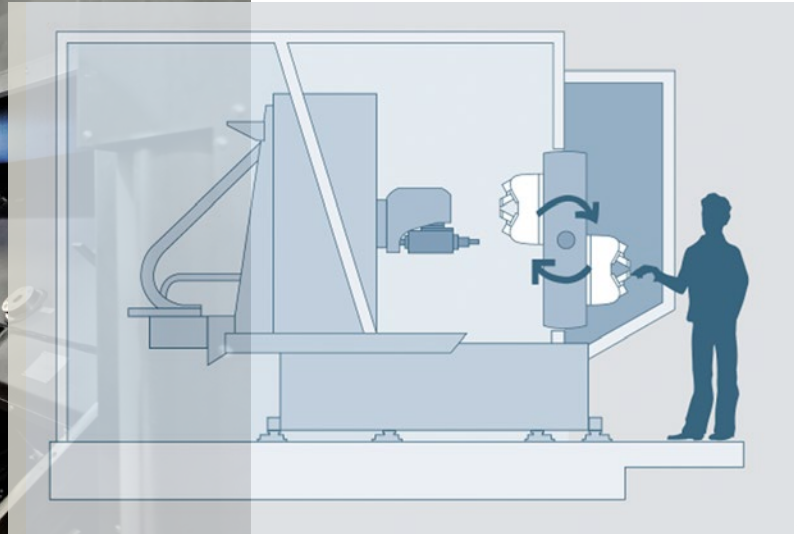
The Beta S with optimized suction: all material remnants fall directly onto the splinter conveyor

EiMa Maschinenbau GmbH

Siemens AG/W. Marschner

tances traveled as well as the cutting performance, the CNC is now able to reliably calculate the wear on each tool and its remaining service life. If a tool's remaining service life is insufficient for the next machining process, it is automatically replaced with a spare tool. Thanks to this function, tools can be utilized optimally, while

process reliability is also improved through the elimination of waste caused by tools that are substituted too late.

Optimized machine design
For the Beta S, Eima developed an innovative workpiece mounting design that combines the process-related advantages of vacuum mounts with those of mechanical clamps and that is perfectly suited for high-volume CFRP series machining. Several robust circular suction cups are combined with Sinumerik-controlled swiveling workpiece clamps. If one of the tension clamps interrupts the current machining task, the CNC quickly removes the clamp blocking the milling path until the risk of collision has passed. Additionally, the clamp system is monitored fully electronically and also visualized on the Sinumerik HMI Pro operator interface.

To maximize machine-use efficiency, the Beta S also has a horizontal swivel table that can hold several workpieces to be machined in parallel, as well as a tool magazine, also rotatable, that

makes it possible to load and unload tool pieces and retool fixtures for a new batch or component while the machine is in operation.

Thanks to an aerodynamically optimized and energy-efficient exhaust system, workpieces come from the machine to the Beta S precleaned and almost dust-free — something that is very important for explosion protection. Heavier splinters and larger debris from machining fall directly onto the splinter conveyor, while dust is sucked upward in a flow-optimized manner.

Successful collaboration
With the Beta S, Eima has established itself as an expert partner for CFRP machining — from single-item machining to large-scale series production. The combination of a successful machine design, the structure's high rigidity and the control system–related measures for tool utilization enables cost-effective and stable large-scale CFRP series machining. ∎

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Technology at a glance
- Sinumerik 840D sl with NCU 720.3PN and PCU 50.5-P
- Sinumerik Operate with automotive-specific HMI Pro
- Sinumerik TP 015A operator panel front
- Sentron PAC4200
- Synchronous action to detect tool wear
- Complete process control and monitoring
- Profibus and Profinet validation on all machines

Reaching new heights

Industry: Using advanced Sinumerik CNCs from Siemens and robotic handling technology, MJC Engineering devised a unique solution to an engineering challenge brought to the company by GKN.

Spin forming, like no other metal-forming process, has the ability to form very large and thick plates quickly and accurately. When commissioned to build a series of metal-spinning machines for use at GKN's plants in Camarillo, California, and Orangeburg, South Carolina, MJC Engineering, a custom machine tool builder in Huntington Beach, California, set about developing a solution that would spin form production-run components out-of-round by 8½ to 9 inches in various aluminum alloy blanks measuring up to 270 inches in diameter and 5/8 inch in thickness, while holding tight tolerances. These

were verified by thermal imaging cameras and fed back by the CNC for accuracy tracking. It was also important to integrate the heating torch for in-process adjustments.

Combining old and new technologies
GKN was confident that MJC Engineering, a specialist in metal-spinning machines for applications such as sheet spinning, flow forming, wheel spinning and rotary forging, was the right partner for the task. Carl Lorentzen, MJC Engineering president, and his team combine the same traditional metal-forming process with modern CNCs

MJC Engineering uses Sinumerik
to produce laminar-flow lip skins
for state-of-the-art aircrafts

and robotics to create the state-of-the-art manufacturing process used to produce laminar-flow lip skins for the engine housings on latest-generation passenger aircrafts. The lip skin is the highly engineered aerodynamic structure that makes up the leading edge of jet engine nacelles.

Adapting to the challenges

Though highly efficient in operation, the lip skin CNC metal-spinning machines built by MJC Engineering and currently located at GKN in California and South Carolina are reliant on the precise and consistent application of heat throughout the metal-forming cycle. Even the slightest variation in heating would contribute to undesirable results in the formed part.

Until recently, manufacture of these lip skin components relied upon human intervention to control the direct application of heat throughout the spin-forming cycle. While this method could certainly produce a functional part, the associated variations in part consistency created downstream difficulties and challenges in subsequent fabrication and assembly operations. In the past, lip skins were produced by other methods, including draw forming, bulge forming and drop hammering. The spin-forming and machining techniques now used at GKN have been found to reduce overall manufacturing time and tooling costs while improving part consistency.

In an effort to reduce variation in the CNC spin-forming process to support high-rate programs such as those for latest-generation aircrafts, GKN Camarillo joined forces with MJC Engineering in Huntington Beach to create an automated CNC solution. That solution is now a reality and consists of robots that apply heat in a precise and absolutely consistent manner, tied directly to a program that shapes the part. This careful interplay between the heating and spin-forming operations is made possible by the Sinumerik 840D sl CNC, which integrates and monitors every movement between the spinning machine controller and the heating robot controller, resulting in a smooth-flowing production scenario with perfect timing and high marks for efficiency, according to James O'Sullivan, GKN general manager.

In operation, the machine takes the overhead crane-loaded 270-inch-diameter blank, fixes it to the mandrel with the tailstock of the machine, rotates it on a 150-hp motor-driven spindle and then progressively applies heat via the gas torch on the robot arm. Thermal imaging cameras closely monitor the heat readings over the entire surface to create multiple control zones. When inconsistencies are detected, the heat is appropriately adjusted in real time by the controllers. The heated material is then formed over the mandrel into the desired size, with out-of-round conditions ranging from 8½ to 9 inches, typically. Onboard

Simatic S7 PLC technology controls the various mechanisms, while the CNC integrates and feeds back all data to the PLC.

Continuous innovation

Solid Edge by Siemens is the CAD program MJC Engineering uses for the design of the lip skin machine, while Siemens NX CAM translates the design data into machine execution steps. Each MJC machine involved in this project also incorporates Sinamics drives and Simotics motors. As electrical engineer Don Hebert explains, "There are seven axes of motion controlled by the CNC. We created custom screens for teach-in and playback on the machine to facilitate faster commissioning and troubleshooting on-site for the GKN operators."

And the technology is advancing quickly. Per Carlson, MJC Engineering vice president and general manager, adds, "From the time we built the first machine for Camarillo to the latest machine in Orangeburg, we have transitioned to newer technology; that's how fast things are moving." ∎

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MJC Engineering machine to form 270-inch-diameter aluminum sheets into lip skins for the nacelle of engines

Layer by layer to the workpiece

Software: Thanks to the comprehensive Siemens PLM NX software, the potential of additive manufacturing can be fully exploited. Siemens uses a software platform to facilitate the design, simulate technology and define an optimum construction strategy — three features that help enhance the properties of a workpiece in additive manufacturing. As a result, the production of goods becomes much more flexible, enabling the development of new products and the optimization of business models.

Today, there are several different types of procedures for different applications that fall under the term "additive manufacturing (AM)." All these procedures have one thing in common: the workpieces are created layer by layer. Examples of this method are powder bed fusion, directed energy deposition and material extrusion. Additive manufacturing allows for workpiece geometries that conventional manufacturing methods cannot handle. With additive manufacturing, highly complex structures can be created from high-quality materials in a single process, while guaranteeing light weight and at the same time a high level of stability. Examples of this are spiral shell shapes and turbine blades with irregular cavities.

The material quality and stability, the low weight of the products and the completely new design possibilities (freedom of design) make this process especially interesting for lightweight construction and bionic structures — for example, in the aerospace and automotive industries but also in medical technology.

Competitive advantage thanks to additive manufacturing

Additive manufacturing creates innovative new products that can provide companies with significant competitive advantages. Already in the development process, all the steps can be checked immediately with rapid prototyping, making it possible to quickly and easily adapt the product to customer-specific requirements or technological challenges. In the production stage, no complex equipment or special tools are required — which is a great advantage for single-piece or small-batch production in particular. Because highly complex structures can be completed in a single step with this new method, no subsequent assembly steps are necessary. And spare parts handling becomes much more efficient in many cases, as it can be done in-house (spare parts on demand).

An integrated CAD/CAM-CNC chain

Siemens has played an active role in the development and use of additive manufacturing for several years and is the only company to offer an integrated software and automation solution for additive manufacturing. This makes it possible to implement AM-specific product designs and simulations extremely efficiently and accurately using the NX PLM software. Numerous functions enable the optimization of components and processes prior to the production of parts. All the stages involved in machining can be

generated parallel to the additive development process. Integrating data storage in one platform, Teamcenter, ensures data consistency. This becomes particularly apparent if changes are made based on a parts simulation, for example. Such changes no longer require time-consuming conversion and implementation, as is often the case with traditional production methods. Data loss during data conversions is also a thing of the past.

For machine and downstream process automation, Siemens offers the scalable and integrated portfolio of the Sinumerik and Simatic automation systems. Detailed order planning and

DMG Mori

With additive manufacturing, rocket nozzles measuring 700 mm in length can be produced on the LASERTEC 4300 *3D* from DMG MORI

control, allocation of the required parameters and traceability across the entire process chain are provided using software modules from the MOM (Manufacturing Operations Management) portfolio. As an extension of a manufacturing execution system (MES), MOM makes it possible to determine many kinds of production sequences for the entire system. MOM systems are the core element that connects PLM and automation in real time. ■

Additive manufacturing in practice

The LASERTEC 4300 *3D* from the leading machine tool manufacturer DMG MORI, a hybrid milling machine based on a lathe, can handle workpieces with diameters of up to 600 mm x 1,100 mm. The maximum power of the 3-kW diode laser, which is protected from coolants and flying splinters, is 10 kW. The LASERTEC 4300 *3D* can be used for finished products and prototypes, repairs, and coatings. For example, the additive manufacturing of a rocket nozzle (see image above) measuring 700 mm in length takes approximately 10 hours.

Thanks to additive manufacturing, engineering data can be generated on the fly. To achieve this, the correct programming and CNC are required. Together with Siemens, DMG MORI has developed a specialized CAM module to enable even inexperienced operators to control the programming: NX Hybrid Additive Manufacturing. The add-ons for additive manufacturing ensure the module is just as user-friendly as conventional CAM milling systems.

As a CNC, the Sinumerik 840D sl can also be used; this ensures that the same control system can perform both milling and additive manufacturing.

DMG Mori

"King of baskets"

Software: Marlin Steel exemplifies the future of the US machine tool industry. Facing global competition and decline, the company set out on a new course — one that has resulted in 700% sales growth and a strong position in America's fourth industrial revolution.

Marlin Steel is a machine shop dedicated to workplace automation and investment in employee education. The shop has been featured in American business media such as Bloomberg Business, CNN, CNBC, FOX, the Wall Street Journal and the New York Times, among others. But this was not always the case.

Marlin Steel was once known as the "king of bagel baskets." Founded in 1968, the Brooklyn, New York, steel wire manufacturer established a niche by hand welding its manufactured wire to form baskets for the bagel market. The company went on to become the dominant supplier of wire baskets to bagel bakeries everywhere. So when Drew Greenblatt bought the company in 1998 and moved it to Baltimore, Maryland, the plan was to upgrade operations and bring a thriving business into a new century. After 30 years of bagel basket market domination, what could go wrong?

What went wrong was that soon after purchasing the company, Greenblatt discovered that the bagel basket market was shifting in favor of foreign-manufactured wire baskets. The newly acquired company was in jeopardy because competitive basket prices were falling below what Marlin Steel paid for the steel alone.

Breaking away from the past
Around this same time, Greenblatt received an important phone call, which presented an intriguing and fortuitous question: Could the bagel basket shop custom engineer and

»*As a machine tool manufacturer, you have a choice: invest in modern technology based on Sinumerik and achieve success or go under.*«

Drew Greenblatt
Owner of Marlin Steel

manufacture a special basket for one of the world's largest airline manufacturers?

Greenblatt says the opportunity to work with a highly-renowned company made him realize the critical relationship between quality, engineering and speed: "Quality Engineered Quick became our mantra and our future," he recalls. "We were moving into the Siemens world, where you measure performance in increments of plus or minus 0.01 mm. Until then, we had done business in a world measured by plus or minus a bagel, and so long as the bagel stayed in the basket, the customer was very pleased."

Quality Engineered Quick meant breaking away from the past and from the hundreds of wire basket manufac-

turers using alternating current (AC) welding to produce wire-formed baskets. Dating from the early 20th century, the AC welding process involves the manual clamping of copper electrodes to weld the intersecting wires. Each weld leaves a deposit of scars, divots and pockmarks. This requires labor-intensive cleanup to produce a basket that is safe and hygienic for food, medical, pharmaceutical and other customer applications.

A greater return
Greenblatt says his company's ascent with the airline manufacturer compelled him to invest in truly advanced, CNC-driven welding technology. The opportunity was not to just cut costs and try to compete with Chinese wages. Greenblatt was determined to leap ahead of competitors by investing in CNC technology that would bring the highest possible return at every level — machines, operations and people.

At the machine level, an incremental first step was to produce faster welds. But another need was to eliminate the post-weld cleanup process. "Our biggest technology investment was a Siemens CNC-driven medium-frequency welder," Greenblatt says, "It's a Versaweld CSR102 jig welding system built by Ideal Welding Systems. And it's powered by a Sinumerik 840D sl control package."

A key advantage of the machine is the vertical motion of the z-axis welding head, which enables the automated welding of basket wires. In the time it

1 Programming at the Sinumerik CNC keeps the company's engineers free to focus on new products and customer development

2/3 Due to Sinumerik 840D sl, the Versaweld machine produces welds 30 times faster than other automated welders
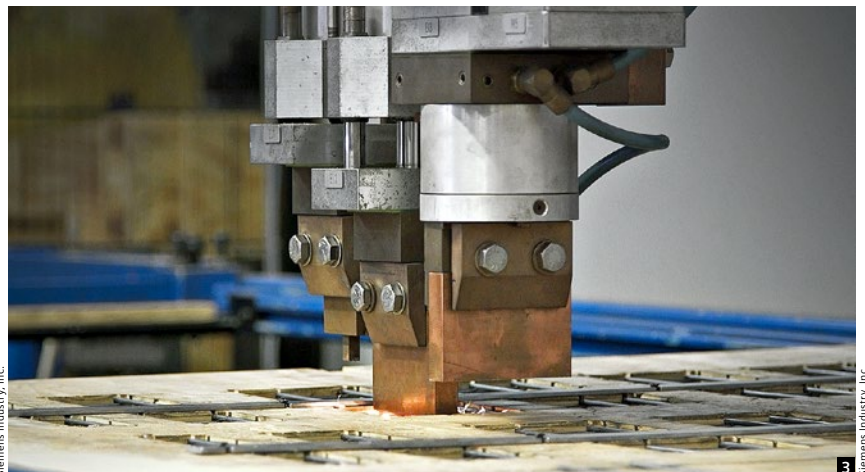
takes to complete two welds using conventional AC welding, the Sinumerik-driven Versaweld CSR102 can finish 60 welds. Each weld is completed in 2/1,000 of a second, 30 times the speed of other automated welders on the market. So heat saturation is diminished, minimizing deformities as a result of the weld and producing a basket without the cleanup time and labor costs.

New digital technologies

At the operational level, the investment in advanced CNC technology is helping Marlin Steel integrate a new generation of digital technologies, ranging from robotics to additive manufacturing. Operational schemes have been reconfigured for increased productivity; deburring has been eliminated by the Siemens-driven medium-frequency welding operations; and

the system does not miss weld intersections, thus eliminating a rework step that was part of past operations.

At the employee level, the removal of the costly cleanup phase has enabled the company to win new customers, increase revenue and redirect resources to support an entirely new business model: one centered on a more skilled and empowered workforce. "Today, 20% of our employees are degreed mechanical engineers," Greenblatt says. "We are now shipping custom-engineered and -manufactured wire baskets to 39 countries — regions where we now have the competitive advantage."

Anything is possible

The Sinumerik CNC platform has brought Marlin Steel a return that is game changing, but Greenblatt

knows the game goes on. His company has only just begun its move into the era of Industrie 4.0. He has become an often-quoted believer in the return of American manufacturing by way of investments in leap-ahead technology that will lift up a new generation of skilled workers.

"We are in a very dynamic, global marketplace," Greenblatt says. "Quality Engineered Quick means we have to be even more focused on engineering, more focused on shipping faster, and that means staying focused on having the best CNC technology." ■

Watch the video:
http://ow.ly/E8iA303oAfl

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MULTIVAC Sepp Haggenmüller SE & Co. KG

Intelligent packaging

Software: The more complex the production process, the more important it is to find a solution that can consistently simulate the entire process. Multivac, a packaging solutions manufacturer, shows how cross-site process integration can be achieved.

The Multivac Group, headquartered in Wolfertschwenden, Bavaria, specializes in the development and production of industrial packaging solutions. These systems are usually designed and manufactured individually in close cooperation with customers from the food and consumer goods industries or from the field of medical technology. Highly specialized individual modules ensure that every packaging problem receives a custom solution.

Since 2010, Multivac has introduced a standardized system landscape at its four largest production sites — in Germany, Austria, Spain and the United States — using a multi-step integration process. In addition to complete intersite data storage in the production area, the standardization also includes programming and simulation. Data and resource management is carried out using the

Teamcenter PLM (product lifecycle management) system, and the turning and milling machines are programmed using NX CAM. This creates a consistent production and work environment that provides the machine manufacturer the flexibility it needs to master complex production tasks.

Consistency for complex production tasks

The Multivac programmers use the many user-friendly standard functions in NX CAM, but they have also developed their own standardized templates for frequently used program functions. This enables the high program capacity that is necessary for providing the almost 100 machine tools and machining centers, some of which are automatic, with the required number of programs. All data are stored centrally using Teamcenter. In this management environment, the NC program lifecycle can be tracked and replicated at any time, and all relevant information about the individual tools can be accessed. This makes intersite collaboration within the company much easier, because both the NC programming and production resources can be implemented more flexibly. It is easier to shift the production of parts to be manufactured to a different machine or a different site. Michael Müller, who is responsible for NC programming at the Lechaschau site in Austria, explains the advantages of an integrated CAD/CAM-CNC process chain: "It is because we have access to the same, standardized database on all sites — including data from NX CAM

Multivac machines are custom built for applications in the food, consumer goods and medical technology industries

— that we have reached our goal of achieving the greatest possible consistency between the virtual and physical levels in production. Because we simulate the programs in NX CAM, quality is consistently high, so that now even turning programs can be run on the machine without prior simulation. At least for three-axis machining, the machining begins immediately after the clamping check."

Standardized CNC system

In the past, the packaging machine specialist used many different control systems on the machine tools and machining centers. This put the company at a real disadvantage, because the machine operators' and programmers' expertise was limited to certain systems and it was not always possible to shift the production of individual parts to other machines and sites. This is why, after the introduction of the standardized system landscape, the company wanted to switch to a uniform solution for the machine control system as well.

The perfectly coordinated process chain made up of NX CAM and Sinumerik CNC technology allows for maximum productivity in the manufacture of high-quality tools

Sinumerik and NX CAM

CAD software	CAM software	Post-processor	CNC system	Production
Design of the workpiece	Definition of production steps	Creation of the CNC program	Interpretation of the CNC program	Machining

Maximum productivity

Sinumerik

NX CAM

Siemens AG

The future control system also needed to provide as much flexibility for production as possible.

Sinumerik proved very successful in the existing production landscape and also in terms of all CNC-specific criteria that were directly dependent on the capacity or functions of the control system. Multivac decided to use only turning and milling machines with the latest generation of the Sinumerik 840D sl CNC and to purchase the user interface Sinumerik Operate.

Since then, the company has been benefiting from many Sinumerik-specific advantages, including the user-friendliness and simple language-switching feature. Müller reports: "The key combination Ctrl+L allows the user to switch easily from German to English or Spanish, which has made familiarization much easier for me and our American and Spanish colleagues." Because Teamcenter also supports multiple languages, the integration of new sites and day-to-day collaboration between teams spread across the globe is much easier.

A paper-free future

Production at Multivac is not yet completely paper-free, even though achieving this would be relatively easy with the current system landscape. "Many people just feel comfortable with a piece of paper in their hand at the machine," says Müller with a smile. "That's why we have yet to do away with our set-up sheets." Following the successful harmonization and integration of production, and the standardization of the control system technology, Multivac is now also planning to integrate toolmaking in order to optimize tool handling, inventory, turnaround times and delivery times. ◼
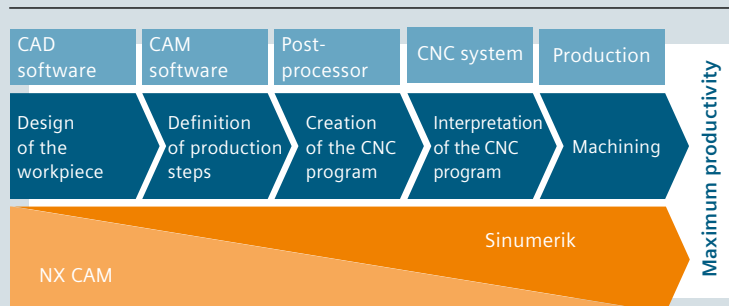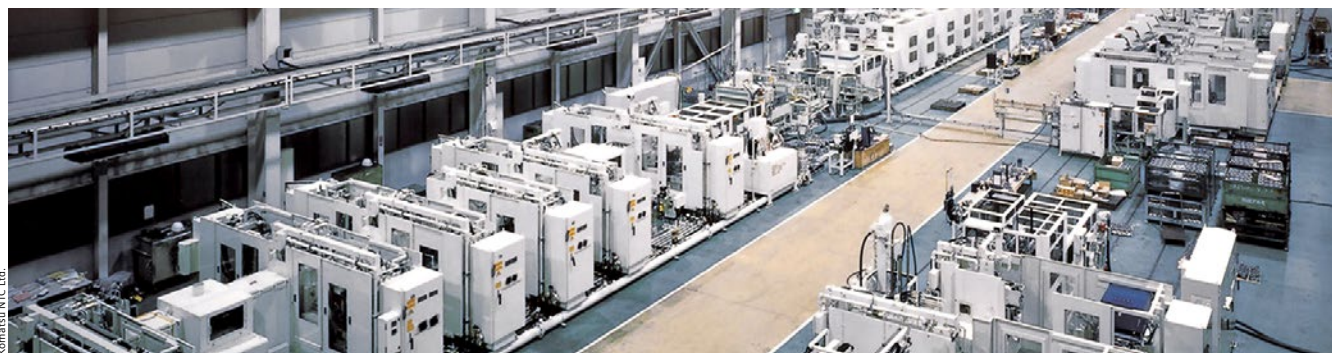
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In the plant at Komatsu NTC Ltd., production is well prepared for Industrie 4.0

Next-generation manufacturing

Software: To optimize the execution and testing of control programs, a Japanese machine tool manufacturer needed a solution that would merge the real and virtual environments and thus help the company move toward next-generation manufacturing.

Komatsu NTC Ltd. specializes in the design, manufacture and sale of transfer machines, dedicated machines, grinders, machining centers, crankshaft millers and wire saws. As a member of the Komatsu Group, the company develops world-class products with a focus on quality first and

the goal of continually improving customer satisfaction. Meeting evolving customer demands is therefore a key challenge for the company. Yoshiharu Oyabe, general manager of the Control Center R&D Division at Komatsu NTC Ltd., says, "The importance of machine configuration soft-

ware is increasing and the development process is becoming more complex."

Improving communication
Previously, information exchange between the mechanical design and control design teams was carried out in meetings for each development

step. It was difficult to arrange brainstorming opportunities for extremely busy teams, with the result that design progress was hampered by poor communication regarding specification changes. There were cases, for example, in which interference between the mechanical and electrical parts was not discovered until the final stages of the design process, meaning that machinery was unable to operate as required. In addition, the mechanical design team would make a prototype during the control design process, and the control design team would be forced to modify the control program to meet those technical requirements. To avoid such reworking, the company needed a tool to perform 3D modeling of the controlled object from the early stages of the design process and to verify the validity of the electrical design and control programs for each development step.

The Mechatronics Concept Designer allows Komatsu NTC Ltd. to change the shape and dimensions of machine parts in accordance with requirements
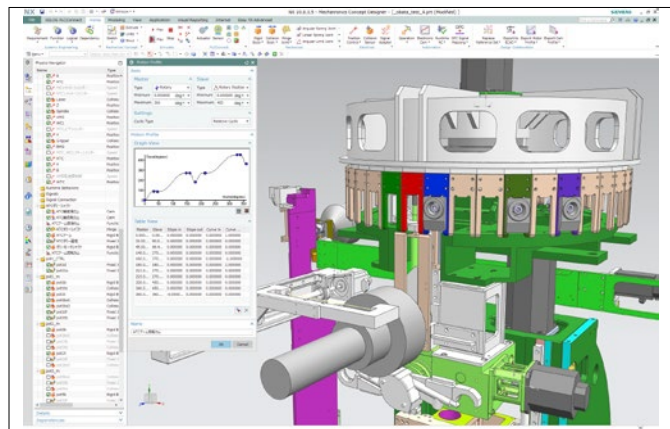
»Using MCD enables us to move with consistency from the concept design stage to the development steps of mechanical design and control design.«

Takafumi Asatani,
Software developer in the Control Engineering Center at Komatsu NTC Ltd.

Takafumi Asatani of the Software Development Section in the Control Engineering Center of the R&D Division says, "When moving toward next-generation manufacturing based on Industrie 4.0, the merger of the real and the virtual is a major theme. We wanted to implement virtual commissioning in an environment in which real equipment is reproduced virtually so as to develop efficient control software."

Complete virtual commissioning
In 2015, Komatsu NTC Ltd. began the selection of tools for virtual commissioning, comparing and considering various tools in terms of a number of evaluation criteria. As a result, Siemens PLM NX software and the Mechatronics Concept Designer (MCD) module were introduced into the control design area. Asatani explains, "Using MCD enables us to move with consistency from the concept design stage to the development steps of mechanical design and control design. The only tool to achieve complete virtual commissioning that is equipped with the various functions needed for HIL (hardware-in-the-loop) is MCD." In a development period of approximately six months, Komatsu NTC Ltd. created an environment enabling the use of

NX and MCD. After starting the runtime environment, the control design team instituted basic and applied training with the support of Siemens. The solution was introduced smoothly and without confusion.

Streamlining development
Komatsu NTC Ltd. is now accelerating the sharing of information between the mechanical design and control design teams and streamlining the development process through the use of NX and MCD. For example, the control design team uses MCD to change the shape and dimensions of machine parts in accordance with requirements. Because these changes can be shared instantly with the mechanical design team, both teams are able to take consistent development steps by referencing the latest design information.

In addition, the new environment enables 3D modeling of the controlled object from the early stages of the design process as well as verification of the validity of the electrical design and control programs for each development step. Virtual commissioning is also achieved by using HIL with MCD. In fact, Komatsu NTC Ltd. engineers execute and test control programs in an environment that allows them to

reproduce real equipment virtually, get a sense of the conditions under which failures or errors occur, and perform debugging.

Looking to the future
By linking MCD and computer-aided engineering (CAE), Komatsu NTC Ltd. can now measure the deterioration and wear of parts caused by the operation of the equipment and establish a mechanism to evaluate the remaining service life of the machine. The company also plans to use MCD for remote support when an abnormality occurs in equipment after delivery. Specifically, the company is aiming to develop an early resolution system that will make it possible to identify the root cause of the abnormality before making a site visit by reproducing NC/PLC data from before and after the occurrence of the abnormality on MCD. Oyabe says, "From applications to infrastructure, Siemens can provide total solutions in all areas. By promoting next-generation manufacturing with Siemens integrated solutions, we hope to develop aggressively not just in Asia but also in Europe." ∎

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High performance for large parts

Hardware: A flexible manufacturing cell producer's expertise and the Sinumerik 840D sl CNC make an ideal combination for machining large connecting rods for an Indian railway company at high speeds.

The machine tool is fitted with the user-friendly Sinumerik Operate user interface

The French company Ceri, a producer of flexible manufacturing cells, has developed and built a CNC machine for drilling large connecting rods for the assembly and maintenance of train combustion engines. The custom-made machine was delivered to Indian Railways in Patiala in May 2015. "This was a public contract awarded through an international invitation to tender. Certain elements were therefore part of the specifications," explains Arnaud Sabia, CEO of Ceri.

Above and beyond the customer's requirements

At the machining center, three different types of connecting rods can be machined using manual format changes. Automated quality control is carried out on the inserted connecting rods. The 40-kg connecting rods, which have a center distance of almost 600 mm, are then fed into the five-axis CNC machine and locked into place. Then two vertical spindles driven by a Simotics M-1PH8 machine the workpieces: one spindle machines the small end of the connecting rod,

the other the large end. Because the two spindles are controlled separately, they can work fully independently of each other. Thanks to a special multi-level tool, three different machining steps can be carried out in a single process: roughing with two machining plates; preliminary machining with one plate; and finishing, also with one plate. The plates are offset for preliminary machining and finishing to ensure the greatest possible precision. This means that with a tolerance of 25 µm for drill holes, strict measurement requirements can be maintained and a surface quality of R_a 0.4 achieved. With an additional polishing stage, Ceri has even been able to achieve a value of R_a 0.2 for those connecting rods that require a high surface quality of R_a 0.25. If even higher precision is required, the position of the individual machining plates can be set automatically using a Simotics S-1FK7 servomotor. These corrections can compensate for the wear on the cutting tools and deviations caused by heat-induced expansion.

Each multi-level tool enables complete machining steps — from roughing to surface processing

24

Production capacity is also excellent thanks to the high speed and feed rate. The customer's specifications required a manufacturing capacity of 24 connecting rods in eight hours. In machining 48 pieces, Ceri's machining center far exceeded this target — an impressive achievement given the hard forged steel it was machining and the workpieces' large dimensions.

Great control
in three separate ways
Ceri fitted the machining center with a control system that met all the customer's requirements — it is user-friendly, flexible and robust. With Sinumerik 840D sl and the intuitive Sinumerik Operate user interface, the user can create operating programs very easily using ShopMill software. Sinumerik also offers high flexibility when programming, such as when the T-slot table needs to be adapted to the needs of the customer during the machine's lifecycle, for example. Because the CNC's central unit runs on a Linux operating system with HCI function and does not need its own hard drive, the control system is particularly low-maintenance. The Windows environment can be maintained at any time, however, using a PCU50. Customers can access Siemens' support and its various services in India, but they can also use the optional Sinumerik telemaintenance service.

Failsafe and energy efficient
Because the machine tool needs to be used in a region of India that is susceptible to frequent unforesee-able power failures, an inverter and a 24-V battery ensure that the system is failsafe. The tools are also protected from damage during machining, as Sinumerik 840D sl ensures that the cutting tool is removed from the machined work-piece by retracting one or more axes by a few millimeters if there is a power failure. Sinumerik 840D sl also enables the recovery of the rotating spindles' kinetic energy to supply the machining axes. Stored electrical energy can be released on short notice thanks to capacitor modules built into the CNC. These functions can be parameterized directly in the CNC system.

A greater focus on direct customers
The contract with Indian Railways represents new territory for Ceri. "The machine delivered to India was a new experience in direct export for the Ceri team," reports Sabia. This area of business will now be expanded further. "We now approach large cus-tomers more confidently by showing them what advantages our company can offer them if they need capacity for the development and delivery of ready-to-use solutions," says Sabia. "The integration of Siemens technol-ogy into our machines offers us signi-ficant advantages in that regard." ∎

The five-axis machine tool can process large connecting rods

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Financing the digital future

Financial services: The digitalization of production requires modernization and therefore, extensive investment in machines, software, processes and training. Traditional financing can often be inflexible, but Siemens Financial Services offers support with attractive financing solutions.

Today, the "fourth industrial revolution" means that many industrial companies need to upgrade their current machines and systems or buy new ones in order to digitalize their operations. But the funds for new investments are often limited, and traditional bank loans can be too inflexible. There is an alternative: flexible financing models such as those offered by Siemens Financial Services (SFS). These models include solutions based on total cost of ownership or performance, including special financing models for energy-efficient technology (such as energy performance contracting) and continuous financing solutions with predefined options for

subsequent investments that might be required due to technical advances. These flexible models allow for predictable payments during the term of the contract, and the term, frequency and level of payment can be adapted to suit the individual requirements of the company.

Technology and financing in one package

Schwäbische Werkzeugmaschinen GmbH (SW) has decided to digitalize in order to remain one step ahead of its competitors. En route to Industrie 4.0, the machine manufacturer is working with Siemens — as the company's partner for both

technology and financing. The result is the type of attractive complete package that is normally seen only in the portfolios of significantly larger companies. This approach allows SW to offer its customers not only the best technological and business solutions but also appropriate financing. SW's customers — often medium-sized companies from the auto parts industry — can therefore also make larger investments. And with framework conditions that traditional loans do not offer. ■

↗ **siemens.com/finance**
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»*Classic investments with depreciation cost the company its liquidity, and leasing models are often rigid. We offer these types of financing as well, but we also partner with manufacturers and purchasers to develop models that are significantly more intelligent. One example: the customer pays only for the hours when it is actually using the machine and therefore earning money from orders. The experts call it pay-per-use. The good news is that the term and the amount of financial liability are based on the customer's business success. And we at Siemens Financial Services finance it. The machine manufacturer is paid for the machine, just as with a traditional purchase. A normal bank would never offer this type of model.*«

Peter Welp**,** senior manager, Captive Development, Siemens Financial Services

Siemens AG

iStock

Create threads at the press of a button

Female threads can be created in many different ways. The thread experts at Emuge-Franken and Audi have developed what is by far the most efficient method. The new technology is called Punch Tap, or helical thread-forming, and allows M6 female threads to be created around 75% faster than with other processes.

As a technology partner, Siemens provided mechatronics support to aid implementation and ensure an easy-to-use cycle with which users can integrate helical thread molds into a CNC program. ◼

Learn more about this new technology and availability here:

↗ **siemens.com/cnc4you**

Siemens AG/P. Klingauf

Modular system interfaces

Sinumerik Integrate Run MyRobot/EasyConnect provides a system interface between machine tool and automation. It is based on the VDMA standard sheet 34180, which the German Machine Tool Builders' Association updated in 2016. Thanks to its modular design, this standard can be easily adapted to an individual system and if necessary expanded to include the system's own definitions. In practice, this simplifies definition input by the system operator and supplier — for example, if the machine and automation are from different manufacturers. It also simplifies system documentation, as both the signals and the accompanying timing intervals are fixed. An example application with documentation for Run MyRobot/EasyConnect is also available that describes a typical application scenario — the loading and unloading of a turning machine. ◼

↗ **sie.ag/2aZcAiJ**

Siemens AG

Perfect production planning

Whether during production planning, apprenticeship or training, CNC users can prepare themselves perfectly for machine work with the Sinutrain for Sinumerik Operate offline programming station. All they need is a standard PC or laptop. Thanks to the original CNC kernel, NC programs can be evaluated almost entirely offline. This enables operation and programming to be carried out in exactly the same way as with the real Sinumerik system. Because Sinutrain can be aligned to the real machine, Sinutrain will mirror the real machine control system's configuration (e.g., axis configurations, cycles). The basic version of Sinutrain, which is free for an unlimited time, provides the perfect introduction to the software and is now on the market for the first time as part of Version 4.7.

The new versions of Sinutrain replicate the software Version 4.7 SP3 and Version 4.5 SP6. Knowledgeable users will notice the new "workbench" framework interface, which virtually maps the production machining hall and enables users to get a quick overview of all machines. ◼

↗ **siemens.com/sinutrain**

motion world —
trends in CNC Automation

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