

motion world

Trends in CNC automation

2017

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Digitalization is revolutionizing the world of machine tools

Once again, digitalization will be the key theme at this year's EMO — the world's biggest trade fair in the machine tool industry — taking place in Hannover, Germany. Under the motto of "Digitalization in Machine Tool Manufacturing" and with around 1,200 square meters of exhibition space, Siemens will be demonstrating how machine tool builders and end-users of all sizes can benefit from digitalization. Our Siemens trade fair presentation will focus on our extensive, all-encompassing, and integrated digitalization portfolio. We will demonstrate how companies in the machine tool industry can leverage digitalization to help them significantly increase the flexibility and efficiency of their production, considerably reduce the time needed for development and market launch, and secure and strengthen their competitiveness in global markets.

Digitalization changes everything. This sentence shows how significant the key theme of the trade fair has become. Because of the dynamism and opportunities made possible by digitalization, the traditionally conservative machine tool sector is now becoming one of the pioneers of the fourth industrial revolution. It is impressively demonstrating the potential digitalization holds for achieving greater productivity. Digitalization is fundamentally altering the way products and manufacturing methods are being developed, production processes managed, and operating states recorded and optimized. Digitalization makes it easier to implement ideas more quickly, unlock innovation, accelerate production, and speed up time-to-market.

In this edition of motion world, you will be able to read how Siemens is driving digitalization in the machine tool industry, what our extensive, all-encompassing, and integrated digitalization portfolio looks like, and the highlights awaiting you at the Siemens booth at EMO 2017. We look forward to welcoming you there, and warmly encourage you to experience the fascinating world of the Digital Enterprise for the machine tool industry at our Siemens booth in Hannover.

Sincerely,

Dolfson

Dr. Wolfgang Heuring CEO Siemens Digital Factory Motion Control

In Machine Sinumerik/ Sinumerik Edge

In Line Sinumerik Integrate

> In Cloud MindSphere

Networking at all levels

Digitalization: The digital transformation is changing the way machine tools are built and operated. Siemens offers a digitalization portfolio that is perfectly tailored to the varying requirements of machine tool builders and end-customers.

Today, large quantities of digital information can be collected with high frequency within the production process. This development is based upon the fact that storage capacities are growing almost without limitation, and that modern IT systems can be both flexibly linked up and used to process large volumes of data at an ever-increasing pace. Digitalization thus holds enormous potential for improvement in production in general and in the machine tool industry specifically.

For example, Siemens supports machine tool operators in adapting work steps to suit their production on a digital twin. However, they are also able to use real-time data more efficiently, and increase plant availability by monitoring machine status. Another aspect is continuous analysis of machining processes in order to identify and exploit optimization potential. The result? Enhanced productivity and manufacturing quality.

From the field to the cloud

But how can these enormous volumes of data be made available in a targeted and appropriate manner? With the Digital Enterprise Suite, Siemens provides companies wanting to go digital with software-based systems and automation components that meet all requirements of the industrial value chain in an integrated way. The **CNC Shopfloor Management software** portfolio is tailored specifically to the machine tool industry, making it the first choice of corporate managers all the way to machine operators in small and medium-sized companies. This all-encompassing IT infrastructure is subdivided into three levels: In Machine, In Line, and In Cloud, which correspond to the three platforms of

CNC Shopfloor Management software

Sinumerik/Sinumerik Edge, Sinumerik Integrate, and MindSphere. This makes it possible to create customized functions from the field to the cloud. With a scalable, direct, and indirect connection to the cloud, users have appropriate access to the control system for their application at all times.

Three levels of digitalization

With Sinumerik Edge (In Machine level), Siemens brings the performance of the edge computing established in the IT world to the shopfloor — and therefore directly to the machine. The tailored hardware and software solution even processes and analyzes high-frequency process data in real-time. This data can also be transferred to the cloud, where it is used for cross-site visualization. Siemens provides special applications (Edge Apps) for this purpose. Machine builders and service providers already have the option of developing and implementing their own Edge Apps.

The Sinumerik Integrate platform (In Line level) provides various applications for optimizing availability and productivity on the basis of local servers operated by the user. For instance, a local version of the Analyze MyCondition application facilitates production-relevant condition monitoring, for example with synchronization, circularity, and universal axis tests. With the 3D visualization tool Analyze MyWorkpiece /Toolpath, a 3D display of the finished geometry from the CAD system, the NC program, and the recording of the tool path can be compared after machining. This allows the user to identify unnecessary non-productive time, potential for optimization in the NC program, and causes of errors in the machining process.

The MindSphere platform (In Cloud level) offers further customer benefits. For example, connecting to the cloud allows use of functional applications such as the "Manage MyMachines" MindApp. It also allows machine operators to visualize the operating states of individual machines and entire machine parks — from anywhere via the web. This makes running them more transparent, and ultimately more efficient. Machine builders, on the other hand, can use Manage MyMachines to continuously record the status of machines remotely. This allows them to maintain the machines more effectively, and tap into new business models, for example in the area of service. The various services and apps are conveniently setup and managed from the cloud.

New business models

The decision which services should be used at which level lies with the company using them. However, it is clear that new opportunities for data exchange will cause a change in the relationships between machine tool builders, suppliers, and operators, and give rise to new business models. Whether one-off license fees or usage or service-based billing for the provision of infrastructure and platforms as services, or a mixed form — anything is possible. In the future, services will be able to be booked online at the click of a mouse, and flexibly adapted to reflect changing circumstances. On the basis of the levels model, machine tool builders and end-customers will be able to specifically select and implement personalized digitalization strategies. Thanks to the integrated approach of the CNC Shopfloor Management software from Siemens, all the different options can be scaled up in any direction.

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Digitalization for everyone

Digitalization: We spoke to Uwe Ruttkamp, head of the Machine Tool Systems business segment at Siemens, about the potential of digitalization for machine tool builders and operators in both large and small operations.

Mr. Ruttkamp, how far advanced is machine tool building in terms of digitalization?

Uwe Ruttkamp: Digitalization is a key driver of growth and profitability in the international machine tool industry, and has been causing it to change for some time now. However, we feel it is important to provide our customers — both machine tool builders and end-users — with advice as they move through the digitalization process while offering our comprehensive portfolio of solutions to help them on their way to becoming a digital company.

And what challenges will machine builders and users have to overcome in order to be successful in the world of digitalization?

Ruttkamp: In light of advancing digitalization, production companies will have to meet increasing requirements in terms of time-to-market, flexibility, guality, efficiency, and safety and security measures. Along with their hardware and software, machine tool builders and users must embrace the convergence of the real world and the virtual world, in order to be able to benefit. Machine builders and end-customers have different requirements and expectations for digitalization. Machine tool users want to create transparency when it comes to production processes, and achieve an increase in productivity by networking their machines within the production process. Machine tool builders, on the other hand, want to optimize their engineering process and pursue new business models. With Siemens' integrated approach to digitalization, which encompasses the entire value chain, it is possible to meet the

requirements of all companies in the machine tool industry, and sustainably improve their competitiveness.

So what integrated portfolio of solutions does Siemens offer when it comes to digitalization?

Ruttkamp: Within the framework of the Digital Enterprise Suite, Siemens offers a consistent and integrated portfolio of digital platforms and a range of applications specifically for the machine tool industry. This clearly illustrates how digitalization can run seamlessly from the machine tool all the way to a company's management level. For machine builders, the digitalization services extend from the machine concept and engineering through to commissioning and service. For machine operators, the range of digitalization solutions covers the entire value chain — from product



setup time reduced by



An increase in capacity utilization in mechanical pre-fabrication of







cycle time when producing several parts of up to



»Digitalization is a key driver of growth and profitability in the international machine tool industry.«

Uwe Ruttkamp, Head of the Machine Tool Systems Business Segment

development and production planning through to actual production and digital service. With this holistic approach, Siemens is the only company that can map the real process chains of the machine builder and machine operator in an integrated way in the virtual world using a digital twin.

In concrete terms, what benefits do you see in using these integrated digitalization solutions in production and in engineering?

Ruttkamp: One of the outcomes is a significant increase in manufacturing productivity. In concrete terms, this means reducing the setup time for machine tools by as much as 60%, and a 20% increase in capacity utilization in mechanical pre-fabrication. On top of that, the cycle time for producing several parts is reduced by up to 20%.

So does that mean that even small and medium-sized enterprises can utilize networking of machines? Ruttkamp: I firmly believe that digi-

talization can be exploited in a beneficial way by small and medium-sized companies. That is exactly what we are currently demonstrating at one of our own factories, the electric motor factory in Bad Neustadt an der Saale, Germany. There we are showing how products and solutions from our own portfolio can be implemented step by step in an existing and running production environment around the size of a traditional medium-sized firm. One of the things that we are using is our first MindSphere application specially for the machine tool sector: Manage MyMachines.

This application gives machine operators an overview of the important details and operating states of their machines in a cloud-based format. The transparency that this provides makes it possible to respond quickly and optimize production processes. Small and medium-sized enterprises can also benefit from digital simulations, which replace expensive test runs on the machine.

Thank you for this informative interview, Mr. Ruttkamp.

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Seamless connection of the virtual and real value chain

Digitalization: What can digitalization look like in practice? At this year's EMO in Hannover at the Siemens booth D60 in Hall 25, machine tool users can find out how they can benefit from Siemens' solutions — from product design to production and service — using the example of mold making. Machine tool builders can learn more about the services that Siemens offers to help them with their digitalization strategy.

Machine tool user

Machine tool builder



Experience integrated digital production and optimum use of manufacturing resources. Ideal interplay between the CAD/CAM-CNC process chain and tools for centralized management of production resources considerably increases efficiency of production. Digitalization is changing all areas of companies — including both product development and production. Manufacturers are discovering completely new opportunities for meeting market requirements: Shorter product launch times are speeding up time-to-market, greater flexibility is facilitating costeffective personalization of products, and more efficient production is helping to protect limited resources and the environment. However, digitalization is also increasing the quality of products — an aspect that is becoming increasingly important in decision making by customers. However, throughout all of this, the data security of production plants must also be ensured.

This requires transformation into a digital company, in which the entire value chain, from design to service, is looked at holistically.

With the Digital Enterprise Suite we offer a comprehensive portfolio featuring integrated solutions from the machine tool all the way to the enterprise level. As a result, machine operators and manufacturers benefit from a seamless connection between the virtual and the real world throughout the entire value chain.

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Optimize your production: We provide new HMI concepts for machine operators — for example new panels or personalized control consoles that can be configured to make them easier to operate. New milling and mold-making functions increase productivity. The new Sinumerik Edge platform for analyzing process data makes the machining process even more efficient.



Production execution

Services



More transparency in the pro-

duction process means more

MyMachines MindApp, which

is connected to MindSphere, provides a convenient overview

of the status of machine tools.

During the digitalization of your

production, we also support you

with our usual Motion Control

Services as well as repairs and

spare parts supply.

efficient production. The Manage

Digitalization needs education

Understanding of CAD/CAM CNC chains plays a key role in ensuring that the training of young people in machining-based occupations is future-proof. Be impressed by our training package, which prepares CNC specialists for the requirements of the future.

Machine operation



Machine tool builders can see for themselves that new multitechnologies such as additive manufacturing make completely new production options possible, and that the integration of robots into the production process increases machining efficiency.

Machine services



MindSphere, the cloud-based, open IoT operating system, makes it possible for you to develop more effective service models. This means that you can use digitalization to tap into new areas of business.

Transparent manufacturing

Digitalization: The Siemens factory in Bad Neustadt, Germany manufactures servo-motors and asynchronous motors. The motor factory links up its manufacturing areas so that key process performance indicators can be monitored at all times while continuously optimizing processes. The Sinumerik Integrate platform with its applications and NX software deployed at the factory enables seamless integration of the CAD/CAM-CNC process chain.

The Manage MyPrograms application ensures the integrated flow of data from production planning to manufacturing. This allows management of CNC program data throughout the factory



Servomotors are manufactured to meet specific requirements at the Bad Neustadt plant

Components are designed in NX as part of the Siemens PLM Software solution

Siemens manufactures around 600,000 servomotors in approximately 30,000 versions at its site in Bad Neustadt an der Saale, Germany. The production of so many different parts in a wide variety of batch sizes requires the highest degree of flexibility in closely interwoven processes. "We have a large machine park made up of old and new machines from various manufacturers," says Peter Deml, plant manager at the Bad Neustadt motor factory, about the challenge while also pointing out the solution: "The backbone of manufacturing digitalization is networking the entire machine park — including seamlessly integrating production and development. "The Sinumerik Integrate platform provides applications for analyzing and managing data for networked plants. Intelligent use of data relevant to production makes it possible to substantially improve technical and organizational processes as well as manufacture products more flexibly and efficiently.

Optimizing plant availability and maintenance

If you want to increase the productivity of a plant, first you need your production processes to be transparent. Machine data such as capacity utilization, availability, performance, and quality can be reliably recorded using the Analyze MyPerformance application. Employees can use the captured data to increase plant availability and optimize the production schedule. Peter Zech, head of mechanical prefabrication and maintenance at the Siemens motor factory, explains what this means in practice: "Analyze MyPerformance allows us to visualize and analyze malfunctions or setup processes on machine tools. This allows us to identify and avoid factors that cause downtime, thus maximizing machine output." In this way, Analyze MyPerformance offers completely new approaches for optimizing maintenance and repair of machines.

By processing detailed status information, the Analyze MyCondition application forms the basis for more efficient maintenance and continuous monitoring of quality-related machine parameters. "In the past, we defined our maintenance intervals very rigidly based on length of operation. But with Analyze MyCondition, we are in a position to plan maintenance in a far more targeted and better way," says Zech. Analyze MyCondition flags problematic machine values at an early stage, enabling efficient, automated remote service functions to be applied before a problem arises. Users are also free to specify the required variables themselves.

A seamless CAD/CAM-CNC process chain

The Siemens motor factory utilizes an integrated process chain consisting of NX CAD, NX CAM, and Sinumerik CNC to ensure its processes are efficient and fault-free from product development through to manufacturing. Zech takes the example of a bearing shield to explain the advantages: "First the draftsman designs the die-casting tool and the shape of the die-cast part in NX CAD. The machining simulation in NX CAM provides support in optimizing traverse paths, and helps to avoid collisions during subsequent manufacturing on the milling machine. This tool then creates the bearing shield blanks using the die-casting process. The fully automated rotating cell reworks the mounting surfaces based upon the data from NX. Right through to the quality check and final assembly, each stage of the process refers back to the original CAD data."

The Manage MyPrograms application ensures the integrated flow of data from production planning to manufacturing. This enables programs and additional production information (such as drawings) from production planning to be easily downloaded to the machines. Changes made by the operator can be reassigned to produc-

tion planning as well. "Manage MyPrograms allows us to visualize and manage our highly varied machine park and corresponding NC programs — which helps us to keep track of things and ensure we only use approved programs," explains Zech, also adding that "using the integrated CAD/CAM-CNC chain based on NX and linking up production planning with manufacturing through Manage MyPrograms enables us to introduce product modifications or new products considerably more quickly than before."

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Symposium on digitalization in metalworking

The new digitalization arena at the Siemens motor factory in Bad Neustadt, Germany was opened on May 5, 2017. Less than a week later, it hosted the symposium on digitalization in metalworking on May 11 attended by around 50 managing directors from small and medium-sized metalworking enterprises. Together with Siemens, well-known machine tool builders and the University of Applied Sciences Würzburg-Schweinfurt provided information on the implementation and benefits of digitalization. Symposium participants had the opportuntity to attend a wide range of interesting plenary presentations, live demonstrations in the six themed areas, and — as a special highlight — go on a tour of the motor factory to see real applications demonstrated in combination with digital solutions. Intelligent networking optimizes unit costs

The technology center allows Siemens to demonstrate the opportunities offered to manufacturers by the PLM NX software

Digitalization: At its new technology center, BG Werkzeugmaschinen GmbH partners with well-known companies to present the entire production chain — from CAD/CAM and CNC programming to the actual products manufactured using advanced turning, milling, and combined machining centers.

BG Werkzeugmaschinen GmbH is the exclusive machine tool distributor for Spinner for the German regions of southern Hesse and northern Bavaria. Here, in the small town of Hösbach, the company established a new technology center in the spring of 2015, to offer customers the best possible consulting services. A light-filled and airy building is home to around 20 Spinner machines in various designs, from a simple turning machine to a complex CNC five-axis milling/turning center. What makes the technology center unique is that it maps the entire production chain in an integrated manner. There is even a model training workshop at the site, including all the technical equipment needed.

Variety in machining

Managing directors Bernhard Glassl and Erik Wagner do not want to single out one machining center as the star of the show. However, they do have a few personal favorites, all of which are equipped with a Sinumerik CNC 840D sl. These include Spinner TTS series turning centers capable of working with up to three tools on two spindles simultaneously, with twelve power-driven stations on each turret. The special thing about these machines is that each turret can be used on both spindles. The programSync function in the Sinumerik 840D sl enables perfect sequencing of programs, with the user able to see the machining blocks and all of their related steps and calculated durations on the control panel and quickly determine if one of the three turrets is not running at optimal capacity. »We advise customers on the creation of complex five-axis programs, but also demonstrate the fact that NX can make conventional contract manufacturing of simple parts more productive.«

Alexander Freund, Product Manager, Siemens PL and former NX CAD/CAM Consultant with Conmatix

Glassl, the company's founder, also has a soft spot for the Spinner U5-2520 five-axis center, which allows all axes to be operated simultaneously. This means that even freeform surfaces of the highest precision and finish quality can be manufactured. The Sinumerik MDynamics technology package really pays off in the Spinner U5, because the Advanced Surface motion control is extremely helpful in simultaneous five-axis machining. This function enables the programmer to set or adjust the program sequence at any time so the machine works at optimal speed while achieving the specified surface quality.

CAD/CAM system for complex and simple applications

Well-known partner companies of BG Werkzeugmaschinen also offer their services in separate rooms of the technology center. For example, Conmatix Engineering Solutions GmbH demonstrates the capabilities of NX as part of the Siemens PLM Software solution. Alexander Freund, product manager at Siemens PLM and former NX CAD/CAM consultant at Conmatix, explains what his company is all about: "We advise customers on the creation of complex five-axis programs, but also demonstrate the fact that NX can make conventional contract manufacturing of simple parts more productive." The software specialist offers attractively priced entry-level packages tailored to the respective application that can be expanded at any time. Additionally, a number of technical options are already available as standard such as importing 3D data.

Hösbach also has a training workshop where interested customers can complete NX CAM or Teamcenter courses. Instruction is given by Siemens PLM-certified trainers from Nexeo GmbH, an affiliate of Conmatix.

Intelligent networking of production

Another special feature in Hösbach is a Siemens demonstration of intelligent production networking, and how it can be used to successfully lower unit costs — even for small and medium-sized enterprises. The demo Spinner CNC machine tools are connected to a server that acts as a platform for data analysis and management. Sinumerik Integrate programs such as the Analyze MyPerformance





Special features of the technology center: an on-site training workshop (above) and demonstrations of intelligent machine networking (left)

software tool are installed as basic applications. This visualizes all the machinery for the production manager on a central server that records information on the capacity, availability, performance, and quality of each machine, and can include this data in the calculation of the overall equipment effectiveness. Thomas Hamann, Siemens service consultant, adds: "This kind of indicator provides reliable information on the productivity of individual machining centers and of the entire manufacturing process." Should the production manager then realize it would be more effective to manufacture a product on another machine, action can be easily taken thanks to Sinumerik Integrate Manage MyPrograms. Hamann explains: "Manage MyPrograms allows all the key steps for changing a program to be taken from the server including downloading the program to the CNC of any machine."

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Digital process chain in the power industry

Digitalization: The Power & Gas and Large Drives divisions of Siemens AG joined forces to successfully complete a project: Using Sinumerik VNCK, they reliably mapped the behavior of Sinumerik controllers — including the kinematics of large special machine tools — in Siemens NX.

NX CAM Simulation driven by the real controller software

NC Programming Simulates all codes and commands

Post-processing Accurate motion and timing

Integrated Solution Minimizes on-machine testing

> Sinumerik VNCK

The Power & Gas and Large Drives divisions of Siemens AG develop and manufacture gas turbines, large engines, and generators at their premises in Berlin. Various special machine tools process these large workpieces. "Some of our machines use Sinumerik 840D pl, but the powerline controllers with HMI Advanced and MMC103 are not yet integrated into NX. This means that our digital process chain contained loopholes we wanted to close," says Markus Sprissler, NC expert of the Siemens Power & Gas division. With this in mind, the declared goal of the project was to greatly improve simulation in NX, and by doing so increase reliability for production further down the line.

Controller-based simulation

Builders of standard machine tools often find it relatively easy to integrate their plants into CAD/CAM systems because there are many different options available to them. Users of special machines, on the other hand, are often left to their own devices when it comes to integration into digital process chains. Sinumerik VNCK (virtual NC kernel) is a tool that makes it possible to map the behavior of both standard and special machine tools and their controllers in virtual machines extremely accurately. The postprocessor transmits its commands to the VNCK, which executes the commands exactly as the machine's Sinumerik controller would. In addition, machine-specific information can be transferred to the kernel from the controllers. In this way, the simulation is essentially run by the machine's own control system. The 3D model of the machine displayed in NX works in more or less exactly the same way as the machine — including axis positions of right-angle heads or feeds. The experts from Power & Gas and Large Drives worked with Siemens PLM and the VNCK Support Center to carry out the integration of the VNCK, and subsequently launched extensive tests at the two factories in Berlin.

Realistic simulation

Manfred Moritz, head of NC programming and expert in CAM technologies at Large Drives, explains the results of the tests: "Part of the tests involved conducting simulations using the old CSE (Common Simulation Engine) and the VNCK, and comparing the results with each other and with the behavior of the actual machines. The CSE integration was already highly advanced. However, it was expected that a VNCK simulation would guarantee functionality for the extremely sophisticated new six-axis machining center with its highly complex integrated turning, milling, and grinding and its component measurement mechanism. The result is impressive: the VNCK-controlled simulations have now taken us far closer to real-life machining."

Another advantage is that, because they are integrated into NX through VNCK, the machine controller user inter-



»The precise simulation and greater quality of NC programs that we are able to transfer to the machines have bolstered the confidence machine operators have in the digital process chain.«

Markus Sprissler, NC Expert, Siemens AG, Power & Gas

faces are available in the CAD/CAM system with the same range of functions and the same look and feel. This means that it is possible to work offline and program new cycles that will look exactly the same in NX as they do later on in the machine controllers.

Precise, realistic simulation

The extensive tests in Berlin have shown that the VNCK integration meets the ambitious expectations. The integrated digital process chain and highly realistic simulation make it possible to dispense with run-in and NC program tests that used to be necessary on the machines. Typical issues such as collision control, optimized traverse paths, and tool changes can be handled in the NX simulation. The run-time analyses — which are especially important for the machining of large workpieces, and therefore for production planning at the two Berlin-based factories — are very precise. With all these benefits in mind, Markus Sprissler takes a positive overall view: "The precise simulation and greater guality of NC programs that we are able to transfer to the machines have bolstered the confidence machine operators have in the digital process chain." The major challenge with digital twins of processes and plants involves creating a truly exact copy. Any deviation leads to weaknesses in the simulation, causes a gap between the processes on the computer and reality, poses risks, and causes errors. However, in Berlin, this challenge has been impressively overcome by using the digital VNCK-controlled twin.

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An infinite variety of shapes

Digitalization: Manufacturing completely new component designs, including final workpiece finishing, all-in-one clamping: that is what motivated Joachim H. Hoedtke, managing director of Hoedtke GmbH & Co. KG to invest in new additive manufacturing technology.

Hoedtke GmbH & Co. KG already introduced laser machining during the 1970s, and benefited from the knowledge acquired. "First of all, we used the laser cutting procedure. Then, the laser welding process," says Hoedtke. "The next step is the additive manufacturing process, during which a metal powder jet is melted in three-dimensional space using a laser." Since the end of 2014, Hoedtke has been using a Lasertec 65 3D from DMG MORI equipped with a Sinumerik 840D sl. This multitasking machine combines generative laser powder cladding, also known as directed energy deposition (DED), and five-axis simultaneous milling in one clamping. The machine is integrated in a continuous CAD/CAM-CNC process chain with NX software for hybrid additive manufacturing.

Additive and ablative machining in one clamping

By developing the Lasertec 65 3D, DMG MORI was able to combine the benefits of the DED process, such as high build-up rates and generative build-up on existing component surfaces during the additive process, with advanced, highly complex five-axis milling capabilities. The Lasertec 65 3D is equipped with a Sinumerik CNC 840D sl that, thanks to the open architecture used for the operator interfaces and the real-time range, makes it ideal for efficiNX with a plug-in for hybrid additive manufacturing offers a consistent design and programming solution including a post-processor and simulation for laser powder cladding and milling

> ently linking different multitasking technologies. Multitasking typically designates the combination of several machining technologies in one machine. The benefits provided by the hybrid machine concept is obvious. "The laser powder cladding process allows us to apply large amounts of material within a very short time. Using this highly productive process allows us to rapidly manufacture three-dimensional components," explains Vanessa Seyda, technology expert for additive manufacturing at Hoedtke. "Depending on the nozzle used, at maximum it is currently possible to achieve a 3 mm-wide melting trace with a rough surface using a laser powder cladding process." Five-axis milling is required to achieve the accuracy required for the functional surfaces of complex components. It is important that the operator can flexibly alternate between laser powder cladding and milling during the machining process. Only then is it possible to rework places no longer accessible on the finished workpiece. Furthermore, the five-axis machine kinematics allow the part to be positioned during the additive setup. With the Lasertec 65 3D, functional surfaces can be post-processed in one clamping, allowing highly precise results to be achieved.

Integrated programming solution for hybrid processes

A CAD/CAM system tailored to the DED process is the basis for tool path planning. It is important to select a suitable strategy for the execution of additive and ablative processes and implement this in the software. The NX CAD/CAM software with the plug-in for hybrid additive manufacturing provides a consistent design and programming solution, including a post-processor and simulation for laser powder cladding and milling. "Of course, working with a single software solution delivers benefits for us from the design to programming through to production," says Seyda. "Only with NX from Siemens PLM Software are we able to prepare the data for both the additive and the ablative processes." Numerous simulation and analysis functions in NX allow users to optimize component and process prior to parts generation. "The simulation in the software is very important, because even the most minor shock at the spindle or laser head would cause tremendous damage," adds Steffen Heitmann, who operates both the NX and the machine at Hoedtke. In addition to additive development steps, such as preparing the CAD design, analyzing set-up capability, generating the set-up strategy



The combination of additive and ablative manufacturing processes on one machine allows users to rework functional surfaces with the utmost precision in one clamping

or the laser paths, it is possible to create all the process steps required for mechanical machining at the same time. The CNC program generated in NX is then downloaded directly to the machine. "The Sinumerik CNC 840D sl accesses the server, meaning the machine can load the program immediately after the post-program has been completed," explains Heitmann. At this point, the Sinumerik 840D sl can precisely execute tool and part movements in combination with the Sinamics S120 drives and the related motors.

An innovative pacesetter

By using the complete industry-ready DED solution, Hoedtke is demonstrating once more its value as an innovative pacesetter in this industry sector. The hybrid programming solution NX Hybrid Additive Manufacturing allows completely new component designs. For example, if in the past a workpiece has only been manufactured by applying an ablative process on several modules, this workpiece can now be designed as a single part.

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motion world 2017

Up to 50 program changes a week have to be managed at the Siemens geared motor factory in Tübingen



Adopting digitalization at its own pace

Digitalization: The Siemens geared motor factory in Tübingen, Germany is proof positive that even an existing heterogeneous machine park can successfully transition to the digital age. Manage MyPrograms a modern solution for managing NC programs is being used at the factory site.

A glance at how geared motors are manufactured at the Tübingen factory reveals a highly varied fleet of machine tools, which has grown organically over the years. Here, the mechanical components of Simogear geared motors are manufactured on over 50 partially automated machines. The site is a good example of successfully introducing the intelligent use and management of production-related data based upon existing machine infrastructure.

Simplified management of programs on the machine

At the Tübingen production plant, NC programs are managed using the Manage MyPrograms application on the Sinumerik Integrate platform, with the machines connected to the corresponding Sinumerik Integrate server. A major benefit of the Manage MyPrograms application is that it is fully integrated into the Sinumerik Operate user interface. This means that machine operators always see the same thing on the CNC, regardless of whether they are in the standard Sinumerik or Manage MyPrograms application. "We can access the NC programs on the server directly from the control interface and download them to the machine before executing them," says machine operator Mario Demertzoglou.

Another advantage of Manage MyPrograms is its protected versioning of NC programs. The Siemens factory in Tübingen has improved traceability by reliably documenting the date from when a given NC program was used for machining workpieces. Siemens has pooled Manage MyPrograms with other applications which enable machine tools to be networked on the Sinumerik Integrate platform. All of the bundled applications make it possible to enhance the productivity of CNC machines and plants. "This means that the operator can either use a single solution or combine several functions into a package," explains Stefan Nothdurft, team manager for production planning.

One step at a time

The Siemens geared motor factory in Tübingen demonstrates that Sinumerik Integrate is a powerful platform that enables the shift to digitalization, even with a very heterogeneous machine park. As it pursues its goal of becoming a digital factory, the Siemens geared motor factory in Tübingen plans to implement even more applications to supplement Manage MyPrograms, including plans to roll out the Analyze MyPerformance and Manage MyTools software solutions.

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Machine turning under full control

Automation: Together, innovative electromechanical design and Sinumerik 840D sl combine to enable rapid retooling in the new CNC eight-spindle automatic machine from Schütte. This means even complex turned parts can be manufactured economically and with extreme precision from as few as 7,500 units.

Flexible mass production is in demand in many industries, for example in the automotive, fittings production, medical technology, precision mechanics, and optical sectors - some of the most crucial to Cologne, Germanybased Alfred H. Schütte GmbH & Co. KG. Because the company always strives to meet the challenges set by its customers in these industries, the machine tool builder has developed the ACX series, featuring a new Sinumerikcontrolled eight-spindle automatic machine. Dr. Markus Krell, technical manager at Schütte, explains some of the details: "We always equip the ACX to precisely match the requirements of our customer's product range. The machine is highly versatile and even suitable for complex parts. The double four-spindle operation is also useful,

because it allows two identical parts to be produced at the same time."

Flexible CNC technology that is easy to use

The ACX automatic will be especially attractive to automotive suppliers, which often work in three shifts six or seven days a week. For these companies, unscheduled downtime means costly unproductive machine time. The reliability of the ACX has utmost priority, which is why the company decided to equip the ACX series with Sinumerik 840D sl. Because the ACX series has 16 machining channels to manage, and, depending upon the setup, up to 85 axes to control, Siemens has equipped Sinumerik 840D sl with a triple NCU (numerical control unit) - resulting



Machine operators appreciate the easy handling of the ACX automatic which features the high-end Sinumerik 840D sl CNC and customized SICS user interface

in a complex process that runs quietly in the background without the user noticing. The entire CNC process is simple to control, using a single user unit. The Sinumerik 840D sl also enables the control and adjustment of all machining technologies, which is useful when implementing a wide variety of requirements. Machine operators can store several different programs for different products in the control system. Product changes can be carried out easily using the clearly structured and customizable SICS user interface developed by Schütte and inspired by the Sinumerik Operate interface.

An impressive range of services

Because Siemens offers control system, drive, and control cabinet technology from a single source, all components are perfectly matched. This is helpful not least when it comes to the all-important synchronicity of the rotary axes involved in machining, which immediately compensates for any fluctuations in cutting pressure, and therefore speed of rotation. The level of service offered by Siemens is also impressive. Krell confirms: "We are always in contact with sales and service staff, meaning that we are able to receive very competent, specialist advice in all areas." In addition, Siemens has service centers with trained employees worldwide, so that it can respond quickly, wherever the customer may be.

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Thanks to Safety Integrated plus, machine tool builders are guaranteed compliance with strict European safety directives

Delivering enhanced machine safety

Automation: When the protection zones on machines and plants are made accessible, all motion axes can only traverse very slowly and, when required to, must immediately come to a complete stop. The new Safety Integrated plus software makes configuring and commissioning CNC systems even easier and faster.

Machine builders and plant manufacturers in Europe must adhere to strict safety regulations. This applies to conventional metal cutting, machining composites, nibbling, lasering and additive manufacturing, as well as the corresponding handling and use of robotics. In the European Economic Area, a wide range of directives and standards regulate what safety requirements OEMs are required to fulfill. Machine directive 2006/42 EC has been in effect since December 29, 2009. In accordance with this, for many years manufacturers have had to implement various safety measures for their machines to fulfill these strict regulations. The Safety Integrated (SI) software, which was developed by Siemens over 20 years ago, has not only proven itself to be very reliable, but can also be optimally adapted to any relevant technology.

Configure up to 50 percent faster

The newly released version of Safety Integrated can be operated with all currently available NCUs of the premium Sinumerik 840D CNC. This presents the machine builder with a key advantage because, thanks to SI plus, configuration and commissioning can be carried out much more quickly. Previously, it was necessary to write a complete program for the NCK, as well as another one for the PLC; in the future, only one will be needed for the PLC. This alone leads to time savings of at least 50%. Another advantage: The fail-safe program for the PLC is written using



Safety guidelines for machine manufacturers

Since December 29, 2009, machine directive 2006/42 EC has regulated the safety directive requirements that machine tool builders have to fulfill if they wish to market machinery and safety components within the European Economic Area. To comply with 2006/42 EC, experts and associations recommend the application of standards such as EN 62061 or EN ISO 13849. The latter standard is preferred by the German Machine Tool Builders' Association (VDW — Verein Deutscher Werkzeug-maschinenfabriken e.V.) and by German machine tool manufacturers, and Siemens certifies its Sinumerik CNC safety solutions in accordance with this standard.



When protection zones on machines and plants are made accessible, if required the machines must immediately come to a complete stop

20% faster to commission

> 50% faster to configure

the widely used and convenient Simatic Step 7 Professional (TIA Portal) PLC software. This makes SI plus configuration and programming a relatively fast and easy task.

Because SI plus is linked to the required TIA Portal software via a joint license, it can be used together with the Sinumerik Step 7 Toolbox to configure a safe machine tool. For Tino Grass, application engineer for machine tools at Siemens, this is a huge advantage: "We use Step 7 TIA to produce numerous certified failsafe modules that users can simply implement into their safety program. We also provide solutions for a wide range of machine concepts and technologies, and the OEM can also implement many individual safety requirements."

Graphically supported commissioning

Safety Integrated plus also makes it easy to carry out more than just configuration and programming using Simatic Step 7 Professional. Commissioning is also very clearly organized allowing it to be carried out around 20% faster than with the standard version of SI. As commissioning expert Grass explains, "the previous SI interface for commissioning was similar to a table that listed all the necessary axis machine data one after the other. With Safety Integrated plus, we offer a graphical display that presents the axes and their links so clearly that not only beginners, but also experienced commissioning experts can more rapidly and easily grasp the connections. When combined with the acceptance test integrated into Sinumerik Operate, acceptance of safety functions can be achieved very rapidly."

Machine tool users can reap additional benefits from the additional functions in SI plus, such as Safe Direction (SDI). For example, it is possible to monitor the direction of rotation of expensive tools that should only cut in one direction. Furthermore, Safely Limited Speed encoderless (SLS) enables reliable monitoring of highspeed spindles on asynchronous motors that are operated without an encoder — a useful feature for equipment such as woodworking machines.

Standard version for established machine types

Despite all the advantages of SI plus: Those who already have Safety Integrated on their machine should continue to use it, because data from the system-integrated SI cannot be transferred to the drive-based SI plus. The predecessor version offers the same level of safety as the new version. Both versions come with the Safety Evaluation Tool (SET) that makes it easy to comply with crucial standards. Specifically, SET helps the user to calculate the Performance Level (PL) and the Safety Integrity Level (SIL). Ultimately, the programmer receives a report that complies with standards and can be integrated into documentation as proof of safety.

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Ensuring a smooth ride

Automation: Niles-Simmons meets the demanding requirements of wheelset manufacturers for rail vehicles with an advanced special machining center that can perform any turning and milling project in a single clamping. The innovative machine tool is driven by a new torque motor approximately one meter in diameter.

When it comes to smooth running, rail vehicles are at a clear disadvantage compared with cars, because they have no rubber tires to smooth out any uneven sections of track. Nevertheless, passengers expect a comfortable and quiet ride, especially on high-speed trains. Among other factors, wheelsets are decisive for quiet running. That is why manu-

The Wheelturn RQMC with a Siemens direct drive in the table and two slides



facturers including ICE, TGV and CRH demand the highest quality from their wheelset suppliers. Niles-Simmons Industrieanlagen GmbH Chemnitz, Germany, part of the NSH-Group, has repeatedly improved its RQQ Wheelturn, specifically designed for train wheel manufacturing, most recently with the Wheelturn RQMC in 2016.

Precise bores guaranteed

The newest version allows manufacturing companies to produce highspeed railway wheels on a single machine. The Wheelturn RQMC has two slides, one of them designed as a combined turning-milling unit. The combined vertical machining center can carry out all drilling and milling work in addition to all turning operations. "This means we substantially simplify and accelerate our customers' processes," says Rainer Haberkorn, marketing and sales manager at Niles-Simmons. When it comes to the control system of its new Wheelturn, Niles-Simmons is not willing to compromise, and relies on the high-end Sinumerik 840D sl CNC.

As soon as the gantry loader places the forged blank in the machine, the Sinumerik CNC starts the program. Now the RQMC can begin roughing all of the internal and external surfaces. When turning fits, a trial cut can be executed before the final cut so that the diameter can be measured and the tool adjusted if necessary. The workpiece touch probe also enables measurement of datum references and positions on the wheel for correcting any tool wear. One by one, the combined turning-milling unit then performs drilling and milling tool changes as it completes all the boring and grooving. The bores for locking the brake disks must be plane-parallel to a tolerance of a few hundredths of a millimeter, because even the most minor inconsistencies would cause significant vibration when the train brakes are applied. "Because the wheels are manufactured with our RQMC in one machine and because we use a highly precise Siemens direct drive for the table, we can reliably guarantee the necessary precision is achieved," says Haberkorn.

Formula for success: the segment motor

The newly developed Simotics T-1FW68 segment motor used as a plate drive was crucial in enabling implementation of the machine's latest version. The motor is around a meter in diameter and, unlike the Simotics torque motors from the T-1FW3 and T-1FW6 series, the stator and rotor are composed of individual parts that are only assembled once inside the machine. Reinhard Robotta, product strategy manager at Niles-Simmons, explains: "It would have been almost impossible for us to integrate a conventional torque motor of this size into the machine. With the new segment motor, it's not a problem." Dr. Bernhard Pause, technical manager at Niles-Simmons, adds: "This new drive system has enabled us to decrease the number of mechanical parts in

our vertical turning machine and increase its functionality."

At a mounting height of 300 mm, the motor installed in the ROMC can develop over 30,000 Nm of torque. No conventional drive can achieve this level of dynamic performance. Switching from high-torque roughing at 50 rpm to rapid finishing at 300 rpm can be done in just a few seconds. The new wheelset-manufacturing machine is now also free of loud motor rolling noise. The machine runs very quietly because no mechanical elements such as gears or belts are needed for power transmission. The non-contact drive has yet another advantage: it is wear free and thus requires very little maintenance.

Internationally respected: **High-performance CNC controls** In addition to the outstanding performance and control precision of the high-end Sinumerik 840D sl CNC, Robotta values its ease of operation and wide selection of convenient cycles that make machining easier for the user: "This includes the normal machining and measuring cycles, the easy-to-operate swivel cycle as well as the convenient engraving cycle, which makes it possible to engrave text anywhere with simple input." Haberkorn emphasizes yet another important point: "Siemens has a good global reputation and we operate internationally. The control system works without a hitch in all of the relevant languages, and the supply of spare parts by Siemens is perfectly organized on all world markets. We and our customers as well, value this very highly."

»This new drive system has enabled us to reduce the number of mechanical parts in our vertical turning machine and add to its functionality.«

Dr. Bernhard Pause, Technical Manager, Niles-Simmons

Highly advanced technology for precision parts

Automation: Controlled by high-end Sinumerik CNCs, electron beam machines from pro-beam systems enable perfect welding operations and precise surface hardening — helping to ensure a high level of quality and cost efficiency in parts manufacture in the automotive and aerospace industries.

Since its founding over 40 years ago, pro-beam systems GmbH has become the market leader in electron beam technology — and continues to expand. The company now has 250 employees in seven countries. Among other applications, Sinumerikcontrolled machines are used for welding satellite tanks and various engine parts. Well-known automotive manufacturers use electron beams to surface harden the working surface of their camshafts.

Utmost precision and maximum strength

The advantage of electron beam technology is that when decelerating, an accelerated electron gives off energy in the form of heat at the precise point of contact. The surrounding material largely remains cold, meaning this machining procedure produces far less thermal distortion than any other welding process. The electron beams are also easy to direct and can be accurately controlled using pro-beam's deflection technology, which is interfaced to a high-end Sinumerik CNC 840D sl from Siemens. This enables highly precise hardening or inclusion-free deep welding effects with extremely strong and narrow seams.

To be able to focus the jet perfectly, the plants produced by the specialist company work in a vacuum, allowing the best metallurgical values to be achieved. "Generating a vacuum is also less expensive than working in a protective atmosphere — and does not involve any harmful emissions," adds Tobias Frenzel, managing director of pro-beam systems GmbH, based near Chemnitz, Germany.

Faster welding, soldering and perforation

In addition to its accuracy, quality, and flexibility, the electron beam procedure stands out for its extremely high productivity. A direct comparison conducted on a user's premises showed that it took around 314 minutes to create a meter-long weld seam using powder welding, while the new electron beam plant completed the same task in 8.3 minutes, that is approximately 38 times faster. The electron beam plant can also take the place of soldering tasks because combining "slot-in coolers" is faster and results in considerably less warpage. It is also far easier to remedy any defects that may occur during soldering. pro-beam's plants also perform extremely well when perforating filters and sieves for use



»With electron beam plants, we can work 10 to 100 times faster than laser plants.«

Tobias Frenzel (center), Managing Director, pro-beam systems GmbH





From high-precision surface hardening of small motor shafts to welding large guide blade carriers for gas turbines, pro-beam's Sinumerik-controlled electron beam plants stand out for their oustanding performance





in sectors such as the food industry and glass wool manufacturing. Holes of up to 0.06 mm can be created in an extremely short period of time — up to 3,000 holes per second. "When it comes to these types of application, we can work 10 to 100 times faster than laser plants," explains Frenzel.

High-end CNC: Delivering flawless technology and service

The control system, drive technology and electromechanical structure need to meet the highest requirements before pro-beam's machines (which are developed and manufactured exclusively in Germany) are suited for their high-precision operation. The company has been relying on Siemens components since 1988. Today, pro-beam uses the high-end Sinumerik 840D sl CNC, which, combined with digital drives, meets all requirements for positioning accuracy and speed. Another key factor is that it complies with strict automotive specifications and is recognized across all industry sectors around the world.

This can be attributed in part to its outstanding technical features, such as rapid axis interpolation times, high processing speeds, and the ability to execute a variety of workpiece and electron jet axis movements synchronously, as well as to the fact that top service is guaranteed — anywhere in the world. This is extremely important for a medium-sized enterprise such as pro-beam, which operates internationally, says Frenzel. Michael Hofner, head of automation technology development, confirms that cooperation with Siemens is excellent: "Whenever we needed competent support with the control system integration, Siemens always delivered within the shortest of time."

The open control system is another benefit: "The Sinumerik CNC provides various data interfaces as well as convenient standard command sequences, which we use as the basis for developing specific cycles for our customers," explains Hofner. The only thing that remains complex is com-

weld seam

meter

Power welded: **314 minutes**

Electron beam welded: **8.3 minutes** 38 times faster

piling the CNC programs. pro-beam experts have to create several primary programs and subprograms to request the correct beam power depending on the required welding or hardening depth, and input the jet paths and speeds in combination with all of the different axis movements. "Once that is done, all that is required is a little fine-tuning on the machine and the welding or hardening process can begin," says Hofner. ■

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Climbing to the top

Automation: The renaissance of Spyder Manufacturing illustrates how the fate of a shopfloor manufacturer can be tied to its machine tool investment decisions. It is also the story of how this secondgeneration company stumbled upon a business breakthrough: CNC that is intuitive and empowering.

Originally a manufacturer of lawn and garden parts and accessories, Spyder Manufacturing has been through several transformations. Once employing more than 30 people, Spyder Manufacturing experienced a steep decline when global competition and shrinking profits forced the company to downsize its production and workforce. The company was spending thousands of dollars on outsourced machining, both locally and overseas, especially for more complex parts. Today, the California-based family business designs and manufactures its professional arborist equipment and supplies on CNC machines equipped with a Siemens Sinumerik 840D control.

A fever for change

"There was nothing advanced about our shopfloor," Matt Monnig, design engineer at Spyder Manufacturing and son of company founder and president Gary Monnig, recalls. "So I asked my dad if I could look into how investing in CNC-based machining might revitalize our company, and he immediately agreed." Entirely by coincidence, no more than five minutes later a CNC machine tool dealer walked in the door. Soon, a new Fryer MC40 milling machine featuring the Sinumerik 840D CNC was delivered and installed on the company's shopfloor.

The power of intuitive CNC

After graduating from high school, Matt Monnig had helped his dad run the company, but he had only dabbled in the machining side of things. That is why not long after delivery of the milling machine, Fryer Machine Systems' field service engineer, Trever Lowe, arrived to begin what was scheduled to be four days of training on its operation. However, almost at the outset, Matt Monnig came down with the flu. "When Matt returned at the end of the week, I realized that we had about four hours of scheduled instruction time left," Lowe recalls. Within only a few hours, Matt Monnig needed to learn how to use a CNC machine for the first time. Not only that, but he would be learning to program complex contour milling directly on the machine while using one of the world's most powerful controls, the Sinumerik 840D CNC.

Lowe summarizes that "when learning to program a Fryer machine, if you can understand the complex processes, then in time you will figure out the simpler steps. So that's what I did. In less than four hours, I showed Matt the most complex programming. Ever since, when customers ask me how much training time is needed on one of our machines, I tell them about Matt — someone who didn't know anything about CNC, but who in less than a day picked up enough CNC know-how to relaunch his business."

Programming at the machine

Ahead of Lowe's arrival, Matt Monnig had invested over four thousand dollars in CAD/CAM programming software. He admits: "I never used the software, because Trever showed me during our short training session that the Sinumerik 840D has something called 'conversational programming.' I just found it so much easier to understand and to work with than the complicated offline software." The ability to program at the control empowers both the operator and the owner to efficiently produce more than they could otherwise. Instead of waiting for a CAD/CAM programmer to download a G-code program to a machine, an operator can quickly set up the next program and keep production rolling.

"Not long after we bought our first Fryer machine, I drew up an improved version of our climber product," Matt Monnig recalls. The new product design was soon validated by the CAD/CAM capabilities of the Siemens control. Using highly intuitive, graphically-guided functions such as the contour calculator, the shopfloor could easily carry out design work for refining manufacturability directly on the machine. And at the same time, they were establishing the program to produce it. With no G-code language barriers in the way, the shopfloor could plan, design and manufacture a new generation of products.

Optimizing resources

For Gary and Matt Monnig, achieving a greater return on their CNC investments includes taking greater control of their business, while enabling their people and operations to become increasingly efficient. Spyder Manufacturing is able to design next-generation products and bring them to market, thus keeping pace with market demand. This includes top-selling articles such as their arborist equipment that bring together "old world" machinist skills and creative leadership to capitalize on the most intuitive and powerful CNC solution available. Today, Spyder Manufacturing owns three Fryer MC40 milling centers, all equipped with Sinumerik 840D CNCs. Before the company's investment in Fryer and Siemens, it took their shopfloor a month to manufacture 50 sets of tree climber products. Now they manufacture nearly 500 sets each month. Higher production capacity and efficiency have brought a nearly tenfold increase in sales of the company's flagship product.

Looking back, Gary Monnig and his son Matt consider themselves fortunate to have stumbled upon the best possible strategy for revitalizing their business. Looking ahead, they plan further investments in Fryer machines equipped with Siemens technology, knowing that anything is possible given the right set of circumstances: the entrepreneurial desire to ask what if, a machinist's compelling imagination to see the way forward, and the power of intuitive CNC to make it happen.

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Top: Matt Monnig (right) and his colleagues strive to continously improve existing products. Center: Thanks to their CNC investments, Spyder Manufacturing has revitalized its operations. Bottom: The family business manufactures arborist equipment and supplies

A perfect combination

Automation: When machining processes are the focus of production, the work itself can be done by a robot. Le Créneau Industriel has recognized this and developed a robotic machining solution controlled by a Sinumerik 840D sl.

Not long after it was founded in 1978, the French company Le Créneau Industriel began to develop machines with CNC software designed specifically for sophisticated technical applications. At the end of the 1990s, the company gained a foothold in aeronautics — a field that it still specializes in today. Addressing the industry's special needs, Le Créneau Industriel had then developed an innovative solution for contouring sheet aluminum in varying thicknesses. Today, the aerospace experts at Le Créneau Industriel have combined state-of-the-art numerical control technology for high-precision machining with modern robotics.

Specialized in composite material machining

The aerospace industry is relying more and more heavily on composite materials. This prompted Le Créneau Industriel to develop a five-axis machining center that met the rigidity requirements for machining exactly such materials. The result was a multi-spindle drilling machine for manufacturing composite material components for engine nacelles. Impressed by this new development, a major European aerospace manufacturer commissioned Le Créneau Industriel to design a new multi-purpose machine. The machine should combine high-speed machining techniques with ultrasonic cutting of components with a honeycomb core.

Laurent Combaz, CEO of Le Créneau Industriel, explains: "Our skills lie in developing machining processes for specific applications. To accomplish this, we are always looking for the best options in terms of programming, tool choice, or machining strategies." Realizing this, it made perfect sense to concentrate on the design and have the work itself executed by a robot. No sooner said than done: in 2015 Le Créneau Industriel began to focus on developing a machining solution that uses robots.

Le Créneau Industriel's solution for machining composite materials using Sinumerik CNC and robots stands out for its high level of precision



A successful combination of CNC and robots

Because those responsible for the project realized that it would be difficult to handle the challenge of combining CNC and robots without outside expertise, they identified reputable partners from the fields of automation, robotic equipment, tooling and machining to help turn the project into reality. They opted for Stäubli Robotics, whose robots are known for their robustness. In terms of the control system, Siemens was the partner of choice. "We have been using Sinumerik CNCs exclusively for around five years. For us, these are the only controls that meet our requirements in terms of performance and functions," explains Laurent Achard, research and development engineer. The key benefit of combining CNC and robots is that the machining robot is programmed and can be controlled the same way as a traditional machine tool. This means manufacturers do not need to adapt their usual machining processes. The first robot cell to be programmed and controlled using a Sinumerik CNC 840D sl was developed at the end of 2015 through close collaboration between the companies.

Precision has the highest priority

Once a numerical control system has control over the robot, another challenge needs to be addressed: How to achieve the high level of precision required for the aerospace industry? First, the absolute precision of the robot had to be increased, and second, the machining processes had to be further optimized to minimize mechanical strain on the robot. Thanks to a combination of mechanical and ultrasonic processes, the robot is not exposed to excessive force when machining honeycomb core components. This made it possible to focus on improving the robot's precision and designing the architecture and kinematics of the robot cell. In 2016, Le Créneau Industriel conducted numerous tests in order to perfect the process, check the cutting tools, verify their service life, test various honeycomb structures, and machine increasingly complex shapes. "All of these tests allowed us to obtain solid expertise in robotic machining," says Bruno Botton, head of the research and development department.

Outstanding potential

To demonstrate the potential of this innovative solution, which delivers numerous benefits (half the footprint, increased speed, great flexibility, ease of integration into a production line, etc.) to manufacturers in the aerospace industry, Le Créneau Industriel has commissioned a demonstration model of the plant for machining honeycomb core components at its site in Annecy, France. Interested companies are invited to try out producing sample parts, or even pilot series.

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Safely into outer space

Automation: Augsburg, Germany-based MT Aerospace subjected a 25-year-old complex flow-forming machine used for manufacturing booster casings in the Ariane 5 launcher system to a comprehensive retrofit and put it back into operation after only three months of downtime.

After blast-off, it only takes two minutes for the two Ariane 5 launcher system boosters, each filled with 237 tons of solid fuel, to completely burn out and be jettisoned at an altitude of approximately 80 km. Primarily tasked with delivering communication satellites into orbit, the launcher system requires booster casings consisting of seven cylinders and two domes each. It takes about one year to manufacture these steel tube blanks, which have to go through various manufacturing steps including machining, forming, tempering, measuring, welding, coating and finishing.

At the center of the manufacturing process stands the MT Aerospace

flow-forming machine, which is unique worldwide. Production manager Michael Servo explains the technical principle of the counterroller flow-forming machine: "We use four pairs of rollers that compress the steel at a pressure of around 100 tons per roller. Within around 75 minutes we press the material from 50 mm to 8 mm, elongating it from the approximately 1 meter blank to almost 4 meters, the equivalent of an 80% deformation."

Flexible CNC — perfect for retrofitting

One factor crucial in ensuring a troublefree forming process is precise manufacturing of the steel tube blanks. A large vertical lathe equipped with a high-end Sinumerik 840D sl CNC rotates the rollers to achieve uniform material thickness of 50 mm. Wilhelm Weise, booster production foreman, emphasizes the benefits of CNC: "We can deploy our employees flexibly in machining production and, when it comes to servicing, we have a single supplier we are very satisfied with." Thanks to its flexibility, Sinumerik can also be adapted for use in a wide range of production processes. This became especially clear during the comprehensive retrofit that MT Aerospace commissioned Siemens to carry out in 2014. The three-month timeframe for completing the work helped avoid protracted plant downtime.



Overcoming challenges on schedule

Thanks to perfect planning on both sides, it was possible to meet the ambitious schedule and MT Aerospace was able to supply its customers without delays. One of the biggest challenges was the flow-forming machine, found nowhere else in the world. "There is nothing comparable that we could have used," reported Siemens sales consultant Stefan Asam, whose team spent six months preparing the retrofit project. While the production process had to remain unchanged to fulfill aerospace industry requirements, technical improvements also had to be integrated as well.

For example, a transition from analog to digital drive technology was carried out. This meant that almost all motors. drivers, cables and control cabinet elements had to be replaced and connected to the new Sinumerik 840D sl CNC. As a retrofit expert, Asam found that connecting the 18 axes to the control system using Drive-Cliq was

relatively easy because the NC can manage up to 31 axes. However, he felt the reliable calibration and force control of the eight Z axes running in the gantry unit posed quite a challenge. "All four pairs of rollers had to be perfectly synchronized. This meant adapting all the axes individually to match specific machine conditions." Further important elements for guaranteeing a stable forming process are the wide range of integrated safety functions. For example, an intelligent "emergency retraction switch" was installed as part of the retrofit. If an employee activates the emergency stop switch, all rollers move away from the material in a controlled manner and stop immediately. This reliably prevents any lasting damage to the machine or the component.

MT Aerospace was also very pleased with the display of the processes on the user unit, which can be used not only to monitor plant status, but also to use input masks for generating and activating NC programs. And one

other thing impressed the people at MT Aerospace: It was possible to connect the existing 350 kW DC motors to the digital drive technology. "In the end, the Siemens specialists managed to use Sinamics converters for the coupling, which allowed us to save a lot of money," says Servo.

Competent service ensures a high degree of reliability

The flow-forming machine has been in operation again since March 2015 without breakdowns, thanks to regular maintenance work. If more complex servicing is required, MT Aerospace can count on competent support from Siemens. A four-person service team is on site to ensure the fastest possible response time. This enables Servo to avoid plant downtime and ensure the required annual quota of booster casings can be delivered.

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