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Practical knowledge for the shopfloor

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Digitalization

- Not always identical:
digital twins of machine tools
- 4 For machine tool operators and machine builders, different virtual images are required
- Focus on digitalization
- 8 Do you have questions about the digital future in your working environment? We have the answers!
- Industrial Edge – the power of digitalization in manufacturing
- 10 To support digital manufacturing, Sinumerik Edge is available as a machine-oriented platform for apps



CNC knowledge

- Save time on every groove and slot
- 11 Trochoidal milling is used relatively little today, but offers several advantages
- Identifying errors
- 12 The "Analyze MyWorkpiece /Toolpath" PC tool facilitates the search for quality defects in freeform surfaces
- Update for the compact class
- 14 With the Sinumerik 828 V4.8 SP3 software, new functions are available
- Angle heads save retooling
- 16 With angle heads, many machining steps are completed in just one clamping



On the shopfloor

- Consistency ensures skilled workers
- 18 Thanks to Sinumerik CNCs, Benz can systematically train its own skilled workers
- Perfect music pleasure through precision
- 20 For the production of high-quality record players, Wirth relies on Sinumerik 808D Advanced
- The controller is key
- 22 Pausewang benefits from the perfect combination of control systems and machine tool

Cover photo: Siemens AG



Education and training

- Digitalization starts during vocational training
- 24 The Haidlmaier training center demonstrates how training has to adapt to digitalization
- CNC online learning
- 26 Siemens offers an increasing number of CNC online learning resources, accessible from anywhere
- Network expansion
- 27 The Rhine-Hessen Chamber of Skilled Crafts is a new Siemens training partner for Sinumerik CNC training
- CAD/CAM qualification for machine tool operators
- 28 ebiz Pocking complements its training program with an additional qualification of CAD/CAM planner
- Sinumerik live – Video tutorial:
Direct programming of dynamic 5-axis machining in Sinumerik Operate
- New Sinumerik-certified trainers



News

- 31 Modular pens /
Enter the world of Sinumerik via an app /
Dates

Wirth Tonmaschinenbau manufactures classic record players for analog high-end music pleasure



Wirth Tonmaschinenbau Manufaktur

The digital twin – a matter of perspective

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1001
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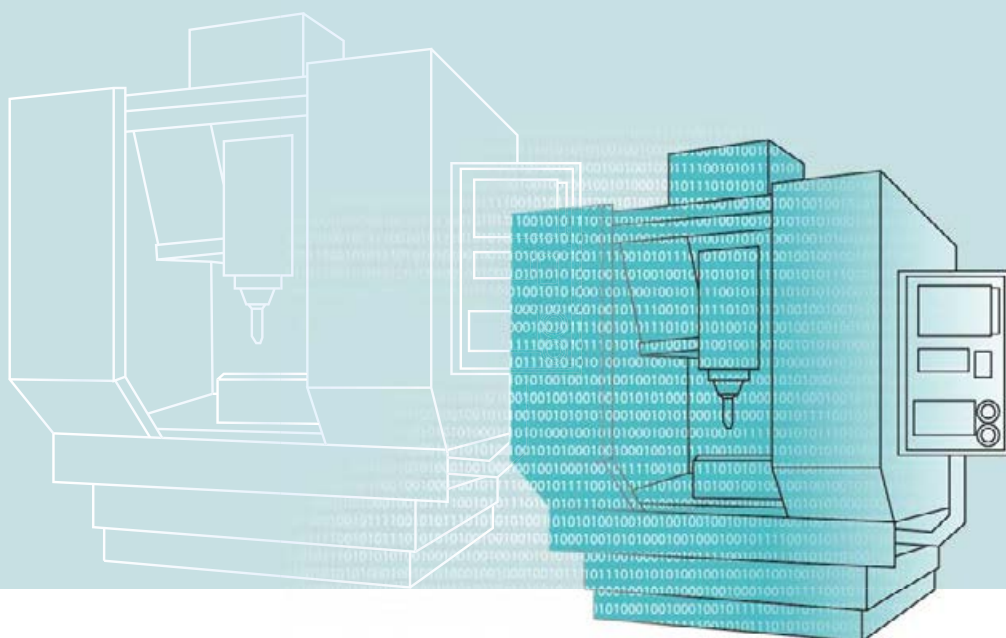
Digitalization

Digital support opens up new ways to further increase efficiency, flexibility, and profitability in manufacturing. It allows processes and procedures to be anticipated, tested, and optimized in the digital, virtual sphere. This is achieved with the help of digital twins, which represent machine tools and their properties on a virtual level.

The requirements for a digital twin differ greatly depending on perspective: a machine builder uses it when developing the machine, its components, and its PLC and CNC software — often right through to virtual commissioning before the machine is even physically complete. This saves time and minimizes the development risk.

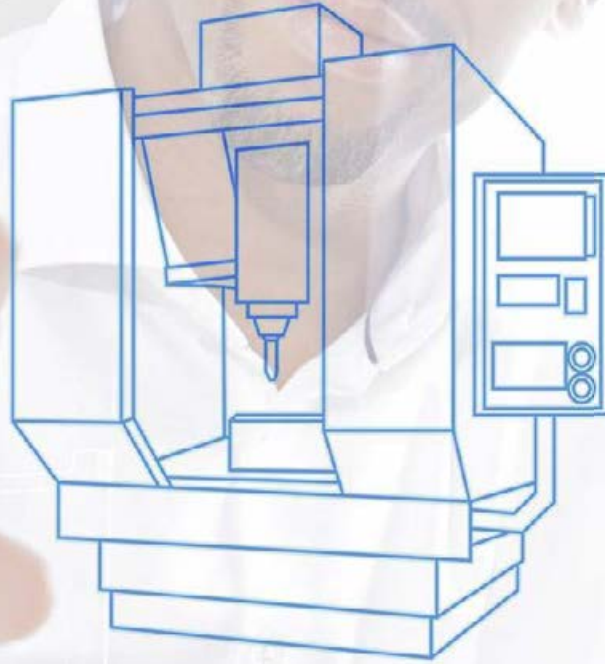
On the other hand, the way that a machine operator looks at a digital twin is quite different, with the goal here being to verify and optimize parts programs. As such, the range of digital twin functions that are of importance in the field of manufacturing are quite different to that of machine building.

The different perspectives on digital twins correspond to different operation environments for hardware and software. Understanding these differences is key to the successful digitalization of manufacturing. The following pages explain more. ■



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Digitalization



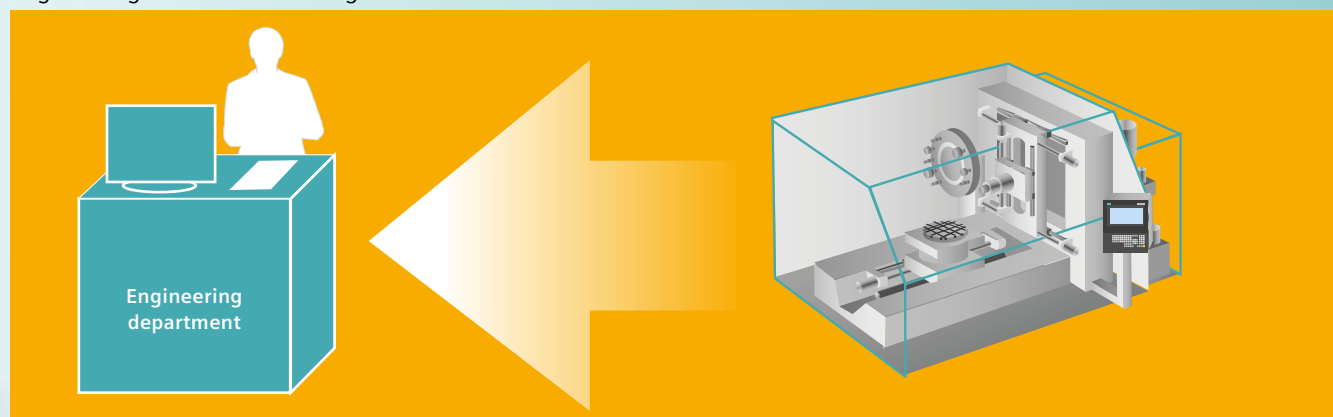
Not always identical: digital twins of machine tools

In the light of increasing digitalization, it is important to understand that digital twins are not always the same. The example of a machine tool illustrates that machine operators and machine builders need different virtual images to map their specific requirements.

There are two very different application scenarios for digital twins in the lifecycle of machine tools: One is determined by the requirements of the machine builder, and involves application during the design, engineering, commissioning, maintenance, and servicing of machines. The second application scenario concerns the machine tool

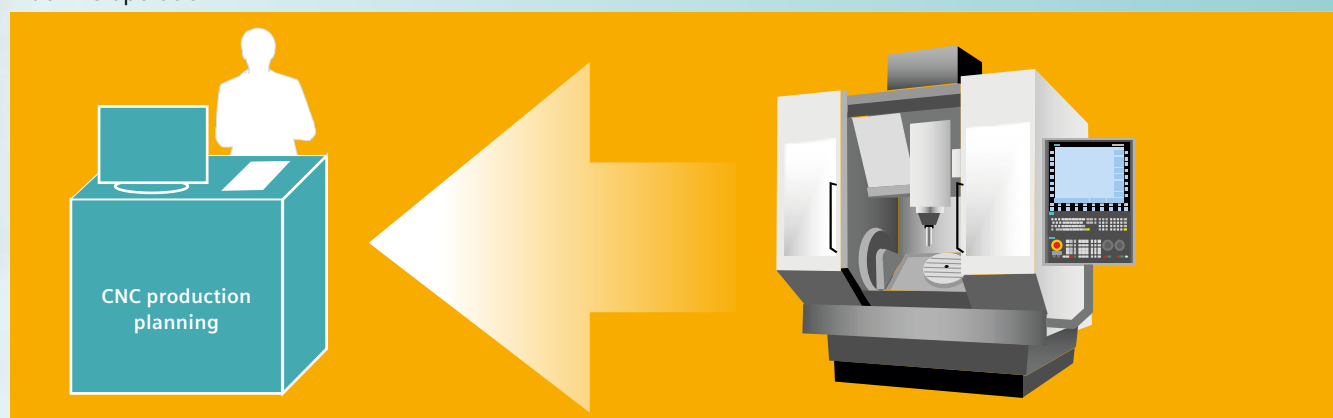
operation, particularly the creation and verification of reliable CNC programs. It is important to be aware of and understand these differences when digitalizing production and purchasing new machines. For this, it helps to be familiar with the basics of how digital twins are designed.

Engineering and commissioning of the machine tool



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Machine operation



A powerful tool

A machine tool is a complex mechatronic entity, and its digital twin is complex, too. Like the real machine tool, the digital twin needs to be segmented into modules: a virtual image of the CNC equipment, a virtual image of the machine behavior, and a virtual image of the mechanics.

The digital twin concept potentially covers all phases of a machine's lifecycle. This ranges from the development, engineering, and commissioning of the machine, to its use in manufacturing a wide variety of workpieces, to servicing and maintenance: all of this is monitored, planned, checked, and optimized on a virtual level with a digital twin.

Only some of the options are of interest

Requirements for the digital twin differ greatly depending on the machine's life phase (i.e., development, use, service). The machine operator uses a digital twin to ensure, on a virtual level, that CNC programs are fault-free and will deliver the desired machining result on the first go. This saves the machining time otherwise spent to run in the parts program step-by-step.

It also allows the operator to ensure that a new NC program will not cause any collisions between a tool or clamp and the machine or workpiece.

In short: during production, the digital twin is there to ensure that the machine will run reliably and is relieved of process steps that serve no purpose. The fact that the machine itself will function as intended is taken for granted, and not checked using the digital twin.

Electrical engineers, software departments, and machine builders' service technicians, on the other hand, are interested in exactly that: they use the digital twin to ensure that the machine will function in line with its specifications. Testing the interplay between the CNC application and actuators, sensors, and the mechanics is the key here. All conceivable operating situations are played out in advance, and special occurrences are taken into account in the CNC application. Following approval and delivery of the real machine, service technicians use this digital twin to track down malfunctions and offer solutions without having to travel to the customer.

The area of focus for the machine builder is shortening the development periods and time-to-market. This is achieved by shifting development stages to the virtual sphere, saving the creation of mechanical prototypes, and maximizing the operating safety and availability of the machine. Unlike the machine tool operator, the machine builder does not have to create fault-free CNC programs, but makes use of tried-and-tested, quality-assured parts programs for prototype tests that need to be run.

These two fundamentally different perspectives shape how the digital twin is used — that is to say, the software and hardware environment in which it is deployed. These differ depending on how the digital twin is to be used, what options it must offer the user, and which are not needed.

Digital twin and chipping production

When it comes to parts programming and production planning, the core task of the digital twin is to ensure that CNC programs are fault-free. The virtual image of the CNC equipment within the digital twin is used to simulate the execution of CNC programs. There are two different approaches to doing this available on the market. The first option emulates the function of the CNC — that is to say, it simulates the CNC in the machine software.

The second option uses the CNC's real system software. For Sinumerik, this is performed by the virtual numerical controller kernel (VNCK). The Sinumerik VNCK contains the same system software as a Sinumerik CNC. As a result, the virtual Sinumerik CNC in a digital twin behaves in exactly the same way when executing parts programs as the Sinumerik CNC behaves in the real machine. The reliability that a part which has been tested and optimized using a digital twin will be machined in precisely the same way on the real machine as it was in the simulation — with the same process safety, speed, and machining

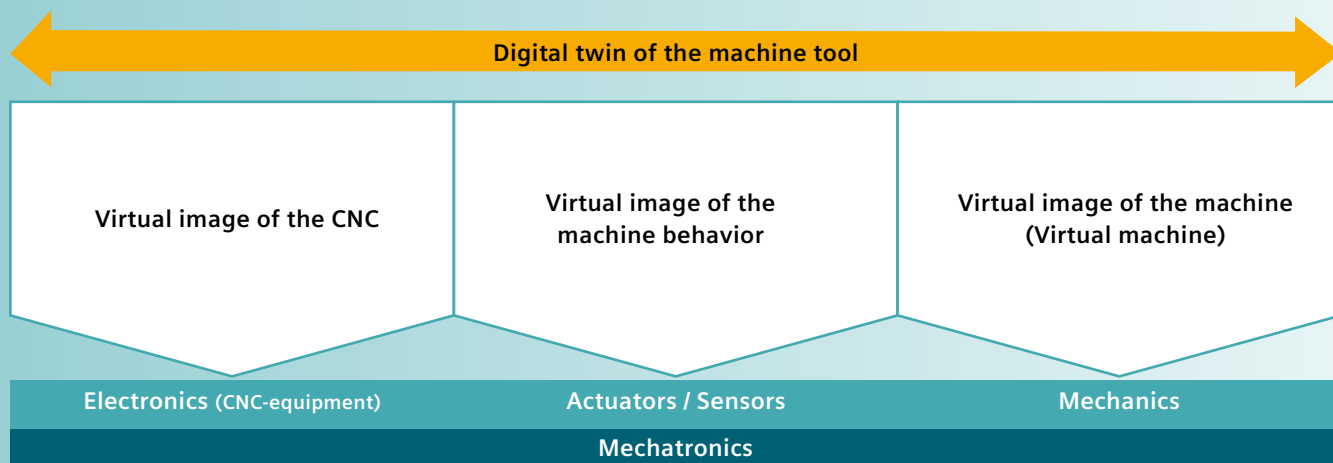
quality — is especially high with VNCK-operated digital twins of machine tools. It means that the goal of producing an in-spec part straight away, even in one-off production, is achievable even with complex workpieces.

Aside from the VNCK, the virtual image of the machine's mechanics is important for the practical aspects of working with the digital twin: it visualizes each and every moment of the production process, meaning that it can be monitored on the PC. In addition to the optical display of machine and tool movements, the digital twin is responsible for reliably identifying and flagging collisions between the tool and part, clamping, and machine components — which ultimately involves visualizing the machining itself through removal simulation. The NX Virtual Machine software is one of the leading systems in the visualization of machine movements as well as material removal, and this software also supports seamless integration of the Sinumerik VNCK.

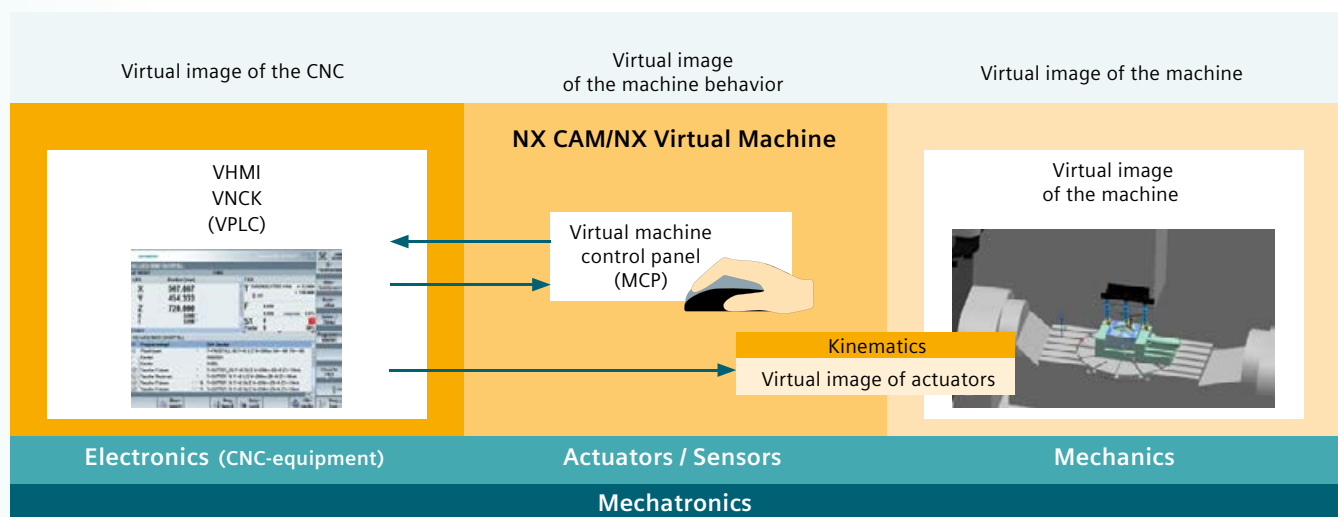
The third aspect of a digital twin — the simulation and manipulation of the behavior of individual machine components, actuators, and sensors — has only minor significance in CNC production planning. All that is required here is a realistic virtual machine control panel (MCP) that operators of the virtual twin can use to operate the simulated machine and manipulate execution of the CNC program.

Engineering: Focus on machine details

The behavior of any machine is determined by the interplay between a large number of different actuators and sensors. Let's take the example of a tool changer: The spindle must adopt the tool changing position, a slide opens a flap, the spindle clamp has to be opened, a gripper clutches the previous tool, moves the new tool into the spindle, the clamp is closed, the gripper is retracted, the flap is closed. In development, commissioning, and servicing, a digital



The digital image needs to be segregated in modules, just like the real machine tool



NX Virtual Machine: the simulation PC operator himself represents the virtual machine behavior during CNC simulation in the virtual machine

twin not only simulates the behavior of all the involved machine parts, actuators, and sensors in the virtual sphere, but must also allow for specific adjustments in their interaction.

Hardware-in-the-loop

Unlike the simple NC kernel, there is no virtual image of the CNC equipment that completely encompasses the CNC, PLC, and drive control functions. Therefore, machine builders need an interface between the virtual and the real world, to control their digital twins with real CNC and drive components using a test rack.

Implementing the Simit and NX Mechatronic Concept Designer programs offered by Siemens is one solution to this. Simit realizes the connection of hardware signals and fieldbus with the actuators and sensors of the digital twin. The NX Mechatronic Concept Designer essentially ensures that the mechanical components of the machine mapped out as a 3D model move as intended, for example along a guide rail or around a joint — or do not move at all, if they are fixed together. Thanks to these software products, a machine's CNC equipment is put into operation without real prototypes. The machine's mechanics and electrical equipment are represented by the digital twin. When a customer reports a fault, this digital twin allows machine service departments to track down the problem, analyze it, and offer detailed advice to technicians on-site. The compatibility of software updates or function expansions is verified without affecting the availability of the machine itself. The collision avoidance and machining simulation features that are so important in production play a minor role here.

Strictly speaking, a "digital twin" operated by means of hardware-in-the-loop is not a full virtual twin of the

machine tool — seeing as a real CNC is used to control it. The simulation computer "only" provides the virtual image of the machine's mechanics and simulates the behavior of all machine parts in detail.

The digital twin as a means of communication

Use of digital twins in development and in production planning are by far the most important forms of application. However, in practice the distinction between the two different applications is not so precise and the resulting application somewhere in-between. Machine builders will also work with the VNCK and the NX Virtual Machine to explore new technological functions and their impact on the mechanical design, and to create functioning models of the machines to highlight their functional selling points.

Machine tool operators, on the other hand, are often involved in the engineering phase of their new machines, therefore coming into contact with the digital twin for machine tool engineering and commissioning. For customized versions of series machines, for example, the special functions are often worked out in detail using digital twins. With special machines or large machines, it is essential for machine builders to discuss possible solutions with the future user as early as the design phase.

All in all, digital twins are not only powerful tools for development, production, and servicing, but also represent a highly efficient means of communication when it comes to conveying ideas, features, and requirements. ■

➤ siemens.com/cnc4you
✉ andreas.groezeinger@siemens.com

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Digitalization

Focus on digitalization —

You ask, we answer

Be it politics, media or management: the topic of digitalization is on everyone's lips. But what impact will it have for operators of CNC machines? What do machine operators now have to adapt to? CNC4you addresses these issues in the "Questions and Answers on Digitalization" series.

Digitalization is changing work processes and will have a definite impact on how we work with CNC machines over the coming years. These changes will demand different modes of operation, as well as new, additional qualifications and skills from employees in production.

In this CNC4you series, we will take an in-depth look at the question "How will digitalization change our jobs?" and provide you with plenty of information and tips — always with a specific focus on your jobs. Alongside this, we will be offering "Questions and Answers on Digitalization" online for our readers, as well as explaining trends and describing new technologies, all on our CNC4you portal (siemens.com/cnc4you).

What questions do you have about the digital future in your field of work? Write to tell us what you would like to know about digitalization by sending your questions to **contact.cnc4you.i@siemens.com**. We will provide you with answers through our own research and interviews with experts.

In this year's first edition of CNC4you, we have already answered the first few questions. Now, we'll move on to the topic of "Digitalization in our workplace". ■

"How will digitalization change working time models in CNC production?"

"How will shopfloor programming change? Is it still needed in view of CAD/CAM technology?"

➤ siemens.com/cnc4you
✉ schlegel.thomas@siemens.com

The fourth industrial revolution is leading to the wide-scale networking of machines. Humans are essential for this interaction between machines, guiding them intuitively through the work process or improving operations with their own professional experience. Recent studies show that digital transformation in German companies is progressing at different speeds and with varying intensity. Many skilled workers fear this will only result in an added burden and increased flexibilization. However, it is more likely that new working environments will provide a wide range of employee-friendly solutions.

One conceivable solution, for example, is further developing the working time accounts introduced a few years ago. This involves employees largely organizing themselves depending upon the order situation and delivery deadlines; rigid shift schedules do not exist. This not only makes it easier to balance work and family life, but also offers more freedom in the workplace: with an integrated, virtualized, and highly automated production facility, peak workloads can be better planned and accommodated in advance. When it comes to job sharing, with several colleagues sharing one workstation, digitalization could allow better planning of alternating half-day and half-week units. The working time models in CNC production are likely to become more flexible and agile as a result of digitalization — benefitting both companies and employees.

CAD/CAM technology has been increasingly used alongside classic shopfloor programming for years. The advantages are obvious: the G-code is already created during production planning, downtimes are reduced and the machines made more productive. In addition, errors that may occur when transferring a drawing are eliminated because the CAM software takes the data directly from the CAD software. Many industries and manufacturers will aim to make greater use of this potential in the future. Nevertheless, shopfloor programming and the expertise required of machine operators remains important. This is partly because the systems are only able to respond to special events to a certain extent. Special machine and material behavior or unexpected dynamic effects are only some examples of such eventualities. Optimal start-up settings and quick fixes during operation require operators with in-depth knowledge and experience regarding production and machines. Another reason in favor of classic shopfloor programming is that the process chain using CAD/CAM technology to the machine is capital-intensive. In many applications, especially for small quantities and parts with low/medium complexity, this will not be cost-effective. Shopfloor programming still remains the more efficient solution.

Our tip:

Working time solutions are as unique as the companies in which they are implemented. Find out what your company already has on offer for employees regarding “Work 4.0”, and speak to your supervisors about possible future developments in working time models. If you wish to help shape the opportunities for flexibility, it is also a good idea to seek training on the new machines and work processes, which will make you particularly valuable to your company.

Our tip:

Extensive experience and comprehensive expertise are an invaluable asset when working on CNC machines. Use your existing skills and continue to develop them. Broaden your knowledge, for example by learning about production planning. New job profiles, such as that of a production engineer, or training as a certified process manager in production technology, will break down the rigid boundaries between planners and operators and offer experienced CNC professionals new fields of activity.

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Digitalization

Industrial Edge — the power of digitalization in manufacturing

A combination of hardware and software, Siemens' Sinumerik Edge provides a machine-oriented platform for apps that facilitate digital production support and optimization.



The Edge devices from Siemens are powerful and standardized industrial PCs

The process-related data constantly arising in the course of digitalization are analyzed by means of algorithms and apps. In the best case, the results obtained can directly support and optimize production. However, this requires considerable computing power — and a CNC is usually unable to provide it without jeopardizing process stability and quality.

Combining data and computing power

With Industrial Edge, Siemens has created an IT concept that brings the data from production and manufacturing together with globally quality-assured digitalization functions on locally installed Edge computers that are precisely tailored to the relevant digitalization task. Edge computers allow high-frequency CNC data to be recorded, pre-processed, and analyzed locally, in real time, and with virtually no impact on the CNC. At the same time, with their Internet connection, the computers are “on the edge” of the cloud.

Edge devices from Siemens are powerful, standardized industrial PCs with a Linux-based operating system that is specifically designed for connection to clouds and controllers. CNCs are connected to Edge computers such as these via a local high-performance interface in the plant network. With a second interface, the Edge computer is connected to the network present in all modern production plants.

Using apps, the management, system maintenance, and provision of necessary digitalization functions are carried out online using the MindSphere industrial cloud platform. This globally accessible, open IoT operating system offers, alongside an online memory and computing power, extensive service, technology,

logistics, and management functions, including software distribution and much more — all in accordance with the strictest data protection and security guidelines, of course. The apps that support on-site production on the Edge devices are installed and kept up to date via MindSphere.

Because they are (indirectly) connected to MindSphere, the machine tools supported by Sinumerik Edge are simple to administrate and manage. Thanks to the Edge computer's connection to MindSphere, it is possible to use “traditional” cloud-based services where required — for example needs-based maintenance, or fleet management of manufacturing centers.

Mini Edge glossary

Edge computing	Decentralized data processing at the “edge” of a network, represented in concrete terms by a local computer designated for Edge computing The opposites of Edge computing are cloud computing (centralized data processing, Internet-based), and local data processing (in production, e.g. directly on a CNC)
Industrial Edge	Siemens' cross-industry solution for Edge computing is designed to meet industrial requirements
Edge app	Software that runs on Edge computers and implements digitalization functions on-site
Sinumerik Edge	Version of Siemens Industrial Edge for CNC machines
MindSphere	Open Internet of Things operating system from Siemens, implemented as an industrial cloud solution. MindSphere is used in all industries, and largely regardless of the size of the company. One of these industries is the manufacturing industry, including the associated supplier firms
MindApp	Software that runs in MindSphere and centrally provides digitalization functions (Internet-based)

The architecture of Sinumerik Edge is designed for the complex computing processes of three, five, and multi-axis, as well as multi-channel, path and motion control. The apps' operator interface fits seamlessly into Sinumerik Operate. For example,

Edge-based trochoidal milling can be called up directly from the cycle and program editors in Operate using the "Optimize MyMachining /Trochoidal" app, being operated and parameterized in exactly the same way (see article below).

However, the complex algorithms behind the function do not place strain on the CNC as they run on the Edge computer. ■

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✉ bjoern.rosenbaum@siemens.com

Save time on every groove and slot

Saving time in manufacturing results in real financial benefits and contributes to competitiveness. With this in mind, it makes sense for companies to look at trochoidal milling — a little technique used today. Trochoidal milling is available as an app when digitalization is implemented with Sinumerik Edge.



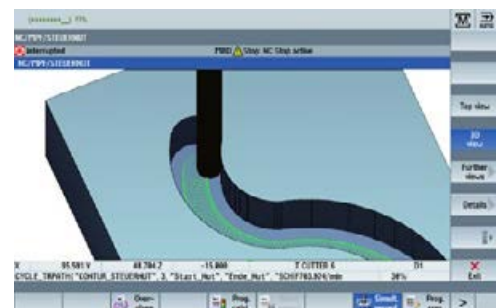
Trochoidal milling brings considerable increases in productivity when milling grooves, slots, and cut-outs with a flat base. It uses a milling tool with a small diameter. This milling tool is guided in a circular or curved motion in such a way that there is only a small wrap angle between the milling tool and the material to be cut. This also means a low cutting force and allows chips to be removed from the workpiece and tool quickly. The result is reduced friction and improved heat dissipation through the chip, which in turn facilitates excellent feed depths, high path speeds, and good tool utilization.

Although the tool covers a longer distance due to the circular path, the machining time is considerably less than with contour-parallel multi-pass milling or milling at the width of the groove. Trochoidal milling speeds up many work steps — often by 1.5 times or more. However, purely manual programming of a trochoidal tool path is very time-consuming. In practice, this cutting strategy has, until now, more or less only ever been used in CAD/CAM-generated parts programs.

Trochoidal machining as an app-based cutting strategy

With Sinumerik Edge (see article on page 10 of this edition), trochoidal milling is now implemented using the Optimize MyMachining /Trochoidal Edge app. The app is installed on the Edge device via the MindSphere cloud platform. This means that trochoidal milling is available as an additional cutting strategy (configurable directly on the operator panel) to the Sinumerik CNCs connected to the Edge device.

The contour defined in the program editor or via DXF file is then converted into a trochoidal production process by means of a complex algorithm. The trochoidal tool path is calculated on the Edge device and returned to the CNC to be processed as a sub-routine. As such, the CNC's performance is unaffected, despite the CPU-intensive procedure. In addition, Optimize MyMachining /Trochoidal generates tool paths that are highly homogeneous and match the dynamics of the relevant machine — with the result that the machine runs more smoothly and lasts longer.



In trochoidal milling, a milling tool with a small diameter is selected. When milling grooves, for example, a milling tool is chosen that is significantly smaller than the groove width.

With the Optimize MyMachining /Trochoidal Edge app, highly productive trochoidal milling can be programmed quickly and easily right on the machine. Using it is worthwhile even for small batches and one-off items. ■

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✉ bjoern.rosenbaum@siemens.com



Identifying errors

The “Analyze MyWorkpiece /Toolpath” PC tool enables a systematic search for the causes of quality defects in freeform surfaces. This guarantees quality assurance, even before the first machining trial.

When the surface quality of a freeform workpiece fails to meet expectations, virtually all the stations between the CAD system and the tools used could be possible sources of error: the output of the CAD system itself, the output of the CAM system or post-processor, the parameterization of the CNC and the drive controller, the mechanics of the machine, the tools, the coolant — theoretically, even the workpiece material.

Tracking the “garbage in, garbage out” effect

The quality of each process step between the CAD system and the

workpiece depends upon the input data from the previous process step. Thus, in a systematic search for the causes of surface quality defects, the output data of the individual system parts must be scrutinized: the STL file of the CAD system, the mpf file from the CAM system/post-processor, the logging of position setpoints (IPO trace) generated by the CNC during execution of the parts program and, finally, what the drive controllers have made of this in conjunction with the machine mechanics and the tool (IPO trace of the actual position values). This requires the use of appropriate tools.

The mold-making Quick Viewer in Sinumerik Operate can already visualize the parts program that represents the CAD point cloud as the start and end points of G1, G2 and G3 sets. This can be done online, i.e., directly on the machine. The Analyze MyWorkpiece /Toolpath PC-based tool offers a technologically deeper insight. In addition to STL files, it can also display transcripts of the interpolator output of the CNC (IPO trace), retaining the reference to the parts program: for each data point, the respective set is displayed in the parts program.



Quality assurance from the first chip

Siemens AG

velocity). As a result, the data causing the quality defects can be found sooner and indications of the causes can be identified.

Inhomogeneity in the point cloud generated by the CAD system found on the faulty workpiece surface is one example for this: it indicates bad parameterization of the CAD output. Discontinuity in the local tool path curvature may be due to the contour support points being too close together: these "double points" force an atypical and unintended curvature of the tool path, which puts too much strain on the machine tool's speed control. To discover the cause of the quality defect, it is necessary to check whether these double points in the CAD data coincide with surface transitions or whether they occurred during the implementation via CAM system or the postprocessor.

In the IPO trace's 3D view of the position setpoints, the chord length is color-coded per IPO cycle and thus the current path velocity is indirectly shown (path velocity = distance per IPO cycle). Anomalies here indicate adverse speed control by the CNC. This is remedied by changing the settings of the Look Ahead function, the COMPCAD data set compressor and/or CYCLE832. However, a comparison with the trace of the actual position values provides an indication of insufficiently optimized drive controllers or machine/tool vibrations.

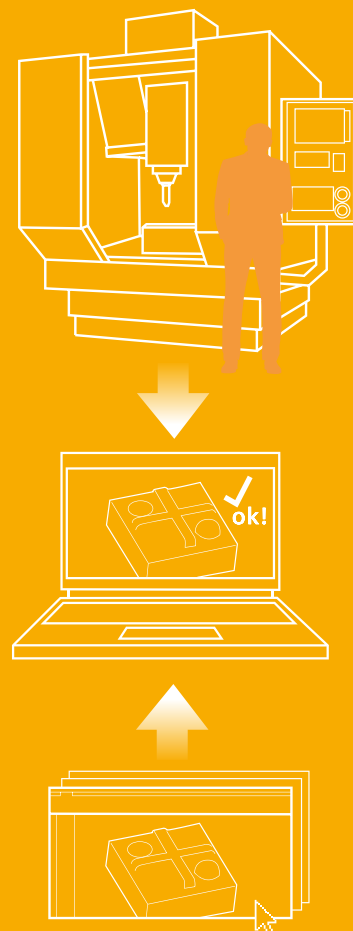
Direct comparison in 3D

Analyze MyWorkpiece /Toolpath can display data sets from different origins side by side in 3D for comparison. By directly comparing the output of the CAD and CAM systems or the IPO trace and the CAM data, the causes of error can be identified and isolated. Analyze MyWorkpiece /Toolpath assists with the qualitative data analysis by displaying various selected properties of the data series in color-coded form. Colors represent aspects such as local density of the point cloud, the local curvature of the tool path or the length of the chord section of the tool path for each interpolator cycle (and thus the path

Quality assurance from the first chip

With Analyze MyWorkpiece /Toolpath, all the critical points of the process chain can be visualized in a practical way. As a result, causes of quality defects in freeform surfaces that are otherwise difficult to detect are systematically resolved. With experience, this results in a considerable increase in expertise regarding the technological relationships and interactions in the process chain.

Analyze MyWorkpiece /Toolpath is implemented as PC-based software so that the machine tool can continue to be used during a search for causes. It is thus possible to perform quality

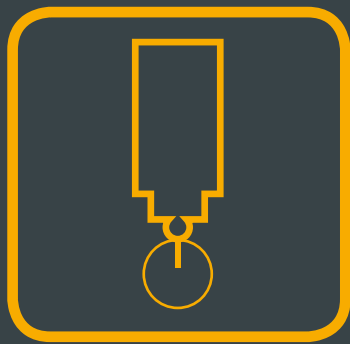


Analyze MyWorkpiece /Toolpath is an important means to analyzing the process steps in free-form surface production

assurance on CAD/CAM data even before the first workpiece is manufactured. This is particularly important when machining large-sized workpieces with high use of material and cutting time. Here, Analyze MyWorkpiece /Toolpath also allows for quality assurance in the position and speed logging for production simulation carried out with the Sinumerik virtual numerical controller kernel (VNCK). VNCK is included in software such as Sinutrain and the NX CAD/CAM system, for example. ■

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✉ bjoern.rosenbaum@siemens.com



Update for the compact class

Siemens is setting new standards for machine tools in the medium performance and price range with its V4.8 SP3 software for the Sinumerik 828D control system. Users can now benefit from many functions that were previously reserved exclusively for the premium machine tool segment.



With its Sinumerik 828D V4.8 SP3 software, Siemens offers a control system designed for the mid-range machine segment and for highly flexible work in small and medium-sized companies, as well as for series production. The new software version of the Sinumerik 828D CNC with PPU.4 (panel processing unit) marks a milestone with its many new functions. It opens up completely new possibilities for companies and users — especially when it comes to taking the leap into digitalization.

Benefitting from networking

The flexible work that takes place in small and medium-sized manufacturing companies in particular can benefit from networking: access to central data and programs minimizes errors, reduces project turnaround times, and saves a good deal of travel paths and enquiries. The control system and machines can now be integrated more easily via the OPC UA standard. The Sinumerik 828D controller with V4.8 SP3 software no longer just transfers data and information to higher-level systems such as an MES, but also receives alarms, events and programs from

other programs and computers. This means that even smaller companies, such as job shops, can save machining programs centrally and transfer them from production planning to the respective machine with the click of a mouse, for example.

By using Sinumerik 828D with an external PC remote control, other enabled PCs are transferred to the panel via Virtual Network Computing (VNC) for data and programs containing work schedules or drawings to be called up without numerous travel paths. These and other data can be exchanged extremely quickly on the network thanks to the 1-GB Ethernet ports on the new machine panels. And the new panels also have rear USB ports, so that CompactFlash card readers can be integrated easily into 15" hardware, for example. All front and rear USB ports are configured with complete flexibility via the program manager.

With MindSphere, Siemens provides a cloud platform for networking industrial machines and processes and

offers applications, such as the Manage MyMachines MindApp, in which Sinumerik 828D controllers can be integrated. Thanks to the Manage MyMachines MindApp, responsible persons, production managers, and managing directors can view machine states and data from the shopfloor anywhere, anytime, even from mobile devices.

Winning new customers with new possibilities

To avoid a fatal price war, contract manufacturers must secure the loyalty of existing and new customers with better performance and higher productivity. This is where Sinumerik 828D and its new functions come in.



For example, nodding compensation not only facilitates commissioning for machine builders (thus reducing costs and effort for users), but also offers better surface finishes in milling.

Advanced Positioning Control (APC) Eco functions also make it possible to operate the machine more accurately and efficiently — without having to increase the cost and duration of machining with additional measuring instruments and cycles.

In addition, the Sinumerik 828D CNC now also offers a second control channel for milling and thus additional integration and control options for automation systems or handling robots.



Reliable machine protection

One of the great strengths of Sinumerik CNCs is the unique Top Surface function for improving surface finishes. The latest update makes this tool available on all Sinumerik 828D software versions for milling — an absolutely unique feature in this class of controller and a real competitive edge for the companies using it. The Collision Avoidance Eco function has a similar goal. This function works by using protected areas and distances, which can be configured by the user. Collision Avoidance Eco is therefore perfectly tailored to the demands of flexible contract manufacturing and helps protect capital goods.

The 15.6" panels of the Sinumerik 828D control system have been multi-touch compatible for quite some time. This facilitates fast and convenient operation. What is new, however, is the side-screen navigation. With a simple swipe, additional information such as machine states or process data can be faded in and out on side screens, thus not taking up space on the operating and programming interface. It is very easy to configure the information that is to be displayed on the side screens and where it is to be displayed.



Added value on all levels

Whether networking (connectivity), machining options (technology), hardware or operation (smart operations/HMI), the new Sinumerik 828D 4.8 SP3 software version scores highly in all areas. Innovations such as Top Surface, Advanced Positioning Control and Collision Avoidance Eco open up many new

Sinumerik 828D 4.8 SP3 software

The most important innovations at a glance

Networking:

- Enhanced OPC UA integration (alarm and events, file transfer)
- External PC Remote Control
- Integration in MindSphere via the Manage MyMachines MindApp

Technology:

- Top Surface
- Collision Avoidance Eco
- APC Eco (improved positioning — with simple commissioning)
- Nodding compensation
- Second machining channel

Hardware / smart operation

- Configurable side screens
- More powerful CPU
- More USB interfaces, 1 GB Ethernet ports



possibilities for users and increase the efficiency and productivity of machine tools. Thanks to the networking options, in particular, the integration into MindSphere via the Manage MyMachines MindApp, even small and medium-sized businesses can benefit from digitalization. ■

➤ [siemens.com/sinumerik](https://www.siemens.com/sinumerik)

✉ michael.geschwill@siemens.com



Angle heads save retooling

Angle heads (see image on page 18) are being used more and more, particularly when it comes to multi-tasking machining. In aircraft construction, for example, turbine components are not just turned and milled in one clamping fixture – the use of angle heads also allows drill holes, slots and grooves to be machined in places that are not so easily accessed with the existing machine kinematics.

For these angle heads to be used, Sinumerik must be able to calculate them appropriately. There are two types of tools in the Sinumerik tool management system that can be used to define the angle head: Type 130 and 131 – end mill and end mill with corner rounding. ■

Loc.	Type	Tool name	ST	D	Length 1	Length 2	Radius	H	D	U	Max. Speed	HL
130	ANGELHEAD		1	1	278.778	135.283	6.888	4	4	3	1800	200.000
131	ANGELHEAD		1	1	278.778	135.283	6.888	4	4	3	1800	200.000
132	ANGELHEAD		1	1	278.778	135.283	6.888	4	4	3	1800	200.000
133	ANGELHEAD		1	1	278.778	135.283	6.888	4	4	3	1800	200.000
134	ANGELHEAD		1	1	278.778	135.283	6.888	4	4	3	1800	200.000
135	ANGELHEAD		1	1	278.778	135.283	6.888	4	4	3	1800	200.000
136	ANGELHEAD		1	1	278.778	135.283	6.888	4	4	3	1800	200.000
137	ANGELHEAD		1	1	278.778	135.283	6.888	4	4	3	1800	200.000
138	ANGELHEAD		1	1	278.778	135.283	6.888	4	4	3	1800	200.000
139	ANGELHEAD		1	1	278.778	135.283	6.888	4	4	3	1800	200.000
140	ANGELHEAD		1	1	278.778	135.283	6.888	4	4	3	1800	200.000
141	ANGELHEAD		1	1	278.778	135.283	6.888	4	4	3	1800	200.000
142	ANGELHEAD		1	1	278.778	135.283	6.888	4	4	3	1800	200.000
143	ANGELHEAD		1	1	278.778	135.283	6.888	4	4	3	1800	200.000
144	ANGELHEAD		1	1	278.778	135.283	6.888	4	4	3	1800	200.000
145	ANGELHEAD		1	1	278.778	135.283	6.888	4	4	3	1800	200.000
146	ANGELHEAD		1	1	278.778	135.283	6.888	4	4	3	1800	200.000
147	ANGELHEAD		1	1	278.778	135.283	6.888	4	4	3	1800	200.000
148	ANGELHEAD		1	1	278.778	135.283	6.888	4	4	3	1800	200.000
149	ANGELHEAD		1	1	278.778	135.283	6.888	4	4	3	1800	200.000
150	ANGELHEAD		1	1	278.778	135.283	6.888	4	4	3	1800	200.000

Figure 1

Loc.	Type	Tool name	ST	D	Length 1	Length 2	Radius	H	D	U	Max. Speed	HL
130	ANGELHEAD		1	1	278.778	135.283	6.888	4	4	3	1800	200.000
131	ANGELHEAD		1	1	278.778	135.283	6.888	4	4	3	1800	200.000
132	ANGELHEAD		1	1	278.778	135.283	6.888	4	4	3	1800	200.000
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139	ANGELHEAD		1	1	278.778	135.283	6.888	4	4	3	1800	200.000
140	ANGELHEAD		1	1	278.778	135.283	6.888	4	4	3	1800	200.000
141	ANGELHEAD		1	1	278.778	135.283	6.888	4	4	3	1800	200.000
142	ANGELHEAD		1	1	278.778	135.283	6.888	4	4	3	1800	200.000
143	ANGELHEAD		1	1	278.778	135.283	6.888	4	4	3	1800	200.000
144	ANGELHEAD		1	1	278.778	135.283	6.888	4	4	3	1800	200.000
145	ANGELHEAD		1	1	278.778	135.283	6.888	4	4	3	1800	200.000
146	ANGELHEAD		1	1	278.778	135.283	6.888	4	4	3	1800	200.000
147	ANGELHEAD		1	1	278.778	135.283	6.888	4	4	3	1800	200.000
148	ANGELHEAD		1	1	278.778	135.283	6.888	4	4	3	1800	200.000
149	ANGELHEAD		1	1	278.778	135.283	6.888	4	4	3	1800	200.000
150	ANGELHEAD		1	1	278.778	135.283	6.888	4	4	3	1800	200.000

Figure 2

Example of an angle head:

View of an angle head in the Sinumerik tool management system with length 1, length 2 and radius. (Figure 1)

To configure the angle head, the parameters screen must be called up using the "More information" softkey.

To be able to input vectors 1, 2 and 3, MD18114 must be set to = 3. Please note that this activation may only be carried out by authorized partners such as Siemens Service, the machine builder or your service partner. (Figure 2)

Example of a tool description:

In a machine tool with a horizontal machining spindle, the tool tip should be swivelled 60° in the direction of the negative Y-axis.

The lengths L1_GK, L2_GK and V_GK are fixed lengths in the base body [GK] of the angle head. The length L_TOOL is the length of the tool clamped in the angle head. The angle specification ANG_1 is the angle at which the angle head is set. (see Figure 4)

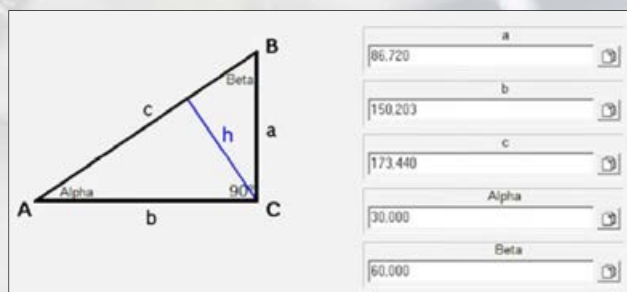


Figure 3

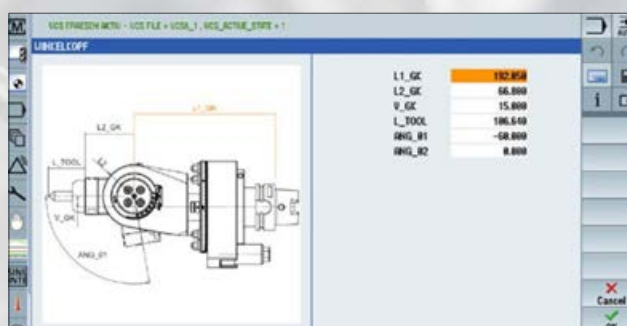


Figure 4

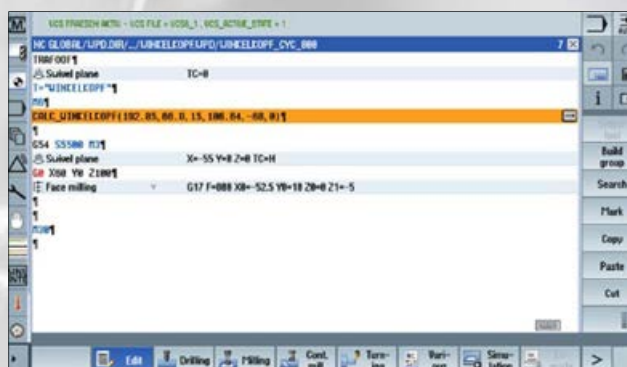


Figure 5

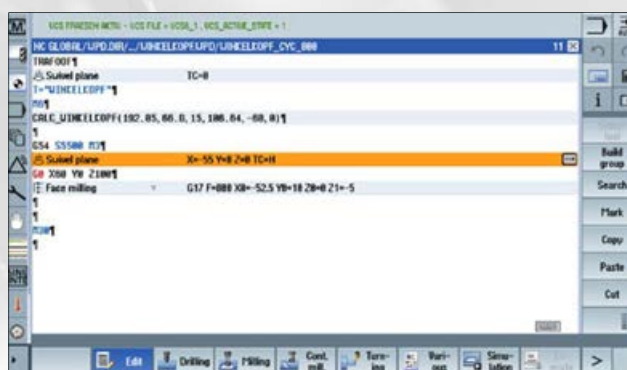


Figure 6

The length L1_GK applies to the Z-axis, V_GK to the Y-axis, and L2_GK + L_TOOL are split between the Z and Y axis depending on the set angle (ANG_01).

The following sum has been formulated to calculate the tool length at a set angle of -60°: (Figure 3)

$$L2_GK + L_TOOL = 173.44 \text{ mm}$$

$$a = \sin(\text{Alpha}) \times c$$

$$b = \cos(\text{Alpha}) \times c$$

$$c = 173.44 \text{ mm}$$

$$\text{Beta} = 60^\circ$$

$$\text{Alpha} = 30^\circ$$

$$a = 86.72 \text{ mm}$$

$$b = 150.203 \text{ mm}$$

This results in the following lengths:

$$L1: 192.050 \text{ mm} + 86.720 \text{ mm} = 278.770 \text{ mm}$$

$$L2: 150.203 \text{ mm} - 15.000 \text{ mm} = 135.203 \text{ mm}$$

The vectors are calculated as follows:

$$\text{Vector 1} = \cos 60^\circ = 0.5$$

$$\text{Vector 2} = \sin 60^\circ = 0.866$$

In order to simplify these inputs and calculations, machine builders have in some cases created cycles to calculate the values and write them into the tool data.

For this, the necessary data is called up on a cycle screen. (Figure 4)

By pressing the OK button, the cycle with the input parameters is transferred to the NC program. (Figure 5)

Here, the length components and vectors are calculated and written into the tool management system during the program runtime.

Examples for programming:

The "swivel plane" cycle (CYCLE800) takes the vectors for an angle head into account. It lines up the tool according to the programmed plane (CYCLE800), taking the tool vectors into consideration (Vector 1,2,3 in the tool data). (Figure 6)

The TOROT command is used to align the cutting tool even without CYCLE800.



On the shopfloor

BENZ GmbH Werkzeugsysteme

Consistency ensures skilled workers

Benz is a specialist for exchangeable units such as angle heads and multi-spindle heads, among others

Finding skilled workers is a challenge that many companies face today. Because of this, Benz GmbH Werkzeugsysteme uses Sinumerik CNCs on machine tools, both in its training workshop and on the shopfloor. As a result, the skilled workers that Benz trains can be taken on quickly and without a long induction period.

Today, Benz GmbH Werkzeugsysteme excels in manufacturing tool and machine technology for all industries. After its foundation in 1946, the company began its journey toward becoming specialists in CNC unit technology, initially with agricultural products and drawing parts. Over the years, the company has become the only full-service supplier of driven tools, exchangeable units such as angle heads, multiple-spindle heads and high-speed spindles, modular quick-change systems, broaching units, large drill heads, 2-axis NC heads and system technology. Exchangeable units are add-on modules that extend the functionality of machine tools, enabling the complete machining of

complex workpieces. For example, a 3-axis milling machine is upgraded so that machining operations can also be performed in a tilted space without having to set up additional mechanical axes. This significantly increases the machine park's productivity.

Benz solutions are employed across the world and offered for sale by branch offices and partners. Benz also operates several global service bases for maintenance and repair. The exchangeable units are usually custom-made for specific components. Marketing manager Nadine Uhl explains: "Our solutions help our customers to optimize their

production process. Functions other than the basic functionality of connecting the cutting tool to the machine spindle as a tool carrier can be combined. Among many other things, speeds or torques can be changed or gear trains branched for parallel processing. With an angle or swivel head, for instance, complex workpieces can be manufactured on a single machine, even with standard turning or milling machines — for internal machining in hard-to-reach areas of the workpiece, for example."

The search for skilled workers

Of course, well-trained skilled workers are also required to manufacture the highly complex units. Rather



»Our trainees are integrated into the production process at a very early stage and thus learn about the requirements from the bottom up.«

Bernd Kinnast, Head of industrial training at Benz

than leaving the selection of those workers to chance, the company established its own training workshop, which was then optimized by heads of industrial training Ivo Reinberger and Bernd Kinnast.

The first machines to be installed were two FP4 milling machines from Deckel. Siemens retrofitted both machines and equipped them with Sinumerik 840D sl. As part of further modernization measures, a 635V DMG milling machine and an MTRent T25Y turning machine with Sinumerik 828D were also purchased.

These investments formed the basis for the company to train five trainees a year for its own needs precisely on the control system used on the shopfloor. In addition, Siemens has adapted the Sinutrain CNC training software to the respective configurations of the machines used for the theoretical part of the training. Sinutrain is therefore identical to the respective operator interfaces and axis configurations of the machines in the training area.

Perfectly tuned for vocational training

Ivo Reinberger is extremely impressed by the simplicity and clear design of Sinumerik, saying: "The operating

concept of Sinumerik Operate is the perfect solution, especially for vocational training. At Benz, training industrial mechanics is very demanding, especially with regard to the complex demands in production. That's why we are happy to be able to reduce the time spent on actual CNC training and concentrate more upon production technology and using our own units in additional lessons."

70% of the parts produced on the training machines will later be used in Benz products. Bernd Kinnast explains: "Our trainees are integrated into the production process at a very early stage and thus learn about the requirements from the bottom up." The training workshop is now one of the company's shining stars. As part of a collaboration, Benz trainees are now even teaching trainees from other companies.

In addition to the dedication of the two trainers Ivo Reinberger and Bernd Kinnast, the deep technical understanding is also due to the fact that, from the outset, Benz has consistently adapted its equipment to the exact conditions of its own production. The transition from teaching to production is therefore possible with hardly any induction. Every trainee has been taken on so far — in fact, the indi-

vidual business units are desperately waiting for the newly trained skilled workers. Thanks to the breadth and depth of content of the training, these skilled workers cannot only be deployed in machining production, but also in assembly, quality testing and service.

The mechanical production department at Benz is equipped with 30 CNC machines. "Our average batch size is two to three, meaning almost everything is custom-built to customer specifications. This is where the high level of training pays off immediately as we do not have long-term components," explains Ivo Reinberger. Thanks to its specially trained employees and technically high-quality products, Benz is perfectly prepared for the competition in the machine tool industry. The universal focus upon Sinumerik CNCs for the training workshop and for the shopfloor is just one of the factors guaranteeing success for the future. ■

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✉ karsten.schwarz@siemens.com



Wirth Tonmaschinenbau-Manufaktur

Perfect music pleasure through precision

By manufacturing classic record players for high-end analog music pleasure, Wirth Tonmaschinenbau has been fighting against increasing digitalization in music since 1996. The company uses CNC turning and milling machines with Sinumerik 808D Advanced control systems to produce their high-quality devices.

Company founder Karl Wirth takes the record out of its cover, lovingly cleans the black disk and places it carefully on the record player. The tonearm descends slowly, its diamond tip sliding into the groove. The music that it produces is of a quality that is rarely heard today, as digital music has experienced a sharp rise since the introduction of the CD in the early 1980s, remaining popular to this day. However, a new trend is emerging among music listeners and audio professionals — the reemergence of vinyl.

Karl Wirth's view on the digital versus analog debate is unequivocal: "The compressed recordings of digital media may have some advantages as a sound experience and for straightforward consumption. But if you want to listen to music as a connoisseur, paying attention to every sound, and if you're looking for relaxation and a mellow way to wind down, then a classic record and high-end equipment is for you."



Siemens AG

»Our manufacturing workshop has a real net output ratio of more than 90%.«

Karl Wirth, Wirth Tonmaschinenbau GmbH

Turning a passion into a career

Karl Wirth ended up producing record players by accident. He used to be a production manager in the automotive industry and built a record player for fun in the training workshop. When he then went to a high-end audio trade fair with an audio equipment dealer friend, taking along a prototype of the record player, he came back with 50 orders. "After that, there was no turning back. I promised the customers at the trade fair that I would deliver the devices," says the company founder.

And so, in 1996, Karl Wirth turned his passion into a career. First, he made and installed the record players in the basement of his parents' house, working with suppliers from his time in the automotive industry. Over time, more and more international high-end audio equipment dealers and the press started noticing his products — by 2002 he had become so successful that he needed to move into the company's current building in Altdorf, Germany. Today, Wirth Tonmaschinenbau GmbH manufactures over 800 record players a year under its brand name Acoustic Solid. The range spans the entry-level model priced at just over €1,000 to top models with prices reaching €40,000 for unique, custom-made pieces.

Precise production of all components

"The structure of a record player is simple: it is made up of only a few components. The differences, even those in the sound quality, are down to the coordination of the various components, the materials and the high-precision manufacturing," explains Karl Wirth. "Our shopfloor has a real net output ratio of more than 90%. This means we

know the quality of each and every component and are extremely flexible." This way of working facilitates innovation: the Acoustic Solid's platter bearings, for example, which are manufactured with extreme precision and cast with a special sliding coating, are considered legendary among fans.

Karl Wirth has been using CNC turning and milling machines with Sinumerik 808D Advanced control systems for about seven years now. The latest investment on the shopfloor is an OPTImill F2 milling machine. In a small side room, the finished turntables and other components are polished to a high gloss. The standardized Sinumerik 808D Advanced control system on the turning and milling machines has many advantages, as Karl Wirth explains: "We mostly work with only one employee operating all the machines in our small production department. Instead of having to switch between the various control systems, our employee can work with a standard interface and call up stored programs. This speeds things up and reduces mistakes."

Making the impossible possible

The milling machine also needs to cut threads for various components. However, the manufacturer quickly made it clear that this was not possible with the machine and without a position-controlled spindle. Independent Sinumerik trainer Hans-Peter Moser came to the rescue. "The training itself was perfect for us — on the shopfloor and always with a close link to our processes and products. However, another advantage was that the trainer was able to show us a workable way of thread-cutting on the Optimum machine that met our requirements. The only additional investment was a compensation chuck."

With careful testing, (partial) assembly and packaging, a few steps are taken out of production. Wirth Tonmaschinenbau is more about workshop assembly and craftsmanship with attention to detail than industrial production. But it truly pushes the boundaries when it comes to distribution: almost half the products are sent to customers and partners abroad. Acoustic Solid record players are stunning in both their look and sound, and have fans on all continents — and that's partly down to Sinumerik. ■

Sinumerik 808D Advanced — Technology in detail

- Panel-based compact CNC
- User-friendly entry-level solution for simple milling and turning applications
- Simple operation, commissioning and maintenance
- 8.4" color display
- Up to five axes/spindles
- Simatic S7-200 PLC programmable controller
- Standard data transfer via USB and Ethernet

➤ siemens.com/cnc4you

✉ armin.baernklau@siemens.com



The controller is key

Together with Siemens, Mazak has adapted Sinumerik for some of its series and will continue to supplement its machine tool portfolio. After all, control systems and machine tools are a perfect match — as contract manufacturer Pausewang from Gingen an der Fils in Germany agrees.

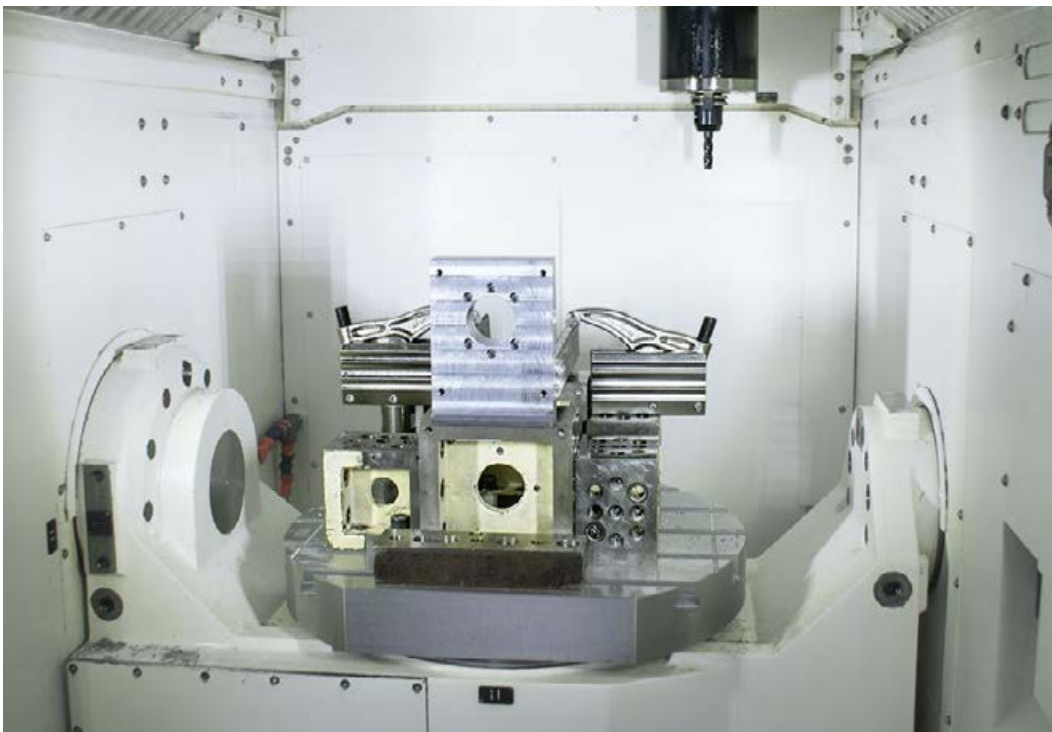
Holger Pausewang's path to self-employment was something of a gradual development. The qualified industrial mechanic gained initial experience with a medium-sized Swabian machine manufacturer, where he became a master craftsman and, as a deputy manager, was jointly responsible for tool and roller rack production. Pausewang then steadily worked his way toward his independence. His initial sideline job went well: he bought a used cold rolling machine, overhauled it in a garage (back then he did not have a workshop), and began to generate orders.

Growing the customer base

When Holger Pausewang finally found a workshop for rent, he bought a used Deckel FP4 milling machine with a Siemens 3M control system. Since then, Siemens control systems have been his first choice. As such, it was only logical that his first new acquisition, a Spinner milling

machine, also had Sinumerik CNC with ShopMill programming. He gradually gained more and more customers in the Göppingen area of Germany and, in 2012, took on his first permanent employee. The small company started specializing in prototype production, mold and fixture construction, test stands and contract manufacturing of machine components.

It soon became apparent that the increasing workload meant it was necessary to invest in a machining center. Pausewang analyzed machine concepts from various manufacturers, before opting for a Mazak VTC 800/30R. "Mazak is a big name in machine tools, primarily because of the stiffness of the cast bed and the associated high degree of machining accuracy," says Holger Pausewang. "That impressed me, and that was precisely the sort of machine I really wanted."



The Mazak Variaxis is a very flexible machining center that can precisely machine a wide variety of workpieces



Holger Pausewang is delighted: investing in Mazak machines with Siemens control systems is securing the future of his company

»We sat down with the Mazak sales representative and quickly found a suitable machine.«

Holger Pausewang, Pausewang Metall- und Zerspanungstechnik

Tapping into new target groups

Pausewang initially made contact with Mazak in 2013 at the EMO trade fair. Although the VTC 800/SDR exhibited there was equipped with a bridge rather than a rotary table, Pausewang was convinced that the VTC 800 was the right addition to his production line. Another plus point was that although it had previously only been available with Mazak's proprietary control system, at that year's EMO, the VTC 800 was introduced as one of the first Mazak machines with a Siemens control system. Mazak was hoping this would win over new target groups. Traditionally, a lot of companies in Germany and central Europe have equipped their production lines completely with Siemens control systems. In addition, many vocational schools and training companies teach their trainees the basics of programming on machines with Siemens control systems.

With its flexible operating concept, Sinumerik can be adapted to the operating philosophy of modern machine concepts. Thanks to the open system in terms of the various areas of application — from milling and turning, to grinding and lasering, to additive manufacturing — the CNC can be optimally adapted to the technology of a machine. What's more, it offers a high degree of freedom in production automation. These are all advantages that the manufacturer was able to use to adapt the control system to its own machines.

Alan Mucklow, Group Product Manager for Europe at Yamazaki Mazak, adds: "We know that users who have been using Siemens control systems for a long time want to continue doing so and want to use a single programming solution in their factory. By offering Sinumerik CNC for our machines, we are enabling these customers to take advantage of the technology and quality of Mazak with all its benefits at the same time."

Accuracy attracts customers

For Holger Pausewang, the cooperation between Mazak and Siemens was a stroke of luck. In 2014, he installed his first Mazak VTC 800/SR machining center with the

Sinumerik 840D sl control system in the new workshop. At the same time, the second permanent employee joined the team, which largely consists of skilled toolmakers and industrial mechanics. "Finding a CNC miller is not an easy task. I've had good experience with training technically qualified people in CNC milling," reports Pausewang.

Thanks to its accuracy, the new machine attracted additional customers: "We almost only carry out single-item production and small batch sizes of up to five units, so retooling takes up a large part of the machining time. That was fine to begin with, but as we started taking more and more orders, we realized that we would not be able to manage with just one machine in the long term. So we sat down with the Mazak sales representative who had already provided excellent advice when purchasing the first machine, and quickly found a suitable machine."

As of early 2017, a second Mazak with Siemens control system has been in use at Pausewang — the Variaxis i-600 5-axis machining center. The machine is ideal for machining cubic parts up to 350 x 350 mm. "Mazak machines are up to any machining task," says Holger Pausewang. "We machine a very wide range of workpieces and also work with diverse materials."

Pausewang already has concrete plans for the future: "We want to further integrate the turning department in the future. A horizontal milling-turning center from the Integrex series would allow for turning and milling in one clamping. My dream machine, the Integrex 1250, would allow us to get into large-part machining. That is a market with much less competition. Our customers benefit from the enormous flexibility we are able to offer them as a smaller company. Of course, this machine will also be equipped with a Sinumerik CNC." ■

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✉ armin.blaschke@siemens.com

Digitalization starts during vocational training

Operation, technologies, processes — digitalization will affect and revolutionize large parts of the machine tool industry over the next few years. How does training need to change accordingly? Initial answers can be found in the training workshop of the Austrian toolmaker Haidlmair.

Beverage crates, folding boxes, drawers, garbage containers, boxes for storage systems — we encounter products made by Haidlmair GmbH's high-quality injection molding tools all the time in our day-to-day lives. Over three generations, the Haidlmair family, from the idyllic town of Nussbach in Austria, has transformed the company from a small forge to one of the world's leading developers and producers of high-quality injection molding tools.

The management team, headed by managing director Mario Haidlmair and controller Rene Haidlmair, consistently focuses on quality and innovation in order to further develop the company's market position. The many

machine tools in the large production hall are almost completely paper-free and work as a data hub with Siemens NX and Teamcenter. The products are developed using Siemens NX as a CAD/CAM and PLM system, data and programs are transferred from production planning to the machines via Teamcenter, and they are then viewed by the operators on their own monitors.

In terms of training, there are certain consequences, as Christian Riel, deputy technical manager at Haidlmair, explains: "We have been using NX as a CAD/CAM system since 1985 and were certainly one of the first users in the tool and mold-making sector. Even in the training workshop,

all employees learn how to work with CNC systems, including with the Sinutrain training software and Siemens PLM software. Their various modules are the core of our technical IT landscape. This allows us to work completely paper-free in production."

Immediately productive

Each year, eight to 12 trainees begin their four-year training at the Haidlmair training workshop. They are all employed productively on the CNC machines after a very short basic training in manual metalworking. The trainees manufacture small workpieces for orders or as spare parts on the machine tools — and 3D printers are also available for teaching. The goal is that every single workpiece that is produced in the training workshop will later enter production.

In addition to classic CNC programming on the milling and turning machines, which is also required for the final examinations, trainees experience and learn the completely digitalized value chain from very early on — starting with CAD/CAM design and downloading programs right through to company-specific process chains. This comprehensive and practical training in the digital value chain is the reason why all newly hired skilled workers at Haidlmair start off in the training workshop.

Because Haidlmair uses machine tools with Sinumerik CNCs in the most modern area of production, this CNC has become an important part of the training. The full-time trainers received comprehensive training for



Each year, 8 to 12 trainees begin their four-year training at the Haidlmair training workshop. They are supervised by Wolfgang Eisterlehner, head of training (left), and Roman Dannesberger, CNC trainer (right)

this during a train-the-trainer course in the Erlangen TAC (Technology and Application Center). In the training workshop, the basic training in Sinumerik programming and operation takes place offline on the Sinutrain virtual programming station. The comprehensive documentation that Siemens provides especially for trainees and trainers is also used there. In the virtual Sinutrain Workbench, different machines with different software versions can be simulated, allowing the trainees to quickly get to grips with the version they will be working on in the future. The training workshop includes a DMG Mori milling machine with Sinumerik 840D sl as well as an EMCO milling machine with Sinumerik 828D, on which the trainees will later put the simulation from the PC training area into practice. They manufacture in a very specific way here, learning not only how to program and operate the Sinumerik CNC, but also all the machine-oriented work steps.

State-of-the-art equipment

What is striking is how many new and well-equipped machines the training workshop has. Stefan Knödlstorfer, technical manager at Haidlmair GmbH, explains: "We deliberately invest a great deal in state-of-the-art equipment. Some trainees have told us that they work on more modern and higher-quality machines than their fathers, who work as trained professionals in other companies in the area. In our training workshop, we want to use representative of the machines and modes of operation that our next generation of skilled workers will also come across after completing their training — for example multi-touch, integrated measuring cycles and additive processes." Trainees who stand out with excellent performance are even given the opportunity to gain experience at one of the company's foreign locations.

Haidlmair has already received several awards for its work as a trainer (becoming a state-approved training company, for instance), but that is not the only reason the company is popular among trainees. "As yet, we have not had much difficulty filling

apprenticeship spots. Of course, we prepare all trainees for the traditional examination content in the qualification, but the young people know and immediately see that we train for the digital future of our industry here," says Knödlstorfer with pride.

Fully automated machine cluster

It is precisely this future that the trainees can see and experience in the production halls. In a new building, there are four DMG Mori DMU 80 P duoBLOCKs, equipped with completely identical hardware and software — all controlled by a Sinumerik 840D sl. The special feature is that the four 5-axis machines act as a networked cluster, as a uniform manufacturing system. The workpieces are loaded and unloaded

via an automated pallet warehouse. When completely filled, the pallet warehouse is sufficient to allow the four machine tools to operate completely autonomously around the clock for four days. The process is fully automated. The tool magazine, pallet warehouse, the entire automation technology and the master computer come from the Austrian company Promot Automation AG. All in all, this production system is a prime example of the production concepts that trainees will find in the industry in the future — and Haidlmair trainees are well prepared for this. ■



In the virtual Sinutrain Workbench, different machines with different software versions can be simulated



CNC online learning

A great many CNC professionals are taking advantage of the free training paths offered by Siemens. The reason is clear: as an operator, you can gain the skills to maximize the output of your machine, increase your value to the business, and further your career. As an owner, it's a chance to enhance staff skills to generate increased revenue.

Getting to a Siemens training center may not always be possible for you. But there are still plenty of options. Live, online courses are presented monthly, and include insightful question and answer sessions. Courses are archived and available on-demand, meaning they can be accessed anywhere, anytime. Siemens' ever-growing CNC online learning resources are regularly updated, and for larger groups, custom online training sessions are available.

Strategized learning methods

"Our online campus, featuring dozens of technical webinars, is located at usa.siemens.com/cnc4you," explains Chris Pollack, Virtual Technical Application Center Manager for Siemens. "All of the topics that are covered in our hands-on classroom courses — such as variable-based programming, logic-based programming, and multi-axis milling and turning — are covered online as well."

He continues: "We have a strategy for how we want people and manufacturing to excel. You begin with a five-minute

how-to video as an introduction. You will then be motivated to immerse yourself in a webinar or two and really start digging into a topic. You can follow that up by enrolling in a self-paced learning module or an instructor-led class to start engaging hands-on with the technology at a high level."

Focus on trends

The curriculum not only provides you with hands-on experience using actual Siemens CNCs, it also focuses on the trends that are shaping today's machining industry.

Courses are separated into four main categories: milling, turning, general operations, and maintenance/service. These categories provide everything that programmers, operators, and maintenance staff need to advance their careers, and everything a shop owner needs to turn their shop into a competitive powerhouse. ■

➤ usa.siemens.com/cnc4you
✉ john.meyer@siemens.com



Online or in the classroom, sessions using Sinutrain software provide the knowledge you need to propel your career forward and turn your shopfloor into a powerhouse



Network expansion



Siemens AG / Karl-Horst Röder

From left to right:
Karl-Horst Röder (Siemens
Frankfurt), Frank Schuchmann
(metal workshop trainer for
BBZ 1), Jürgen Fisch (division
manager of the vocational
training center)

The Rhine-Hessen Chamber of Skilled Crafts is the latest Siemens training partner to join the worldwide network of Sinumerik CNC training. Siemens is thus supporting regional training on Sinumerik-controlled turning and milling machines in both theory and practice.

With its "BBZ 1" vocational training center and its modern machine park, the Rhine-Hessen Chamber of Skilled Crafts offers ideal conditions for training. This new, 4,300-square-meter vocational training center in Mainz-Hechtsheim, Germany, was inaugurated in 2015. It currently has room for 3,500 apprentices and 800 students taking courses on master craftsmanship and retraining programs. The cross-company training covers the fields of electrical engineering, automotive engineering, metal construction, sanitation, heating, air conditioning and hair-dressing.

Using Sinutrain training software, the operation and programming of the CNC machines with Sinumerik can now be clearly demonstrated in the theoretical lessons. Machining programs created there can be simulated and tested on a PC before they are transferred to the machines via a network.

"The software packages and training materials provided by Siemens as part of the partnership open up completely new possibilities for designing and interlinking teaching in theory and practice," says Frank Schuchmann, metal workshop trainer. And Jürgen

Fisch, division manager of the vocational training centers, notes: "We want to maintain and expand the connection to modern metalworking. We see this partnership as a great opportunity to maintain a high level of up-to-date knowledge in the field of CNC technology." ■

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✉ karl-horst.roeder@siemens.com

CAD/CAM qualification for machine tool operators

ebiz Pocking is a Siemens training partner and hosted the CNClive4you event in June 2018. The education and training institute is supplementing its program with an additional qualification of "CAD/CAM planner", which was the main focus of the event.

Converting a CAD design directly into a parts program using CAM functions is no longer exclusively the domain of large companies and key industries. The demands on small and medium-sized suppliers are also characterized by shorter innovation cycles and increasing customization of end products, but also by machines and capital goods. As such, these manufacturing companies are increasingly using CAD/CAM systems as a logical supplement to JobShop programming.

"Large companies use CAD/CAM, and suppliers have to follow suit," says Johann Huber, head of the ebiz Pocking education and training institute. "Specialists are desperately needed for this in many regions, including here." It is for this reason that his institute has developed the "CAD/CAM planner" training course, which has been approved by the German Chamber of Commerce and Industry. This is the first chance for machine tool operators in Germany to gain a formal additional CAD/CAM qualification.

A logical supplement to machine operator training

"Knowledge of ShopTurn and ShopMill already gained in basic training forms the basis for the training," explains Johann Huber, outlining the concept. "That's what we build on in the CAD/CAM training with NX. This CAD/CAM system is held in high regard by manufacturing companies thanks to its universality, its openness and its seamless integration into the Sinumerik CNC world. In addition,

models of machines used in production can easily be integrated into NX and used in production simulation." In practice, this means that the parts program created by the CAD/CAM chain can already be completely verified for the target machine and checked for collisions in the simulation. "We use this with our 5-axis machine, for which DMG has supplied us with a detailed 3D model of all components. A parts program that has been generated from NX and checked in this way can be launched immediately on the target machine with 100% feed rate — the usual test runs with line-by-line execution and reduced feed rate are no longer necessary," explains the institute's director. This also allows for the economical production of small batches and individual pieces for which there is no budget for test runs or prototypes. However, this all depends on whether production employees can use the CAD/CAM system.

Become a CAD/CAM planner in 12 months

The qualification as a "CAD/CAM planner" conceived by ebiz Pocking and approved by the German Chamber of Commerce and Industry requires students to have completed training as a machine tool operator, and lasts for twelve months. During this time, students will learn how to create and modify 3D designs in NX-CAD and how to turn 3D data into parts programs for various manufacturing strategies, including additive manufacturing processes. "That is one of the advantages of NX: it supports all basic subtractive and additive manufacturing strategies," explains Johann Huber.



»Models of machines used in production can easily be integrated into NX and used in production simulation.«

Johann Huber, head of the ebiz Pocking education and training institute (center) in conversation with Armin Bärnklaus, responsible for end-customer promotion at Siemens (right)



Participants at the CNCLive4you event and trainees at ebiz

Siemens AG / W. Marschner

Additive manufacturing processes are becoming increasingly significant and will develop into a standard technology like turning and milling in the course of the professional life of today's trainees. For that reason, ebiz Pocking is already cooperating with the Environmental Campus Birkenfeld at the Trier University of Applied Sciences. The Birkenfeld research institute is the first to use the Sinumerik virtual numerical controller kernel (VNCK) for additive manufacturing processes. This is the exact same virtual CNC kernel that is also used in NX-CAM, bringing the CAD/CAM training for machine tool operators full circle. NX-CAM with NX-Hybrid supports a large segment of the most important additive manufacturing principles as standard. If the user has the right machine, there is also the NX-Powder module for implementing 3D designs using powder-based additive manufacturing.

"With the CAD/CAM planner additional qualification, trainees reach around the same qualification level as that of a master craftsman," explains ebiz institute director Johann Huber, underlining the importance of the new course. He is convinced that, "in light of recent digitalization and increasing flexibility in production, such skilled workers will be desperately sought after in the coming years." ■

ebiz: customized and contemporary training

ebiz GmbH is a non-profit company that works in youth and adult education. This includes vocational qualifications and training, as well as integrating jobseekers, direct consulting in companies and supporting students. In addition to the headquarters in Passau, ebiz operates sites in Pocking and Mühldorf and has partners in other locations, including Dresden and Chemnitz.

➤ siemens.com/cnc4you
 ✉ armin.baernklau@siemens.com

From machine tool operator to CAD/CAM planner



Trained machine tool operator

The qualification as a CAD/CAM planner requires students to have completed training as a machine tool operator



CAD/CAM training with NX

The course is based upon knowledge of ShopTurn and ShopMill gained in basic training



Production simulation

The parts program created using the CAD/CAM chain is checked in the simulation



CAD/CAM qualification

A similar qualification level to that of a master craftsman is attained



Sinumerik live —

Video tutorial: Direct programming of 5-axis machining in Sinumerik Operate

In the Sinumerik live video series, we present applications engineering to you in a way that is clear and easy to understand. It is intended to show you individual topics regarding the use of the Sinumerik CNC based upon practical examples.

The fifth part of the video series features the topic: Direct programming of 5-axis machining in Sinumerik Operate. At first, the theoretical basis of multi-axis/multi-side machining is explained, and then, using a practical example, a component is milled directly in the 5-axis machine.

✉ armin.baernklau@siemens.com



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Click here for the video:

➤ bit.ly/2v2V2Jj



New Sinumerik-certified trainers

Siemens awards special Sinumerik-related certificates to freelance trainers. In order to obtain a certificate, it is necessary for trainers to demonstrate their Sinumerik-related knowledge in a multi-day course.

One of the new coaches is Sebastian Pelz. As a trained mechatronic engineer, he gained initial experience in CNC technology during his apprenticeship. Until 2009, he worked in the production of CNC-controlled machines, and at this time, began further training to become a master tradesman in industry metals. Since 2010, he has been involved in initial and further training, mostly in the field of machining technology —

from conventional methods through to CNC technology. He specializes in Sinumerik — from DIN/ISO through ShopTurn and ShopMill to Sinumerik Operate. Currently, he's studying for an industrial engineering degree alongside his job.

➤ siemens.com/cnc4you
✉ karsten.schwarz@siemens.com



Sebastian
Pelz

Modular pens

The new CNC-workpiece is not just comfortable to hold, it can also be personalized: The modular ballpoint pen can be produced in two lengths depending on hand size and can be finished with a custom engraving. The pen comprises six turned parts (cap, tip, three shafts and sealing end) and can be manufactured in a material mix of aluminum, brass and/or plastic in four production steps. For assembly, the tip and shafts 1 and 2 are screwed together, a large capacity refill inserted and fixed with an M8 grub screw. Then, shaft 3 and the sealing end are screwed on and the cap fitted. To ensure a better grip and robustness against small scratches and knocks, the surface is matte. The pen has been developed by the vocational school BBS-Burgdorf and is custom produced and awarded as special recognition there.

All CAD drawings, programs and the manufacturing description required for production are available for download via the CNC4you portal:

➤ sie.ag/2vliZuF
✉ armin.baernklau@siemens.com



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Dates

CNClive4you with new events and topics — get informed now in the events section of the CNC4you portal. Here you'll also find an overview of additional trade fair dates and training courses.

BI-MU	October 9-13, 2018	Milan, Italy
JIMTOF	November 1-6, 2018	Tokyo, Japan
Formnext	November 13-16, 2018	Frankfurt, Germany

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News



Siemens AG

Enter the world of Sinumerik via an app

Sinumerik at your fingertips

This popular Siemens app will simplify your workload and increase your productivity. It contains all of the current training manuals for the Sinumerik CNC system and will ensure you always have the latest updates. With no more heavy manuals to carry, machine tool users have access to over 5,000 pages of vital CNC instruction and content.

A handy G-code compatibility tool also lets you to quickly find compatible codes for Siemens and ISO G-codes. The glossary feature is your reference guide to CNC terminology, and web links to service, support and social media feeds open the door to our online user community.

Don't wait — download the Easy CNC app for your iOS and Android devices today for free.

➤ sie.ag/2vPXz9I
✉ john.meyer@siemens.com

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Digital Factory
Gleiwitzer Straße 555
90475 Nuremberg, Germany

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Contact: contact.cnc4you.i@siemens.com

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