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CNC4you

Practical knowledge for the shopfloor

1/2019

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Digitalization

- 4 Siemens Industrial Edge — turning big data into smart data
A platform that is paving the way for the digital factory of the future
- 7 Focus on digitalization
Got questions about the digital future in your field of work? We have the answers!



CNC knowledge

- 8 3-dimensional milling radius compensation
Sinumerik 840D offers two types of 3D tool radius correction



On the shopfloor

- 10 Working hand in hand
FTM and EYPro rely upon Sinumerik 840D sl to create their joint product
- 13 Utilizing the calm before the storm
Südzucker uses Siemens control technology for various maintenance measures at its site in Rain



Industry news

- 16 Skilled workers desperately needed
CNC workers need to acquire the right digital skills
- 19 “Digitalization will succeed more quickly if we have specialists working on the machines”
Interview with Detlef Tanne and Frank Martin Clauß from Nachwuchsstiftung Maschinenbau gGmbH



Education and training

- 20 Adapting CNC training in light of digital change
Thanks to continuous knowledge transfer, CNC trainers and instructors are always up to date
- 22 The Middle Kingdom on a visit to Russia — WorldSkills 2019
We spoke to trainers, judges and participants during the Chinese preliminary rounds for WorldSkills 2019
- 25 Behind the scenes: “Sinumerik live” video tutorials
The presenter of the video series answers our questions



News

- 26 Software portfolio expanded / Mill your own stylish pen holder / We're curious to find out your Sinumerik experiences / CNC4you info mailing — register today!



Südzucker AG

We would like your opinion

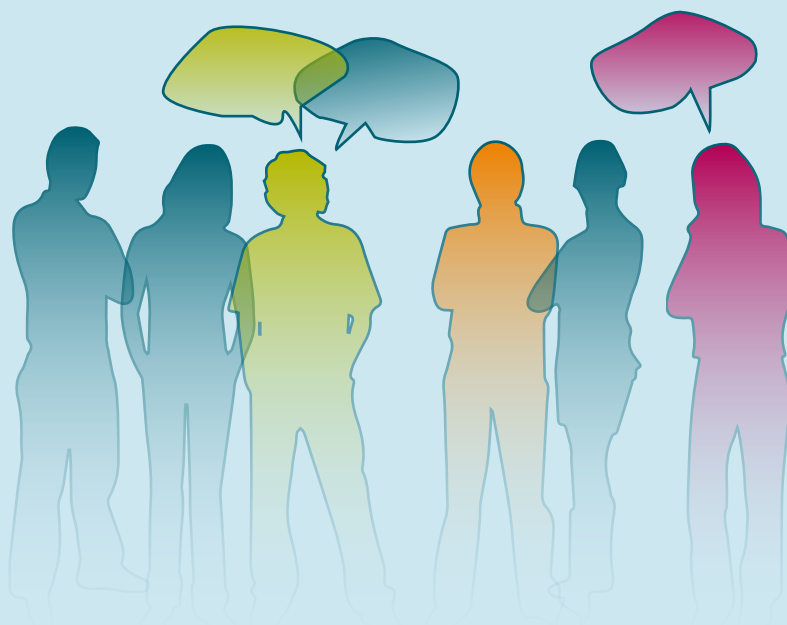
The capability to make high-quality products requires a competent and well-trained workforce — and that is true in every sector and country. As such, making young people aware of different professions and of the benefits of solid training must be a key goal for business and politics. Let us look at China, for example (more from page 22 onwards): Here, efforts are ongoing to improve training and incentives for young people in order to generate a positive culture with regard to skilled workers. A large part of this edition of CNC4you deals with the global shortage of skilled workers, and the action that needs to be taken in order to overcome this shortage. Read more about this from page 16 onwards. You also seem to be concerned with the topics of shortage of skilled labor and digitalization: We repeatedly receive submissions regarding these topics — for example, for our “Focus on digitalization — you ask, we answer” section (page 7).

We want to make our print edition of CNC4you even more interactive for and with you. That means: we need your help!
Send us your questions — and we will answer them.
Tell us your success stories — we will be offering prizes (more on page 27).
It could be you, who is featured in the next edition of CNC4you — we will publish the best submissions.

Your opinion is important to us, so we would like your feedback.
Are there any topics that you feel are missing from CNC4you? Which articles do you really like, and what topics need to be handled in even more detail?
E-mail us at **contact.cnc4you.i@siemens.com** with your opinions — we look forward to hearing from you.

But for now, happy reading!

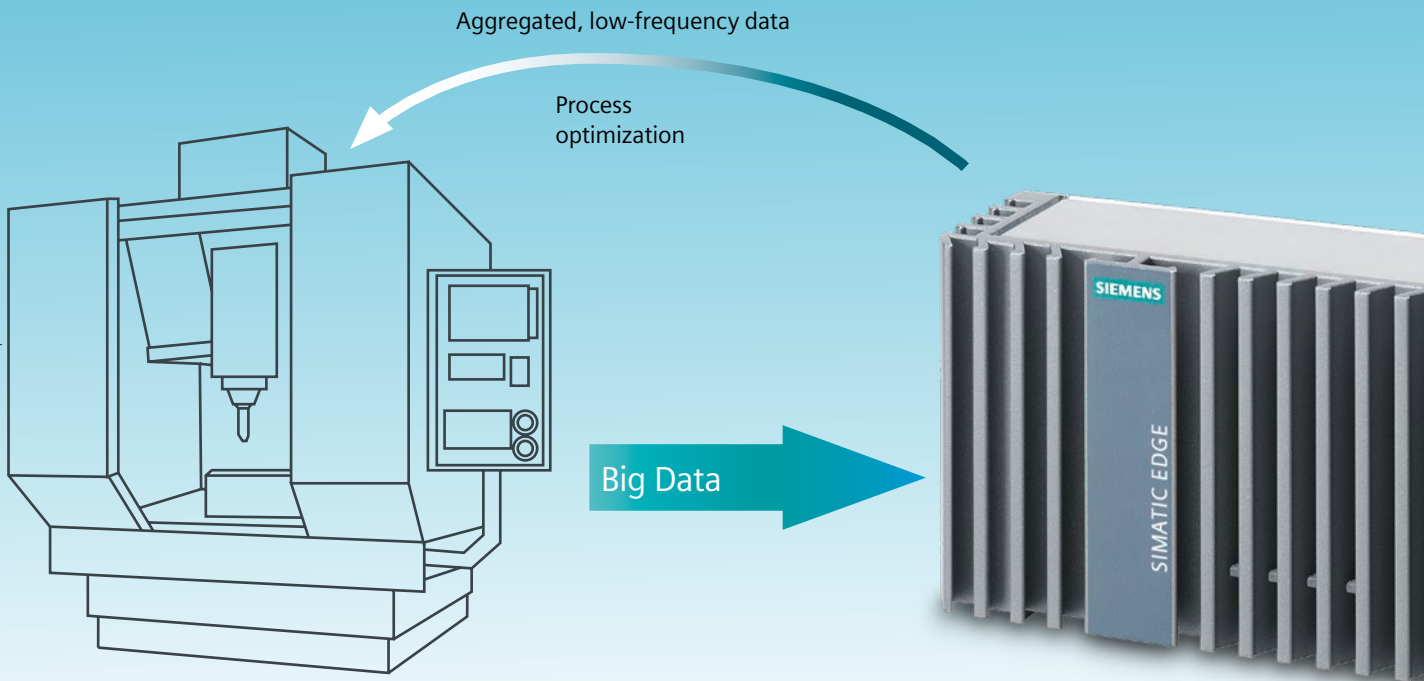
Your CNC4you team



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Digitalization

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Machine tool

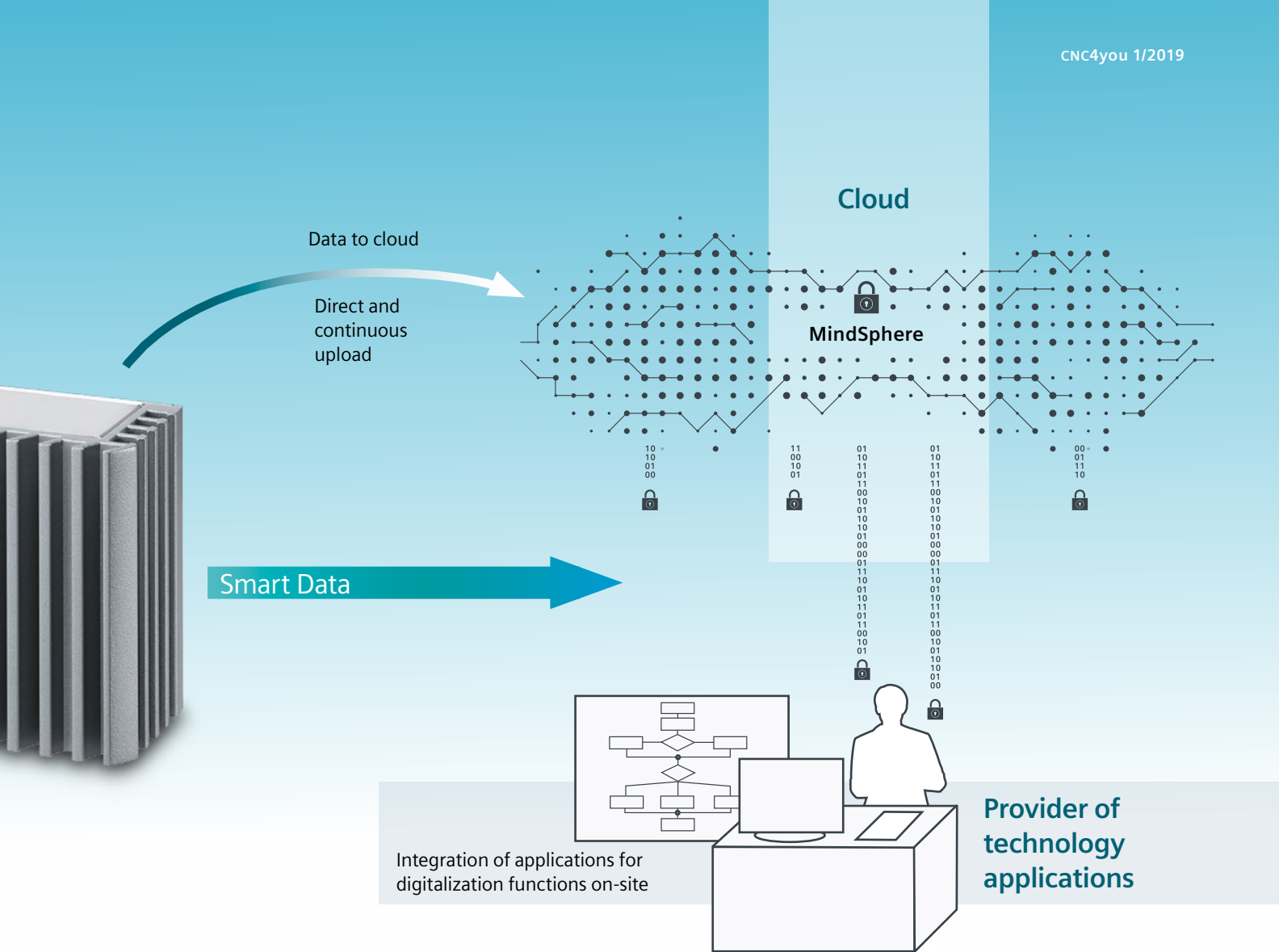
Controls
Sensors

Edge computer

- Interface between local and global data processing
- Machine-oriented data processing and evaluation in real time

Siemens Industrial Edge — turning big data into smart data

Digitalization is marching on in the manufacturing industry too. However, many machines and plants are not equipped to keep pace with this development. With Industrial Edge, we are offering you a key tool to help you on your way to the digital factory of the future.



The term “edge computing” simply means shifting computing power to the edge of a network.

With traditional local computing, the necessary devices are installed and set up once. Data transmission is mostly performed through local networks or external storage media. Updating devices always involves intervention in the IT infrastructure, which is why it is rarely done.

Cloud computing is the exact opposite. Here, data is transferred to a central data center, processed, and the result re-imported. While the cloud’s data center is very powerful, the potential volume of data is quickly restricted by the bandwidth of the connection, meaning that it is not possible to use all process data that is generated using the cloud.

Edge computing technology is an interface between local and global data processing. A powerful industrial computer is located at the machine, facilitating resource-friendly processing of data streams. It also functions as an interface with the cloud, which will now be supplied with processed data – meaning less data traffic. Machine-oriented processing makes it possible to process and effectively utilize even high-frequency data that permits only a short check-back indication time (latency).

“Computing at the edge”

But what exactly is Industrial Edge? This digitalization platform is much more than just a hardware item. With the help of highly refined analytics, it expands existing automation procedures to include machine-oriented data processing — directly within manufacturing companies. ➤

Applications are managed and installed via the cloud. This means that Industrial Edge has an advantage over local networks in that applications can be updated at any time without having to intervene in the production process. Direct connection to the cloud also allows Industrial Edge to upload processed data directly and continuously.

Machine tools generate up to 2 MB of process data per second. Uploading this data to the cloud from several machines is not possible. Thus intelligent algorithms must be used to reduce the volume of data. Big data is turned into smart data, and Industrial Edge combines local, efficient data processing in automation with the advantages of the cloud.

Why Industrial Edge?

Siemens' IT concept combining hardware and software brings production and manufacturing data together with globally quality-assured edge computers that are tailored to the relevant digitalization task.

You might think that machine tools with Sinumerik already have a very powerful processing unit that will cover these tasks. Sinumerik does indeed feature powerful processing units, but the core competence of a numerical control unit (NCU) is path and speed control, which is ensured by the machine builder. The architecture of the CNC machine is tailored precisely to this core competence. Although computing power for additional data analysis algorithms may exist, sufficient capacity cannot be guaranteed.

With this in mind, Industrial Edge facilitates the integration of applications from various sides. Thus applications both from Siemens and from machine builders are made available. In addition, Industrial Edge will create a relatively open environment in which various technology providers and manufacturers of tools or clamping aids can develop their applications.

Direct implementation in the CNC would not be possible because these have already been customized by the machine builders and do not offer a uniform platform. This customization is necessary because machine builders have to guarantee the productivity and quality of the machining process. Industrial Edge is separate from this system and thus offers a foundation for other technology providers.

The aim is to create a new business segment around Industrial Edge that various providers can utilize. With cross-industry influences and global developers of applications,

Source of process data	Data cycle rate	Volume of data / sec
Machine assemblies, peripherals (→ PLC cycle time)	~ 0.1–10 sec	→ ~ 5 KB
Tool path guidance (→ interpolator cycle)	~ 1–10 ms	→ ~ 0.1 MB
Machine axis control (→ position control cycle)	~ 1–2 ms	→ ~ 1–2 MB

The CNC permanently generates large volumes of data at different cycle rates, which can be channeled into the analysis and control of various production processes

Industrial Edge should become established as a platform for digital transformation. To this end, Industrial Edge has its own development platform for easy and fault-free programming of applications. Runtime software ensures connectivity with connected automation devices and with the Edge Management system. This connection is an interface to the IIoT cloud. It facilitates further processing of data in higher-level IT systems as well as administration and updating of the applications themselves.

Open to all applications

Industrial Edge is not only used for analyzing and processing CNC machine process data, but also offers a platform upon which data from other sensor technology installed in the machine will be processed. For example, camera images can be constantly evaluated in order to be able to mechanically monitor component clamping. Results of the data processing by Edge applications will be imported directly back into the machine, therefore optimizing the current process and minimizing wear and improving quality.

Edge computing is going to be a core aspect of machine tool use in future. Only by using applications with a specific technological background can further increases in productivity be achieved. Industrial Edge creates an environment that facilitates real-time evaluation of data — thus laying the foundation for use of future-oriented technologies. ■

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Focus on digitalization —

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Digitalization

You ask, we answer

“Digitalization” is on everyone’s lips — but what exactly does it mean for the work of machinists and CNC specialists? In this article, we continue our series with questions and answers on the topic of digitalization.

In this series, we address the question “How will digitalization change our working environment?” We will be providing a great deal of interesting information and tips — always focused upon your specific workplace. Further information as well as the questions & answers from previous issues can be found in the CNC4you portal. Write and tell us what you would like to know

about digitalization. Please send your questions to **contact.cnc4you.i@siemens.com**. We will find the answers through our own research and interviews with experts. ■

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“Will digitalization lead to a greater workload?”

Expert opinions differ on this. Companies will continue to push for increases in efficiency and reduction of throughput times. But is that the same as feeling like you have a bigger workload? It is very rarely the work itself that causes stress. Stress is much more frequently caused by feelings of losing control, fear of making mistakes, and lack of transparency. The reason for this is the perceived need to react ever faster to new orders, products and requirements.

Seen from this perspective, new digital technologies should actually relieve some of the burden. For example, virtual production on a digital twin enables identification of errors or collisions before any damage can occur — and therefore before the associated fluster, frustration and stress can ensue. Another example is predictive maintenance — that is, intelligent management of maintenance intervals. Instead of having to be checked by an operator, computer systems use sensor data to determine when maintenance will be needed and how it should be performed to achieve maximum time efficiency.

Our tip:

Process optimization is not just a question of management. Your practical knowledge as a machining expert is also needed. Where can new technologies be used to eliminate errors? Where can information from systems be used to support your practical work? If new systems and technologies are doing the groundwork for you, processes will be made more accurate, more transparent and, therefore, less stressful, even at higher throughput.



3-dimensional milling radius compensation

Not just two, but three-dimensional: Sinumerik 840D offers two types of 3D tool compensation — for face milling on free-form surfaces and for circumferential milling on structural components.

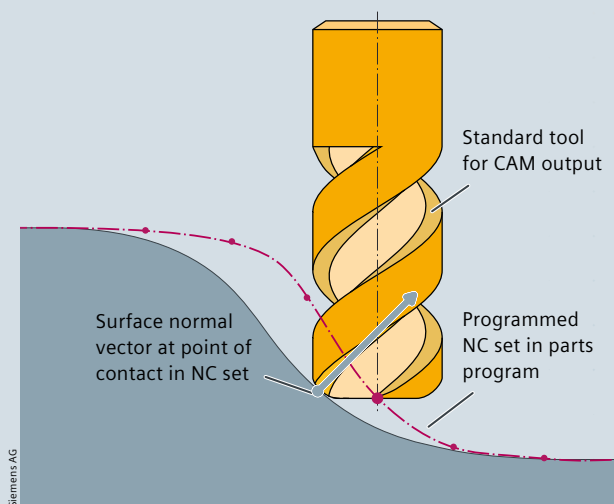
In two dimensions, it is implicitly clear that the (standard) tool is aligned vertically to the compensation plane and therefore the compensated path is always vertical to the path tangent in the X-Y plane. In three dimensions, the tool orientation normally changes continuously and thus the compensation direction must also change. It is now defined by a vector in space. We must distinguish between two situations. On the one hand, the circumferential milling of structural components and on the other hand, the face milling of free-form surfaces. ■

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Read the detailed section on 3D milling radius compensation in our latest tool and mold making manual (p. 120 et seqq.)
➤ sie.ag/2VoxPMS

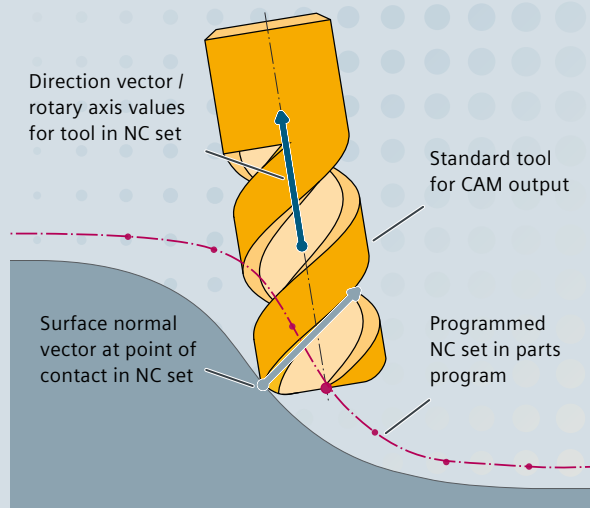


Face milling with vertical tool orientation – CUT3DFD



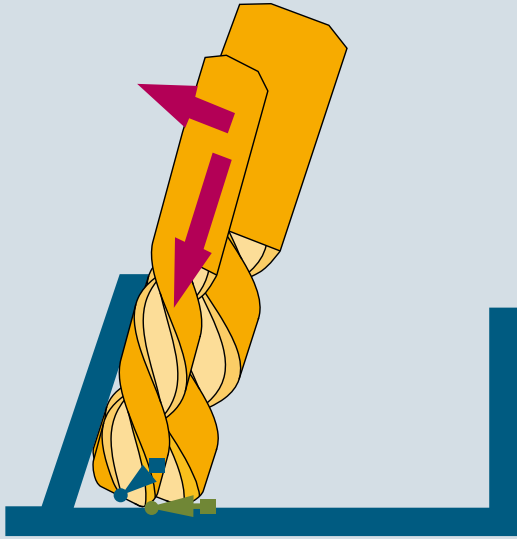
Since the tool is not always vertical to the plane to be machined as with two dimensions, a constant offset is no longer sufficient. The compensation value and the compensation direction now depend upon the tool radius, the rounding radius and of course on the tool orientation relative to the workpiece surface. This means

Face milling with variable tool orientation – CUT3DFD



that we require additional information about the surface. The compensation is defined with CUT3DF/CUT3DFD and activated with G41/G42, whereby there is no difference between G41 and G42 in this case. Switch-on must be performed in a linear set (G0/G1). With G40, switch-off can be performed in a linear set or in a separate NC set.

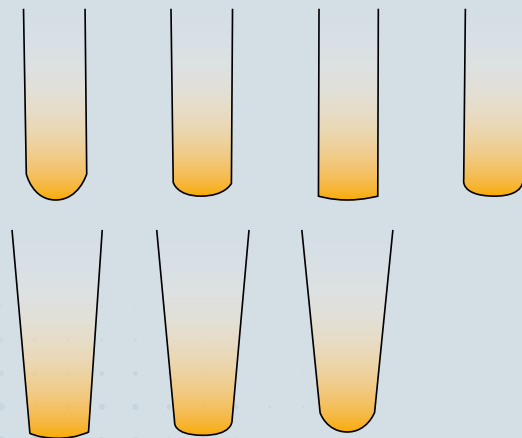
Circumferential milling with CUT3DC/CUT3DCD



The 3D tool compensation of a differential tool for circumferential milling is defined with the command CUT3DCD and activated with G41/G42 (left/right). It should be applied when the programmed contour refers to the center point path of a differential tool and the machining is to take place with a tool that deviates from this. In circumferential milling, the direction of compensation is always vertical to the plane on which the mill is moving. This is always defined by the current path tangent and the tool vector and normally changes in each interpolation increment.

In CAD/CAM, the milling paths can be calculated using a standard tool, and the difference calculated through wear input in the CNC.

Overview of tool types for 3D compensation



The following tool types are permitted in conjunction with 3D compensation:

For circumferential milling (also with limiting surfaces), the 3D radius compensation is limited to cylindrical tool types (top row).

For face milling, the 3D radius compensation works on all types of tool used for machining free-form surfaces, meaning also the conical types of the bottom row.

Explanation of the commands

3D circumferential milling

CUT3DC	3D tool offset for circumferential milling (only with active 5-axis transformation)
CUT3DCD	3D tool offset for circumferential milling with a differential tool (only with active 5-axis transformation)

Face milling

CUT3DF	3D tool offset for face milling with or without orientation changes
CUT3DFD	3D tool offset for face milling with a differential tool with or without orientation changes

3D circumferential milling with limiting surface

CUT3DCC	3D tool offset for circumferential milling with limiting surfaces with 3D radius compensation: Contour on the machining surface
CUT3DCCD	3D tool offset for circumferential milling with limiting surfaces with a differential tool on the tool center point path: Infeed to the limiting surface



On the shopfloor

Working hand in hand

Two independent companies in one building: FTM Neresheim and EYPro are working closely together to offer their customers optimum solutions. In a joint project for the guild of chimney sweeps, the two companies have developed a test bench for calibrating measuring devices for the measurement of particulate matter in heating systems.

If you search for FTM Neresheim on the internet, you will find very little information. Manfred Metzger started setting up his own workshop for manufacturing mechanical components in idyllic Neresheim, located in the Swabian Jura region of Germany, ten years ago. Back then, he and his friend Markus Schnele were still employees of a medium-sized company. Equipped with plenty of courage and expertise, in 2008 they decided to establish their own companies and house them under one roof.

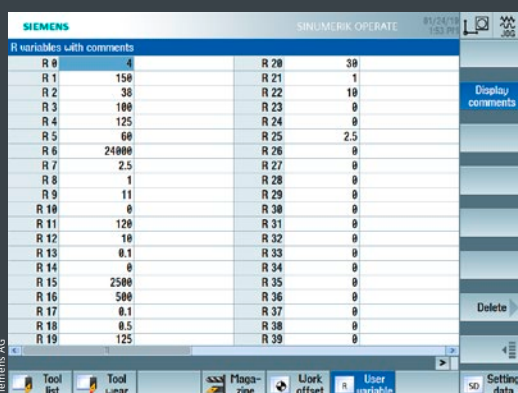
Schnele established EYPro Mugrauer & Schnele GmbH, which manufactures customized automation, calibration, and dosing solutions. EYPro now counts many well-known customers in the automotive, medical technology, solar technology, and consumer goods industries among its regular customers. The company's strength lies in the implementation of entire projects, from design, to engineering, to production of modules or whole automation facilities. The manufacture of mechanical components at FTM has played a significant role in EYPro's success. >



Technology in detail

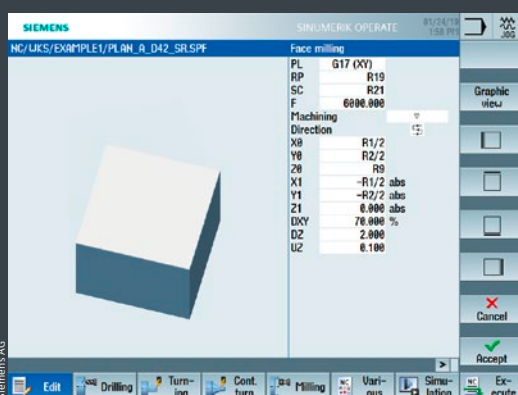
Workpiece programs can be designed universally if the value of an address (e.g. X..., Z..., S) or entries in the cycle screens are replaced by a variable (here: calculation parameter "R").

The R parameter values are displayed as a list in the Sinumerik CNC, and can be described directly in the "Parameters" operating area under the "User variable" soft key.



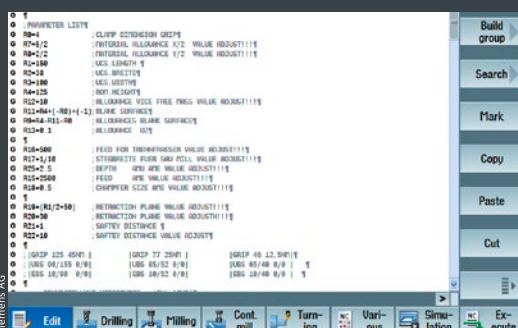
R address	Value	R address	Value
R 0	0	R 20	30
R 1	150	R 21	1
R 2	30	R 22	10
R 3	100	R 23	0
R 4	125	R 24	0
R 5	60	R 25	2.5
R 6	24000	R 26	0
R 7	2.5	R 27	0
R 8	1	R 28	0
R 9	11	R 29	0
R 10	0	R 30	0
R 11	120	R 31	0
R 12	10	R 32	0
R 13	0.1	R 33	0
R 14	0	R 34	0
R 15	2500	R 35	0
R 16	500	R 36	0
R 17	0.1	R 37	0
R 18	0.5	R 38	0
R 19	125	R 39	0

The R parameters can be annotated in the parameter list in order to facilitate a better overview of which R parameters are used for what.



R address	Value	Annotation
R 1	150	CLAMP EXTENSION GROUP
R 2	30	PROTECTIVE CLEARANCE X/Z VALUE ADJUST!!!
R 3	100	PROTECTIVE CLEARANCE Y/Z VALUE ADJUST!!!
R 4	125	MAX. LENGTH
R 5	60	MAX. DEPTH
R 6	24000	MAX. DEPTH
R 7	2.5	MAX. DEPTH
R 8	1	MAX. DEPTH
R 9	11	MAX. DEPTH
R 10	0	MAX. DEPTH
R 11	120	MAX. DEPTH
R 12	10	MAX. DEPTH
R 13	0.1	MAX. DEPTH
R 14	0	MAX. DEPTH
R 15	2500	MAX. DEPTH
R 16	500	MAX. DEPTH
R 17	0.1	MAX. DEPTH
R 18	0.5	MAX. DEPTH
R 19	125	MAX. DEPTH

Values can be assigned automatically both in the R parameter list and in the part program.



R address	Value	Annotation
R 1	150	CLAMP EXTENSION GROUP
R 2	30	PROTECTIVE CLEARANCE X/Z VALUE ADJUST!!!
R 3	100	PROTECTIVE CLEARANCE Y/Z VALUE ADJUST!!!
R 4	125	MAX. LENGTH
R 5	60	MAX. DEPTH
R 6	24000	MAX. DEPTH
R 7	2.5	MAX. DEPTH
R 8	1	MAX. DEPTH
R 9	11	MAX. DEPTH
R 10	0	MAX. DEPTH
R 11	120	MAX. DEPTH
R 12	10	MAX. DEPTH
R 13	0.1	MAX. DEPTH
R 14	0	MAX. DEPTH
R 15	2500	MAX. DEPTH
R 16	500	MAX. DEPTH
R 17	0.1	MAX. DEPTH
R 18	0.5	MAX. DEPTH
R 19	125	MAX. DEPTH

The R parameters can then also be used as a variable value in the cycles.

Required values can also be calculated by the control system while the program is running. The usual mathematical notation must be complied with when using calculation functions / operators.

Processing priorities are set using round brackets. Otherwise, the "multiplication/division, addition/subtraction" rule applies. The degrees must be specified for trigonometric functions.

Examples:

Assignment of values in non-exponential notation

R0 = 3.5678
R1 = -37.3
R3 = -7
R4 = -45678.1234

Assignment of values in exponential notation

Word	Meaning
R0 = -0.1EX-5	R0 = -0,000 001
R1 = 1.874EX8	R1 = 187 400 000

Assignment of a calculation function

Word	Meaning
R5 = SIN(25.3)	R5 corresponds to the sine of 25.3 degrees.

Assignment of calculation functions with R parameters

Word	Meaning
R1 = R1+1	The new R1 is the result of the old R1 plus 1.
R1 = R2+R3	R1 is the result of the addition of R2 and R3.
R4 = R5-R6	R4 is the result of the subtraction of R6 from R5.
R7 = R8*R9	R7 is the result of the multiplication of R8 and R9.
R10 = R11/R12	R10 is the result of the division of R11 (numerator) by R12 (denominator).
R14 = R1*R2+R3	The calculation follows the rule "multiplication/division, addition/subtraction" → R14=(R1*R2)+R3
R15 = SQRT(R1*R1+R2*R2)	R15 corresponds to the square root of the following sum: (R1) ² +(R2) ²

Note: The values of the R parameters are retained after M30, RESET, and Power ON.

Both firms are independent companies, but their collaboration under one roof is a real win-win situation: On the one hand, EYPro has direct, fast access to production capacity, making it possible to manage requirements and deadlines in a very flexible way. On the other hand, Metzger is able to save a lot of money on web advertising or flyers, as 80% of his production orders come from EYPro.

Successful collaboration

An exciting project that very clearly illustrates the cooperation between the companies EYPro and FTM is the joint development of a product: a test bench for calibrating measuring devices used to measure particulate matter in heating systems, for which FTM supplied all of the mechanical components. The test bench was commissioned by the guild of chimney sweeps, which has to be able to prove and provide evidence that the devices used to measure particulate matter are correctly calibrated. EYPro and FTM were the perfect partners.

The right equipment is essential

As a former production manager, Metzger brought a wealth of expertise to the foundation of FTM as a company. However, there were — and still are — many challenges surrounding technology and procedures. The size of the batches to be produced is between 1 and 10 workpieces, and the cost pressure is immense. From the beginning Metzger put every single available cent into the equipment for his manufacturing business, as this is a key prerequisite for the company's success. Metzger already had experience with various CNCs, but the flexible programming of Sinumerik appeared to him to be the best solution from the start. Today he has three milling machines and one turning machine from DMG MORI, all of which are equipped with Sinumerik 840D sl, the Sinumerik Operate operator interface, and ShopMill or ShopTurn graphical programming.

Exactly the right solution

Metzger is delighted with the options offered by ShopMill and ShopTurn programming. In addition to the many graphically supported cycles, he is impressed by the flexibility of the CNC programming. R parameters make it easy to flexibly configure the shape (length, width, height) of component families and the design of drilling patterns. Each machining program at FTM is structured in a similar way. Parameters — which can be annotated in a clear fashion by means of text inputs — supply the cycle screens with concrete values for the respective part in the component family. The actual machining programs (feed, feed speeds, etc.) never have to be changed, and the geometry is defined by the R parameters. Recurring machining sequences are summarized into program blocks, for example, for the withdrawal or basic position of the machines. Metzger says: "Only with Sinumerik do I have this level of flexibility and convenience. This programming philosophy is exactly the right solution for my manufacturing."



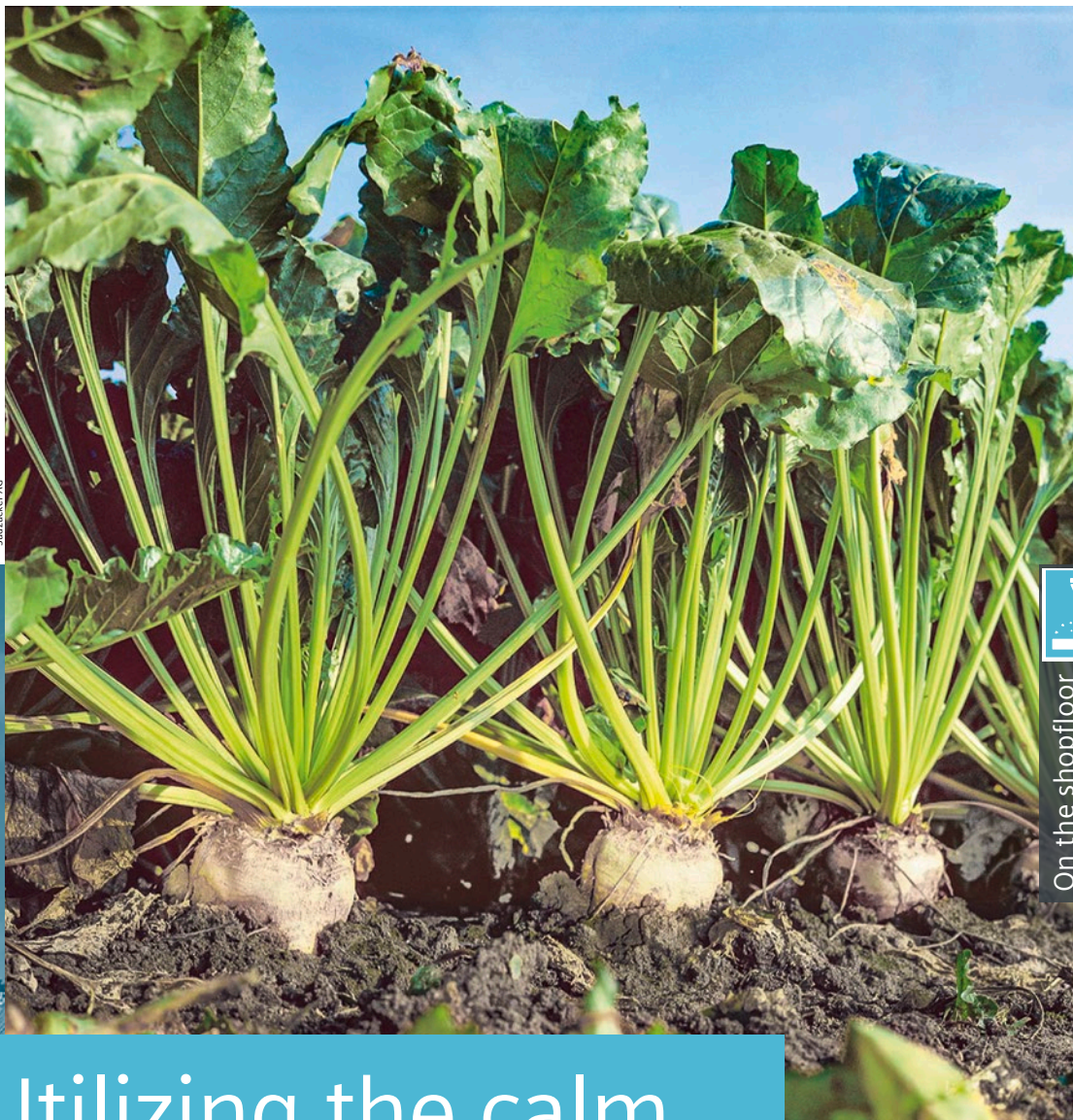
Typical component at FTM: batch sizes from 1 to 10 call for easy and flexible production planning



Manfred Metzger: "The flexible operating and programming philosophy of Sinumerik 840D sl is the perfect solution for my manufacturing. Whether DIN ISO, cycle, or high-level programming language — everything can be combined in the workpiece program. This particularly makes the programming of families of parts easy and clear to configure."

FTM can only ensure the necessary level of quality and compliance with deadlines with the help of qualified machine operators. With this in mind, Metzger swears by additional training in-house, directly on his machines. After a short search he found a list of Siemens-certified trainers for Sinumerik on the CNC4you portal. These include Peter Schweyer and Hans-Peter Moser, who over the past few years have been closing gaps in knowledge among new employees or in the operation of new machines at FTM. ■

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Südzucker AG



On the shopfloor

Utilizing the calm before the storm



Südzucker AG's sugar production at its site in Rain am Lech, Germany, runs at full speed five months of the year. The other seven months of the year are used for maintenance of equipment in the sugar factory. Several of the maintenance measures employ control technology from Siemens.

>

Südzucker AG

Thomas Jaumann works tirelessly to support the maintenance team in preparing Südzucker's sugar factory in Rain am Lech for the annual beet production. The start of September is when things really kick off: Large numbers of trucks bring sugar beet from the region to the factory in close succession. Mountains of the sweet vegetable as high as houses build up in several giant storage areas, waiting to be turned into the finest granulated sugar over the next five months.

However, Thomas Jaumann is relaxed when we visit in August. The machinist has almost finished his work for the year. "Production stops in spring and summer. Within just under seven months, the entire production facility — including conveying systems and pipelines spanning kilometers, their numerous drives, pumps and valves, and numerous tanks for different steps of the process — is serviced, restored, modified, and expanded," he explains during a tour of the plant.

One thing quickly becomes noticeable: the giant halls are almost completely devoid of people. Only a few of the 220 employees are to be seen. Thomas Jaumann explains: "From July onward, the staff have a chance to take a breath, go on vacation and prepare for the sugar beet production starting at the beginning of September. That is when everything gets very hectic here. We work in four shifts, 24 hours a day, 7 days a week. Up to 12,000 metric tons of sugar beet are processed here each day."

Internal maintenance creates flexibility

Seven months for maintenance may seem like a long time — but a glance at the giant plant in Rain makes the scope of this challenging task clear. More than 3,000 drives of different sizes and levels of power have to be inspected and serviced. Even the inspection of the plant just after the production takes weeks and, without its own maintenance team and workshop, the company would never be finished with maintenance by the

following September. "We do a mix here. We have the more complex, difficult or large parts produced or repaired externally. However, there are a lot of things that our electricians and metal workers can do much more quickly and flexibly in-house. Our top priority is for everything to be ready again in September. Thankfully, because we have our own workshop, we are able to work during the campaign as well," explains Jaumann.

Alongside a number of manual lathes, the sugar factory's large workshop hall has a new pièce de résistance: a ROMI C510 with Sinumerik 828D and ShopTurn. Jaumann, a trained machinist, chose the ROMI on account of its stable machine bed and reliable mechanics. And in his experience, the Sinumerik 828D is the perfect control system to go with it: "We work like a contract manufacturer here: shopfloor programming on the machine based on workpiece measurements or data sheets, one-off items or very small

series with a high level of variance in different sizes and levels of complexity. In maintenance you can do a lot of damage, and mistakes cost time that we don't have. This is why I insist on having a sound, reliable control system on the machine."

Changing tasks throughout the year

Südzucker also uses control technology from Siemens in the production facility. Jaumann mentions one of the reasons for this as he tells us about his tasks during the sugar beet harvest. At this time, many of the electricians and metal workers in the factory suddenly become process engineers, who monitor the plant and the sugar production on screens in a special centralized control room, and control them using computers. "We actually have two jobs here: maintenance in the off-season, process and machine control during production. When I started here as a machining technician, I was introduced to the processes of sugar production and



»We actually have two jobs here: Maintenance in the off-season, process and machine control during production.«

Thomas Jaumann, Machinist
at Südzucker AG in Rain am Lech

machine control for the first time. At first, I was a little confused, but now I see this seasonal change of tasks as a bonus and an interesting change of pace. Plus, during the campaign, it is beneficial if you know a drive unit that is sending a fault indication to the monitor in detail from having serviced it."

This has an impact on the training concept in the factory: "We provide our metal workers with additional training in CNC. This is a real plus point for us when competing for talent, and represents a real benefit for the three to five trainee industrial mechanics that we have each training year. We have now equipped computers in the training room with

SinuTrain — which leaves the shop-floor more time for productive work."

Tips from an independent Sinumerik trainer

Employees have received support with the machine from Hans-Peter Moser, an independent, Siemens-certified CNC trainer for Sinumerik. He provided an introduction to the programming of the machine and the efficient use of SinuTrain with numerous practical tips and tricks. He even showed the team how to use the ROMI and Sinumerik to manufacture a new plastic roller and re-center a used centrifugal head that has become grooved and unbalanced. "I got in touch with Mr. Moser following a recommendation from

a nearby firm. I think the concept of independent trainers makes a lot of sense. These are experienced CNC machinists who know the ins and outs of the applications. We have learned a lot from Mr. Moser. The turning machine with Sinumerik CNC opens up new options for us, and reliably creates more flexibility," says Jaumann, summing up the advantages. ■

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✉ armin.baernklau@siemens.com

Each day
over 500
trucks
deliver the beet

Sugar beet production:
24/7
in four-shift operation

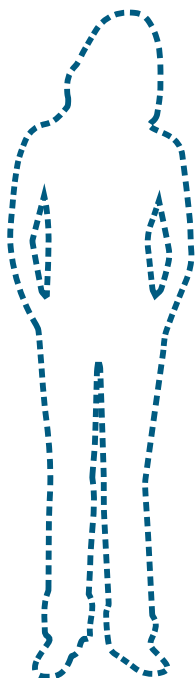
12,000 tons
of sugar beet
are processed each day

ROMI C 510

Siemens AG | P. Krontfeld

Südzucker AG

Alongside a number of manual lathes, the maintenance workshop at Südzucker AG has a new jewel in its crown: a ROMI C510 with Sinumerik 828D



Skilled workers desperately needed

Whether it be central Europe, China, or the United States — manufacturing firms everywhere are having difficulty finding skilled workers. Aging societies are reinforcing this trend, even in the machine tool industry. This is good news in terms of the job and salary prospects of CNC professionals — but only if they acquire up-to-date digital skills.

The Boston Consulting Group painted a bleak picture of the impending shortage of skilled workers in the key countries for the machine tool industry back in 2014 (see diagram 1). It stated that there will be a significant lack of well-trained skilled workers by 2030 — particularly in Europe, but also in North America and Asia.

Economic advisors earn their money by exposing problems, and many such studies seem somewhat exaggerated when we look back on them later, partly because governments and business leaders introduce countermeasures. However, it is true that there has been little success in counteracting the shortage of skilled labor in the five years since the study was published. In fact, aging populations and the booming global economy are exacerbating the situation. This is illustrated by recent data.

The situation in Europe

In Germany, 61% of companies cite the lack of skilled workers as currently the greatest obstacle to production and growth (see diagram 2). Vacancies in mechatronics/automation technology are now remaining unfilled for over six months — these are not the extreme cases, but the average. The striking thing is that both large corporations and small contract manufacturers are facing difficulties. And

if companies cannot find operators for their machines, they will be more reluctant to invest in new machines and in the expansion of their capacity.

All over Europe more than one in five companies complained of difficulties in filling vacancies for skilled workers in 2018 (graphic 3), including the southern European countries, which are still affected by the financial crisis and have a relatively high level of unemployment. The figure has never been so high Europe-wide.

Skilled labor shortage in the United States

In the US, the government is taking often drastic action to bring production back to the country after years of mass outsourcing to low-wage countries. However, job market experts believe that the greatest obstacle to this is not the resistance of other countries to tariffs and political pressure, but the shortage of skilled workers inside the United States itself.

The baby boomers — people born in the post-war years, when there was a marked increase in the birth rate — will be retiring over the next 10 years. In mathematical terms, the US job market is losing skilled workers every second, amounting to more than eight million over the coming 10 years. On top of that, the long-standing

process of deindustrialization is having an impact: The United States has enough highly qualified white-collar workers and unskilled workers for the booming service firms. But there is a lack of specialist workers with average levels of qualification who have the basic technical knowledge required to operate machines and tools reliably, and who are able to solve any problems that arise. Over 60% of smaller companies are complaining of problems finding exactly this type of machine operator — that is to say, the skilled workers who form the backbone of manufacturing firms.

Breakdown of traditional structures in China

With its “Made in China 2025” strategy, the Chinese government wants to guide the country from its past as a cheap backyard workshop and extended workbench of the rich industrialized nations, to a future as an industrialized country with its own technologically leading companies. With this in mind, the State Council’s 2017 report on the work of the government calls for a new mentality toward skilled workers, improvements in the incentive system, and increased training of skilled workers. China needs these training reforms desperately. The demographic impact of the former one-child policy, the fact that the Chinese education system is far



By 2030, several countries will be confronted with a significant labor shortage

Europe

France



6% / -1%

Germany



-4% / -23%

Italy



8% / -4%

Spain



17% / -3%

UK



6% / -1%

Russia



-5% / -24%

Americas

Brazil



-7% / -33%

Canada



3% / -11%

Mexico



6% / -8%

USA



10% / 4%

Asia-Pacific

China



7% / -3%

India



6% / 1%

Indonesia



5% / 0%

Japan



3% / -2%

South Korea



-6% / -26%

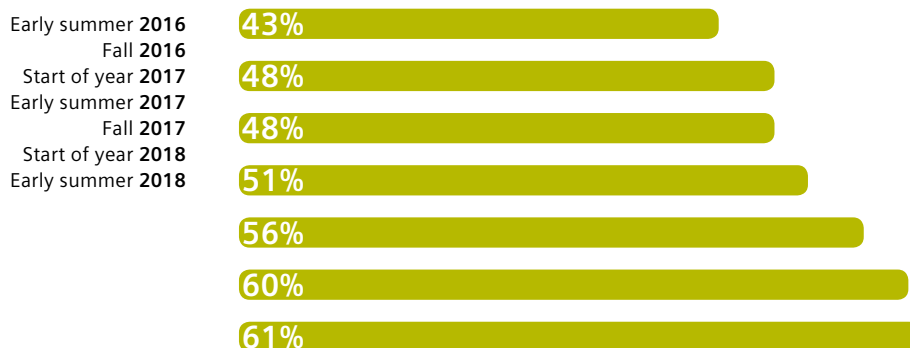
- Shortage
- Actual shortage (surplus of 5% or less)
- Surplus

2020 / 2030
Labor shortage or surplus

Graphic 1

Sources: EIU CountryData database;
ILO LABORSTA database;
United Nations population database; BCG analysis

Companies see the shortage of skilled workers as the biggest risk to growth in Germany



Graphic 2

Source: DIHK Economic Survey 2018

Over 20% of all EU companies are complaining of a shortage of skilled workers

Share of industrial enterprises that indicate that insufficient labor is limiting production



Graphic 3

Source: Reform Barometer 2018, BusinessEurope



Case study: Spain

Spain also has a lack of CNC professionals. That was clear from our conversation with Javier López, who manages train-the-trainer activities for Sinumerik in Spain.

In what way have you noticed the shortage of skilled workers in Spain?

Javier López: There are plenty of workers and up-and-coming talent, but there is a lack of operators with sufficient practical CNC experience. If providers could give their customers an operator with each machine, they would enjoy excellent sales — but no one buys machines that cannot then be operated. This is having a detrimental effect on Spanish companies' efforts to modernize and digitalize.

What are the reasons for this?

Javier López: It is a combination of several factors. Combined study and training courses with large amounts of practical work are still not widespread enough in Spain. Added to this is the fact that, after the long economic slump, universities and training institutes have no money to invest in new, modern machines. The same thing applies to companies. On top of that, there is a lack of coherent concepts that offer more than just low-cost training machines. Siemens is the only supplier that offers not only cost-effective equipment, but also train-the-trainer concepts and the teaching materials and tools (such as SinuTrain) needed to close the gaps.

removed from practice, and a traditional attitude of disdain for work in the manufacturing sector have led to a lack of skilled workers and well-trained machine operators. This is compounded by a significant increase in demand for more skilled workers each year caused by the still very impressive — though slowing — growth of the Chinese economy.

The problem also affects foreign companies with sites in China. According to a business climate survey carried out by the German Chamber of Industry and Commerce in China back in 2015, 82.4% of German companies were having major problems finding suitable specialists for their production sites there. Unfortunately, the trend is on the up — particularly because, alongside foreign companies, an increasing number of Chinese companies are competing for the shrinking pool of skilled workers in China.

Skilled workers shouldn't be complacent

So the global outlook is great for CNC professionals, experienced machine operators, mechatronics engineers, and automation engineers? Secure job and attractive career and salary prospects? Yes and no. "Yes" because, as stated above, there will continue to be high demand for skilled workers, despite advancing automation — for demographic reasons if nothing else. And "no" because the digitalization of production will require additional qualifications in future. Skilled workers who have been working for companies for some time do not have this additional knowledge in digitalization. As there is going to be a lack of new skilled workers in all core areas of the manufacturing industry, companies and their existing workers only have one option left: more targeted and more intensive training and retraining.

Machine operators that "only" have a good grasp of their CNC are no longer sufficiently qualified for the

digitalization of production. Fundamental knowledge of IT and networks is required, as is knowledge of how to operate and integrate modern mobile devices. Operators must be able to handle robotics, additive technologies and simulations on a digital twin. In the future, it will only be possible for them to reliably solve problems on machines and in processes if they have knowledge of all of the components of a digital value chain, from CAD program to finished workpiece.

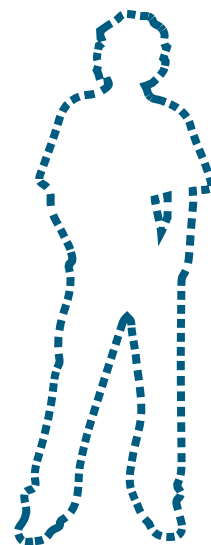
Further training in digitalization required

"The requirements are growing rapidly. To keep up, we have to inform our instructors and trainers about the latest technology trends on an annual basis, and equip them with new materials and tools. Companies are starting to come around, but we still have a long way to go until everyone has grasped how important this is and is prepared to invest and to implement new solutions, such as using webinars and learning platforms for internal retraining of production employees," says Karsten Schwarz from the Digital Experience and Application Center (DEX) in Erlangen, Germany. "It would be helpful if the skilled workers within these companies were open to change, and exerted more pressure and pushed for further training in digitalization."

The worlds of business and politics must take action, too. Advanced training is generally underdeveloped in the United States and China. One reason for this is the high level of fluctuation in the workforce. Investment in training and retraining is only worthwhile for companies if the employees are going to stay with them for a reasonable amount of time and utilize their newly acquired knowledge to the benefit of the company. However, even in Germany and Europe, companies' internal measures fall far short of the level demanded by advancing digitalization. ■

“Digitalization will succeed more quickly if we have specialists working on the machines”

The skilled labor shortage — what is being done in the training sector in Germany? We spoke to Dipl.-Ing. Detlef Tanne and Frank Martin Clauß from the foundation Nachwuchsstiftung Maschinenbau gGmbH.



CNC4you: Mr. Tanne, is there a shortage of skilled workers in Germany?

Detlef Tanne: More than six out of ten companies are reporting difficulties in filling vacancies. This particularly concerns trained specialists — including those who work on milling and turning centers. There are two factors at play here: Firstly, due to the strength of the economy, Germany has a high demand for labor. Secondly, there is a structural shortage: there is a lack of skilled workers with the knowledge and experience required to drive forward the digitalization that has already begun within companies.

Frank Martin Clauß: There is another clear relationship here: Today, all modern control systems and machine tools offer interfaces for networking. However, only four percent of machines in Germany are actually cross-linked. Seen from this angle, digitalization is not so much a technology issue, but a skills and training problem.

CNC4you: What is being done to combat this shortage?

Detlef Tanne: Training in metal-working and electronics-based professions was reorganized as of August 1, 2018. The most important change with regard to digitalization is the fact that basic knowledge in IT and digitalization is finally being seen as a parallel qualification for many professions, and is no longer restricted to IT-related professions. This is extremely important.

CNC4you: What form is implementation taking? Is it working well?

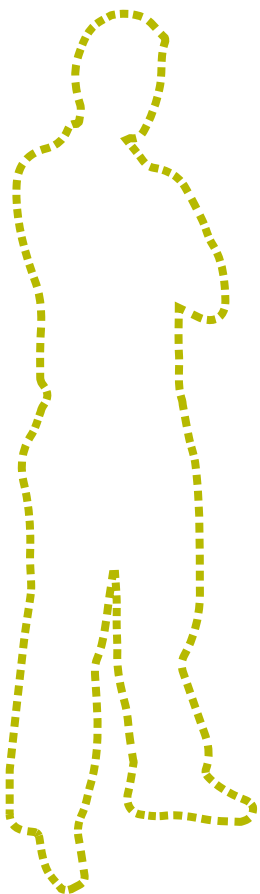
Detlef Tanne: At the foundation, we have become involved in a model campaign: “NRWgoes.digital”. Understanding that Industrie 4.0 is the interplay between all of the processes in a company and a chance at future success –

that is the motivation behind the project being rolled out across the entire state of North-Rhine Westphalia (NRW), “Implementing Industrie 4.0 / Digitalisation in vocational training in NRW”. Under this program, vocational school tutors, trainers, and workshop supervisors receive 25 days of training, split into five five-day blocks. Almost 600 trainers and teachers will go through this training in three years. It is not just new technology and IT-related topics that will be discussed. The central incorporating element is the perspective of process analysis. After all, digitalization isn’t an end in itself; it should be used to help companies improve their productivity, quality, and competitiveness. Trainees will acquire the skills necessary to utilize new technology to the benefit of their companies.

Frank Martin Clauß: The schools are thankful for the NRWgoes.digital initiative and will begin developing didactic materials once the training measures have been completed. Digitalization cannot be brought to fruition through academics and IT specialists alone. If we want faster digital transformation in our companies, we need professionals and machine operators who have appropriate knowledge and who know how to use and optimize new technology in their work. We hope that other German states will take the program as an example — including in terms of equipment supplied by the state. The gaps in digitalization knowledge cannot be closed without serious initiatives driven by businesses, governmental bodies, and training institutes.

CNC4you: Thank you for this informative interview, Mr. Tanne and Mr. Clauß.

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✉ elke.hoerner@siemens.com





Adapting CNC training in light of digital change

The industrial environment is changing rapidly, with new technology and applications calling for new skills. Constant dialogue between industry and trainers and the permanent transfer of expertise in CNC training are the only way to ensure that trainers and training are up-to-date.

Good skilled workers are rare — and this shortage is often seen by the public as an obstacle to growth and the economy's ability to change. With this in mind, efforts are ongoing to find new concepts that will make it possible to offer attractive, up-to-date training and ensure a broad base of well-trained skilled workers. These skilled workers have to not only master the traditional specialist expertise, but also prepare for the digital transformation of production in the industrial sector. After all, today's

trainees are the workers that will have to stand their ground in the modernized, digitalized economy of tomorrow. With the MT Expert training program, Siemens is promoting intensive dialogue and the transfer of expertise between industry and trainers.

Knowledge transfer through workshops

This constant dialogue is based upon CNC training partnerships centered around the "train the trainer" concept.

CNC training partners — e.g. chambers of craft, vocational promotion centers, universities and vocational schools — can sign their trainers up for CNC operation and programming sessions at DAX. There they will receive CNC education and training on the very latest Sinumerik-based turning and milling machines.

As technology is developing at a rapid rate, Siemens offers annual CNC trainer workshops to ensure that partners are always up-to-date. Here



Basics of
digital twins of
the machine tool

Latest from
the CNC Trainer
Workbench

Background information
on CNC compensations

Basics of cloud computing for CNC robot integration machine tools Trochoidal milling

Additive manufacturing
with vertical
milling centers

An excerpt of the topics for the 2018 trainers' workshop (above) illustrates that machine tool digitalization has an important role to play

they can learn about the latest trends in CNC use and gain important background information on machining and machine tool digitalization. Glancing at the list of topics for the 2018 trainers' workshop shows (see word cloud top right), the matter of CNC digitalization is playing an increasingly large role.

The new CNC Trainer Workbench also provides training partners with a helpful tool in their day-to-day training work. It contains CNC programming examples, from DIN/ISO to CNC high-level language based on Sinutrain, and will now also feature examples for the CAD/CAM-CNC process chain based on NX.

Constant dialogue

CNC training mirrors CNC use in industry. Changes here provide important input for developers of machines and control systems. Therefore, Siemens uses feedback from trainers to detect new trends

and implement them in products. Conversely, CNC training has to react to changes in production as quickly as possible and base its content upon the latest CNC systems.

In short, CNC trainers and Siemens are in the same boat when it comes to digitalization. This is why the "Ideas forum: CNC training of the future" has become a set agenda item for the CNC trainers' workshop. This is not only a discussion forum; it is also used to discuss possible focus topics for upcoming CNC trainer workshops.

In Germany the workshop will be taking place in the familiar setting of the Digital Experience and Application Center (DEX) in Erlangen in 2019. However, there are "Train the Trainer" courses and trainer workshops in many other countries, such as China and India. Training institutes interested in a CNC training partnership can contact their regional Siemens organization with any questions. ■

For Sinumerik users

Are you looking for CNC training or support? See the "Education and training" section on the CNC4you portal for an overview of...

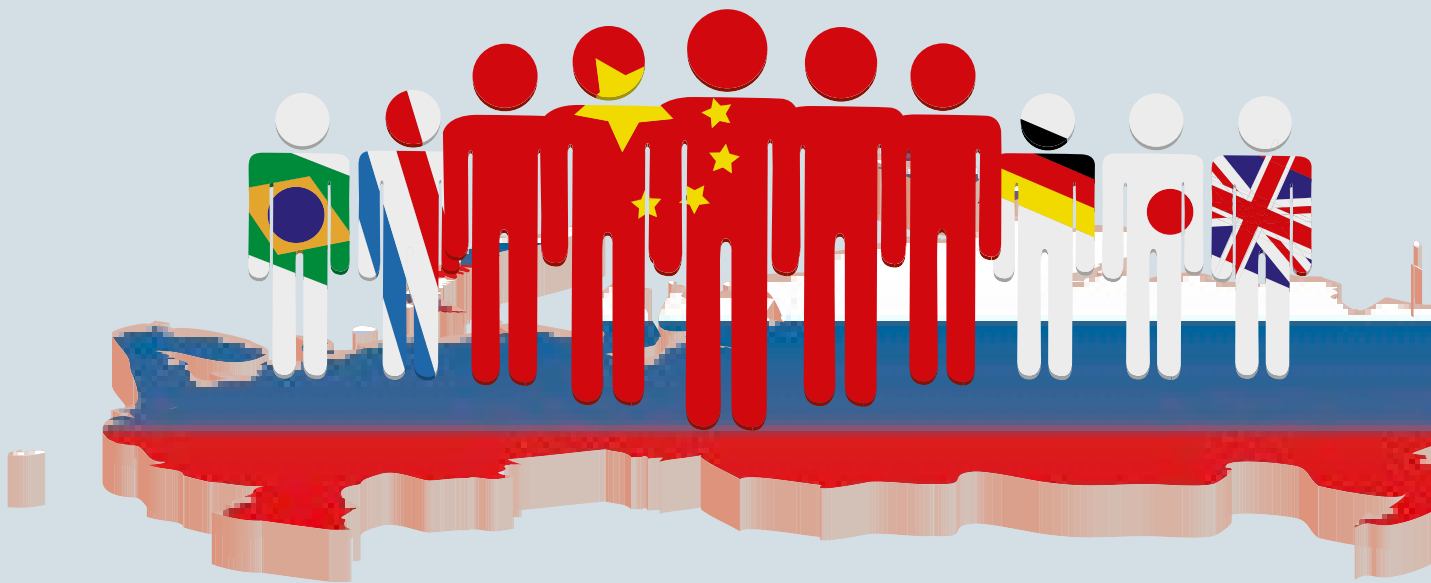
...our training partners

➤ sie.ag/2K89Osg

...our independent trainers

➤ sie.ag/2io3JKi

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✉ andreas.groeizinger@siemens.com



Education and
training

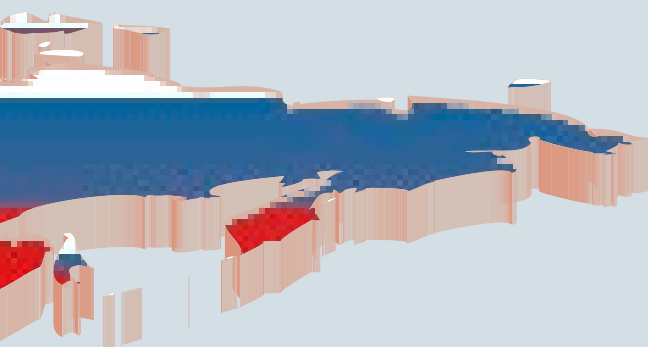
The Middle Kingdom on a visit to Russia — WorldSkills 2019

By now, it is almost a mainstay of CNC4you: our coverage of WorldSkills. The world championship of professions will take place in Kazan, Russia in 2019. In the run-up, preliminary deciding rounds are held in each participating country. We spoke to trainers, judges, and participants during the national competition in China.

Over 1,600 young skilled workers from more than 60 countries and 56 different disciplines will be putting their skills to the test once again at the 45th WorldSkills event in Kazan. However, in order to reach this stage, participants must get through the national qualifiers in their own country. China will also be sending its most skilled contestants to the professional world championships in Russia, and thus hosted a preliminary round last year to find the best of the best: the China Skills Competition 2018.

The breadth and level of projects and the number of participants made this the biggest professional skills competition based upon the WorldSkills standards ever organized in China. National teams were formed from the 10 best-placed contestants in each competition project. Winning teams will represent China at the 45th WorldSkills in Russia.

As Global Industry Partner to the WorldSkills International organization, Siemens provided a total of 61 machine



tools for the five disciplines of CNC Turning, CNC Milling, Prototype Modelling, Plastic Die Engineering, and Manufacturing Team Challenge at the China Skills Competition — all controlled by Sinumerik 828D or Sinumerik 840D sl. Siemens CNC system engineers were also available to help with commissioning and provide on-site support.

The Chinese participants headed for this year's WorldSkills Competition in Kazan have every reason to be optimistic: China won 15 gold medals in 2017. This world championship of the professions is very highly regarded in China, with even President Xi Jinping getting involved in bringing the 46th WorldSkills competition to his country. This event would be the only one of its kind in China to receive support from the highest level. The outcome was as hoped: Shanghai will host WorldSkills in 2021.

Despite being very busy with preparations, several trainers, participants and judges took the time to talk to us about the competition, the challenges, and their experiences with Sinumerik. ■



Siemens Ltd., China

Song Fangzhi,
head judge in the discipline of CNC Turning (senior engineer at Beijing University of Aeronautics and Astronautics)

Could you briefly tell us about the competition and the use of Sinumerik controls?

The China Skills Competition is an important event in our country. One of its aims is to increase awareness of the quality of products and premium products, and to train skilled workers in such a way that they can compete internationally. Sinumerik controls are well established internationally and hold a very big share of the market both in China and worldwide. As in the past, Sinumerik 840D controls will be used exclusively in the CNC Turning discipline at the next WorldSkills. Sinumerik was used at China Skills as well so that our team can train at competition level.

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✉ dawei.hu@siemens.com





Siemens Ltd., China

Tu Yong,

judge for the discipline of Milling
(lecturer at Henan Vocational and
Technical College)

When did you begin using Sinumerik controls, and what advantages do they offer in the China Skills Competitions?

I came into contact with Siemens controls very early on – firstly Sinumerik 802, then Sinumerik 840D, and now Sinumerik 828D. At the competition, the emphasis is upon user-friendliness and reliability, and upon the contestants being able to achieve the desired product quality using the control system. After spending a couple of days seeing the 828D control in action, I thought it was really very good.

You have taken part in numerous competitions. How would you rate China Skills?

This competition represents a platform for high-end CNC machining. It encourages specialists that can and want to dedicate themselves to this sector to work hard and to strive to acquire the necessary skills. It also allows the contestants to interact with people from all over the world, which I think is very valuable.

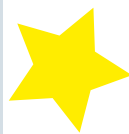


Candidates on the team from
the city of Chongqing:
Ma Houcai and **Li Jie**
(Chongqing Industrial Technician College)

How long have you known about Siemens controls, and what, in your view, makes them stand out in practical terms?

Ma Houcai: I took part in the 44th WorldSkills Competition in 2017 and used the Sinumerik 828D control then. I have worked with many different controls, but the Sinumerik from Siemens is definitely the best in my opinion. The security is high, the operator interface is clearly structured, and the settings for tools and workpieces are very easy to handle.

Li Jie: I have only been working with the Sinumerik for half a month. Compared to what I have used before, Siemens controls are easy to understand, easy to use, and highly effective.



Siemens Ltd., China



Behind the scenes: “Sinumerik live” video tutorials

The “Sinumerik live” video tutorial series has been in existence for around two years now. We took that as an occasion to talk to Tobias Leimbach, the expert and presenter in the videos, on behalf of CNC4you. He was happy to answer our questions.



Hello Tobias. Firstly, could you introduce yourself briefly to our readers?

Tobias Leimbach: I am a trained cutting machine operator and have been working in the CNC industry for 25 years. From series production to special machinery construction for the manufacture of large and individual parts, I have worked in pretty much every area of mechanical production. After completing my training as a master precision machinist, my focus shifted toward sales and applications engineering for holistic production solutions. I have been on Siemens' applications engineering team at the Digital Experience and Application Center (DEX) in Erlangen since 2015, where I am responsible for training and workshops for machine builders, training partners and dis-seminators in Germany and abroad.

Can you tell us how you came to be the face of the Sinumerik live videos?

Tobias Leimbach: My training and many years of professional experience enable me to explain complex topics in a simple way. When the CNC4you editorial team came up with the idea of creating short, informative and practical videos, I was quick to get on board — and have been presenting the video series ever since.

Where are the videos filmed? Do you need a movie studio to make them?

Tobias Leimbach: No. We don't need a movie studio. Siemens has state-of-the-art turning and milling machines at the DEX Erlangen, which we use for the videos. As we usually have training sessions going on and visitors in the machine hall, we always have to find a time slot to ensure uninterrupted shooting. This is usually Friday afternoons.

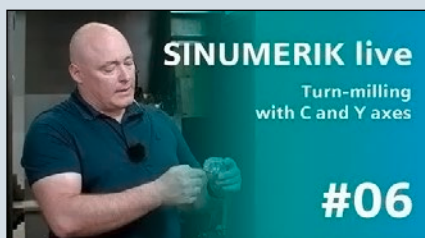
Where do you get the ideas for the videos?

Tobias Leimbach: Both CNC metal processing in general and Sinumerik more specifically offer an almost endless supply of subject matter. The team regularly meets to decide upon the content of upcoming videos. We also draw upon suggestions from customers or the sales department. I then develop a workpiece application and try to explain it in the video in a way that is easy to understand. It's not always easy, but I really enjoy developing and making these videos between my training work. After all, passing on my knowledge of CNC is not just a job, but a calling.

Thank you very much for talking to us, Tobias!

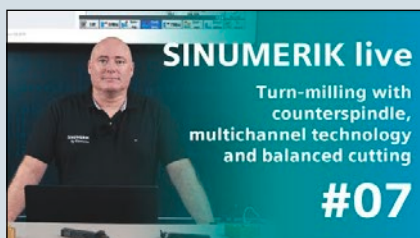


The latest additions since the last edition of CNC4you are two videos on turn-milling:



#6: Turn-milling machining with C and Y axes

➤ sie.ag/20jxmXE



#7: Turn-milling with counter spindle and multi-channel technology

➤ sie.ag/2PAoRIH

Access all of the previous tutorials here:

➤ sie.ag/2IXFX44

✉ armin.baernklau@siemens.com



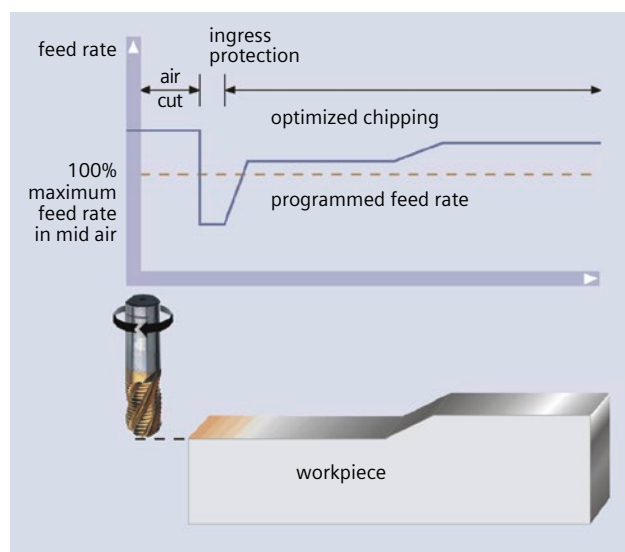
News

Software portfolio expanded

Omatic's products have been part of the Siemens family since the summer of last year. The software solutions for process optimization and monitoring represent an enhancement of Siemens' range of software for the control of machine tools, and there are plans to continue to develop the Omatic products in the future. The innovative solution Adaptive Control and Monitoring (ACM) is now also part of Siemens' product families – a big bonus in the field of feed control. ACM monitors the current cutting conditions in real time and automatically adapts the feed rate to the optimum speed. If overload is detected, ACM reduces the feed rate and triggers an alarm in order to stop the machine.

➤ sie.ag/2IdmlsA

✉ sergej.schauermann@siemens.com



Adaptive feed rate control

ACM functions:

- Real-time feed rate optimization
- Protection at tool entry
- Protection against tool breakage
- Detection of tool breakage/wear
- Process monitoring
- Process recording and visualization
- Tool performance statistics

Benefits for the customer:

- Increased machine productivity: clear reduction in cycle time, meaning a time saving of up to 40%
- Up to double the tool life and increased tool utilization
- Higher quality of parts
- Increased process reliability, no manual feed rate adjustment or visual tool inspection

Mill your own stylish pen holder

In the last edition of CNC4you, we gave you a guide to making a modular ballpoint pen. Now you can mill yourself a place to store it: a stylish aluminum pen holder. This was designed and programmed by Tobias Leimbach from the DEX (Digital Experience and Application Center) in Erlangen, Germany. Despite its free-form surface, the workpiece can be made on a standard three-axis milling machine with Sinumerik Operate – with customized engraving. This pen holder was produced for the first time at intec 2019 – on a Kaast VF-Mill HP 760 milling machine with Sinumerik 828D.

All CAD drawings, NC programs and the production instructions required to make it are available to download from the "CNC workpieces" section of the CNC4you portal or at:

➤ sie.ag/2lpCOsY

✉ armin.baernklau@siemens.com



Tell us and win – a new year could mean new luck

Why have you opted for Sinumerik? What makes our Sinumerik product indispensable to your company? Tell us your success stories involving Sinumerik CNCs and software and win a visit in the Digital Experience and Application Center (DEX) in your region.

How has Sinumerik enabled your company to manufacture unique products? Why did you choose Sinumerik, and what is the best thing about working with it? Send us your success story or fill out our form. Send us images and videos to go with your story, and be creative – it will be worth it! The best stories will be published in CNC4you – with your consent, of course.

Each month, we will pick the best submissions and draw an overall winner from the monthly winners at the end of the year.

The overall winner will be invited to the DEX in your region.

On top of that, every participant, who sends us a success story will win a limited-edition Sinumerik CNC4you mug, a limited-edition Sinumerik CNC4you polo shirt, and the official My Sinumerik Operate User Guide – so taking part is well worth it!

We look forward to reading your Sinumerik stories and experiences!

Your CNC4you team

We're curious to hear about your Sinumerik CNC experiences!



To enter, for more information, or to view the terms and conditions of participation, please visit siemens.com/cnc4you-prize

CNC4you info mailing – register today!

Do you know about our CNC4you info mailing? It is filled with the most exciting CNC manufacturing topics, compiled just for you. It lets you know when there is something new on the CNC4you portal, such as another CNC workpiece to reproduce or a new video tutorial. Interested? Then sign up today.

Subscribed to our info mailing in the past but no longer receive it? Simply re-register.

This link will take you directly to registration:
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Article No.: DFMC-M10087-00-7600
Printed in Germany

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