SIEMENS
Ingenuity for life

CNC4you

Practical knowledge for the shopfloor

1/2018

siemens.com/cnc4you

Digitalization

On the shopfloor

Siemens AG

A new CNC workpiece enables bottles to be easily opened and resealed

CNC knowledge

Education and training

News

Cover photo: Siemens AG / W. Geyer

The digital transformation of CNC training

0100
1001
0110
Digitalization

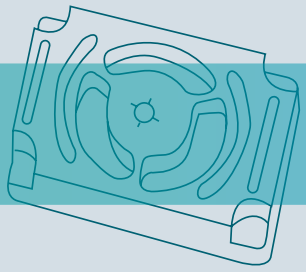
The benefits of the digitalization of machine tools as a response to rapid change in consumer behavior in our society are well known. As such, it is crucial that applications based on digitalization work their way into job descriptions – and therefore CNC training. The challenge here is that the umbrella term of digitalization encompasses a variety of different ways to optimize the CNC production process.

For CNC training facilities, the challenge lies in ensuring that this broad topic is addressed in an in-depth manner and that CNC training is based upon concrete digitalization applications that trainees will encounter in their workplaces. It is necessary that a certain depth of knowledge is acquired in these applications.

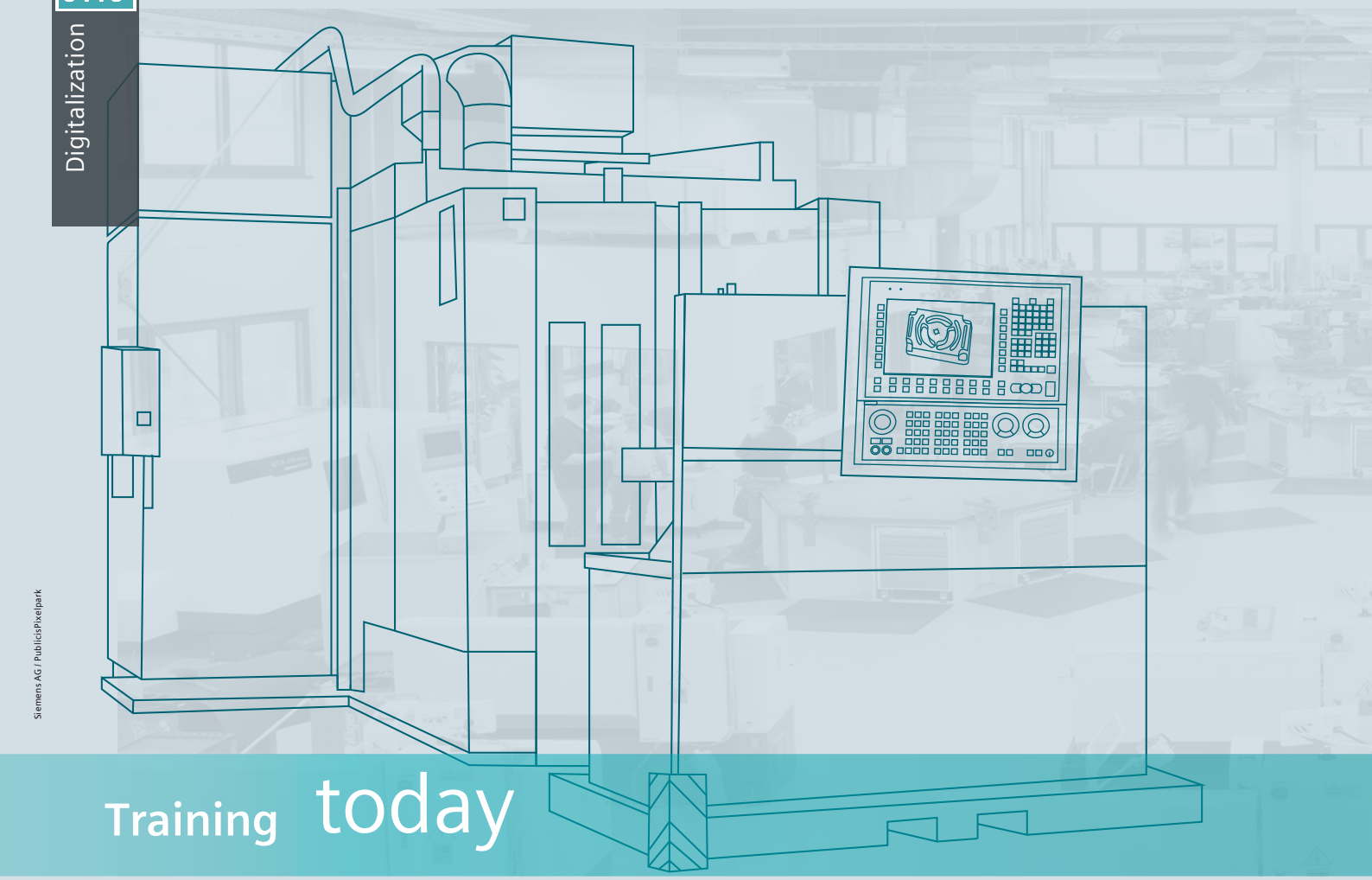
Many pioneering CNC training facilities have already identified these fields of application, and course outlines are being gradually adapted to suit the future competencies of cutting machine operators.

The following pages show how a CNC training partnership between Siemens and vem.die ilw gGmbH, the industry training center for Koblenz, has set the goal of implementing this course adaptation in light of the digitalization of machining. ■

Changes in CNC training

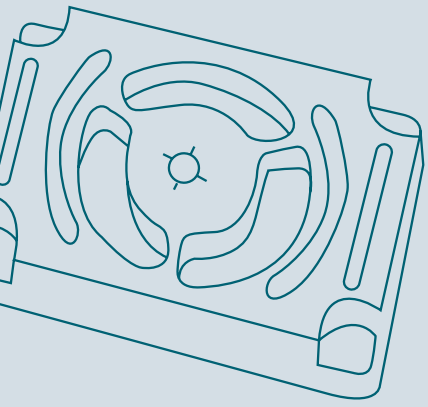


0100
1001
0110
Digitalization



Siemens AG / PublicisPixelpark

Training today



CNC training 4.0

Digitalization is inevitable – and it even affects training professions. A CNC training partnership shows how future cutting machine operators can prepare for the digitalization of their processes.

Training tomorrow

Manufacturing using CNC machine tools is technologically a very demanding field and only makes a decent profit if the manufacturing process is optimally organized. The trend toward customization of products, increasingly short product lifecycles and the associated reduction in time to market are forcing operators of machine tools to take further optimization measures. The goal is to completely eliminate unplanned machine downtime whenever possible. The machine only generates revenue when it is cutting.

Digitalization solutions for the machine tool are inevitable. The opportunities offered by digitalization are already having an impact on job profiles, such as that of a cutting machine operator, for example. In the future, the operator's role will no longer be limited to operating and programming the CNC machine tool. The implementation of digitalization in machining will gradually call for more and more higher-level process knowledge. This means that tasks will be redistributed between production planning and manufacturing.

The skills of tomorrow

Skills such as expertise in machining, including correct selection of cutting speed with regard to the component material, or CNC operation and programming, will continue to be required, but will increasingly be supported by IT processes. Competent handling of these IT processes is therefore a very important prerequisite for the practical implementation of digitalization. CNC training can readily tap into this trend.

Dr. Peter Marx is the managing director of vem.die ilw gGmbH, the cross-company training center for industry in the region of Koblenz, Westerwald and Eifel, Germany. He sees himself as a visionary in this area. "As a training

›

SIEMENS AG / W.Geyer

In the medium term, digitalization is going to have an impact upon the machine tool workplace and thus on job descriptions. Competent handling of IT processes is an important prerequisite for successful implementation of digitalization

vem.die ilw gemeinnützige GmbH

provider, we have to offer our clientele the most pioneering training possible under the best conditions," explains Marx. As a provider of CNC equipment and a leading provider of digitalization solutions for the industrial environment, Siemens sees it as its duty to support commercial education and training as one of the pillars of the industry, particularly when it comes to preparing for future challenges.

Valuable CNC training partnership

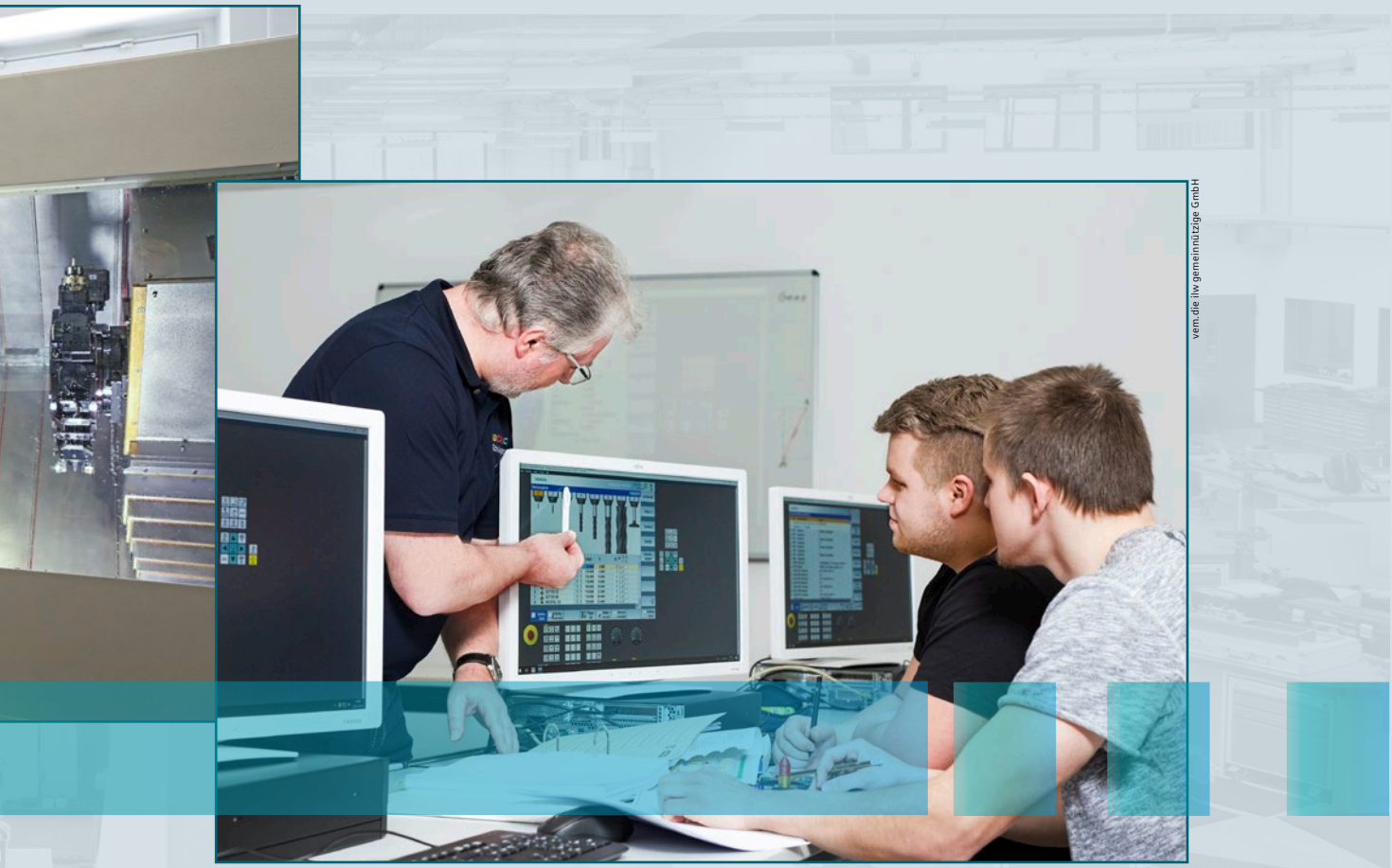
It was this shared motivation that gave rise to a CNC training partnership between vem.die ilw and Siemens Machine Tool Systems. The objective of this partnership is to make a core part of the course material – CNC operation and programming – as sophisticated and as pioneering as possible. "The theoretical part of CNC training takes place on Sinutrain, a training software used in training facilities that is identical to the control system," explains Marx, adding: "This is the first benefit of digitalization. Sinutrain provides a virtual map of material removal and can thus be used for training and as an offline programming system in the industrial environment of CNC production planning."

Practical implementation is then carried out on modern turning and milling machines equipped with Sinumerik CNCs. "You have to have felt the material in your hands. This is why we build up the training step by step. First, the trainees learn conventional turning and milling, and then the CNC comes into play. Following virtual training with Sinutrain, the trainees must be able to independently manufacture workpieces on the CNC machines," explains Marx.

The digital twin of the machining process

The process chain, based upon NX CAD/CAM and Sinumerik CNC, forms an essential part of the training partnership from the beginning as more and more CNC manufacturers are choosing CAM systems over traditional CNC programming on the machine. The ability to simulate CNC programs created offline using CAM with a virtual Sinumerik on a virtual machine greatly increases process reliability, and it also enables the virtual introduction of CNC programs.

This first important step toward digitalization of the machining process shifts the work away from the machine



vem.die ilw gemeinnützige GmbH

»Knowledge of production data could become a field of expertise for cutting machine operators in the long term.«

Dr. Peter Marx, Managing Director of vem.die ilw gGmbH

and toward CNC production planning. Marx believes that the production process using machine tools is poised for change: "The digital twin to machining will be indispensable in the medium term. It means that the machine starts cutting earlier, therefore increasing productivity. However, cutting machine operators now have to master the corresponding IT processes. Teaching these skills will now be part of our specialist cross-company courses."

Next steps in the digitalization of CNC training

The CAD/CAM CNC process chain is far from the end of this development. Further steps toward digitalization of the machining process must be implemented in CNC training. Examples include planning of tool requirements, or management of CNC programs. A key buzzword in the context of digitalization is the Internet of Things. Cloud services for machine tools are already being offered.

"Training providers need to come to grips with this matter as early as possible," emphasizes Marx. "As digital natives, young trainees will already have a great deal of affinity for such topics. However, we still have to approach them in a methodical way. Knowledge of production data could become a field of expertise for cutting machine operators in the long term. Such information is also interesting for mechanics working in maintenance, as well as for the electronics engineers who have to set up the information system in the first place." Siemens also sees this as its duty: MindSphere, the open, cloud-based operating system for the Internet of Things, provides the optimum basis for future-proof training in this digitalization application. ■

↗ **siemens.com/cnc4you**
✉ **andreas.groezinger@siemens.com**

0100
1001
0110
Digitalization

Focus on digitalization –
You ask, we answer

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

Those working on the shopfloor or in production planning on (virtual) CNCs today are benefitting from a technological revolution that began back in the 1950s. The first NC machines that came onto the market in the 1960s and transformed into highly flexible CNC machines by around 1970 (as a result of the development of integrated circuits and microprocessors) triggered many emotions and fierce debates – all quite similar to those stirred up by the current topics of digitalization and Industrie 4.0. Back then, many people feared the loss of jobs while others put emphasis on the enormous potential in regards to reductions in workload and increased efficiency. Today, we know that many traditional jobs on manual workbenches have disappeared. However, there have also been new market and product developments resulting in the creation of new jobs with completely different qualifications.

Digitalization is changing workflows and will have a concrete effect on work with CNC machines over the coming years. These changes will demand different modes of operation and also require additional new qualifications and skills from employees in production. CNC4you will be posing the question "How will digitalization change our jobs?" while exploring the answer in detail through a variety of articles that provide you with lots of information and tips – always with a concrete link to your job. Alongside this, we will be offering "Questions and Answers on Digitalization" online for our readers, in addition to 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 then provide you with the answers through our own research and interviews with experts.

On the following pages we will begin by asking two questions to explore the topic of "Digitalization in the workplace". ■

↗ **siemens.com/cnc4you**
✉ **schlegel.thomas@siemens.com**

"What impact will additive manufacturing processes such as 3D printing have on machining processes and work on machine tools?"

Additive manufacturing will be used more and more in a variety of areas in the future – including in place of and in competition with machining processes or injection molding. A few years ago, the financially and technically feasible applications were still limited in regards to materials, with limited workpiece sizes as one-off products or in small batches. However, today a wide range of plastics, metals, and ceramics can be used for additive manufacturing.

Customized mass production, functional design, high energy and resource efficiency as well as shorter innovation cycles – the advantages of additive manufacturing are being leveraged more and more in the industrial environment. Whether it is powder bed fusion, directed energy deposition, material extrusion or jetting – all these techniques build up workpieces layer by layer based on digital 3D design data. These techniques allow extremely complex structures to be created, which are both light and stable – in fact, finally, parts can be cost-effectively created with batch sizes of just 1. The first 3D printing solutions came from pioneering companies that were allied more with traditional printing processes than machine tools. However, these were mostly solutions for small workpiece sizes such as for medical technology or in the field of spare parts / small components. Now there are prototypes of machine tools that have special print heads as the tool which enable them to "print" a wide range of materials. The key benefits are the precision and stability of machine tools; the size of machining rooms or the length of the traverse; their flexibility (three-axis/five-axis) and speed; and the fact that CNC programming is part of an everyday process chain. Modification of cycles for use in additive processes seems logical.

Many workpieces manufactured using additive processes also require finish-machining, such as in the form of surface treatment or hole drilling. Therefore, for many service providers and suppliers it makes sense to offer customers complete solutions that encompass both additive processes and machining.

Our tip:
Use your knowledge from the areas of CNC programming, materials, and economic machining; obtain additional qualifications in the field of additive manufacturing processes; and find out about the behavior of new materials that are suitable for additive manufacturing. It is highly likely that the 3D printing head will become an additional machine tool in your milling and turning centers, or that you will be operating CNC-controlled machines for additive manufacturing alongside the milling and turning centers used in production – and combining the various technologies in the manufacturing processes.

"Production has to become ever faster, while at the same time software and machines are becoming ever more complex. How will digitalization change the acquisition of knowledge and skills for employees in production?"

The dynamic development of digitalization in production calls for lifelong learning. If you want to successfully survive in your career as a CNC expert, you will need to continually expand your knowledge. Course outlines will need to be critically assessed to determine whether they still meet the requirements of networked production. During the course of a three-year vocational training program, technology can develop so quickly that the program's objectives can become out of date. Industries and associations are already offering additional qualifications alongside training. Traditional job profiles will gradually disintegrate. For example, modern CNC machining centers are already demanding skills in both turning and milling – and soon in 3D printing, too.

The need for further training will increase dramatically with digitalization. Processes will change and operators will need to adapt to new tools and software. This will not be able to be achieved in reasonable time – or at reasonable expense – solely through traditional attendance-based training in which trainers and trainees teach and learn in a room at fixed times. In the future, more and more employees will acquire knowledge through webinars, forums, tutorials, colleague networks, knowledge databases and online searches.

In order to solve problems with CNC machining much faster, on-the-job Internet research will be used more frequently. Our forums, as well as the relevant manufacturers of machines, tools, and control systems, also offer materials in the form of PDFs, articles, diagrams and videos.

Our tip:
Familiarize yourself with the extensive research and assistance options available on the Internet – including how to distinguish trustworthy and reliable offers of help from advertising; or identify unreliable, incorrect sources of information. In particular, industry forums – Internet portals where colleagues come together on a range of professional topics – offer many opportunities to acquire knowledge besides traditional formats. In addition, you can put your experience with online research to good use at home.

Siemens AG

From l. to r.: Alois Penzkofer, user support at Siemens, Witali Reiswich, trainer at Michelin, and Martin Trepesch, head of the technical department at Optimum, are delighted about the successful collaboration

Future-proof training

Rapid technological progress presents major challenges for trainers – and many companies and vocational schools are still teaching on outdated machine tools. The training workshop run by tire manufacturer Michelin is breaking new ground in CNC technology while taking advantage of the benefits of technology leasing.

Modern car tires are incredibly high-tech products. Manufactured using complex production processes, they can ensure traction and short braking distances in almost any weather, while also being extremely long-wearing and fuel-efficient. Every day, more than 22,000 tires in sizes from 16 to 18 inches leave the Michelin factory in Hallstadt – near Bamberg, Germany – which employs over 900 people. In order to keep up with the demand for skilled employees, there are currently 45 young men and women in the training workshop going through their three-and-a-half-year training as industrial mechanics and electricians. “We train to our own requirements, and employ all of our trainees whenever possible. CNC technology has not been a priority in the past. It was merely

›

part of vocational school training, and not relevant to the exams in our training professions. We wanted to strengthen this area in order to better prepare our trainees for the future and to maintain Michelin's long-term competitiveness as a training company," explains trainer Witali Reiswich. However, there is a stumbling block on the road to this goal: the age-old issue of cost.

Special leasing concept for training workshops

At the central workshop in Hallstadt, precision blades that are used as tools in tire production are manufactured on a machine tool equipped with Sinumerik 840D sl. The programs – for both series production and for the many prototypes – are developed in a tool chain with SolidWorks and Sinumerik. The trainees occasionally used the machine to create smaller programs and workpieces, such as trophies, but with increased utilization of the machine overall this was no longer possible. "We then looked into investing in a three-axis milling machine for the training workshop. However, this was financially unfeasible. Our biggest concern was that the technology becomes outdated very quickly. After all, training on an old machine is counterproductive," highlights Reiswich. "Thankfully, we then came into contact with machine tool builder Optimum and found out that we could benefit from its concept for schools and training workshops."

Optimum works closely with the publishers and teaching aid specialists from Dr.-Ing. Paul Christiani GmbH & Co. KG, based in Konstanz, Germany. Together they are able to offer machines for teaching and training, as well as provide training sessions to help trainers and trainees gain certifications in Sinumerik.

Always up to date

A collaboration between machine tool builder Optimum and Siemens Financial Services ended up resulting in an opportunity that was able to support the Michelin training workshop's investment plan. With technology leasing from Siemens Financial Services, Optimum offered the tire manufacturer an OPTImill F150 with Sinumerik 828D. The benefits are clear: instead of a one-off large investment, Michelin now pays fixed, calculable leasing installments which can also be deducted as operating costs.

EXPLAINED IN BRIEF:

Technology leasing

Dirk Schwalb, senior vendor manager at Siemens Finance & Leasing GmbH, explains the leasing model:

"Technology leasing offers considerable benefits in markets and times of rapid technological change. The reason? The lessee only pays during the defined usage phase – meaning that they pay considerably less than the purchase cost. The lessor remains the owner of the machine. At the end of the term, the lessee returns the machine and receives an offer for a new technology leasing machine. Alternatively, they may choose to extend the lease or purchase the machine outright. This flexibility is a key advantage. If the market changes or there are more modern versions of technologies or machines, this concept allows companies to always be using the latest technology. Technology leasing is a cost-effective way to handle technology risks and investments required for short-term peaks in the order situation. However, because this form of financing requires a lot of industrial and technical expertise on the part of the lessor, there are very few providers. Siemens Financial Services offers this financing directly to companies, or in conjunction with manufacturers. The manufacturers' ability to take back and retrofit the machines reduces the depreciation even further, and the lessee benefits from especially favorable conditions – as have we in our collaboration with Optimum for the Michelin training workshop. The tire manufacturer is always able to train based on the latest CNC technology and gains a clear upper hand in the competition for trainees."

Siemens AG

»We now know that we will always have access to the latest technologies, machines, CNCs and tools in the training workshop.«

Witali Reiswich,
Trainer with tire manufacturer Michelin

The leasing contract runs for five years, after which Optimum – working together with Siemens Financial Services – switches out the used machine. Michelin receives the current successor model featuring the latest technology, and the cycle of leasing installments begins again.

Reiswich is delighted, particularly for his trainees: "We now know that we will always have access to the latest technologies, machines, CNCs, and tools in the training workshop. That is a key plus point for our training." In addition, trainees can now create and simulate programs with Sinutrain on the computer in the teaching room, away from the machine. Thanks to Sinumerik Operate, the machines have the same operator interface and the programs are fully compatible, meaning that the programs can also run in the training workshop. The advantage here is that the training machines can assist in the production of the precision blades during peak workloads.

"The OPTImill F150 was set up in the training workshop in October, 2017. We are currently working on integration into the training schedule and shopfloor operation, as well as concrete training content. We receive support in the form of the documents available on the Siemens website, as well as additional certification options through training sessions from Optimum – especially as it is located nearby," explains trainer Reiswich. ■

↗ **siemens.com/cnc4you**
✉ **armin.baernklau@siemens.com**

Collaboration between Optimum and Christiani

Complete solutions for modern training

Everything for the training workshop from a single source – from CNC machines, shopfloor equipment, didactic concepts and teaching materials, all the way through to the raw parts for the examination task. This is what machine tool builder Optimum and teaching aid specialist Christiani want to work together to offer worldwide in the future. The two companies have established an intensive collaboration, and soon customers will even be able to order Optimum machines from Christiani. The complete, modular offerings of the two companies aim to make work and investment in modern training easier for schools and teaching institutes all over the world. "Training is in great need of modernization all over the world. At the same time, companies are desperately seeking employees that can understand and operate digitalized workflows, modern machines, and tool chains. The lack of qualified workers threatens to bring progress to a halt. In collaboration with Christiani, and using modern financing tools from Siemens Financial Services, we offer solutions that will allow training to keep up with technological advancement and digitalization," says Martin Trepesch, head of the technical department at Optimum, in explanation of the machine builder's involvement.

Pushing feedrates

Machine builders promise up to 100 m/min in rapid traverse (G0). Imagine if this rate could be used for the feed, right? Well, tool specialist Hufschmied is working on exactly that.

Twenty-five years ago, the father and son team of Rudolf and Ralph Hufschmied founded Hufschmied Zerspanungssysteme GmbH. Very early on they started to tackle the specific challenges posed by the machining of materials such as thermoplastics and thermosetting plastics, foam, graphite, glass fiber and carbon fiber composites, ceramics, and tough steel.

"Our area of expertise is heavy-duty machining. Today we offer special tools for customers in the fields of automotive, aerospace, plastics and mold-making, and dentistry. However, the tool catalogs that we give to our customers show only a few examples. Over 80% of the tools that we deliver are process and workpiece-specific versions," explains Ralph Hufschmied, adding: "Essentially, what we offer our customers is not only tools, but time. Our technical department analyzes the entire process, including programming, machine settings and options, the tool and the workpiece. The team then develops optimizations, tests them, and implements them in the customer's operations."

Hufschmied's aim is to push boundaries. This particularly applies to milling with the G-code G0: rapid traverse. "In practice, the feedrates are between three and eight meters per minute. Part of our work is about increasing that multiple times," says Hufschmied.

Hufschmied Zerspanungssysteme GmbH

»Over 80 percent of the tools that we deliver are process and workpiece-specific versions.«

Ralph Hufschmied, Managing Director of Hufschmied Zerspanungssysteme GmbH, Bobingen, Germany

The machining of materials such as thermoplastics and thermosetting plastics, graphite, and carbon fiber composites poses particular challenges for tools

Fooke GmbH

Milling in rapid traverse

In practice, feedrates are subject to certain limits. It all begins with the settings on machines and control systems that are designed by manufacturers for operation within tight safety limits and high base accuracies. For example, the tool or workpiece must remain secure inside the machine, and damage to the spindle or tool needs to be prevented. This means the operator cannot run the machine at its limits – and this is where Hufschmied comes in.

"We know customers' processes and workpieces. Our collaboration with machine builders and with Siemens as a control systems manufacturer allows us to adjust machines and processes in a customized manner and develop a suitable tool. With all of this knowledge, it is possible to 'loosen the reins' on the machine, so to speak. As many customers also write their programs offline via PLM and CAD/CAM tools, it is even possible to intervene in the programs' software routines. For the simulations, the software has to know that the machine is able to travel more than the normal range under the optimized processes, and also know how this is possible," says Hufschmied, explaining the optimization of customized process chains.

Visible increase in efficiency

This results in customized processes in which variables such as feed, spindle speeds, accuracies, dynamic and jerk values, setting angles, and tool geometries are precisely matched to one another. This gives rise to special tools such as the Graftor ball end and toric end mills, which combine roughing and finishing in a single work step for the machining of graphite workpieces in tool, mold, and model making, as well as in electrode manufacturing. With the Graftor, customers can achieve feedrates of up to 80 m/min.

The entire process chain is tested at Hufschmied. For example, for mold-making it is tested on a five-axis EiMa Gamma S high-portal machine, equipped with a Sinumerik 840D sl and multi-touch panel. This makes it possible, in particular, to test the dry machining of fiber composites. Considerably higher feedrates can be achieved when deburring and when roughing plastics, or when completing surface post-treatment on additively manufactured workpieces for rapid prototyping – with no negative impact on dimensional accuracy or surface finish.

"Our customers benefit from our experience and our close collaboration with machine builders and Siemens. This allows us to intervene so deeply in settings and processes. In addition, we work with universities in research and development in the field of high-speed cutting. If the entire process chain is optimized, it is possible to achieve significant efficiency gains, as a customer example shows: In the past, he took eight days to get to his finished model; now, after several optimization projects, he can produce it in just over eight hours," says a visibly proud Hufschmied. ■

↗ **siemens.com/cnc4you**
✉ **alois.penzkofer@siemens.com**

CNC knowledge

High praise for functionality and convenience

The latest software release 4.8 adds new functions to Sinumerik Operate. Additional measuring cycles, numerous programming simplifications and new technology cycles now make work even easier.

In the previous release, improvements to measuring during setup (JOG mode) and process measurement in Automatic mode were among the focus areas. However, with new software version 4.8 developers have managed to harmonize measuring cycles in both operating modes even further, and develop core innovations – in both programGUIDE and ShopMill programming. In JOG, probes on the ball can now be calibrated and two or more holes or spigots of varying diameter can be aligned. In the process measurement cycles, setpoint values can now be specified as a reference point for the adjustable zero offset, as when measuring in JOG.

An interesting example of the new measuring cycles in version 4.8 is the kinematics measuring cycle Cycle9960. Instead of having to call up three cycles per rotary axis, the user can now launch the entire measurement with a single cycle based on Cycle800 or the kinematic chain. Every rotary axis is measured over a maximum of 12 measuring points (Cycle996) instead of the previous three.

Programming simplified

The usability of the CNC has a direct impact on the speed and quality with which programs are created. With software version 4.8, Sinumerik Operate offers numerous improvements in the program editor. For example, the search function has been reworked, and cycle call-ups can now be simply deleted using the delete or backspace keys. Font sizes can also be easily adjusted to suit display resolution.

Smart Operate now offers even more comfort on high-resolution multi-touch panels in sizes of 15 to 24 inches and in the modern 16:9 format. Additional functions and views open up in side screens at the edge of the Sinumerik Operate interface. There are seven widgets as standard, quickly informing operators of actual value, zero point, alarms/messages, axis load, current tool, downtime and program runtime. With an optional display manager, the content and position of views can be flexibly changed on 22/24-inch displays. A PDF viewer, machine functions, or a virtual keyboard can also be brought up in a side screen.

In addition, values calculated in the considerably improved pocket calculator can simply be marked and adopted into cycles or input screens. This shortens entry time and minimizes errors.

Reliable remaining time display

Using gestures and softkeys speeds up work considerably. Thus, in the expanded online documentation operators will now find overviews of all existing and new multi-touch gestures and softkeys. The documentation has also been improved in the opposite direction: the operator can bring together diagnostics data in the form of an alarm list and save it as an associated file – in order to make it available to maintenance technicians, for example.

With production being timed with increasing precision, information on progress is becoming ever more important. In the past, a CNC program had to be run through before the remaining time display was available for further machining. In mold-making with numerous individual pieces, the progress of work was therefore not always transparent. In software version 4.8, the remaining time is displayed right from the first machining, based upon an estimate.

Siemens AG

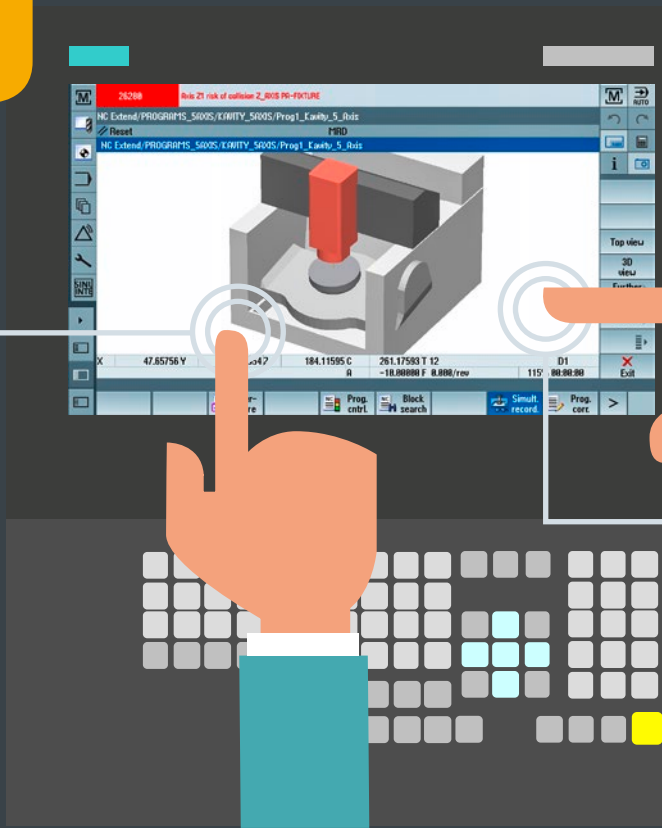
Views can be flexibly changed on the 22/24-inch displays of multi-touch panels via a display manager

»Scalable protection of the machine for all control operating modes.«

Expansions in collision avoidance

»Every rotary axis is measured over a maximum of 12 measuring points instead of the previous three.«

Benefit of the new Cycle9960



»Side screens with additional functions and views.«

Greater comfort on high-resolution multi-touch panels

Siemens AG / PublicisPixelpark

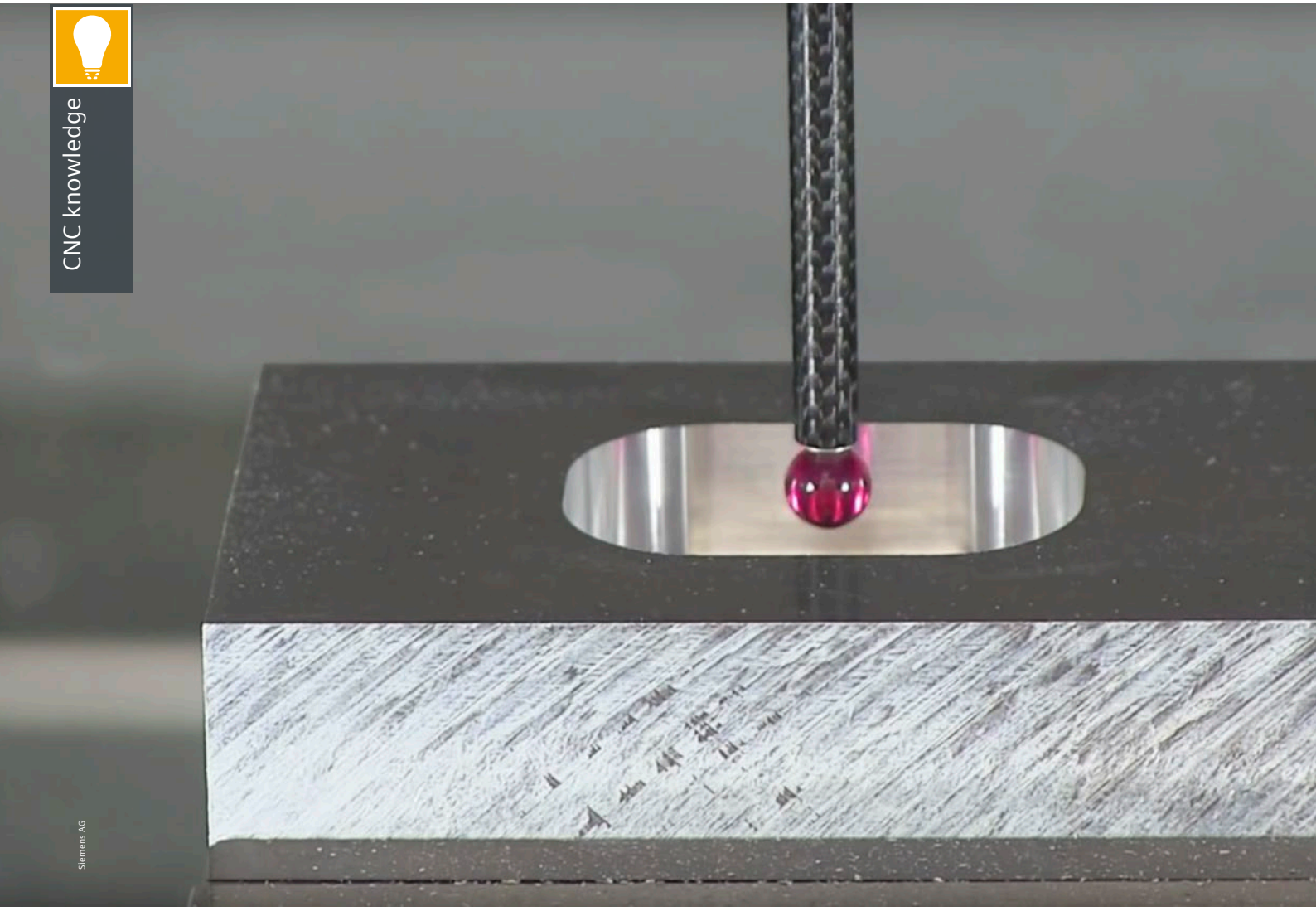
Tool wear correction

Software version 4.8 of Sinumerik Operate also offers additional advantages in the field of machining technology. Examples include the expanded functions for 3D tool radius correction: CUT3DFD (face milling) and CUT3DCD (peripheral milling). In CAD/CAM, the milling paths can be calculated using standard tools, and the difference corrected in the CNC. The difference can be stored as wear input for the current tool in the CNC, or as a programmed tool correction offset. This saves time-consuming recalculation of the program in CAD/CAM.

Collision avoidance has been greatly expanded in software release 4.8, and now offers scalable machine protection. Three collision avoidance methods are available for all JOG, MDA, and AUTO control operating modes: Collision Avoidance Eco, Collision Avoidance and Collision Avoidance Advanced. Unlike the traditional version based upon STL files, the Eco version uses primitive objects such as cuboids or rectangles, and a reduced number of protected areas. This considerably increases the speed of calculation, and eases pressure on the control system. Depending upon the application, programming phase or objective, collision avoidance can be switched on or off with a mouse click. ■

↗ **siemens.com/cnc4you**
✉ **wolfgang.reichart@siemens.com**

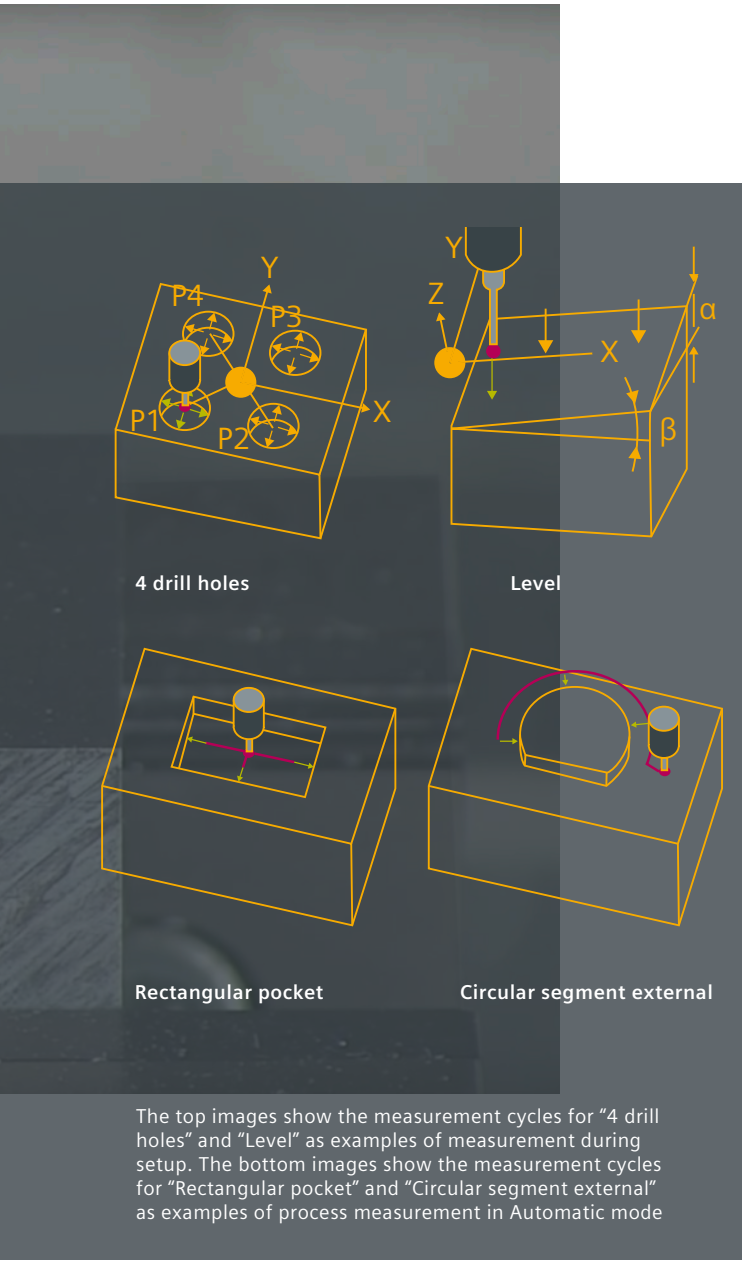
CNC knowledge



When implementing process measurement in Automatic mode, the dimensional accuracy of CNC workpieces can be automatically checked using Sinumerik measurement cycles, and corrections made as necessary

Precise workpiece and tool measurement

In addition to machining, modern CNCs can perform a number of different measuring tasks. There are two different applications; measurement during setup of a component, and process measurement in Automatic mode in order to ensure component quality.



The top images show the measurement cycles for "4 drill holes" and "Level" as examples of measurement during setup. The bottom images show the measurement cycles for "Rectangular pocket" and "Circular segment external" as examples of process measurement in Automatic mode

When measuring during setup (operating mode: JOG), the CNC must be informed of the workpiece's zero point before machining a new component. As this is still an unknown variable at this point, the measuring process requires operator input. The operator selects the desired measuring option on the CNC user interface and positions the measuring instrument near the object to be measured by manually moving the axes – for example, using the handwheel. The CNC then performs the actual measurement automatically, and the result is immediately stored under the desired adjustable zero offset, such as G54. This means that a CNC measuring program does not need to be written.

CNC Sinumerik offers a wide range of measuring functions for determining the zero offset. For example, when making a measurement across four drill holes, the intersection of the drill holes is determined as the zero offset. At the same time, the basic rotation – the rotation of the workpiece coordinate system – is entered under the zero offset. Depending upon the machine features, there are triggering touch probes available for workpiece and tool measurement. However, simple measurements can also be made with manual gauges, or by scratching using the tool. In these cases, the measuring process is not automatic; the operator has to confirm contact between the measuring instrument and the object to be measured by means of a softkey on the CNC user interface.

For guaranteed quality

Process measurement in Automatic mode should ensure the desired quality of machining during the actual machining time, and is normally used to check dimensional accuracy in series production of workpieces. Known variables are re-measured in a fully automated process by calling up measurement cycles in the CNC program. A common application is the measuring of fits using the measurement cycle. Here, the deviation between the setpoint and the actual value is entered under the wear for the relevant tool, so that during the next CNC program sequence the deviation in the dimensions of the fit can be compensated for. Component quality can be ensured in large batch sizes by means of CNC tool management with sister tools. Further cycles implement fully automated measurement of tools in order to identify tool breakages during tool change, interrupting the machining process if necessary.

Sinumerik measurement cycles that Siemens offers for process measurement in Automatic mode support any triggering measuring probes. One exception is laser measuring systems; there are no standards here, meaning that there are no turnkey solutions offered for this measurement method in the basic scope. However, if necessary, machine builders can implement laser measuring systems with their specific operating and measurement functions using Sinumerik user interfaces.

The results of measurement functions during setup and of process measurement in Automatic mode can be stored in log files in CSV format, and then processed in a higher-level management execution system (MES). This makes the measurement functions of Sinumerik CNCs important aids in the digitalization of machining processes. ■

↗ **siemens.com/sinumerik**
✉ **andreas.groezinger@siemens.com**

Motivation to achieve technical excellence

WorldSkills in Abu Dhabi has come to an end. The final outcome for the German team with its 42 starters in 37 disciplines: a silver and two bronze medals – which is too few, thinks Tobias Leimbach, workshop manager for the "CNC milling" skill.

Siemens employee Tobias Leimbach supervised GermanSkills and was also present at the international professional championships in Abu Dhabi as workshop manager. Leimbach has come back from the desert metropolis with mixed feelings. On one hand, he saw fantastic performances and great dedication from the German team; on the other hand, he realized that the international frontrunners have a considerable lead. Leimbach sees this as an alarming indication of the state of training in craft and industrial firms – and as a wake-up call to companies, politicians, and society. We spoke to him about what needs to change in order for Germany to be able to keep up.

Mr. Leimbach, are you happy with the performance of the German participants at WorldSkills in Abu Dhabi?
Tobias Leimbach: No, not exactly. The trainees that competed had already demonstrated their exceptional crafting abilities at GermanSkills. In terms of milling/turning, I can say that the tasks in Abu Dhabi were exceptionally difficult. Added to this was the enormous time pressure and the unusual, stressful situation of being in the hall with all of the spectators. I have utmost respect for all of the participants.

But you are not completely satisfied?
Tobias Leimbach: As the motherland of craftsmanship, Germany shouldn't be happy with twelfth place on the medal table and only three medals. If you look at the points that were achieved in the competitions, you will see a considerable gap between us and the international frontrunners. We may take a skeptical view of the Asian training models, but our direct neighbors – Switzerland, Austria and France – are also managing to keep up.

What are the differences, and what can we learn from the other nations?
Tobias Leimbach: There are even considerable differences in the organization and importance of the national skills competitions. In Asia, as well as countries such as Switzerland, they are organized with great state involve-

D MEDIA HUB PZE.

Left:
WorldSkills Abu Dhabi 2017 was an impressive event for all involved. The international professional championships were accompanied by stunning ceremonies with around 20,000 participants at the beginning and end of the event

Right:
Many participants at WorldSkills used headphones or earplugs in order to be able to concentrate better. This allowed them to focus on their tasks amidst all the excitement

ment. The companies see the competitions as an opportunity to position themselves as exceptional training firms in the fight for new talent, even on a cantonal level. It is an exhibition. The winners in these countries gain a lot of attention in the media and from the public – and that applies to both the trainees and training companies. We are a long way from this in Germany; usually the smaller companies can't afford the expense. A lot more support is needed, as the trainees have to be given time off for the training sessions and national competitions, and must be taught by good trainers on the machines used in the competitions. Abu Dhabi showed that intensive training is essential.

What form should that take exactly?
Tobias Leimbach: The WorldSkills champions from Asia are more or less heroes in their countries; they embody their nations' economic emergence among the international elite. The trainees are encouraged, the competitions are supported by the state, and the teams are constantly being brought together to practice with the best trainers on the best machines. I'm not saying that we should copy everything, but I think that we have been complacent with our economy's successes for too long, and that we now have a training problem in craft and industry. Workshop managers from other nations asked me why there was such a big difference between German industry's position on the world markets and the placement of the trainees at WorldSkills.

Siemens AG

What would you like to see changed?
Tobias Leimbach: It is important to increase the profile of GermanSkills and WorldSkills, and to once again motivate people to achieve technical excellence – in both industry and society. On top of that, we need to think about how we can get more small companies and their trainees interested in these competitions. Sometimes with smaller companies at the moment, trainees are desperately needed as workers alongside attending school. And it is not only in school education but also in dual study courses where there needs to be more focus on quality. Those that give trainees time off for competitions should receive compensation for doing so. The immediate preparation of the GermanSkills winners for WorldSkills often lies solely in the hands of the relevant company and trainer – and that is not always ideal. Former WorldSkills participants or trainers and experts with WorldSkills experience could be used for this. When it comes to technical training in international competition, Germany needs to work even harder in order to face the national and international challenges. ■

»In terms of milling/turning, I can say that the tasks in Abu Dhabi were exceptionally difficult.«

Tobias Leimbach, Workshop Manager for the "CNC milling" skill

D MEDIA HUB FZE.

The German team had a total of 42 entrants in Abu Dhabi

Education and training

Peak performance under pressure

GermanSkills champions in the categories of CNC turning and milling, Lukas Bosslet (Festo) and Eva Wahl (Chiron) were members of Team Germany at WorldSkills in Abu Dhabi. We spoke to them, and their instructors Florian Schmitt and Herbert Mattes, about their preparation – and the adventure that is WorldSkills.

Ms. Wahl and Mr. Bosslet, how did you enjoy WorldSkills in Abu Dhabi?
Eva Wahl: WorldSkills is a really impressive event. Unfortunately, because of the tight competition schedule, the participants don't get very many or very long breaks, but I managed to fit a lot into them.

Lukas Bosslet: Honestly, I didn't get to see much outside of the hall. I was, of course, at the ceremonies at the start and at the end, along with the almost 20,000 other participants. But otherwise I was very focused on my tasks – as I needed to be.

Were you satisfied with your results and final position?
Bosslet: My original goal was the final of GermanSkills. The fact that I won that and qualified for Abu Dhabi was already more than I'd expected. Given the very stiff competition and the difficulty of the tasks, I'm very happy with my twelfth place at WorldSkills.

Wahl: It was similar for me. The WorldSkills competitions didn't go exactly as I'd imagined, but in hindsight I'm very pleased with thirteenth place, after all.

Herbert Mattes: I'd like to put in a word for our two participants here, actually. It seemed to me that the examiners at WorldSkills overshot the mark a little this year. There was one milling task that none of the participants were able to complete and that even experienced professionals and experts would have struggled with.

Florian Schmitt: At the end of the day, the German and international competitions are extremely challenging – not only for the trainees, but also for the companies training them. Not only were the tasks set difficult; the conditions in Abu Dhabi were tough, as well. The participants had to concentrate on an extremely difficult task under great time pressure, in a giant hall, and right beside a large number of spectators. Anyone that is unable to remain calm and focus has no chance.

What was the crowd's effect on you as competitors?
Bosslet: After the task was presented, I had 15 minutes to talk to my supervisor. For the rest of the competition – several hours – I was on my own,

Worldskills Germany/Jörg Wehrmann

»WorldSkills is a really impressive event.«

Eva Wahl,
Chiron-Werke GmbH & Co. KG

and didn't notice much of what was going on around me. Most of the participants wear earplugs or headphones so that they can concentrate. The tasks would have been completely impossible without all the preparation.

Wahl: It was the same for me. I practiced a lot in advance, but when you are actually competing under major time pressure, everything is much more extreme.

Schmitt: Given the level of the tasks and the extreme time pressure, even as an instructor I break into a sweat just watching. I have the utmost respect for all of the participants, regardless of the final rankings – and I'm sure that most of the supervisors would agree with me on that.

So what exactly did you do to prepare?

Bosslet: Some of the training courses on the software took place in the run-up to GermanSkills. For Abu Dhabi, we also took part in a preliminary competition in Russia, along with other nations. As of summer 2017 I had completed my apprenticeship and could focus intensively on preparing.

Schmitt: The preparations are a big time commitment for both the participants and the companies training them. At Festo, we have a good setup and have modern machines – the same as those used in the competition.

Wahl: Anyone that wants to do well in the skills competitions has to be dedicated. To prepare for GermanSkills, we spend hours on the machines in the evenings and on weekends. Chiron assigns great importance to training for the competitions. Time off, special training courses, travel to practice competitions – I was always well supported.

Mattes: The trainees and their instructors have to put blood, sweat, and tears into it – without real commitment, good performance would just be a question of luck.

What is it about WorldSkills that will remain with you as competitors and companies?

Bosslet: The competitions and the training courses were an extraordinary experience. I improved my skills considerably and became a lot faster at handling tasks on the machine, which is why my final apprenticeship exams seemed relatively easy. I will definitely benefit long term from WorldSkills.

Wahl: I invested a lot of time in the competition – but it was worth every minute. I learned a huge amount, it was fun and I made a lot of contacts within the team.

Schmitt: Taking part in the competitions is also highly worthwhile for Festo as a company, which is why we now take part in the German qualifiers on a regular basis. It enhances Festo's national reputation for high quality in trainee instruction and as an employer. This helps us to bring new talent into our company – good employees form the foundation of our success, after all.

Mattes: Chiron also has clear objectives attached to its involvement in the competitions. We use the participation and success of our trainees to position ourselves as a flagship for training in the craft sector and in industry – far beyond the boundaries of our region. We want to be a highly attractive company for good trainees. ■

Worldskills Germany/Jörg Wehrmann

»Given the very stiff competition and the difficulty of the tasks, I'm very happy with my 12th place at WorldSkills.«

Lukas Bosslet, Festo AG

↗ **siemens.com/cnc4you**
✉ **tobias.leimbach@siemens.com**

Successful collaboration (from l. to r.): Alois Penzkofer (Siemens User Support), Bengcon employees Stefan Hirsch (Environmental Campus lecturer) and Prof. Dr. Peter Gutheil (Dean of the Environmental Campus), and Karl-Horst Röder (Siemens User Support)

Education and training

The complete training package

Covering everything from designs in Siemens NX, to simulation, to the machine itself, public and private institutes can now provide training across the entire digital process chain (CAD/CAM CNC).

This has occurred as a result of the Bengcon spin-off of the Environmental Campus Birkenfeld at Trier University of Applied Sciences, Germany. In Birkenfeld, PAL editors have been developed and adapted to suit Siemens NX. This means that training facilities can now order the entire package through training specialist Christiani: Siemens NX licenses, PAL editor, virtual machine tools, documents, and instructor training. “NC program design is not enough for us. The trainees must also be able to execute their designs on virtual machines. Until now there has been no digital process chain included in training. There were enormous gaps everywhere, meaning that trainees had to solve the puzzle themselves and lose time integrating the components,” says Stefan Hirsch of Bengcon, outlining how the situation had been.

Another feature of almost all German facilities for vocational training of industrial mechanics/cutting machine operators and CNC specialists is that training and examinations are carried out in the manufacturer-neutral

»Training facilities all over the world can now get a solution for teaching the entire digital CAD/CAM CNC process chain from a single source.«

Alois Penzkofer, Siemens User Support

PAL format, as an introduction to NC programming. The problem is that there are no CAD/CAM solutions or machines that work with this format in real life. However, the team at Bengcon has developed a solution to this: in collaboration with machine builder Optimum and global technical training specialist Christiani, they have put together a complete package and developed a manufacturer-neutral PAL editor for Siemens NX.

Training editor with help and examination functions

The result is a PAL editor optimized for training: this solution is completely integrated into Siemens NX, and offers students extensive help functions. Trainers can also provide programs with gaps that the students have to fill in. Christiani offers corresponding practice and examination programs. A program edited in PAL can then be exactly simulated in Siemens NX. Virtual machines have been developed for this purpose: a lathe, three-axis and five-axis milling centers, and two machines from Optimum.

Another specialized training editor has been created for programming using Sinumerik – with numerous helpful additional functions for students and trainers. With programming in PAL, the simulation is where it ends. But with this new editor, students can now learn the expanded Sinumerik options, simulate their programs in Siemens NX, and then process them on the workpiece using Optimum machines with Sinumerik CNCs. Once again, the collaboration between the university spinoff and the training specialist has closed a loophole: the mapped Optimum machines can be ordered from Christiani with a postprocessor at a reasonable cost.

On Siemens' side, the project has been supervised and monitored by Alois Penzkofer from the regional Siemens User Support: "I salute the Bengcon start-up team and their dedication. They have not only developed amazing editors and virtual machines: they also worked tirelessly until all partners were networked and until they had put together a convincing, complete training package. Training facilities all over the world can now get a solution for teaching the entire digital CAD/CAM CNC process chain from a single source. This is not only good for trainees, it is also a valuable contribution to our society, which is experiencing great upheaval as a result of advancing digitalization. The companies that then hire these young people who have this additional knowledge will also benefit, as their new employees will be perfectly equipped for the tasks of tomorrow." ■

Siemens NX

Siemens NX is an interactive CAD/CAM/CAE system and was originally developed by Unigraphics Solutions and based upon its own Parasolid modeling kernel. The company was taken over by Siemens, and has since been operating as Siemens PLM Software, which develops and sells the software.

Siemens PLM offers Siemens NX for educational institutions in a single package known as an "Academic Bundle" at a reduced cost (the educational institution must be not-for-profit). The Academic Bundle includes all modules necessary to map the aforementioned digital process chain.

CAD – computer-aided design:
A computer-based design process

CAM – computer-aided manufacturing:
Computer-aided manufacturing using software that is independent of the CNC machine to create the NC code

CAE – computer-aided engineering:
Computer-based simulation and calculation based on CAD data models

CNC – computerized numerical control:
Computerized numerical control is an electronic process for controlling machine tools (CNC machines)

↗ **siemens.com/cnc4you**
✉ **alois.penzkofer@siemens.com**

Sinumerik live –

Video tutorial: “Multi-face machining milling (3+2 axes)”

In the “Sinumerik live” video series, we explain various topics to do with Sinumerik applications in a practical, simple, and easy to understand way.

In part four, “Multi-face machining milling (3+2 axes),” the focus is upon the fundamentals of milling, and upon 3+2-axis milling using Sinumerik Operate – specifically featuring plane swiveling with Cycle800. In the video, the theory is first explained and then demonstrated using a practical example, in which a workpiece is milled live directly on a five-axis machine using a Sinumerik 840D sl CNC.
Watch the video on YouTube:
↗ **bit.ly/2IPqpeJ**


Siemens AG

New certified, trainers for Sinumerik

A total of three new members have joined the ranks of certified Sinumerik trainers. In order to gain certification, the candidates had to prove their Sinumerik-related knowledge throughout a multi-day course.


Siemens AG

Herbert Heinemann

One of the new trainers is Herbert Heinemann. A machine fitter by trade with a degree (Dipl.-Ing.) in electronics, he set up his own business in 1990 offering adult education in computing and has been running CNC courses with officially recognized examinations since 1999. Heinemann has been working for the past six years as a tutor to certified mechanical technicians at a vocational school, in subjects such as manufacturing and automation technologies – as well as in design and technical communication. He specializes in the operation and programming of Sinumerik 810D/840D sl and 828D with Sinumerik Operate and Sinutrain, as well as in CAD/CAM software.


Hans-Peter Oehler

Hans-Peter Oehler

Hans-Peter Oehler is also newly certified. With years of experience as a user and applications engineer in the field of milling and turning, and most recently as a training manager and independent lecturer specializing in NC programming with Sinumerik 810D/828D/840D sl, he has been successfully sharing his knowledge as a freelance programmer and trainer since 2014.


M. Adamski / A. Kartschmit

Anton Kartschmit

The third recently qualified trainer is Anton Kartschmit. He immediately followed his training as an industrial mechanic with further training as a master craftsman in metal. Kartschmit

A practical 2-in-1 workpiece

A new CNC workpiece makes it easy to open bottles and seal them again. The workpiece is made up of two turned parts – a head and a sleeve – manufactured in a CNC turning machine. The contours for the sleeve and head are created in the integrated contour editor and processed using the roughing and finishing turning cycles. Sinumerik Operate offers easy-to-configure cut-off and undercut machining cycles. The finished workpiece then only requires a spiral coil and an O-ring, and it can be used as a corkscrew or bottle stopper. The corkscrew spiral must be screwed into the head, and the O-ring placed over the sleeve in the recess. To open bottles, the sleeve is inserted into the radial drill hole in the head with the conical section pointing forward, creating a corkscrew with a T-shaped grip. When storing the corkscrew away, the head – including the spiral coil – is screwed into the sleeve, becoming a bottle stopper.

All the CAD drawings, programs, and the production description are available to download from the cnc4you portal at:

↗ **sie.ag/2Dwr16Y**
✉ **armin.baernklau@siemens.com**

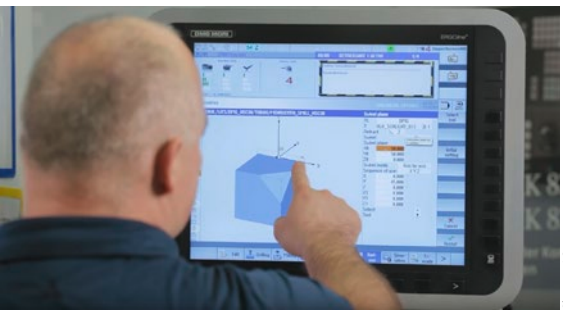
Siemens AG

Siemens AG

This and other videos can also be found under Tips and Tricks for CNC machining at

siemens.com/cnc4you:
↗ **sie.ag/2EFqi30**

✉ **armin.baernklau@siemens.com**



Siemens AG

gained experience with Sinumerik through his last employer, Dekra Akademie GmbH in Bielefeld, Germany, which has a training partnership with Siemens. He worked as a trainer in CNC milling in Bielefeld up until the summer of 2017. He currently works for Nachwuchsstiftung Maschinenbau, a foundation that aims to support up-and-coming mechanical engineers, on a regional project focusing upon cutting machine operators.

You can find an overview of all of our certified trainers in the "Education and Training" section of the CNC4you Portal. You can also book the listed trainers for courses here.

↗ **siemens.com/cnc4you**
✉ **karsten.schwarz@siemens.com**

Stay up to date with cnc4you

Visit **siemens.com/cnc4you** for more information about current news and to download manufacturing instructions for the latest workpieces.
Subscribe to our info mailing to ensure you don't miss out on any news: **siemens.com/cnc4you-infomailing**
Would you like to read cnc4you news on the go? Then the cnc4you app is what you need: **siemens.com/cnc4you-app**

Published by
© Siemens AG 2018

Digital Factory
Gleiwitzer Straße 555
90475 Nuremberg, Germany

For further information please visit:
siemens.com/cnc4you
siemens.com/sinumerik

Contact: contact.cnc4you.i@siemens.com

Article No.: DFMC-M10036-00-7600
Printed in Germany