

# TebisWorld

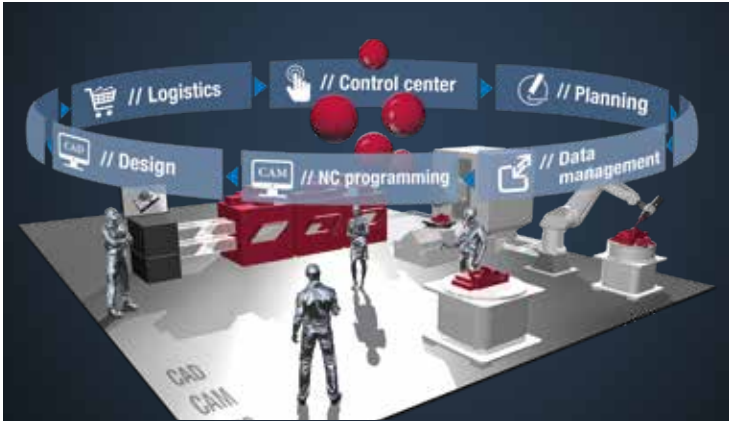
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## 5-axis milling – Interview with Product Manager Helmut Vergin

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| Tebis Consulting | Interview with Diedrich Diedrichsen | Simulation technologies  
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Dear  
readers,



Ulrike Keller, Marketing

Were you at AMB in Stuttgart, Germany, last September? If so, you're sure to recognize the part on the title page. Tebis employees Andrea Krispler and Ingo Vincon gave a live demonstration showing how quickly and easily this turbine casing can be planned, programmed and manufactured. Ingo was in high demand as a CAD/CAM expert between the shows.

I wanted to hear from him what made the visitors so curious. There were a wide range of factors, he said. According to Ingo, automated NC programming with templates was a hot topic. The Tebis CNC simulator was also met with great interest. It ensures that only NC programs that have been completely collision-checked are sent to the machine. And several visitors were unaware of how much time can be saved with the new 5-axis functions and modern circle-segment cutters. Many also found digital manufacturing management with the ProLeiS MES exciting. "Finally," says Ingo, "people were thrilled by the whole package. Everyone needs high-performance CAD/CAM software. People are currently concerned about major issues like the shortage of qualified personnel and competitive pressure. They want to find out how they can make their manufacturing faster, simpler and more reliable."

Do these questions concern you as well? If so, you will find your answers in this issue. Let us inspire you!

Ulrike Keller

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# Looking back at 2018 Recap

2018 just came to an end. Time for a recap of the year at Tebis. Make yourself comfortable and join us in taking a look back at 2018. What most characterized this past year, and what were the trends?



Team Tebis on the podium



MES  
for Industry 4.0



Speed and reliability  
in the CAD/CAM process



Machining volume with heart



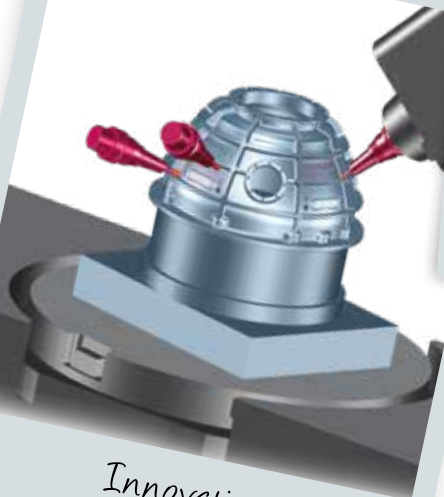
Higher performance



Open House – the industry  
meeting place



The winner is...



Innovative  
5-axis technology



On the road



On the road

## On the road

Tebis was represented at nearly 80 events in Germany and abroad in 2018. These included open houses at our partners' sites and major industry tradeshows. Tebis attracted lots of interest with its end-to-end CAD/CAM/MES platform presented at shows worldwide, such as AMB in Germany, IMTS in the USA, CIMES in China and JIMTOF in Japan.

## Open House – the industry meeting place

Do you remember the Tebis Open House? Or perhaps you were there yourself? More than 700 visitors from Germany and abroad visited the Tebis Open House on June 20 and 21. The atmosphere was informal as usual and the content highly

professional. Under the motto "We bring it all together," event visitors were able to exchange ideas about machines, tools and clamping devices with more than 20 of our hardware partners, delve into the world of business theory in our management lounges and gain new insight into Tebis solutions at 24 high-profile presentations.

## Faster CAD/CAM processing

Tebis software performance has improved significantly. NC calculations, loading, response and search times, machine simulation – virtually everything has gotten faster. Speed has doubled again in reroughing. Milling areas are optimally combined, and small areas that should not be machined are automatically detected.

## Innovative 5-axis technology

The hot technology topic in 2018 was Release 6. New and optimized functions in 5-axis simultaneous milling were focal points. 5-axis NC programs for roughing and finishing and for contours and engraving are now easier for every CAM user. The work is simplified by clever preparation functions for complex parts. Support for circle-segment cutters saves time due to maximum cutting performance.

## MES for Industry 4.0

The ProLeiS starter packages from Tebis offer a convenient and cost-effective way to get started in digital manufacturing management. Order planning and control with an MES application (manufacturing execution system) connects manufacturing with project management. This ensures optimal preparedness for the future, because consistent planning and control are what make Industry 4.0 possible.

## Team Tebis on the winners' podium

Tebis employees are committed to climate protection. At the German STADTRADELN event, a regional cycling competition, a group of 22 cyclists from Tebis won third place in the category "Team with the most kilometers" in the group ranking for the participating municipality of Planegg. Two colleagues took second and third place in the individual ranking. Mayor Heinrich Hofmann presented the prizes in the Planegg town hall.

## The winner is ...

Tebis won two special awards in 2018. In the "competitive strategies" category in the "Best of Consulting Mittelstand 2018" competition hosted by the Wirtschaftswoche magazine (WiWo), Tebis won first place. The jury was impressed by the results of the Tebis consulting project for Swiss mold manufacturer Formbar AG. Have you seen the "Tebis Forever" heart? The German Design Council, which confers the German Design Award each year, selected the Tebis slogan "If machines were to decide..." for its "Special Mention" category. The centerpiece of the slogan is the "Tebis Forever" heart. Tebis can display this honor for the entire coming year.

## Machining volume with heart

By the way, the "Tebis Forever" heart is not just a design, it also exists in reality. We milled this heart from a block of aluminum weighing a good 250 kilograms. The finished "Tebis Forever" heart has a wall thickness of only 12 millimeters and weighs less than 15 kilograms – meaning a machining volume of more than 94 percent. The mirror-like surface was achieved through precise 5-axis machining. Tebis makes it possible.







INTERVIEW WITH HELMUT VERGIN | TEBIS AG PRODUCT MANAGER  
5-AXIS MILLING

This interview appeared in the November issue of the *maschine + werkzeug*® trade journal.



# “The first customer was thrilled with our solution”

INTERVIEW – **Tebis** offers more support for 5-axis milling.

Product Manager **Helmut Vergin** explains how simple 5-axis milling has become with Tebis Version 4.0 Release 6.

**Mr. Vergin, what have you focused on in Release 6?**

On the one hand, we have seen new tool types and milling strategies taking hold in die and mold manufacturing over the past two years. On the other hand, the shortage of qualified personnel is becoming increasingly critical – for our customers as well. We therefore wanted to make our software much easier to use. In many cases in the past, it was necessary to design additional guide geometries. This was cumbersome and required experience in NC programming, a skill that is becoming increasingly rare. Especially if users do not often work with a specific function, they feel somewhat inhibited in their programming. We have simplified many things in the new release to remove these inhibitions.

**What are the new types of tools, and what are the corresponding milling strategies?**

Twenty years ago, the big hit was high-speed cutting with a ball cutter. Since then, controls have improved and machines have gotten faster. The market found new life a few years ago: New high-performance tools like high-feed cutters, high-performance cutters, barrel cutters (circle-segment cutters) and new milling strategies like adaptive roughing have emerged and provide many positive arguments in favor of milling as opposed to additive processes. However, many of our customers are wondering what tools they should be using and when, and what strategies to use with them. And we want to help them on their way.



**Is Germany out in front with these issues, or are these global trends?**

The German die and mold manufacturing industry is certainly close to the leading edge. For example, barrel cutters have been available for impeller manufacturing for several years. Two years ago they broke out of this niche, and the German market is certainly in the lead. This trend has not yet fully penetrated in the rest of Europe. It is just beginning now. However, anyone who knows the Italian, Spanish and Portuguese mold manufacturers, expects that it will not take long. Our service teams in these countries are well-equipped for this purpose.

**What functions have you integrated in the software for 5-axis milling?**

First, let me clarify the term: For Tebis, 5-axis milling includes not only 5-axis simultaneous machining but also 5-axis avoidance milling as well as multi-sided machining (tilted 3-axis machining), because these require machines with five axes. We simulate all of these cases in our software. If users want to optimally machine a part with 5-axis simultaneous milling and use the best milling strategy for each area, they can very easily subdivide it using the Tebis CAD functions and select the areas. The areas can also consist of multiple individual surfaces, making the work much simpler.

**Can this milling program be changed again?**

Yes, the user splits the part into the desired areas with the preparation functions in the "NC preparation" module and the Tebis software then automatically creates the milling area. The user modifies the tool, starting position, tilt vectors and path smoothing and saves these in the NCJob. He or she checks the program in the clamping orientation on the virtual machine in Tebis and changes a few parameters if necessary. And when the part goes to production and the machine is available, the user clicks a button to start the processing.

**What makes this solution stand out compared to the competition?**

Certainly, a unique selling point of the Tebis solution is that users can mill across surfaces with all functions. There are solutions on the market that have integrated strategies for the barrel cutter, but they only work on a single CAD surface. In Tebis, the tool travels over the selected milling area in a single path – complete and without interruptions – no matter how complex it is. Of course, milling across surfaces has a positive impact on the surface result and on machining time. Using barrel cutters in 3-axis milling with tilted tools is also very simple: No complex tilt calculations are necessary for line-by-line processing of surfaces; the software does it all.

**Who is most interested in these 5-axis functions?**

In die manufacturing, the new functions are especially appropriate for large forming dies in the automotive industry. For example, outer skin surfaces can be processed with simultaneous 5-axis machining, saving a lot of time. The area of application for the software is far larger in mold manufacturing. For example, our customers in this segment benefit from the 5-axis functions when milling mold inserts and guides. This includes milling strategies for roughing free-form geometries and free-form pockets, for side and face finishing, for machining contours and for engraving.

**Are customers already using Release 6?**

Yes, the first customers have been working with it since early July of 2018.

**What kind of feedback are you getting from these customers?**

Very positive – especially regarding the simplified user interface. The first customer who used our solution was thrilled. He downloaded the software, started the first part and was finished with the 5-axis simultaneous program in five minutes. The biggest saving with the 5-axis NC programs used with high-performance cutters is time. Depending on the application, time savings of up to 70 percent are possible. Another customer who was initially very skeptical about whether he could achieve the necessary precision with barrel cutters has since completely changed his manufacturing and saved a full 50 percent of the time required for milling guides. But of course, this always depends on the application. We always want to achieve the best result for our customers. We therefore also offer comprehensive consulting services.



HELMUT VERGIN

Helmut Vergin has been the product manager for CAM/automation processes at Tebis since 2008. The industrial mechanic was responsible for mold manufacturing work preparation in earlier positions before joining Tebis in 1997, where he initially worked in Support and Quality Assurance. His profile is rounded out by his training as an operations manager, technical product manager and industrial marketing manager.



More information: [www.tebis.com/en/](http://www.tebis.com/en/)



# Tebis simulation technologies: No compromises

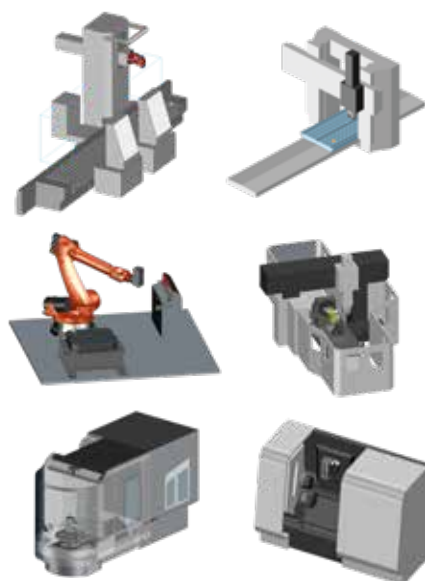
Reliable manufacturing is collision-free manufacturing. And manufacturing quickly means optimally utilizing the machines and accounting for all components with ideal traversing and retract movements. The Tebis CNC simulator unites reliability and speed.

While searching for a new CAD/CAM system, die manufacturer GEDIA Gebrüder Dingerkus GmbH from Attendorn, Germany, had a clear goal in mind: unattended manufacturing over the weekend – which only works if all machines operate continuously with no interruptions. GEDIA ultimately chose Tebis. Hermann Geueke, head of machining, justifies his decision: "To reduce our collision rate to zero and to avoid time-consuming checking after postprocessing, we needed a simulation of the machine model and the tools in the virtual world that had millimeter accuracy." Many CAM systems only simulate the output NC code. Only then can the NC programs be adjusted in the control-specific NC format – this is not especially convenient for the NC programmer or the machine operator and requires additional communication. Tebis therefore takes another approach: The NC programs are completely collision-checked before postprocessing. Essential prerequisite: It must be possible to simulate the real manufacturing environment in the virtual CAD/CAM world with no ifs, ands or buts. Tebis achieves this with intelligent process libraries.

## Digital process libraries for greater reliability

Tebis supports all common machine types from various manufacturers on the market and their geometrical and kinematic properties. The machine library contains more than 800 models in 3,000 variants – including multi-axis, gun drilling and multifunction machines, such as turning/drilling machines and lathes with a main and secondary spindle.

### Virtual machines



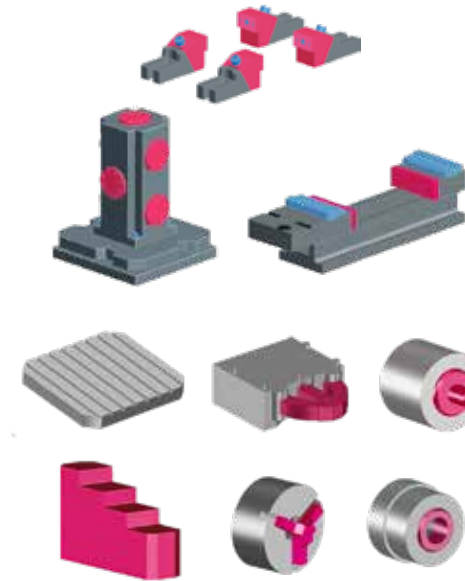
There is no tool that cannot be represented in the Tebis tool library. Precision is key: Tebis accounts for the contours of the tools with absolute accuracy. Modern high-performance tools – like HPC cutters (high-performance cutting) for roughing, HFC cutters (high-feed cutting) for finishing and prefinishing and circle-segment cutters for finishing – can therefore be used with perfect results.

### Virtual tools



Other equipment like jaw chucks, steady rests and tips as well as machine tables, mounted parts and partitions are stored in the unit library. The portfolio also includes virtual clamping devices.

### Virtual units and clamping devices



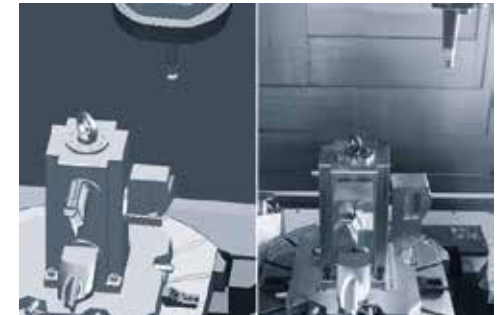
## Controlling rather than being controlled

The manufacturing environment could not be precisely simulated without high-precision process libraries. But the CNC simulator can do even more: It checks the complete machining scenario with all of its dependencies – including tool and table changes, setups, starting points and connection conditions, limit switch limitations and axis and traverse movements. The operator controls the machine at all times. This person controls all the details of what it will do next. For example, retract movements must be optimally adapted to the manufacturing situation: The real world precisely follows the movements in the virtual world.

Carsten Wurm, head of the CAM programming team at GEDIA, also has a high regard for the precise machining time calculation in this regard: "(It) ... enables us to exchange the sister tools ... completely automatically." The machine run times are determined by assessing the machine cycles and the processing speed of the control.

## The entire process chain at a glance

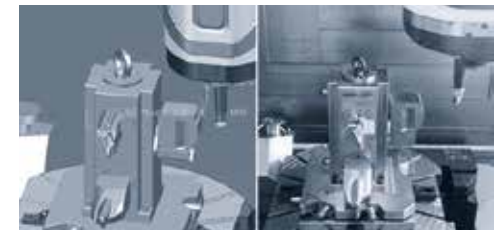
The CNC simulator is also a very useful tool for cost estimation and manufacturing planning. Specifying machines, machine heads and clamping devices, selecting shuttle tables and dies, defining reference points, determining the number of machining operations, displaying and avoiding potential collisions – this is all done prior to NC programming. This lightens the load on the NC programmer, who can focus exclusively on the core task. The programmer uses the libraries and the manufacturing knowledge stored in templates to automatically generate collision-tested NC programs.



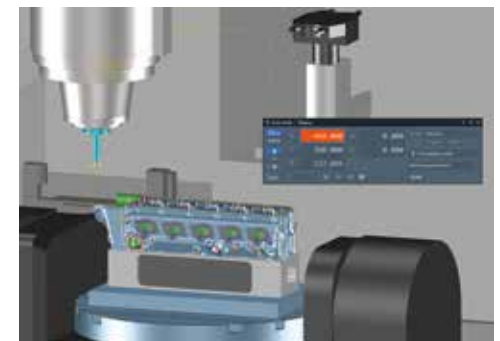
Automatic milling with maximum safety distance.



Direct connection with fixed C axis with no safety distance.



With user-defined macro and reduced safety distance.



The CNC simulator checks all components, all positions and all movements.

More information:  
[www.tebis.com/cnc-simulator](http://www.tebis.com/cnc-simulator)







# Turning and milling as complete machining

Machines that can do turning, milling and drilling reduce machining changes and reclamping steps and decrease logistics cost en route to the finished workpiece. At the same time, precision increases because turning, drilling and milling are all performed in the same setup. If the machine has a primary and secondary spindle, parts can be completed on all sides without manual reclamping. However, the safe and efficient operation of these options – which allow turning/milling machines to be operated with the least possible user intervention and monitoring – place special requirements on the CAD/CAM process.

For many parts, especially in mechanical engineering, their manufacturing requires multiple processes for turning, drilling, 2.5D milling and 3D milling, all the way up to 5-axis simultaneous milling. Modern complete machining centers for combined turning and milling are appropriate for manufacturing these parts as efficiently as possible with few setup operations and machine changes. However, because machines of this type are an expensive manufacturing resource, they need to deliver a high degree of value creation: In other words, they must be machining around the clock at the maximum possible capacity. A current study by the WBA Tooling Academy Aachen and the Fraunhofer Institute for Production Technology IPT shows that nearly 40 percent of turning programming is performed on controls on idle machines. It is therefore recommended that all processes be first represented digitally and simulated in a CAD/CAM process. This ensures that the part can be machined without interruptions after clamping the workpiece and the tool changer equipment.



## End-to-end Job Manager for all machining operations

The Tebis Job Manager combines all machining operations for turning, drilling and milling needed to produce the workpieces suitable for manufacturing. The large number of available machining functions and strategies ensures that all necessary machining operations can be programmed, resulting in a complete digital process. With the end-to-end material model, material removal in milling/turning is documented from the blank to the finished part. Then the currently available material can be used as the starting point for the next machining operation – from turning to milling and back again. The blank model is used to determine the location of the material to be machined for all machining operations with a high material removal rate. With material tracking activated, this blank is updated in real time following each cut. This allows you to visually follow the manufacturing progress at all times and realistically simulate all machining operations. In conjunction with the implemented automation, the machining functions also automatically find the geometries to be machined in the part and calculate the toolpaths. This significantly simplifies manufacturing of similar geometries.

## Libraries with digital twins of all manufacturing resources

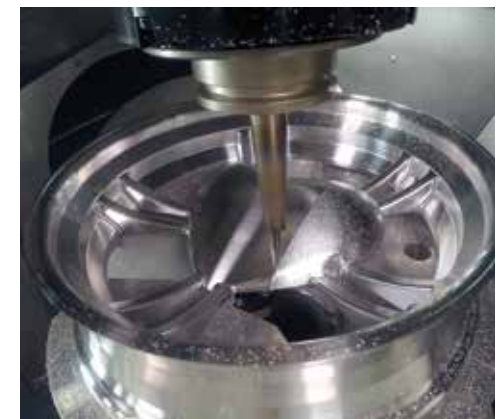
The part and blank are present as digital elements in the CAD/CAM process. Special attention must be paid to the manufacturing resources that Tebis manages as digital twins in libraries. In addition to the virtual representations of the machines with units and clamping devices, the tools also play a special role. All tools for turning, drilling and milling can therefore be managed in a common tool library in Tebis. Special tools like shaping, striking and side-milling tools are also supported. All individual components are available to the user in a true-to-life representation – from the cutter to the tool holder – and are assembled to form complete tools that enable the performance of all collision checks. More details on the libraries and collision-checking are provided in the article "Tebis simulation technologies" on the previous two pages.

## High reliability with collision-checking

When calculating the toolpaths, there are different strategies for automatically avoiding collisions between the part and shank and the tool holder, depending on the function: turning, milling or drilling. These include automatic switching to a longer tool, automatic avoidance and automatic reduction of the machining areas until they are free from collisions. In addition, each machining operation can be planned in detail in the digital representation in order to find the optimal tools and tool tilt directions before calculating NC programs. Additional machining units like a tailstock with a quill or steady rest are frequently used in turning/milling. Their use is best specified and controlled using the Tebis Job Manager during NC programming. This avoids subsequent complex adjustments on the machine.

## Complete simulation and complete NC program

As explained, Tebis rules out collisions with the tool components during program calculation for turning/milling. Subsequent collision-checking also examines the machine components like an equipped turret and the traverse paths between individual toolpaths. This results in an end-to-end collision-free NC program for all turning, drilling and milling operations. The NC program also controls the machine units, including clamping elements, tailstocks and steady rests. A complete digital representation of the manufacturing environment and virtual-collision checking of all machining operations ensure that the goal is achieved: The machines in real manufacturing operate without interruptions.







# A system for digital manufacturing

Remaining competitive means more than just producing high-quality parts. Increasing deadline pressure demands more efficient order planning and control. This is supported by an MES such as ProLeiS: The software provides a precise overview of manufacturing, enabling more flexible planning and more efficient manufacturing. Customized ProLeiS starter packages provide easier access to digital manufacturing management for small and medium-sized companies.

As a result of digitization, institutions like industry association BITKOM and Fraunhofer predict productivity increases of roughly 25 percent over the coming years due to improved order planning and more transparent manufacturing. However, industries like die and mold manufacturing traditionally involve manually intensive processing. Small and medium-sized enterprises (SMEs) are confronted with the challenges of achieving greater automation and efficiency while still maintaining the highest possible quality and precision. This is no easy task, as the manufacturing process involves many specialists whose work has to be coordinated in order to remain within the cost constraints and to ensure quality.

## On course for Industry 4.0

This requires increasingly precise order planning and control – and the ProLeiS MES (Manufacturing Execution System) is designed for exactly this purpose. "In order to manufacture efficiently, you need quick access to all relevant data," says Robert Aulbur, responsible for the MES division at Tebis. The ProLeiS MES starter packages give companies easier access to digital manufacturing man-

agement and represent an important step toward Industry 4.0. This enables companies to manage increasing deadline pressures and tool complexity.

## The key to efficiency

The underlying concept of the Tebis ProLeiS MES application (process, instrumentation and control system) is to provide a current and comprehensive visualization of resources, status, causes of errors and information from all manufacturing areas. The MES enables automated manufacturing planning based on BOM items. The application gathers data from all areas, from software systems, processing stations and people, on a server. It also networks departments such as manufacturing with manufacturing planning or with project management. The benefit: greater transparency. An exact overview of all manufacturing projects is the key to simplified project planning and greater efficiency. ProLeiS enables users to optimally plan, control and monitor all manufacturing orders, in the best possible way from the first inquiry to the finished product.



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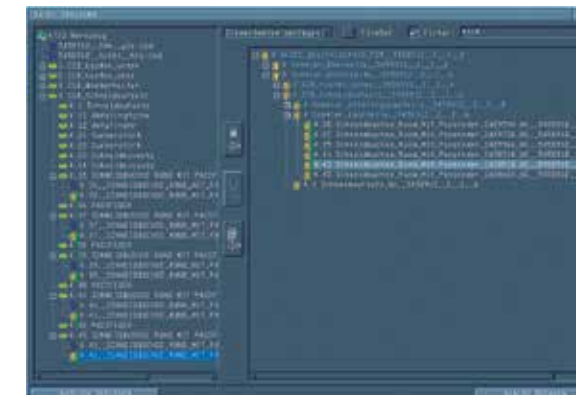
*In order to manufacture efficiently,  
you need quick access to all  
relevant data.*

[Robert Aulbur, MES division at Tebis AG]

1) Use ProLeiS to automatically create individual CAD model files from a complete assembly file: for example, for cutting dies.

2) The machine operator only sees released manufacturing orders and processes them in accordance with the sequence specified in ProLeiS.

1)



2)



## Initial results are quickly visible

There is no doubt: Any company that wants to remain competitive must venture into the world of digitized manufacturing. "Companies know this. However, many are still shying away from the perceived associated effort," Aulbur says. Based on his experience, it is best to start out small and then expand. "We know from many projects with enterprise customer projects with a very wide range of orientations and market positions that it is easier to embark on the path to digital order control once the process has been launched and the customer experiences its immediate success." Tebis has therefore configured the ProLeiS MES with starter packages such as Manufacturing Data Management (MDM) and Machine Data Acquisition (MDA) to enable an easy, phased entry. Experience has shown that MDM and MDA are a very effective approach because they quickly produce tangible results. Individual startup scenarios are also possible: for example, through preliminary and detailed planning with a connection to an existing ERP system.

## Everything in its place

The ProLeiS MDM starter package brings structure to file management. All manufacturing data – from the first bill of materials to the last related document – are managed centrally on a single server. This eliminates extensive searching for CAD data and other project documents and avoids to continuously check the data for current status. A file cannot be opened and modified simultaneously by more than one employee. The costly use of incorrect NC programs in manufacturing is a thing of the past.





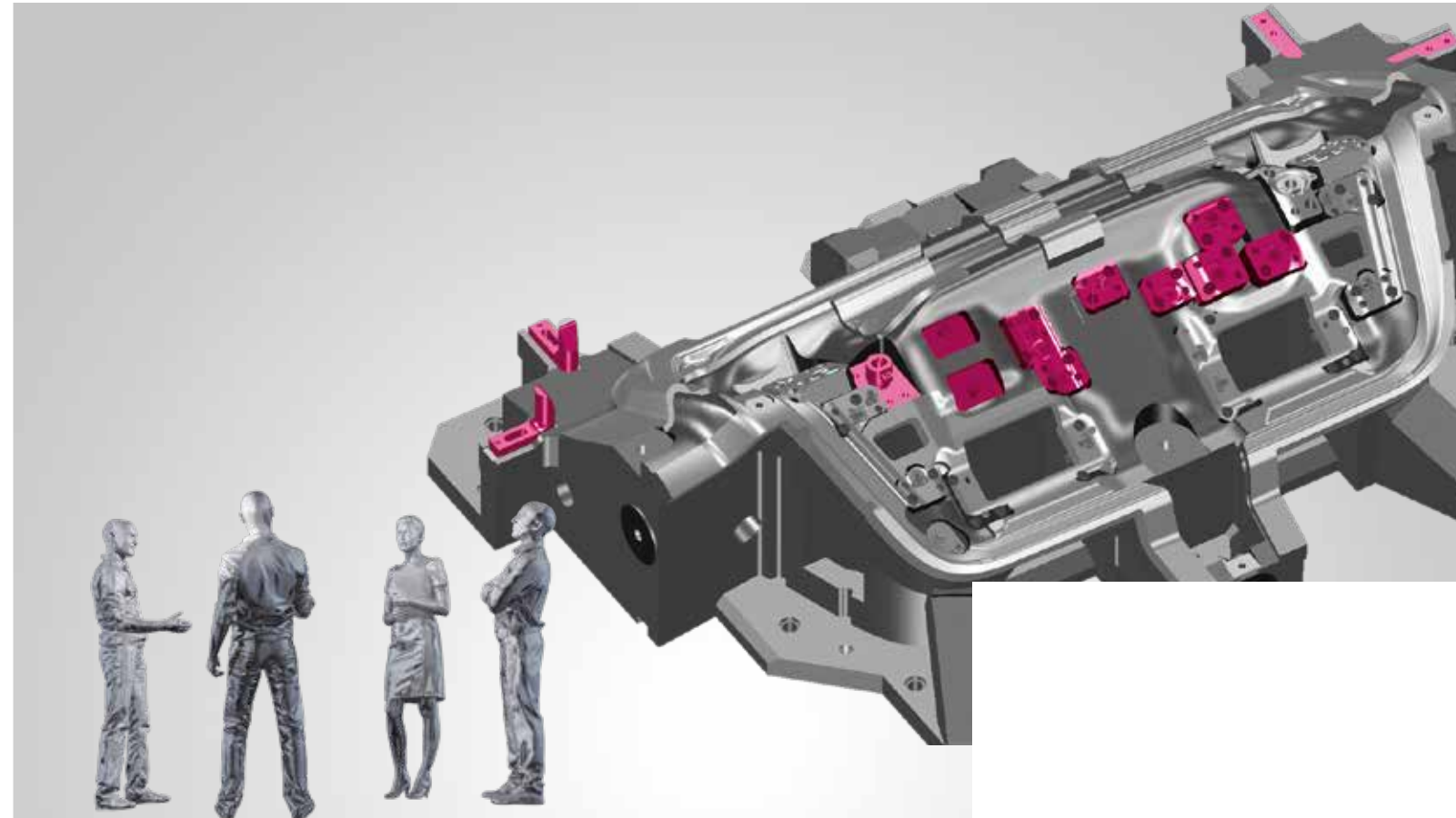


### Easily find changes

Controlled access privileges also simplify the work, because employees receive the subtasks assigned to them with only the corresponding files through role-specific access. These are processed in the specified sequence: Once a task is completed, the user releases the part for the next work step. Changes, including subsequent changes by the customer, are documented in the log, which is visible to all. ProLeiS saves time and nerves: The Tebis Splitter splits CAD assembly files into individual Tebis CAD manufacturing files at the click of a button. The modified areas are directly indicated in an automatic comparison between the old and new versions. Overall, companies accelerate their manufacturing processes and minimize errors with the MDM starter package.

### Increase machine capacity

The second MDA starter package has the machines as its focal point. Companies obtain a better picture of their actual machine use as well as historical data. The key elements are a virtual diagram of the manufacturing building and the integration of various machine controls. A traffic light system shows the operating state of the machines in real time, both on screen and on mobile devices. This is supplemented by transparent access to all key data, including current machine status, machine statistics, run times, setup time and faults. An analysis enables users to identify frequent causes of errors and to correct them in a timely manner. The MDA starter package thus makes manufacturing more reliable. Companies become more flexible and increase their machine utilization.



Detail planning  
Tool management  
Capacity  
Logistics  
ERP interface  
**Control center**  
General planning  
Procurement  
Quality assurance



### Phased expansion

But the ProLeiS MES can do even more. Companies have the option of gradually expanding ProLeiS to the complete MES scope for manufacturing planning and control. The on-time provision of materials and tools and the integration of third parties also unleash enormous potential and help companies increase their profitability," Aulbur explains. Initial successes are often seen as soon as all of the machines are connected and data management is working. "As soon as our enterprise customers recognize how simple and effective the first step to digital order processing is, most of them immediately take the next step," says Aulbur.

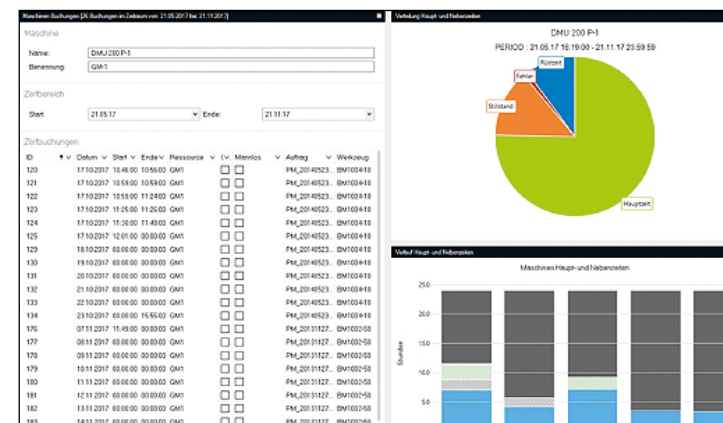
### Plan precisely, deliver on time

Manufacturing planning is usually the next focal point. The project manager manages all planning tasks in the ProLeiS MES. First, the user prepares preliminary planning based on customer-specific planning templates and determines whether sufficient resources are available to accept the order. Detailed planning starts with an import of the bill of materials, which is imported from Excel or

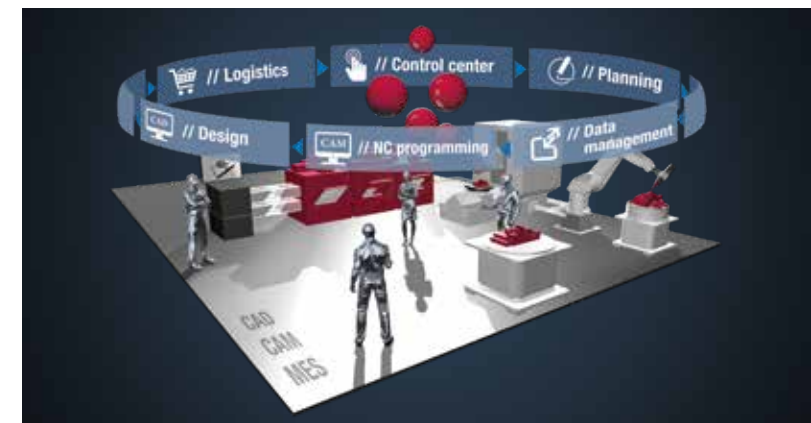
from a CAD system. The manufacturing planner first specifies scheduling milestones for a project. These indicate when which parts have to be fabricated in order to start assembly and tryout of the complete die. They then define the specific CAD/CAM/NC processes that will be used to manufacture the parts as well as the employees and machines that will do the work. In this case, too, task templates simplify the work in the subsequent manufacturing steps.

### Success through digitization

Company owners, project managers and manufacturing managers always have an overview of all processes in ProLeiS MES. They can identify impending faults in advance and can quickly respond on different levels. Digitized manufacturing with reliable analyses available in real time – in conjunction with networked departments – represents an essential tool for optimizing and automating manufacturing processes. ProLeiS represents the software platform for this and supports efficient and on-time manufacturing. This enables even SMEs to deal with an increasingly complex manufacturing world and to secure part of the predicted productivity increases for their operations.

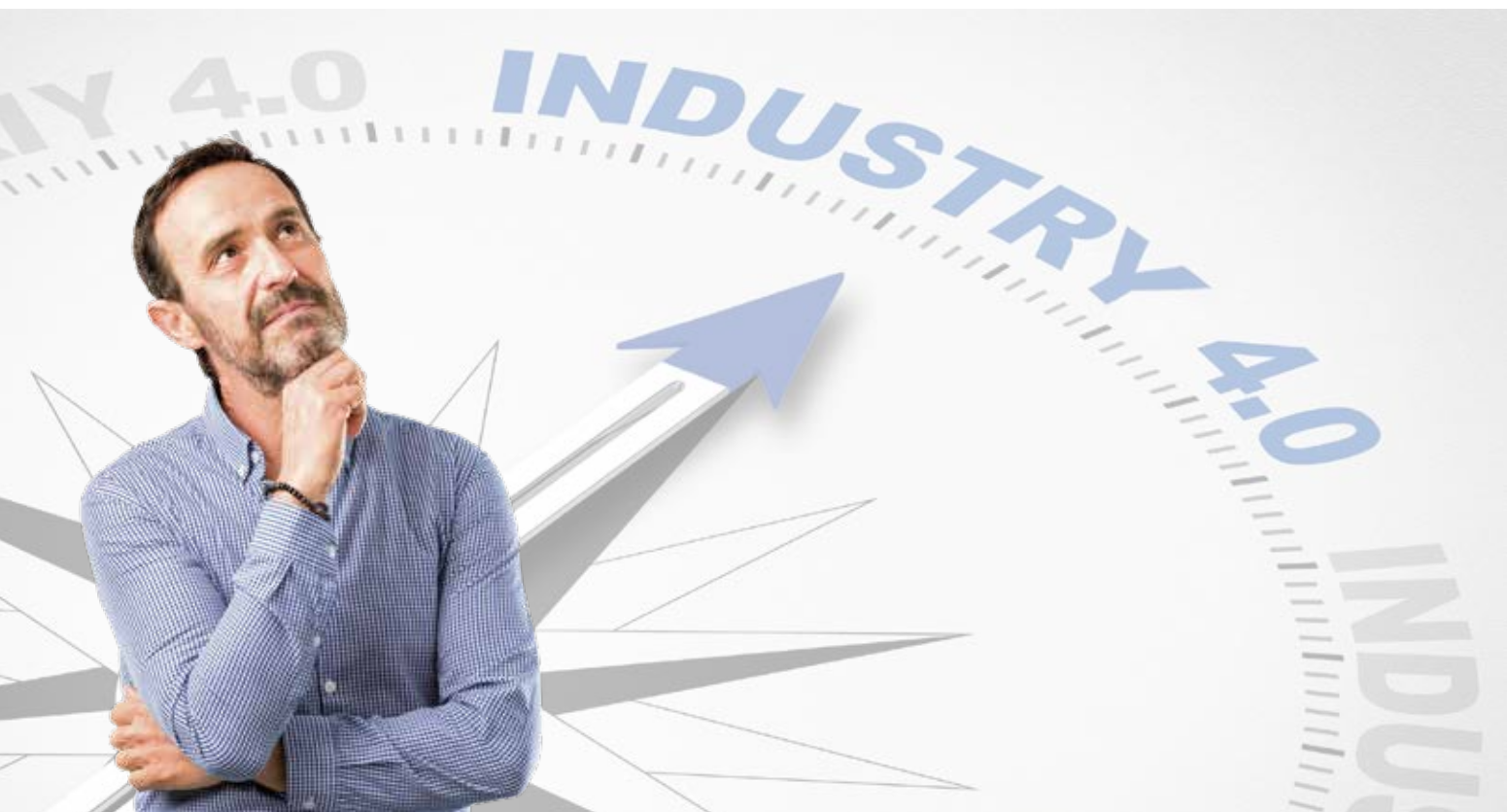


Automatically prepared statistics (shown here for manufacturing times and downtimes) enable comparison of manufacturing data and make decisions for process optimization easier and more understandable.



Digital manufacturing management: Every aspect of order processing can be digitized with ProLeiS. Higher-level networking offers greater transparency for better planning and control of single-part manufacturing.





# Shaping the future



Where do I stand with my company? Where do our strengths lie, and what are our weaknesses? Are we on the right path to the future of Industry 4.0? And if not, what do we have to do? The VDWF (German Association of Tool and Mold Manufacturers) and Tebis provide the orientation that was often missing in the past, with measures that include an Industry 4.0 readiness assessment and the die manufacturing market survey.

Die, model and mold manufacturers have always had to compete in the international market. Flexibility is an important prerequisite for successfully shaping the future. But the basic orientation is often lacking: What direction should we take? What measures are right for us? As an industry expert, Tebis has long supported its customers on their

path to digitization. Tebis has also played a key role in establishing the "Marktspiegel Werkzeugbau" (die manufacturing market survey) initiative. The goal: to promote the future viability of die, model and mold manufacturing. All die, model and mold manufacturers can now participate. You can register on the German website:

[www.marktspiegel-werkzeugbau.com](http://www.marktspiegel-werkzeugbau.com)



**MARKTSPIEGEL  
WERKZEUGBAU**



## What is the "Marktspiegel Werkzeugbau"?

The "Marktspiegel Werkzeugbau" is a joint initiative by Tebis AG, the GINDUMAC used machinery platform, and the VDWF. The survey collects and analyzes data from member companies and anonymizes and publishes them as a market report. Over the long term, this will lead to greater market transparency and will allow valuable industry trends to be identified.

## What goals is the initiative pursuing?

To provide an orientation and comparability, the initiative will inform the industry about developments in die, mold and model manufacturing. It has developed performance indicators that can be used as a new industry standard. Companies will be able to use these indicators to rank themselves relative to their competition. The report is a reliable and realistic source to use for management measures.

## How is the "Marktspiegel" report prepared?

The report is based on data from participating companies. The members of the initiative are analyzed annually in four areas:

1. Company performance indicators
2. Production, organization, processes
3. Marketing, communication, sales
4. Digitization, automation

The initiative evaluates the results and generates the ZINDEX (future index) and key performance indicators for a comparison of companies.

## What information does the report provide?

In addition to the ZINDEX, each company receives a confidential report section. It provides insight into the company's development level based on recorded data and includes recommended actions for key decisions for the future. Managing directors can use this information to derive specific measures.

## How is the "Marktspiegel" industry and trend report compiled?

This is a comprehensive general report that will be published by the initiative every two years for the Moulding Expo beginning in 2019. It contains the BINDEX (industry index) and is based on anonymized evaluations from the ZINDEX. The "Marktspiegel" therefore reflects developments in the industry and serves as a trend barometer.

## What is done with the data?

The collected company data belongs solely to the participating companies. They provide the data only to prepare the "Marktspiegel." The data are managed by a neutral trustee who anonymizes them before passing them on. The "Marktspiegel Werkzeugbau e.G." association ensures that the data are safe and in good hands.





Presentation of the "Best of Consulting Mittelstand" award to the Tebis Consulting team headed by Jens Lüdtkke.

# Outstanding consulting

We are outstanding, and not just for our customers and employees: The *WirtschaftsWoche* (WiWo) magazine has also recognized us. Our consulting team put itself in an unusual position: **Tebis Consulting** exposed itself to scrutiny from the outside. This was an exciting shift in orientation, but it was ultimately successful – a jury of scientists representing the industry selected us for “Best of Consulting Mittelstand 2018” (award for medium-sized companies) in the “competitive strategies” category.



The air is full of tension, and you can hear a pin drop as German TV presenter Eva-Maria Lemke announces the winner. "And the winner is ... Tebis Consulting!" Seven people with beaming faces mount the podium at the award ceremony on November 20 and revel in the applause. The tension has vanished; the team stands in the spotlight, happy and relieved. "We awaited the results from the jury with great excitement," says Jens Lüdtkke, head of Tebis Consulting. "Of course, we were a bit uncertain about whether the jury would give our customer project the same high marks we did. We are very proud to have won first place as "Best of Consulting Mittelstand 2018."

Kaspar Hürlimann, managing director of Formbar AG, was also delighted – long before the award ceremony. That's because the customer project involved the repositioning of his company.

”

*Tebis Consulting gave us outstanding support. It is really great that the team has been recognized for our success. It shows that we chose the right consultant.*

[Kaspar Hürlimann, Managing Director, Formbar AG, Switzerland]

The long-established Swiss company had its origins in foundry model making and was operated as a family business for three generations. When Kaspar Hürlimann took over the helm as Managing Director, Formbar AG specialized primarily in large orders from the foundry industry. But revenues were not developing as expected. The tough market and price situation and increasing outsourcing to Eastern Europe had resulted in decreased utilization of capacity. This was complicated by the fact that only 30 percent of the model and mold manufacturer's activity was in the Swiss market: Large fluctuations in the Euro/Swiss Franc exchange rate resulted in more losses. "It was a very difficult time then, and many told me that I could not do it," recalls Hürlimann. He quickly realized that the product portfolio had to be expanded if the company was to get back on track for success.

The skilled model builder finally stumbled across Tebis – almost by chance. "We wanted to be faster and better. To do this, we had to orient ourselves more toward process thinking and identify potentials for optimization. Where are our strengths and weaknesses? How can we most effectively utilize our machinery and employees?" explains Hürlimann. Tebis Consulting started with a comprehensive analysis at Formbar AG. The Tebis ex-

perts built on their assessment by working with Kaspar Hürlimann to develop a new target market strategy. In addition to management consulting, the concept included employee training and coaching sessions as well as parallel implementation. The Swiss workers also took the process optimization advice to heart.

The result: a clear plus in efficiency and process reliability. Machine run time was doubled using the same personnel. Thanks to the resulting flexibility, Formbar acquired new customers: In addition to casting models, the company now also manufactures parts for the motor sports, aerospace and automotive industries. It benefits from the enormous wealth of experience of its employees and the versatility of its machinery. Sales were increased by 70 percent and profits by 40 percent. The company is now also viably positioned for the future in the Swiss market. The managing director summarizes: "Our customers are convinced by the quality of our products and our on-time delivery. Tebis has certainly played a large role in enabling us to work so efficiently today."

Kaspar Hürlimann and Jens Lüdtkke, "Best of Consulting Mittelstand" award ceremony.

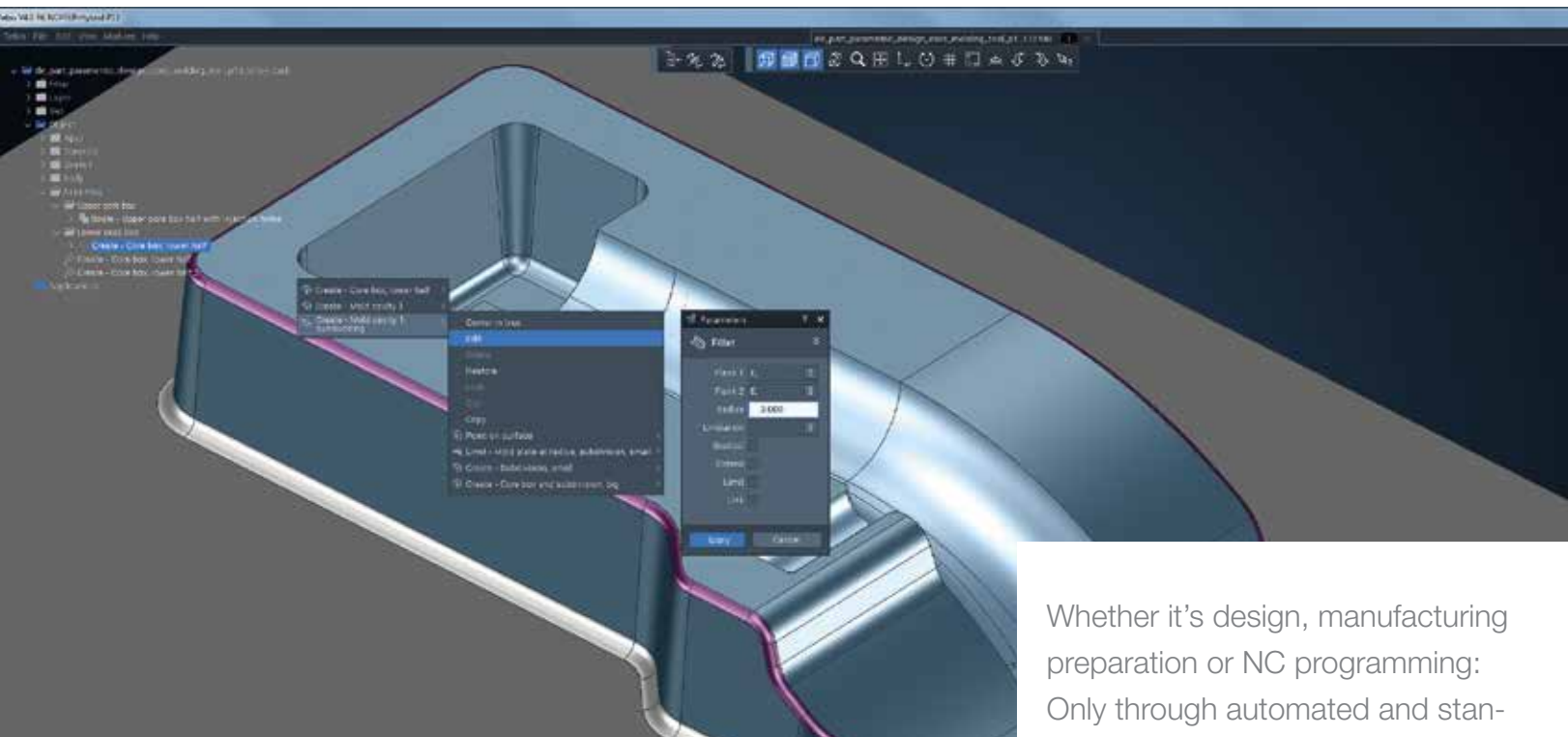


## IN A NUTSHELL

### The project competition

The *WirtschaftsWoche* magazine started the "Best of Consulting" competition nine years ago. Since then, the well-known business magazine issues one of the most comprehensive consultancy surveys in Germany every year, and now also includes medium-size companies. Consulting companies can compete with up to three customer projects in various categories. A scientific advisory board and jury review the success of each project. The evaluation is based on quantitative and qualitative criteria – such as the effect on operating results, market and industry expertise, and customer satisfaction – and nominate the top three winners.





# Designing with Tebis simpler than ever

Whether it's design, manufacturing preparation or NC programming: Only through automated and standardized processes can it be ensured that procedures are fast and reliable and that the implemented tools can be easily used. The associative/parametric design available starting with Tebis Version 4.1 represents a clear breakthrough in this regard. The time savings is enormous.

So what exactly is parametric/associative design? "Parametric" initially means simply that element parameters like length, radius and direction can be changed later. "Associative" describes the mutual interdependence of the elements: If one element is changed, other elements are immediately adjusted automatically, with no additional design effort. All components of the part are interlinked – there is no faster way to set up and modify a model.



## Parametric/associative design – is it worth it?

But is parametric/associative design really worth it for everyone? Changing a dimension, rounding an edge, extending and cutting surfaces, expanding topologies... Many employees in design and manufacturing preparation will say that they can quickly complete these tasks without using parameters.

Taken as a whole, however, these seemingly minor tasks require a huge amount of work. For example, Johannes Grosch, managing director at Johannes Grosch CAD/CAM-Dienstleistungen, Germany, who is currently testing the Tebis prototype, can now position the dial indicator supports on his test gauges three times as quickly as before. Another advantage: The overall design is automatically checked for plausibility. This ensures that nothing important is forgotten and that surface transitions and connections still fit together after changes are made. Potential collisions can also be detected sooner.

And with the right templates, it is also very easy to design and subsequently change the model. All steps are saved in the structure tree and can be reproduced at any time.

## Quickly achieving goals with individual templates

In addition to Grosch CAD/CAM-Dienstleistungen, ten other Tebis customers in various industries are currently testing the prototype, including Modellbau Nachtigall GmbH and Schürfeld Umformtechnik GmbH. However, testing the software is not the only goal of this project partnership. Special templates with which repetitive tasks can be easily automated are being developed for each company – the users don't need to expend any effort on the design logic or the development history of the part.

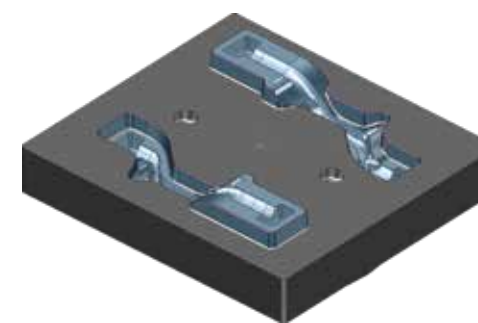
In a nutshell: Parametric/associative design is useful for those who receive modifications, who want to automate repetitive design process steps and who work with different variants and intermediate design status – and nearly every company meets at least one of these criteria.

## What our project partners are saying

“

*We use layer blanks to mill the 3D models for a mold. In the past, we had to create levels for them, adjust the level separation distance if necessary, smooth, offset and round the curves, create the bottom and side surfaces and finally copy the bottom surfaces for the cover surfaces and create a topology. All of this is now partially automated using the template we developed with Tebis. We can easily change the design of the layer model blank at any time.*

[Marcel Wanders, CAD/CAM Department Head,  
Modellbau Nachtigall GmbH, Germany]

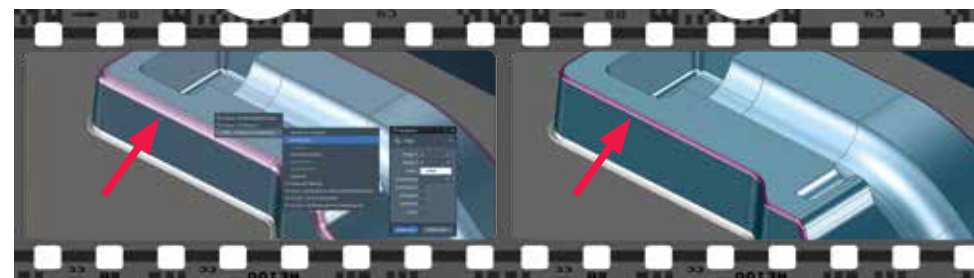


## Practical applications

### Reducing radii for a core box

Reduce the radius in the context menu. The radius changes all around; all transitions fit together.

*Breaking up a topology, extending surfaces, combining flanks in a topology and round – none of these steps are necessary anymore.*



”

*Our initial impression of the Tebis prototype is completely positive: If we change engravings or parts, we now achieve our goal faster. For example, we now reduce radii with a few clicks without having to extend the surfaces again. Another advantage is that 2D contours can be easily created using the "Sketch" function. This also enables us to quickly modify the 3D geometries derived from them.*

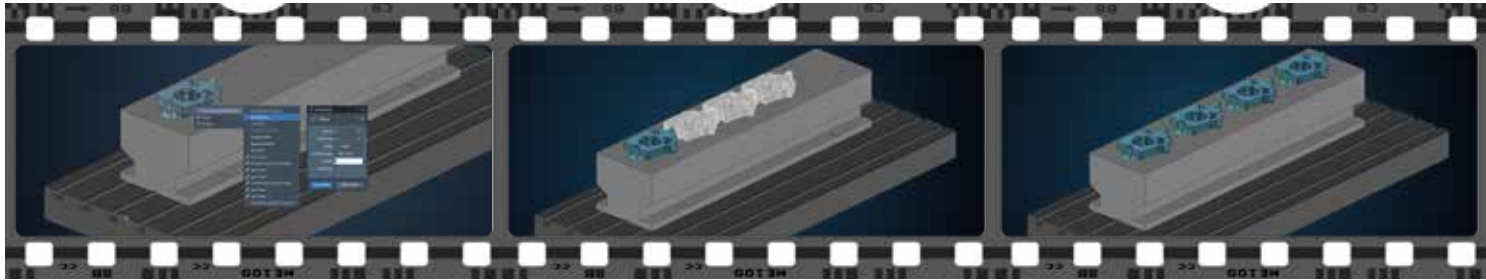
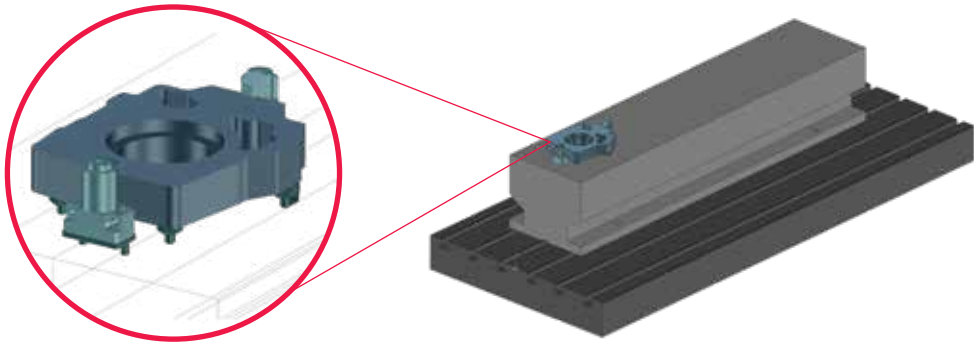
[Andreas Kaltefleiter, Head of CAD/CAM and Machining,  
Schürfeld Umformtechnik GmbH, Germany]



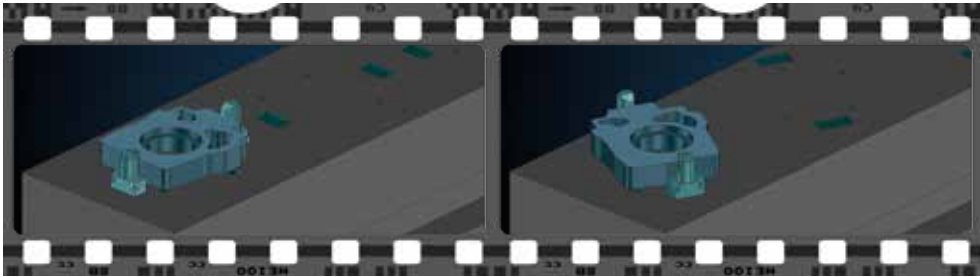
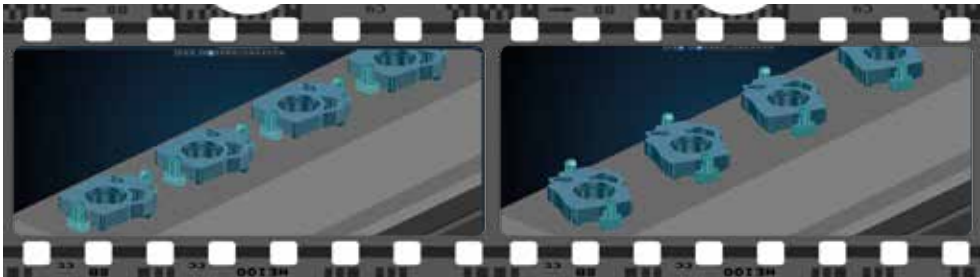
Practical applications

Clamping mold parts

Create and position any number of mold parts.



Automatically reposition mold parts with all the required pockets.



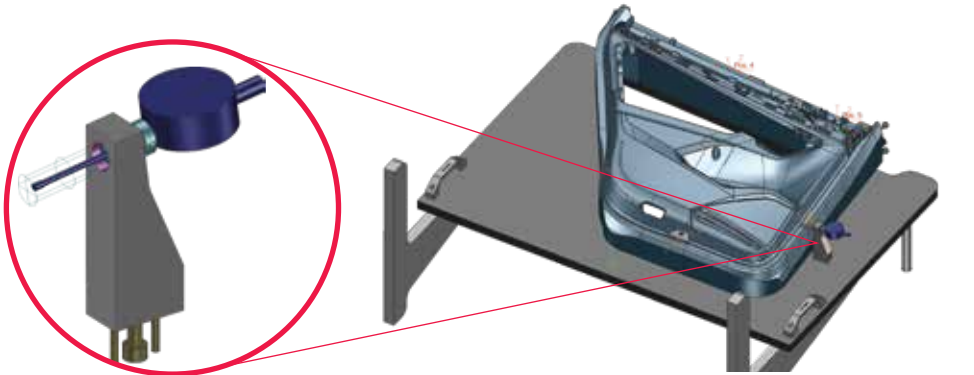
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*Instead of four minutes, I now only need one minute to position a dial indicator support on a test gauge. Adding up the tasks, this means: What used to take me a day and a half of work now takes just four hours.*

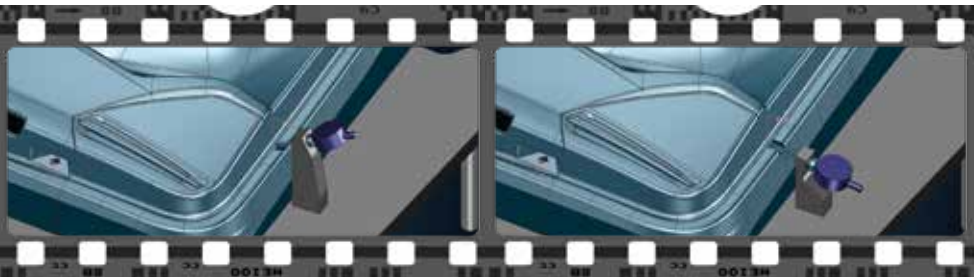
[Johannes Grosch, Managing Director at Johannes Grosch CAD/CAM-Dienstleistungen, Germany]

Positioning dial indicator supports for a test gauge using templates

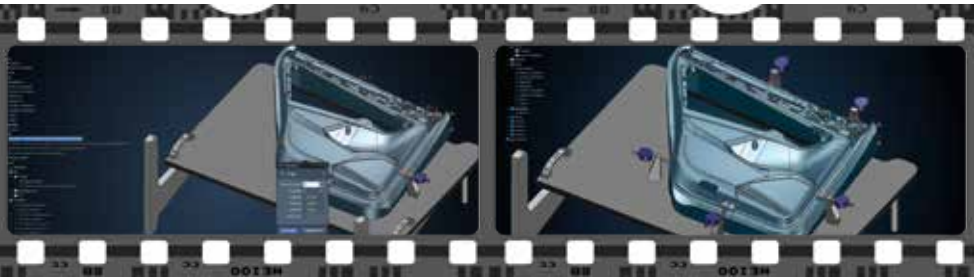
Import template for dial indicator support with probe, mounting bush, indicator and subtraction bodies for support and base plate ...



... adjust angle according to specifications ...



... transform dial indicator support.







## SUCCESS STORY

HEINZ SCHWARZ GMBH &amp; CO. KG | GERMANY



This can't be done without a motivated team ...

# Heinz Schwarz GmbH & Co. KG

## Clearly thrilled and measurably improved

We all like to talk about the golden rules of business success. Some rely on solid data and clear structures, while others prefer to stick with the “gut feeling” of an experienced workforce. Die manufacturer Heinz Schwarz GmbH & Co. KG in Preußisch Oldendorf, Germany, has managed to reconcile both factors – with the result that the company has been able to enormously increase its productivity in small parts machining since 2016.



When Heinz Schwarz decided to start as an entrepreneur in 1964, he found everything he needed to get started on his parents' property: The garage and henhouse were quickly converted to a shop and office. But the pragmatic young man could hardly have dreamed at that time that the company bearing his name would become one of the largest independent die manufacturers in Germany. With its roughly 300 employees, the company has now established itself as a reliable partner to the automotive industry, commercial vehicle manufacturing and agriculture. In addition to classic die manufacturing, it offers everything from complete development to series manufacturing. Such an accomplishment requires perseverance. The 2008 financial crisis was certainly the most severe test Heinz Schwarz GmbH has had to undergo to date. The family business was close to the end at that time.

### Navigating the crisis

First-class products, a stable customer base and especially a team of experienced and well-trained specialists, however, led a group of investors headed by Oliver Kesseböhmer to place their belief in the future of the company. In early 2013, the consortium acquired all business areas and provided the new managing directors, Diedrich Diedrichsen and Henrik Minnich. Much was done in the following years to return the company to success: Heinz Schwarz GmbH invested many millions in a tryout center and acquired new machines for small parts manufacturing. Starting in 2015, the focus was on improving processes in small parts manufacturing.

### Gut feeling meets data

Initially, the key was to reconcile solid data with the “gut feeling” of the participants. “We were all in agreement that everything was taking too long,” recalls Anne Theile-Wielage, division manager for Mechanical Manufacturing. “Active surface design took too long, NC programming took too long, setup took too long, machining took too long and the machines were standing idle too frequently. But in terms of ‘why,’ opinions diverged.” What was missing was a set of data that everyone could understand. An objective outside perspective is extremely useful in this kind of situation.

### An outside perspective

Schwarz GmbH has relied on Tebis CAD/CAM software for 2.5D and 3D programming since 1995. One reason is the large number of available milling strategies that contribute to successful milling quality: Because Schwarz has increasingly specialized in the visible parts of the vehicle over the course of time, a high surface quality is absolutely essential. Tebis also provides many solutions for transparently storing machining information in the system, thereby making it accessible to all employees. The die manufacturer has also been benefiting from the advantages of Tebis morphing technologies since 2011. When it came to bringing an objective partner on board to optimize the processes, the choice was Tebis. Diedrichsen remarks, “Tebis provides comprehensive process consulting and has precise knowledge of our industry. No one else can offer this combination.” What followed was an unmatched joint project management that ended with clearly measurable results.

### Standardizing the small parts process

“In the first project, ‘Process standardization and productivity in the small parts process,’ we wanted to reduce the time input by employees and enable multiple machine operation,” Theile-Wielage summarizes. The project, divided into three project phases – “Analysis and assessment,” “Implementation” and “Conclusion and evaluation” – ran from September 2015 until March 2016. Working with Tebis, discussions were conducted across departments to evaluate solutions for each process step, to locate weaknesses and to determine where potential existed. “It quickly became clear that we had to take action in active surface design and NC programming if we wanted to make any improvements,” says the division manager. “Small parts preparation was extremely cumbersome. And there were umpteen different templates in programming – the programmers and machine operators had to constantly discuss them.”

### Clear milestones and responsibilities

Clear and realistic goals were set and assigned to subprojects, along with milestones and responsibilities. The goal was to significantly reduce expenditures for preparing the exact solids and for NC programming. Another goal was to improve parallel setup.

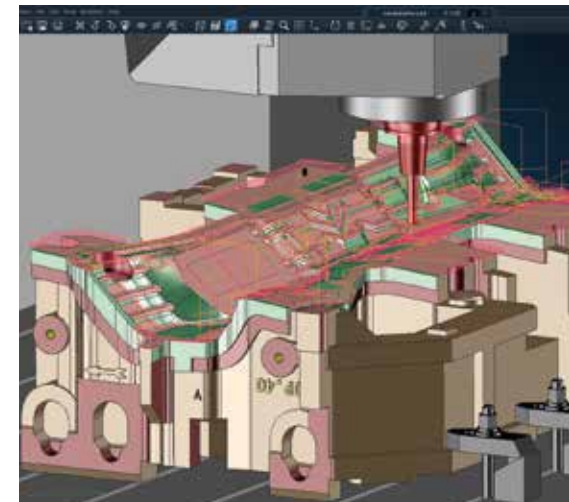
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*Tebis provides comprehensive process consulting and has precise knowledge of our industry.*

[Diedrich Diedrichsen, Managing Director]

These tasks could in turn be linked to specific measures. The key words here are preparation of the small parts in exact solids with Tebis, consistent use of Tebis simulation, automation of 2.5D machining with variable features and programming with standardized templates and process libraries. To make the changes measurable, actual conditions were recorded at the start of the project.

Tebis simulation methods are also used in planning. The indicated calculation times in the small parts process are accurate down to the minute, and kinematics and tool-specific cutting data are fully applicable in practice – these are all essential prerequisites for manufacturing with less employee effort, including nights and weekends.





SUCCESS STORY  
HEINZ SCHWARZ GMBH & CO. KG | GERMANY

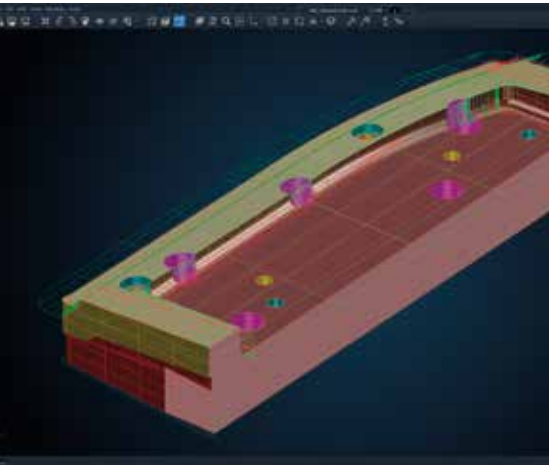
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*With Tebis’ industry expertise, we were able to improve the overall die quality.*

[Diedrich Diedrichsen, Managing Director]

Goals surpassed

The overall project was very carefully documented. The individual steps could therefore be reliably evaluated. Theile-Wielage is delighted: "We have far exceeded our initial goals. This is the case for small parts preparation and NC programming as well as parallel setup; reduced-personnel manufacturing and multiple machine operation have also become a standard element of our small parts production." The expenditures for preparing the exact solids and for NC programming were also significantly reduced. "We now produce roughly 70 percent of the small parts from solid material using templates," Theile-Wielage says. "The proportion of parallel setup has also been increased. We have noticeably reduced the employee effort required for the product. This has an immediate effect on throughput: We now manufacture at least 50 percent more parts compared to 2015, when we started the small parts project. And this trend is continuing."



Active surface and solid geometry can be combined in a single part with the "Exact Solid Preparation" add-on. Similar parts are combined in categories for which automated NC programs can be created.

Front-loading active surface

Since productivity was so greatly improved in the small parts process, in the summer of 2016, the company also embarked on optimizing the large parts process in active surface design. Stefan Ardel, division manager for Engineering and Design, says: "Up to that point, we had only used Tebis for overbending in design; now we wanted to use the software for the entire active surface design." In this context, "Front-loading with active surface preparation" means designing sheet-metal thinning, pressure and spot-facing surfaces as well as all radii directly in the active surface: NC programming now uses exact active surfaces that are matched and optimized for each individual part. Now only six employees design the active surfaces – using Tebis exclusively.

The entire process chain at a glance

The importance of collaboration across departments becomes especially clear again: "What happens in the active surface has a very big impact on the downstream process steps," Ardel explains. "Even if active surface preparation initially takes somewhat longer – the time requirement for programming and especially for fitting the die in tryout is so greatly reduced that, in general, it has already yielded a positive result to the bottom line. With Tebis' industry expertise, we were able to improve overall die quality. The surfaces are so precise that machining with efficient HFC tools is no problem. We will continue to work together and make adjustments in order to become more efficient."

IN A NUTSHELL

For more than 50 years, Heinz Schwarz GmbH & Co. KG in Preussisch Oldenburg has been a well-known manufacturer of blanking, progressive, multi-stage and transfer dies for the automotive industry, commercial vehicle manufacturing and agriculture. The product spectrum includes everything from classic die manufacturing and complete development to the series production of parts. With roughly 300 employees, the company ranks among the largest independent die manufacturers in Germany.



- In order to optimize the procedures, processes were analyzed, measures derived and implemented.
- The focus was on more efficient preparation of the small parts, consistent utilization of the Tebis simulation technologies and automation of 2.5D machining.
- Thanks to the optimization measures, reduced-personnel manufacturing and multiple machine operation have since become a standard element of our small parts production.



INTERVIEW WITH DIEDRICH DIEDRICHSEN, MANAGING DIRECTOR OF SCHWARZ GMBH & CO. KG  
GUT FEELING MEETS DATA

# Gut feeling meets data



Interview with Diedrich Diedrichsen, managing director of Heinz Schwarz GmbH & Co. KG since 2013, on successful process changes in the company.

**Mr. Diedrichsen, productivity at Heinz Schwarz GmbH & Co. KG has increased enormously since 2016, especially in the small parts process. Expenditures for active surface preparation has decreased significantly, as has costs for NC programming. With the reduction in downtime, you produce your parts much faster than two years ago. Overall, you've been able to significantly reduce the employee effort in producing your products. You have also started some improvements in large parts manufacturing. So tell us, how did you manage this?**

When I took over management at Schwarz in early 2013, the situation was not very good for the company. This was certainly tied to the after-effects of the 2008 financial crisis. When evaluating our improvements, you also have to consider where we started. Small and large parts manufacturing were definitely taking too long. It was important to find out where the problems were in our internal procedures. And that requires a solid analysis. I like to quote the American statistician William Edwards Deming, who was a true pioneer in the field of quality management at the beginning of the last century: "In God we trust; all others must bring data."

**So you're not a big fan of gut feeling?**  
No, actually I am. It is not just pure technical knowledge that makes a good employee; knowing intuitively exactly what has to be done in a particular situation is critical. This is only possible after many years of experience.

**But?**  
Many gut decisions are good. But it wasn't possible in this case to get a real handle on the problem. There were different department perspectives; everyone had a slightly different opinion about the matter. We were also missing an objective outside perspective. Before any decisions could be made, we had to discuss everything with Tebis and place our observations on a sound basis. Trust your intuition and use it, but check it with rational thinking and logic!

**And what was the result?**  
After the analysis, we had solid numbers on how much time was needed for active surface design, programming, setup and machining as well as for method development, assembly and tryout. We knew exactly where the weak points were.

**What measures did you derive from the analysis?**  
We set clear goals for each of these areas. For small parts, we wanted to achieve these goals by preparing the small parts as exact solids and by introducing Tebis template technology, with the help of Tebis implementation. This would enable parallel setup and the operation of multiple machines. For large parts, we wanted to design the active surfaces entirely with Tebis. Overall, standards and automation became particularly important.

**Now, truthfully, Mr. Diedrichsen: Is it really that simple? When a traditional company is in the red, a group of investors takes the helm and comprehensive changes are imminent, which creates a lot of uncertainty among employees. But don't objective statistics and analyses as well as key words like standardization and automation make employees even more suspicious? Nobody wants to be just a cog in the wheel.**

It was difficult, especially in the beginning. Everyone had their own individual work methods, and they managed very well using them in their own areas. Why would they want to change that? But we were able to demonstrate very quickly that we could be more productive with more standardization and automation. That's the big disadvantage of gut decisions: They're difficult at best for others to understand. Employees, colleagues and supervisors can only support decisions and help to implement them if they can understand them. That can be achieved with data and analysis. We brought everyone affected in all departments on board and dealt openly and honestly with the challenges. But to be honest, we still continue to have discussions if things don't go as planned. Organizational development is a marathon, not a sprint.





INTERVIEW WITH DIEDRICH DIEDRICHSEN, MANAGING DIRECTOR OF SCHWARZ GMBH & CO. KG  
GUT FEELING MEETS DATA

***Collaboration across departments is a big problem in many companies.***

There can be no progress without mutual understanding. This has proven true in the active surface process in particular. After small parts, we also implemented a new active surface process. Active surface design is right at the beginning of the process chain. Our goal is to include as many product details as possible in the design of the active surface. This means more work for design in the first step. If the designers only see their own area, of course you need to expect to meet with resistance. However, when they discover that this approach pays off many times over in NC programming, and especially in tryout and die assembly, they understand the big picture and go along with the changes. Daily work is simply more pleasant when people communicate better and more frequently.

***The major importance of the “soft” factors...***

Again, it's all about the employees. Of course, there are always individual cases where we have to depart from the standards and react quickly and flexibly. There is no substitute for an employee and his or her experience in these cases. I often use the metaphor of a highway: There are multiple lanes, and it makes sense to use all of them. And if a situation demands something out of the ordinary, we might also have to expand the median, stop traffic in the opposite lane and use an extra lane – but we need rules and very clear communication to achieve this.

***So what's your recipe for success, in a nutshell?***

First: Be deliberate in including both "young blood" and "old hands" across all department boundaries. Second: Objectively standardize gut feeling with a joint analysis of the current situation. Third: Define goals from the bottom up and agree on these internally as well as externally. Fourth: Ensure uncompromising transparency. Fifth: Implement stringent project management, including evaluation of success. And last but not least: Engage a strong partner with a neutral outside perspective.

***So the outside perspective is important?***

You need someone who provides unbiased assistance throughout the process and who brings you back down to earth with open and honest criticism, if necessary.

***And Tebis does that for you?***

Software is now a large part of our investment budget and operating costs. All partners in this area are therefore important partners for ongoing development. However, Tebis certainly has the additional advantage that these colleagues know the industry and know what's important in process optimization. This includes consulting, analysis and sound training of employees as well as support in implementing specific software solutions. We have met regularly and jointly reviewed our development. Of course, not every function is suitable for each application – but we're working on it.

***We have often discussed the fact that both hard and soft factors affect each other mutually. So what's your conclusion?***

Both data and gut feeling lay the groundwork for successful optimization projects. We view our relationship with Tebis as a long-term partnership for viably increasing the efficiency of our large and small parts process. You said it yourself at the beginning: We've been able to significantly reduce employee effort in producing the product and have again become competitive in this area.

***Mr. Diedrichsen, thank you for this conversation.***



Diedrich Diedrichsen at the Tebis Open House in 2017.



SUCCESS STORY  
INTEGRITY TOOL & MOLD INC. | CANADA

# Integrity Tool & Mold heads for the top with Tebis

Integrity Tool & Mold has an impressive footprint of over 24,000 square meters and more than 100 spindles at three locations: Oldcastle (Canada), Pulaski (USA) and Queretaro (Mexico).

Once a small workshop, the company has worked its way to the top in the mold manufacturing sector in less than one generation. The necessary efficiency is achieved with Tebis as an end-to-end system in manufacturing.

Since its founding in 2001, Integrity Tool & Mold Inc. in Oldcastle, Canada, has built on design, the latest technology and continuous improvements – and that has paid for itself. Additional locations in Pulaski, USA, and Queretaro, Mexico, have since been opened. Over 600 employees worldwide – 360 of those in Canada – now produce roughly 400 injection molds per year with over 100 spindles in a total production space of about 24,000 square meters.

"Integrity began using Tebis on a large scale in 2011," explains Vernon Benson, account manager at Tebis America Inc. "They had the strategic vision of a central software that would be comprehensive enough to cover the entire process, thereby opening up many advantages. Their research revealed that Tebis is just that software. They were fascinated by the new possibilities." Like simulation, for example. "It is crucial that we check our programs carefully and under realistic conditions before we use them in manufacturing," says Ryan Hotchkiss, head of manufacturing at Integrity. "Tebis makes this possible, enabling us to manufacture unattended with no concerns. A few years ago," he adds, "we were using an external simulation software that did not allow us to manufacture unattended on a larger scale."







What's different now?

Tebis simulation technology represents entire machining sequences in a virtual machine environment. With Tebis, users can optimize machine operation and detect and avoid potential collisions between the part and tool geometry. This is especially useful for 5-axis milling, which is becoming increasingly important for Integrity. "Before calculating an NC program," says John Kowalczyk, senior manager of Global Strategic Accounts at Tebis America, "the tool tilt angle can be analyzed in detail, also accounting for head geometry and machine kinematics. The tool holder components defined in the Tebis tool library are also included in the collision avoidance calculations, and the Tebis Simulator checks all machine components and limit switches."

This reliable simulation provides many advantages. As already mentioned, Tebis enables unattended manufacturing, which saves time and reduces costs. Tebis also helps prevent tool damage and expensive repairs to machines due to collisions and reduces setup and machine run time. The simulation also supports order costing and provides important functions for planning and coordination.

Kowalczyk mentions another advantage of fully integrated simulation in Tebis that is often overlooked. Simulation using software from third-party providers forces the user to export the data from the CAD/CAM system and then load it and check it in the simulation software. If problems occur, the steps have to be repeated until the errors are corrected. "As a result," says Kowalczyk, "programming slows down and the error sources multiply. This is not the case with the integrated system from Tebis."

Fast and easy, thanks to automation

But the Tebis process at Integrity consists of more than just simulation, even if that is very important. "Automation in Tebis, for example, programming with templates, is extremely valuable for us," says Hotchkiss. The automation he is talking about is enabled by the Tebis process libraries. They re-



Ryan Hotchkiss, head of manufacturing (left), and Tyler Upham, NC programmer, check Tebis and automatic machining on a Promac Sharav GVT 5-axis machine.

”

*We were able to improve efficiency by using a single end-to-end system for the entire manufacturing process.*

[Ryan Hotchkiss, Head of Manufacturing at Integrity Tool & Mold]

flect the actual manufacturing environment and manufacturing knowledge. All tools, machines and clamping devices are stored there along with their geometric and technical properties. This makes the work easier for NC programmers, because they can specify the right machine, the optimal setup and the appropriate tools as well as feed rates and speeds in this virtual environment. "The program is essentially written in advance," says Benson.

Hotchkiss adds: "In Tebis, our programmers can work based on features and can use templates to standardize the preparation of similar programs. They are also supported by stable algorithms that enable faster preparation and programming, even for large parts and complex geometries. We can also accelerate NC programming with parallel calculations. And we save a lot of time in manu-

facturing thanks to multiple setups and tool matching." The key words are simplification and speed. These are advantages for every manufacturing operation, but especially for a company like Integrity that has grown very quickly, because it is often difficult to find qualified programmers.

Of course, a faster and simpler process that results in a mediocre product would be no good. Fortunately, this is not the case with Tebis. "Programming with Tebis is world-class," says Hotchkiss. "This is an extremely powerful manufacturing software that is based on surfaces and not on simplified meshes. Our products are highly complex, and we need a software that supports this. The surface-based concept from Tebis is the right solution – and it creates surfaces at outstanding quality."



Broad base and intensive collaboration

Integrity has over 80 Tebis workstations and uses a large selection of Tebis products in addition to the Simulator, including Mold and Die industry packages, Collision Avoidance, Viewer NC, Surface Morphing, Reverse Engineering, Electrode Preparation and 5-Axis Milling, just to name a few. In addition to the capabilities of the software, Ryan Hotchkiss sees the great advantage of the collaboration between Integrity and Tebis in the fact that it provides a comprehensive process from the CAD data to the final product, based on a single software system.

"We were able to improve efficiency by using a single end-to-end system for the entire manufacturing process," says Hotchkiss. "This means that we can find everything in just one file. Working with multiple files in different programs is time-consuming and error-prone. Many processes can be automated using Tebis. These advantages come to bear especially when there are design changes." Also, he adds, new employees can be trained more easily.



1) Jason Henderson, NC programmer and user, on the Fidia GTF 35 5-axis machine.

2) Davide Savio, plant manager (left), and Bobby Charron, NC programmer, check the programming in Tebis.

”

*The service quality at Tebis is outstanding.*

[Ryan Hotchkiss, Head of Manufacturing at Integrity Tool & Mold]

”

*Programming with Tebis is world-class.*

[Ryan Hotchkiss, Head of Manufacturing at Integrity Tool & Mold]

Although the software has successfully proven itself, the Tebis team knows that you can't just implement a software system and hope that it works. Long-term success comes from working together to solve problems and achieve new results. Tebis also receives very good marks in this area. "The service quality is outstanding," says Hotchkiss. "We have a meeting about continuous improvements once a month with the team from Integrity," says Kowalczyk. "We discuss problems and think about the next steps. We know that Integrity will continue to grow and will be looking for new approaches for the process and for machining, because they are in a leading position in these areas and we want to support them in that role."

IN A NUTSHELL

- Integrity Tool & Mold has grown by leaps and bounds and now has more than 600 employees, more than 100 spindles and manufactures 400 injection molds per year.
- Integrity uses over 80 Tebis workstations and has all the functions required for mold manufacturing.
- Stable and fully integrated simulation in Tebis enables Integrity to use unattended manufacturing on a large scale.
- Automation in the manufacturing environment and manufacturing knowledge in templates results in easier and faster NC programming.
- The process at Integrity is being continuously improved through an ongoing collaboration with Tebis.





SUCCESS STORY  
INVENIO GMBH ENGINEERING SERVICES | GERMANY

# invenio GmbH Engineering Services Flexible and solution-oriented

German innovation prize, top career opportunities and other awards:

Leading automotive manufacturers as well as companies in medical technology, household appliances and equipment manufacturing rely on the expertise of invenio, a global engineering solution provider. What is the recipe for success of this medium-size company, which scores just well with its own employees as it does with German industry?

Team Manager Andre Reuschel  
and Production Engineer Martin  
Mayer discuss future steps.

A visit to the Nauheim manufacturing site offers an impressive look at how invenio handles challenges. This division specializes in prototypes, series and contract production as well as in the manufacturing of gauges, measuring fixtures, models and castings. Many of the 40 members of the team have interdisciplinary expertise and more than 20 years of experience in mechanical manufacturing and in model, gauge and prototype manufacturing. If desired, the engineering unit can take on overall project management – from consulting on costs, deadlines and quality factors all the way to technical implementation.

When asked about their recipe for success, it's no surprise that Andre Reuschel, team manager in Nauheim since 2005, speaks first about his employees: "Our collaboration is characterized by flat hierarchies and short decision paths. With a mixture of diligence, willingness to take risks and an entrepreneurial mindset, we establish ideal conditions for covering a broad range of offerings while responding in a flexible and solution-oriented manner to new conditions and special customer requirements," says Reuschel.

”

*Tebis can't be beat here; the  
surface quality is great.*

[Andre Reuschel, Team Manager, invenio GmbH  
Engineering Services]

First steps with Tebis:  
Trainer Raimund Dinyer shows  
trainee Armin Kajevic how NC  
programming works with Tebis.



## Investment in the future

This is not to say that Reuschel was able to land in a feathered nest. The challenge in 2005 was to establish a strong and competitive site on essentially virgin territory during a period of intense competition and rising cost pressure. The machinery is now ready to take on all manufacturing tasks. This includes 5-axis simultaneous milling machines as well as a universal milling machine for 5-sided machining, three 3-axis machines, five CNC lathes and three 3D measuring machines in an air-conditioned measuring room. Practices including a three-shift operation ensure that even rush orders are quickly completed. Reuschel and his team are very pleased with the CAD/CAM software: invenio has relied solely on Tebis for its NC programming since the early 1990s. "Especially when manufacturing complex parts, everything has to fit; accuracies and tolerances have to be in perfect alignment,"

Reuschel explains. "Tebis can't be beat here, the surface quality is great." But they still sensed that they had not yet explored all potentials. Therefore, someone from Tebis Implementation was brought to the company for the first time in 2012.

## The right partner matters

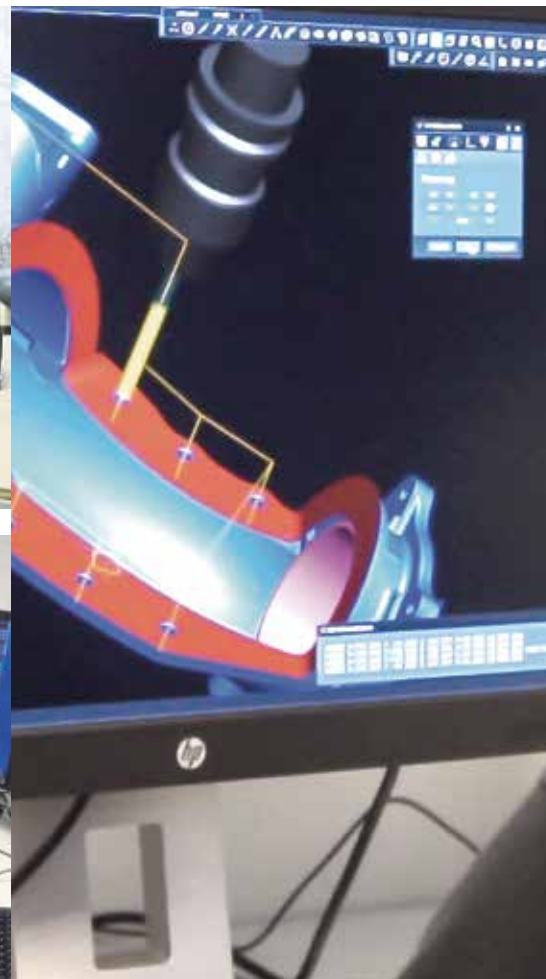
"We wanted to be sure that we were using the software optimally and configuring and implementing it precisely in line with our needs," says Reuschel. "The Tebis employees have a great deal of experience and take a very process-oriented approach. After only two days, we had a significantly better understanding of how processes can be automated using Tebis." As a result, the process libraries were built independently, especially the tool library, including cutting data.

## Automation is the key

Five years after the beginning of the collaboration, Reuschel wants to take it a step further: "Automation is the key for achieving a sustainable position in the market. What Tebis has to offer here is amazing." Their processes were closely scrutinized along with Tebis. The result: The company is well-positioned – but the automatic functions are not being reflected one-to-one in manufacturing. This close collaboration entails helping the business to help itself. Process libraries and templates will be carefully analyzed by Tebis Implementation. The results will yield specific measures that invenio will implement on its own. The initial expenditure pays for itself later many times over," says Reuschel. "We feel very well cared-for and in good hands with Tebis, in terms of software as well as services," summarizes the team manager from Nauheim.

## IN A NUTSHELL

- invenio, founded in 1986 as a traditional engineering office by engineer Alfred Keschtges in Rüsselsheim, Germany, has grown over the years to become an international group of companies. It has successfully positioned itself in the market with four divisions: development, industrialization, software and consulting.
- invenio provides the highest level of engineering and technology services and is known for its reliability, short lead time and outstanding quality.
- With 21 locations around the world – 12 in Germany and nine internationally – the company has more than 1,500 employees, with 600 of them working in Germany.
- Alfred Keschtges is now Chairman of the Supervisory Board of invenio AG, with Kai F. Wißler serving as the Managing Director.



NC programmer Andreas  
Scheuermann benefits from  
automated feature technology  
in 2.5D machining.





# Manufacturing more efficiently with modern high-performance tools



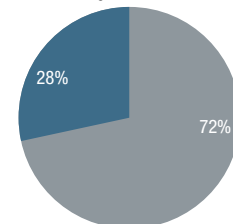
Modern high-performance tools are extremely powerful. Time savings of more than 60 percent can be quickly realized in adaptive roughing with HPC (high-performance cutting) tools alone. And time savings of more than 80 percent can be achieved in finishing with circle-segment cutters – compared with machining with conventional ball cutters. However, many companies are hesitant to implement these tools.



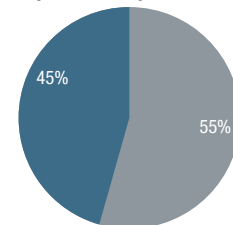
Time savings on such a scale are impressive. So it's no surprise that many are interested in HPC and circle-segment cutters. We had well over 100 registrations just for our webinar on the subject of high-performance tools last September. We wanted to know the exact figures and asked the participants whether they are currently using high-performance tools in their companies. The astonishing result: Despite their enormous potential, high-performance tools have not yet secured a permanent position in most tool magazines. This is especially the case for circle-segment cutters, which only seven percent of those surveyed are using. However, 85 percent can easily imagine doing so. And there's room to grow for both of the better-known HPC tools: A good 49 percent are considering using them in the future – which is nearly all of those who are not yet doing so. We have summarized the advantages of adaptive roughing with HPC cutters and of finishing with circle-segment cutters in an overview for you here. And we will show you how Tebis supports the use of these high-performance tools – because the CAD/CAM software also has to be a perfect fit to really get the maximum benefit.

## Survey of webinar participants

Are you familiar with the advantages of HPC tools?

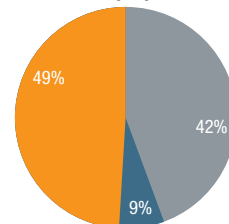


Are you familiar with the advantages of circle-segment cutters?

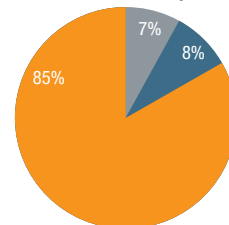


■ Yes  
■ No

Do you use HPC tools for roughing?



Do you use circle-segment cutters for finishing?



■ Yes  
■ No, our part geometries are not suitable for this.  
■ No, but we can certainly imagine doing so if the advantages are convincing.

## Adaptive roughing with HPC tools

✓ Time savings of more than 60 percent

In adaptive roughing, the path layout is automatically adapted to the geometry without full-cut machining. Thanks to the large depth of cut and small lateral stepover, this roughing type is especially suitable for parts with many steep areas – whether you are manufacturing hard or soft materials.



A comparison of HPC and reversible-tip tools.

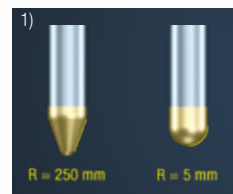


3-axis adaptive roughing.

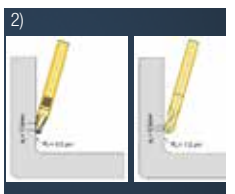
## Finishing with circle-segment cutters

✓ Time savings of more than 80 percent

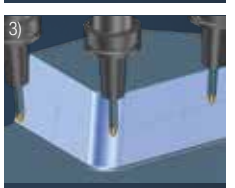
Compared with conventional ball cutters, circle-segment cutters have very large radii in the cutting area. This enables them to achieve a uniform roughness with very large path distances in finishing and prefinishing. Machining is significantly faster and the results are outstanding. It is suitable for both 3-axis tilted as well as for 5-axis simultaneous machining operations.



1) A comparison of circle-segment and ball cutters.



2) Larger path distances and better surfaces.



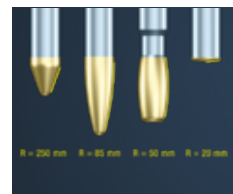
3) For 3-axis tilted and 5-axis simultaneous machining operations.

## Tebis and modern high-performance tools are therefore an excellent match

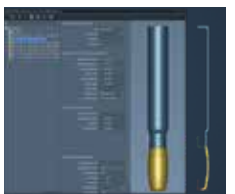
■ **Tebis supports all tools:** Any tool contours can be quickly and easily developed with a curve and can be represented one-to-one in the virtual world.

■ **Optimal roughing:** 2.5D, 3D and 5-axis machining operations can be very easily combined with integrated blank transfer.

■ **Efficient 5-axis milling:** You benefit doubly in 5-axis milling when finishing with circle-segment cutters. Connected milling areas can now be machined in a single operation with no extra design effort.



Circle-segment cutters with tapered, oval, barrel and lenticular geometry.



Create any tool contours with curves and model in Tebis.

## ADDITIONAL INFORMATION

Take a look at our webinar: [www.tebis.com/webinars](http://www.tebis.com/webinars)  
The webinars and registration pages are only available in German. More information about the individual tool types is available on our website:



[www.tebis.com/hpc-milling](http://www.tebis.com/hpc-milling)



[www.tebis.com/circle-segment-cutters](http://www.tebis.com/circle-segment-cutters)





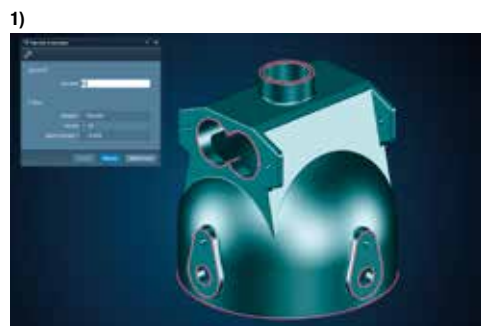
# What's ahead in 2019

## A look into the future

Our magazine began with a recap of 2018. Now let's look at some of the highlights we have planned for 2019.

### Version 4.0 Release 7

The next release of our current Version 4.0 will be launched in the first quarter of 2019. Here are some of the most important new features at a glance:



#### User interface

##### ■ Transferring user configuration

Transfer toolbars, work environments and other user settings from a previous release with the click of a button.

##### ■ Directly printing screenshots

Send screenshots directly to the printer, in black and white for increased contrast if necessary.

#### Machine technology

##### ■ Tool database with extended automatic name assignment

Simplify tool management with the ability to access even more automatic name assignment properties in the tool library. These include thread type and number of edges and programming length and insert length of the tool assembly.

##### ■ Tool measurement

Extend tool measurement to include tools with complex cutter geometries. The diameter can now be output for each cutter reference point to call up a measurement cycle.

#### Interfaces

##### ■ Importing STEP data

The new STEP interface can be used to specify whether to include covered geometries and covered axes as well as axes and references in the import. You can also more efficiently import small structures.

#### Manufacturing preparation

##### ■ Active surface design

Use the "ActSurf/Contour" function to create the outline surfaces for cutting and restriking dies with a step relief at any cutting angle.

##### ■ Detecting sharp part edges (Figure 1)

All sharp edges in a part can be detected with the new "NCPrep/Edge" function. Bores that are countersunk can be omitted, if desired. You can store the generated edge surfaces with a structure for optimal preparation of deburring with NC templates.

#### NC calculation

##### ■ Multi-axis deburring (Figure 2)

Machine edges with ball or tapered cutters using the new "NC5ax/MBurring" function. Quickly and easily create practical toolpaths for deburring with automatic tilt direction calculation and automatic avoidance of shank and tool-holder collisions.

##### ■ New sorting options

Paths can be further sorted from outside to inside or from inside to outside in the "Axis parallel" strategy in the "NC3ax/MSurf" function. This provides perfect surfaces in every situation.

##### ■ Residual stock analysis in the Job Manager (Figure 3)

Have the residual stock displayed with color shading based on toolpaths and use the new online measurement function. You can now quickly obtain analysis results in the Job Manager with the "NCBase/RSimu" function.



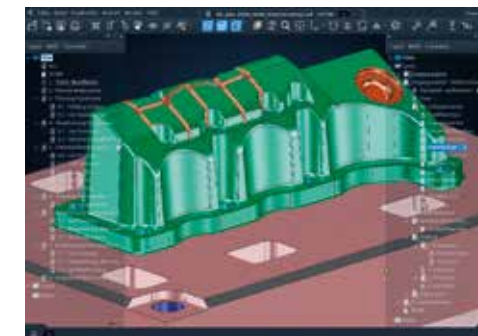
### Tebis Version 4.1

A new Tebis Version 4.1 is planned for 2019. The new version does not just provide intuitive and simple operation in the new associative/parametric design (see article "Designing with Tebis – simpler than ever," pages 20-23).

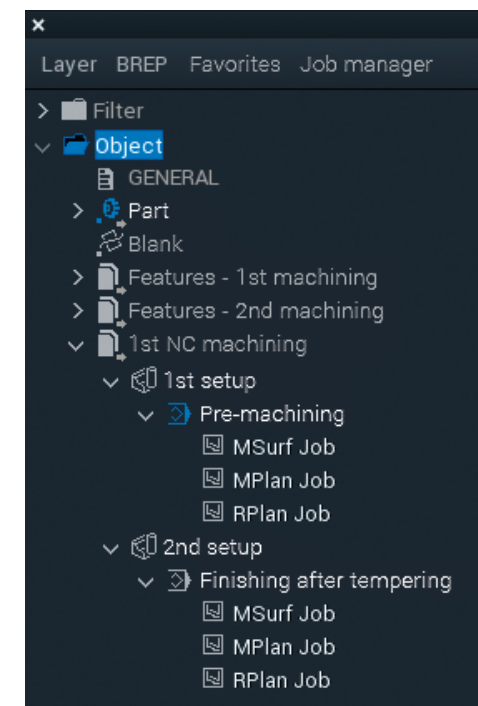
Because the new design options have brought greater focus to the structure tree, our developers have closely examined this area and considered what improvements could be made to make the user's work more effective and simpler.

The result is a structure tree with many new options – among other things, the Job Manager can now be created and managed from the structure tree. With a mouse click, the display can be limited to the parts the user wants to focus on for quick orientation in the structure tree headings. The structure tree can also be opened a second time and displayed in a separate window.

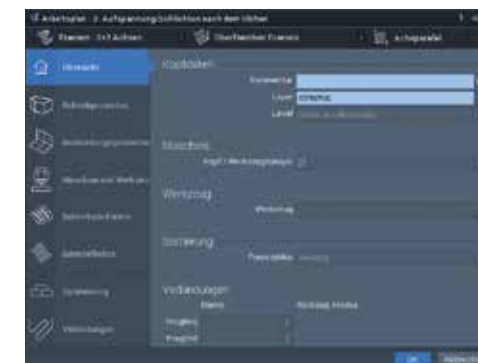
We will continue to develop the automation and standardization of manufacturing processes in Tebis Version 4.1. This includes the connection between Tebis CAD/CAM and our ProLeis MES software, working with templates, continuous blank tracking and configurable processes. The editing functions will be revised and simplified throughout the system for this purpose. This step also simplifies the use of the system, while the scope of possible applications continues to grow. These are only some of the new features coming in Tebis Version 4.1.



Tebis Version 4.1 with the structure tree opened twice with filters (left) and layers (right).



Tebis Version 4.1 with the Job Manager integrated in the structure tree. The structure tree is displayed here as a separate window.



Tebis Version 4.1 with the new overview dialog for the new structured editing functions in the Job Manager.

### 2019 Tebis Open House

The 2019 Tebis Open House will be held on May 8 and 9. Over the course of these two days, we will present the latest technology, along with examples of end-to-end manufacturing processes and viable ways to boost your competitiveness. You can look forward to a broad range of topics and a stimulating program with industry-specific presentations, inspiring discussions and top keynote speakers.



2018 Tebis Open House.

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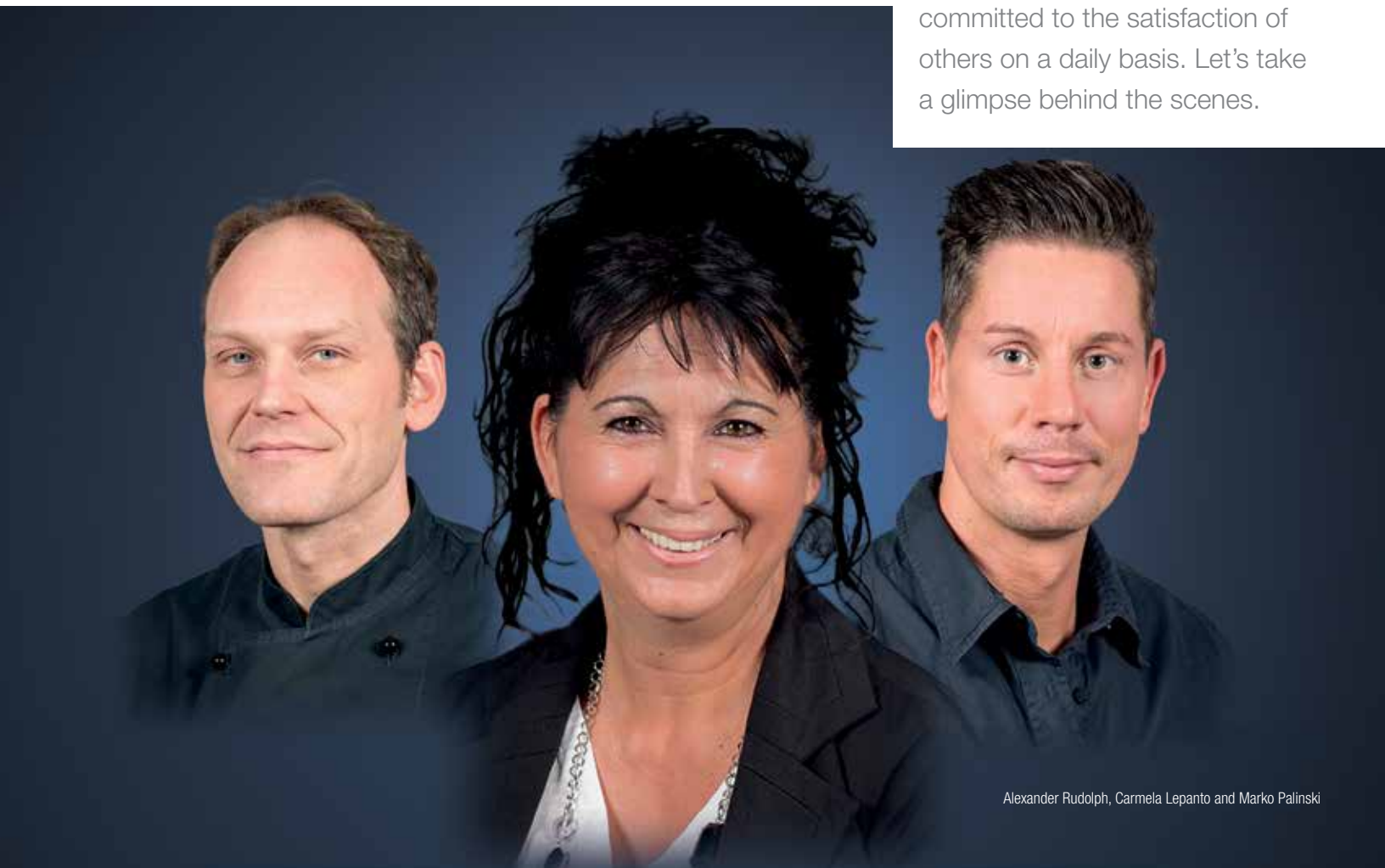






# Keeping everything running Restaurant & Service team

“Meals will be served.” “A snack will be provided during the workshop.” These and similar enticements can always be found in invitations to events at Tebis. “Affordable lunches in our own restaurant with a summer deck” are advertised on the career page of the Tebis website. Visitors are served in our facilities nearly every day. Beverages are available for employees at the coffee stations all day long. To provide these and many other services, Tebis needs people who organize it all and are committed to the satisfaction of others on a daily basis. Let’s take a glimpse behind the scenes.



Alexander Rudolph, Carmela Lepanto and Marko Palinski



- 1) Carmela Lepanto in the Tebis restaurant.
- 2) Marko Palinski and Alexander Rudolph at the grill on the Tebis deck.
- 3) Whether for employees or visitors, the Tebis restaurant offers fresh food and beverages every day.

Five employees at Tebis provide for the well-being of their colleagues and visitors. The workday starts very early for most of the team. For those working in the restaurant, it starts at 6:00 a.m. And by the time all other employees have arrived, around 9:00 a.m., they have ensured that fresh coffee is available at all the coffee stations in the departments and that all meeting rooms have been set up.

## Where it all comes together

Carmela Lepanto has been working at Tebis since 1991 and is responsible for service and organization. It is thanks to her that everything runs smoothly. Just a few examples: She organizes the beverage area in the Tebis restaurant, checks the cleaning done by the cleaning company and is the contact for technicians performing repairs or maintenance work in the building. She plans the work for the assistants in the service area. Orders of coffee, beverages, fruit and baked goods are all in her hands. She is also responsible for the culinary equipment and cleanliness of the coffee stations and all meeting rooms and supports Tebis AG during in-house events. No Open House or other event takes place, and no guests are served without her first having overseen it all. She keeps a keen eye on everything, sees if anything is missing and passes on the information to any others who are responsible. At lunch time, Lepanto also works as a barista at the beverage area in the Tebis restaurant, pampering guests with professionally brewed espresso, cappuccino and latte macchiato. She is supported in this work by assistant Heidi Zimmermann.

## Fresh every day

Food is prepared fresh every day at Tebis. For more than 15 years, skilled chefs Marko Palinski and Alexander Rudolph have been cooking daily for employees and guests. They provide employees with butter pretzels and croissants at the beginning of the day, after which they start preparing lunch. They begin serving their dishes at 12:00 noon sharp. Employees can also enjoy fresh smoothies prepared in-house several days a week.

The company restaurant has a wide variety of foods available. In addition to dishes with meat and fish, the menu also includes a vegetarian or vegan alternative every day. The chefs ensure a varied and attractive menu with continuously changing meals and fresh, high-quality ingredients. When the weather is good in the summer, they fire up the grill on the restaurant deck in the morning and are ready at lunchtime with grilled meat, fish and vegetables. They are also responsible for the well-being of participants at larger events at Tebis AG, including the Tebis Open House and holiday parties. They are both supported by Haydee Despaigne-Sagarra. She assists in preparing the meals and keeps the kitchen spotless.



## AXEL T. SCHILLING

Axel T. Schilling is head of the Personnel/Services Department and head of the Restaurant & Service team. He praises the reliability and independent organization of the team. He describes Carmela Lepanto as the “kind-hearted soul of the company who always has a sympathetic ear for everyone.” He appreciates the large repertoire of the chefs who, as he puts it, “are always inventing and trying new things.”





These pages list the little tricks and suggestions that can make working with Tebis systems even easier and more efficient. The tips are followed by references to corresponding sections in the context-sensitive help, where users can find detailed information and instructions placed in context.

## TIPS AND TRICKS

### Easily create 6-sided blanks



We work with large cast blanks that only deviate from the CAD geometry in a few areas. I need a closed blank in Tebis so that all colliding contours can be detected in the collision check. Do I have to scan the entire blank to do this?



No. Tebis allows you to create a blank from six directions. Therefore, you only have to scan the areas that do not correspond to the geometry.

#### Here's how you do it:

- 1\_Create offset surfaces (orange) if necessary for planar surfaces.
- 2\_Scan the areas that deviate from the CAD geometry.
- 3\_Select the "NCPrep/BLANK" function (create blank). The "Blank" dialog opens.
- 4\_Select the "6-side offset" option. Select the mesh and the CAD data.
- 5\_Confirm your entries. The system creates the blank for the entire component.
- 6\_Use the "Design/Element" function if necessary to check if the blank is completely closed. "0" is displayed for the "Boundaries" entry. The volume is also displayed. If no volume is displayed, the blank is not closed!

**Note**  
For more information on creating blanks, open the context-sensitive help in the "NCPrep/Blank" function.



### Calculating milling paths for undercut areas



This trim steel has undercut areas in the tilt direction. I use separation surfaces to limit the milling area to prevent too much milling in the air when re-roughing with the "Nc3axJob/RPlan" function. Is there an easier way?



Yes. If you view the blank only from the tilt direction, milling areas are generated to the deepest point in the blank in the tilt direction. This can also result in milling paths being determined for areas that no longer have to be machined. It is therefore possible to view blanks from different directions for calculating the milling areas. Viewing from two sides is recommended in your example.

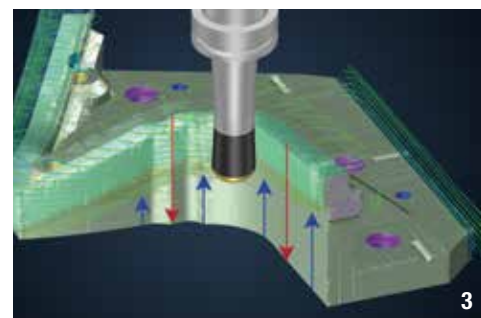
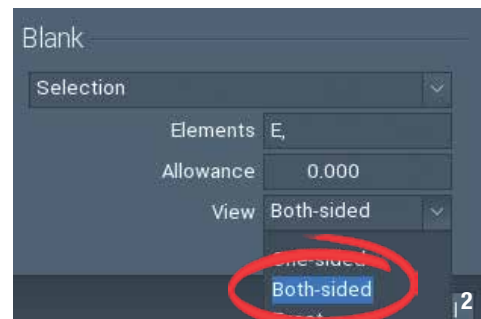
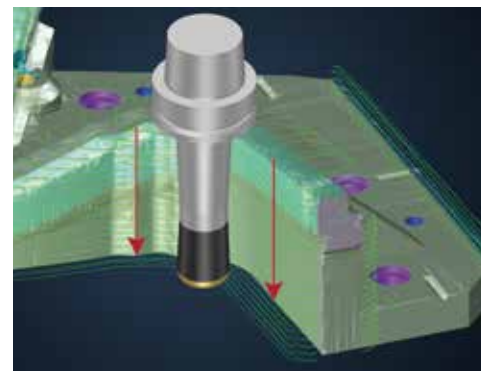
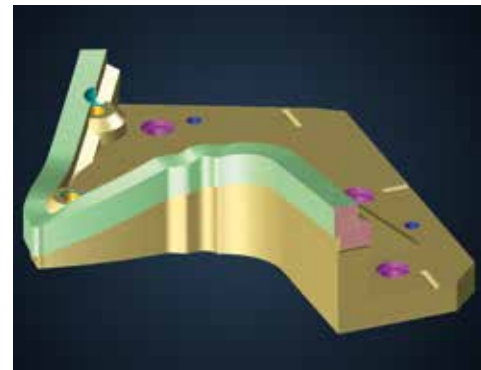
#### Here's how you do it:

- 1\_Open the "Elements" dialog for the corresponding NCJob in the Job Manager.
- 2\_Select the "Two-sided" option for the "View" parameter.
- 3\_Start the calculation. The blank is viewed in both the tilt direction (red) and in the opposite direction (blue) for determining the milling areas. The corresponding milling areas are combined with each other. This prevents machining operations with no contact.

#### Note

In addition to the "One-sided" and "Both-sided" options, the "Exact" option can be used to determine the exact contour of the blank. This option is recommended, for example, for blanks where areas that have already been machined are completely covered (see the tip regarding "Exactly determine blanks for milling paths"). Note that calculation with the "Exact" option takes considerably longer.

You can learn more about viewing blanks with undercuts by calling up the context-sensitive help for the "View" parameter in the "Blank" area of the "Elements" dialog.





## Exactly determine blanks for milling paths



The “Calculating milling paths for undercuts” tip explains that blanks can be viewed from both sides for calculating milling paths. The large pocket in this part has already been milled, and only the area outlined in red is to be roughed up using the “Nc3axJob/RPlan” function. However, the “Both-sided” option does not yield an optimal result. What is the best thing to do in this situation?



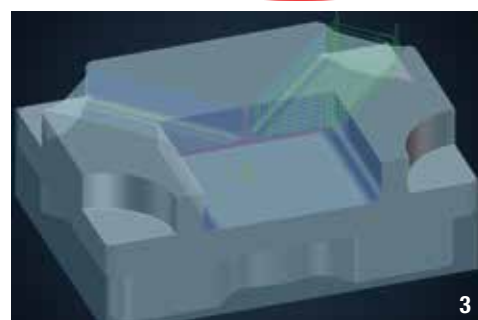
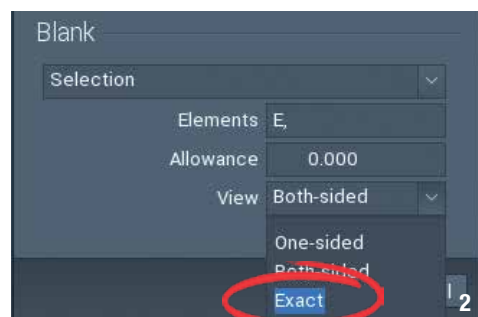
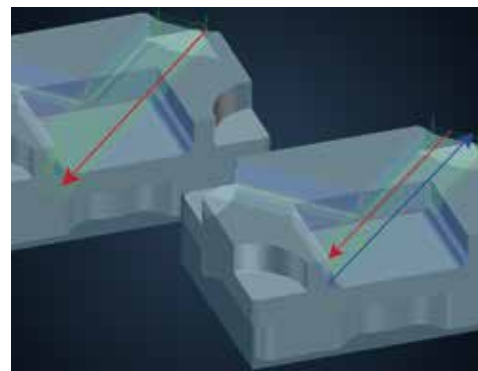
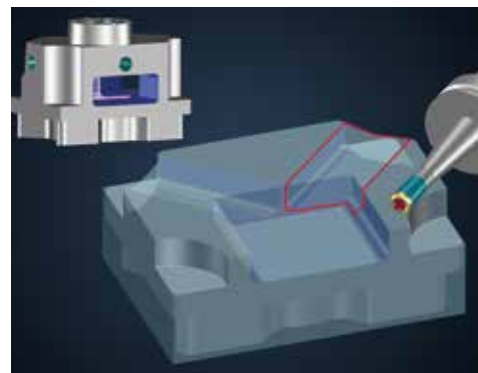
In the “Both-sided” option, the blank is viewed in the tilt direction and in the opposite direction for determining the milling paths. The determined areas are then combined. Areas that no longer have to be machined and are “behind” the blank in both directions are not recognized. The image shows the one-sided (above) and two-sided (below) views for your example. However, it is also possible to determine the exact contour of the blank.

### Here’s how you do it:

- 1\_Open the “Elements” dialog for the corresponding NCJob in the Job Manager.
- 2\_Select the “Exact” option for the “View” parameter.
- 3\_Start the calculation. The blank is decomposed in individual milling planes to determine the milling areas. The milling paths are only calculated for areas that actually have to be machined.

**Note**  
The calculation with the “Exact” option takes considerably longer. Therefore, if possible, this should only be used for corresponding geometries.

You can learn more about viewing blanks with undercuts by calling up the context-sensitive help for the “View” parameter in the “Blank” area of the “Elements” dialog.



## Determining suitable tools during planning



In the machine check, I discovered that the tool I selected for an NCJob is too short. Now I have to replace the tool in the NCJob and collision-check the machining operation again. Can I determine in advance which tool is right for my NCJob?

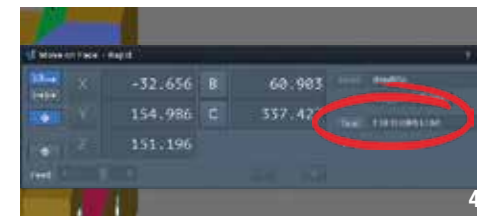
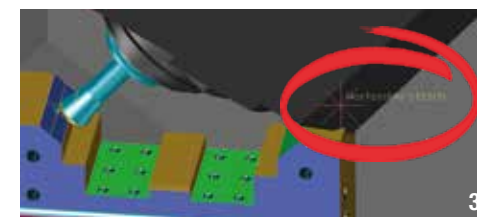
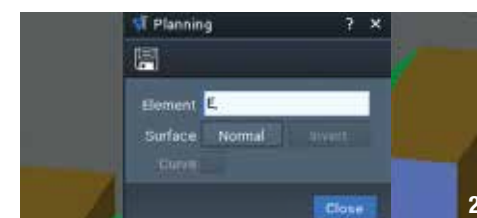
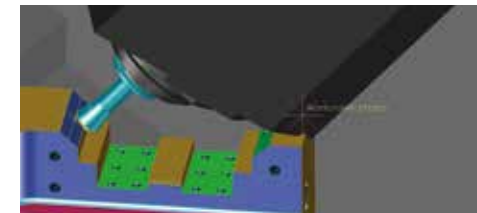


Yes. The Tebis simulation methods allow you to determine suitable tilt directions and tools in advance during the planning phase.

### Here’s how you do it:

- 1\_Select the “Simu/TPlan” command (Planning tools and tilt directions). The “Planning” dialog opens.
- 2\_Select one or more elements for which machining appears to be critical. You can now move the tool along these elements by holding down the left mouse button.
- 3\_The part collision is indicated with a red star. A yellow text flag appears next to it.
- 4\_Click the “Tool” button on the machine control panel to select a different tool. The “Tool selection” dialog opens.
- 5\_Select a longer tool and confirm your inputs.
- 6\_The check shows that the new tool passes this point with no collisions.
- 7\_In the “Planning” dialog, click “Save” to save the path of the tool as a text field. The appropriate tool can now be quickly selected in NC programming. The tilt axis system is also saved.

**Note**  
In the “TPlan” function, open the context-sensitive help menu to obtain more information about how you can plan with tools and tilt directions.





## Trade show calendar: January - June 2019

Interplastica	1/29/2019 to 2/1/2019	Moscow, Russian Federation
Intec	2/5/2019 to 2/8/2019	Leipzig, Germany
Industrie Lyon	3/5/2019 to 3/8/2019	Lyon, France
JECworld	3/12/2019 to 3/14/2019	Paris, France
MECSPE	3/28/2019 to 3/30/2019	Parma, Italy
Tebis Open House	5/8/2019 to 5/9/2019	Martinsried, Germany
Moulding Expo	5/21/2019 to 5/24/2019	Stuttgart, Germany
MSV – International Engineering Fair	5/21/2019 to 5/24/2019	Nitra, Slovakia
Metalloobrabotka	5/27/2019 to 5/31/2019	Moscow, Russian Federation
Subcontratación	6/4/2019 to 6/6/2019	Bilbao, Spain
International Paris Air Show	6/17/2019 to 6/23/2019	Le Bourget, France

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