Tebis

A CIMdata Program Review

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Tebis

Tebis software is used by toolmakers to design and build made-to-order mold and die tooling primarily for the automotive sector, and for component manufacturers in the aerospace and mechanical engineering sectors. With a mix of direct sales and distributors throughout Europe, Asia, and the Americas, Tebis AG and its subsidiaries serve major markets worldwide. While many may recognize Tebis software as being a superior NC programming solution for producing high quality Class A machined surfaces; the real strength of the current Tebis offering lies in its ability to provide a wide range of innovative solutions and services for many important steps within a customer's manufacturing process chain. This, coupled with a new pricing model, makes Tebis a viable option for many early phase companies that formerly may have opted for a solution based solely on low acquisition cost.

Introduction

This CIMdata program review addresses elements of the full range of Tebis software functionality, beginning with capturing and importing customer product and component data through to final assembly; and for die making beyond assembly through to tool tryout and correction. Additionally, this review addresses Tebis Consulting, the Tebis AG department that provides manufacturing related consulting services. Tebis AG's present and future outlook, as well as their software go-to-market strategy, round out the topics covered in this review.

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Tebis AG

Tebis AG offers solutions for model, mold, and die, aerospace, mechanical engineering, and industrial design industries.

Tebis AG offers solutions for model, mold, and die, aerospace, mechanical engineering, and industrial design industries. Customers report that the company provides them a means of optimizing their manufacturing processes to deliver high-quality results in a predictable and consistent manner that improves both profitability and customer satisfaction. They are viewed by CIMdata as an industry leader in guiding and assisting made-to-order model, mold, and die manufactures in the optimization of their entire manufacturing process chain. Finally, the company has particular strengths in the degree of automation possible in NC programming, and in quickly and efficiently creating machined Class A finish quality with minimal machine runtime.

Tebis AG Background

Headquartered in Martinsried, Germany, Tebis AG was formed in 1984 and two years later released its first version of the Tebis CAD/CAM software for CNC

cutter path creation on a DOS-based PC, and established Volkswagen and BMW as its initial customers. The company operates globally from its headquarters in Germany. It has subsidiaries in Germany, other European countries, the United States, and the Asia.

Today, Tebis AG provides a wide range of manufacturing process optimization software and services to customers in various industries with emphasis on automotive, aerospace, mechanical engineering, and consumer products. Tebis software is used by companies of all sizes. The company has approximately 310 employees worldwide, with 220 located in Germany. Their product development staff is estimated to be 140 people. Tebis products are currently used in more than 2,000 customer installations around the world.

Strategy for Growth

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The Tebis sales strategy is country dependent, with Tebis subsidiary offices providing sales, implementation, and support where a significant established customer base exists. In any location around the world, customers buy Tebis software and services either through the local Tebis office or from a local Tebis authorized distributor. Through Tebis AG or a Tebis subsidiary, countries that offer direct sales and support include the United States, Canada, UK, Portugal, Spain, France, Germany, Italy, Sweden, and China. In countries or regions where it is either customary, expedient, or required, it distributes products through local distributors. Tebis maintains long-time distributors in Japan, South Korea, Russia, India, Czech Republic, Turkey, and Thailand. They are represented in China through a mix of distributors and direct offices. Tebis has nine direct offices and twelve distributors worldwide.

Whether a customer is serviced directly by a Tebis office or by a distributor, they are supported by phone or e-mail. In areas supported by a distributor most support is provided by the distributor, with assistance from a Tebis AG office as needed.

To grow the company, Tebis has identified the markets of North American and China as its greatest opportunities, and has invested heavily in those countries over the last two years by hiring additional sales and support personnel.

Tebis has also recognized the need to adjust their product-pricing model to be successful in capturing market share within these two markets. For many years, Tebis customers were located primarily in a handful of discrete European manufacturing communities. The dense concentration of customers within each discrete community allowed word-of-mouth to be an effective means of communicating and educating about the value proposition of Tebis software functionality among the community's prospective customers. Educated prospects are able to understand the reasonableness of an asking price because they more clearly understand how well an offering's functionality aligns with their specific processes and needs. Therefore, the asking price for a full-function seat of Tebis was not an impediment to closing additional sales within each discrete community.

When Tebis originally entered the North American market, the product was priced to include most of the Tebis product's functionality, similar to the pricing model that was successful in the European market. However, absent the word-of-mouth education typical of Europe, the product soon gained a reputation in North America of being too expensive.

Today, to facilitate success in the expansion in the North American and China markets, Tebis has adopted a product-pricing model that allows its customer to purchase a customized configuration of functionality based upon the customer's current processes and their immediate needs.

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This approach allows a customer to begin use of the Tebis solution with substantially less risk. It creates the opportunity to introduce Tebis to shops that are early in the development of their manufacturing processes. And more importantly, it allows new customers to realize an immediate return on investment. While at the same time positioning themselves, when they are ready, to quickly and easily take advantage of the significant manufacturing process optimization capabilities available in the suite of Tebis application packages, add-ons, process libraries, and interfaces.

To help its prospective customers gain a better understanding of how Tebis can help transform their manufacturing processes, even before buying, Tebis can apply its consulting services to analyze and identify immediate needs, and also map out a long-term process improvement program.

CIMdata expects Tebis' current pricing model to enable faster growth and adoption not only in the Americas, but also in other markets.

Present and Future Outlook

Tebis has consistently been one of the top ten independent CAM companies in CIMdata's CAM Market Analysis Report (MAR) over the last several years. Tebis gained this ranking based solely on organic growth, unlike many competitors that have grown through mergers and acquisitions, or by combining their CAM offering with their own enterprise CAD and PLM-enabling solutions.

Based on recent estimates derived after the publication of the CAM MAR for calendar year 2015, CIMdata estimates that Tebis had 2015 revenues of US$46.9 million, making Tebis the largest independent CAM solutions provider in that year.

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Due to the new Tebis pricing model, their heavy investment in sales and support personnel in North America and China, and other factors, CIMdata projects that in 2016 Tebis AG revenues will grow significantly to approach an estimated US$60.0 million.

Tebis Version 4.0 Release 2 was the version evaluated in this review. Tebis completes a major release on a bi-annual basis. Version 4.0 Release 1 was released to North America in October of 2015. Smaller releases and service packs are provided several times a year.

Tebis Product Portfolio & Service Offering

As a leader of CAD/CAM and MES software, Tebis creates highly automated process solutions for designing, developing and manufacturing made-to-order (MTO) tooling and components. Tebis is highly valued by its manufacturing customers worldwide. They suggest that for others who are ready to move their operation to a higher tier of performance, Tebis offers a real opportunity to increase quality, flexibility, competitiveness, customer satisfaction, and profitability.

Tebis offers one of the most complete suites of machining technologies for its target market, and includes milling, turning, drilling, trim cutting, laser cutting, laser hardening, hammer peening, and sinking and wire EDM. Tebis enables users to handle huge parts on their machines, and quickly and efficiently create Class A finish quality, offering the opportunity to avoid manual refinish work.

To design and prepare CAD-files for manufacturing Tebis offers a variety of easy-to-use CAD functionality, highly specialized for prismatic and free-form geometry.

To design and prepare CAD-files for manufacturing, Tebis offers a variety of CAD functionality.

The software has an integrated virtual machine technology for representing the customer's real machining environment for planning clamping set-ups and for collision-avoiding NC path calculation. Tebis NC functions can be used automatically, and can be effective for made-to-order production.

A customer's manufacturing environment and know-how can be stored in individual process libraries. Doing so can guarantee safe, standardized production processes and enable users to run automatic template-based NC programming.

For optimizing resource capacity, planning and controlling the manufacturing process, Tebis offers Proleis, a software suite directly integrated in the Tebis user interface providing access to product data, machine data, tool data, and organizational data.

Tebis software and services are based on contemporary technology and years of expertise developed in optimizing manufacturing processes across industries like prototyping, tool and die, automotive, aeronautics, and mechanical engineering.

Tebis positions itself as the only CAD/CAM software provider with its own corporate consulting department. The Tebis Consulting service is different from the services typically delivered by a solution provider's local sales and support office, or from a provider's authorized distributor. While local sales and support offices provide CAD/CAM software-related services for manufacturers, Tebis Consulting offers business-level services for manufacturers.

In terms of services provided, sales and support offices typically provide training, pre-sales and post-sales application engineering services, personnel to manage service requests, and software maintenance tracking and reporting related activities. Tebis Consulting, on the other hand, provides services to analyze a manufacturer's processes and competitiveness, and creates

recommendations for strategies to improve NC automation, machine productivity, reliability, and quality. Tebis Consulting provides concrete measures to optimize a manufacturer's entire manufacturing process from design to finished product. Suggested improvements are based upon data obtained at the customer's facility, combined with Tebis Consulting's own internally developed benchmarking database.

Furthermore, Tebis Consulting has been known to take-on the responsibility for the success of an agreed upon program of process and organizational change to ensure that the new processes and procedures have a permanent effect. During implementation and upon completion of a process and organizational change program, Tebis is compensated based on predetermined and agreed upon success criteria. CIMdata believes this risk-sharing partnership in implementing a process and organizational change program gives a big advantage to manufacturers who seek to optimize their end-to-end manufacturing competiveness and business performance.

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While many CAD/CAM solution providers may profess to offer similar services, the actual services offered are typically limited to teaching customers how to apply the features of their software to individual steps in the customer's existing manufacturing process. Tebis Consulting is distinctive in the industry in that it focuses much more on a customer's business drivers such as market differentiation, competitiveness, and process repeatability—all of which together drive profitability by creating predictable and repeatable business performance.

Tebis Consulting services are delivered by a team of Tebis AG personnel who together have many years of professional business and manufacturing consulting, as well as practical experience in model making, mold making, die building, and mechanical engineering.

As shown in Figure 1, Tebis' software products cover CAD, CAM, and MES, with emphasis on the manufacturing-related aspects of design, and the high quality of surfaces produced by its NC programs. Tebis provides entire manufacturing process solutions for model making and prototyping, die manufacturing, mold manufacturing, gauge manufacturing, and mechanical part production and assembly. Tebis also covers such areas as workshop-oriented NC programming and quality control, as well as providing file viewers to support paperless manufacturing. All products use the same database and user interface, and are based on the same releases, a decisive advantage when supporting process chains.

Tebis offers innovative solutions for many important steps within their customer's manufacturing process chain. This is a key strength of the Tebis offering. With Tebis, end-users can optimize steps in their process, and achieve cost-effective, repeatable, and predictable results.

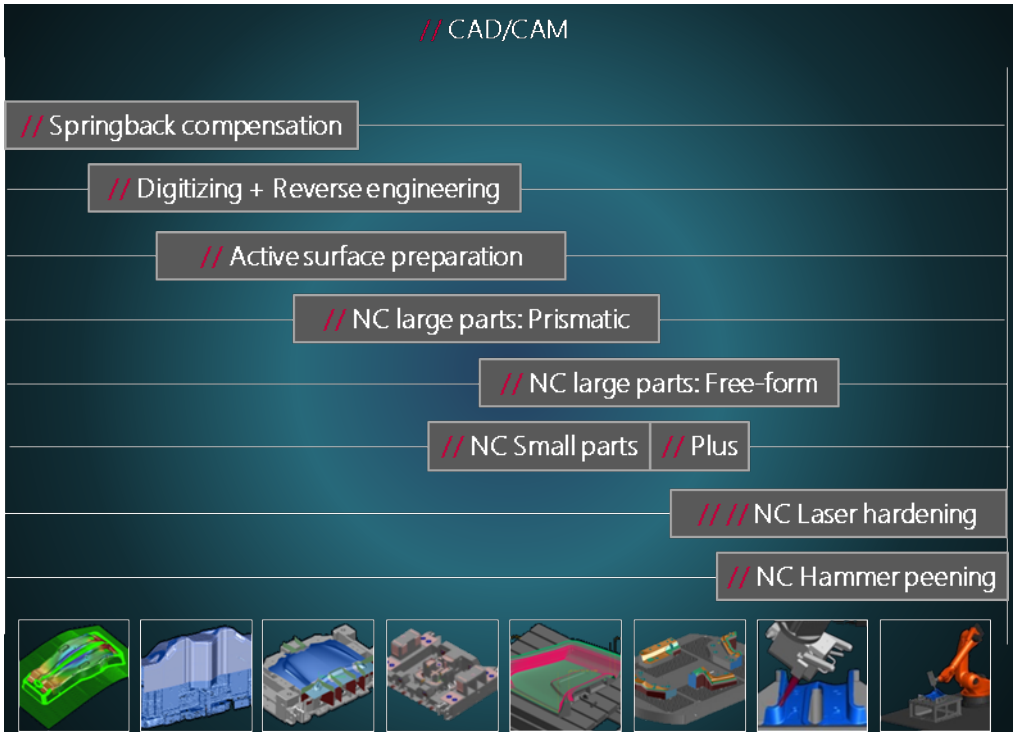

Figure 1—CAD/CAM Portion of the Typical Die Manufacturing Process

Tebis provides Industry Packages for three industrial applications:

- Mold & Die
- Mechanical Engineering
- Industrial Design

Each Industry Package is available at different performance levels, like professional and premium. They are configured consistent with the functionality appropriate for that package's respective manufacturing process chain.

To complement an Industry Package, Special Packages can be chosen to configure a workstation for specialized design or manufacturing activities. There are currently eight Special Packages offered:

- Design
- Manufacturing
- Trimming
- Laser Cutting
- Lathe
- Wire EDM
- Viewer
- DNC

In addition, Tebis offers a variety of Add-Ons to complement and specialize Industry and Special Packages. Tebis organizes its Add-On offering into these categories:

- Design
- Manufacturing
- Manufacturing preparation
- NC automation
- NC safety
- NC efficiency
- Quality assurance
- Data management
- Manufacturing planning and control

Process Libraries are used to define the customers manufacturing environment and methods inside Tebis software:

- Virtual machines
- Post-processors
- Cutting tools
- Features and NC templates
- Clamping devices
- NC documentation templates

Tebis offers node-locked and floating licenses.

Tebis offers node-locked and floating licenses for its Packages and Add-Ons. Floating licensing allows each workstation within a manufacturing facility to be configured in real-time for its intended use in the process chain, providing an optimal workstation price-performance ratio for even the most cost-conscious buyers. With Tebis, an early-stage manufacturer of made-to-order tooling can configure a workstation that compares favorably in price and performance with many lower cost products on the market.

CIMdata believes the long-term cost of technology can be significantly reduced by making early investments in products from solution providers that are already capable of providing additional technology and assistance that may be needed to grow a business to higher levels of performance as required. As a made-to-order tooling manufacturer's business begins to grow, a strictly low cost solution may not have the functionality to enable the business to compete favorably with the next level of performance within its respective industry. In many cases it becomes necessary and costly to replace the low cost solution entirely, perhaps along with many of the processes that were developed in conjunction with that software.

Fortunately, with Tebis, when it is time to move to the next level of manufacturing process chain optimization, software packages can be upgraded to a higher performance level and add-ons can be appended over time to result in a very impressive collection of capabilities to optimize and improve a made-to-order tooling manufacturer's processes and business performance. This is one of Tebis' key market differentiators.

With its release of Version 4.0 in 2015, Tebis introduced an entirely new, highly intuitive user interface specifically developed for CAD/CAM applications. The new user interface allows users to design and save multiple work environments, and a user can switch between them at any time. A user's saved work-environments can be imported and exported for exchange with other Tebis workstations.

Using Tebis, a user can scan physical parts and read in CAD data, check for quality, repair and process the data, construct hybrid models, and generate Class A surfaces. Several automatic functions are available for design and tool construction.

When modeling, the user can interactively model and optimize surfaces, change points of interpolation, smooth surfaces, and evaluate the results using analysis tools. Any complex surface combination can automatically be deformed using topological deformation rules. For reverse engineering, surface creation features permit users to create surface models out of mesh models and channel them into downstream production development and manufacturing processes. Tebis does not provide software for solid modeling but does offer surface, mesh, and surface/mesh hybrid modeling.

NC programming is available for 2.5D drilling and milling, turning, 3+2-axis roughing, surface finishing and pre-finishing, residual stock machining, high-speed cutting, 5-axis milling, mill-turning, 5-axis laser cutting, 5-axis trimming, gun drilling. Using the collision avoidance in the course of 3-axis NC programming, users can automatically generate collision-free 5-axis toolpaths without needing a license for the 5-axis simultaneous milling module.

Tebis uses the compute-intensive approach for toolpaths by calculating the toolpaths on mathematically precise CAD surfaces—Tebis only uses simplified mesh models when no exact surfaces are available. This is unlike many CAM software providers who employ surface machining algorithms for doubly curved surfaces that use a mesh model representation of the surfaces from which to compute and establish each tool-path point. When this is the case, the resultant tool path lies on the mesh, and not necessarily on the surface from which the mesh was created. While in some cases the difference may be meaningless, it is important in the case of machining Class A surfaces. Class A surfaces are generally surfaces that are visible in the final product or where the aesthetics of the surface carry a significant contribution in the appearance of the product.

When a Class A surface is being finish-machined with a very accurate CNC machine, the difference between whether a mesh model or the actual surface was used to compute path-points is likely discernable, and in many cases it is possible to actually see the small facets or patches that make up the mesh with the naked eye. If that is the case, the machined surface will certainly require benching; a manual process that removes visible defects in a machined surface, but in doing so may result in a machined surface that does not favorably match the intended surface in the CAD model.

CIMdata believes direct machining of Class A surfaces (Figure 2) that the Tebis software offers is a distinct advantage to shops that currently machine, or intend to machine, Class A surfaces. This distinct advantage also applies for shops that must produce machined surfaces that are highly accurate in respect to their underlying CAD surface model.

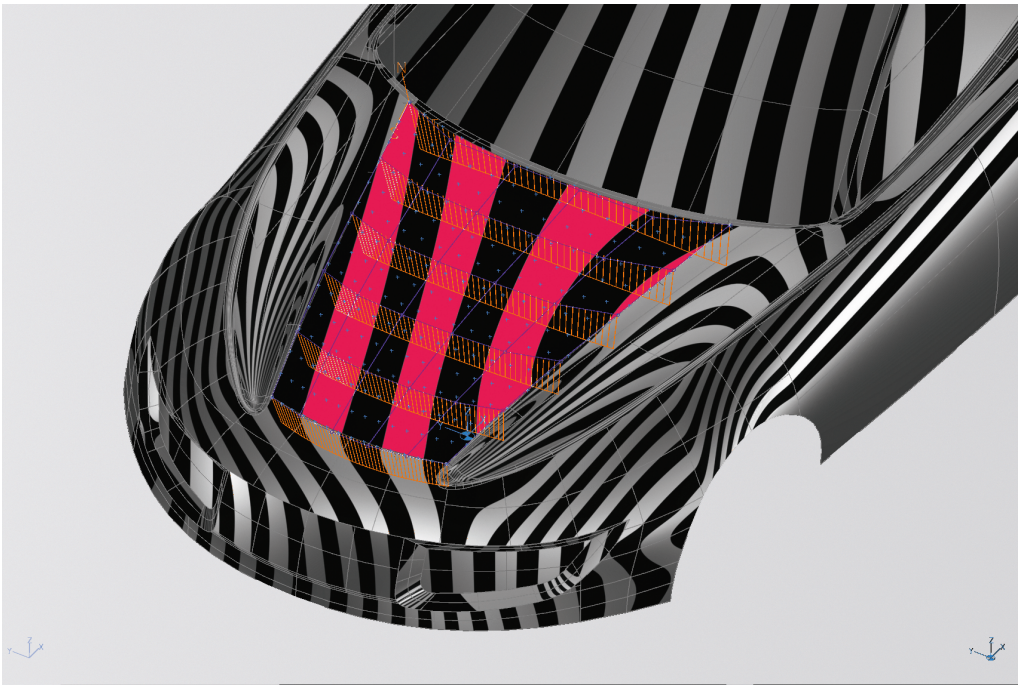

Figure 2—Class A Surface Design and Machining

During a visit to Century Tool & Gage (Century), a 100 employee made-to-order compression mold builder for large and medium applications for the automotive, heavy truck, aerospace, and personal watercraft industries, Mickey Guckian said "We cut our first CNC machined mold component in 1988. Over the years since then we've changed NC software providers three times. We justified each change on capabilities that improved our process." Mickey, a long-time manager at Century, started the CNC department and has been responsible for the machines, software, and tooling purchasing, and also the hiring of staff to program, operate, and repair the machines. He is also involved in all the testing required to keep up with current technology and applications.

Century attributed the Tebis direct surface machining capability as one of the reasons they switched to Tebis for NC programming.

Today, Century uses Tebis for NC programming in the office, and on the shop floor by machine operators that are trained in the methods and processes used at Century. About twenty percent of the tooling manufactured by Century contains Class A surfaces. Mr. Guckian described their experience with Class A surface machining and attributed the Tebis direct surface machining capability as one of the reasons Century switched to Tebis for NC programming. Mr. Guckian observed that Tebis has improved significantly since his first look several years ago. He indicated that Century looked at Tebis a few years ago and felt that Century's then current NC provider gave Century an advantage over Tebis and other providers' solutions. After some period of time Century began using Tebis

only for roughing, while retaining seats of the incumbent's software for finishing. Today, Century uses Tebis for both roughing and finishing.

In the discussion about Class A machining, Mr. Guckian went on to say, "If you're a shop that wants to stay competitive in building quality tooling, you must invest in accurate machines or convert your existing machines to the latest linear motors, servo drives, and CNC controller. It makes no sense to make an investment in machine accuracy and then use CAM software that's less accurate than the machine itself."

Multiple machining strategies are available for each machining function.

Multiple machining strategies are available for each machining function. In roughing, the software generates intermediate results for each single layer when calculating NC programs. The intermediate geometries provide information about the thickness of the material remaining on the target, allowing the programmer to apply intermediate strategies only to the areas where material still remains. Intelligent algorithms enable smooth path transitions, layer-to-layer.

Finishing strategies supported include axis-parallel, curve-parallel, isoparametric, contour-parallel, Z-profiling, Z-variable, equidistant, and curve-parallel-variable. High-speed milling is supported. Additionally, several strategies are available to help NC programmers re-machine specific fillets and other concave recesses where large tools leave un-removed material.

Both feature-based NC design and knowledge-based machining are provided in Tebis.

Both feature-based NC design and knowledge-based machining are provided in Tebis. Users can import features from many different systems and formats. Users can convert automatically bored-holes, threads, planar surfaces, and pockets found in both mold and die designs, and turn the presence of those features into NC programs.

The internal tool library in Tebis, manages not only the geometric data, but also the cutter material and material-specific parameters (feed rates, speeds). The library can include holder components as well.

Tebis provides a strong capability in 5-axis milling. The simultaneous 5-axis program provides rapid surface smoothing, face and roll milling, and considers head-geometry and machine kinematics. The kinematic processes consider the tool being used, the head geometry, and machine kinematics and travel limits, as early as during the NC program calculation. The integrated dynamic lead angle prevents gouging in the rear cutting-edge zone. Calculated 5-axis NC programs can be simulated in shaded real-time modes, and analyzed for collisions. In 5-axis positioning, the programmer can select a path point's tool-tilt direction and interactively check and correct the tool-tilt. The selected tool-tilt direction is then used for the remaining programming.

In the case where the beginning raw material is not a single cuboid, beginning stock models can be defined by combining any number of similar or dissimilar cuboid blanks. Cast models, such as those used for pressed metal tooling, can also be used to define the beginning stock model.

The Tebis NC Simulator simulates toolpaths and provides collision checking of all defined machine components. NC programs are output in the controller format after all toolpaths have been successfully tested.

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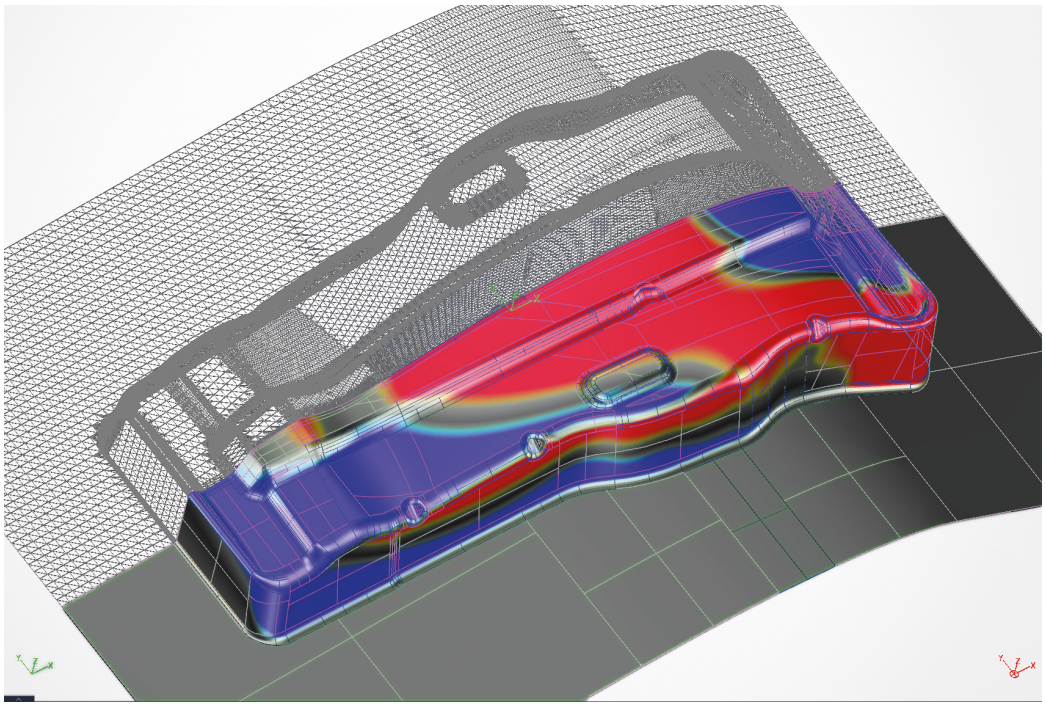

Figure 3—Tebis Design Add-On for Surface Morphing

To reduce the number of tryout loops in pressed metal tooling, users can benefit from the automatic spring-back compensation functionality offered with the Tebis Surface Morphing add-on (Figure 3). This add-on is suited for morphing surface models over large areas in forming tool manufacturing, design, and model and mold manufacturing.

During the tryout step in manufacturing a pressed metal tool, it is possible to make manual modifications to the tool to cause it to produce the desired physical and dimensional characteristics in its manufactured part. Incorporating those manually made modifications into the original CAD model of the tool is a critical and necessary procedure to assure the data model remains consistent with the physical tool to support subsequent steps in the process. With Tebis, to save time during any tryout step, a high-quality mesh can be generated by converting multiple digitized paths into an optimized and thinned point cloud. The mesh can be used as reference data to create and modify the tool's surfaces to reflect the manually made modifications. This capability is extremely beneficial if used consistently.

Tryout is only one of the steps in the manufacturing process chain, however, when manufacturing a single pressed metal forming tool, it is a step that often must be repeated to achieve the desired physical and dimensional characteristics in the manufactured part. Each tryout iteration is labor intensive and ties up costly machinery and equipment. Minimizing the number of tryout iterations can be central to achieving a manufacturer's on-time delivery and project

profitability. The accurate characterization in the CAD model of manual modifications helps minimize tryout iterations.

Equipped with CAM modules, CAM stations can be used to NC program on the shop floor. Working in combination with Tebis DNC, one can directly assign such a CAM workstation to a specific NC machine, allowing the user to place each toolpath directly into the controller queue right after it is calculated.

In the quality arena and directly on the milling machine, Tebis add-ons are available for measuring and final control of workpieces, direct variance comparison of the finished component with the underlying CAD model, and logging of the results.

The Tebis Viewer Systems enable access to the digital data environment without supporting paper documentation in the process chain before and after NC programming is complete, from the preparation of a proposal to the machine manufacturing and assembly.

The Tebis Viewers are also well suited for users with little or no CAD/CAM experience. All Tebis software products for use on the shop floor are designed to supply CNC machine controllers with NC programs in their preferred format. This is made possible by the universal Tebis post-processing concept, which is integrated into CAM workstations as well as Viewer, Simulator, and DNC stations.

Conclusion

Tebis has a significant presence in, tool and die firms in Europe, US, and Japan. Automobile manufacturers including Audi, BMW, VW, Opel, General Motors, Ford, Tesla, Seat, Volvo, Saab, Honda, Toyota, Mazda, and Hyundai use the solutions. The high-quality surface finish on components produced using Tebis created NC cutter paths are one of the software's greatest assets.

There are many metal cutting solutions in the market, and Tebis has one of the best collections of functions and strategies for surface model preparation and NC cutter path generation within its target markets. Tebis' most outstanding strength lies in its ability to optimize its customer's business competitiveness and profitability by providing a wide range of solutions to optimize its customer's entire manufacturing process chain.

Tebis provides a wide range of solutions to optimize its customer's entire manufacturing process chain.

Any made-to-order tooling manufacturer that is ready to move its business to a higher tier of performance, even if they have researched Tebis in the past, should consider exploring the current Tebis offerings.

The current Tebis pricing model allows each workstation within a manufacturing facility to be configured to precisely match its intended use in the process chain, providing an optimal workstation price-performance ratio for even the most cost-conscious buyers.

Tebis can provide experienced consulting and services to develop a plan for customers to utilize and implement the full potential of the Tebis software in

conjunction with the customer's specific equipment and current process of designing, developing and manufacturing made-to-order tooling.

About CIMdata

CIMdata, a leading independent worldwide firm, provides strategic management consulting to maximize an enterprise's ability to design and deliver innovative products and services through the application of Product Lifecycle Management (PLM) solutions. Since its founding over thirty years ago, CIMdata has delivered world-class knowledge, expertise, and best-practice methods on PLM solutions. These solutions incorporate both business processes and a wide-ranging set of PLM-enabling technologies.

CIMdata works with both industrial organizations and providers of technologies and services seeking competitive advantage in the global economy. CIMdata helps industrial organizations establish effective PLM strategies, assists in the identification of requirements and selection of PLM technologies, helps organizations optimize their operational structure and processes to implement solutions, and assists in the deployment of these solutions. For PLM solution providers, CIMdata helps define business and market strategies, delivers worldwide market information and analyses, provides education and support for internal sales and marketing teams, as well as overall support at all stages of business and product programs to make them optimally effective in their markets.

In addition to consulting, CIMdata conducts research, provides PLM-focused subscription services, and produces several commercial publications. The company also provides industry education through PLM certification programs, seminars, and conferences worldwide. CIMdata serves clients around the world from offices in North America, Europe, and Asia-Pacific.

To learn more about CIMdata's services, visit our website at www.CIMdata.com or contact CIMdata at: 3909 Research Park Drive, Ann Arbor, MI 48108, USA. Tel: +1 734.668.9922. Fax: +1 734.668.1957; or at Oogststraat 20, 6004 CV Weert, The Netherlands. Tel: +31 (0) 495.533.666.