

# CAM SYSTEM FOR A CONNECTED WORLD



## What is the role of the CAM system in a connected world of the future?

Everyone is talking about digitalization, Industry 4.0 and the “Industrial Internet of Things (IIOT)”. While large companies are investing in their future, decision-makers at small and medium-sized companies in the field of machining production are asking themselves what their possible courses of action and opportunities are in this context. The arguments put forward in favor of digitalization are well known and make sense, including a shortage of skilled workers, cost pressure, growing quality requirements, and the production of variant-rich products in small quantities. After all, no machining company today can afford to let production capacity go to waste.

**OPTIMIZATION THROUGH DIGITALIZATION AND CONNECTED PROCESSES?**  
This e-paper presents you with the most important features a modern CAD/CAM solution should have for this purpose.

Machine tools should be utilized to maximum capacity, while non-productive time caused by setup operations and maintenance need to be reduced. For this, it is also important that the appropriate tools and the correct NC code are available on time and that potential errors are prevented from the outset.

Almost all modern approaches to process optimization have this prerequisite in common: connectivity. Only when all systems communicate with each other can all information be processed digitally without data disruptions.

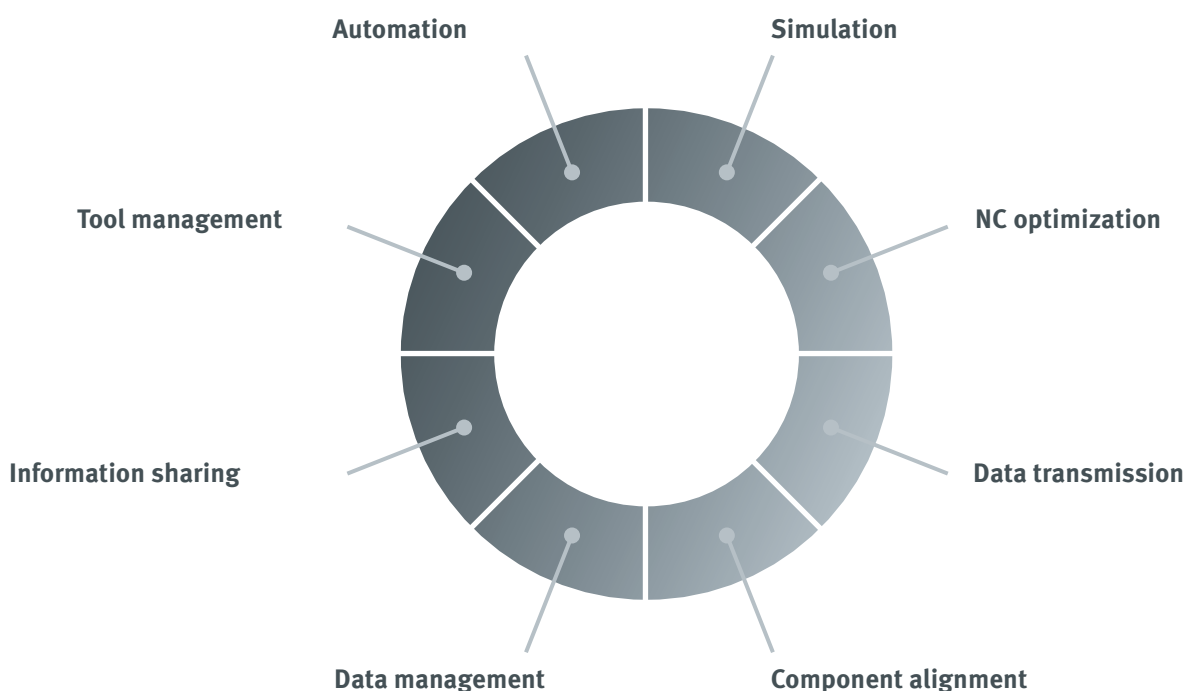
### Heterogeneous IT landscapes...

Some suppliers deliver a comprehensive IT landscape for connected manufacturing that includes product lifecycle management (PLM), manufacturing execution system (MES), CAD, CAM, tool management, integration of machine controls and much more. While this may make sense and be feasible for large companies, it is not always appropriate, especially for small and medium-sized companies. This is especially true for classic contract manufacturers, who have a heterogeneous landscape of individual software systems: The comprehensive digitalization approaches based on the overall solution of one provider are often overdimensioned. For most companies, therefore, it would be more efficient and economically viable to optimize the individual areas of the process chain step by step.

### ...move the CAM system into the spotlight

However, digital process chains rely on connectivity. And this is exactly where the CAM system comes into play as a central component of connected manufacturing. Why is that so? It's because the CAM system is at the core of the most essential and longest established digital process. After all, regardless of what other IT systems are used, the path from design to product is digital. CAD data is imported into a CAM system. Toolpaths are then programmed before a postprocessor converts the data into NC codes for a machine tool.

Even if all your processes and workflows are already configured to your satisfaction, there is always potential for optimization in a wide range of areas.

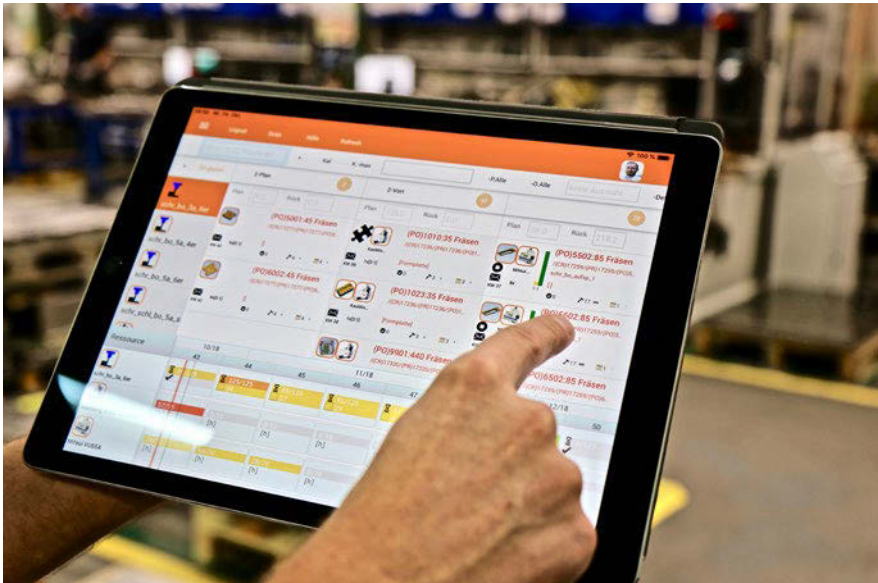


## What must a CAM system be able to do as the centerpiece of connected manufacturing?

### 1 Data Management

The more complex the products and individual components and the more parts and variants to be produced, the more important systems for planning and controlling production and for managing data become. Different companies pursue different strategies in this regard. Those who manufacture their own products may use a PLM system to manage the data required for manufacturing. A contract manufacturer, on the other hand, is more likely to use an MES. Still others may map their product- and manufacturing-related data to an enterprise resource planning (ERP) system. For products or components, it is not only the CAD data that is decisive, but all data that accumulates in the process chain

for manufacturing. There is plenty of potentially valuable data to manage, including CAM data, NC codes, information on manufacturing parameters or required tools, machining times, and so on. The CAM system is involved in many processes that generate data. Therefore, CAM software manufacturers must provide interfaces to all systems that handle manufacturing-relevant data. Only if this requirement is met, does it become possible, for example, to automatically load CAD data and transfer CAM data and NC codes to the systems that manage data.



CAM and MES: agile production control with the Hummingbird MES.

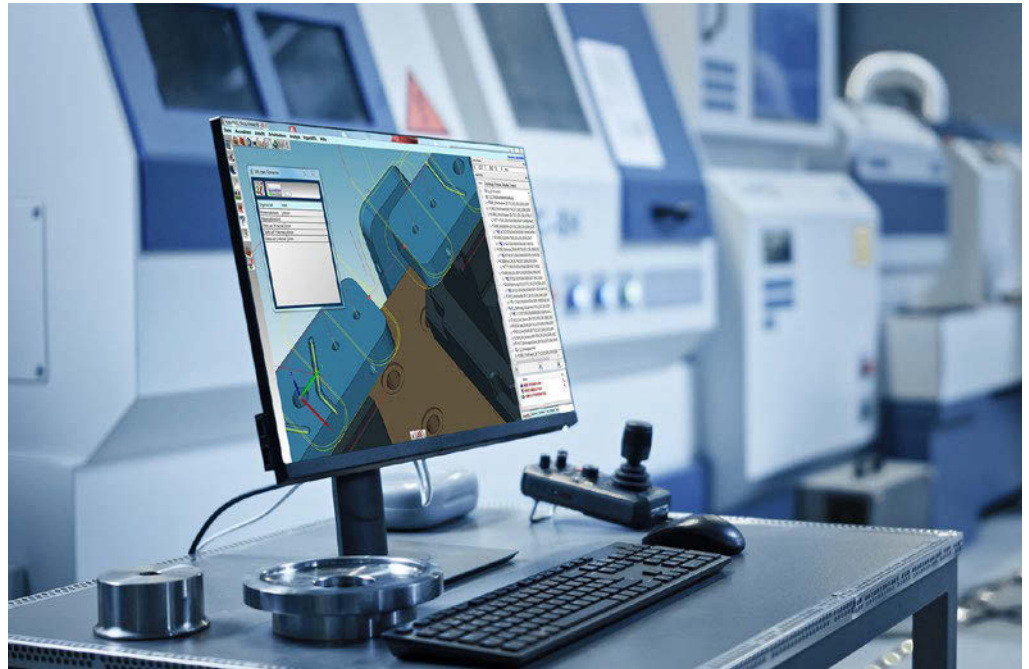
### 2 Information Sharing

In large companies, employees from a wide range of departments need to be able to view CAD data. This includes the work preparation, purchasing and quotation preparation teams, as well as team managers. It does not make sense to purchase additional CAD licenses or to use licenses alternately to provide all stakeholders with access to this data. Similarly, it is not a viable solution to convert component schematics into other data formats or to print them out. To ensure company-wide transparency with regard to important product information, the CAD system should offer optional viewer solutions for viewing the original data. The corresponding viewer workstations should be able to open original data in real time and read-only format. A notification of interim changes may also be helpful. In addition to viewing tools, functions for analyzing CAD data are also important. The ability to display product manufacturing information (PMI) as well as the ability to dimension and analyze component surfaces should be available.

A CAM data viewer is also desirable to facilitate communication between CAM programmers and machine operators. This is the only way to create transparency for machine operators with regard to CAM programs. It also allows them to run simulations, view milling parameters, feeds or tools, and track individual processes. The flow of information should be bidirectional. If machine operators have the ability to feed information back to

programmers via a CAM viewer, programmers can additionally benefit from the machine operators' know-how and learn in a seamless manner what needs to be changed to optimize the result.

Viewer solution right at the machine: improve shopfloor safety by viewing and simulating production-relevant data directly next to the machine.



### 3 Tool Management

Configuring the right parameters for tools is crucial to ensure machining efficiency and quality. Also, tool data and cutting values should be managed together with the tools, because it would be an inefficient task to enter the former time and again. Finally, the use of tools generates useful empirical data, for example on tool life and cutting values, which must be documented and exploited. In addition, the measurement data of the individual tool is used to prepare for a given machining job. A modern CAM system must therefore offer tool data management for all parameters. And here, too, connectivity is of great importance. It should be possible to import data from tool manufacturers and create 3D data from tools so that they are correctly displayed in the CAM system. It should also be possible to read tool information from the machine and write data back to it. Furthermore, interfacing with planning and commercial tool inventory management systems is important as well.



The various types of technology data are just as diverse as the tools. A CAM system must therefore be able to reliably manage and use tool and technology data.



## 4 Automation

In connected manufacturing, many processes can be automated. Ideally, the CAM system is included in these process chains as part of the IT infrastructure and can communicate with upstream and downstream systems. Automation of the CAM programming itself is also recommended so that it does not become a bottleneck in the overall process. This involves much more than traditional programming aids such as work templates and feature recognition. This is because workpieces, no matter how different, are created using similar work steps that can be easily standardized based on the elements in the CAD model. Therefore, a modern CAM system can also automate processes involving free-form surfaces or more complex surface composites. Given that any process includes recurring steps, a CAM system must also be able to automate the entire CAD/CAM process. Not only specific CAM use cases such as drilling and pockets, but also CAD processes offer enormous potential for automation. Especially when preparing parts, a lot of time must be devoted to creating the basis for CAM programming through additional surfaces and boundary curves in non-automated environments.

## 5 Communication with the Machine Controller

A core aspect of connected manufacturing is communication with the machine. Transferring NC data manually to the machine via USB stick is no longer state of the art. The CAM software should therefore enable a direct, simple and confusion-proof transfer to different machine controllers. However, this connectivity only lays the foundation; it takes bidirectional communication between the machine and the CAM system to open up decisive potential for optimization. Only when the CAM software receives information from the machine tool does comprehensive process control become possible.

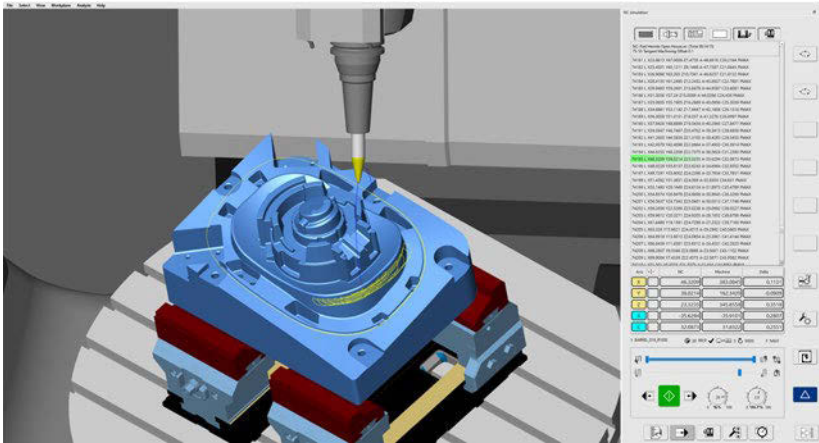
Bidirectional communication between the machine and CAM solution enables unrivaled process control and process reliability.



## 6 Simulation

After creating a CAM program, machining should be simulated as a rule. This safety measure prevents the calculated toolpaths from leading to collisions in the workspace of the machine tool. Process reliability is further increased if the machining simulation is not only executed within the model generated by the CAM software, but on the basis of the finished NC code. This turns the model into a digital twin of the actual machining conditions, and it enables the software to work with a virtual machine. As a result, the CAM system must do more than just generate NC code – it must also simulate and optimize it. This is how the virtual machine closes the gap between the digital world of programming and the physical world of machining, opening up new avenues to eliminate errors and make the process safer.

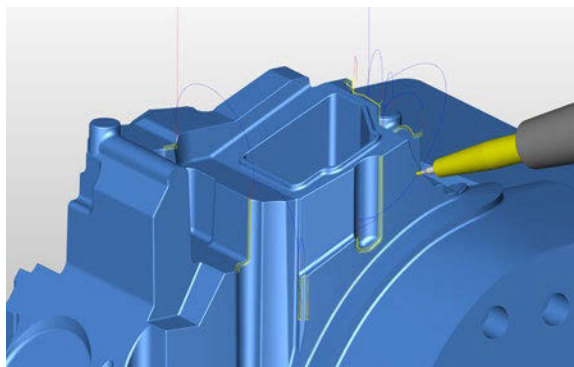
Connected manufacturing brings tremendous progress in this context: Bidirectional communication between the CAM system and the machine allows the CAM software (or external simulation software connected with it) to draw on real machine data.



**hyperMILL® VIRTUAL Machining: safely generate, optimize, and simulate NC code in a single system.**

## 7 NC Code Optimization

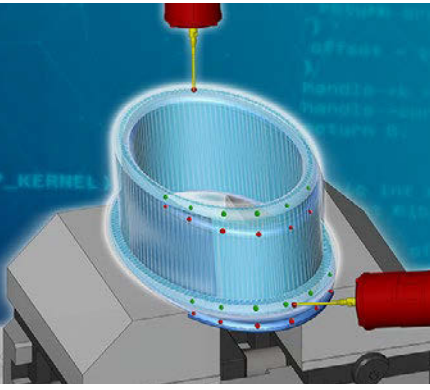
Another advantage of the digital twin is optimized toolpaths that take into account the specific machine and its physical limitations. In general, there are different ways to tackle machining tasks. With the help of a digital twin, this process can be optimized down to the last detail, and unnecessary movements can be eliminated. Given the high degree of complexity, if axis positions were optimized manually, it would be difficult to factor in the effects on all subsequent machining steps and make decisions that produce ideal results. Therefore, a CAM system should offer the possibility to optimally adjust the NC code to the machine characteristics in order to ensure efficient and safe machining operations. And there's another advantage of digital optimization: Programs can be created in a largely machine-neutral format since adaptation to the machining center takes place during NC code generation.



**Motion-optimized programs ensure smoother machine operation while also helping to reduce machining times.**

## 8 Component Alignment

Connected manufacturing with the machine and the digital twin pave the way for new processes, such as reliable alignment of an in-process workpiece that has been machined previously. This is required, for example, to align cast, forged, or welded blanks produced with 3D printing that have small or irregular allowances for finishing or further processing. Because this process has previously been a manual task requiring a lot of experience, precision, and patience, it has also been a time consuming and error-prone process. Therefore, a CAM system should offer the option of making part alignment easier and more reliable. An innovative approach to implementing this requirement is a virtual world in which programming is mapped to the real world of clamping. So far, the approach taken has always been to try and transfer the clamping setup from the CAM to the machine in a difficult and time-consuming manner. But it is much easier to go about it the other way around. When doing so, connected processes and the digital twin make it possible to take the actual clamping setup from the machine and have the CAM system adjust the NC code accordingly. Excellent CAM software offers such a function that speeds up processes enormously and ensures more reliable processes.



Fast, safe, precise: intelligent part alignment at the touch of a button in real time with *hyperMILL*® BEST FIT.

## 9 Cooperation and Partnerships

A CAD/CAM solution is only as good as the people and experience that built it. You should therefore choose a manufacturer who is firmly established in the industry, with long-standing experience and the demonstrated drive to continue innovating for many more years to come. After all, experience is and remains an important key to success, even in the field of connected machining processes. That is why partnerships, for example with tool or machine manufacturers, and close cooperation with customers are indispensable today. The digitalization of manufacturing processes is advancing rapidly, and therefore the provider of your CAD/CAM solution should also keep evolving and should always consider the entire process landscape. Only together, in constant exchange with strategic development partners and customers, can innovative solutions to problems be found and trends be set and established in this dynamic field.

### Summary: The connected CAM system brings processes together

This e-paper shows the important role that modern CAM software plays in connected manufacturing and why a CAM system should be able to be connected with other systems along the process chain. These features turn it into a key component of solutions that increase efficiency, accelerate processes, and reduce costs in machining production. Integration with machine controls is of particular importance here. Additional benefits can be achieved by connecting with systems for capacity planning and process control. The CAM system is at the center of the all-important data flow from design to the finished product. That is why a CAD/CAM system rich in interfaces and forward-looking functions can support digitalization and optimization measures – even in a heterogeneous IT landscape.