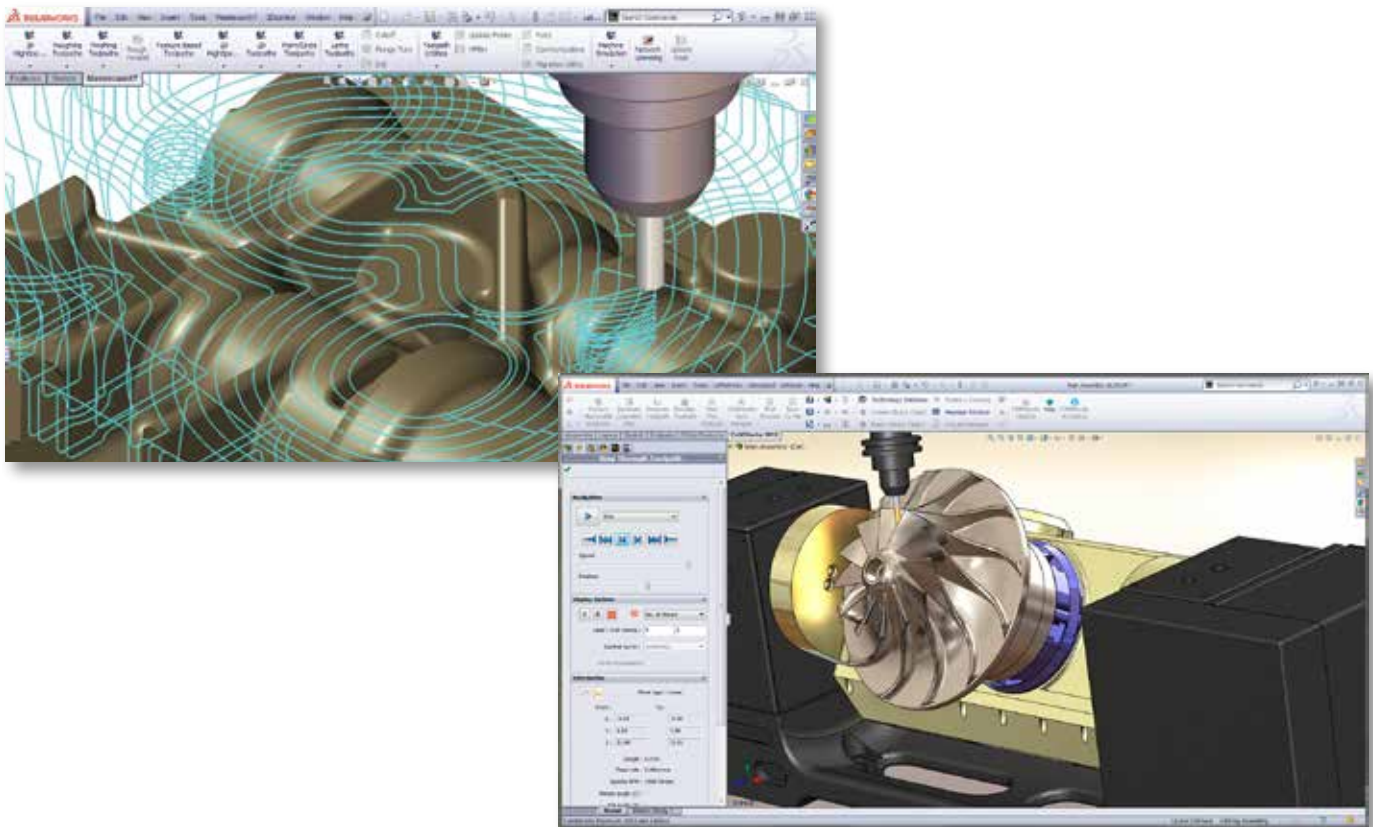


CAD/CAM INTEGRATION: SIGNIFICANTLY IMPROVE YOUR PRODUCT DEVELOPMENT PROCESS

White Paper



Product development has historically involved two divided processes: first, designing a product, and then manufacturing it. The use of separate, non-integrated CAD (design) and CAM (manufacturing) tools to develop products has created a communications barrier between design and production, resulting in cost, time, and quality issues, especially when design changes are necessary or manufacturability disruptions arise. By using an integrated CAD/CAM solution, you can overcome the problems associated with the traditional disconnect between design and manufacturing. With an integrated CAD/CAM platform, you can reduce cycle times, control costs, and improve quality, while simultaneously cultivating cooperation and collaboration between product design and manufacturing personnel.

INTEGRATING THE DESIGN THROUGH MANUFACTURING PROCESS

Manufacturers face intense competitive challenges in today's global economy. Regardless of the industry in which you operate, as a manufacturing organization you must consistently develop products that your customers want to buy, cost-effectively manufacture those products, and successfully sell them at a profit. In short, competitive pressures compel your company to continuously generate higher levels of innovation, efficiency, and productivity.

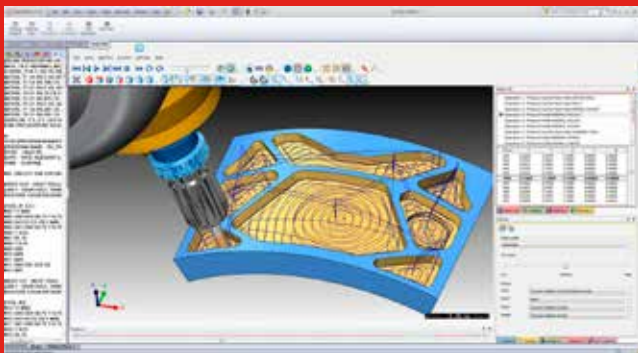
Those unrelenting goals are the driving forces behind technological advances in product development, and nowhere is that more apparent than in the integration of the design through manufacturing process. Until recently, product design and manufacturing groups generally operated as separate, autonomous functions and organizations. Whether they are machining parts, developing jigs and fixtures, or making molds, manufacturing engineers, machinists, and production personnel typically do not get involved in the development of a product until the design is released for production by a design engineer.

The product development transition from design to manufacturing is almost always a handoff of 3D design and tooling data, and associated 2D drawings. Because designers and manufacturing engineers use different tools for handling design data—one uses CAD software to design the product and the other uses a CAM application to create tool paths and machine molds—the handoff has typically not been clean, requiring data imports, translations, and conversions. Moreover, once the handoff is made, a virtual wall in terms of communication can go up between design and manufacturing. This lack of communication is the basic problem that an integrated CAD/CAM platform solves. However, the potential positive ramifications of the solution are much more widespread.

This paper will explore how an integrated CAD/CAM solution can help you unify the design through manufacturing process, and the benefits of doing so. What is integrated CAD/CAM? It's a CAM solution that uses a CAD system as its front-end, geometry engine. Instead of importing or converting a CAD file, or some other data format, such as IGES or STEP, an integrated CAD/CAM platform performs CAM operations on the CAD file itself, offering full single-window, bidirectional associativity between the CAM application and the CAD system. This technological advance offers many advantages that can help you boost productivity, control costs, and resolve manufacturability issues.

A Case in Point

A 50 percent improvement in productivity



BobCAM for SOLIDWORKS™ – Multi-axis high speed adaptive roughing

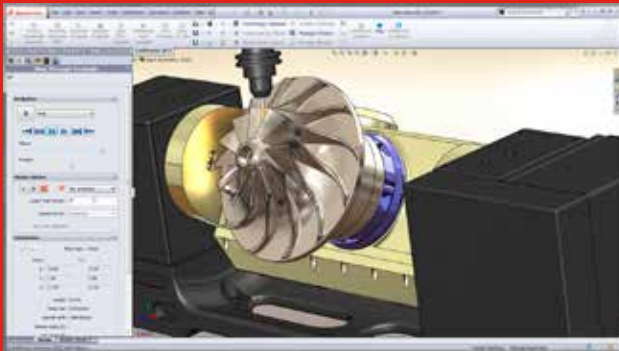
Since implementing an integrated SOLIDWORKS® CAD and BobCAM for SOLIDWORKS solution, Texas Chassisworks has realized a 50 percent improvement in manufacturing productivity. Based in Tyler, Texas, the company produces high-end drag-racing cars and associated parts. Prior to implementing an integrated CAD/CAM solution, Texas Chassisworks had to convert designs to IGES files, and then import them. This approach resulted in multiple operations that were time consuming. With BobCAM for SOLIDWORKS software, a certified, integrated CAD/CAM solution for SOLIDWORKS, the company can apply CAM operations directly to the SOLIDWORKS CAD model and use advanced tool-path operations to decrease cycle time by 50 percent. This productivity improvement enabled Texas Chassisworks to transform piecework business into a full retail billet steering arm parts line.

THE INTEGRATION OF CAD AND CAM

To understand the potential benefits of an integrated CAD/CAM platform, it's helpful to contrast the workflow processes associated with the traditional, sequential, non-integrated approach to design through manufacturing versus the concurrent, collaborative workflow process made possible by an integrated CAD/CAM platform. Each approach will be examined in detail for both injection-molded and machined parts.

A Case in Point

From orders to parts



CAMWorks – 5-axis machining of an impeller

CP-Carillo, a leader in the production of pistons and rods for the power-sports and motor-sports racing industries, is leveraging the Applications Programming Interfaces (APIs) of the integrated SOLIDWORKS CAD and CAMWorks CAM solution to fully automate the design and part programming of its products. When an order is received, technical sales personnel enter the specifications in an interface created with the SOLIDWORKS and CAMWorks APIs. Once the specifications for the model are entered, the software automatically generates the design model and tool paths for the part, which are then machined following a quick check. This integrated, automated approach reduces overall lead time by 85 percent, including a 95 percent reduction in design time, a 75 percent drop in CNC programming time, and a 20 percent decrease in scrap and rework.

The non-integrated approach

Using CAD and CAM systems that are not fully integrated, the workflow between design and manufacturing is a linear, sequential handoff of design data, with each subsequent back-and-forth iteration occurring late in the process, adding potential costs and delays. After a design is released to production, manufacturing personnel have to import, convert, or translate the data into a file with which they can work to program tool paths for machining either a part or a mold. If there are design geometry, material cost, or manufacturability issues, these have to be relayed back to the design engineer for resolution, and the process repeats.

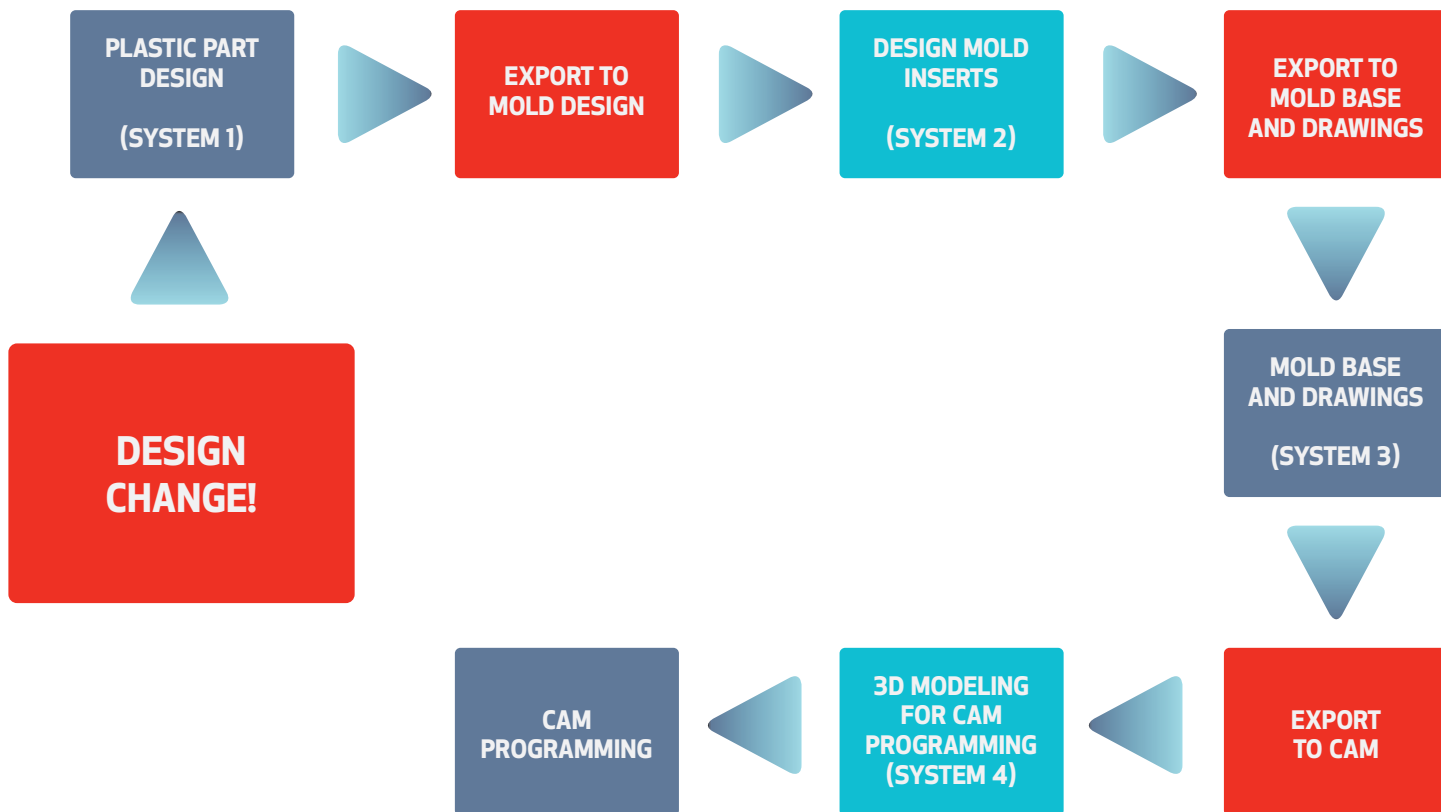
These types of problems often go undiscovered until after the creation of tooling and the start of production, resulting in costly scrap and rework. Plus, when an issue is detected, additional linear iterations between design and manufacturing are typically necessary to resolve an issue, and the resolutions they employ are sometimes reached as a matter of expediency—to avoid more iterations and busy work—rather than quality. In the case of molded parts, additional linear steps are required to create a prototype mold, mold base, and mold inserts. Again, any subsequent iterations needed to address mold performance—such as draft, fill, and parting line issues—require a lot of extra work to iterate between design and manufacturing. Even more disruptive are design changes or engineering change orders (ECOs) that emanate from product design, requiring manufacturing operations to start all over again.

The non-integrated approach to design through manufacturing has several disadvantages—the most critical being the increased potential for inaccuracy. Whenever you have to convert, translate, or import a file—moving from one data format to another—there are opportunities for error as well as a lack of documentation of design changes made for manufacturing reasons that never make their way back to product design.

Secondly, the lack of integration adds time at almost every step. CAM operators program tool paths after the fact and after unnecessary data conversion and translation steps. Addressing manufacturability issues late in the process adds time. Design changes and ECOs create lengthy delays because manufacturing programming has to be redone, and tolerance and dimension information has to be manually updated. In the case of mold development, unnecessary prototype mold iterations are often required to address performance issues.

Time is money, and all this wasted time adds cost to production and shrinks profit margins. High levels of scrap, rework, and tooling changes represent lost money. Working with non-integrated tools not only creates barriers to communication, it also adds training requirements and additional maintenance expenses.

As alluded to earlier, the non-integrated approach to design through manufacturing can also lead to a lack of healthy interaction between design and manufacturing personnel. The communications barrier raised by working in different systems creates separate organizational silos, each of which is protective of its own territory, and limits the power of collaboration and teamwork.



The non-integrated approach to design-through-manufacturing adds unnecessary time and costs related to communication barriers and iterations late in the process.

Non-integrated CAD/CAM workflow disadvantages:

- Data translations create barriers
- Data accuracy can be in jeopardy
- Concurrent design can be thwarted
- Time consuming
- Expensive to maintain and train

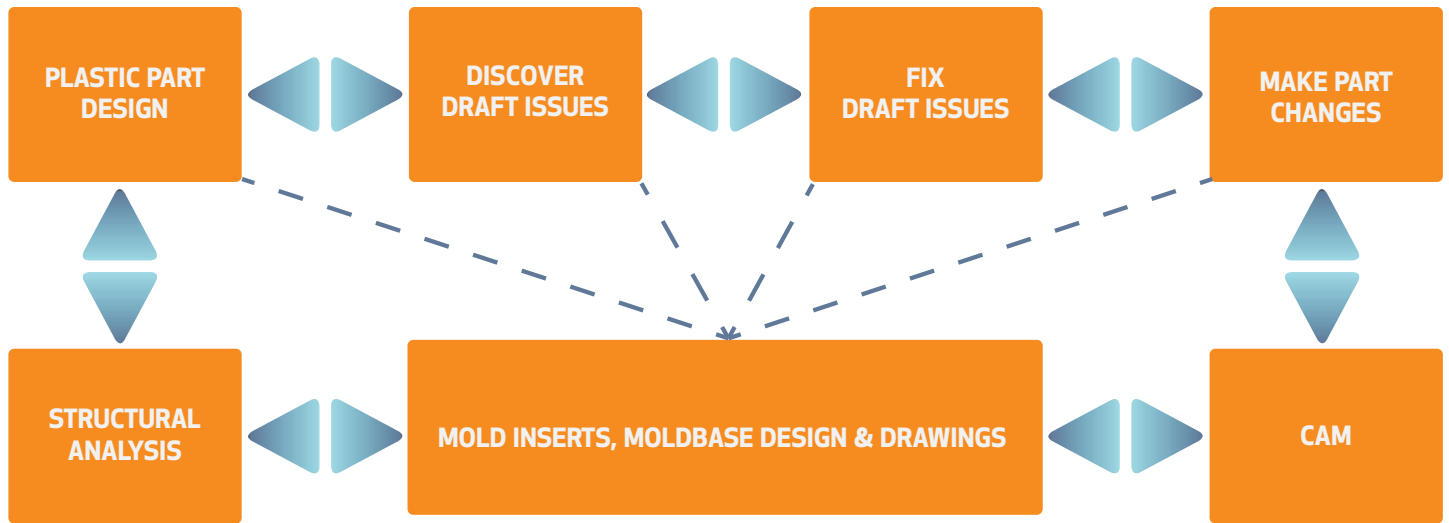
How does CAD/CAM integration improve the process?

By using an integrated CAD/CAM platform, what was once a linear, sequential workflow with a high probability of costly, time-consuming iterations at the back end becomes a concurrent, collaborative process with more efficient, timely, and cost-effective interactions occurring early in the sequence. The critical factor underlying this improved design through manufacturing workflow is the common data format and the valuable communication that it facilitates. An integrated CAD/CAM system provides one model supporting both design and manufacturing functions instead of having various file formats, numerous data translations/conversions, and different CAD and CAM models. To the CAM system, the CAD model becomes the sole geometry in play.

This single-model paradigm breaks down the communication barriers between design and manufacturing. Working with the same data is analogous to speaking the same language. With common tools in hand, design and manufacturing engineers can iterate during the development process, before tooling is created, costs are incurred, and scrap is produced. Iterations that once consumed time and held up production can now take place more quickly, as part of the development process itself, and without repetitive data manipulations.

Manufacturing personnel can create tool paths in parallel with design instead of after the fact, so production is prepared once a design is released. Because both design and manufacturing engineers work from the same solid model, all design changes and updates automatically propagate to all associated tool paths and drawings, transforming design changes and ECOs from arduous, time-consuming, and costly undertakings to simple steps toward improving the quality of the product and its manufacture.

This more streamlined, collaborative approach leverages the knowledge and experience of manufacturing professionals early in the process, when their input can make the most significant contribution by identifying and addressing potential cost and manufacturability issues. Iterating up front in a common virtual environment is faster, costs less, and produces better products. It also helps designers and manufacturing engineers work more closely together, better understand each other's perspective, and ultimately benefit from the professional growth that can inspire new ideas and innovation.



CAD/CAM integration enables a concurrent, collaborative approach to design through manufacturing, which improves communication and quality, and saves time and money.

Integrated CAD/CAM workflow advantages:

- Data translations are avoided
- Data accuracy is secured
- Concurrent design is promoted
- Far less time than export/import
- Less costly—less systems

THE BENEFITS OF INTEGRATED CAD/CAM

The concurrent, efficient workflow made possible by an integrated CAD/CAM platform can generate substantial productivity gains that shorten design-through manufacturing cycles, reduce production costs, and improve manufacturing and product quality. The specific benefits that save time, reduce costs, and improve quality are detailed below:

TIME

Improved quality – Working with a single model and data format—with no need to import, translate, or convert data—eliminates chances for error, maintains high levels of accuracy, and minimizes delays related to design errors.

Elimination of wasted effort – Accessing design data in a single data format is simple and straightforward, eliminating file conversions/translations and the need to update drawings and associated tool paths when changes are made.

Pre-production iterations – Resolving design for manufacturability issues prior to production is more efficient than after a design is released for production.

Enhanced collaboration – Working within the same 3D geometry environment facilitates collaboration between design and manufacturing personnel, accelerating the design to manufacturing transition.

Improved handling of design changes/ECOs – Propagating design changes to the CAD model automatically to all associated drawings and CAM data facilitates and speeds up the processing of design changes and ECOs.

More efficient production – Iterating on production planning as part of the development process—prior to production—results in more efficient throughput and fewer manufacturing issues.

Greater opportunity for automation – Working in an integrated CAD/CAM environment offers greater opportunities for automating design through manufacturing processes, such as leveraging design tables to drive multiple production configurations or Application Programming Interfaces (APIs) to automate particular functions.

COST

Faster design through manufacturing cycles – Accelerating design through manufacturing cycles saves time and money.

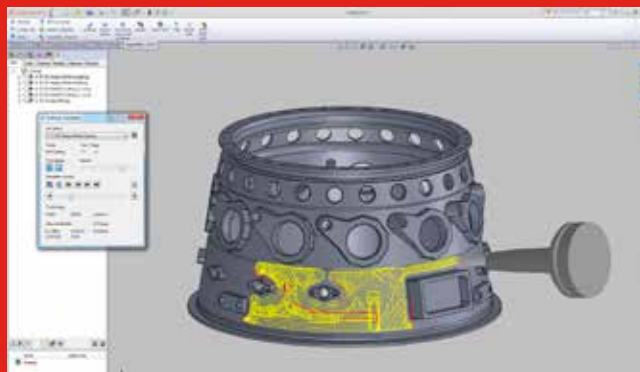
Early identification of cost-effective production techniques – Evaluating cost-effective production techniques and materials early in the process can result in significant cost savings.

Lower levels of scrap and rework – Resolving geometry, cost, and manufacturability issues up front leads to lower levels of scrap and rework, saving time and eliminating unnecessary costs.

Reduced training/maintenance costs – Working in an integrated CAD/CAM system consolidates training and maintenance requirements and associated costs.

A Case in Point

Growth through integration



hyperMILL for SOLIDWORKS – Multi-axis machining

5th Axis, Inc., is an engineering, prototyping, and automated production company that services the aerospace, semiconductor, electronics, and medical device industries. The company's specialty is producing hard parts of high complexity. Using the integrated SOLIDWORKS CAD and hyperMILL for SOLIDWORKS CAM solution, the company realizes a host of productivity benefits that has allowed it to increase its shop space, number of employees, and profitability. One example of how 5th Axis leverages CAD/CAM integration is the use of SOLIDWORKS sketches to drive tool paths. By making a simple sketch in SOLIDWORKS and programming a tool path to it, it's easier to remove burrs from previously machined parts.

QUALITY

More effective communication – Collaborating on the development of a product through more effective communication—rather than treating design and manufacturing as separate, sequential functions—can result in higher levels of quality and innovation.

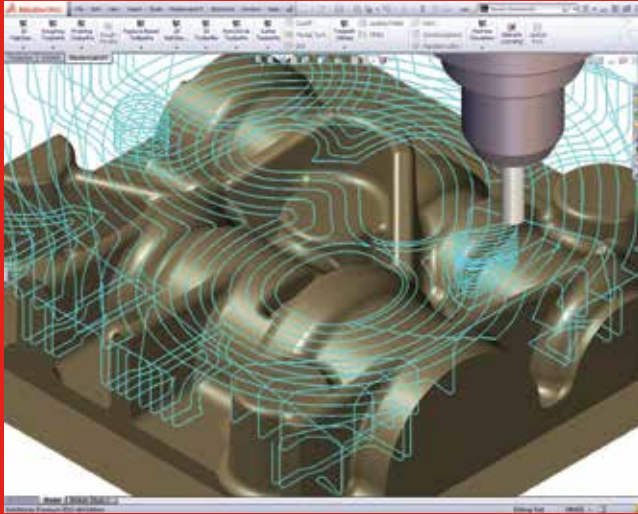
Improved accuracy – Operating on a single, common model and data format eliminates the potential for manual errors that can negatively affect quality.

Fewer machining issues – Iterating on manufacturability up front as part of product development minimizes the likelihood for machining issues once production starts.

Early pinpointing of mold problems – Identifying potential mold issues—such as not enough draft, insufficient wall thicknesses, inadequate mold fills, or parting-line problems—prior to production can increase the quality and effectiveness of molding operations.

A Case in Point

Paperless mold design and manufacturing



Mastercam for SOLIDWORKS – 3-axis milling

Because its manufacturing personnel can access the actual SOLIDWORKS model, interrogate dimensions, and begin machining almost immediately, Summit Tooling, Inc. has eliminated paper drawings from its mold design and manufacturing processes. That's one of the many traditional steps that the company has eliminated using the integrated SOLIDWORKS CAD and Mastercam for SOLIDWORKS CAM solution. With an integrated solution, Summit Tooling has realized a 50 percent boost in productivity over traditional machining methods. The new approach accelerates the handling of design changes, shortens lead times for customer delivery, and gives mold designers/moldmakers a greater degree of control over the final product.

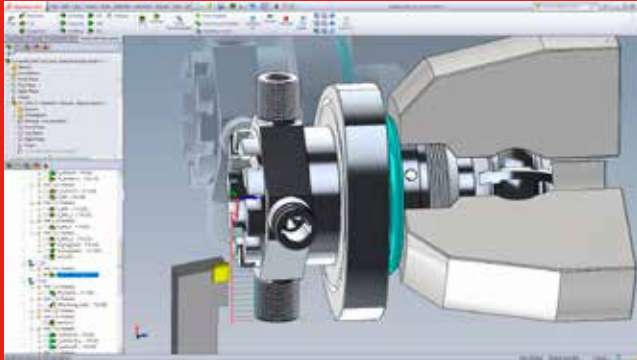
Integrate CAD/CAM with SOLIDWORKS CAM Partners

Dassault Systèmes SOLIDWORKS Corporation has teamed up with eight industry leading CAM partners to enable the possibility of eight fully integrated CAD/CAM solutions for SOLIDWORKS customers. Known as Certified Gold Partners, these CAM companies have created special versions of their products that actually run directly inside SOLIDWORKS CAD software, thereby allowing customers to design and create NC toolpaths in the same system. This relationship between SOLIDWORKS CAD and its partner CAM companies provides the broadest possible access to an integrated CAD/CAM solution. Even if you already use SOLIDWORKS CAD software alongside one of these eight CAM systems, you can realize many of the additional productivity-enhancing benefits that are outlined in this document with the latest version of the integrated CAM solution.

For example, design and manufacturing engineers can both take advantage of design, cost estimating, and design for manufacturability tools available in SOLIDWORKS design software to create product designs as well as manufacturing jigs, fixtures, and tooling. In addition, manufacturing engineers can configure tool paths for an entire family of parts; use sketching tools to drive tool paths; select the most cost-effective materials and manufacturing processes for each part; and assess the manufacturability and moldability of components. Most importantly, if a design change occurs during design, all the work done by the manufacturing engineer is preserved and updated—there is no need to export the new design and import it into the CAM software. Because of this improvement, design changes that come late in the product development cycle are more easily adopted by manufacturing, resulting in a better product that is delivered on time.

A Case in Point

Making changes a snap



SolidCAM – Mill-turn machining

Since implementing the integrated SOLIDWORKS CAD and SolidCAM CAM solution, Manufacturing Services Inc., has realized substantial productivity improvements, particularly when the company needs to make design changes to a part. Based in Lancaster, South Carolina, Manufacturing Services manufactures production-run parts, prototypes, and injection molds for its customers. Depending on the complexity of the part, the firm is saving anywhere from 15 to 60 percent of the time it would have taken using a non-integrated solution. Design changes, like changing a fillet or adding draft to a part, are much easier and faster to handle because Manufacturing Services can use SOLIDWORKS CAD software to tweak the model and then update the tool paths automatically.

Manufacturing engineers and estimators will also have access to SOLIDWORKS Costing, an automated, cost-estimating tool that provides automatic estimates of manufacturing costs for a particular part based on a manufacturer's specific manufacturing environment. Specific manufacturing data, such as material costs, labor costs, machine speeds and feeds, and setup costs, can be entered in a template and used to drive cost estimates on parts automatically. Manufacturing can share this information with design, so that while a designer is developing a product, he or she can automatically get a manufacturing estimate in seconds—with the click of a mouse—without ever leaving SOLIDWORKS CAD software.

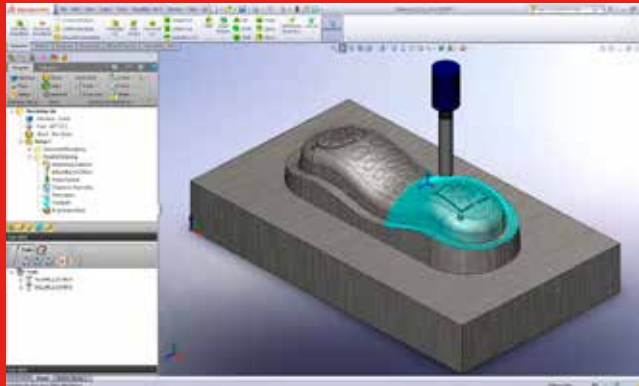
SOLIDWORKS CAD software also contains a range of design for manufacturability capabilities. You can check clearances and eliminate interferences. With the SOLIDWORKS DFMxpress tool, you can determine if there are design features that are either impossible or expensive to manufacture. You can also evaluate draft, undercut, and wall thickness issues for molded, cast, and forged parts and tooling. With the addition of SOLIDWORKS Plastics software, you can even simulate and optimize injection-molding operations.

Complete CAD/CAM integration opens up a new world of possibilities for streamlining the design through manufacturing process. Fully integrated CAD/CAM solutions for SOLIDWORKS include:

- BobCAM for SOLIDWORKS: BobCAD-CAM, Inc.
- CAMWorks: Geometric Technologies
- hyperMILL for SOLIDWORKS: Open Mind Technologies AG
- Mastercam for SOLIDWORKS: CNC Software, Inc.
- VisualMILL for SOLIDWORKS: MecSoft Corporation
- SolidCAM: SolidCAM Ltd.

A Case in Point

Developing a replacement part for a vintage car



VisualMILL for SOLIDWORKS – 3-axis mold machining

McKim Design & Fabrication leverages the integrated SOLIDWORKS CAD and VisualMILL for SOLIDWORKS CAM solution to achieve 25 to 40 percent timesavings and take on unique projects. For example, the owner of a 1949 Ford convertible could not find replacements for the fold-down top's two broken hinges. So, he turned to McKim Design & Fabrication to make one. Using SOLIDWORKS CAD capabilities, the Houston-based company created a solid model and rapid prototype of the broken hinge, and then designed the flat-plate fixture needed to water cut the part. Because McKim uses an integrated CAD/CAM solution, modeling the part, producing a rapid prototype, developing the fixture, and machining the part was quick and painless.

Boost productivity, control costs, and improve quality with SOLIDWORKS integrated CAM solutions

Streamlining the design through manufacturing process using an integrated CAD/CAM solution represents the next big advance in product development. To compete successfully, all manufacturers need to generate higher levels of innovation, efficiency, and productivity. Breaking down the communication barrier between design and manufacturing engineers creates the opportunity for effective, efficient cooperation and collaboration. A completely integrated CAD/CAM solution—where the CAD system serves as the geometry engine and all CAM operations function off the original CAD model—can serve as the enabling platform for boosting productivity, controlling costs, and improving quality.

With eight different integrated CAM partners to choose from, Dassault Systèmes SOLIDWORKS Corporation offers the broadest, deepest set of options for integrating SOLIDWORKS CAD software with a leading CAM system. This integration both eliminates repetitive time-consuming tasks and opens new avenues of efficiency, cost containment, and quality control.

To learn more about how SOLIDWORKS CAM Partner solutions can help you integrate CAD and CAM technologies to produce better products more efficiently and cost-effectively, visit <http://www.SOLIDWORKS.com/sw/resources/videos/cad-cam-slam.htm>, or call **1 800 693 9000** or **1 781 810 5011**.

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