

15 CAM Initiatives

For Sustainable Machining Business Effectiveness

How to take advantage of evolving Mastercam CAM software capabilities to become progressively more effective in your manufacturing business niche

It's a story I have heard over and over again. There are two shops in the same market with similar equipment, software and customers. One shop is struggling to get enough work and maintain healthy profit margins. The shop's management is convinced that a competitor is undercutting them with ridiculously low pricing that will ultimately cause both businesses to suffer. But if you visit the other shop, you will discover that the business is thriving. Truth is, the first shop is not being underbid, it's being out-machined.

Jimmy Wakeford, Owner, Barefoot CNC



Don't Be Outmachined: According to Jimmy Wakeford, CEO of Barefoot CNC, (Mastercam reseller for the Carolinas) many shop managers think they are being underbid by competitors when they are actually being outmachined because the shop is not taking advantage of the latest technology. Mr. Wakeford (right) is shown here consulting with Jerry Soots, CEO of Gray Manufacturing Technologies (Denver, North Carolina), an aerospace start-up that relies heavily on five-axis CNC equipment.

Overview... Getting better, faster, cheaper

Failing to improve quality, reduce lead times, and drive out costs are the surest ways for a manufacturing business to fall behind competitors and, ultimately, fail. Instead of focusing all of its energy, attention and resources on capturing and delivering the next order, successful manufacturing businesses find some time to learn about and implement measures that will make them better, faster and cheaper. Taking better advantage of their CAM resources is one way they go about moving forward with this never-ending objective.

CAM Initiatives are on-going programs (large or small) advocated and driven by top management who encourage manufacturing personnel in the shop to take the time necessary to investigate how they can use equipment and software they already own (or could easily acquire) to do their work more effectively. CAM Initiatives are sometimes formal, including a written policy with specific goals and objectives and frequent reviews to make sure progress is being made and results obtained. More often, CAM Initiatives are simple ad hoc efforts to solve some problem or do some frequently-repeated task more efficiently. These efforts take place because ownership and management appreciate and encourage them. This white paper reviews 15 CAM Initiatives that have been undertaken by some Mastercam shops to become more competitive and to achieve greater quality and productivity while using less manpower and equipment resources.

1. Say no to drawings.

Some shops spend hundreds of hours annually redrawing parts that have been submitted to them as PDF or paper drawings. Where did these PDFs come from? Most of these drawings were generated based on models resident in their customers' CAD systems. When shops make a point of consistently and politely asking the customer for the CAD file, the savings resulting from elimination of hours spent duplicating the model can be tens of thousands of dollars.

2. Educate everyone up to his or her potential.

We know a shop that finds a way to say yes to nearly every request employees make to get additional training. It funds or partially funds a variety of CAM learning experiences, including:

- Formal courses at universities and community colleges
- Training provided by Mastercam resellers
- Online learning opportunities offered by such sources as Streaming Teacher, eapprentice.net and Mastercam University
- Mentoring arrangements where employees teach each other
- Strategically using the help of programming consultants who provide training along with writing critical Mastercam programs

The more people you have who are conversant with CAM, the better, even if they never become programmers. On the other hand, programming talent is very hard to come by. Some who are given the opportunity to learn CAM will discover they have a talent that will allow them to earn a better living while helping to sustain your business into the future.

The U.S. Army wants every soldier to know how to use an M16 rifle, even the cook and bottle washer. At A-Line, we want every employee to know how to operate a basic Haas mill or lathe, accompanied by a basic understanding and use of Mastercam. These are the essential tools of our business. With trained Mastercam programmers in each of our machining cells, we have the ability to respond quickly to our customers' needs.

Rob Muru, President, A-Line Precision Tool, Toronto, Canada

If your education initiative is working well, you might even consider training every CNC machinist on your staff to be a Mastercam programmer also. Some would argue that this expansive attitude toward having multiple CAM users is costly in terms of additional CAM seats and computer hardware. There are, however, costs associated with having only one or two proficient programmers in a company. These include:

- Chronic overtime to meet programming work load.
- Delayed first-piece manufacturing and the costs of playing catch-up.
- Cost of not having enough trained programmers when the primary programmers are on vacation, sick or leave to take another job.
- Cost of underused equipment when programming resources are not sufficient to keep pace with equipment available to perform work already in the queue.

We have 40+ CNC spindles, lathes up to 5-axis, CNC mills up to 5-axis, and our entire EDM department; everything is programmed with Mastercam. We have no specialists either. Only toolmakers. And every toolmaker in the company uses and aspires to be 100 percent fluid in Mastercam. We have 18 seats. It's the lifeblood of the company.

Bob Bechtold, President, HARBEC Inc., Ontario, NY

3. Integrate CAM with safety initiatives.

Manufacturers do not usually equate CAM optimization with safety but there is an important

connection that cuts both ways. Generating toolpaths to thoroughly deburr parts on-machine eliminates costly secondary operations while minimizing the opportunity for someone cutting a finger, or for a sharp edge cutting a strap during shipment, or for customers returning parts due to excessive burrs. What's more, the fewer times that workers have to move or reposition parts because setups are not right the first time or inspections can be performed on-machine instead of at a CMM, the less potential there is for accidents. So making CAM a safety consideration turns out to be a double win.

4. Fix what isn't broken

Just because the engineers and programmers have found a good way to manufacture parts does not mean that there may not be an even better way to do it. "If it ain't broke, don't fix it" is an antiquated idea that costs many shops big dollars. There can be gold in refining manufacturing processes that were good enough just a couple years ago but that can be greatly improved based on current CAM capabilities. A number of shops have realized the enormity of this opportunity and have made some of their staff process improvement specialists whose primary job is to develop ultra-efficient processes both for existing programs as well as new work that is being quoted. One shop that has adopted this process has realized productivity improvements up to 30 percent for manufacturing processes revisited in this manner.

Some manufacturers, particularly in the aerospace and medical markets, are reluctant to improve their processes in this manner because of the "red tape" involved in requesting and certifying new procedures. However, their OEM customers with understandably strict process certification requirements are also looking to their vendors to reduce costs every year. Process improvements generated via advanced CAM strategies are one of the best ways to satisfy these expectations.

5. Become familiar with game-changing dynamic machining.

A number of the suggested CAM strategies to follow involve application of advanced dynamic machining strategies made possible by the new “material aware toolpaths” that have been introduced with the last several versions of Mastercam. Here are some of the benefits that may be obtained when Mastercam users identify applications in which dynamic machining strategies can be applied:

- Optimizing cutter performance by dynamically controlled feeds, speeds and rules of engagement in conformance with the cutters unique characteristics.
- Lateral force reduction: The material condition where toolpaths self-adjust to eliminate excessive force on thin walls that might bend and push them in the path of the cutter on the other side.
- No broken cutters because the toolpath algorithms won't allow the tool to be buried.
- More secure holding of parts with difficult shapes because the tool won't apply excessive force and snap the part out of the vise or holding fixture.

6. Run lights out.

Running lights out allows you to amortize the cost of sophisticated equipment over many more spindle hours per day. By using material-aware dynamic toolpaths with improved reliability features and incorporating in process inspection with spindle probes and automated off-set corrections, shops can achieve unattended machining success rates approaching 100 percent. There are even small “garage shops” that are nearly doubling their productivity by running CNC equipment at high speeds on a lights out basis. This allows them to compete with shops that have more manpower. Considering the cost and durability of today's advanced CNC equipment, it only makes sense to use them as often as possible. This, of course, makes it essential to have

programs that you can run unattended with complete confidence. This confidence factor is addressed by the exceptional reliability of Mastercam's dynamic machining strategies and reliance on one or more of its simulation capabilities to detect potential material removal problems or interferences before the program arrives on the shop floor.

7. Increase feeds and speeds.

Learn to use reliable dynamic toolpaths along with simulation so that you can confidently run your machines at the highest possible cycles without stressing tools and equipment or damaging parts. Dynamic toolpaths do not cut blindly but are "aware" of the condition of the material during every stage of machining. They use this intelligence to automatically adjust feeds and speeds to avoid burying the tool. Cutting is done at high speeds at shallow radial cuts using as much of the tool's flute length as possible. This approach minimizes tool wear and stresses on the part while, in many cases, dramatically reducing cycle times.

Mastercam's Dynamic Machining features allow us to produce very hard, precision landing gear component parts at high throughputs, while minimizing tool wear and dramatically reducing programming time. It is something I could not have imagined five years ago. It's an entirely new way of machining.

Dal Rogers, Owner, V&M Precision Machining and Grinding

When a shop improves machining productivity by 25 percent, not only are deliveries shortened but the need to purchase additional expensive CNC equipment may be postponed.

We took a high production aluminum part that was typically running at 22 inches per minute and used high speed machining techniques to adjust feeds and speeds upwards, but within safe limits. The part was taking three hours to complete before the adjustments, but only 45 minutes after them. Based on these results, the company changed its policy on feeds and speeds, mandating that all production work would be produced at the highest reasonable throughputs.

Ron Branch, Consultant, 5th Axis Programming

8. Combat the curse of tool wear.

Prematurely worn tools cost a lot of money. They impede productivity by compelling frequent tool changes. They can hurt quality when tool wear impacts accuracy and finish. Vendors to CNC manufacturing companies are well aware of this problem and have been making concerted efforts to reduce tool wear.

Mastercam gives me the exceptional control over the toolpaths that I need to manufacture the components used in my designs, and I don't have to be a CNC coder to use them. Dynamic milling lets me aggressively rough out parts without having to worry about breaking tools. Mastercam's simulation feature allows me to visualize what is going to happen on the machine so I can be sure my

manufacturing process will be safe and effective.

Richard Douglas, Chief Technologist, Douglas Fluid and Integration Technology



Better Manufacturing Process Control: Richard Douglas, chief technologist of Douglas Fluid & Integration Technology, LLC (Prosperity, South Carolina) relies on his background with materials and processes in the semiconductor industry to devise bench-ready device solutions for fuel cells, alternative fuel processing and process testing. He said "Mastercam gives me exceptional control over the toolpaths I need to manufacture the components for my designs, and I don't have to be a CNC coder to use them."

For example, Dynamic Toolpaths in the last few releases of Mastercam use higher speeds, minimal stepovers and full flute engagement to dramatically minimize wear. In the latest version (Mastercam X7) a new 3D oscillating toolpath spreads the wear over large tool areas during trimming operations.

9. Manage tool libraries.

Another way to machine faster is to invest in tools that have been designed to take advantage of high-speed toolpaths. Some of the new coated tools are much longer lasting because they allow

better heat transfer and have superior lubricity. Manifold improvements in cutter life and productivity have been seen with these tools, particularly when used in combination with Mastercam toolpaths optimized for the specific cutters. Powerful tool libraries within Mastercam allow programmers to develop a history of tools, usage, and their cost relative to machine productivity. This ongoing data collection grows deeper over time and becomes a competitive advantage for the shop using it. The latest version of Mastercam takes direct aim at optimizing this aspect of machining performance by significantly improving the Tool Library feature and making it stand-alone so that it can be used independently by toolroom managers and others concerned with optimal tool utilization and reducing tool cost.

10. Embrace complexity with 5-axis machining, and have a launch plan.

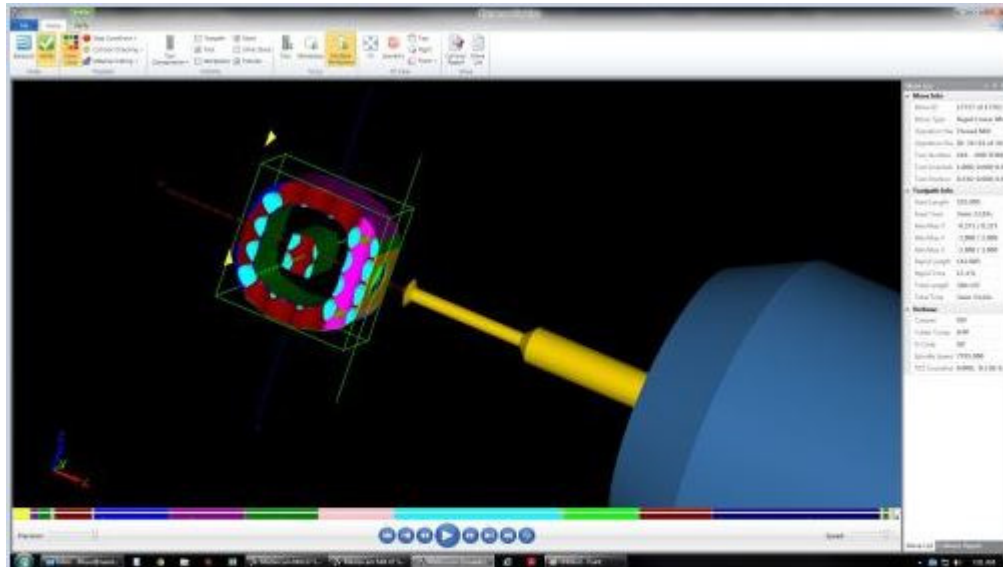
Many CAM initiatives look at ways advanced technologies can be used to broaden the company's market space. Most of the work that has migrated overseas has involved simple parts that can be readily manufactured with manual equipment in countries where labor costs are low. Becoming conversant with 5-axis and multi-tasking CNC and CAM technology allows many good manufacturers to stay in the game by taking on parts of increasing geometric complexity and manufacturing them on a single setup basis. These same manufacturers are able to use their experience, knowledge base, and advanced manufacturing systems to capture programs in new markets when their traditional customer base has suffered a downturn or been eroded by offshore competition. They are in a stronger position because they are no longer dependent on a single market for their business opportunities. Although multi-axis makes it possible to capture complex work and manufacture it productively, the cost of multi-axis downtime is significantly greater than with conventional equipment. One of the worst things that can happen is to install sophisticated equipment without having a launch plan for its use. Such a plan might include:

- Machine-specific training in multiaxis Mastercam programming.
- Training in critical controller and postprocessor issues.
- Development of a post-processor that resolves controller issues and facilitates “post-and-go” operation.
- Development of a Mastercam program for one of the company's most representative part families.
- Development of a tested manufacturing process, including workholding solutions for this and similar parts.
- Securing of application-specific instructional materials including videos that can be used by programmers and operators in early phases of equipment use to shorten the learning curve.

11. Create confidence--simulate, simulate, simulate.

With multi-axis machining, particularly 5-axis, a great many tool movements are occurring simultaneously in multiple locations. In this case it is absolutely necessary to protect your equipment and expensive part by thoroughly simulating the manufacturing process. However, many 3-axis mill and turning users can also find accurate simulation to be advantageous.

This routine compares STL data taken from Mastercam's model of the final machined part directly with the SolidWorks model. It is very much like inspecting the finished part before it has been manufactured. I compare 100% of the parts I program with the SolidWorks model. I can look at this comparison and know instantly if I have it right or wrong within 0.0001 of an inch. This is hands down my most beneficial tool in the software.



Simulation Builds Confidence: Nexxt Spine LLC, (Noblesville, Indiana) routinely compares STL data taken from Mastercam's model of the final machined part directly with the SolidWorks model. It is very much like inspecting the finished part before it has been manufactured.

There are many levels of simulation available to Mastercam users.

- Mastercam's traditional Backplot and Verify combined in the latest version to simulate tool movement and appropriate material removal.
- STL Compare allows the programmer to directly compare the Mastercam-generated STL file with the actual CAD model of the part.
- Simulation of movement including tool, tool-holder and spindle.
- Full machine modeling and simulation within Mastercam.
- Third party simulation software that incorporates kinematics for exceptionally accurate determination of potential interferences.

Making greater and better use of simulation may be just what is needed to improve confidence in your CAM programs so that you can move forward with a number of the advanced machining

strategies outlined here.

Mastercam seamlessly imports files from CATIA, SolidWorks, and other CAD software. Once the program is generated, the resulting output can be exported as an STL file that can be compared directly to the model to detect insufficient or excessive material removal or unwanted conditions such as thin wall deflections or burring. This level of verification along with simulation of material removal and interferences are sufficient to safely manufacture high precision components on conventional CNC equipment.

Brad Harris, Shop Manager, Stewart-Haas Racing

12. Maximize 5-axis ROI with 3+2 machining.

To make the most of good 5-axis equipment you have to keep it in constant motion making parts. If shops reserved 5-axis equipment for only simultaneous 5-axis machining, few would be able to keep the machine productive on a full-time basis. Many shops get the most of the value out of the 5-axis equipment using it to do 3-axis machining on parts that previously required multiple machine set-ups. This 3 + 2 machining on 5-axis equipment allows many different 3-axis operations in multiple planes with just one setup. In many cases 3 + 2 is reason enough to purchase 5-axis equipment. Shops that have not looked into 3 + 2 would do well to consider making in an initiative to develop this proficiency.

13. Learn how to make and use templates.

By simply creating templates and keeping them close at hand it is often possible to improve

programming productivity many times over. Templates are an easy way for programmers to share techniques that result in safer and more efficient manufacturing operations. Expanding the use affords a venue for standardizing manufacturing strategies to minimize errors and greatly improve machining productivity. Many of the fine-tuned toolpaths and other operations within these templates can significantly improve work cell productivity.

With the advances Mastercam has made in the last three or four iterations of their product and the dynamic toolpath training we have received from our Mastercam reseller, productivity in the shop has skyrocketed. I am programming faster. I have templates set up for each of the mold plates and a template for the electrodes. I merge my geometry from SolidWorks into Mastercam -- I'm picking lines, picking surfaces, right from my default file and programming faster than I ever thought possible. Electrodes that used to take me a half an hour or so, I am now programming in minutes.

Eddie Higginbotham, Manufacturing Engineer, ASH Industries

14. Take advantage of your spindle probes.

Most new CNC machines purchased today are equipped with spindle probes but few of these are being used effectively, if at all. Some manufacturers are reluctant to use spindle probes because they believe that expensive CNC equipment should not be used for measuring parts. The reality is that when parts have to be brought to a CMM for in-process inspection, far more valuable time is expended transporting the part, waiting for the inspection, transporting the part

back to the machine and setting it up again. Probing during setup allows for a faster and more accurate orientation of the part with more precise tool offsets. During manufacturing, spindle probe data delivered directly to the inspection software may be used to generate reports just as if the part had been measured on a CMM. Until recently, programmers had to insert manually generated macros at appropriate intervals to incorporate probing into CNC programs. Now the Productivity Plus probing module in the latest version of Mastercam allow the programmers to create these probing functions from within Mastercam. Learning how to use this capability can improve quality with more immediate in-process gaging feedback, reduce inspection time and improve overall manufacturing productivity for many Mastercam users.

15. Deconstruct the latest Mastercam release.

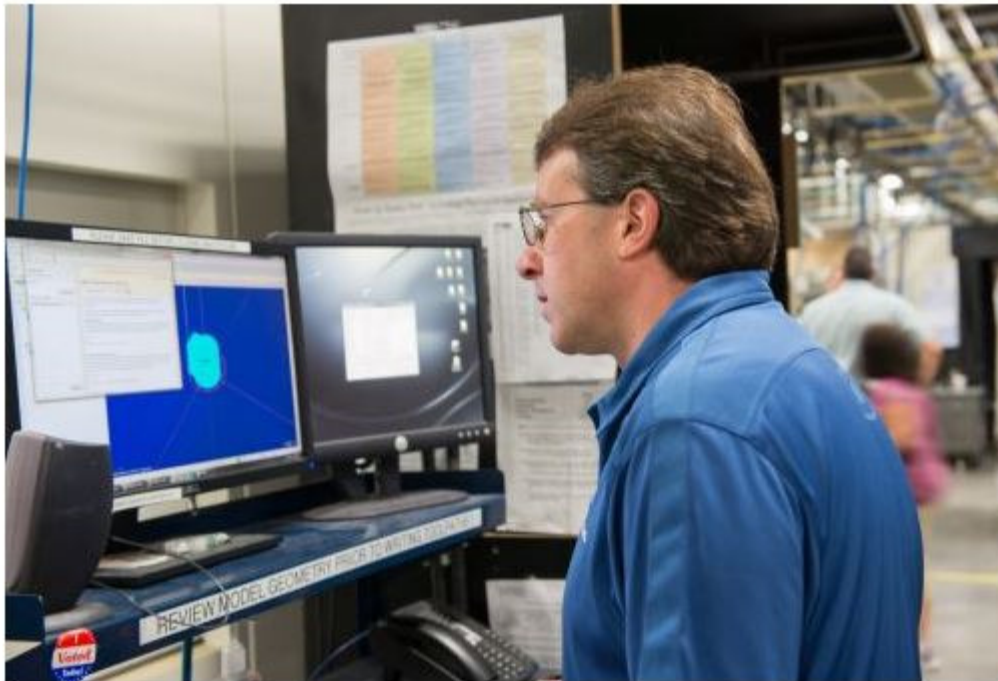
There are quite a few Mastercam users who can hardly wait to get the next release of software to see what's in it for them. Some are so eager, in fact, that they become beta users in order to be ahead of the curve when new features prove to be stable. There are many other ways to determine how the next release can help you achieve your most important lean manufacturing objectives.

- Attend a Mastercam new release seminar given by your reseller at their location or your shop to learn about new CAM features.
- Appoint a programming team member to deconstruct the latest version to see what would be most useful.
- Or make it a team initiative. Choose one or two features and implement them on selected projects.

Once the new strategies have been applied successfully on the test cases, roll them out for more general use. Invest some of the time savings generated in this manner to implement additional timesaving strategies.

We use Mastercam to program 3-, 4-, and 5-axis machining centers to grind sophisticated custom lenses using diamond-cutting tools. Mastercam's continuous development of features that support our requirements for precision and productivity have allowed us to support growth with only minimal increases in manpower to operate and program our increasingly advanced CNC equipment. Working through our local reseller, Mastercam meets our everyday needs for support and provides us with upgrades that address critical issues.

Al Gould, Director of Research and Development, Optimax, Ontario, NY



Grinding Optical Lenses on CNC Machines: "We use Mastercam to program three-, four- and five-axis machining centers to grind sophisticated custom lenses using diamond-cutting tools. Mastercam's continuous development of features that support our requirements for precision and productivity have allowed us to support growth with only minimal increases in manpower to operate and program our increasingly advanced CNC equipment."—Al Gould, Director of Research and Development, Optimax, Ontario, New York.

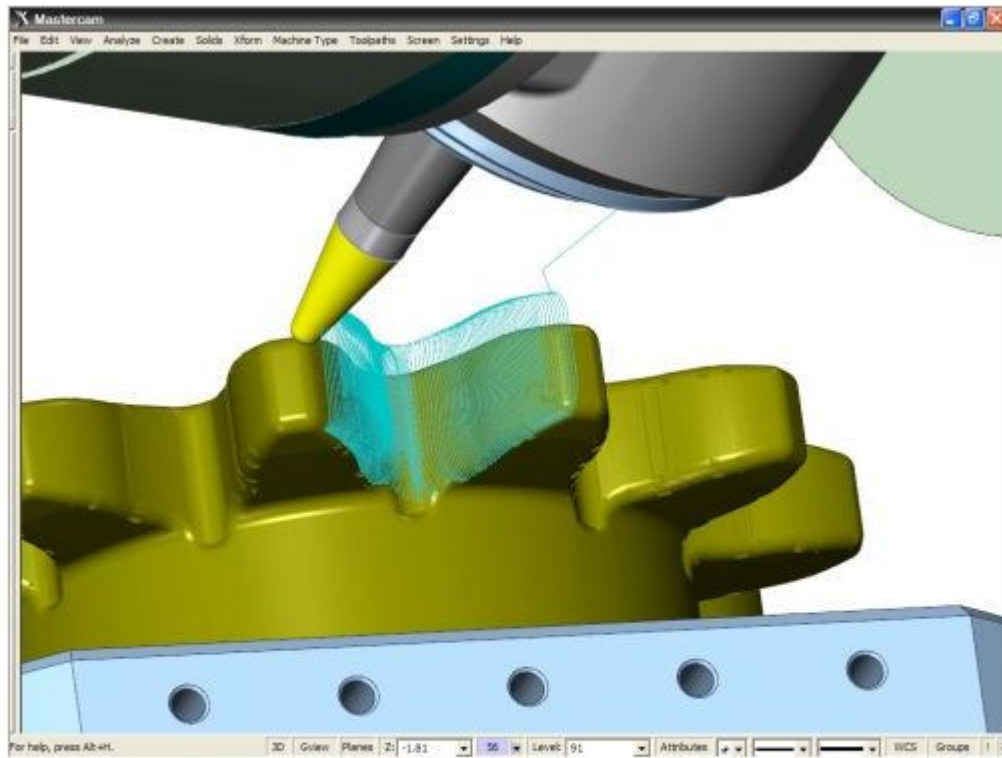
Final Word

Enlist your Mastercam reseller

CNC manufacturers need to encourage CAM Initiatives so that they can make the most of the technology and software they have purchased. We can't say which, if any, of the CAM Initiatives mentioned here would be the best one to tackle first at a given shop, but there is someone who can — your Mastercam Reseller. They are eager to work with customers to develop initiatives insuring that your investment in Mastercam (money already spent) provides your shop with exceptional benefits. Because of their years of experience observing how things are done in many different shops and industries, they are in a unique position to recommend equipment, best practices and innovations that can make a CNC manufacturing business more productive and competitive. A shop may have some specific area of improvement in mind, but that is not always necessary. Simply ask the general question: "What can we do to improve our productivity using our CAM system?" Chances are, the answer will include some very specific and far more detailed versions of the initiatives outlined here.

Mastercam gives us the flexibility to turn around the part and get it out to the customer as quickly as possible. It has been a pleasure to see the software progress. Mastercam is constantly tweaking and upgrading the product to fit the programmers' and the machinists' needs. We have had good support from our reseller. They are close by and they have been able give us training in-plant and at their facility, so we can take full advantage of everything Mastercam has to offer.

Aaron Bruning, Production Operations Manager, Snyder Industries



Five-Axis Gear Simulation: Heavy equipment part designs are typically delivered to Snyder Industries (Tonawanda, New York) as prints. One of the first things the company does is model everything in Mastercam—not just the part, but also the pallet setup and the machine itself. Being able to view a complete simulation of the part being manufactured gives the programmers confidence that the part can be manufactured at high speeds without encountering any interference.

###