CNC MACHINING

volume 4
number 14
summer 2000

Success on the High Seas

CNC MACHINING

> volume 4 > number 14 > summer 2000

> C O N T E N T S

FEATURES

Transfer Lines to HMCs at Dana 6
Model Business Cuts the Real Thing 10
Success on the High Seas with Harken 14
Opening the Lines of Communication in CAD/CAM 28

INDUSTRYNEWS

Editorial: Survival of the Fittest 2
Gearing up for IMTS 2000 3
Trade Show Calendar 34

PRODUCTUPDATE

Mini Mill: Big Features in a Small Package 36
TL-15: Affordable Double-Ended Turning 37
eXtra Rapid Traverse Option Speeds Production 37

RACINGREPORT

PacWest Moves Up in Indy Lights 4
Haas Offshore Team Still Undefeated 4
Hendrick's Nadeau Showing Promise 5

EDUCATION

Hands-On Training at Penn State 32

THE MASTHEAD

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photo by Sharon Green
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in•no•va•tion n. 1. something new or different introduced

Innovation drives advancement. Without it, the world would be a boring place indeed. In this issue of *CNC Machining*, we hope to alleviate the boredom by introducing a few things that are new . . . and a few that are different.

America's Cup yacht racing is by no means new, but it is different . . . and it's far from boring. In fact, it's the ultimate sailing competition. For our cover story, we visited Wisconsin-based Harken, a company that manufactures hardware for sailboats, including the America's Cup boats. Founded by brothers Peter and Olaf Harken, the company revolutionized the sailing industry by using plastic ball bearings and roller bearings in their innovative sailboat fittings. Today, Harken gear is considered the best in the world.

In the world of consumer products, being the best often hinges on how a company's product looks and feels, rather than on how it works. When success depends on such subjective whimsy, it's a good idea to gauge the public's reaction to a new product before investing huge sums of money to make it. Our story on Contour Incorporated details how this Silicon Valley modelmaker helps companies prove out new products by machining accurate models of their latest innovations.

From the Silicon Valley we head north to Canada, where Dana Corporation's Heavy Axle Plant in Barrie, Ontario, has developed a new way to use Haas HMCs to increase production and flexibility. We'll show you how they did it.

You'll also find an informative piece from our friends at Pathtrace Engineering Systems about the problems associated with data transfer from CAD to CAM. They're solving compatibility issues by combining solid modeling with CAM systems in a single "intelligent" package.

On the education front, we visit Penn State for a look at their recently opened "Factory for Advanced Manufacturing Education." This innovative study environment includes all the elements of a real manufacturing facility, and provides students with an outstanding hands-on learning experience.

Be sure to see the Race Report for a complete update on the latest Haas racing sponsorships, and check out the New Products section and IMTS preview for a look at what's on the machine tool horizon.

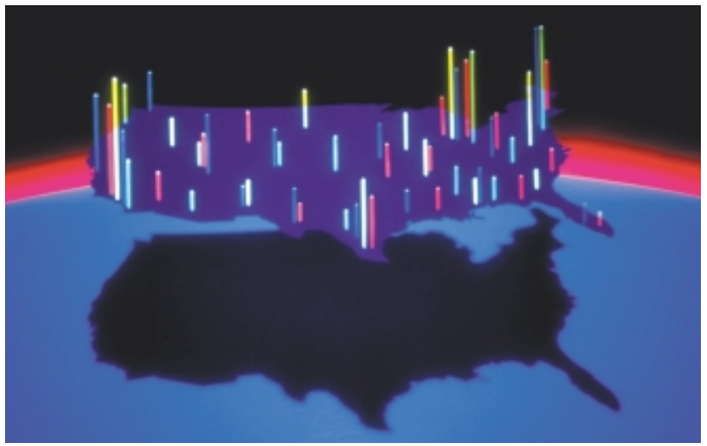
It's another packed issue, so sit back, relax and enjoy!

The stunning sailing photos gracing our cover, table of contents and main story are the work of Santa Barbara photographer Sharon Green. For 20 years, Sharon has traveled the world, capturing the defining moments of competitive sailing. The images in this issue are from this year's America's Cup and Louis Vuitton Cup challenge. To see more of Sharon's work, check out her website at www.ultimatesailing.com, or give her a call at 805-682-1175.

Survival of the Fittest:

Adapting to Change

Over the past six months, I have traveled around the country to attend the openings of a number of Haas Factory Outlets. I think I've logged more miles than the presidential candidates have this year. From the Northeast, to the Deep South, to Oregon, to places in between, I have had the pleasure of meeting many amazing people. I have seen uses for machine tools that prove that American ingenuity and the entrepreneurial spirit are alive and well.



In this magazine, you will read about some of the technology and innovation that continue to drive the U.S. economy. When I hear Bill Clinton take credit for the boom in the U.S. economy, I'm dubious. It ranks up there with Al Gore taking credit for inventing the Internet. The U.S. economy is booming despite our federal government and Alan Greenspan. We continue to grow because of the productivity gains made by the citizens of America. From the high technology of the Silicon Valley, to the new manufacturing methods at Dana's Barrie, Ontario, facility, the economy continues to grow – despite the lack of skilled employees.

Necessity is the mother of invention – never has this been more true. In Detroit, I saw CNC horizontal machines with slices taken out of their sheet metal to improve parts loading. In the Carolinas, I visited James Tool, a company that showed me a number of innovative ideas for making better parts and making them faster. From simple jobs to complex turnkey systems, they set up machines and design the fixtures to improve their customers' processes. In Indianapolis, a customer told me, "We are now beginning to use CNC machines to their fullest extent. We are making parts faster and holding better tolerances than ever before."

Everywhere I have visited, I have been greeted with evidence of how our industry adapts to new technology and continues to cope with the shortage of skilled operators. Through innovative methods, we have taken some of the labor out of the manufacturing process to compensate for the lack of available employees. Schools are beginning to realize just how important a skilled workforce is to this country's economic survival, and are bringing the latest technology and methods to the classroom. Such centers as Penn State's "Factory for Advanced Manufacturing Education" provide students with the hands-on experience they'll need when they enter the real world. Everyone I met at Penn State was excited about preparing today's engineers for the future. I was amazed at the facility they have put together to launch these new programs.

What's my point? I have never been so excited about the possibilities for the future of manufacturing in America. Through innovation, ingenuity and plain old necessity, we continue to improve productivity, bring new products to market and improve the quality of life for the world.

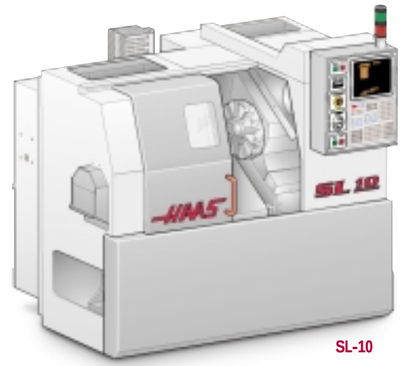
Haas Heads to Chicago for IMTS 2000

Every two years something really BIG happens in Chicago. No, it doesn't involve Duh Bulls or Duh Bears; in fact, it has nothing to do with sports whatsoever. It's an event that, despite its importance, probably doesn't even raise a blip on the radar of John Q. Public. But to the manufacturing world, it is huge – an event that portends the future.

On September 6, 2000, the International Manufacturing Technology Show (IMTS) descends upon Chicago's McCormick Place for an eight-day stretch of manufacturing excitement. This biennial show is the largest industrial trade show in North and South America, and one of the largest in the world. As such, it attracts exhibitors and attendees from around the globe. This year, more than 1,400 companies from 36 nations will exhibit the newest and finest machinery and equipment available on earth, in more than 1.4 million square feet of exhibition space.

Five-Axis Bar Machine

More than 100,000 attendees are expected to converge on this year's event in search of new ways to improve their processes, productivity, quality and precision. In one convenient location, they'll find all of the latest machine tools and products for the factory floor, as well as the next generation of cutting-edge computers, controls and manufacturing software.

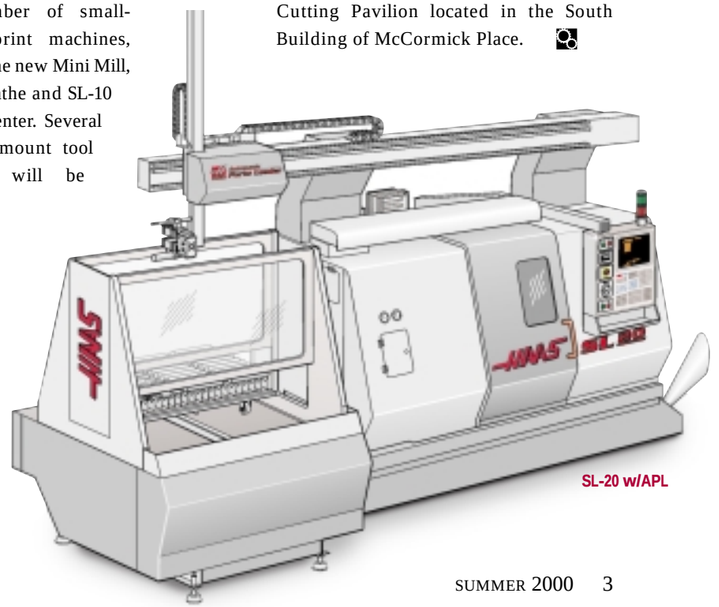


SL-10

As usual, Haas Automation will be at IMTS in force, filling its 10,000-square-foot booth with 30 of the company's latest CNC machines. Attendees can expect to see a full assortment of VMCs, HMCs, turning centers and rotary products, as well as several concept machines and a host of high-productivity options and features.

Among the machines on display in the Haas booth will be several prototypes, including a five-axis HMC with automatic bar feeder, a large-frame vertical turning center and a five-axis VMC with a trunnion-style table. Also expect to see a number of small-footprint machines, like the new Mini Mill, Mini Lathe and SL-10 turning center. Several new side-mount tool changers will be among the high-productivity options, including a 24-tool side-mount for small-frame VMCs (VF-0 through VF-2), a 40-tool side-mount for mid-size 40-taper VMCs and two serpentine-style side-mounts (available in both 60-tool and 122-tool configurations) for Haas HMCs.

There will be plenty more, as well, so make your reservations now to attend IMTS 2000. Haas Automation will be located in booth #8232 of the Metal Cutting Pavilion located in the South Building of McCormick Place.



SL-20 w/APL

> RACE REPORT

It's summer again, and the motorheads amongst us are turning their thoughts – and televisions – to racing. This year, Haas Automation's racing associates are taking the company logo into the winner's circle on both land and sea!

Take, for instance, PacWest Racing Group's new driver Scott Dixon. He's proven himself by winning the first two races in this year's Indy Lights competition. And "Big Mo" Gugelmin posted his first podium finish (2nd place) at the rescheduled running of the CART race at Nazareth, the best finish he's had in years.

The recent CART race at Belle Isle in Detroit found PPI Motorsports rookie Oriol Servià earning his first podium finish (3rd place) in the CART FedEx Champ Car series. His "tennis ball" yellow racer is beginning to jump from "rear-view mirror" status to that of a major front runner.

At sea, Bill Bowen (Haas Offshore Race Team) is still undefeated in his second year of offshore racing. As defending champion of his class (he took top honors in his rookie year) he and throttle-man Matt Grant recently slammed his 29-foot Warlock powerboat through the swells off Ventura, California (a mere 10 miles from Haas Automation headquarters), to take yet another class win.

Overall wins aside, Haas Automation's association with the racing fraternity illustrates the close relationship between precision driving and precision machining. This relationship is further strengthened when prospective clients have the opportunity to tour these racing facilities to see first-hand how Haas CNC machines are making the parts that win races.

Scott Dixon (above) powers out of the "Hairpin" during the Long Beach Grand Prix Indy Lights race. The PacWest charger currently leads in the points standings.

PacWest Racing Group

CART CHAMP CARS

Mauricio Gugelmin, as mentioned above, has shown major improvement over last year, and is starting to rack up some points in the championship race. Teammate Mark Blundell is in the points, as well – an important accomplishment, as points are only awarded to the first 13 finishers, and first place only earns 15 points. Break during the race or get out of pit-stop sequence, and you may as well not be in the race, because if you're out of the points, all you get is experience!

CART INDY LIGHTS

Scott Dixon, new driver for the PacWest Indy Lights team, served notice at Long Beach that he is a hot-shoe to contend with. Winning the first two races of the season, Dixon is on top of the standings and showing no signs of slowing down. Teammate Tony Renna is also on board with points, and showing a desire to finish one-two with Dixon.

PPI Motorsports

CART CHAMP CARS

Cristiano da Matta, who took over the Pioneer car (#97), and his new teammate Oriol Servià (#96), are making a name for PPI Motorsports as a pair of hard-charging drivers out to park their cars in the winner's circle. As noted above, Servià just got his first podium finish in Detroit, putting his Haas-stickered Reynard within sight of winning the race overall, as he was only nine seconds out of first place!

ATLANTIC SERIES

PPI drivers Andrew Bordin and Dan Wheldon posted an impressive 2-3 finish at the Canadian Grand Prix in Montreal to move them into the number one and two positions in the series championship. The two drivers head back to the United States separated by a mere two points, so expect some friendly rivalry for the remainder of the season.

SCORE OFF-ROAD

Larry Roeseler has joined legendary Off-Road racer Ivan "Ironman" Stewart as teammate for PPI's 2000 off-road campaign. The team has been out in the desert logging as many miles as possible on their new Toyota Tundra in preparation for the two 2,000-mile races they will run this year.

Hendrick Motorsports

WINSTON CUP SERIES

The Winston Cup championship title is up for grabs, as only four drivers have won two races this season. It's the top ten finishers that are racking up the point totals, and Jeff Gordon's #24 entry is languishing in 10th overall with two wins and nine top tens. Close on his heels is teammate Terry Labonte in his #5 Monte Carlo. Currently in 12th place overall, Labonte is still a frequent lap leader, but also the target of many an errant bumper!

Jerry Nadeau, the new team driver in car #25, is the up-and-coming favorite for the 2000 season. During the majority of the first 16 races, he has either been leading or running up front, only to fall victim to mechanical breakdowns, or the car-mangling antics of fellow competitors. Keep an eye on this car!

CRAFTSMAN TRUCK SERIES

Jack Sprague (#24), driver of the Chevrolet Silverado pickup entry from Hendrick Motorsports, is in a heated battle for the lead in the points standings. The competition is so close, the series is now known as the "Crashman" series. What's a little bent metal if you win the race?

C&C Motorsports

Dividing their driving chores among various race vehicles – SCRA Sprint Car circuit, NASCAR Winston West sedan racing and the SCORE off-road racing championships – Troy Cline and partner Joe Custer are presently focusing on their NASCAR entry, with the Haas name on the hood of their 600-hp sedan racer. While this is a developmental year for this effort, they are running against some well-equipped competition: every car in the series runs parts that have been machined on a Haas.

Jeff Gordon (#24), shown with teammate Jerry Nadeau, turned left *and right* to win the recent Sears Point race in Sonoma, Calif. This gives Gordon six road course wins in a row.

A Transfer of Duties

Haas HMCs supplement transfer lines for axle production

Story & Photos
Scott Rathburn

Anyone who has ever worked on a car or truck is probably familiar with the name Dana. Based in Toledo, Ohio, the company has supplied parts to motor vehicle and engine manufacturers since 1904.

Today, Dana Corporation is the third-largest independent supplier of automotive components in the world, producing original-equipment and aftermarket parts for – according to the company's 1999 annual report – "nearly every one of the world's 750 million vehicles on – or off – the road."

That's a lot of parts!

To manufacture those parts, Dana operates major facilities in 33 different countries. One such facility is the Heavy Axle plant in Barrie, Ontario, Canada.

Axles are Dana's largest core product, with the company's Spicer® Axle Group providing OEM parts to such companies as Ford, General Motors, International and Mack Truck, among others. The 200,000-square-foot Barrie facility produces about 750 axle housings per day for Class-5 through Class-8 heavy trucks. The finished housings are sent to Dana plants in the United States and Canada for assembly with gears and shipping to the final customer. In essence, the Barrie plant is an OEM within an OEM.

Established in 1979, the Barrie facility has historically employed dedicated transfer-line equipment to manufacture axle housings; it is equipment that was custom built for that purpose . . . and expensive.

The typical heavy axle housing consists of two pressed-steel halves, a pressed-steel back cover, a carrier flange, a set of brake flanges, a pair of spindles and an assortment of brackets. This assemblage of parts is welded together into a single package that then travels through the Barrie plant for additional machining processes. Among other things, these processes include drilling the brake flanges, cutting a keyway in each spindle and threading the spindle ends. These final operations have traditionally been performed on a seven-station transfer line (using multi-spindle drilling heads to drill all holes at once), and a spindle threading machine. Only in recent years have CNCs entered the picture.

"We are trying to replace some of our multi-spindles with CNCs," says John Robbins, Dana's process engineer, "because of the quality of the parts they produce."

Although the plant's seven-station transfer line produces an axle a lot faster than a CNC machine, some of the equipment has been in use for going on 25 years. Changeovers for a new axle model are time consuming and difficult, and any changes are very expensive.

The advantage of CNCs is that they are versatile. Changing a hole pattern for a new axle only requires building an inexpensive drill jig and reprogramming the machines. Plus, the CNCs are much newer machines, and they're more accurate.

In recent years, accuracy has become more of a concern for many OEM suppliers, including Dana. Today's vehicles, including heavy trucks, are being held to a much higher quality standard than ever before, and OEM components are expected to assemble faster, easier and more accurately in order to reduce labor time and cost per part.

When Dana's Barrie facility secured a contract to produce a new axle for Ford, the plant's existing transfer lines were already near capacity. The new axle not only put a strain on existing equipment, but called out tighter tolerances than some of the older machines could handle. "It had a unique brake flange pattern," explains Robbins, "and we were having trouble keeping up on the existing equipment, so we had to increase our volume somehow."

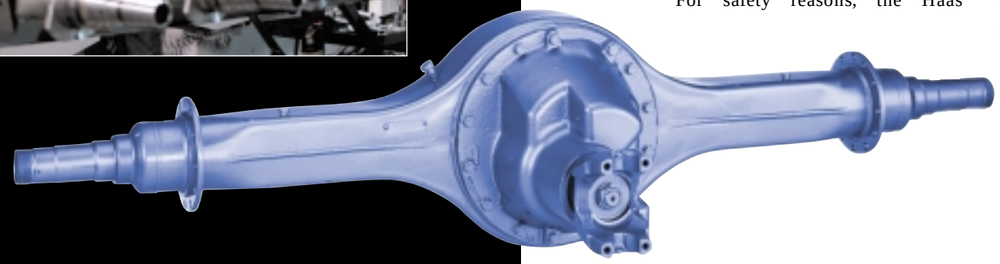
The decision was made to machine the Ford axle spindles and brake flanges on a horizontal machining center rather than the transfer line. The machining center would provide the extra capacity needed for the new axle, and could easily hold the tighter tolerances specified by Ford.

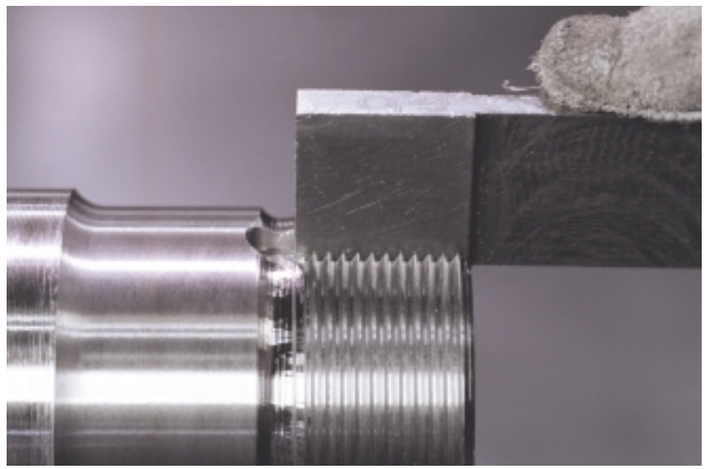
Working with Barrie Machine Tool (a turnkey group operated by the local

Haas Factory Outlet, a division of Sirco Machinery), Dana engineers determined that a Haas HS-1 horizontal machining center would do the job; but, according to Mike Hough, manager of Barrie Machine Tool, "The cycle time was horrendous. They were just going to go with one horizontal machining center and turn the axle around, essentially machining the part twice."

To reduce handling and increase throughput, Hough suggested buying two horizontals and putting a common fixture between them, rather than having to turn the axles around. Hough explains: "We would build a hydraulic fixture to hold the axle, and have that controlled by a programmable logic controller (PLC) that interfaces with the two Haas machines." The engineers at Dana agreed, and the end result was a turnkey system that machines both ends of the axle at the same time in a single setup.

The system consists of a pair of Haas HS-1 horizontal machining centers setup facing each other with a common fixture between them. The fixture is keyed to the tables of both machines, and the axle





housings are hydraulically clamped in position during machining. A PLC interfaces to both Haas machines and controls the fixture, so that the operator has one console to start the entire cycle.

For safety reasons, the Haas machines are slaves to the fixture, so that the machining cycle cannot start until all of the functions of the clamping fixture are met.

Axle housings are loaded manually into the "two-headed" Haas horizontal and locked into the hydraulic fixture. A Renishaw probe system on each machine then locates the centerline of the axle for the thread milling operation. Once the centerline has been determined, the two machines simultaneously drill the holes in both brake flanges, then cut a keyway in each spindle and finally mill the threads on both wheel ends. Total cycle time is four minutes and forty seconds per axle housing, including load time.

"The Haas machines allow us to have a separate line for the Ford axles," explains Robbins, "and we like that." He adds that the Ford line "now looks after itself, as opposed to having to schedule it into another piece of equipment."

"Once they had the first set of Haas machines in there working successfully," notes Hough, "they decided to put in a second set of Haas machines." This second set was originally slated for thread milling only, but after the success of the first Haas turnkey, the decision was made to build the second set the same way to perform all of the machining operations.

Unlike the seven-station transfer line, changeovers on the Haas machines are fast and easy. The common fixture is designed to accept any one of the axle housings that the plant produces.

Please see DANA page 34

It Feels Like the Real Thing . . .

Contour Corners the Silicon Valley Model Shop Market

Story & Photos
Preston Gratiot

What do you do when you want to check the ergonomic feel of a product that only exists on paper or in a 3D database? How do you show prospective investors how your new design works and that it will attract sales when all you have to show is an artist's rendering?

The answer to these common challenges is really quite simple. Take your ideas to a model shop like Contour Incorporated and let its team of expert modelmakers turn your dream concept into a colorful and tactile sales tool: one that you can hold in your hands or pass around the conference table for all to see and feel.

SILICON VALLEY DESIGN

Contour Inc. is a full-service model shop that specializes in developing prototype project studies into production-ready consumer items. Contour can even assist with package design by providing pre-production replications to ensure that the product and packaging hit the marketplace with a perfect fit.

An example of one of the many projects Contour is currently working on consists of a number of simple puzzle pieces representing the different chemical elements as listed on the periodic table of elements. Most of these are simple two-axis models, but an occasional bit of three-axis work is thrown in when additional complexity is required. When completed, this "chemical symbol" library will allow students and professionals to design or illustrate chemical compound groupings by connecting the individual elements together, much like common puzzle pieces.

Because the professor developing this illustrative learning aid is blind, the model "elements" have been designed with raised portions on the top of each piece that allow them to be identified by feel. Contour is helping develop a book of these models that illustrates each of the different elements of the periodic table. The book is filled with pages indicating the elements by name in both Braille and in letters. Embossed representations of the elements as they are cast in "puzzle-piece" form are also included.

Contour also works on a large volume of study models for clients. These are typically form-study models that allow Contour's customers to see how the final product's surfaces will look and feel. Contour obtains an exceptional end finish on its models using a variety of materials such as Renshape*, ABS, acrylic, polycarbonate, aluminum, etc. These materials are conducive to making models easy to finish for pre-production photography. The creation of form-study models gives Contour's clients a head start on the marketing and advertising of their products.

**(Renshape is a registered trademark of Ciba Chemical Specialties Corporation)*

ADVANCED-SURFACE MODELS AND MULTI-AXIS MACHINING

Because the design trend has been towards more complex three-dimensional surfaces, most of the models that Contour currently produces require three-axis machining. According to Jim Baratono, Contour's model shop manager, "there is very little 'two-axis-only' work currently done at Contour. Contour uses state-of-the-art computers and software to generate the code necessary for three-axis machining. It also relies on powerful machining centers to cut three-axis models. Contour uses SolidWorks and Pro Engineer for design software, and SURFCAM as its primary machining software.

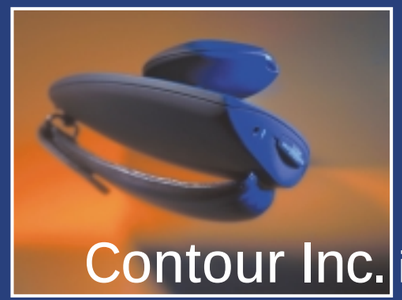
Much of the prototype work that Contour performs for its clients is in the early developmental stages, requiring Contour to prototype several different concepts for one product. Contour's customer then chooses which of the concepts they want to develop, and Contour continues to advance the prototype process with the client, all the way through engineering and initial molding.

Contour performs work for clients in many different industries, including computer, medical, airline, consumer products, automotive, manufacturing, engineering and industrial design.

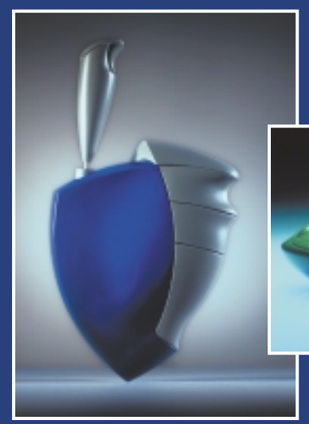
Contour's 4,000-square-foot, Haas-filled machine shop, above, is bright and expansive, providing the staff of six modelmakers with plenty of open space to perfect their designs.

Most design concepts are fashioned in some form of plastic, providing an easily workable, yet realistic, final product.

Silicon Valley design



Contour Inc. is a full-service conceptual model shop that specializes in developing prototype project studies *into* production-ready consumer items.



photos courtesy of Summit ID
photography by Rick French
415-546-6919

CONTOUR TEAM

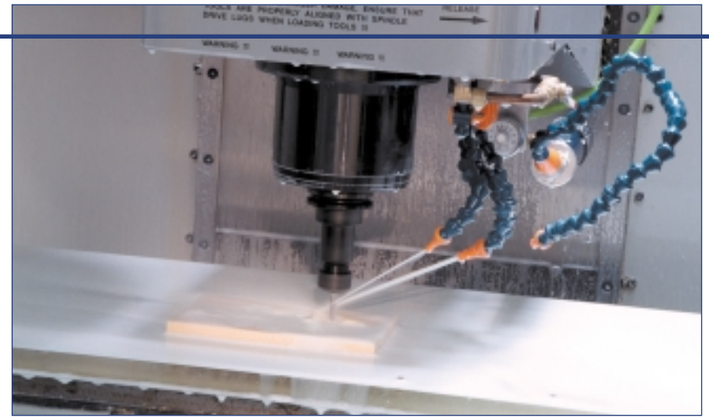
After working in product development for seven years, Jim Abendroth began Contour in January 1991. Abendroth holds the positions of president and CEO at Contour. Contour currently has about 25 employees. “The Company is staffed with people who have all worked together at some time in our past,” says Baratono. “The ‘Silicon Valley’ modelmakers are actually a close-knit group of about 30-50 specialized machinists. There are no traditional CNC operators at Contour. We are programmers who need to be versatile and ready to build whatever is necessary.”

In August of 2000, Contour will be moving from its Mountain View location to a 12,000-square-foot building in Sunnyvale, California. At this new location, the machine shop will cover approximately 4,000 square feet, with the remaining space allocated to molding, assembly, programming and general office space. Contour also operates a facility in Tempe, Arizona. At both its new location in Sunnyvale and its Tempe location, Contour will continue to provide high-quality, cutting-edge product to new and existing clientele.

ON THE SHOP FLOOR

There is a need for extremely fast turnaround of one or two days in the design industry. Contour is known for being able to meet the fast-paced deadlines of its clients. The faster Contour can cut the models, the quicker the model can be finished and delivered to the client. To enable it to meet its customers’ needs, Contour has six Haas machining centers at its California location, and another five machines in its Arizona facility. In California, Contour works four VF-3s and two VF-OEs. In Arizona, Contour has two VF-1s, one VF-0E, one VF-5 for larger projects and one SL-20 CNC lathe with a bar feeder.

Contour had been installing Haas machines at a pace of about one every six to eight months. With its current ratio of eleven full-time programmers to eleven machines at both of its facilities, Contour has achieved a nice balance for being able to meet the needs of its customers. The modelmakers at Contour are highly skilled and are able to perform programming, machining and finish work. In addition, Contour frequently uses multiple fixturing to optimize machine use, and sometimes runs the machining centers around the clock to meet customer deadlines.



MONEY & MANAGEMENT

Abendroth believes that the Haas machines deliver a great value for the investment. “We have looked at comparably equipped new machines for twice the money,” Abendroth says. “At Contour, we have found that it doesn’t pay to buy a used piece of equipment when we can buy a new Haas for either the same amount or slightly more.” According to Abendroth, “Used machines do not have all the latest features, specifically in high-speed machining, which Contour needs and which Haas provides.”

Baratono states that the controller is actually his favorite item. “It’s quick, it’s fast and we run everything DNC in here. We don’t do any manual programming. Everything is done in SURFCAM. I run everything off one computer using Extreme Multi-DNC. I need high feedrates, high code generation and good block throughput. This gives us a fast machine doing a lot of three-axis services. Since we’re doing almost everything in either plastics or aluminum, we need to be able to run efficiently, push lots of code and maintain good accuracy.

“These machines are accurate to within five tenths (.0005”), and better than that if set up properly,” says Baratono. “I’ve seen $200,000 machines running at 700-1200 inches per minute maintaining sharp corners. But then you have to realize that you could buy four Haas machines for that price, slow the feeds down slightly, do the same cutting with four spindles, and get a lot more production for your $200,000! That’s why we like the machines. We like the way they work. I can run at 200 inches per minute all day long and it just does everything I want it to do. I don’t know what Haas has planned for the future, but I hope they keep improving the speed of the machines, so we can push more blocks per second through the controller. It would also be nice if the high-speed machining (HSM) option were a standard item – we need it,” says Baratono.

PROTOTYPES TO PRODUCTION

Many of Contour’s projects involve the production of one-offs. Others may entail as many as five or six copies of a prototype. Contour does some short-run production, and plans to expand the volume of this business in the future. This would allow Contour to run overnight and nail the cycle times down. According to Abendroth, “There are plenty of model and machine shops that perform two-axis machining. At Contour, we specialize in doing models that are more complex and out of the ordinary. We enjoy the challenge of the three-axis machining, and find this work to be more rewarding.”

Contour, Inc.
650-969-6263

All Ye Who Sail, Harken These Words

Story and photos by
Scott Rathburn
unless otherwise noted

The America's Cup is considered the Holy Grail of international sailing competition. Its origin dates back to 1851, when a sleek, black schooner from New York crossed the Atlantic to challenge England's self-proclaimed supremacy in the world of yacht racing. Aptly named America, the schooner bested 16 English challengers in a race around the Isle of Wight to win a solid silver trophy known as the "One Hundred Guineas Cup."

In 1857, the owners of America donated that silver trophy to the New York Yacht Club, along with a Deed of Gift specifying "that it shall be preserved as a perpetual Challenge Cup for friendly competition between foreign countries." The trophy was dubbed the America's Cup in honor of the yacht that won it, and it has become the longest contested trophy in international sports.

For most of its long history, the America's Cup remained just that: America's Cup. For 132 years, boats flying the flag of the New York Yacht Club bested all challengers to successfully retain the trophy. It wasn't until 1983, when "Australia II" defeated NYYC's "Liberty," that the Cup found its way to foreign shores. America regained possession for a few years in 1987, then lost the Cup to New Zealand in 1995. The America's Cup currently resides at the Royal New Zealand Yacht Squadron in Auckland, New Zealand, following that country's successful defense on home seas against Italy's "Prada" challenger this past February.

Over the years, America's Cup racing has become one of the most prestigious and expensive sports in the world. Once primarily a battle between the United States and England, the Cup now draws challengers from many nations. This past Cup saw syndicates from Italy, Japan, France, Switzerland, Spain and Australia, in addition to five challengers from the U.S. and the defending team from New Zealand. It has truly become a world sport, and for those involved, it is serious business.

For Peter and Olaf Harken, the America's Cup is more than business, it's an opportunity to do some serious R&D. The brothers Harken are the men behind the company Harken, a Pewaukee, Wisconsin-based manufacturer of what is considered the best marine hardware in the world.

Harken first used the America's Cup for research and development in 1976. They had just developed their first high-load, big-boat blocks with thermoplastic bearings, something no one else had done, and the America's Cup provided the perfect opportunity to test the blocks in the real world.

"The America's Cup-type boats, with the day-to-day training and racing that they do for something like six months, put wear and tear on equipment that you just can't get anywhere else," explains Peter Harken. "There is no other racing venue that will put wear and tear on the equipment in that short of a time."

The other advantage to the America's Cup, Peter adds, is that the boats don't go out for several days at a time, they go out for several hours a day. "So if something breaks, or if something isn't strong enough, they come back in with it and we can attack it. It gives us immediate feedback, and we can take greater chances on making equipment that's closer in strength-to-weight ratio."

As with most racing, the mantra for the America's Cup is always lighter, stronger, faster. This applies not only to the boats themselves, but to the equipment, as well. Weight savings in one area, such as hardware, can be used to add weight in other areas for better performance. For Harken, that means constantly walking the fine line between strength, weight and failure.

For most of its products, Harken relies on outside vendors for machining and manufacturing. This approach has proven quite successful for the day-to-day operations; but when it comes to the America's Cup, reaction time is critical. "The demands are very high on us," says Peter. "Everybody wants everything instantly. That's custom-type work where we have to do it quick

"The America's Cup boats put **wear & tear** on equipment that you just can't get **anywhere** else."

Photo Courtesy Harken

and fast, and we have to be able to change quickly, get new stuff out in a hurry if that piece has failed."

For this reason, past Cups have been stressful events for Harken. "Every time we went into one, the whole company would shudder," says Peter. "The hard part was the hassle of getting parts done fast, and when we needed parts immediately, we'd have to go to other shops and beg to get them done. Lots of times they would come late; they wouldn't be on time when we needed them. Then you've got the customer yelling at you, and that's hard on the service people. It's a real strain."

After the 1995 America's Cup in New Zealand, Harken started bringing some of their processes in-house to better prepare for the next Cup in 2000. "We decided that we had to do a lot more of this kind of work ourselves," Peter says. "It's much easier in our own shop to say: 'Stop, get onto this right now.' You can do that, no matter what the situation is."

Harken had a few manual machines already, but needed more capacity to handle the expected workload. After careful consideration, they decided to purchase a Haas VF-3 vertical machining center to expand their machining capabilities.

"We looked at a lot of different machines," says Len Post, CNC machinist and programmer at Harken. "We wanted more than just a decent machine that was going to hold up; we wanted service. Service is important to us, as I believe it would be to any machine shop. The Haas was the best machine for the price, and the service is phenomenal. I've never seen better service – ever."

"A lot of the other machines were close in price to the Haas for the initial machine," adds Peter Harken, "but as soon as you wanted options, the other builders put what I call 'hose-job' prices on them. Haas did not do that at all. The prices were far less, regardless."

"But price was not the deciding factor," Peter says. "We also looked at local and national service, and the cost of repair parts. Haas was better than any other manufacturer, by far!

"Speed was another consideration," he says. "We could get into machines that were much faster and had shorter cycle times, but they were $30-$40,000 more, and we could only put two vices on them. The cycle time was too short for the operator to move on to

"These boats are POWERED by the HUMAN ENGINE. The HARDWARE is the critical link that transmits KNOWLEDGE between man and boat."

– Peter Harken

another job. He was stuck at that machine, basically, just to change parts and do a simple, quick secondary job like deburring or checking parts.

"We determined that the larger table of the VF-3 would allow us to use four big double-acting Kurt vices and mill eight parts in one cycle. The cycle time would be long enough that the operator could do something else. He could do secondary operations, he could go to another machine, set up tooling or just use his expertise elsewhere.

"We've proven that we get more production output from our manpower with a higher capacity machine that has a longer cycle time," Peter says. "This allows the operator to do another meaningful job, plus it takes the repetitive drudgery out of the work day. Our people are excellent, and we don't want them stuck on one machine all day long getting bored."

Kevin Monahan, Harken's manufacturing manager and former chief engineer of the custom department, says the VF-3 has given them a lot more control than in years past. "We have a better handle on the quality, a better handle on what we're going to make, and when. We can control our inventory, because we can make smaller batches. We can control our costs more accurately. It just gives us much more flexibility than if we went to a job shop and asked them to do the work for us."

Peter agreed, "It's made everybody's lives a lot less tense, because we can react fast. If I have to make just one piece, I can jump into the Haas. We can pull the production out of there if we need to, and just do it. We've learned how to get in and out of that machine fast, so we can do just a onesie or twosie in there and not disturb the production flow that much."

Harken still outsources much of their heavier production, Peter says, "because we're not a real full-blown production shop, as yet." He adds that they're doing more and more in-house, though, and one of the reasons is pricing. "People look at sailboat gear as high-priced stuff. Well, it is. And the only reason it is, compared to, say, other products in the hardware store, is because of numbers. The sailboat industry is a very small industry, in general. We don't produce in the hundreds of thousands; we can't get the economies of production. But yet, we can't just ask big prices.

"We have to learn how to do really short-run stuff efficiently, so we can sell at a price the public will pay. A lot of times with outsourcing, it's hard. Job shops are always looking for the big run, naturally. They like to set up a machine and let it run. So we're always in that kind of a battle. If I only need a hundred pieces, they'll do it, but the price will be up there," explains Peter.

"That's one of the reasons we're getting in our own machines. We don't want to spend the time on that kind of battling around; we just want to get at it. Whether it's one piece, or fifty, or a thousand, we can do it without justification, and it's just made life a hell of a lot easier."

Such small runs are common with the America's Cup gear, and the lead times are always short. "Frequently what happens is we'll get a call from a customer today, and he'll need a part as soon as we can get it," Kevin explains. "We'll get the order today, we'll design it tomorrow, we'll make it the following day and we'll ship it. If we had to send the work out, we'd be scrambling to find a shop that could meet that kind of lead time. With the Haas, we can do it, and a lot of people come back to us because we can give them that kind of service."

Having the machining capabilities in-house resulted in a very successful America's Cup for Harken in 2000. "We had far less hassles than we had last time (1995)," Peter remarks. "This was a very smooth Cup. There wasn't any strain on the people, and we were on time with probably 95 percent of the stuff. We were always on time with the critical things and got them to the teams. The end result was that all of the syndicates said we did a really good job. We had far more boats to handle this time than we ever have: we handled 17 boats. The most we ever handled in the past was four or five new boats, so it was a huge jump, yet it was ten times as smooth."

"We had gear on every boat," notes Kevin. "We had complete deck hardware packages on 11 of the boats, and we had blocks and travelers – everything except winches – on 16 of 17, and we had steering components on the 17th boat. You kind of hope for that kind of market share, but you never really expect to get it. It's kind of a two-edged sword, because once you get the orders, then you've got to produce the stuff, and that was the challenge. The Haas was always there for us, and we were able to produce the parts quickly."

Kevin adds that Haas CNC machines will continue to play a key role at Harken. "We're looking at every opportunity to bring more work in-house, and that means buying lots of new machines. We're looking to add another VF-3, and probably one of the new Haas Mini Mills, immediately."

Although the next America's Cup is three years away, Harken isn't sitting back and resting on their current success. They're already preparing for 2003, when New Zealand will again defend the title on home seas. "We will be back there in full force in August of 2002," says Peter, "and we are right now designing new gear. New boats will begin to appear by the end of next year, and we'll have to have new gear ready for trial. As they say in New Zealand, 'We're full on!'"

The America's Cup is a lot of work, but for Harken, it is worth the effort. "People ask why we do the America's Cup, put such a big effort into it," says Peter. "Do we do it for the glory and the PR and all that? No. It truly is our R&D. They always wonder, 'Is there a trickle-down effect to the Joe Public?' And we say, 'Big Time!' Every big-boat block and piece of big-boat gear that's in our catalog is a pure trickle down from our R&D in the America's Cup."

Harken Yacht Equipment
262-691-3320

Sweet Addiction

As a student at the University of Wisconsin, young Peter Harken had to work hard to support his addictions. It was the '60s, after all, and such habits were not cheap. At first, Peter's father subsidized his son's collegiate endeavors; but when off-hours playtime proved more important than studies, Peter found himself dropped from the parental dole and set adrift to fend for himself.

Having to pay one's own way usually changes one's priorities; but for Peter Harken this was not the case. Old habits die hard, and his studies continued to take a back seat to his extracurricular activities. He just couldn't rid himself of the monkey on his back

That monkey was sailing, a sporting habit Peter picked up as a young boy in the Philippines. He and brother Olaf (two years his junior) learned to sail at a yacht club in Manila, where they tended their own boats, polished their skills and eventually took up racing. By the time the Harken boys entered college in the States, they were both hopelessly addicted.

Olaf's college life followed much the same path as Peter's, with his engineering studies at Georgia Tech regularly playing second fiddle to road trips to see his brother in Wisconsin. The two spent as much time as possible on the water, and when the water turned hard, they switched to ice boating. According to Olaf, "It was more fun to play up in Wisconsin. They had more toys up there."

In Wisconsin, Peter fell in with a motley crew of fellow sailing addicts who had visions of starting a small-boat company. They were all members of the U. of W. Hoofers Sailing Club, and they wanted to build collegiate sailboats for competition. In 1965, they formed a company called Scanda to fulfill their dreams. For Peter, the major impetus for building boats was the fact that he couldn't afford to buy his own. He couldn't afford to buy his own deck hardware, either, a fact that soon became moot.

To ease his financial troubles, Peter worked part-time at a company called Gilson Medical Electronics. As luck would have it, the owner was an avid sailor. "I worked in their development area," explains Peter, "first in the drawing room; then I was asked to fill in when one of their chief engineers left."

The owner of Gilson Medical had a philosophy that the guys who designed the parts also had to make them. "So I had to learn how to machine," says Peter. "I could go to the machinists and have them make the parts, but I really had to understand the process. I got heavily involved in running the machines myself."

By the time the Harken boys entered college, they were both hopelessly addicted.

story and photos by Scott Rathburn

The brothers Harken: Olaf (left) and Peter.

That hands-on experience, combined with access to the machines, gave Peter the tools to design and build his own sailing hardware. "My boss let me work after hours to do it," he says. It was during this process that Peter Harken made a discovery that would eventually revolutionize the design of sailing hardware. He just didn't know it at the time.

The discovery came while Peter was developing parts for a machine that had to operate in a very acidic environment. "I had to come up with a bearing system that could take this acid environment," he says, "but because it was a medical-type piece, it couldn't have grease or anything like that. So I thought, 'Jeez, I wonder if they make plastic ball bearings?' In those days, they were not common at all," Peter notes. "I found a very small company in New Jersey that made them, and I brought them in.

"While I was fooling around with this machine, I was also building my own pulleys. I looked at the bearing system that I'd come up with and thought, 'Maybe I ought to put that in my pulleys.' So in the evenings, when I should have been studying, I was sketching up some new designs for the pulleys to use these plastic balls."

Bearing-type pulleys were not new to marine hardware, but those on the market used metal rollers and required lubrication. "I concluded that plastic balls that didn't require lubrication would be better in salt water," says Peter. "Besides, at the time, I couldn't afford the commercial stuff, so I came up with a design with plastic ball bearings and built it."

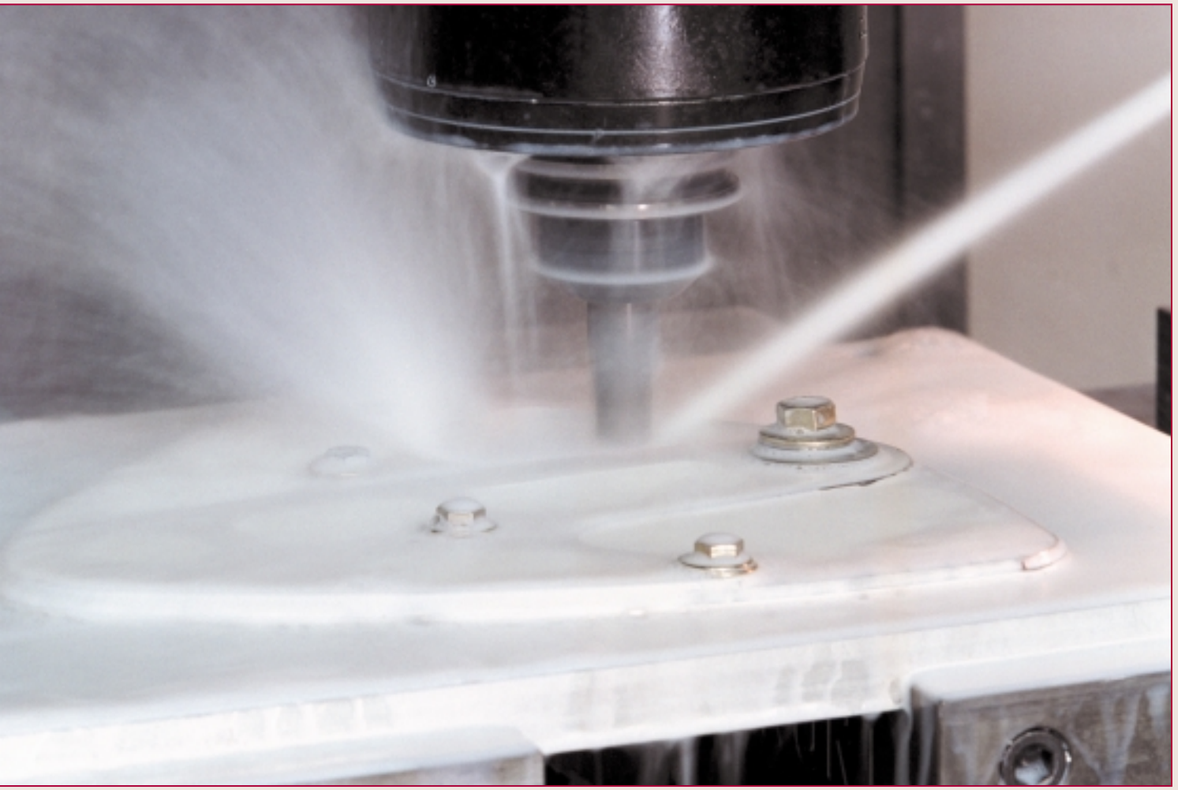
Those first designs saw immediate duty on Peter's own E-Scow (a 28-foot one-design racing sailboat) and ice boats. People began to take notice. "We were involved in Olympic sailing and all that, and all of a sudden, the guys in racing saw that, in light airs, the sails on my boat were going out faster, and the equipment was moving much easier, than on their boats. They began to ask, 'What have you got there? Will you make me some?'"

Peter started making his plastic-ball-bearing pulleys for friends and competitors alike, charging them only five or ten dollars. "It was costing me a ton more," he says.

Despite local interest, the rest of the sailing world did not rush to embrace Peter's new designs, so the principals of Scanda eventually disbanded to seek their fortunes elsewhere. Peter, in essence, was left holding the bag.

Brother Olaf, fresh from a stint in the Navy, offered to lend a helping hand. Armed with an engineering degree and a desire to get involved, he returned to Wisconsin to join Peter.

The brothers Harken knew they had a "better mousetrap" with Peter's plastic-ball-bearing sailing gear,



and they saw a niche in the college sailboat market they thought they could fill. So in 1967, they rented a 60-foot-long garage in Waukesha and formed a company called Vanguard to build fiberglass dinghies for the college-sailing crowd and manufacture Peter's small-boat hardware.

Building boats was familiar territory, but the hardware business was another story.

The Harkens shopped their plastic ball-bearing blocks around to several national distributors, but the results were less than encouraging. Finally, they approached their friend Gary Comer, who owned a budding company called Lands' End, for help marketing the devices. Comer agreed to put the blocks in his catalog, with one caveat: the Harkens had to be prepared to supply the product. Comer also suggested they market the blocks under the Harken name rather than Vanguard, reasoning that other boat manufacturers might be hesitant to use hardware with another boat builder's name on it. The Harkens agreed, and thus was born Harken blocks.

With distribution taken care of, the brothers turned their attentions to production. "Injection molding was really how this stuff had to be made," explains Peter. "I couldn't keep machining them the way we were, because the pricing was just out of line. We had to get into injection molding and stamping dies, but we just didn't have the money for that kind of tooling." A solution presented itself soon enough.

The Harkens' landlords, the Stippich brothers, just happened to run a tool and die business. "We showed them this stuff – we had it in a cigar box – and they said, 'We'll just do this on the side,'" recalls Peter. "And they did it for nothing. They did the assembly and everything. I think they felt akin to us, because they saw two young brothers starting out the way they had, with not much money. They were helping us along, I think, kind of from their heart. They told us, 'Hey guys, if it fails, don't sweat it.'

"Well, it grew out of hand!" exclaims Peter. Harken hardware took off, and quickly became much more than a side job for the Stippiches. "Pretty soon it got so big they had to split the business: one took the tool and die business, and the other brother took the hardware business."

Harken gear quickly gained favor among the racing crowd for its speed and performance, and by 1968, Harken pulleys played prominently in the Olympics. "Two of the American boats won gold medals," Peter recalls, "and our equipment was on those two boats. Then word kind of got out all over the world. People were asking, 'What was that gear that was on those boats?'"

The brothers had arrived. By the mid 1970s, Vanguard was a major force in junior, collegiate and Olympic sailing, building four or five models of boats for national and international competition. By the 1980s, they were considered the premiere small-boat builder in the world.

During the same period, Harken blocks became the performance standard for small-boat hardware. Peter constantly expanded the product line by putting plastic ball bearings into every piece of sailboat gear he could think of.

Up to that point, Harken had been known only for its small-boat fittings and gear, but Peter felt his designs would work just as well on a larger scale for big boats. "In 1976," he says, "we created our first high-load, big-boat block with thermoplastic bearings. No one had done that before."

Peter was quite close to the Swedish America's Cup team, so he asked them to try out the new block. "Our testing had shown it would take the load," explains Peter, "but you never really know until you go to sea and work it in an America's Cup-type training program." The new block ended up lasting through the entire campaign. "It was the only piece of equipment they never had to change out. That really proved that we had something that could survive out there in the big-boat sailing scene."

By 1983, Harken gear could be found aboard most of the America's Cup 12-Meter boats. The following year, Harken was a sailboat and equipment supplier for the Los Angeles Olympic Games. The company was on a roll.

By 1986, however, the boat building side of things had lost much of its appeal for Peter and Olaf. "The '84 Olympics in Los Angeles were our last hurrah," says Peter. "The kind of boats we were building were ruled by outside authorities, and Jesus, they'd be changing the rules on the boats, and we'd have to change the molds all the time. It was costing us an arm and a leg. We were being ruled by doctors and lawyers and guys who weren't boat builders, weren't technicians. We said, 'We can't continue our company like this, and have our employees live under this, just because we like boat building. We'll never be able to grow, really, with some outside force controlling our destiny.'

photo by Bob Grieser © 2000

“The hardware business was completely under our control, and it needed expansion. It had been rather successful in spite of the fact that we were spending 80 or 90 percent of our time on the boat business. We thought, ‘Jeez, what would happen if we spent full-time on the hardware business?’”

The decision was made to sell Vanguard to Steve Clark of Rhode Island. “It’s now quite a large, and very good, small-boat company called Vanguard Racing Sailboats,” notes Peter. “Our guys taught him how to build the boats, and we did a very nice transition. We have a very good relationship with Vanguard Racing, and they use all of our gear. We’re very happy that the tradition has gone on.”

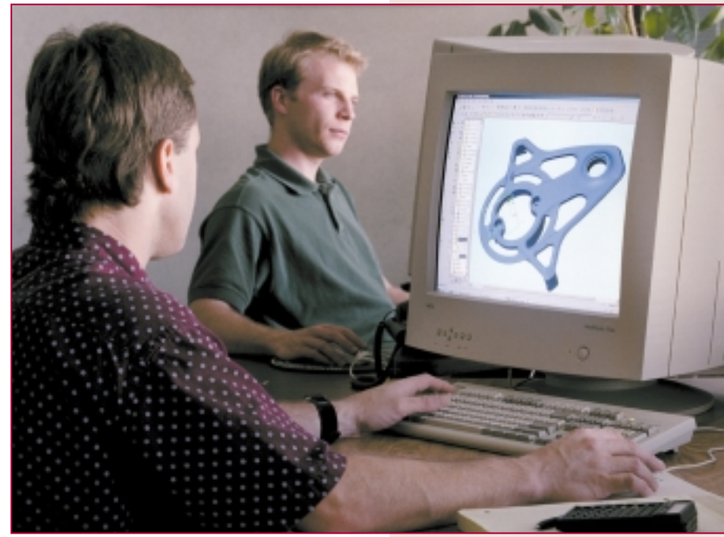
The sale of Vanguard left the Harkens free to concentrate on the hardware business; it left them with a surplus of former boat builders, as well. “We sent them to technical school in Waukesha,” explains Peter. “They became machinists and welders and every other thing for the hardware business. We still have a lot of the same people.”

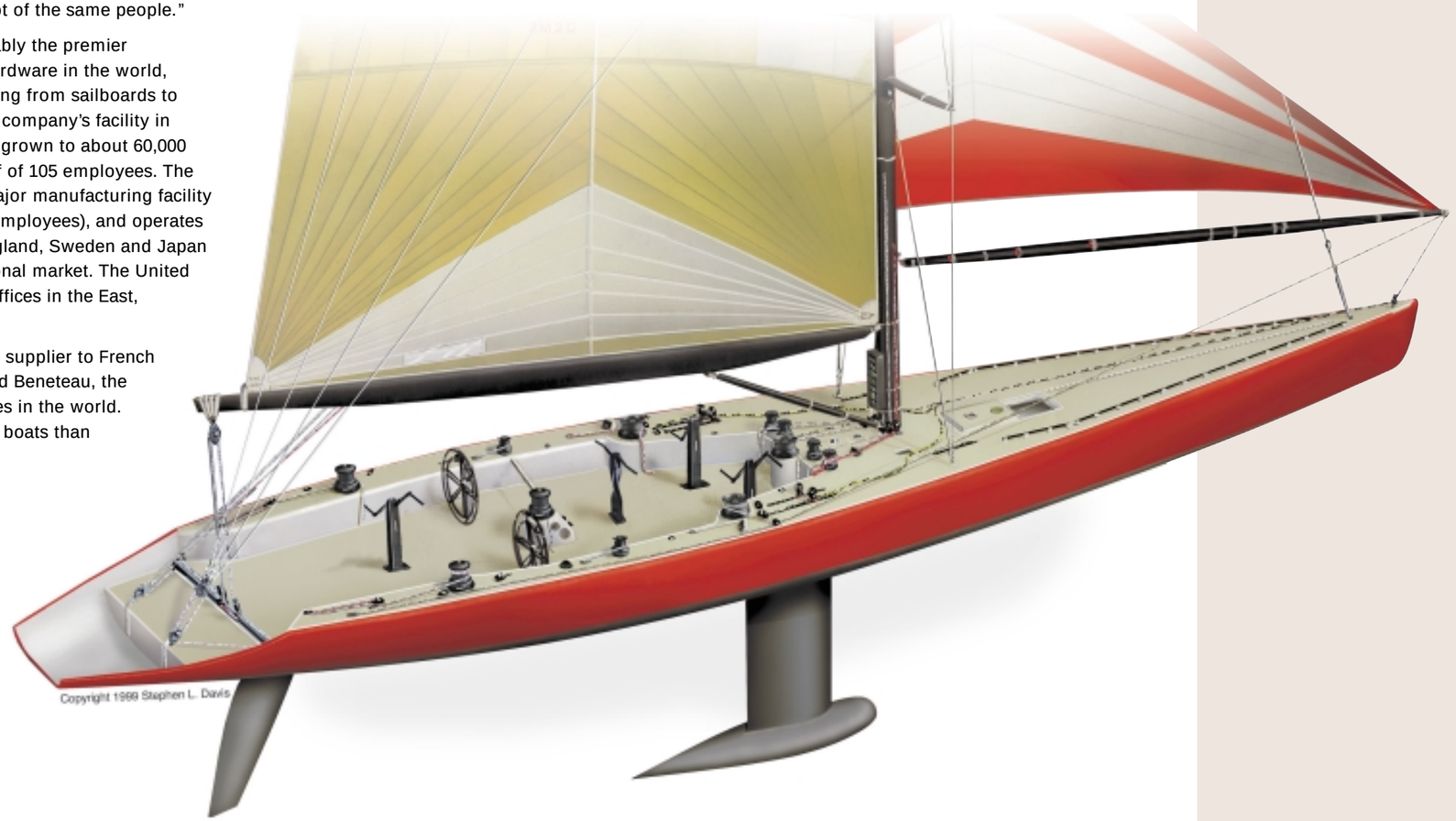
Today, Harken is arguably the premier manufacturer of marine hardware in the world, providing gear for everything from sailboards to America’s Cup yachts. The company’s facility in Pewaukee, Wisconsin, has grown to about 60,000 square feet, and has a staff of 105 employees. The company owns another major manufacturing facility in Northern Italy (with 45 employees), and operates trade offices in France, England, Sweden and Japan to help serve the international market. The United States is served by trade offices in the East, Southeast and West.

Harken is also an OEM supplier to French boat builders Jeanneau and Beneteau, the two biggest boat companies in the world. “They pump out far more boats than almost all of the U.S. companies combined,” says Peter. Of course, the three largest builders in the U.S. – Hunter, Catalina and J-Boats – use Harken hardware, as well. “They like having our gear on their boats, because people recognize it,” Peter adds. “We have a good name worldwide.”

That good name now also dominates America’s Cup competition. This year’s Cup found Harken deck hardware on 16 of the 17 new boats, and complete winch systems aboard 11 boats. Winning is everything in this highly competitive arena, so it’s no coincidence that this year’s defender and challenger both relied on Harken gear.

Founded on a handful of plastic ball bearings, Harken has risen to the top of the sailing world to become the standard by which all others are judged – not bad for a couple of old sailing junkies.





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Intelligent CAM

CAD to CAM - The Problem of Data Transfer

Story
Dave Boucher

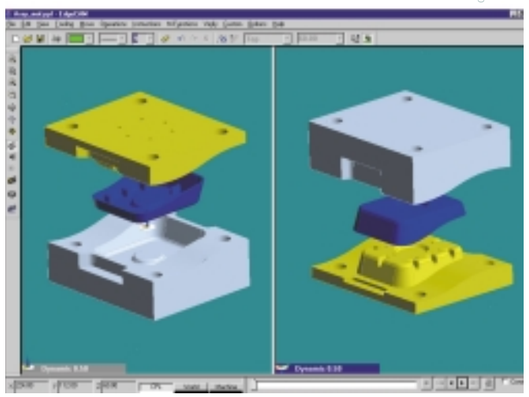
Pathtrace Engineering Systems

Images
Courtesy Pathtrace

Although the terms CAD and CAM frequently appear side by side, transferring part files between the design stage and the machining stage of the manufacturing process has never been as straightforward as it should be.

The principal problem caused by this mismatch, the loss and corruption of data, has led to the widespread use of standard data transfer tools such as IGES and VDA-FS. However, as nearly every system vendor has a slightly different interpretation of the standard, these translators have earned a reputation for being unreliable.

The problem of data transfer has been compounded in the last few years with the growing popularity of mid-range CAD solid modelers. In addition to providing pure geometry, solid models also provide topology and geometric information, telling us much more about how a part is constructed. As a result, there is an ever-greater amount of information to be transferred.



Solid model CAM packages, such as EdgeCAM's Solid Machinist, are ideally suited to mold & die applications.

To ensure that this additional information can be used during manufacturing, developers of the latest generation of solid model CAD products – Mechanical Desktop, Inventor, SolidWorks and Solid Edge – have taken a fresh look at the problem. By focusing their resources on the systems design capability, and enlisting CAM integration partners via programs such as the Autodesk Mechanical Applications Initiative (MAI), the Solid Edge Voyager program and the SolidWorks Partner Program, compatibility issues have been eliminated.

BEST-OF-BREED

Thanks to these partner programs, end users can pick complimentary integrated CAD and CAM systems to suit their specific requirements.

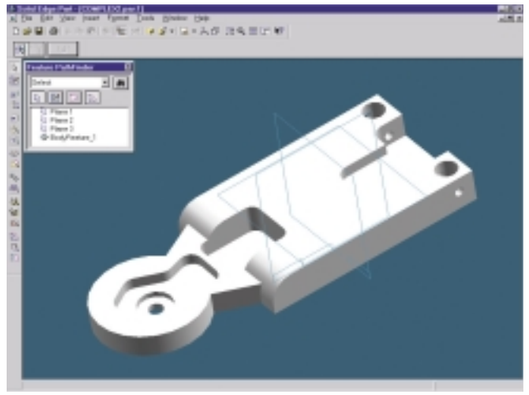
This tight integration between CAD and CAM means that the information contained within the solid model can be easily and reliably transferred from the user's CAD system to his best-of-breed CAM system. Once a solid model is loaded into the CAM system, the user can analyze the model topology to optimize or automate the manufacturing process.

As the push towards greater automation of the process continues, so the technology supporting it is growing more complex and more "intelligent."

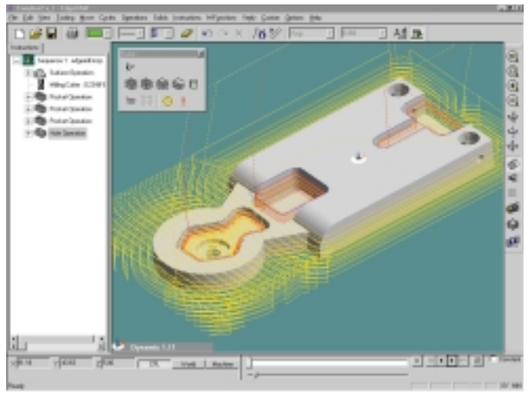
ASSOCIATIVITY, INTERCHANGEABILITY, INTEROPERABILITY

With the dramatic increase in information contained in the solid model, associativity has become an increasingly common term in the CAD/CAM industry, and one that is frequently misused. Associativity is in fact one facet of CAD/CAM interchangeability, more correctly known as interoperability.

In both the CAM and the CAD environments, interoperability is the ability to work on the same file or data from within either application. Thus, where interoperability exists, there is no need to copy and reformat the CAD data for the benefit of the CAM system, nor is there any need to keep and manage multiple files for different processes. Interoperability eliminates the potential for errors due to loss and corruption of data; that is, errors caused by translating data from one format to another.



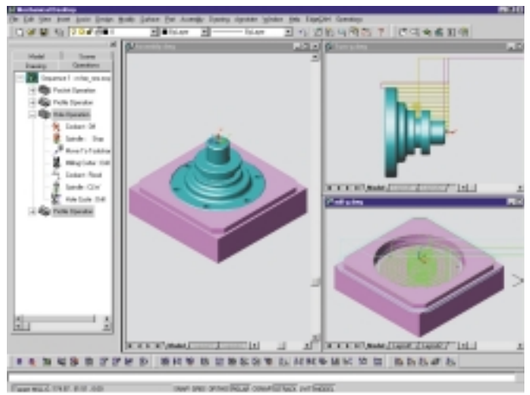
A part designed in a commonly used solid model CAD system . . .



can be transferred directly into EdgeCAM Solid Machinist with no loss of design data.

Users realize major benefits through associativity between the design stage and the downstream process. For example, associativity allows the user to modify the design model (CAD) and automatically see the effect of those modifications on the toolpath (CAM) – the toolpath automatically regenerating to reflect any design changes.

Taking integration one step further puts the CAM product within the CAD environment, keeping all on-screen activities at both stages of the design-to-manufacture process in familiar territory. However, there is a potential downside to this form of integration: A modern CAM system has hundreds of different machining choices, only a few of which can be offered within a CAD system's user interface. If full flexibility and a full range of commands is to be retained, the CAM system should work within its own user interface.



Systems such as EdgeCAM for Mechanical Desktop take the integration concept one step further, sitting within the CAD system.

SINGLE SOURCE CAD/CAM?

It's increasingly likely that CAM vendors will eventually develop their own solid modelers. Likewise, vendors of solid modeling systems will inevitably develop complementary CAM packages. Will this be the most beneficial solution for the customer? For some users, maybe, but most prefer to have a choice of which solid modeler they use, finding a CAM package to suit their products and their choice of CAD system. To fit into this best-of-breed short list, the CAM vendors must offer integration with a wide spectrum of different products, or else offer different "flavors" of systems designed to integrate with the more widely used CAD systems.

FUTURE INTEGRATION

To succeed in the CAM industry, companies must continue to develop and offer greater levels of integration, making as much use as possible of the increasing information contained within the solid model. A time will shortly come when manufacturing information is considered an integral part of the design, with the CAM process automatically retrieving that information. We can also expect integration between different third-party applications, and the sharing of common information. For example, there may be information in the solid model that both the CAM and the FEA (finite element analysis) systems use – downstream applications sharing common attributes from the solid.

Making the design-to-manufacture process faster is another industry goal requiring innovative information management. Automating the process requires speed and consistency if the

objective is to make it less error prone. Users want the ability to machine a component in a fast and efficient manner and then, if applicable, to transpose that strategy to a similar component or a family of parts, avoiding reprogramming and other opportunities to introduce errors. This efficient use of machining "knowledge" helps to further increase overall productivity.

KNOWLEDGE-BASED MACHINING

Knowledge-based machining lets the user develop tailored strategies for machining a component, and save these strategies as templates for machining similar components.

In the information age, a great deal of a company's intellectual capital is carried around in the heads of its employees. Knowledge-based machining systems allow the pooling of this information for the benefit of the company as a whole. For example, the tried and tested speeds and feeds a company uses for certain material/tooling combinations can be lost when people move on, and those employees left to fill the void are forced to start the empirical process from scratch. A database designed to hold this knowledge, incorporated within a CAM system, makes the information available to everyone. Tooling, inserts and material data can be used to offer optimized cutting conditions, or can be tailored to suit very specific conditions. As a safeguard, the CAM program can use its inherent "intelligence" to prevent a programmer from using the wrong tool type for the material being machined.

Other aspects of automation are becoming available that can provide additional knowledge of various machining strategies. Both surface machining and mold & die provide good examples of where different parts of the model require differing machining strategies.

OPERATIONAL PROGRAMMING

Operational Programming is another time-saving feature facilitated by knowledge-based machining. Not yet widely available, operational programming clusters a series of machining operations pertaining to a particular feature into a single operation, simplifying the programming process.

Knowledge-based machining also allows for the automatic analysis of a solid model to define machineable features. Automatic Feature Recognition (AFR) can be achieved in a CAM system in one of two ways. A solid model loaded from another package is converted back to a parametric history tree, or a Parasolid file loaded into a CAM program is automatically analyzed to identify features such as holes, bosses and pockets. Once the features are identified, the program can offer suitable tooling and appropriate feeds and speeds.

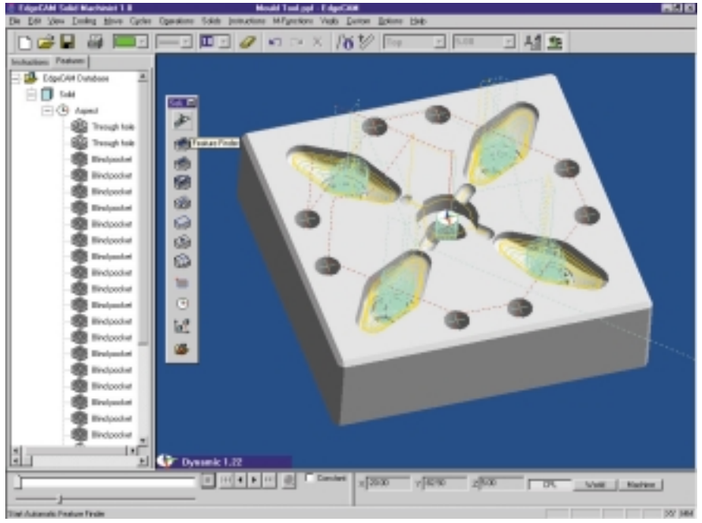
Midrange solid modelers simplify the design of products with complex blends and fillets. This has led to an increase in the demand for CAM systems with more advanced surface machining capability.

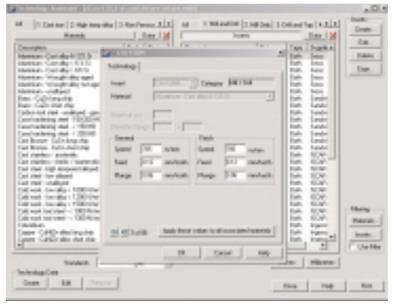
Traditionally, prismatic parts have been machined in 2D with X, Y or Z cycles, and rarely required a CAM system with surface machining capability. These days, even for production applications, there is a growing demand for surfacing machining. As the technology permits, many CAM systems will mutate to provide users with hybrid systems capable of production machining and more complex surface machining capabilities. Some of the capabilities found in specialist systems, for example mold & die, will also find their way into these hybrid solutions.

The rate of change and progress in the CAM industry is accelerating. As recently as four or five years ago, "large" models had perhaps 100 surfaces. Today, models commonly have up to 2000 surfaces, putting a huge load on the computational ability of the CAM software. CAM developers have to do more than just meet this challenge. They have to stay one step ahead of the users' requirements by building in faster response, much higher levels of overall performance and improved capability. However they develop, CAM systems will need to work flexibly with solids and surfaces, as well as accept data from any source CAM system. The goals of performance and speed will continue to be goals for future releases of CAM software, making the manufacturing process faster and more reliable.

MACHINE TOOL TECHNOLOGY AND CAM

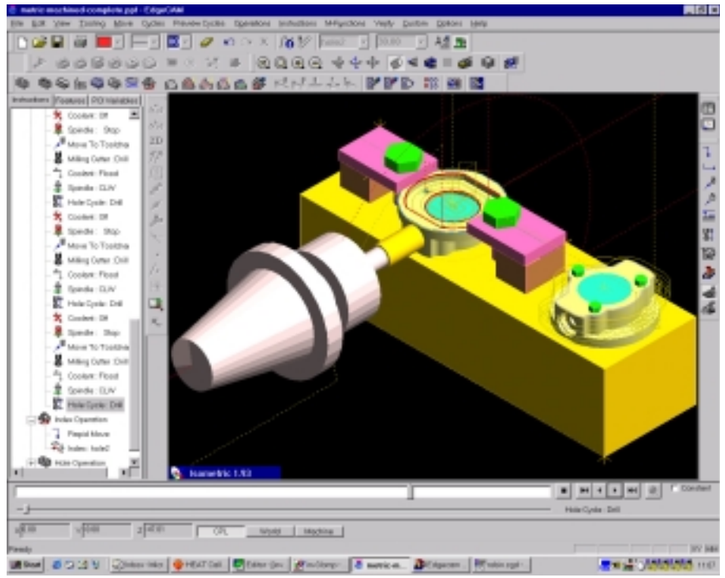
The rapid growth in machine tool technologies has a direct affect on the CAM process and systems. Growth in areas such as high-speed milling, 5-axis machining, and complex turning involving driven tooling and sub-spindles, needs to be accounted for by CAM providers. Where manual programming is too difficult, end users expect their CAM systems to stay ahead of the cutting technology. A shop spending $80,000 on a machine tool is buying a lot of machining capability – capability that needs to be exploited to justify the investment.





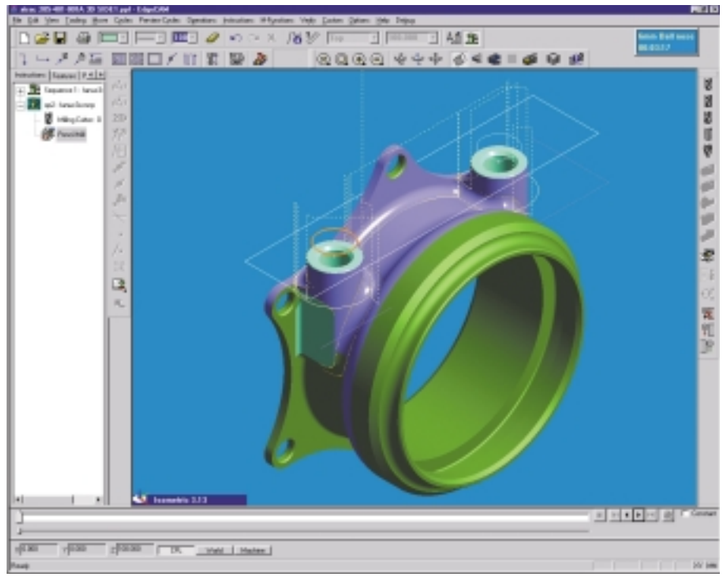
Using Feature Finder (above), EdgeCAM Solid Machinist automatically scans the imported solid model looking for machineable features.

EdgeCAM's Technology Assistant (left) stores valuable tool and material data. This data can be used to speed up the programming process and eliminate potential for error and variation when selecting speeds and feeds.



As users demand higher levels of performance from CAM systems, the systems themselves have to present this complex data via clear and simple user interfaces. EdgeCAM Solid Machinist for Inventor (above) uses a combination of high-quality graphics and an innovative operations browser to map a machining strategy.

Pathtrace Engineering Systems
909-937-1222



Haas Technical Center Finds FAME at Penn State

Hands-on learning – that is the philosophy behind the Industrial and Manufacturing Engineering program at The Pennsylvania State University (Penn State). Only through hands-on experience can students make the theories they discuss in the classroom come alive on the shop floor.

Story & Photos
Preston Gratiot

But providing outstanding hands-on experience requires equipment and laboratories that are outstanding, as well. To this end, Penn State has opened its new "Factory for Advanced Manufacturing Education" (FAME), a state-of-the-art study environment that has all the elements of a real manufacturing facility.

Located in the recently completed 60,000-square-foot Leonhard Building – the new home of Penn State's Harold and Inge Marcus Department of Industrial and Manufacturing Engineering – the FAME laboratory features 10,200 square feet of floor space dedicated to advanced manufacturing technology.

Attendees tour the new Haas Technical Center at Penn State during grand-opening ceremonies in June. The Haas Technical Center is part of the school's recently opened Factory for Advanced Manufacturing Education.

California-based Haas Automation, Inc., has partnered with Penn State to provide the necessary equipment for the CNC machine tool portion of the FAME lab. The school's new Haas Technical Center is a modern CNC machine shop fully equipped with 10 brand-new Haas machining centers and turning centers.

Grand opening ceremonies for the new Haas Technical Center took place June 8 at the Leonhard Building. Representatives from Haas Automation, Penn State and the Pittsburgh Haas Factory Outlet were on hand to share their words with those members of the community and media in attendance.

"On behalf of Haas Automation, I want to let everyone know how excited Haas is to be a part of this program. When we first looked at the original presentation, we noted that this is one of the premier engineering colleges in the country. This Industrial Engineering department graduates engineers that are recruited by the pillars of industry all over the country . . . all over the world. We are thrilled to have the opportunity to participate in this program, and we look forward to the continuation of this program over the next ten years."

– Denis Dupuis
General Manager
Haas Automation, Inc.

The Haas Technical Center is the result of a unique alliance between Penn State University, Haas Automation and the Haas Factory Outlet – A Division of DSM Machinery, Pittsburgh, PA. It is part of a rapidly expanding network of Haas Technology Centers throughout the country, and proof of Haas Automation's continued commitment to bringing cutting-edge technology and education to the engineers of tomorrow.

"I want to take this opportunity to thank Haas Automation for their very generous gift of the CNC machines here, and also to thank the Haas Factory Outlet, Pittsburgh, because they played a very key role from the beginning in getting us all together and making this happen. Pretty soon, we will be celebrating the 100 year anniversary of our degreed program here, and we are sure that this facility will continue to attract not only the outstanding students, but the outstanding faculty and staff to this area."

– A. "Ravi" Ravindran, Ph.D.
Professor and Head
The Harold & Inge Marcus
Department of Industrial &
Manufacturing Engineering

The recently completed Leonhard Building is home to Penn State's Factory for Advanced Manufacturing Education (FAME), a state-of-the-art study facility that provides students with hands-on experience in a real-world manufacturing environment.

The goal of the FAME lab is to provide students with the first-hand experience of working on a modern, integrated factory floor. Studies include such diverse manufacturing processes as casting, welding, forming, injection molding, assembly and, of course, CNC machining. The curriculum also offers laboratory courses in supporting fields, such as manufacturing processes and automation; robotics; quality control and metrology; work measurement and ergonomics.

"This endeavor would never have been possible without the efforts of HFO-Pittsburgh, and particularly Jeff Detar, Sales Engineer. Jeff was, like myself, working behind the scenes doing a lot of the work needed to make this happen. I also want to thank Tom Jonas and everyone else at Haas for making this happen."

– Michael Immel
Manager
Manufacturing Systems Laboratories
Pennsylvania State University

One of the more innovative teaching aids now in use at the facility is a portable multimedia-broadcasting cart. This allows an instructor to lead a class session via video camera from the CNC machine, while the students sit in the classroom nearby. Each student can comfortably view the machine and verbally interact with the instructor during the live video presentation, all while seated in the adjoining PC classroom. For larger groups, or for repeat presentations, the lesson can be viewed in the 90-seat Inyong Ham Auditorium, which itself is equipped with the latest computer and telecommunications technology. When compared to the more typical mass of students normally found crowded around a teacher and machine, the effectiveness of the FAME multimedia system is readily apparent.

Established in 1908, Penn State's Industrial Engineering department is the oldest running program in the United States, with more than 7,500 alumni. Currently rated in the top five Industrial/Manufacturing departments (according to the *U.S. News & World Report*), the Penn State Industrial Engineering department supports more than 400 students annually.

The Harold & Inge Marcus Department of Industrial & Manufacturing Engineering
310 Leonhard Building
The Pennsylvania State University
University Park, PA 16802

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DANA continued from page 9

"It's the same fixture," explains Robbins. "There's a bushing plate that lines up the drills for the brake flange holes. We just replace that."

Both Robbins and Hough agree there have been problems with the thread milling operation in the past. "We never actually intended to thread mill on the Haas machines," explains Hough, referring to the first turnkey, "so the fixture wasn't really designed to hold the spindle end very firmly. The axle itself is not an easy part to actually hang on to, and it's very prone to vibration, just because of the shape of it. It's a hollow piece of steel."

To solve this problem, the engineers at Barrie Machine Tool designed a new fixture with an extra clamping register that comes in for the thread milling operation. This fixture clamps the axle close to the spindle end to reduce vibration, which results in more accurate threads and extends the life of the cutter. At present, only one of the Haas turnkeys has the new fixture, but the other will be upgraded as soon as technicians can get into the machine without disrupting production.

With both sets of Haas machines up and running, the plan, according to Robbins, is to have one set dedicated to the Ford axles, and the other set dedicated to short runs of any axle the plant produces. "The new fixture will do any model that's in-house," he says. "If we have a short run of any product, we can run it through the Haas machines without having to set up two or three other machines. It saves us changing over our seven-station, which is a very long changeover time.

"Probably one or two times every week we have to do 20 pieces of this, 20 pieces of that to make up our full orders," Robbins continues, "and our changeovers can be fairly lengthy on some of the other equipment. On the Haas, it's quite quick. It's a program change and the bushing plates. On the other equipment you're probably talking an hour and a half, two hours. The Haas is probably half an hour or twenty minutes, if that. That's where the benefit is, for short runs and drop-in orders."

Although CNCs may never completely replace dedicated transfer line equipment at Dana's Barrie Heavy Axle Plant, they definitely will play an increasing role. The company's "two-headed" Haas horizontal machining centers provide the added capacity, flexibility and accuracy needed to respond quickly to the rapidly changing product mix common to today's automotive industry.

Dana Canada Inc.
705-737-2300

2000 Trade Show Calendar

Show and Location	Dates and General Information
IMTS Chicago, IL Sept. 6-13, 2000	IMTS, the largest manufacturing technology show in the Americas, will play host to more than 1,400 exhibitors at McCormick Place. Haas will be showcasing more than 30 machines in booth #8232, as well as a full selection of rotary tables and accessories.
Northern Alabama Industrial & Machine Tool Show Huntsville, AL Oct. 10-11, 2000	The Von Braun Civic Center is the location of this annual manufacturing technology, machine tool and metalworking show. Visit booths 630-635 and 702-707 to see the Haas line of HMCs, VMCs, turning centers, and rotary products.
Kentucky Industrial & Machine Tool Show Louisville, KY Oct. 11-12, 2000	This show combines construction materials and supplies, hardware and tools, and manufacturing technology. The Haas line of machine tools, rotary tables and accessories can be found in booths #325 and #424.

Haas Mini Mill Boosts Job Shop Profits

Running a small job on a big CNC machine can be inefficient, and may even cut into profits. The new Mini Mill from Haas Automation, Inc., provides an economical solution for small parts machining in a super-compact package that is loaded with full-size features.

The new Haas Mini Mill has a space-saving footprint of only 6.5' x 6.5', yet provides a generous work envelope of 16" x 12" x 10" (xyz). Designed to run on either single- or three-phase power, the Mini Mill is perfect for start-up shops or as a first step into CNC machining. It is also a valuable addition to any shop needing a "second-op" machine, or wanting to add another spindle where space is at a premium.

The Mini Mill features a 40-taper vector-drive spindle that accepts standard CT 40 tools, and it comes equipped with the same easy-to-use Haas CNC control found on every Haas machine. A 7.5-hp direct-drive spindle yields speeds to 6,000 rpm for cutting aluminum, yet provides enough low-end torque for cutting steel. Cutting feedrates up to 500 ipm are possible on the Mini Mill, with rapids of 650 ipm for fast cycle times. The Mini Mill's 36" x 12" table (28.75" T-slot length) provides plenty of room for fixturing, and a 10-pocket automatic tool changer comes standard.

Base priced at less than $30,000 (US), the new Mini Mill from Haas is a compact solution with big advantages.

The Mini Mill's 40-taper spindle delivers 33 ft-lb of steel-cutting torque at 1,200 rpm, and spins to 6,000 rpm for finishing work. Combine that with travels of 16"x12"x10" and a 36"x12" table, and you have a small-footprint VMC that can easily handle the typical machine shop job.

The New Color of Rotary

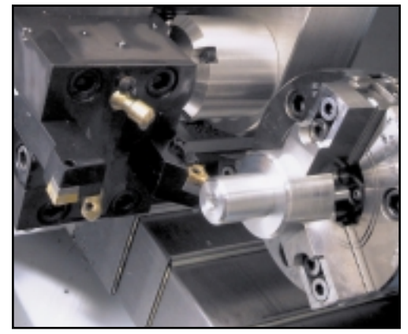
No, you're not imagining things, those are Haas rotary products. They just have a brand-new look.

Starting July 1, 2000, all new Haas rotary tables and indexers will feature a new light gray color scheme and crisp red logos.

Dual-Spindle Turning Center Increases Production

Keeping parts flowing through a high-production shop is the key to keeping profits flowing into the bank account. Having to move the same part from machine to machine for different operations increases setup times, adds to manpower costs and reduces part accuracy. The new TL-15 dual-spindle lathe from Haas Automation, Inc., allows turning of double-ended parts in a single setup on one machine.

Built on the shop-proven Haas SL-20 platform, the TL-15 CNC lathe features a 20-hp vector-drive main spindle with 8" chuck, and an 8-hp sub-spindle with 5" chuck. Both spindles provide speeds to 4,000 rpm standard, and the main spindle has options for 5,000 rpm and 7,000 rpm. Maximum cutting diameter for the TL-15 is 10", with a maximum turning length up to 15", depending on the type of workholding and tooling used. The TL-15 comes standard with a 12-pocket tool turret that holds a combination of six VDI 40 tools and six bolt-on tools. Special twin-bore and twin-turn toolholders are included for sub-spindle work.



The addition of live tooling and full C-axis options to the TL-15 increase versatility further by allowing such secondary operations as milling, drilling and tapping to be performed both on the face of the part and around the diameter. With these options, the TL-15's main spindle is capable of fully interpolated, bi-directional synchronous motion for milling flats, hexes and flutes. The end result is a finished part off the machine with no need for additional setups or operations. Add the Haas Servo Bar 300 automatic bar feeder and the automatic parts catcher option, and full lights-out operation is possible.

The new Haas TL-15 CNC lathe – a high-production turning center at an affordable price.

High-Speed Rapid Option Speeds Production, Reduces Cycle Times

Time is money, and nowhere is this more true than in the world of machining, where the amount of time spent cutting a part is directly related to per-unit profit. Machining the same part in less time means more money in the bank.

The new XRT eXtra Rapid Traverse option from Haas Automation, Inc., boosts rapid traverse speeds to 1,200 inches per minute and cutting feedrates to 833 inches per minute for reduced cycle times and faster production. Available on Haas Automation's most popular VMC models, the XRT option uses high-pitch ballscrews to provide rapids and cutting feedrates nearly 70 percent faster than on standard models.

The Haas eXtra Rapid Traverse option is perfect for any shop wishing to reduce cycle times, especially high-volume shops where multi-part fixturing is the norm, and for complex applications like mold making, pattern making and graphite machining. By reducing the amount of non-cutting time, increasing cutting rates and shortening tool change times, the new XRT option virtually guarantees higher throughput.

Combine the XRT option with a 10,000- or 15,000-rpm spindle for even higher metal removal rates, or pair it with the Haas High-Speed Machining option for high-speed contouring of complex geometries.

Exceeding the Industry's Highest Standards of Quality Assurance.

HAAS AUTOMATION INC.

ACCURATE.

Margin of error: ≤0.0001 **800.331.6746**