CNC MACHINING

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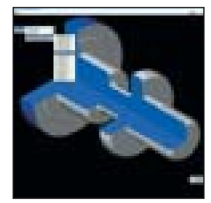

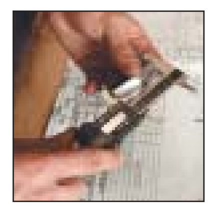

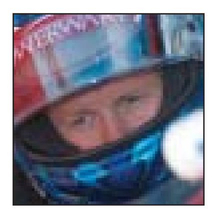

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IN THIS ISSUE

Petroleum products are such a major part of our day-to-day lives that we pretty much take them for granted. Rarely do we realize just how dependent on them we are, or just how many things would be affected if the world's supply of oil were to suddenly dry up.

Oh, sure, we all notice when the price of gasoline goes up, but most of us (this writer included) do little more than complain. Rather than actually making an effort to conserve – carpooling, buying fuel-efficient vehicles, using alternative forms of transportation – most of us just bite the bullet, fill up our 8-gallon-per-mile SUVs and go about our business.

The thing is, it's more than just gasoline. Petroleum products make our daily lives possible. Fertilizer, heating oil, natural gas, jet fuel, diesel oil, lubricants, tar, asphalt, plastics, nylon, household chemicals and, yes, gasoline, all depend on oil. It provides the power to heat and cool our homes, the fuel to transport us to and from work – it allows us to live, not just survive.

For our cover story this issue, we take a close look at the history of oil – its discovery, its uses throughout time, the evolution of production – and visit several shops that are involved in machining for the oil field.

In another oil-related piece, we pried Matt Bailey, our European Correspondent, away from the balmy shores of the Mediterranean to visit a Southern California company that is taking oil production to new levels of efficiency and energy savings. DynaPump has developed a line of hydraulic pumps for the oil field that not only pump as much as ten times more oil, but do so while using one third to one half the energy. Now, *that's* conservation.

Our piece from GibbsCAM deals with conservation of another sort – conservation of knowledge. This article gives some pointers on how a company can protect its knowledge base – machining processes, tooling standards, machine tool specifications – from walking out the door when employees retire or leave the company.

On the education front, where knowledge begins, we visited Delgado Community College in New Orleans for a look at machining in the Big Easy.

As always, you'll also find the latest race report and much more.

So sit back, relax and enjoy!

THE MASTHEAD

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A World Together

I spent the first part of September traveling throughout Europe, ending up at the EMO show in Hannover, Germany. This has to be the largest show in the world. There were stands for machine tool manufacturers from almost every country in the world – 39 in all – and some 23 halls of products on display to more than 200,000 visitors.

The sheer number of machine tool manufacturers was astounding, and the products were amazing. There were machines on display that I had never seen at a trade show before, whether it be IMTS in Chicago, MACH in Birmingham (UK), JIMTOF in Japan or CIMT in China. Some manufacturers brought single machines that filled their 10,000-square-foot stands – machines larger than most job shops. There were small machines as well, and everything in between. I was impressed by the exhibits and the sheer number of attendees who pored over the equipment.

The technology on display in Hannover showed why there is an overcapacity in the world's manufacturing sectors: Today's machines greatly outperform those of only 20 years ago. With faster rapids, and spindles that cut at speeds of 50,000 rpm and higher, it is no wonder the world is able to produce more for less.

EMO truly is a world show, bringing together manufacturers, industry professionals and distributors – including Haas distributors – from every continent. As such, it is the perfect venue for the Haas International Distributor Council meeting.

This year's meeting precipitated some very lively discussions. Each member spent time discussing the economic situation in their respective country. Interestingly, everyone complained that the media were very loose with the R word (recession). Yet, their economies were not in recession – officially – with the exception of the South American nations. The general consensus was that most of the world's economies are in a no-growth or slow-growth situation, with the times being extremely difficult for the machine tool industry. It appears our industry is in general malaise throughout the world.

Despite this, EMO was very impressive overall, with solid attendance and more suppliers than one would have thought possible. The terrible tragedy of the terrorist attacks on the World Trade Center and the Pentagon dampened spirits on the opening day of the show, but also seemed to bring the world together. Shocked by the event, people from every country expressed their sympathy, sadness and support for the United States. All of the Haas people at the show were blessed with the kindest wishes from friends and acquaintances from many countries, and we would like to thank them. Where will this lead? Maybe we will know more by the next issue.

EMO 2001 – A Show to Remember

Haas products are nothing new to Europe, or to the European show circuit. In fact, several thousand Haas-built machines are installed throughout the continent, and Haas has been present at EMO in both Germany and France. But this year marks the first time Haas Automation's new European subsidiary has exhibited at the world-class event.

As the exhibition team put the finishing touches to the 905-square-meter (9,738-sq-ft), red and gray liveried booth, everyone agreed that Haas Automation Europe's show debut in Hannover, Germany, was going to be one to remember.

No one could have imagined why: The events of September 11th, the day before the opening of EMO 2001, ensured that everyone present would remember forever where they were on that dreadful day – a mnemonic marker as indelible through time as the assassination of President John F. Kennedy. Probably more so.

But even when normality is so violently shaken, shows must, and do, go on. The Haas Automation Europe team had just eight days to remind the engineering world that American resolve is ubiquitous, and is made of many things – including iron and steel. Be assured, the job was done with the style, passion and professionalism that has become the company's global hallmark.

EMO 2001 (Exposition Mondiale de la Machine Outil) attracted some 200,000 engineering decision-makers from the four corners of the European continent and beyond. Of those who came to visit booth B70 – Hall 13, no one could fail to notice that a small factory of 26 Haas machines was busy making chips on an industrial scale. Comments were frequent that few other exhibitors were doing likewise.

Included in the temporary Haas "machine shop" was a wide range of the company's VF series vertical machining centers, SL series turning centers – including the twin-spindle TL-15 lathe – and HS series horizontal machining centers. For the world's press, new offerings such as the Vertical Turning Center (VTC-48), the VF-6TR five-axis trunnion machine and the high-speed Super Mini Mill were the main attractions.

The Haas Mini Mill giveaway caught just as many inquisitive eyes, proving equally as enticing to hopeful European engineers as it was to visitors of IMTS 2000. Some 4,000 attendees filled in application forms in the hope of taking delivery of the $30,000, small but capable CNC vertical machining center. Only one company, however, Blaupunkt GmbH in Hildesheim, Germany, has to find the 4 square meters (42 sq ft) of floor space for the machine.

As well as an opportunity for Haas Europe to meet and welcome customers and press, EMO 2001 also provided a time and place for prospective European resellers to meet the company. Haas Technical Center programs for Germany, Spain, France, Italy and Eastern Europe are proceeding at an impressive rate. The awareness these programs have generated throughout Europe helped ensure that well qualified applicants attended EMO – and the Haas stand – in good numbers.

Witnessing such an impressive and successful exhibition presence, it's easy to forget that Haas Automation came to Europe just a few months ago. But youth has never been a hindrance where determination, hard work and talent are also abundant, and, although EMO 2001 will be remembered by all because of its coincidence with the tragic events in the U.S., it will also be remembered by many as the debut of Europe's newest and most innovative CNC machine tool company.

In racing – as in machining – precision, speed, reliability and consistency are the primary ingredients for success. Combine them in the right proportions and you have a recipe for a championship. As the 2001 race season draws to a close, it is fairly clear which teams have developed the best recipes. Will these recipes garner the same results in 2002? Who knows? A few recent developments have thrown some new ingredients – and drivers – into the mix.

NASCAR

WINSTON CUP SERIES

With just a few races left in the series, it looks like Hendrick Motorsports will end the 2001 season with another championship. Jeff Gordon (24) is at the top of the points standings going into Martinsville with a 237-point lead over Ricky Rudd. Gordon's win in the inaugural race at Kansas Speedway, his sixth win for the season, went a long way toward securing what will be – barring disaster – his fourth NASCAR Winston Cup championship.

photos courtesy Scott Desfor ©

Barring disaster, Jeff Gordon will soon claim his fourth Winston Cup title.

Fellow Hendrick driver Jerry Nadeau (25) put on a spectacular show at Dover, snagging second place behind Dale Earnhardt Jr. after working through the pack from 41st position. Nadeau is ranked 19th going into Martinsville. Teammate Terry Labonte (5), a long-time Winston Cup veteran and former series champion, continues to have a lackluster season, with only one top-5 finish and three top-10; he currently sits in 24th place.

For 2002, Hendrick Motorsports has added Busch Series driver Jimmie Johnson to the roster. Johnson is currently ranked eighth in Busch points, with one win, four top-5 finishes and nine top-10 finishes. He will be part of a team co-owned by Rick Hendrick and Jeff Gordon.

PPI's Ricky Craven (32), who has logged three top-5 finishes this season, has moved up to 24th place, while teammate Andy Houston (96) has dropped back to 44th position.

CRAFTSMAN TRUCK SERIES

Hendrick Motorsports driver Jack Sprague (24) is poised for another championship, with four wins and 13 top-5 finishes. Going into Las Vegas, he is first in points with a 64-point lead over Joe Ruttman. Teammate Ricky Hendrick (17) sits at sixth in the points after scoring his first Craftsman Truck Series career victory at Kansas Speedway. Hendrick is also second in points for Rookie of the Year.

photo courtesy Dan R. Boyd ©

PacWest Racing's Scott Dixon, who clinched the Indy Lights championship last year, is on his way to winning the CART Rookie of the Year award this year.

CART

PacWest Racing's Scott Dixon (18) continues to hold his own during his rookie season driving Champ cars. Going into the Grand Prix of Monterey, round 19 of 21 races, he sits in eighth place, with a win at Nazareth and five top-5 finishes. Dixon also leads the standings for Rookie of the Year, and is the series leader in laps completed this season, having logged 2,069 of 2,149 laps. Veteran driver Mauricio Gugelmin sits back in 24th position going into Monterey, with only four top-10 finishes this season.

In the Indy Lights series, PacWest rookie Dan Wheldon (1) is tied for second in the standings going into Monterey, a mere 26 points out of first place in the series, and is also tied for the Rookie of the Year title. Teammate Mario Dominguez (17) currently sits in fourth place with three races left in the series.

Ilmor Racing Engines

Ilmor Engineering continues to provide engines for CART, Formula One and the IRL racing series. The Ilmor Aurora engines for IRL competition have proven quite successful this season, with driver Scott Sharp finishing out the year in third place in the points standings.

photo courtesy Ilmor Engineering

IRL driver Scott Sharp, above, autographs a Haas VF-4 at Ilmor Engineering. Ilmor provides the Oldsmobile Aurora engines for Sharp and other drivers in the series.

NHRA

J&B Motorsports driver Todd Veney continues to blast the Haas logo down the strip in the Federal-Mogul Funny Car series; he currently sits in 16th position. As an interesting note, J&B brings a Haas Mini Mill to the track with them to handle any impromptu machining tasks that might arise.

photo courtesy J&B Motorsports ©

C&C Motorsports

Things are getting pretty exciting for the C&C Motorsports crew. Most notably, they've dismantled their Winston West team in order to concentrate efforts on a new NASCAR collaboration between Gene Haas and Hendrick Motorsports. Expect a major announcement soon on the formation of Haas CNC Racing Inc. for the 2002 racing season and beyond.

Out in the desert, Joe Custer and Gene Haas continue to kick major butt in the Best in the Desert Off-Road Truck Series. They currently hold the lead in Class 7100 after winning the recent Las Vegas to Reno race, the longest off-road race in America. With just one race left in the series – the Las Vegas 200 in December – the duo only have to finish in one piece to clinch the championship.

Troy Cline, the other C in C&C Motorsports, continues to tear up the asphalt in the USAC Western States Sprint Car Division. With four races remaining, Troy is ranked third in the points standings.

Haas

Genuine USA

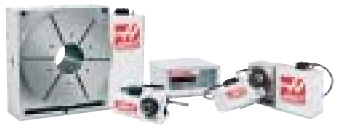
The largest machine tool builder in North America grew from a simple idea. In 1983, Gene Haas developed the first programmable rotary indexer to position parts for machining in his own shop. From that first rotary product through today, our philosophy has remained consistent:

Build the best products possible for the broadest market and offer them at competitive prices.

We have built on this concept for nearly two decades, and to date, more than 32,000 CNC machines and 40,000 rotary products have been sold worldwide. While all these numbers are impressive, they really add up to one simple idea: **Haas is your number-one choice for CNC technology.**

- **45** Haas Factory Outlets
- **120** service vans
- **500** certified service and applications personnel
- **1,700** Haas personnel
- **50,000** customers
- **72,000** CNC products sold
- **820,000** sq ft manufacturing facility
- **$16 million** in local parts inventories

These numbers add up to the largest machine tool builder in the USA.



Rotary Tables and Indexers
- More than 35 models
- More than 40,500 products in the field

Vertical Machining Centers
- 37 VMC models
- More than 26,300 VMCs installed worldwide

CNC Turning Centers
- 8 Lathe models
- More than 4,700 lathes installed worldwide

Horizontal Machining Centers
- 8 HMC models
- More than 1,100 HMCs installed worldwide

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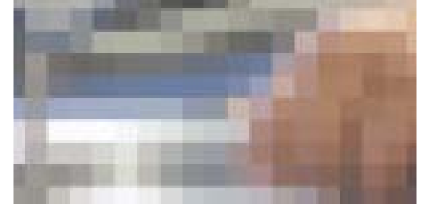


Quantum Leap

In engineering, and manufacturing in particular, the concept of kaizen – the incremental, continuous improvement of a process, product or system – has for some time now been the way forward. A “bearish” approach, to use stock market parlance, but devastatingly effective, as Japanese auto manufacturers have consistently shown.

Story
Matt Bailey

Photos
Scott Rathburn

But whatever happened to the concept of the quantum leap? A dramatic improvement, a substantial change for the better, maybe even a paradigm shift. The bull to kaizen’s bear.

For example, imagine a single development that gave a ten-fold improvement in the efficiency of the internal combustion engine. Considering the number of cars on the road, how much energy would that save? What about ten times more power from jet engines? Cheaper, quicker flights for everyone? How about a silicon chip that could crunch ten times more data than the average? Definitely a quantum leap, even by today’s fast-moving standards.

In fact, a ten-fold improvement in almost anything would make most people sit up and take notice. Which is why oil company executives are sitting up and taking notice . . . of DynaPump.

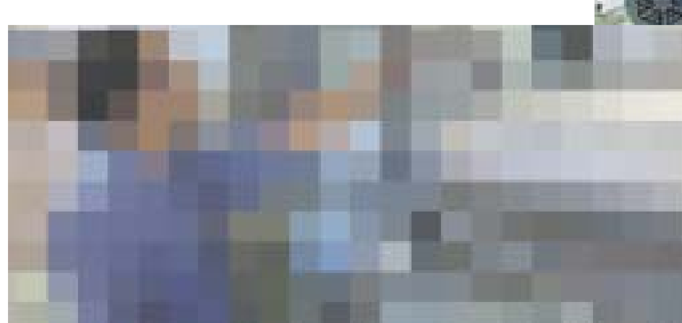
IT’S ALL ABOUT THE MONEY

When it comes to pumping oil, Allan Rosman, president of the Northridge, California-based company, is not a kaizen kind of guy. DynaPump’s range of computerized, triple-cylinder, counterbalanced hydraulic oil pumps brings new levels of efficiency to an activity that has remained virtually unchanged since American oil was first raised in the late 19th century.

“We developed the idea for the counterbalanced hydraulic oil pump in Europe,” says Rosman, “but in 1984, after we’d completed a study of the market, we decided to move to the U.S.” DynaPump Inc. was started in 1993.

“We use pressurized nitrogen as a ‘phantom’ counterbalance,” he continues. “This, combined with ultra-long strokes (up to 360" for the larger pumps) and variable stroke speeds, allows us to pump a lot more oil than traditional beam pumps, using a lot less energy.”

For example, Rosman claims that the energy consumption of a DynaPump unit is one-third to one-half less than running an old-style pump. When you consider that oil pumps run 24 hours a day, every day, and that there are something like 2 million pumps in the world, it’s apparent that the potential energy savings are huge.



“Now, suppose the monthly power cost for a traditional pump is $8,000, and with a new DynaPump unit it’s just $1,000 a month,” says Rosman, “That’s already impressive enough. But now the production is also $100,000 a month more. The oil companies look at the total cash flow.”

And just in case anyone doubts the validity of Rosman’s claims, the numbers are stacking up: DynaPump installations are already working hard in Southern California, where daily flow rates typically exceed 1,000 BFPD (barrels flowed per day). Indeed, some DynaPump units have smashed the world record for total flow from a hydraulic system.

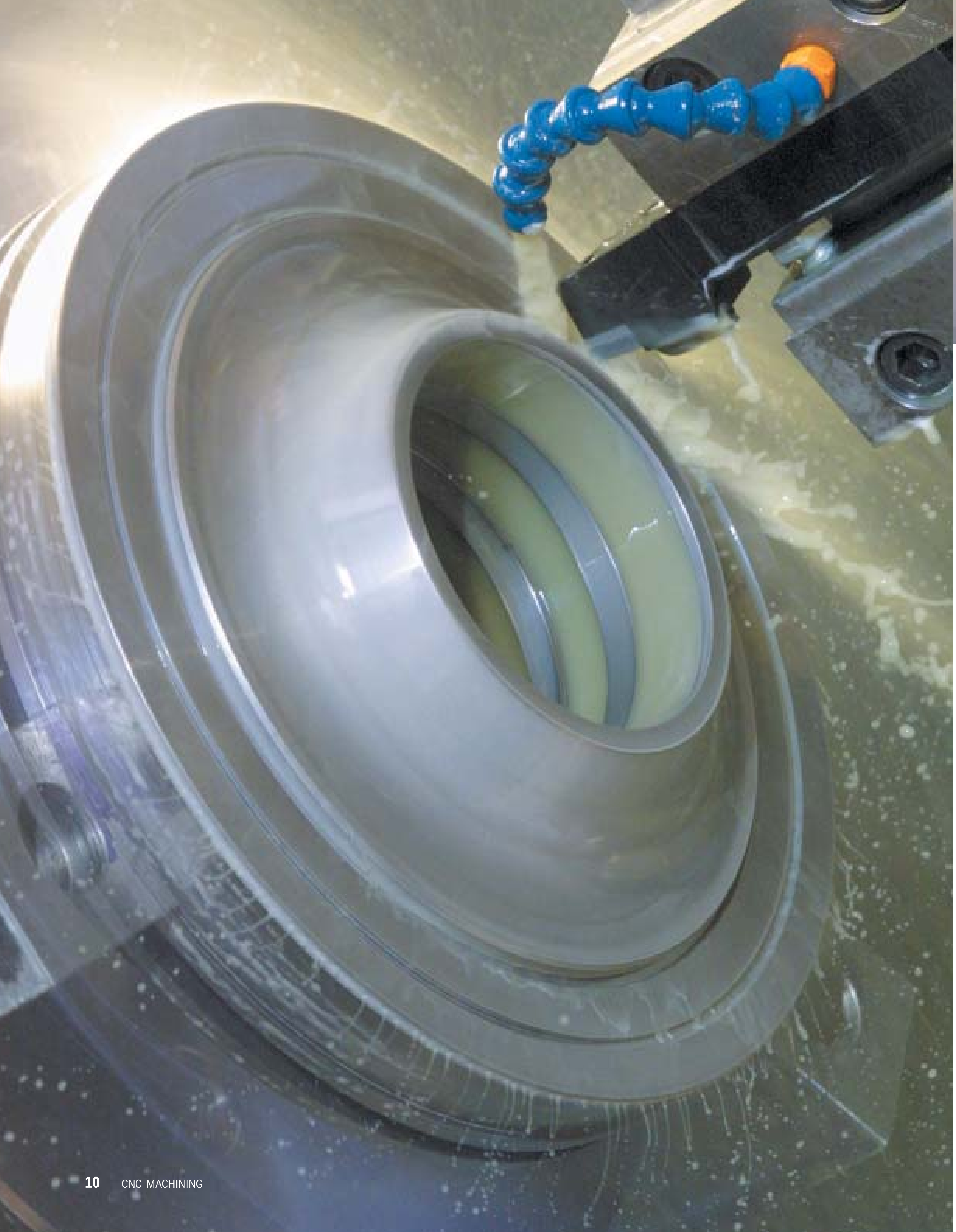
“Then there’s the submersible pump,” says Rosman. “If a traditional submersible pump is consuming 10,000 kilowatts a day, we consume 1,000 kilowatts,” he claims; “a ten-to-one improvement. That’s a staggering amount.”

And you can’t ignore the cost of maintenance: “The submersible pump is difficult to get to,” says Rosman. “Every two years, you’re looking at a $150,000 overhaul. We enter the fray and the annual maintenance cost is just $6,000. So you can see that the pumps pay for themselves very quickly. That’s why we’re talking about a new paradigm. Not just an improvement, a big jump. And, of course, it’s all about the money.”

RAMPING UP

Larry Smith, DynaPump’s vice president of manufacturing, has the task of preparing the company for an imminent and considerable increase in manufacturing capacity. One of the first decisions that he and Rosman made was to make the plunger (the long cylinder in the photograph below) the company’s specialty.

“As production is ramped up, we want complete control over this critical component,” states Smith. “So, we made the decision to bring the machining in-house. This is when we contacted Haas. With their help we worked out the processes, run times, tool changeovers, etc. When we’d



finished, we felt good about the costs – we could buy the machines we needed, make these parts at the right quality and still make a profit."

The Haas Factory Outlet (HFO) in Torrance duly delivered a Haas SL-30 lathe and a Haas HS-1RP. "We wanted the horizontal mill for the pallet changer and the productivity advantages it would bring," says Smith. "We planned to bring more capacity on board as we needed it." It quickly became apparent that the company was going to need bigger machines sooner rather than later, so an SL-40 and an HS-2RP were purchased last year.

The huge plunger arrives turned to size and is loaded into the Haas horizontal by means of two overhead hoists. "We're facing, chamfering, drilling and tapping on the Haas HS-1RP," says Smith. "Originally, we were planning to machine the plungers on a big, CNC long-bed lathe, but now we are convinced that the way we're doing it is much better," he states.

DynaPump was particularly impressed with the speed with which the Haas machines were installed and the support from the HFO and the factory. "When we did have questions or difficulties, things were ironed out very quickly," says Smith. "Also, because we are close to the factory, we had particularly good technical support. We're pushing the envelope a little with some of these applications, so we had a couple of factory guys come over and check things out."

For example, the big nylon pulleys they cut on the HS-2RP are made by a company in Seattle, and initially were being machined by a subcontract machine shop. To have more control over quality, and to make use of available capacity, Smith decided to look for a creative way to machine them on the HS-2RP horizontal mill.

"We're also looking at other components we can bring back in-house, items that we use in the control cabinets, such as manifold blocks. We're in the process of designing an integrated block (hydraulic manifold) in aluminum. These blocks are still in prototype form, but will allow us to dramatically simplify how we assemble the system."

THE SINCEREST FORM OF FLATTERY

Not every fledgling manufacturing company has the advantage of being almost next door to an industry leader.

"We are trying to buy American, wherever we can," says Rosman. "We'd known of Haas for many years, although we'd never done business with them, and have watched the company expand.

"In a way, we want to follow in their footsteps. There are a lot of similarities between our products, our companies and the challenges we face. We've learned a lot from Haas: Keeping the cost down, maintaining quality and manufacturing in high volume. We went to the (Haas) factory, we asked questions, we observed and we could see that, just because the product is less expensive, it isn't compromised in any way."

DynaPump is currently building a 300,000-square-foot factory that will allow production of 4,000 pumps a year. Rosman claims that Haas' rapid expansion to more than 800,000 square feet provides an excellent model for how to cope with such dramatic growth.

NEW PARADIGM

Rosman believes that the question of whether to replace the old beam-type pumps is a no-brainer: "No one does an analysis of whether to buy an electric typewriter or a word processor anymore. It's a waste of time," he says. "There's no argument and no need for analysis. The advantages are so great that no one buys an electric typewriter. The same will be true for our pump. That's what I mean by a new paradigm."

Although the public may perceive oil companies as being bullish organizations, the people DynaPump must convince are not typically known for rash decisions. "We have to show these people that the numbers for our machine are dramatically different," says Rosman. "Not that the machine is different, because that doesn't matter, but that the numbers are different. We come in with such different numbers that you can throw the old pump away and put us in."

If the history and success of DynaPump's Oxnard-based role model is anything to go by, it won't take long for the decision makers in the global oil companies to realize: The oil pump is dead. Long live the oil pump.

DynaPump, Inc.
818-407-7577

Oil!

Tar. Pitch. Bitumen. Asphalt. Naphtha. Petroleum.

Derived from the Greek *petra*, meaning rock, and the Latin *oleum*, meaning oil, the word petroleum literally translates to rock oil. Logically so – the first discoveries of oil were natural seeps along fault lines and cracks in rocks. In some areas, these seeps occurred in creeks, ponds and marshes, with the oil collecting on the surface where it could be easily gathered.

Though oil is arguably the lifeblood of modern civilization, it is by no means a modern discovery. It has been around – and been used by man – since prehistory.

story and shop photos by Scott Rathburn

Ancient civilizations found the substance useful for medicinal purposes, waterproofing and bonding things together. As early as 4000 B.C., the Sumerians used asphalt as mortar for building, and to inlay mosaics in walls and floors. The Mesopotamians used bitumen to seal joints in wooden boats, line canals and build roads. The Egyptians used pitch to grease their chariots, and asphalt to embalm their loved ones. In North America, Native American Indians used crude oil as body paint and for ceremonial fires, and Alaska natives burned chunks of oil-saturated rock as fuel.

Petroleum has always been a multi-purpose product.

By 1500 B.C., petroleum was being used as a source of light: Firepans were filled with liquid oil of the right volatility to burn slowly, without excessive flame or the danger of explosion. Much later, the Romans used a variation on this theme as a weapon of war, launching flaming containers of oil at their enemies.

The Chinese discovered the first underground deposits of oil in salt wells, and in 600 B.C., Confucius wrote of wells 100 feet deep yielding water and natural gas. To transport the oil and natural gas from the wells to where they were needed, the Chinese built extensive bamboo pipelines.

Also around 600 B.C., oil was being extracted for everyday use from the Absheron Peninsula on the Caspian Sea – in present-day Azerbaijan – both as fuel oil for heating and lighting, and for medicinal purposes.

Azerbaijan is the oldest oil-producing country in the world; its name means “the land of fire.” This is due largely to the naturally occurring naphtha springs and gas seepages in the area, which often caught fire. This led the Zoroastrians, who believe fire is holy, to build numerous fire temples there. The fire temple at Baku is thought to be older than recorded history, and as late as 1880, it was still being tended by Zoroastrian priests from India. The fire temple in Surakhany, a suburb of Baku, still stands today.

The first oil wells were quite primitive: Pits several meters deep were dug by hand in areas of natural seepage. The oil simply bubbled to the surface and was extracted with a system of buckets and pulleys. This method was being used on the Absheron Peninsula as early as the 10th century, and remained that area’s predominant method of oil extraction until the early 1870s.

Crude oil ranges in color from almost clear to green, amber, brown or black. It can be as thick as molasses, or flow as freely as water. Depending on the presence or absence of sulfur and other impurities, it is often referred to as “sweet” or “sour.” It is refined into the products we know and love through the process of distillation, in which heat is used to separate the crude into its constituent parts.

The refining of seep or crude oil has a long history, beginning as early as the 13th century in Azerbaijan. At that time, low-density oil fractions were obtained for use in indoor and outdoor lighting – these burned with less soot and smell than seep oil. During the eighteenth and nineteenth centuries, whale and other animal oils were the primary fuels for lighting and lubrication. But as whale populations decreased, these oils became very expensive, and the demand eventually led to the near extinction of several species of whale.

The invention of the kerosene lamp in the 1850s changed everything almost overnight. The public readily switched to the new fuel – it was cheaper, easier to produce, burned cleaner without the smell of animal-based oils and did not spoil, as whale oil did. The discovery that a cleaner form of kerosene could be easily distilled from crude oil – rather than from coal and bitumen, the primary source of the fuel in North America at the time – kicked off a major search for oil. New sources had to be found to meet the growing demand.

Much later, the Romans used a variation on this theme as a weapon of war, launching flaming containers of oil at their enemies.

The first modern oil well (not dug by hand) was drilled by a Russian engineer, F. N. Semyenov, in the Bibi-Eibat area of the Absheron Peninsula in 1848 (although there is evidence the Chinese used bamboo poles with bits attached to drill wells as early as 347 B.C.). By 1854, oil wells 30 to 50 meters deep were also being drilled in the Carpathian mountains of Poland and Romania. In 1858, a major oil field was discovered in Ontario, Canada, while digging for a source of drinking water. And in 1859, near Oil Creek in Titusville, Pennsylvania, Edwin Drake drilled the first well in the United States specifically in search of oil. Plagued by delays, technical difficulties and financial problems, the venture became known as Drake’s Folly . . . until the well struck crude at a depth of only 69.5 feet.

The Drake well is often mistakenly referred to as the world's "first oil well." While it wasn't the first, it was probably the most important to the U.S. oil industry. Not only did it kick off the first American "black gold" rush, but it was also the first well to use drive pipe. By driving ten-foot lengths of cast-iron pipe down to bedrock, Drake was able to protect the upper hole of the well from collapse, so the drilling tools could be safely lowered to the bottom.

The increasing demand for kerosene as an illuminant, combined with the growing supply of crude oil made possible by new drilling techniques, quickly led to the need for refineries in the U.S. and abroad. By 1860, at least 30 kerosene plants were in production in the U.S., and by 1873, about 50 oil-refining plants were operating in Baku.

Demand for kerosene remained high until 1878, when the invention of the electric light bulb pushed the kerosene lamp by the wayside, extinguishing the volatile liquid's commercial flame. The oil industry went into recession.

Despite this, there still was a need for other petroleum products – the machines of the Industrial Revolution still required fuel and lubricating oils. But it wasn't until Karl Benz and Wilhelm Daimler introduced their gasoline-powered automobiles in Europe that the oil industry truly came of age.

Gasoline was just a waste product. At best, it was used as a cheap solvent – at worst, it was deemed worthless and thrown away.

Prior to this, gasoline was just a waste product of kerosene distillation. At best, it was used as a cheap solvent – at worst, it was deemed worthless and thrown away. By 1910, however, America was enthralled with the automobile, and by 1920, millions of cars were already on the road.

Today, gasoline is what drives modern society. It is the hydrocarbon elixir that gets us from point A to point B. Through the use of advanced distillation methods – heat, pressure and catalysts – modern refineries can convert more than half of every 42-gallon barrel of crude oil into gasoline, compared to just 11 gallons of the precious fuel in the early days.

Today's oil industry is a far cry from what it was in the 1800s and 1900s. Modern oil rigs hardly resemble the wooden derricks of yesteryear, and drilling techniques have advanced from hand-dug pits, to spring poles and cable tools, to the modern-day rotary drilling rig.

Currently, there are approximately 1,275 active rotary drilling rigs in the U.S., both on land and offshore, producing more than 5.8 millions barrels of crude per day. Yet, according to the American Petroleum Institute, the U.S. still imports nearly 60 percent of its oil.

With gas prices soaring above the $2.00-per-gallon mark in California this past summer, and rising nearly as high throughout the rest of the country, the

Please, God, let there be another oil boom . . . I promise not to piss this one all away!

need for America to curb its reliance on foreign oil has, once again, come to the fore. As a result, domestic oil production and exploration are on the rise.

Historically, every increase in oil exploration and production has brought with it an increase in demand for machining. Many machine shops in oil-producing states are already starting to reap the benefits of the current boom. This is clearly evident in Louisiana, where machine shops abound, and a high percentage of them are doing oil field work.

Louisiana is the third largest producer of petroleum in the U.S., and ranks third in refining. Much of the state's oil production comes from the Gulf of Mexico, which is one of the most fertile offshore fields in the world. We visited three Louisiana machine shops to see how, and what, they're doing these days.

For Southern Technology & Services, Inc., in Houma, about 40 miles southwest of New Orleans, jack-up systems for offshore oil rigs are a mainstay. Jack-up systems, or jacking rigs, lift a drilling platform out of the water once it has been floated into position. They work much like the lift rack at an auto mechanic shop, except they lower legs to the ocean floor first, before lifting the platform.

Southern Tech has been doing oil field repair work since 1964. Their current facility occupies 30,000 square feet, about one third of which is machine shop, with the remainder being mechanical engineering and welding. At present, the company has only two CNC machines – a Haas VF-9 50-taper VMC with an HRT 450 rotary table, and a CNC turning center from another manufacturer. The rest of their machine tools are manual, including several long-bed lathes and a large horizontal boring mill.

The CNCs were brought on board primarily for production machining of gears for the jacking systems. These gears account for about 50 percent of Southern Tech's work load.

"The CNCs rose out of a need," explains Bryan Bunn, one of the owner's four sons working at Southern Tech. "We were having to send one of the products we manufacture to Seattle for machining. We purchased the Haas to bring that process in-house, so we could save ourselves some money, and better service our customers with quicker turnaround times."

Why Seattle?

"One of the gears we make has a two-thirds diametrical pitch on the tooth," Bunn says. "There are only two hobbing machines in North America that have the cutters to cut the tooth – one in Seattle and one in Canada. We did some research and found that we could profile the gear on a CNC, rather than having it hobbed. The money it saves logistically is just tremendous."

Southern Tech worked closely with the local Haas Factory Outlet (HFO) in Lafayette to select the right machine and prove out the process. "We pretty much did a turnkey for them, with all the testing, to make sure we could do what they wanted to do," says Pat Kane, president of the HFO. "We ran several prototype gears in our showroom, and basically had the programs ready to go for them."

Southern Tech manufactures five different gears for jacking systems, ranging from a 76-tooth gear to an 8-tooth gear. The 8-tooth is the one that led to the purchase of the Haas.

The raw material for the gears (4340 alloy steel) comes in two forms – as solid bar stock in an annealed state, and as rough-cut forgings, where each dimension is up to 1 inch oversize. First, the ODs are roughed out to 100 thou' oversize for heat treat, and the gear diameter is turned to size. Then, the blank is fixtured between the HRT 450 rotary table and a tailstock on the Haas VF-9/50. The gear is then machined in a single operation.

> "There are only two machines in North America that have the cutters to cut the tooth – one in Seattle and one in Canada. We did some research and found that we could profile the gear on a CNC, rather than having it hobbed."

"We go down with an endmill first," explains Dustin Theriot, CNC administrator, "and start roughing it out. Then, we go in with a ball mill and profile the tooth shape specified for that gear. Then we use a finish mill to cut the gear to size." At that point, the gear goes out for heat treating, after which the ODs are turned to size on the lathe, and a keyway is cut on the mill.

By optimizing tooling and feedrates, Theriot says they have cut the cycle times on the 8-tooth gear from 18 hours to 8. "So we've tripled our production," he says, "and we're looking to increase it more. We'd like to get it in the 5- to 6-hour range. Time is money in this business."

Another portion of Southern Tech's business is repair work. Many of the larger oil field components, such as blowout preventers (BOPs), flanges, studded tees, crosses and bearing liners, don't get replaced when they wear, they get repaired. These components are often large forgings, and the only areas that wear are the sealing surfaces or contact points. Rather than replace the entire component, it is easier and less expensive to weld new material to the worn surfaces and machine them to the proper tolerance.

"We didn't think we could use CNCs for repair work," says Bunn. "We thought they were only good for production. It wasn't until we brought them in for production work that we realized, wait a minute, we can do repair work on them. Now, a lot of what we do on the Haas isn't manufacturing – there's something in there being repaired.

"Eventually I'd like to see about a fifty-fifty mix, where we could continue doing the work we've done in the past that's been profitable, and do large production runs on items that we *haven't* done in the past, but the CNCs have enabled us to do."

This will also help insulate Southern Tech from the inevitable bust that follows every oil boom. "There are some things that happen in the oil field that, even

when things are bad, they still need parts," Bunn explains, "especially on the production end. That's where you get the large production runs – on tees and crosses and flanges and things like that. They have to maintain their production facilities.

"I wouldn't say it's constant," Bunn cautions, "it will drop off, but not like the drilling end. When drilling dries up, it dries up – it's dead. Production's not like that."

According to Southern Tech's Ronnie Broussard, they've already had good success with one such product: "We were losing a serious amount of money on the first parts doing them on a manual machine," he says. "We're now making money on the same part with the Haas."

"It's a production block," adds Bunn, "a twelve inch by twelve inch by twelve inch steel block that's drilled into a tee, with ring grooves and a bolt pattern around each hole. We've taken some of the processes from an hour and a half down to several minutes, which, at the end of the month, is a direct reflection on the bottom line."

"There are some things that happen in the oil field that, even when things are bad, they still need **parts**, especially on the production end."

Just up the road, in Lafayette, is TomaHawk Enterprises, Inc., a company that specializes in mud motors, transmission couplings, bent housings and various subs for directional drilling (subs, or substitutes, are adapters for connecting parts of the drill string that otherwise could not be screwed together because of differences in thread size or design).

In rotary drilling, cutting is accomplished by a rotating drill pipe with a bit attached to the bottom of it. A hydraulic- or electric-powered turntable rotates the pipe, and the bit cuts or breaks up the material as it penetrates the rock formations. As the hole gets deeper, lengths of drill pipe are added to the string. To remove the cuttings from the hole, drilling fluid, or mud (a mixture of water, clay, weighting material and chemicals), is pumped under pressure through the rotating drill pipe and through holes in

the bit (much like through-spindle coolant in a machine tool). The mud swirls in the bottom of the hole, picks up the cuttings and carries them to the surface. The mud also cools the bit, lubricates the drill string and creates hydrostatic pressure in the hole to prevent it from caving in.

In directional – or horizontal – drilling, the straight drill string is stopped, and a bent housing, which provides up to 3 degrees of bend, kicks the bit off at an angle to begin the arc for the horizontal hole. Since the drill pipe can no longer rotate to drill, the bit must be driven by other means. This is where the mud motor comes in.

A mud motor basically consists of a power section (a progressing-cavity pump that acts as a motor when drilling mud is forced through it under pressure), a bent housing, a series of transmission couplings, a bearing section and, finally, a rotating bit box and mandrel. The pressure of the drilling mud flowing through the pump turns the rotor of the power section, which drives the transmission couplings. The transmission couplings provide flexible torque transmission through the bearing assembly to the bit box and mandrel, thus providing rotation to the bit.

TomaHawk makes mud motors. They manufacture all of the components except for the power section. The company was founded by Tom Falgout Sr. in 1991. "I got involved with mud motors at the last place I worked," Falgout explains, "and I got enthralled with them. I'm an engineer – I have a Ph.D. in mechanical engineering – and an inventive-type person. I came up with a couple ideas for mud motors that I patented. I started off trying to design motors for other people. Then, after about a year," he continues, "my son joined me, and we decided that the only way to do this right was to be in total control of our own destiny – to manufacture our own products."

> "Our niche is providing innovative engineering services to these smaller companies. We make products available to them that they couldn't get otherwise."

Since most of the major oil companies have their own engineering staffs, they're not that interested in TomaHawk's products. TomaHawk caters more to the little guy. "There are a lot more rigs running out there now," says Falgout, "and a lot more new companies, smaller companies. Our niche is providing innovative engineering services to these smaller companies. We make products available to them that they couldn't get otherwise."

All of the components TomaHawk manufactures are machined out of alloy steel materials to withstand the rigors of drilling. Outer housings – drive housings and bearing housings – are machined out of 4140 and 4145 alloy steel. Components for the transmission couplings, called drivers and drivens, are machined out of heat-treated 4140 (32-38 Rc), and the ball seats and catches that hold the drive couplings together are machined out of 9310, then carburized.

TomaHawk currently manufactures nine different sizes of mud motor. "We have sizes ranging from one and eleven sixteenths to nine and five eighths inches," explains Chad Daigle, mechanical engineer at TomaHawk. "What size motor they're going to use depends on the size of the hole they want to drill."

Although TomaHawk started out as a manual shop, they began switching to CNC in 1994, when they moved from a smaller shop to their current location. Their present lineup of machine tools includes a 50-taper Haas VF-5 VMC and a Haas SL-30 Big Bore lathe, as well as several other CNC and manual machines.

One of the challenges in oil field work is cutting accurate API threads. In the early days of oil exploration, each oil company had its own specific thread for drill pipe and fittings – there was no standardization. Eventually, there were so many different threads that the American Petroleum Institute (API) stepped in to regulate them. Today, API threads are pretty much the industry standard.

What makes these threads challenging is that they have a very steep taper (2–3 inches per foot) and must hold a tight tolerance on both pitch and taper. Daigle explains: "Let's look at a two and seven eighths inch API regular. This is a real standard pin (male) connection. The pitch tolerance is one and a half thou' per inch, and the taper tolerance is two thou' per inch." The ability of a machine to cut these threads accurately is essential, Daigle says, "or the machine would be worthless to us."

When TomaHawk first got their Haas SL-30 BB lathe, they had some problems cutting the API threads on the machine. "The first time we sent parts to QC, the taper and lead were off," notes Daigle. They called their local Haas distributor, the HFO in Lafayette, and a service technician responded immediately. "The service was great," say Daigle. "They came out as fast as we could call."

Working closely with Haas headquarters in Oxnard, California, the HFO service technician diagnosed the problem as a software bug. New software was issued, and the problem was solved. Now, says Daigle, “It [the Haas] cuts a pin connection with no problem, and the service is the best we’ve seen between the three machine brands we have.”

Falgout agrees. “We’re getting good production out of the Haas, and from a maintenance standpoint, Haas has been much better than the other companies. That’s a real plus. Good service is a must, just like in my business.”

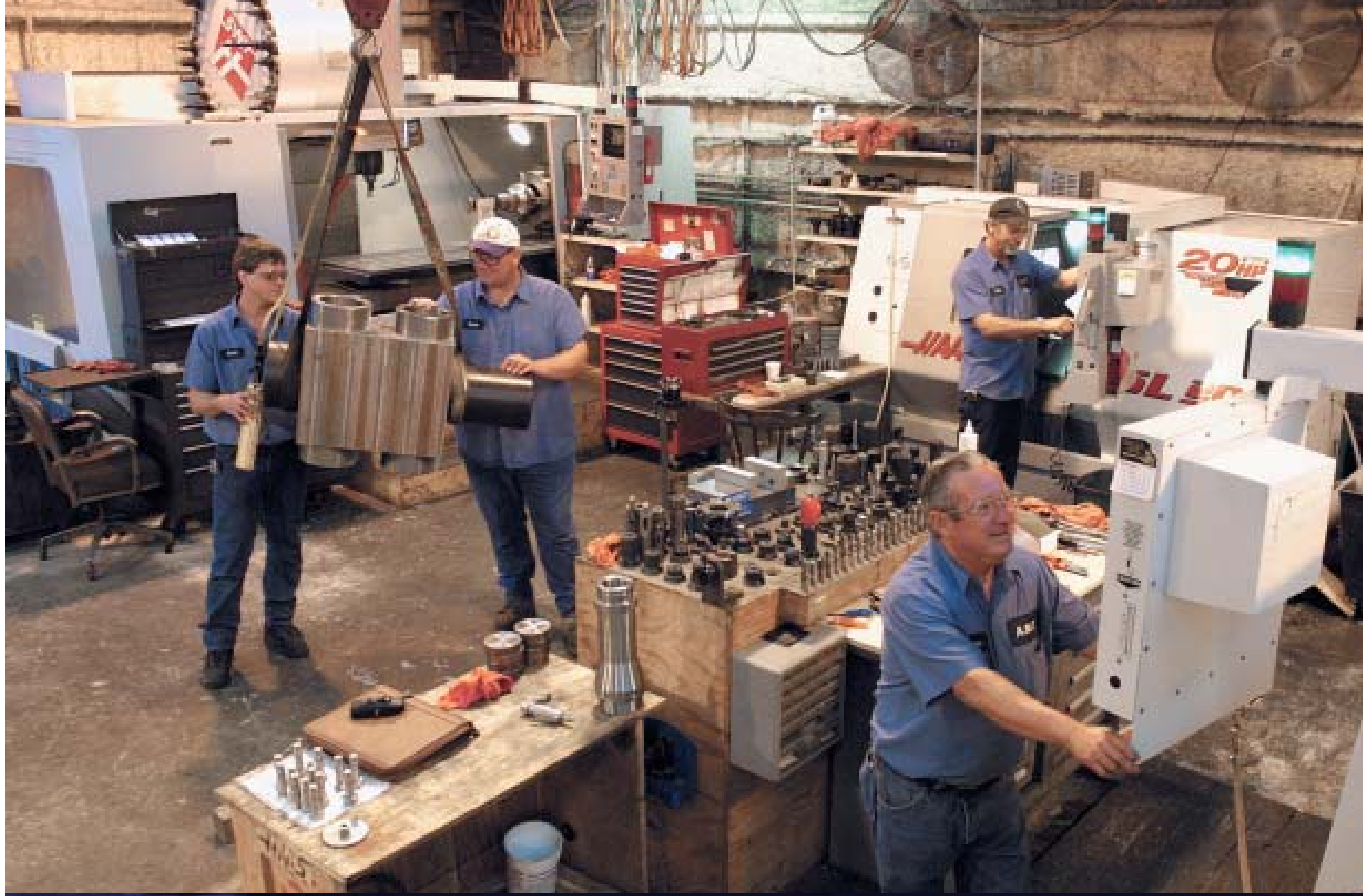
TomaHawk cuts the driving ends of their transmission couplings on the Haas VF-5/50, using an HRT 310 4th-axis rotary table to do the machining in a single setup. “The 50-taper allows us to run some of the bigger parts faster,” says Daigle. Bent housings and drive housings are also cut on the VF-5, as well as some of the ball seats and catches. “I could see us buying a Mini Mill to cut those ball seats and catches,” Daigle notes. “We have a company in Dallas that’s making them for us by the thousand. We could stuff a Mini Mill in a corner and run those things non-stop; we use that many of them.”

More machines are a definite possibility for TomaHawk, says Falgout. But a lot depends on what happens in the oil industry. “The oil field is a fickle industry,” he says. “If it stays healthy for awhile, we’ll probably find a bigger facility and add more equipment.”

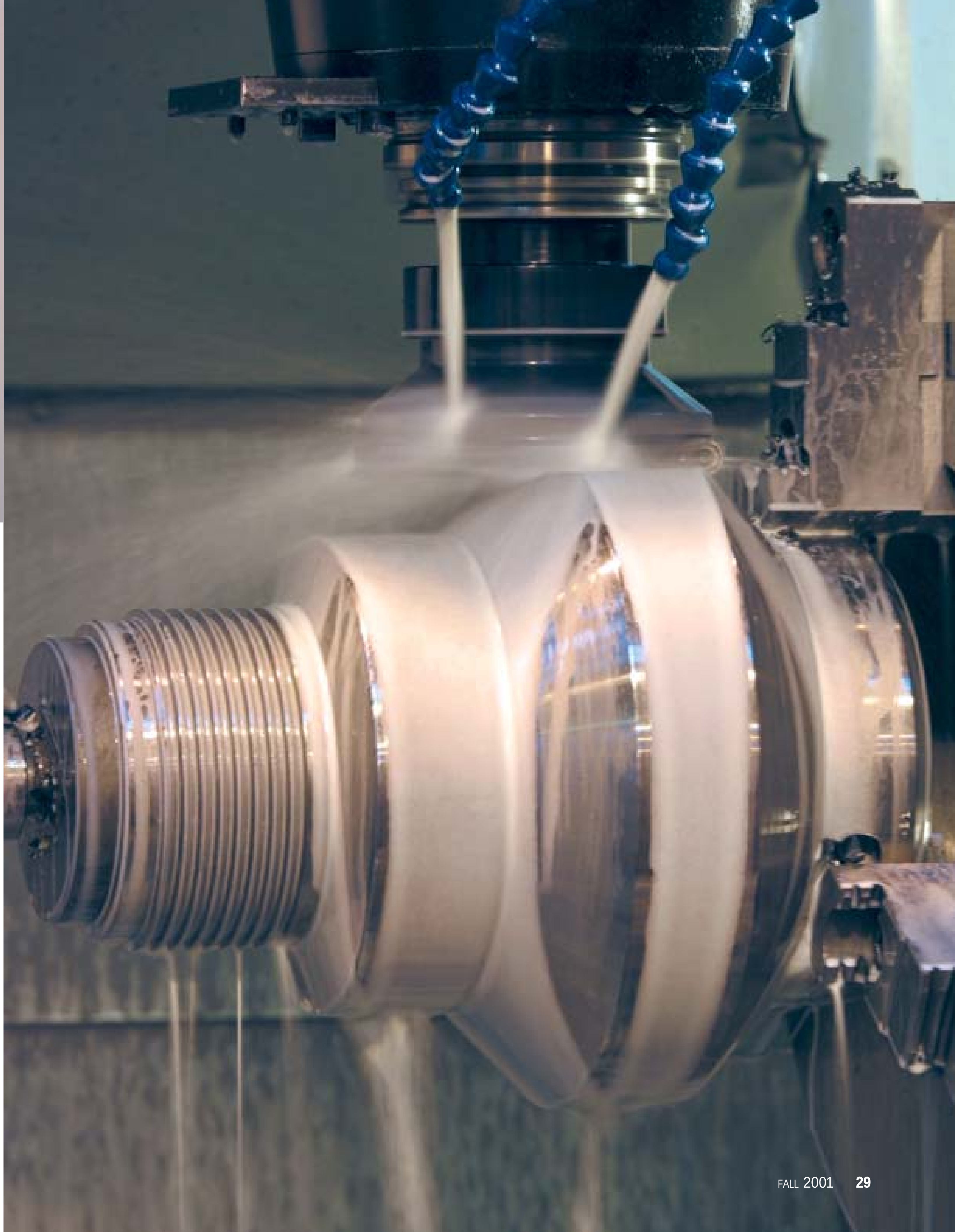
Advance Manufacturing Technology, Inc. (AMT), is located in Lake Charles, near the western border of Louisiana. At present, about 98% of their work is oil field related. “We used to do more work for the refineries,” says owner Brian Leeth, “but we really don’t call on them any more. We do more manufacturing now – blowout preventers, pack-off equipment, a lot of pressure equipment – and we build the accessory tools for different parts of the oil field, such as sub-sea equipment for deep water drilling.”

AMT started in 1987 as a fully manual shop, but began buying CNC machines around a year later. Since much of oil field machining is tubing work, their first CNCs were lathes with large through-holes – they bought a 5.25"-hole Leblond at auction, and later a 9"-hole Leblond.

It wasn’t until 1997 that more CNCs entered the picture. “We were doing our BOPs,” Leeth explains, “and subcontracting out some of that work. One of the companies we were working with gave us a quote to run the rams (an internal part of the BOP) for us, and we didn’t like the looks of the quote. I said: Well, shoot, by the time I pay them to run all the parts, I’ve got half the cost of a machine. Quick, buy a machine!”



“Parts you shouldn’t do on the machine? We did those parts on the machine. We pushed it way over its limits, and we’re happy with it. It soon got to the point where we didn’t have enough machine time to run everything. We needed another machine.”



Leeth contacted Machine Tools, Inc. in Lafayette (now the Haas Factory Outlet), which had a Haas VF-4 vertical machining center in stock. "I'd been buying equipment from Pat (Kane, president of the HFO) for years," says Leeth, "so he was my first call. I had looked at Haas machines before – they've got good pricing, and lots of torque – so we bought that one."

Once the machine was on the floor, AMT put it to good use. "We started doing the rams for the blowout preventers," says Leeth, "and the accessory parts, and the slotting and the . . . It got to the point where we looked back and asked, How did we ever do without it? We pushed that machine way more than its capacity," he adds. "Parts you shouldn't do on the machine? We did those parts on the machine. We pushed it way over its limits, and we're happy with it. It soon got to the point where we didn't have enough machine time to run everything. We needed another machine."

To satisfy their need, AMT purchased a Haas VF-7 VMC and an SL-20 turning center. As often happens when adding CNC equipment, the increase in capacity and capability led to more work.

"It allowed us to bring in a different kind of work," says Leeth, "and more of the same type of work. It gave us capabilities that we didn't have before. We started out as a job shop, cutting connections and doing repair work on farm implements and heavy equipment. We've moved away from that and into manufacturing. These machines have helped us accelerate that growth."

The latest addition to AMT's machine tool arsenal is a new Haas HS-3R horizontal machining center with built-in 4th-axis platter. The large size of the machine (150" x 50" x 50"), combined with the 4th axis, allows them to machine their larger BOPs in fewer operations.

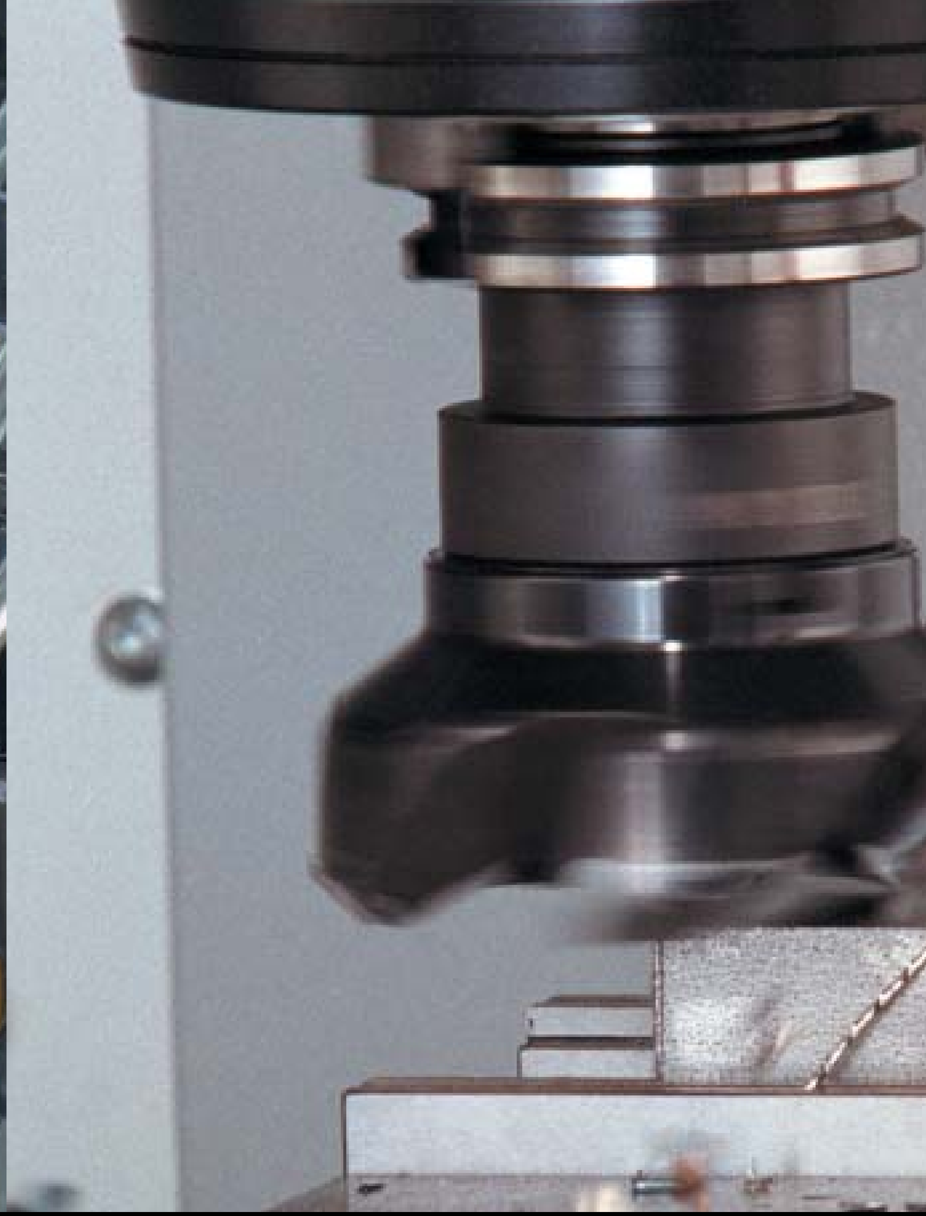
"Our growth areas now are in pressure equipment – the quality of our pressure equipment plus the delivery time of our stuff. And that's why we've bought the HS-3R – it's larger, has better capacity and a higher production rate, and it means we don't have to send anything out to anybody else. The work doesn't leave here, and that's where we're trying to get."

With the petroleum industry as unpredictable as it is, being self-sufficient is probably a good place to be for a machine shop, especially if it relies on oil field work. As AMT's Brian Leeth says, "We can't control everybody else; we can only control what's here."

Southern Technology & Services, Inc.
800-256-1871

TomaHawk Enterprises, Inc.
337-237-5292

Advance Manufacturing Technology, Inc.
337-433-3489



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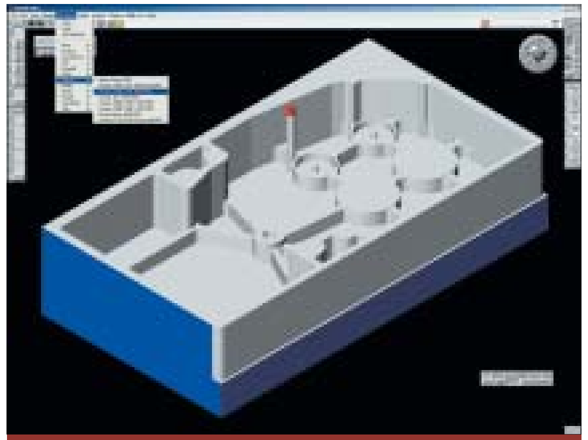
HAAS

Protecting the Business Jewels

Story
John Callen

Manufacturers pride themselves on their responsiveness, their consistency and the quality of their product. Certainly, any manufacturer with these traits is bound to be extremely competitive and command a share of the market. To keep their edge, many manufacturers are upgrading their tools. This includes moving to computer-aided manufacturing (CAM) applications to create programs for their computer-numerically controlled (CNC) machine tools. The expectation is that CAM will not only help them remain competitive, but will give them a clear advantage.

But there is no such thing as push-button CAM, where the CNC program for a given part is instantly created at the push of a button. Instead, today's CAM systems are tools. Like any tool, the actual results are significantly influenced by how it is used and the skill of the user.



Storing standardized processes by process type allows for easy retrieval.

In a typical CAD/CAM scenario, digital models from computer-aided design (CAD) systems provide the part geometry to be machined, and corresponding engineering drawings provide the part's product specifications. It is up to the CAM user to review the geometry and the drawings and make process decisions when creating the part programs. With each new job, the CAM user accumulates more knowledge about the manufacturer's machine tools, the tooling and how best to make use of them. These bits of knowledge are the manufacturer's business jewels.

In today's marketplace, these business jewels are the rarest of all. Experienced machinists are hard to come by, and harder to retain. The new crop of machinists is always relatively inexperienced, especially when it comes to the ways of a particular manufacturer. The knowledge stored in the minds of a company's experienced machinists and programmers – the company's assets – can easily walk right out the door. Some CAM systems, though, can help protect these business jewels.

Process-based CAM systems – systems that focus on the process-engineering nature of CNC programming – are ideal tools for production machining. They allow the user to define highly optimal manufacturing processes to minimize machine cycle time, tool changes and setup. They also have the ability to store and retrieve process data. It's this "stored processes" functionality that can be used to leverage and protect a company's manufacturing expertise.

Building a repository of process information with a CAM system often starts in a very informal fashion. Individual programmers realize the power of this capability and begin to save favorite processes into personal directories for use on later jobs. This is very similar to the process notebooks many programmers maintain – except in a digital format. The goal is to improve their overall programming speed by reapplying existing processes to create part programs very quickly. Eventually, the programmers start sharing processes with each other, and the popular ones begin to be widely adopted, creating an ad hoc standardization. Individual expertise is recognized and shared throughout the group.

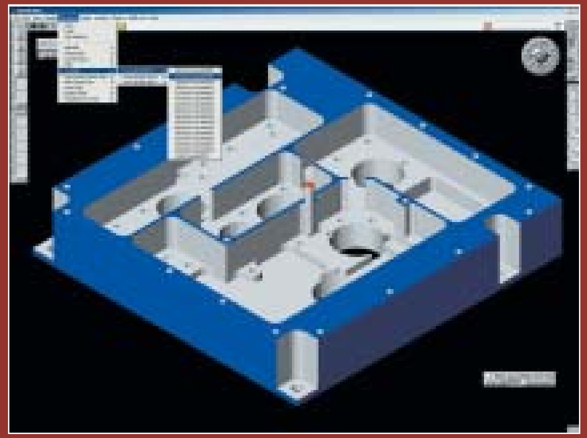
When used in conjunction with a CAM system's multiple-process programming (MPP) capability, the performance improvement of these stored processes is enhanced even further. MPP applies multiple processes – such as center drill, drill and tap, or rough, semi-rough and finish – to the same geometry, maintaining full associativity. These stored MPP processes are extremely powerful manufacturing recipes that accelerate programming dramatically.

But the use of stored processes needn't be done in such an informal, ad-hoc way. Many companies recognize that storing and reusing processes goes beyond just faster programming – storing approved or validated processes in a repository creates a knowledge base of manufacturing expertise. By centrally locating the process repository on a computer network, it is accessible to all programmers. As the information is reused, a level of consistency and repeatability is ensured across the entire company. These standardized processes minimize the variability between programmers, and take the guesswork out of determining which processes to use.

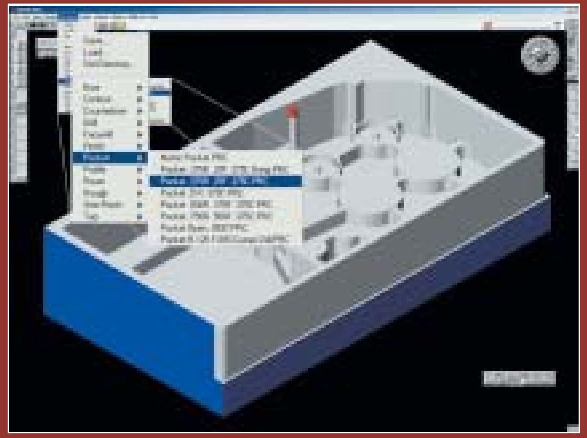
A collection of standardized processes can also be invaluable when bringing new programmers up to speed. Rather than having to develop their own processes from scratch, or rely on mentoring from more experienced programmers, new programmers can access the knowledge base and select the recommended processes for a job.

A CAM system with a directory-based, stored-process capability allows manufacturers to build substantial knowledge bases that can be easily expanded, without the need for highly specialized knowledge engineers. Since the mechanism to store and retrieve processes is so straightforward, the users themselves are the knowledge engineers. Much like dividers in a programmer's 3-ring binder, a directory structure is defined to partition the process information into manageable sections. In some companies, the responsibility for maintaining and populating the process knowledge base is not left up to the general users. Rather, a group or individual is assigned to validate processes prior to loading them into the knowledge base.

Please see JEWELS page 40



Standardized tooling is the simplest form of reusable manufacturing information.



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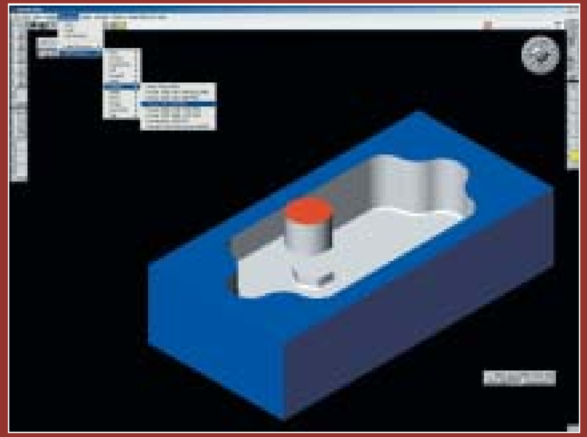
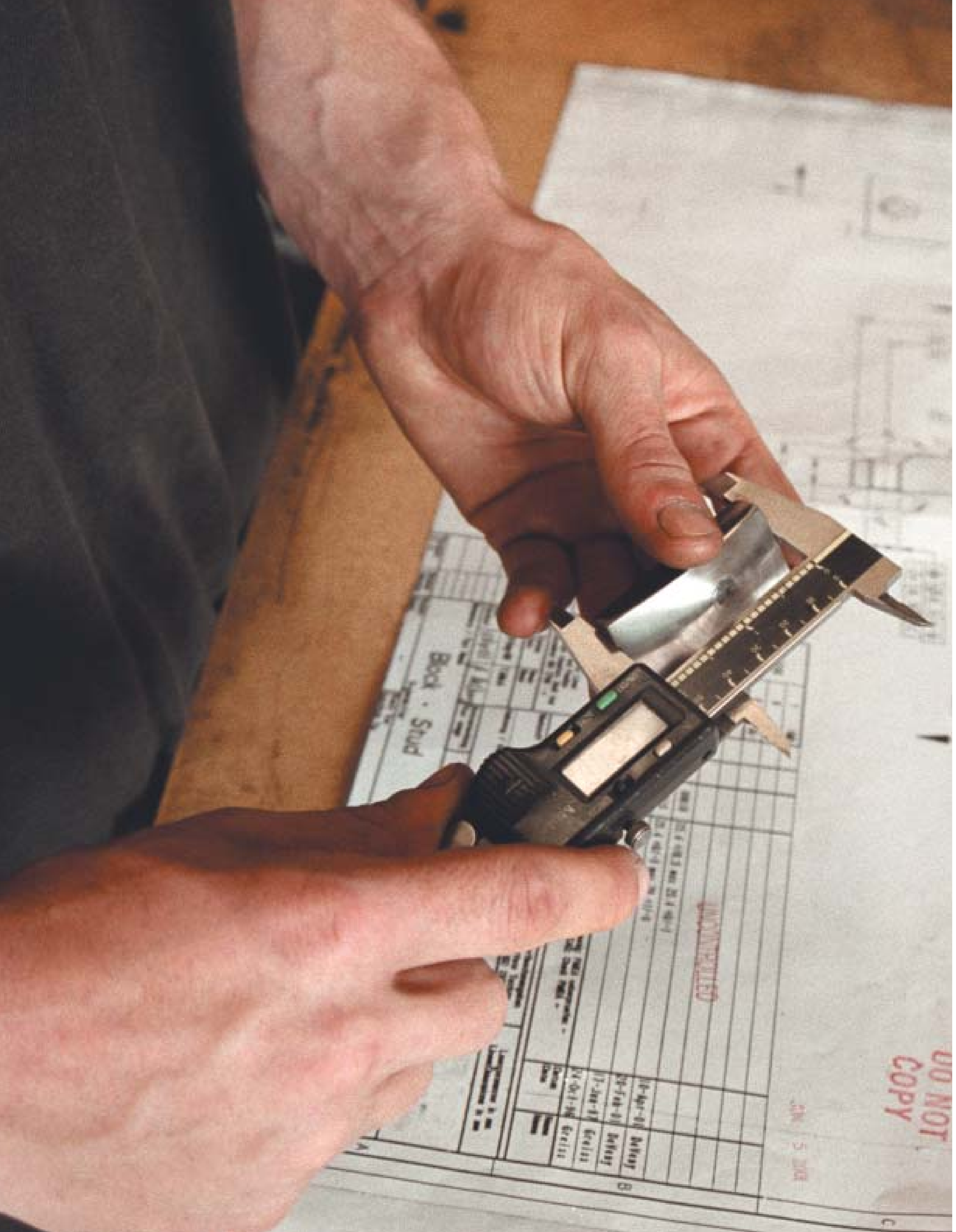


Storing standardized processes by machine type supports machine tool differentiation.



Defining a Good Setup

With today's rapid advances in machine tool technology, machine shops have access to more choices and options in setup configurations than ever before. Multi-axis machines, once the workhorses of high-end shops and OEMs, now have a welcome home in medium and small shops. Thanks to machine builders like Haas Automation, these machines are affordable, accessible and dependable.

Story
Maria Maldjian-Navarro

Photos
Sherry Markle

Multi-axis machining, coupled with the ever-increasing choices of cutting tools, gives shops increased versatility in machine tool setups. It would be wonderful if time and money were of no concern. Shops could sample different setups using the newest and best inserts and toolholders, and the capability of the machine would be the showcased product. Alas! While these machine tools are unquestionably works of technological art, and while it is exciting to watch them perform in full multi-axis, multi-spindle action, they are first and foremost capital investments – they are primarily on the shop floor to generate profits.

How, then, should shops decide what is the best setup on a job-by-job basis? The purpose of this article is not to respond to this question with hard and fast rules. Rather, it is to initiate a dialogue to help manufacturing companies maintain – or possibly reclaim – profitability through practical setup decisions.

Many times a particular machining job can be set up several different ways.

THE GOLD STANDARD

Material is fed into the machine and a finished part drops into the parts catcher or onto the conveyor – this is the "gold standard" of machining. No secondary operations, no burrs, no handling – just push the button and out comes a perfect part. There is a great deal of merit to the gold standard. Consolidating operations into one setup minimizes secondary operations and frees operators from handling and rehandling parts, and possibly damaging them in the process. It also eliminates variables associated with performing subsequent operations, where parts must be referenced properly from previously machined dimensions.

Multi-axis machining has elevated shops to a new level of productivity, quality and

CNC programmer Jeff Mauney, front, programs the machine for the second operation on a part while operator Michael Lail changes over the setup.

efficiency, by enabling parts to be processed in one operation where multiple operations were once the norm. But, is the gold standard always the most practical way to run a job? As any accountant will tell you (notice it is the accountant and not necessarily the setup person), the best way to process a job is the one that takes raw material to finished product in the least amount of time, and with the least amount of tooling and labor expense. The gold standard is usually most profitable when running higher volume jobs, where trained operators, dedicated tooling and gauging and well-established tool-life studies streamline and maximize the production process. However, many shops today have a mix of high- and low-volume production. What factors, then, should be considered when jobs can be set up either conventionally or using the multi-axis tooling functions of the machine?

PROFIT, PROFIT, PROFIT

First, as any shop owner knows, jobs have to be run profitably – all the time. With razor-thin profit margins being cut further by off-shore competition, and the continued shortage of experienced help, shops must run profitably in order to survive and grow. Especially for job shops, the only chance to run a part profitably is often the first time, since there may never be a second order. The goal of maximum profits must always remain foremost when processing a job.

One educator recently told me that shop owners should encourage the younger generation of setup people by concentrating less on profits and more on helping employees gain experience. In his view, those with less experience should have more latitude to experiment with setups, so they might gain experience. If 50% of these experiments were successful, the shop owner would eventually get a good return on the investment.

While this is a noble idea, it doesn't translate well to the shop floor, where just-in-time manufacturing, customer-driven cost savings and expedited deliveries define the machine tool battleground of the job shop. Obviously, the man offering this advice is an outsider.

This divergent view of novel setups versus tried-and-true, get-the-part-done-fast-and-out-the-door setups is at the core of many heated discussions between the shop owner and the setup person. Shops are in business to generate revenue, and the owner's primary concern is maintaining and increasing profitability. While the setup person likely agrees with this goal, their inexperience or misguided priorities can often lead to disastrous results, while simultaneously producing the most elaborate and exquisite setups. Unless certain factors are deliberately taken into consideration at the outset, setups can become one of the "bleeding arteries" that gradually drains a company's resources and ultimately causes it to lose its competitive edge in the marketplace.

It should be clearly stated here that a setup is not an end in itself. It is the means to an end. The goal is to ship top-quality, finished goods to the customer – followed promptly by an invoice. Just as a skilled surgeon works quickly, efficiently and thoroughly, the skilled setup person gets the machine set up quickly and gets the parts running as soon as possible. In other words, "gets in there and gets out."

FACTORS THAT DETERMINE THE BEST SETUP

The key factors that should determine how a job is processed are the following:

- **The quantity of parts being run, the complexity of the parts and the dollar amount of the job itself**
- **Machine capability (is it capable of performing designated secondary operations?), availability and backlog**
- **The experience of the operator running the job**
- **The cost of tooling not normally used in the shop**
- **Additional non-reimbursed costs of tooling and fixturing associated with running the job condensed as opposed to conventionally**
- **Total setup time and cycle time as compared to setting up and running the job conventionally**

For example, is the order for 5 parts, 50, 500, 5000, or 50,000? Again, the goal is to run the job in the shortest time possible. If the order is for 5 pieces and the part is a 1.00" diameter shaft with a 0.187" x 2.00" long keyway, would it be faster to turn it on a manual lathe and mill the keyway on a manual mill? Or would it be faster to program a multi-axis turning center, set up the machine, set up the bar feed and the live tools and then run the part complete? The setup that takes the part from raw material to finished product in the least amount of time – including

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Case Study

To illustrate how different setups can affect a company's bottom line, we processed the same part using two different methods. The production run was 1,000 pieces.

In the first setup, the job is processed in two operations, with the operator running the first operation while the setup man programs the second operation using the background edit feature of the Haas control.

In the second setup, the job is set up to run completely in one operation, utilizing a Haas rotary table. Here are the results:

Two-Operation Setup

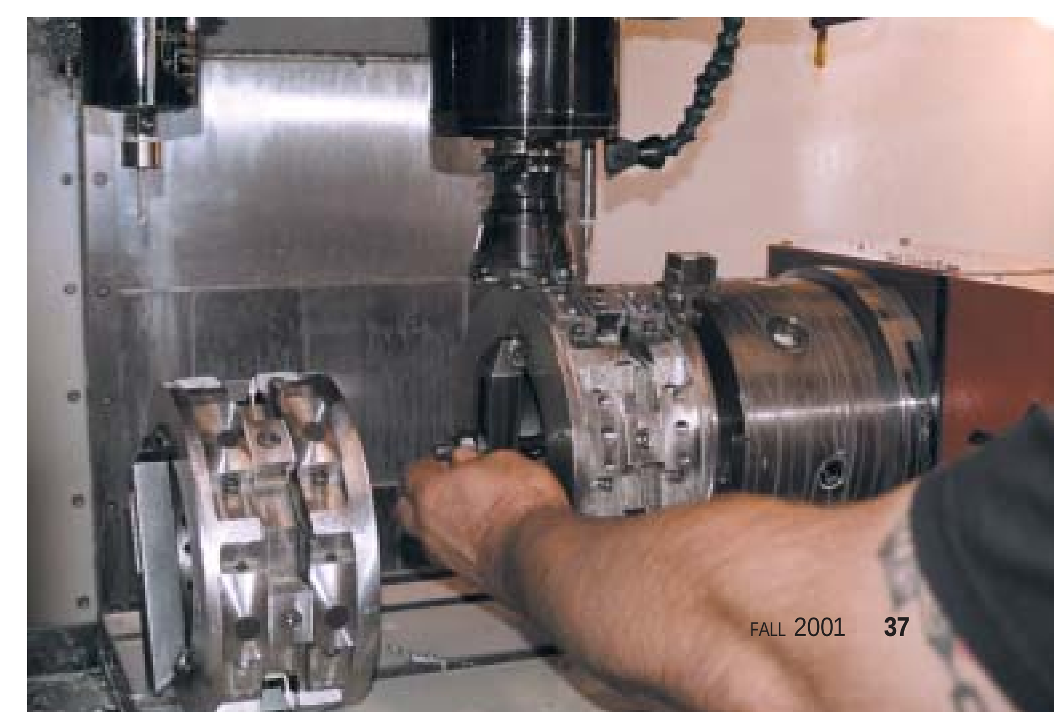
Step	Process	Setup Time	Cycle Time
1	Review operations		
2	Set up vise and program machine to contour part	**3 hours**	**80 sec each**
3	Program 2nd op drill/tap in background edit while operator runs job	**0.5 hour**	
4	Set up vise for drill/tap, check parts	**0.5 hour**	
5	Run finished parts	**120 sec each**	

Total setup/programming time: **4 hours**
Total cycle time: **200 seconds each**
Additional fixturing/special tooling: **none**
Total time from sawcut blank to finished parts: **60 hours**

One-Operation Setup Using Rotary Table

Step	Process	Setup Time	Fixture Time	Cycle Time
1	Design & build 2 fixtures (load one, unload the other)		**40 hours**	
2	Set up fixture, rotary table and program machine	**10 hours**		
3	Run parts			**100 sec each**

Total setup time: **10 hours (2nd run would be less since program is already written)**
Total fixturing time: **40 hours**
Total run time: **28 hours (approximately)**
Total time for complete project: **78 hours**



CNC Training in the Big Easy

Story
Linda Dorr

Photos
Delgado Community College

New Orleans – as anyone who's been there can tell you – is a city that knows how to party. And it doesn't have to be Mardi Gras – any excuse will do, including an educational one.

Delgado Community College, in downtown New Orleans, has two reasons for celebration this year. For one thing, it's the school's 80th anniversary. For another, the Occupational Studies Division recently upgraded its machine tool program to state-of-the-art status. The Center for Workforce Development celebrated the grand opening of a Haas Technical Center in January.

Prior to the arrival of its Haas machines, CNC instruction at Delgado was presented on "a dinosaur," says John Dominio, one of the machine shop instructors.

Delgado's machine tool program is as old as the school, above, which opened in 1921. Prior to the arrival of the Haas machines, below and at right, instruction was presented on a 20-year-old tape machine.

"We had a 20-year-old tape machine." Needless to say, the new CNC lab – which includes a VF-2 vertical machining center, an HS-1 horizontal mill and an SL-20 lathe – has been greeted enthusiastically by all concerned.

The faculty members in the machine tool program – Charlie Robinson, Don Clausing and Dominio – are still in the process of fine-tuning the curriculum. Says Dominio, "We spent the first semester breaking down the operator's manuals," using them as the basis for classroom texts. "We wanted to make the lessons as straightforward as possible. We do not assume that students know anything about these machines – you know what assume spells, right? – so we teach 'em from the ground up." For the initial CNC classes, the instructors used programming examples from the Haas operator's and training manuals. "We didn't need to re-invent the wheel," Dominio said. Then, "we brought people in from the real world" to help complete the curriculum for more advanced classes. "We went out to Laitram" – one of the local machine shops – "and sat down with a couple of our former students who are shop foremen now. We brainstormed with them, asked them what students need to know." They also contacted local shipyards and other manufacturing job shops to solicit ideas for student projects.

Class size is about 15 people max. "The only problem we have is different skill levels," notes Dominio, "but I encourage students to work together, so when I'm busy they can help each other out."

Students in the machine tool program earn a certificate for each class they complete; after two years (or 70 credit hours), they receive an associate's degree. In the beginning and intermediate classes, there's an hour of lecture per week, plus six hours of lab work – the hands-on stuff where the real learning takes place. "The first semester they do bench work," says Dominio. "In the second semester they start working on either a lathe or a mill, and they get introduced to CNC. Then they work on the other machine – mill or lathe – and then go on to advanced general machining and advanced CNC." Students in CNC programming classes spend a few more hours a week hearing lectures, but still put in plenty of lab time. In their final class, students design, program and cut a part – a project solicited from local industry.

Delgado's machine tool program is as old as the school. Isaac Delgado was a wealthy businessman who left a considerable share of his estate to the City of New Orleans for the establishment of a technical education center. The Isaac Delgado Central Trades School opened in 1921 with a vocational program that included a metalworking curriculum. "Delgado's long history in machinist training had a lot to do with the decision to establish the Haas Technical Center here," according to Russ Lamp, Haas Factory Outlet regional manager.

Area businesses are also gratified by Delgado's CNC program. "There's always a shortage of good CNC machinists, even during slow periods," says Mike Glore, president of

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The Haas machines at Delgado give students the opportunity to learn machining on the same modern equipment they will find when they enter the workforce.

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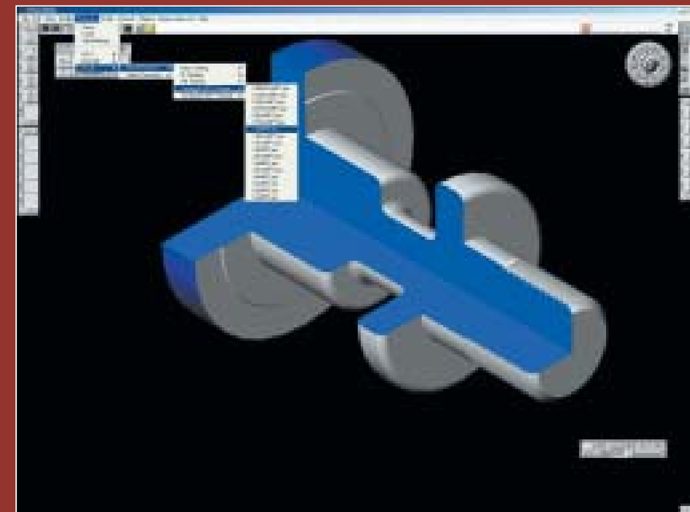
This ensures that the correctness of the knowledge base is managed, further protecting the company's assets.

A variety of different approaches can be used to set up the directory structure for a knowledge base. The most general approach is to define broad machining process categories, such as hole-making, pocketing and contouring, then store specific processes in the categories. For example, a 0.5" x 20 through-hole process would be stored in the hole-making directory, and a 3-pass pocket with 1/16" bottom fillet would be stored in the pocketing directory. Though this flat directory structure is fairly easy to implement as a foundation, its limitations quickly become obvious.

Separating metric from inch processes is probably the first delineation introduced by most companies. This allows metric processes to be stored and retrieved separately from inch processes.

In a facility with multiple machine tools, the process capabilities of one machine tool are usually not directly supported by a different machine. In order to recognize the specific process capabilities of different machine types, the directory structure can be laid out with basic machine types as categories. For example, such machine tool categories as 12-hp, 3-axis vertical milling centers, or 4-axis turning centers, or 20-hp horizontal milling centers, could be used. Additional subdirectories could then be used to structure the knowledge base by units and process categories.

Some manufacturers take the notion of structuring their knowledge base even further, by setting up directories for each specific machine tool, even if it is the same model or machine type as another. This allows a particular process to be tuned to the "personality" of the individual machine tool. This level of specificity, though, may be beyond what a company wants to implement for its standardized processes.



Storing machine-specific processes captures the capabilities of individual machine tools for reuse.

When setting up a process knowledge base, it is a good idea for companies to consider how they want to standardize their processes, and establish the corresponding directory structure for their knowledge base. With an established process knowledge base, manufacturers are not only able to realize the benefits of standardized processes, but also protect their most precious asset – their manufacturing expertise. Storing this process information is one sure way to ensure that what's here today will be here (and continue to be used) tomorrow.

GibbsCAM
805-523-0004

TRADE SHOW CALENDAR

For additional information go to www.HaasCNC.com/news/trade_show.html

Date	Show Name/Location	Booth #
Oct. 30- Nov. 1	**DALLAS APEX** Dallas Mart, Dallas, TX	Booth 211
Nov. 6-8	**DAYTON INDUSTRIAL EXPOSITION** Dayton Convention Center, Dayton, OH	Booth 1002
Nov. 13-15	**GEM STATE CONSTRUCTION SHOW** Western Idaho Fairgrounds, Boise, ID	Booth 2
Nov. 14-15	**BATON ROUGE INDUSTRIAL SHOW** Lamar Dixon Expo Center, Gonzales, LA	Booth 431

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Southern Precision Inc. in St. Rose. Having a source of skilled workers is a boon for local shipyards and the many big and small job shops in the New Orleans region.

The CNC lab is also being used for the New Orleans Job Initiative, a welfare-to-work project for which John Dominio oversees machine tool training. This is an intensive four-month program in which participants attend classes eight hours a day, five days a week. They work on manual machines during the first three months and on the CNC machines for the last month, again completing projects suggested by local industry.

Delgado has a long history of working with regional employers to provide up-to-date training, in all fields. The school's business partners in this regard include local healthcare facilities as well as such luminaries as General Motors, Union Carbide, Shell, Dupont, the U.S. Coast Guard, Lockheed Martin and Litton Avondale. In addition to machine tool studies, the Occupational Studies Division offers programs in technologies such as fire protection, motor vehicles, building design, safety and health, and, of course, computers and electronics. The largest and oldest community college in the state of Louisiana, Delgado is also the fifth largest college in the state – current enrollment exceeds 20,000 annually (there were 1,300 students, all male, in the school's first year).

Barbara Waller, General Manager of Laitram Machine Shop (owners of a Haas VF-4), is one of the new program's biggest fans. "This is a great opportunity for everyone," she says. "We're always looking to recruit more machinists. Thanks to Haas, students have access to new CNC training they didn't have before, and local businesses can use the facility to train the employees they already have. Better trained employees are more productive and they improve profitability, which will allow companies in this industry to prosper and grow." As always, education is a win-win situation – and another reason for celebrating in New Orleans.

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the setup person's time – is the most profitable and practical.

In the above example, the setup person would most likely run the job, as there are only 5 pieces. However, if production warrants the use of an operator, the next question is: Who is going to run the job – a trained operator or a trainee? Even among trained operators, levels of experience vary tremendously. If a trained operator is chosen, setups where secondary operations are condensed may be best. If, however, the operator is a trainee, the job may have to be set up in two stages to accommodate the operator's present level of experience.

In choosing the machine, there are times when a new, fully tooled turnkey machine is the best and most profitable solution, especially when running high-volume, brutally competitive contract work. In this case, your local Haas dealer can work closely with you to choose the best machine tool and tooling to optimize your shop's performance.

For lower-volume production, however, existing machine tools are usually specified. Keep in mind that, while a machine may have multi-axis capability, that does not mean it is practical and profitable to use its full potential every time. Backlog on the machine, expensive non-reimbursed fixturing, additional tooling costs and lengthy programming and setup time may necessitate secondary operations. For example, will running a part jeopardize deliveries of other high-dollar orders which can only be produced on the designated multi-axis machine? Also, consider this: If you have a backlog on a $150,000 multi-axis CNC lathe but have open time on a lower-cost CNC mill, it may be more profitable to run the job in several operations on the less expensive mill in order to minimize backlog and maximize machine tool usage. Again – quality, operator experience, complexity of the part and other factors should be carefully weighed in making the decision.

So, how do you define the best setup? This is a question each company must answer for itself by examining its own unique set of circumstances. By training setup people to ask themselves these questions, and by having open discussions with them, shop owners will teach them the skills to make practical and profitable decisions for the company.

As can be seen from the case study on page 37, clearly there is a point at which the second setup along with associated fixturing costs – even if not reimbursed – is more economical, especially if the customer will repeat the order on a regular basis. Having the option to run a job using different approaches gives shops choices that can increase profits. The key is having a balanced approach, and giving careful consideration to all the factors associated with successful completion of the project.

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