CNC Gear Manufacturing — Where Are We Now?

A report from the cutting edge and elsewhere.

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These days it's hard to get through breakfast without reading or hearing another story about how the computer is changing the way we live, sleep, eat, breathe, make things and do business. The message is that *everything* is computerized now, or, if it isn't, it will be by next Tuesday at the latest. Well, maybe.

No doubt it's hard to find a gear manufacturing facility in the country that doesn't have a computer at work doing something, even if it's only keeping the accounts. But beyond that, the truth is that the computer has come to the gear business a lot slower than to other areas of manufacturing. A lot of people are still out there cutting gears the old fashioned way—electromechanically.

But for how long? How accurate is the message, "Upgrade or die"? Is the vision of "the paperless factory" and CIM an achievable goal or Star Wars hype? Has the small size of the market and the complicated kinematics of the process doomed gear manufacturing to perennially playing catch-up ball in terms of the cyber-revolution? Where do computers fit into gear manufacturing *really*?

For answers to these questions, we went to the people in the field—the gear machine and cutting tool manufacturers, the gear companies and the manufacturers of the computer controls for the machines.

How the Machine Manufacturers See It

Gear machine makers have been building CNC machines for better than a decade and see no reason to stop now. If nothing else, market conditions demand it. "The progress has definitely been market-driven," says Gary Kimmet, The Gleason Works' Vice President—Engineering. "In the past twenty years, there has been a happy confluence of the needs of manufacturers for greater efficiency and lower production costs and the giant advances in the use of the computer."

What the market is asking for now is faster feeds and speeds, simpler, faster setups, more customization, simpler, more user-friendly controls, networking capabilities—in short, anything that will make the gear manufacturing process more efficient and less expensive.

"The next advance in machines will be in terms of speed," says Dennis Gimpert, President of Koepfer America. "Cutting tools today appear to be able to run faster than the machines that drive them."

Peter Kellenberger, Manager of Engineering for Reishauer, concurs. "I see a move toward faster and faster setup and easier operation."

One specific process where many of these issues are addressed is grinding. Kellenberger predicts that new machines will help make grinding decisions. Soon the operator will be able to put gear data into the machine, and the software will propose a specific grinding solution for the gear.

Another new computer-generated advance in grinding is the machine that not only makes

the gears, but inspects them as well. A PC with evaluation software is a part of the machine. Brian Cluff, Vice President of Sales Engineering at American Pfauter, points out that this technology is a special boon to shops grinding large, expensive workpieces. Because the workpieces don't have to be removed from the machine, inspection time is shortened. The same PC-operated inspection probe can optimize stock removal and assist the operator in making grinding decisions.

But grinding is not the only place where gear machine manufacturers see software/hardware advances. Brian Cluff sees a demand, particularly among automotive manufacturers, for dedicated, single-purpose machines with even simpler controls. This demand is driven by the need to continue to lower production costs. "The more you can do on a single machine, the more you can reduce costs, time spent and product variation and, therefore, increase quality."

At the other end of the gear manufacturing market, job shops have a different set of needs, which also can be met by advances in CNC. Job shops need equipment that can do multiple tasks. They should be looking at machines with multiple heads that can shape, hob or mill. The software is resident, and the operator can select what he or she needs for a particular operation.

Gary Kimmet says, "We will be seeing a higher degree of customization in the future.

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Software can be written to meet a customer's unique needs." He also sees increasing user-friendliness in machines. Instructions and machines will be self-explanatory and intuitive.

Where Does the PC Fit in All This?

While many of us immediately think of the PC when we think about any kind of computer technology, gear machine manufacturers differ about the role it will play in gear manufacturing. Gary Kimmet says, "PCs and workstations will definitely play a role. The trend is moving toward network, cellular flow." But he also adds, "This development is all over the map, depending on the needs of particular customers. Some shops will never see themselves as needing this degree of sophistication."

On the other hand, Dennis Gimpert is less impressed with the potential role of the PC. "I don't see them as having much more use than they have today. They will not run gear making machines because they are not "hardened" for the [shop floor] environment. They don't allow real-time simultaneous processing of data from the different axes. They're just not designed to run machine tools."

Peter Kellenberger agrees. "You can use a PC for expanded memory, but there isn't really much call for this from our customers."

Manufacturers also disagree over the role of Computer Integrated Manufacturing (CIM). Brian Cluff says, "CIM is the way all gear manufacturing is going eventually."

But others disagree. Peter Kellenberger says, "I don't believe in the 'paperless office.' Everybody still wants a hard copy."

Dennis Gimpert goes even farther. "It's an extremely expensive option, and I don't think it's practical at this point," he says, arguing that CIM doesn't really apply to mass production situations and is too expensive for the average job shop. He adds, "I don't know of one CIM installation that is truly successful."

He would like the industry to address what he sees as more basic issues. "What's more important right now is that the American gear manufacturing equipment is so outdated. It's more necessary to get good new cutting, measuring and sharpening equipment. That's more important than glitzy computer upgrades."

The Bottom Line

One of the reasons that gear manufacturing has lagged behind other metal cutting process-

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es in the integration of computers has been the smallness of the overall market and the price of new equipment. Computer hardware and software manufacturers have naturally gravitated toward larger markets first, and equipment buyers have sometimes been hard put to come up with the dollars necessary to upgrade their machinery. What are the chances that the fall of silicon chip prices will bring down the cost of new machinery?

Pretty small, alas. Gary Kimmet says, "Costs will drop, but not with the kind of dramatic force seen in personal computers. The global economy will demand this. The other thing you might see is holding the line on price, but incorporating more and more features for the same kind of money." The other machinery manufacturers interviewed either concur with this view or believe the cost of new machinery will remain stable.

Beyond The Black Box

One of the biggest changes in CNC gear manufacturing over the last few years has been in the machine controller or "the black box." Not so many years ago, every gear machine manufacturer built his own. The hardware and software were proprietary. Now driven by cost pressures and the increased power of generic CNCs, there has been a shift toward using commercially available controllers.

In the last few years controller manufacturers have begun to develop the unique algorithms required for gear making, the precise controls required to make an "electronic gearbox" and to customize the software for gear manufacturers. In the past, one of the most difficult parts of computerized gear manufacturing was the programming. The new CNCs allow the manufacturers to embed their own proprietary interfaces—the graphics, screens, special programs, etc.—into the CNC software.

John Turner, Manager of CNC Product Marketing for GE-Fanuc, estimates that as much as 95% of the controller can now be generic, with the remaining 5% customized for the particular gear machine manufacturer.

Mark Devonshire, Manager of Production Marketing at Allen-Bradley, sees the cost of controls coming down while their power goes up. "Machines are now able to do more in less time," he says. "For example, we can better control the tracking of the hobber and the work-

piece. It used to be that you had to make a tradeoff between accuracy and time. You could make gears fast or accurate, but not both. Now that distinction is growing smaller."

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> *— Peter Kellenberger, Reishauer*

But there are some caveats to keep in mind when looking at the possibilities offered by the new CNC controls, particularly when considering the possibility of PC-based control systems.

According to John Turner, "The evolving control architecture may represent an investment risk for gear manufacturers. The real investment is in the software developed to interface the control and the machines. If PCs, which are consumer-driven in development, keep changing, manufacturers are running the risk that in 18 months or less, expensive programming they have written will be obsolete."

Turner sees a split developing. Motion planning, machine sequencing and interfacing, where big bucks are spent for programming, will continue to go in the "traditional CNC." The PCs will handle the operator interfaces, the data storage and communications.

Mark Devonshire sees another limitation. "We can do the paperless factory now, but the problem is people have a bunch of machines from different vendors and of different ages. And you usually can't upgrade your whole system at once. A company could sell a whole system that could speak together, but that's not the way companies upgrade."

The View from the Shop Floor

Gear machinery manufacturers naturally have a vested interest in the latest and greatest CNC upgrades for machines. Where do the gear manufacturers themselves see their place in the world of cybergearing? Not surprisingly, all of the gear manufacturers we talked to have

Yogi Sharma
Philadelphia Gear

integrated computers into their operations to a greater or lesser degree.

According to Paul Roberts, Senior Software Programmer at Cincinnati Gear, his company uses computers most in the area of production management and control—for scheduling, inventory, etc. CNC machines are also important in all the company's milling and turning operations, but it still uses a lot of manual gear cutting machines. Like many other manufacturers, Cincinnati is reluctant to turn over the manufacture of large, expensive workpieces to a computer.

Fred Sowinski, Vice President of Engineering and Technical Services at Falk Corp., which makes gears up to 46' in diameter, says, "Large machines are still mostly mechanical, partially because of the risk involved. We're still more willing to trust people and mechanics rather than computers to do the big, expensive workpieces."

According to Joseph Schulz, marketing manager at Milwaukee Gear, his company uses computers in all aspects of the design and manufacturing process. He sees CNC machines as most useful in turning, hobbing, drilling and grinding and least helpful in finishing processes like deburring and washing. He sees the greatest use for PCs and workstations in the areas of design and keeping track of inventory.

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And what does the highly touted world of CIM look like from the shop floor? At Cincinnati Gear, there is no interconnectivity between engineering and production. Says Roberts, "We're still using blueprints and shoe leather." However, he adds that upgrading in this area is the only way to go. "Using a computer means less chance of screw-ups in terms of torn prints, lost documentation, etc. We're being driven by competition to upgrade computer use in all areas."

Yogi Sharma, Product Manager at Philadelphia Gear, concurs: "PCs and workstations are very much a presence in shops of all sizes. They are being used as interfaces between CAD systems and large machines."

Bill Maples, Marketing Manager at Star Cutter, the cutting tool manufacturer, adds: "You have to do it [use CNC and CAD] to stay on the cutting edge—no pun intended."

Falk Corporation is also working toward completely integrated manufacturing. "Manufacturing and production engineering are on the same mainframe and LAN," says Fred Sowinski. "There's a migration away from mainframes and toward PCs. IBM has made it clear they're not going to support the mainframe forever."

Sowinski also sees a definite trend toward CIM. He observes that machine controllers are becoming so powerful that they can support many functions themselves. Larger (100-200 MB) storage eliminates the need for DNC in some cases. He sees the next step as "a total closed loop—complete integration of design, manufacturing and inspection."

Whither the Job Shop?

This might all be well and good for the big gear manufacturers with lots of resources for capital improvements, but what about the little job shops? Will they disappear, run over by the computer juggernaut?

Not necessarily. Almost everyone we spoke with sees a future for the small shop. There will always be a need for repair services and orders of one and two gears. But the future won't be easy. Fred Sowinski points out, "The pressure is really on to computerize. If a small guy can possibly afford it, he should do it. The competitive and cost advantages will be worth it."

And Bill Maples warns: "Smaller shops will have to develop niche markets. In order to succeed they will need good management, good technology, good marketing and good timing." ○

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