

WORKFORCE PIPELINE

A MONTHLY FEATURE ABOUT TRAINING, EDUCATION & WORKFORCE DEVELOPMENT

Improving Education with Simulation Software

Anyone who's attended technical college in pursuit of a machining certificate or associate's degree in manufacturing knows it's one of the more challenging trades—machinists are expected to understand cutting tools, feed and speed calculations, part measurement, properties of metals and plastics, trigonometry and more. But one thing that's especially important to know is G-code, the nearly universal language used to program computer numerical control (CNC) machine tools.

The ABCs of XYZ

G-code is an alphabet soup of letters and numbers, one designed to move the various machine tool axes through a complex metalcutting dance. With dozens of automated

spindle speeds upwards of 10,000 rpm and rapid traverse rates of 2000 ipm (50 m/min) or more.

At many colleges, this makes program prove-out a matter of one hand riding the feed rate override and the other hovering over the emergency stop button, a nail biting experience for instructors and student alike. After all, one bad line of code is all it takes to crash a piece of expensive equipment, thus delaying coursework and negatively impacting budgets.

With the right software tools and a little common sense, however, these problems can be prevented. That's good news for anyone that operates a machine tool, but doubly so in a school environment, where fledgling machinists pose a higher than average risk of questionable code. Better yet, that same software technology can be used to make toolpaths more efficient, thus improving job profitability and tool life, important considerations in the post-graduation world of manufacturing.



Bates Technical College Machinist instructor Bob Storrar teaches student Terry Francis proper machine setup.

stock removal routines, cutter compensation codes, and machine control functions, even seasoned machinists can be left scrambling for the programming manual. Making matters worse is the fact that modern machine tools are fast, offering

Pioneering in Tacoma

Bob Storrar, machinist instructor at Bates Technical College (Tacoma, WA) has long been a champion of such technology. "We were the first ones in the state to use Vericut," he said. "It's been a big part of our program for nearly a decade."

Vericut, an NC code simulation and optimization tool from software developer CGTech (Irvine, CA), is a graphical software package that works with all brands of machine tool controllers, detecting G-code errors and preventing collisions before they happen. Yet Storrar will tell you the biggest benefit of Vericut isn't crash avoidance, but efficiency. "With 18 people in class, I don't have time to go through three or four hundred lines of code for every student. It's just not in the cards," he said. "Before implementing Vericut, a student would write up a program, load it in the machine, and I would stand there with my hand over the E-stop, sweating bullets through the entire dry run. It was always a guessing game about what would happen."

Now, each student checks his or her own work with Vericut, rather than relying on the instructor. “I figure they are able to solve 75–80% of their problems on their own,” Storrar said. “They can see what’s happening right on the computer screen, so they don’t even come to me anymore except on difficult problems.”

When ready, students bring their completed project file to Storrar, who carries around a USB memory stick containing a perfect model of each assignment. Together they go through Vericut’s “Auto-Diff” function, which highlights discrepancies between the student’s part and how it actually should look. “Most of the time I don’t even have to tell them how to fix it,” he said. “They watch the simulation with me and say, ‘Oh, look. I made a mistake.’ It’s unbelievable how much time it’s saved.”

No More Fire Drills

One hour north of Tacoma sits the city of Shoreline, WA, where manufacturing technologies instructor Keith Smith puts Vericut through its paces at Shoreline Community College. Smith agreed with Storrar’s assessment, and said off-line simulation not only saves everyone a lot of grief, but is an effective learning tool as well. “In the old days, a student would have done his best on a program, then taken it out to the machine and quite possibly crashed and burned. Then it becomes a matter of getting the instructor’s attention long enough to help understand what went wrong. That’s not always easy to do, considering how many students we have in our programs. With Vericut, I can work with them in a no-stress environment, going through their code one line at a time to find areas where they can improve. It’s a real teaching moment.”

Because of his confidence in the software, Smith is able to turn third-quarter students loose as if they were working in an actual production shop. “I give them setup sheets, a program, and part drawings, then tell them to set up the machine and make some parts, just as in real life,” he said. “It’s kind of uncomfortable for them at first, because they don’t know what’s going to happen. What makes a big difference, though, is the Vericut video clip of the different machining operations, which I attach to each job. The student has the

opportunity to review the videos and understand what’s going on. It makes life a lot easier for them.”

Smith is such a fan of machine tool simulation that he recently volunteered his time to participate in a CGTech-sponsored workshop at the California Polytechnic State University in San Luis Obispo, to explain the benefits from an educational perspective. “Many of our students leave here and go to work in the surrounding aerospace industry. Everybody up here has very complex machines, and without some kind of sophisticated verification software, you just wouldn’t be able to machine parts. It’s very popular here.”



Machinist student Geoff Kehler is confident he’s ready to run his CNC program on one of BCIT’s machining centers.

Not Your Father’s Pac-Man

A bit further north, Dave Lewis has used Vericut since the early ’90s. The mechanical technology program head for the British Columbia Institute of Technology (Burnaby, BC), Lewis said Vericut is a perfect fit with today’s electronic-minded students. “Programming is a bit like a video game to them. A CAD/CAM system will basically do anything they ask of it, so you’ll find them burying a ¼” [6.4-mm] end mill a few inches deep in a block of steel. There’s no problem until you stick it on the machine.”

Vericut helps students avoid such faux pas. With many CAD/CAM systems, the workpiece is a block of material hanging in space—a programmer can see tool movement and material removal, but it’s a bit like watching a football game without the turf, end zones, and goal posts. Vericut, though, is able to model the entire machine tool, from the vise jaws and toolholders to the spindle nose and way covers. When a student makes a mistake with a tool length offset, or uses a rapid traverse movement rather than a controlled feed rate, the on-screen graphics make it abundantly clear there’s a problem.

“We find it very useful in finding errors and inefficient machining processes. Overall, it’s a necessary tool for anyone teaching the machine trades,” Lewis said. ➡



Kip Hanson is a freelance writer and manufacturing consultant based in Tucson, AZ. He has over 35 years of experience in manufacturing, management, and IT systems. He can be reached at kip@kahmco.net.