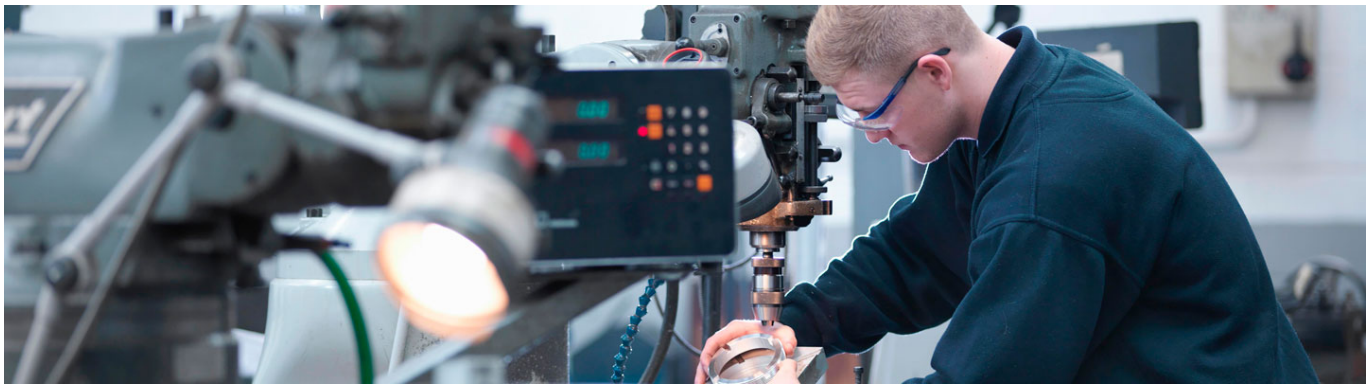

Job Connection

The CNC Machining Skills Gap: A Q&A with Tony Schmitz on Training Tomorrow's Workforce

Roland Jones | Mar 02, 2021

America's Cutting Edge (ACE) is a national initiative to restore the prominence of the U.S. machine tools sector through advances in training and technology. Part of the ACE effort is a new program that uses virtual training and machining simulation to teach essential manufacturing skills. Here's an overview of the program, which is designed to help tackle the nation's skills gap and recover its technical and manufacturing leadership position.

How can we solve the skills gap? It's a challenge that has plagued the manufacturing sector for years and will no doubt have an impact on most machine shops.

A ***2018 study by Deloitte and the Manufacturing Institute*** predicted that by 2028 there would be 2.4 million unfilled jobs in the manufacturing industry due to such factors as shifting skill sets, the introduction of advanced technologies and an aging workforce.

The problem is caused by several factors, including a lack of training in high schools and colleges and a general perception that manufacturing—and machining, in particular—is an outdated profession that's not a viable career choice for students looking for innovative, high-tech work.

Tony Schmitz, an engineering professor at the ***University of Tennessee***, Knoxville, and a joint faculty member at ***Oak Ridge National Laboratory*** (ORNL), is on a mission to change this perception and close the machine tools skills gap.

He created America's Cutting Edge (ACE), a CNC machining training program, in collaboration with the ***Institute for Advanced Composites Manufacturing Innovation*** (IACMI) and ORNL. ACE is supported by the U.S. Department of Defense ***Industrial Base Analysis and Sustainment (IBAS) program***.

In this interview, Schmitz discusses the program and its objectives and the overall outlook for U.S. manufacturers.

Read more: Tackling the Manufacturing Skills Gap: 5 Skills Your Company Will Need Soon

Q: Tell us about the new training program. How did it come about?

Schmitz: The ACE program is a national initiative for machine tool technology development and advancement. As part of the program, we are offering an online component that teaches CNC machining training, which is then followed by a one-week, in-person training opportunity.

At Oak Ridge National Laboratory, as we were planning activities over a five-year time horizon, we understood that it was going to be necessary to provide training for the next generation of the machine tool workforce, which is not just those folks who will be operating the machine tools but also the folks to design the machine tools, the entrepreneurs who own the job shops, and the mechanical designers and engineers who design the parts and need to understand the manufacturing processes. So we realized we needed to develop a training program that is widely accessible.

We also recognized that, independent of what your career trajectory is going to be, if you're going to develop some expertise in machining, you'll also need to be performing operations at the machine tool. That means you'll need in-person training, so there's a companion part of the program that is in person and will be organized at different locations. For this portion of the pilot program we are limiting the participation numbers to 10 at each site. Our vision as the ACE program grows is to use regional locations and expand our in-person machine tool training. Of course, the online training content is available everywhere.

Because manufacturers are concerned about the cost of operations, the final training module features machining cost, including tool wear, vibration considerations and the operating parameters that let you see how you could optimize this process taking all those things into account.

> **"I believe the more people we can expose to this online curriculum, the better chance we have of growing the country's machine tool capabilities from the ground up to what we had several decades ago. I am passionate about seeing the U.S. machine tool industry being at the top of the food chain again."**
> Tony Schmitz
> University of Tennessee, Knoxville

Q: How have you managed the virtual portion of the training?

Schmitz: Similar in function to a flight simulator that provides a safe environment to learn and experience trial and error, we've designed the online training so participants can operate controls and see what is happening on a screen. This lets you train in a very safe virtual environment and see what works and what doesn't work—all without the danger of damaging your tools.

Q: What sorts of things are students learning in the program?

Schmitz: The online curriculum assumes you have no prior experience or machining knowledge. The first module introduces machining and gradually moves up the chain of complexity from forming a chip using cutting tools and understanding some of the different machining processes. Then, we move to computer numerical control, commonly called CNC, and the automated control of machining tools. Next, we turn to a module that introduces computer-aided manufacturing (CAM) programming; students download a CAM software package and subsequent lessons walk through all the individual steps to develop the toolpaths to generate a part.

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We follow the CAM training with an introduction to machine dynamics and the implications of vibrations during machining. I have developed an app called CAM+ that is distributed with the software. CAM+ enables you to simulate machine vibrations. This lesson has three components: It begins with a tap test, where we connect with the MSC MillMax option, which is physically performing tap tests and using that information. CAM+ lets you do a virtual tap test—you select the tool and toolholder combination that is used for a particular toolpath within your CAM software, then select a spindle, put them together in simulation and do a virtual tap test. The virtual test gives users the same information as a MillMax tap test, as completed by your MSC Metalworking Specialist. But in this case, it's done on your computer as a simulation.

Once the virtual tap test is completed, we then generate a stability map, which separates regions of chatter from stable cutting depending on the depth of cut and spindle speed. Essentially, we try different machining parameters within the CAM software, execute those in the CAM+ app, and we can see virtually what would happen if someone actually ran those conditions to make a part on the machine tool. You can even hear the sound the cut would make through your computer's speakers. The idea is to simulate as close to the machine tool experience as possible but still be able to be at your laptop.

Learn how MSC MillMax helps minimize vibrations in machined parts manufacturing.

Q: Who are you trying to reach with the program?

Schmitz: We target two very distinct camps. First, the folks who are already deep into their machine tool careers, who, while they may know a lot about machining, might not be comfortable using an app for machining simulations. The differentiator for this group is the information about measuring vibrations in a system and making better decisions about operating parameters. The idea is to expose them to an approach to machining parameter selection that's different from how they may have learned at an apprenticeship program many years ago.

The other major group is the younger generation. These students are very comfortable in a digital environment, so for them, the notion of using an app to do virtual simulations of machining is instinctive and trivial, but they may not have any experience with machining. For them, the first module offers information about machining and the machine tool industry, and how important it is for U.S. manufacturing and the U.S. economy.

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I got some really important input from one of my Ph.D. students at the University of Tennessee, Knoxville. He said he'd like to share the program with his high school engineering instructor but thought high school students may not know why the topic matters. He recommended I include an introduction, so I added a 15-minute video that provides information about the basics of the machining industry: why it's important, what the U.S. supply chain is, why the machine tool industry has contracted over the past several decades, and what we can do about it. This introduction module is targeted directly at that younger generation, saying, "As I look at the spectrum of careers that are available to me, should I be interested in manufacturing?" And more specifically within manufacturing, "Are machine tools something that I'd like to consider?"

Q: What are your thoughts on the skills gap issue and how we can narrow it?

Schmitz: Jobs are going unfilled today, so the need is now. The ACE training program does not produce machinists immediately. Six hours of online instruction and one week in front of a machine tool is not sufficient to produce a fully qualified machinist capable of making parts in a facility. However, we can motivate entrants into this area based on a clear understanding of the total context of machining and the important considerations. There's also today's workforce that is already making parts. I think we could leverage this training to help machinists make those parts more efficiently by thinking about vibration and how it affects machining processes. We need to expose an entire generation to the benefits of a career in manufacturing. We need to convince both young people and their parents that there's a lack of understanding of what manufacturing facilities look like today: high-tech, clean and efficient. They need to understand that this is a high-tech industry that enables people to work with computers and build rewarding careers.

Q: You launched the training program in December 2020. How's it going so far?

Schmitz: We're about three months into this effort and I'm very happy that we are approaching 1,000 online participants from more than 40 states across the U.S., including students in high school, community college and universities as well as incumbent workers employed in manufacturing. Of course, this is not going to produce the dramatic change in the manufacturing industry that's required—we will need to reach 10,000 online participants or more. For that to happen, the program must expand beyond the folks that I can reach. So if anyone reading this agrees with what I'm saying, please share this program or do it yourself and see if you think there's some value here.

Personally, I want nothing short of a renaissance in U.S. manufacturing and in the machine tool industry in particular. I, and our partners at DoD's IBAS program, want the U.S. to reclaim its global leadership in machine tools. The ACE CNC machining training program is a starting point. I believe the more people we can expose to this online curriculum, the better chance we have of growing the country's machine tool capabilities from the ground up to what we had several decades ago. I am passionate about seeing the U.S. machine tool industry being at the top of the food chain again.

*You can learn more about the ACE CNC machining training program **here**.*

What steps are you taking to train your workers and attract new talent to your company? What skills are necessary for your company to be successful in the future? Share your thoughts in the comments below.