Connecticut Firms Explore New Manufacturing Method

By MARA LEE **maralee@courant.com** The Hartford Courant
8:51 p.m. EDT, June 9, 2011

Airplane engine parts often are cast from molten metal and welded together, or forged. Some are machined from a chunk of metal, and in those cases the waste left after the machining creates "a huge buy-to-fly ratio," in the words of Agnes Klucha, a Pratt & Whitney engineering manager.

Engineers, scientists and technicians are working on a new way to make parts, known as additive technology. Instead of cutting away metal, this process uses a metal powder and a heat source — either a laser or an electron beam — to melt it.

Micron by micron, powder is added to the form and fused into a solid piece of metal.

This idea has a number of advantages, aside from producing less waste. If companies didn't need to stamp and machine the parts, they wouldn't have to create tools to cut and shape the metal. By forming parts using the new process, they could save hundreds of machining hours.

But the biggest advantage of all is that parts made by adding layers can be made into shapes that can't be produced any other way. For instance, additive technology can make a part with a hollow cavity that has no access to the outside.

A part can have cooling channels that are sinuous, rather than along right angles.

In aerospace manufacturing, the development is still in its early stages.

"Right now, we're taking advantage of this technology to make aerospace prototypes," Klucha said.

In East Granby, a small manufacturing firm, Joining Technologies, is also working on additive metalwork.

"We've chosen to be a company whose growth is based on innovation," said Dave Hudson, president of Joining Technologies, which has 70 employees. "Additive is a seed we planted for future growth."

Even though less than 5 percent of Joining Technologies' revenue is coming from additive technologies, the firm expects that figure to grow to 20 percent within two years, Hudson said.

At Pratt, Klucha leads a team of a dozen engineers and draftsmen, with three more joining the group this summer, who work with the company's roughly 5,000 engineers in Connecticut to provide solutions to their design problems. For now, fewer than 5 percent of Pratt's prototypes are made with this method.

"If it's a simple geometry, we can probably get it right on the first try," Klucha said, but more complex parts can take months of trial and error.

There are industries that are using additive technology for parts in use — for instance, for hip implants that have a surface that's pitted to promote bone growth over the metal socket. Still, practical parts are five years away in aerospace, Klucha estimated. She said a part made this way will be used in a Pratt ground-test engine this year.

The technology is further along in Germany, which has been home to innovations in laser welding and laser cutting as well.

"This is something we really need to pursue to compete globally," Klucha said. "We can develop that expertise, and why not do that in Connecticut, why not do that in the U.S., and take it to the next level?"

Joining Technologies is doing just that, by partnering with Fraunhofer, a nonprofit research and development group. Salay Stannard is a young materials engineer who joined the East Granby firm right after graduating from the **University of Connecticut**. She went to Germany for several months to learn about an engine part that uses a conventionally made disk, but adds fan blades by depositing layers of powder rather than by bonding blades onto the disk, or cutting away material to form blades through an electrochemical machining process.

Tim Biermann, a German researcher from Fraunhofer, just arrived in East Granby to work for a year or two in the new joint venture.

Of the additive processes, 85 percent of Joining Technologies' work is not building up parts from scratch, but rather cladding traditional parts, to prevent wear or corrosion, or to repair them.

Scott Poeppel, manager of additive processes at Joining, said many of the parts contracts are so preliminary that they're just making testing coupons, in which a dog-bone shaped piece of metal formed from the powders is put through hardness testing and tensile testing, which tries to stretch the piece to its breaking point.

"That's one of the largest stumbling blocks with this technology," he said. "There isn't a lot of manufacturing data associated with it. You cannot design a critical component without understanding its properties."

The key is to understand the right ways to use the process, Klucha said. "What are some of the capabilities? What are some of the limitations of this technology?

Once the answers to those questions are known, Klucha thinks it will still be a specialty application. "I don't see it displacing conventional methods," she said. Even if there's a time savings, and even with avoiding the tooling and metal waste, she expects it will be more expensive than older methods of making metal parts for many years.

"If something is affordable to be made through conventional methods, it will continue to be made through conventional methods," she said.