Robots becoming a crucial part of aircraft production

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Before the use of robots, technicians at Spirit AeroSystems, wearing welders' jackets and hoods, sprayed hot flames on certain airplane parts to increase their durability.

The intense heat allowed a technician, who hoisted a hose over his shoulder as he sprayed, to stay in the spray booth only 20 to 30 minutes at a time.

"This is a lot easier," said Bob Martin, a flame-sprayer at Spirit who now controls the heat with the flip of a switch.

The automation also increases the accuracy of the flame and improves quality. And it's safer, Spirit officials say.

As in virtually all kinds of manufacturing, the use of robots at Spirit AeroSystems is growing.

When Spirit formed seven years ago, after Boeing spun off its Wichita commercial aviation division, the company had six robots in place. Now Spirit has nearly five times that number.

They're in place in Spirit factories in Wichita; Tulsa, Okla.; Kinston, N.C.; and Prestwick, Scotland. Two-thirds are in Wichita. And most are used for drilling.

Others are used in nondestructive testing, fastening and painting.

"Robots are doing more and more diverse things," said Curtis Richardson, associate technical fellow for automation at Spirit and president of the Great Plains Robotics Alliance.

At Spirit, they're used on the Boeing 787, Airbus A350 and Sikorsky CH-53K programs and in building Boeing 737 and 777 nacelles.

Robots have long been used in the automotive industry, where auto production volumes are high, and the processes are repetitive. They're also used in such industries as health care, military, electronics, packaging, space and mining.

Robots are becoming a small but crucial part of aircraft production, which also uses labor-intensive manual processes. The key is striking the right balance between automation and mechanical processes - and knowing how to achieve the optimum benefit, Richardson said.

"Robots have been doing more and more in our industry," Richardson said. "Spirit is on the leading edge on their implementation."

When considering whether and where to use them, Spirit looks for applications that involve improving safety, ergonomics or the general working environment, he said. It also considers the ability to lower costs and win new business.

The use of robots has been a key factor in Spirit's competitiveness, Richardson said.

"Automation is a big enabler," he said. "We've won business largely because of the automation that's involved in our bid package."

There are cost advantages.

"We've been told by customers had we not (been) automated ... we would not have gotten the work," he said.

New programs have meant new jobs at Spirit.

"No one at Spirit has ever lost their job because we put automation in," he said.

Inside Spirit's 787 hangar, a robot works behind an enclosed cage drilling thick precision holes in a cab structure made from aluminum and titanium. The structure will support the composite materials that form the 787 nose section.

Drilling titanium - a dense, hard metal - is a difficult process for a human, Richardson said. It's labor-intensive and puts stress on shoulders and arms.

"Drilling titanium is hard on people," he said.

A robot can take the extreme pressure needed to drill titanium and save workers from injury.

Cessna Aircraft is exploring the use of automation, including the use of robots.

"We continue to explore opportunities to innovate our processes, including the use of automation in certain areas," said Cessna spokeswoman Sara Monger. "We will make strategic investments in these products where it makes sense to do so for use as a company."

The National Institute for Aviation Research at Wichita State University is looking at ways robots can aid aircraft manufacturers. In the automobile industry, where volumes are high, robots may repeat a task

250,000 times, said John Tomblin, the agency's executive director.

In the aviation industry, "you really have to question yourself: Is a robot needed in that type of production based purely on quantity?" Tomblin said.

The institute is looking at ways robotic applications can be used in low-volume aircraft production to solve manufacturing problems.

"In low-volume production, I think you have to look at what will be the real benefit of having a robot inserted in the production line," Tomblin said.

The National Institute for Aviation Research has a robot on order to work on the painting of composite and metal airplanes and parts.

"Painting, especially with a composite aircraft, is very sensitive," Tomblin said.

If the paint is too thick, the fuselage won't conduct electricity in the event of a lightning strike, he said. If it's too thin, the plane's exterior won't be protected from ultraviolet rays.

Too much paint on an aluminum plane is also a problem, because of the extra weight, Tomblin said. The paint thickness must be exact, he said. Robots reduce the potential for human error.

"It will paint the aircraft the same way every time," he said.

The institute is also using robots in friction stir welding and in reverse-engineering applications.

Robots fill a gap, said Spirit's Richardson. They aren't as flexible as

humans, but they're more flexible than large machines.

They also cost less and don't require large foundations to support them, as do the massive Broetje automated fastening and drilling machines in use in some areas of the plant. And most can be repurposed to do other jobs.

They also can be delivered faster than the large machines. A new Broetje machine takes about 24 months from order to delivery, for example. A robot can be delivered in eight to 12 months, Richardson said.

That was an important feature, especially with Spirit's new business and tight program schedules, he said. Still, he said, robots won't replace the need for Broetje machines.

"It's just the right tool for the right job," Richardson said.

The robot itself is a major component of a robot system and can come from a number of manufacturers. The tools on the end of the system, such as drills or paint sprayers, and the software are then customized.

The robot costs between $50,000 and $100,000. But with the software system and tooling, the final cost is anywhere from three to 10 times that amount, Richardson said.

"It's a serious piece of equipment," he said, and all the costs are weighed in deciding to incorporate a robot into the system.

Spirit and the aviation industry have a lot of room to grow in automating their work.

The majority of the processes are still performed manually, Richardson said. Putting a robot in place is easier with a new project than on

programs already in place.

The industry is also moving to advance safety, so workers on the factory floor could work in close proximity with robots. Today, robots used in manufacturing are usually behind a gate or in a room separate from employees.

Rather than replace workers, Richardson said, robots complement a skilled work force.

Building an aircraft is a complex operation that still requires a manual touch.

And robots require specialized expertise. Robots require employees with skills to program, operate and maintain them.

Robots are productivity tools, very much like calculators, computers or automated farm equipment, Richardson said.

"To attempt to compete in the marketplace without those tools as an integral part of your business model would be nearly impossible," Richardson said. "Robots and automation tools are having a very similar effect on manufacturing industries, even aerospace."