PHOTO: Howard Appelman, Manufacturing domain leader for Boeing Defense, Space & Security (left), checks the quality of holes drilled by automated equipment on the F/A-18 line in St. Louis with Ray Baron, Materials, Process & Physics engineer.
RICHARD RAU/BOEING

"Our domain has great potential for synergy and replication opportunities between the business units."

– Howard Appelman, Manufacturing domain leader for Boeing Defense, Space & Security

The 'productivity lever'

Boeing is developing and searching the world for technologies to meet current and future manufacturing needs

By Bill Seil

Boeing and other aerospace companies highly value titanium for its strength and resistance to expansion, contraction and corrosion.

Limits in the size of equipment at mills, however, have prevented fabrication of titanium parts larger than 4 feet by 12 feet (1.2 by 3.7 meters).

Recognizing an opportunity, Boeing researchers teamed with external partners to develop a breakthrough. Their efforts led to what's believed to be the largest titanium sheet metal part ever made—a jet engine inlet 13 feet (4 meters) in diameter.

That teamwork is exactly what the Manufacturing technology domain is working to accomplish—helping facilitate connections across the company to ensure that production technologies, when appropriate, are replicated and leveraged companywide to improve quality and efficiency.

Mike Vander Wel, Manufacturing domain leader, described it as "pulling the productivity lever" on the Boeing business model.

"The Manufacturing domain strongly supports some of the company's top business priorities," he said. "The nature of the domain directly impacts the bottom line in many areas. Our challenge is to align investments in the right way to have a maximum effect across the enterprise."

There are eight domains, or technology focus areas, in Boeing's Enterprise Technology Strategy. Through this strategy, technologists and business leaders across the company coordinate a "One Company" approach to technology development.

As with the other domains, Manufacturing works with Boeing business programs to ensure that technologies that ultimately support current and next-generation products are ready when needed.

This domain is among the most active in tapping research talent from around the world. It is engaged in collaborative efforts with partners in Australia, the United Kingdom, the Netherlands, Spain, Russia, Italy, India, China and Germany. Projects touch on areas including composite processes, assembly and metals machining.

The domain's diverse research projects fall into several categories, such as metals transformation—which involves taking sheets of aluminum, titanium and other metals and making parts as efficiently and economically as possible.

Creating parts from titanium is a challenge: The metal requires a special high-temperature cross-rolling process to convert it into sheets. That process has been the limiting factor in producing bigger parts.

To help generate ideas to overcome this limitation, researchers from Boeing Commercial Airplanes and Boeing Research & Technology worked with external partners. That collaboration eventually led to the creation of the 13-foot jet engine inlet.

The end result was that researchers discovered how to apply a metalworking process called friction stir welding—long used by Boeing on aluminum—to titanium. In friction stir welding, a rotating pin tool moves along a metal surface to "plasticize" the metal and give it a gooey consistency. As the pin tool moves along the joint where two metals are butted together, it stirs the plasticized portions of the two pieces together, forming a strong bond.

"Applying this technology to titanium required the development of much-higher-temperature stirring pin tools and precision methods," said Dan Sanders, a Senior Technical Fellow in Boeing Research & Technology.

Another of the domain's focus areas

addresses the buildup process from parts to subassemblies to final product delivery. This area, known as integration and delivery, includes developments in robotics, or ways to use automated equipment for repetitive and arduous tasks. Commercial Airplanes' fabrication plant in Auburn, Wash., is using robotic equipment for drilling and riveting large titanium assemblies to drive productivity improvements in platform integration.

"Automation really started here in earnest around 2007," Sanders said. "Prior to that, we didn't have a robot in the factory. Now we have about 30 of them and more on the way. Anyone who's ever had to hand-drill titanium would definitely appreciate this development."

Howard Appelman, domain leader for Boeing Defense, Space & Security, said automated assembly equipment is also on the list of priorities for military programs. He noted that recently installed assembly automation equipment on the F/A-18 Super Hornet line in St. Louis is used to drill precision holes in wing trailing edge flaps.

"Our domain has great potential for synergy and replication opportunities between the business units," Appelman said.

Scott Cunningham, Manufacturing domain leader for Commercial Airplanes, said the domain is examining the needs of both current and future production programs.

"We're looking at automation, new materials, fabrication, inspection methods and assembly technology. Testing and investigation tells us what we can do right now. And with a little more effort, we can look ahead to 2015 and beyond," Cunningham said.

Don Mottaz, director of Assembly and Integration for Boeing Research & Technology and a member of the Manufacturing domain's leadership team, expects to see a lot more automation. "If you look at where robotics is going, the next 20 years should be just amazing," he said.

Developments will range from advanced hand-held tools to complex systems on the factory floor. Mottaz envisions GPS-based equipment—similar to today's navigation systems that guide cars—that tell robots in the factory where to find specific parts.

"I don't think there will ever be a time when these machines manage themselves," Mottaz said. "We'll need people to do that. But I think it will be more of a partnership than it has been in the past." ■

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"The Manufacturing domain strongly supports some of the company's top business priorities."

– Mike Vander Wel, Manufacturing domain leader

PHOTO: Mike Vander Wel, Manufacturing domain leader (right), and Dan Sanders, Senior Technical Fellow, Boeing Research & Technology, are shown with a prototype 13-foot- (4-meter-) diameter titanium nacelle lip skin. Developed and built at Boeing Fabrication Division's Auburn, Wash., site, it demonstrates recent advancements in manufacturing technologies. MARIAN LOCKHART/BOEING