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How Additive Manufacturing Will Change the Government

Military bases are leveraging a new class of 3D printers that use materials such as polymer and metal to offset logistical issues within the supply chain.

The U.S. military has bases in more than 70 countries around the world. Maintaining such a widespread presence across the globe creates issues within the supply chain. While some bases have fully staffed tool shops full of trained personnel who can build-to-order (BTO) most replacement items needed, that is not the case for some smaller outposts. Additionally, some bases are located in areas where supply chains are stretched thinner, making it take longer to get requisitioned parts. This has set up a perfect opportunity for new additive manufacturing (3D printing) technology to help fill a vital need.

Government engineers and researchers spoke about advances in 3D printing technology at a ***recent FedInsider webinar***. The following are some of the most important aspects of their discussion.

Additive Manufacturing Moves Beyond Plastic

The general association with 3D printers are the consumer models that use molten plastic or resin. While these materials are adequate for most home consumers, the military needs stronger and more flexible materials to accomplish their various missions. One such innovation is the implementation of continuous Carbon Fiber into the plastic substrate.

"Our technology has the ability to print continuous fibers, such as Carbon Fiber, which produces parts with the strength of machined aluminum," said Tony Higgins, Federal Leader at Markforged, a company that provides 3D printers and technology to the government and military.

In addition to Composites and Continuous Fibers, Markforged has the ability to use additive manufacturing technology with various types of metal.

"We have a system that prints stainless steel, metal tools and copper," said Higgins. "A lot of our customers are using this type of technology for functional tools, custom tools, work holdings and fixtures."

This new technology and the additive manufacturing advancements have also facilitated the creation of some truly interesting proof of concept items, like a fully 3D printed grenade launcher for the RAMBO project. The weapon went from design to a live fire test in seven months and has shown that even weapons can be manufactured through the 3D process. However, this will not be commonplace as the grenade launcher was a prototype and more research will need to be completed before 3D weapons take the field.

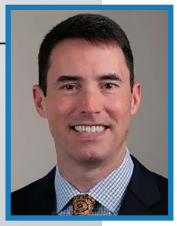
For more practical uses, Higgins cited a current project where the Navy is using additive manufacturing to create metal valve wheels for use in their ships. If the Navy is able to utilize this technology to create parts such as the valve wheel, it will help alleviate repair stresses while vessels are out at sea. By continuing to improve the technology of additive manufacturing, Higgins predicted that the number and type of items that will be created for military use will grow exponentially.

Featured Experts:

- **Megan Kreiger**
  Mechanical Engineer, U.S. Army Engineer Research & Development Center, Construction Engineering Research Laboratory

- **James L. Zunino III**
  Sr. Scientific Technical Mgr., Munitions Future Concepts & S&T, Army (TAC-1), Advanced Materials & Manufacturing, U.S. Army Futures Command, DEVCOM

- **Tony Higgins**
  Federal Leader, Markforged



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Building Literal Bridges (and other structures) with Additive Manufacturing

The military has a wide variety of missions that often involves building and constructing a variety of structures. This can include the need to build bridges in remote areas with poor physical access that makes typical construction projects challenging. To overcome these inherent supply chain issues, the military has looked to additive manufacturing to help fill this hole. In one case, the military was able to successfully 3D print an entire bridge.

"We have a number of different systems that can print everything from concrete to foams to other types of materials," said Megan Kreider, Mechanical Engineer for the U.S. Army Engineer Research and Development Center (ERDC) at the Construction Engineering Research Laboratory (CERL). Kreider worked on the 3D printed bridge project, and explained that there are key differences when manufacturing large structures such as bridges compared with typical manufacturing processes, though there are also many similarities.

"It's all still construction, right?" Kreiger said. "You have to go through a structural engineer, they outline what the reinforcement needs to be, how it's going to be printed and it's highly interdisciplinary." But once that is taken care of, the parts are printed, often right on the site of the construction, and then it's just a matter of fitting them together. While there is more work involved with manufacturing entire structures than simple tools, there are upsides. Kreiger mentioned that additive manufacturing reduces the need for so called formwork, which saves a lot of time, money and manpower. There are also variables when using foams such as cure times and structural performance that requires engineering knowledge to prepare. However, breakthroughs in additive manufacturing will eventually allow the military to complete building type missions more quickly and with greater efficiency.

Additive Manufacturing's Bright Military Future

Generally, when one thinks of additive manufacturing in the military, it's common to assume that all the printed items will be put into the hands of soldiers. While that is true of simple tools, it's not the case with most additive manufacturing. Most of the items are geared toward support functions such as ship parts, replacement items or other needs that benefit the military as a whole.

"Probably about 80% of what we're designing, fabricating and printing isn't actually going to end up in a soldier's hands as a final 3D printed part," said James L. Zunino III, Senior Scientific Technical Manager for Munitions Future Concepts and S&T for the Advanced Materials & Manufacturing. "A lot of it is done to advance other technologies, or to get prototypes designed and fielded more quickly, or to help improve existing manufacturing shortfalls."

While a prototype weapon has been successfully printed, that technology is not ready for mass production. Weapon manufacturing requires different application and tooling processes that are still being streamlined, Zunino said. So the additive manufacturing process still has a lot of development ahead of it, but there are innovative philosophies about its future deployment.

"Eventually, 3D printing will be seen as just another process that you can use to make what's needed," said Zunino. In the future, the Army will simply use 3D printing if it's the most efficient way to build something, and the process itself won't really matter to those who are using the final product, whether that's a wrench, a valve, a bridge or a weapon.

As additive manufacturing continues to improve, the webinar speakers all predicted that new uses for the technology will quickly follow. For example, additive manufacturing has already been deployed to print tools in space, and the Navy continues to test it at sea. Eventually, all of the experiments being conducted today will enable additive manufacturing to become commonplace within the government and the military. And that day is not too far away.

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Hosky Communications Inc.
3811 Massachusetts Avenue, NW
Washington, DC 20016

(202) 237-0300
Info@FedInsider.com
FedInsider.com
Facebook.com/FedInsiderNews
Linkedin.com/company/FedInsider
@FedInsider

carahsoft.

Carahsoft
14993 Sunset Hills Road, Suite 100
Reston, VA 20190
Contact: Lacey Wean

(703) 871-8548
Markforged@Carahsoft.com
Carahsoft.com/Markforged
Facebook.com/Carahsoft
Linkedin.com/company/Carahsoft
@Carahsoft