AUTODESK

Additive manufacturing gains steam across armed forces

New strategy rollout is supported by CAD resources

The United States military is in the midst of a digital manufacturing revolution that will give its warfighters, engineers and mechanics the ability to shape their real-world tools and weapons in real-time.

In this transformation, soldiers, airmen, and sailors are making parts from plastics, metals and other materials for vehicles, infrastructure and even weapons systems in the field using additive manufacturing (AM) technology. They also have to process and share three-dimensional (3D) data generated by that work across platforms and devices. The growing AM movement in the military means personnel won't have to wait on lengthy acquisition processes, long parts or equipment supply lines. They can have defense systems which can be more readily and effectively updated to keep them technologically ahead of adversaries.

In the last few years, the Army, Navy, Air Force and Marines have all been busy harnessing AM technologies, which incorporate 3D printing technologies and Computer-Aided Design (CAD) software, for a host of uses. AM technologies can push innovation and more agile capabilities deeper into their supply chains and design processes.

For example, the Department of Defense (DOD) issued an overarching AM strategy in January, 2021, that laid out the strategy and goals for the program, which included building a more agile and adaptable supply base, as well as coordination between services and education about the use of AM.

The document cited a number of examples that are currently in use, including the U.S. Marine Corps for applying AM manufacturing processes to field print sensor housings to help secure base perimeters. The Army, it said, is using field repair units to print out a low cost cap to protect a million dollar lens on a tank, and the U.S. Air Force is using AM to replace obsolete parts for the C-5 cargo aircraft at five percent of the cost of ordering a replacement through traditional acquisition channels.

The armed forces' use of AM in the field has been growing for several years, but they're still laying the foundational work to make the processes a formal part of their supply chains and design processes. The Army rolled out a policy in 2019 that required incorporating advanced manufacturing into both new and fielded systems. It said the policy would drive its entire acquisition system towards using materials and methods to modernize weapons systems and enhance readiness.

The 2019 Army policy also established overarching guidelines on how to use 3D printing, as well as subtractive manufacturing, a process that carves objects from a solid block of material. It also set up an Advanced Manufacturing Center of Excellence at its Rock Island Arsenal in Illinois. The Rock Island facility is the central location where the Army is developing best practices and promoting execution of AM across the service. The center, according to Brig. Gen. Darren Werner, Commanding General of the Army's Tank-automotive and Armaments Command (TACOM), has 21 3D printers capable of printing polymer, titanium, steel and aluminum, and works closely with the Army Futures Command, the Program Executive Offices for Combat Support and Combat Service Support and Ground Combat Systems.

"Additive manufacturing offers DOD unprecedented supply chain agility while enabling our developers to sustain technological dominance for our warfighters"

Other examples of work underway include:

- The Army has also deployed AM capabilities in hundreds of Mobile Maintenance Equipment systems, which are repair and metal working shops housed aboard trailers that can be drawn up close to forward positions, enabling faster repair and fabrication of essential parts.
- The Air Force is also moving ahead with plans to leverage AM technology on a wider scale. It set up an Advanced Manufacturing Olympics competition in the summer of 2020 in which dozens of teams from industry, government, and academia competed for a million dollar pot of prizes to rapidly develop spare parts for aircraft and other applications.
- The Air Force's Life Cycle Management Center's (AFLCMC) Rapid Sustainment Office (RSO) issued a broad solicitation in January 2021 looking to speed the process of 3D parts production by quickly scanning, identifying and creating 3D models of candidate parts that could be produced by commercial CAD software with minimal human interaction.
- The U.S. Navy is collaborating to use a liquid metal 3D printer at its Monterey, California Postgraduate School university campus. The program allows instructors and students at the facility to experiment using the metal printer to cost-effectively print aluminum end-replacement parts that can shorten its supply chain for deployed forces and to reduce production costs for the Navy and Marine Corps.

Most of the AM activity is driven largely by individual services, however, which can complicate the use of the technology across the services. DOD wants to maximize the impact of AM capabilities across operations.

In January 2021, it issued its AM Strategy, the first common plan for using what it calls "game changing" 3D printing technologies. The DOD's Office of the Secretary of Defense Manufacturing Technology (OSD ManTech), under the Strategic Technology Protection and Exploitation Office (STP&E) in OUSD(R&E), issued the guidance. The vision looks to harmonize and coordinate AM efforts across the services in three key areas—modernizing national defense systems, increasing materiel readiness with rapid prototyping and direct parts production, and enabling warfighters to develop innovative solutions near the battlefield.

"Additive manufacturing offers DOD unprecedented supply chain agility while enabling our developers to sustain technological dominance for our warfighters," said Robert Gold, Director of the Technology and Manufacturing Industrial Base (TMIB) Office in STP&E, who is also responsible for oversight of OSD ManTech. "This strategy ensures that DOD will realize the most benefits from AM technology by structuring our AM activities, aligning funding opportunities, and improving AM implementation efforts – all with the objective of enhancing our warfighters' mission readiness," said Gold in releasing the strategy.

The agility, innovation, and cost savings that AM offers, according to DoD's 2021 plan, is a key to keeping ahead of potential adversaries, bringing modeling and simulation, artificial intelligence, and machine learning to development and production of new capabilities more effectively.

As the DOD's strategy suggests, the need for closer coordination is required among the armed services to insure AM is implemented most effectively.

"The challenge that the Army and Air Force have with new additive manufacturing now is that it's a relatively new technology," said Blaine Duke, product specialist sales executive at Autodesk, a supplier of a portfolio of CAD software used in architecture, engineering and construction for AM.

"AM is exciting. All DOD's users want to be able to work with it"

As a result, the services have been acquiring a host of capabilities and are still developing ways to coordinate and harmonize all of them. The January AM strategy is the next step in that process.

Among a list of goals in the plan, the DOD looks to nail down policies on transferring AM data among machines and personnel, develop data management best practices and better guidelines for AM machines in the field.

Autodesk, said Duke, has a portfolio of AM solutions that can help across the spectrum of developing needs in the armed forces, including enabling designers to able to communicate more effectively with the growing numbers of disparate 3D printers.

Autodesk software can help with 3D model presentation, straightening out workflows and modifying models within CAD to move quickly to the next design version without complicated processing conversions, according to company officials.

"What we have is a portfolio of solutions for making stuff," said Duke. "We can work on the research and development side for reverse engineering parts. We can take scan data to create a design or model that can be sent to a machine shop to do subtractive processing, or to a 3D printer," he said.

AUTODESK.

Autodesk's portfolio, said Duke, can aid subtractive manufacturing processes by being equipment agnostic, meaning it can communicate with a host of unrelated machines.

The design data, he said, is like a Word document being sent to a printer. "We don't care what printer you're printing to. We can print to all of them," he said.

Autodesk's solutions can help across the entire AM process, from development, scanning, and production, according to Duke. "We can help scan data, create a CAD file. We've got tools to send it to the machine shop to do subtractive tool paths on the part and we have solutions for 3D printing for metal printers, less expensive desktop printers, to more complex hybrid printers that do subtractive and additive processes."

The company's solutions, he said, can be valuable because they offer flexibility for a growing cadre of developers who are progressing with the DOD's emerging AM plans.

Facilities such as the Army's AM Center of Excellence at Rock Island that have environments with an array of equipment and younger developers who are learning, can leverage Autodesk's portfolio across capabilities.

"They can design, print to simple devices, then go on to use complex metal printing where it's very expensive, but the interface doesn't change" which simplifies their work, said Duke.

The company already has products that are helping the Army with its computer-assisted manufacturing program. Autodesk's FeatureCAM, a computer-controlled precision machining software, is being used by the Army and Air Force in their applications, according to Adrian Nagel, Colonel, Engineer (Ret.) US Army and Autodesk federal account sales executive for the Army.

"The technology is going to continue to develop," said Duke. "The military, the Air Force, the Army—they're the ones that invest in this kind of important technology early on."

The computer-assisted machine tooling software is part of the Metal Working and Machining Shop Set (MWMSS) of the Army's Mobile Maintenance Equipment shop program, said Nagel. The MWMSS units have been deployed worldwide, he said.

"The Army's been dabbling in 3D printing for a few years," said Nagel. The MWMSS trailers, said Nagel, show the immediate practicality of AM capabilities to ease straightforward supply chain needs.

"If something broke down 20 years ago, like a dump truck, or other vehicle, it could take months to get a replacement part," said Nagel. AM capabilities can shorten that time to days or even hours now, he said.

As AM capabilities and demand grow in the armed forces, Nagel and Duke see them taking on an increasingly important and complex role in how the armed forces modernize their operations, as well as solve everyday maintenance issues. The process allows comparatively immediate results, with new or replacement parts, more flexible, software driven, cloud –supported design, as well as the ability to introduce new design concepts quickly.

"The technology is going to continue to develop," said Duke. "The military, the Air Force, the Army—they're the ones that invest in this kind of important technology early on."

SOURCES

Jan. 2021 DoD Additive Man. Strategy
Department of defense unveils additive manufacturing strategy
Department of Defense Additive Manufacturing Strategy

Army 2019 AM policy
Secretary of the Army approves new advanced manufacturing policy

Army Center of Excellence
RIA-JMTC Additive Manufacturing Center of Excellence marks initial operating capability with ribbon

Air Force
Air Force Searching for Savvier Sustainment
Autodesk goes after the 'early majority'

Autodesk can address the digitization of data to make it more robust, valuable, cost effective for the Air Force.

Airforce Advanced Manufacturing Olympics

Army examples
DOD Uses 3D-Printing to Create N95 Respirators
Army uses innovative process to 3D print parts for aircraft

U.S. Army Combat Capabilities Development Command Aviation & Missile Center – AvMC Additive Manufacturing Facility
Additive Manufacturing facility delivers on modernization, readiness

October 2020
DoD's Defense Visual Information Distribution Service (DVIDS), Brig. Gen. Darren Werner statement on CoE.
TACOM commander touts additive manufacturing advances

Navy/Xerox 3d printing
Xerox and Naval Postgraduate School Announce Collaboration to Advance Solutions with 3D Printing Research

Mobile Maintenance Equipment Systems

Air Force 3-d scanner
Rapid Sustainment Office (RSO) Commercial Solutions Opening (CSO)

AUTODESK.