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### **3D Printing in the U.S. Army**

Three-dimensional (3D) printing has emerged as a disruptive technology, fundamentally altering production and logistics. This technology, which constructs objects layer-by-layer from a digital model, has transformed high-precision health care, to the demanding standards of the aerospace industry. The U.S. Army has rapidly adopted and integrated this capability to solve logistical and operational challenges, significantly enhancing force protection and reducing the decades-old supply chain issues. This strategic shift represents a crucial evolution in military engineering, moving from bulk transportation to on-demand, localized production.

The core argument of this report is that the U.S. Army's sustained investment and implementation of additive construction through programs like ACES has created a revolutionary force multiplier. This capability not only addresses challenges, such as the need for rapid and durable infrastructure, but also promises to redefine future logistics, battlefield mobility, and humanitarian response operations, increasing the Army's strategic resilience.

3D printing was invented in the early 1980's, even decades later the military started applying it to their duties. In 2012, the military faced challenges of places to store equipment, transport bulky equipment, finding temporary housing, and had issues with supply chains. To resolve the challenges the U.S. Army Corps of Engineers began additive manufacturing and

recognized the potential 3D printing had to fix this. After this recognition The Engineer Research and Development center (ERDC) established the Additive Construction program to train soldiers to start training soldiers to have the skill set to create concrete buildings and other protection with 3D printers, but with only available materials they have at that time (Wright, 2025).

According to Hambling (2021), the effort of building concrete structures formalized in the Automated Construction of Expeditionary Structures (ACES) program. The program enables on-demand production of bridges and shelters. Megan Kreiger, program manager for the ACES stated, "Our priority was to develop a capability utilizing 3D printing technology for use in an expeditionary environment, specifically suited for military purposes" (Hambling, 2021, p.1). Having everything shipped in containers and using local materials ensured there are no delays in their construction process.

The first item the Army 3D printed in 2017 was barracks hut or also known as B-Hut. This was a milestone in their construction buildings. Traditional B-Huts are made from plywood, which would quickly degrade and have limited durability. The 3D printed version of this structure used layered concrete creating more resilient and protective structures. (Wright, 2025). Later the EDRC demonstrated that a small untrained team could create the walls of a 512-square-foot hut in just under 48 hours. A year later the Army introduces the ACES Lite system. This was a transportable 3D printer that fits into a standard shipping container and then once unboxed can be set up in less than an hour. The efficient printer was an ideal solution for the forces (Wright, 2025).

Beyond the B-Hut shelters 3D printed bridges have also been explored by the Army. Hambling (2021), notes that the Corps of Engineers have worked on a plant to print modular concrete bridge components for combat operations, and disaster relief. Restoring bridges quickly

is important for both scenarios, as damaged infrastructures can delay troop movement or can isolate civilian communities. Wright (2025), describes a demonstration in which soldiers printed seven reinforced box beams that were later assembled into a 40- foot bridge capable of carrying a fully loaded military truck. The capability shows promise for so many, especially battlefield organizations and humanitarian missions. In these places restoring transportation routes is essential to delivering aid.

The advantages of 3D printing for military operations are limitless and reflect several strategic benefits like reduced logistical burden, speed and efficiency, durability, design flexibility, and humanitarian potential. Wright (2025), provides examples of these benefits. To reduce logistical burden soldiers can print structures on-site using locally sourced materials like sand and gravel instead of shipping prefabricated materials. Having small teams with the skill to complete a building in 24-48 hours saves time and frees people for other tasks. Compared to wooden equivalents concrete structures provide greater weather and threat resistance. For design flexibility 3D printers allow for complex geometries and tailored reinforcement without an increase in cost or time. Going along with these benefits Hambling (2021) notes that for humanitarian potential the technology can be applied in disaster relief to rapidly construct bridges, shelters, or barriers for affected civilians.

Despite all these benefits there still are challenges and limitations that come with the Army's 3D printing. Producing consistent, high quality concrete mixtures in diverse environments is not always straightforward Wright (2025), mentioned. Training is another issue that comes with 3D printing. Although systems like ACES Lite are user friendly, soldiers still require instruction in both material handling and printer operation. The final issue is scalability.

This remains a barrier today. Most projects so far have been demonstrations rather than fully integrated capabilities (Wright 2025).

Both articles Wright (2025), and Hambling (2021), stress that the Army's additive construction programs are moving toward broader adoption. Wright (2025), envisions the technology being integrated into engineering units and taught at military schools, ensuring that soldiers can operate printers independently in the field. Hambling (2021), emphasizes the dual-use value of 3D printing, particularly its humanitarian applications in disaster recovery. Looking ahead, additive construction may redefine Army coordination. Instead of transporting heavy materials, units could deploy with compact printers, producing needed infrastructure on demand. This shift could make Army more supple, sustainable, and resilient in both combat and humanitarian options.

The U.S. Army's embrace of 3D printing represents a significant evolution in military engineering. From the first B-Huts to bridges capable of supporting heavy vehicles, the army has demonstrated the utility of additive construction for rapid, durable, and flexible infrastructure. Wright (2025), highlights the advantages in efficiency and durability, while Hambling (2021), makes notice of the potential for humanitarian assistance. Even though challenges remain in scaling and standardizing. The future of 3D printing in the Army promises to enhance readiness, reduce logistical burdens, and expand the role of military forces in global disaster relief.

## References

Hambling, D. (2021). U.S. Army Corps of Engineers is 3D Printing Bridges. *Forbes*.

Wright, S. (2025). Additive Construction: The Army's Path to Resilient Infrastructure. *Military Engineering Review*, 15(2), 45-56.