Additive Manufacturing and the Land Forces Supply Chain: a Revolution Within a Revolution

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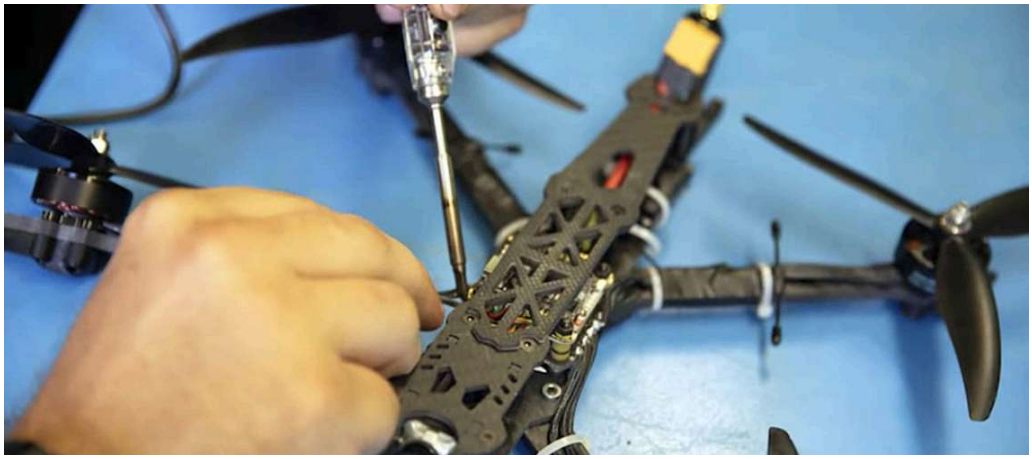

Photo: Repair of an FPV drone inside a mobile workshop deployed by Hawkeye Platoon during Exercise Agile Spirit 25 © 1st Class Brittany Conley, U.S. Army National Guard, Georgia, August 2025 (published by the U.S. Department of War: https://www.war.gov/News/News-Stories/Article/Article/4264091/hawkeye-platoon-leads-army-innovation-with-tactical-drones-3d-printed-lethality/)

Initially introduced cautiously within the armed forces, additive manufacturing — commonly referred to as 3D printing — is now firmly established, with its impact resonating across the entire military supply chain. This shift comes at a time when geopolitical realities no longer permit strategic delay and are accelerating acquisition transformation across defense ecosystems.

Reducing the logistical footprint by manufacturing spare parts as close as possible to the battlefield is now a reality. As the technology matures, the “3D printing + drone” combination is multiplying the effects of doctrinal change underway across modern land forces.

Additive manufacturing does more than accelerate logistics: it reshapes the relationship between the front line and rear support, bringing industry closer to the battlefield and transforming deployed units into micro-production hubs.

With 3D printing, the long-dominant “just-in-time logistics” model has shifted toward “point-of-need sustainment” — in other words, “just-at-contact logistics.”

Re-arming the Supply Chain: Point-of-Need Production for Combat Readiness

(https://www.eurosatory.com/en/)

At the 2025 Annual Meeting of the Association of the U.S. Army (AUSA), Lt. Gen. Christopher Mohan, Deputy Commanding General and acting commander of U.S. Army Materiel Command (AMC), raised the recurring and sensitive issue of intellectual property held by suppliers — often buried within lower-tier subcontractors. He stressed the urgency of restoring platforms — tanks, helicopters, and more — by regaining technical data control to reverse-engineer parts through 3D printing.

“Don’t be surprised if you just see us doing things because we can’t wait”, he stated in Breaking Defense (1).

In practice, “doing things” means downloading parts from secure repositories to print directly in deployable container labs, or scanning parts for reverse engineering, printing prototypes, and validating structural performance organically — all faster and more cost-effective and totally feasible at least for non-critical spares.

This technology also addresses obsolescence challenges. Nations such as the UK have made additive manufacturing a priority, notably through Project Tampa, focused on titanium and nickel printing applications (2).

Multinational exercises — such as NATO Steadfast Defender or RIMPAC in the Pacific — have become proving grounds, with countries like Australia deploying SPEE3D expeditionary metal printers (3). NATO’s DIANA accelerator likewise supports rapid innovation adoption (4), including in Canada and Slovakia (5).

Additive manufacturing must also withstand austere and extreme environments, as the battlefield often takes place where distance and access are a challenge in themselves rendering that kind of technology especially relevant.

Among examples quoted in the media, Australia’s SPEE3D “EMU” units (Expeditionaru Manufacturing Units) operate in both extreme heat and freezing conditions., while India’s Project Prabal printed defensive structures at an altitude of 11 000 feet (HALO environment — High Altitude, Low Oxygen): this project has been the result of a cooperation between the Indian Army, IIT Hyderabad and Simpliforge Creations. Lack of oxygen, extreme temperatures, UV exposure and low humidity are as challengin for troops as they are for machines and such repair and/of production capabilities could turn out to be especially valuable for mountain troops for instance (7).

Forward 3D drone repair and production indeed does illustrate a tactical breakthrough, enabling temporary but decisive advantages — for example, saturating enemy assets.

Toward Embedded Autonomous Logistics: the “Drone + 3D Printing” Breakthrough

U.S. Army Aviation launched the Unmanned Advanced Lethality Course (UALC) to train soldiers not only to operate drones but to design, manufacture, and repair them using CAD tools and polymer/carbon-fiber printers (8). Soldiers can now repair tactical components at the frontline on their own and in record times (8).

As everyone knows, feedback from Ukraine has directly led to the acceleration of this development of new skills within Western armed forces in general, while various recent exercises, such as Agile Spirit 25, echo this trend: this multinational exercise organized by the land command of the U.S. European Command (EUCOM) and the U.S. Africa Command (AFRICOM) – U.S. Army Europe and Africa (USAREUR-AF) – aims in general to strengthen interoperability between allied forces and partners and to test emerging technologies in the field.

(https://www.eurosatory.com/en/)

Having begun in July in Turkey and continuing in Georgia at the NATO-Georgia Joint Training and Evaluation Center (JTEC) in Krtsanisi between July 25 and August 8, 2025, the 12th edition of Agile Spirit brought together military personnel from Ukraine, the United States, Turkey, and Georgia, as well as Germany, Italy, Greece, Moldova, Romania, Bulgaria, Slovakia, Lithuania, and Poland, while Armenia and Japan participated as observers (9). During this exercise, the Hawkeye platoon of the US Army's 173rd Airborne Brigade deployed a mobile laboratory for 3D printing of FPV (First-Person View) drone parts, combining printed parts and commercial components to enable the manufacture of drones directly adapted to their missions in a matter of hours at a cost of less than $500 (10).

The British Army has also developed a battlefield drone production workshop, which it tested during the Bull Storm exercise conducted in Kenya last May (11). In an interview with Soldier magazine, Major Stephen Watts, commander of F Company, 3rd Battalion, The Rifles Regiment, envisaged the manufacture of hundreds of drones by the next Bull Storm 26 exercise and made the following comment: "If we ramp up in the future, we could have just one truck full of 3D printers, generators, parts, cameras, and small ammunition—and our production capacity would be immense." (12).

Such a reduction in the logistical footprint brought about by the possibilities of additive manufacturing on the front line is in line with the predictions of General Christian Jouslin de Noray, former central director of the Integrated Structure for the Maintenance of Land Equipment (SIMMT) within the French Army from 2020 to 2024, who estimated in an interview published on this site in 2023 that "additive manufacturing—or 3D printing—will be one of the solutions that will enable us to move towards logistics that are also much more responsive and much more frugal" (13).

France—notably through the pioneering work of the 17th Artillery Group (GA)—is one of the nations that has focused on developing containerized workshops powered by generators, creating a 3D FMA (mobile autonomous factory) that is currently capable of manufacturing 60 to 80 FPV drones in operation (14).

The same applies to the German armed forces, which operate a modular concept consisting of units known as eAFE (light additive manufacturing unit), AFE (additive manufacturing unit), vAFE (mobile additive manufacturing unit) and AFZ (additive manufacturing center), as well as to the Norwegian armed forces. Applications "cover rapid repairs, combat damage repairs, temporary replacements, and modifications—for example, to adapt existing drone frames for a specific use." (15)

Naturally, drones necessitate countermeasures, and 3D printing now enables the development of solutions against drone swarms, with Ukraine leading the way in innovation in this area as well, producing interceptor drones.

Beyond drones and anti-drone measures, the scope of applications in the field of 3D printing is limitless, and this article only scratches the surface of the subject. What seems important to note in conclusion is that the decentralization of production, or the concept of distributed production analogous to that of distributed operations, via containerized modules connected to secure file libraries, brings repair and manufacturing processes closer to the front line to an unprecedented degree and de facto increases the tactical autonomy of units.

This "on-demand" production logic affects all aspects of support and logistics, including, for example, in the infrastructure domain, the printing of field installations

capable of drastically reducing the time required to set up forward bases (17), or in the field of forward medicine, where applications continue to develop— *ad hoc medical tools and spare parts;* splints, prostheses, and "custom-made" implants; etc. – Among the promising avenues of research are, for example, printed skin clips – currently at the prototype stage – that can facilitate suturing, and printed bone substitutes made of bioceramics, which are currently in the clinical phase (18).

It is therefore clear that the rise of additive manufacturing in land forces is no longer experimental, but rather marks a profound transformation not only in operational preparation, support, and projection strategies, but also in the tactics that these can enable in terms of combined operations.

Faced with the return of high-intensity conflicts, where logistical tempo and industrial resilience determine the ability to sustain operations over time, 3D printing is becoming an efficiency multiplier. It makes it possible to produce parts in a matter of days—or even hours—that were often unavailable for weeks in the past, to maintain the availability of older-generation vehicle fleets despite their obsolescence (and therefore lack of profitability), and to partially free oneself from supply chains that are vulnerable or too complicated to implement.

Furthermore, while this revolution is technical, it is also human, in the sense that the armed forces are now training their soldiers in new skills ranging from computer-aided design and polymer or metal printing to the integration of these capabilities into maneuvers (particularly drones, but not exclusively), whether terrestrial, air-land, amphibious, or other. By forging a new "hands-on" industrial culture, they are building a force that is already different in nature, if only in terms of responsiveness and adaptability to threats.

Although there is still some way to go—particularly in terms of certification and intellectual property—3D printing is no longer considered a simple tool or gadget, but rather a vehicle for transformational strategic autonomy, logistical superiority, and, potentially, tactical superiority in terms of time.

In a world where speed of adaptation has become a key factor for victory, its growing integration closer to the front lines already represents a decisive advantage in the race against time that has become the battlefield of the 21st century, while simultaneously redefining the interactions between the "front " (area of engagement) and the rear echelon (area of support), already undermined by the return of high intensity.

By Murielle Delaporte

Sources

(1)This quote comes from the following abstract: "As a result, Lt. Gen. Christopher Mohan, who serves as the deputy commanding general and acting commander of AMC, said industry should not "be surprised" if the service starts moving forward in trying to manufacture more of its own parts through 3D printing not derived from the vendor's IP, so it can get more of its tanks, helicopters and other platforms up and running more quickly. He acknowledged that this makes industry "apprehensive and weary," but added that he's been transparent with vendors about the service's struggles.
"We've been very upfront with them, and I told one of our industry partners yesterday, don't be surprised if you just see us doing things because we can't wait. We can't wait," Mohan said in an interview at last week's annual AUSA conference."
Source : https://breakingdefense.com/2025/10/dont-be-surprised-if-army-starts-3d-printing-its-own-parts-materiel-command-head/
See also: https://www.ausa.org/news/army-asks-industry-help-streamlining-sustainment

(2)https://www.tctmagazine.com/additive-manufacturing-3d-printing-news/spiral-3-project-tampa-additive-manufacturing-supply-chain/

(3) https://3dprintingindustry.com/news/spee3d-successful-at-the-worlds-largest-international-naval-exercise-232156/

(4) https://www.diana.nato.int/

(5) https://3dprintingindustry.com/news/15-companies-advance-to-nato-diana-2025-phase-2-two-focused-on-3d-printing-244075/

(6) https://3dprintingindustry.com/news/project-prabal-indias-first-on-site-3d-printed-military-bunker-completed-at-11000-feet-238820/

(7) Voir notamment sur ce sujet le Salon international des troupes de montagne (SITM) : https://sitm-summit.com/conferences/

(8) This training program is known as UALC for “Unmanned Advanced Lethality Course”.
To go further, see for instance:
· https://www.halldale.com/defence/us-army-trains-soldiers-drone-3d-printing
· https://3dprintingindustry.com/news/new-u-s-army-course-trains-soldiers-to-3d-print-fpv-drones-243526/ ;
·
https://www.army.mil/article/287907/u_s_army_aviation_center_of_excellence_launches_unmanned_advanc

(9) https://civil.ge/archives/694332 ;
https://www.army.mil/article/287661/agile_spirit_25_concludes_with_unified_display_of_allied_strength_and

(10) https://www.war.gov/News/News-Stories/Article/Article/4264091/hawkeye-platoon-leads-army-innovation-with-tactical-drones-3d-printed-lethality/ ;
https://3dprintingindustry.com/news/u-s-army-builds-3d-printed-drones-in-the-field-242871/

(11) https://3dprintingindustry.com/news/british-army-deploys-bambu-lab-3d-printer-to-manufacture-attack-drones-242725/

(12) https://soldier.army.mod.uk/issues/july-2025/updates/3d-printed-drones

(13) In this two-part interview, General Jouslin de Noray highlighted the increased logistical burden associated with the modernization of land equipment and developed the concept of a more frugal logistical footprint as follows: “For initial projection autonomy, when you deploy a company of VABs, it’s the equivalent of a container. The same initial projection autonomy when we first deployed the new generation Griffon required four containers. Even if we had planned for a large number of containers, we had multiplied our logistical footprint by four. This is normal, because the equipment is much larger and contains many more spare parts. If we can do without some of the spare parts because we can manufacture them ourselves on site, then we will be able to make our logistics much more frugal, lighter, and more agile.”

See: https://www.eurosatory.com/france-frugalite-modernite-et-mutualisation-un-tryptique-au-service-de-lepaisseur-strategique-et-dune-meilleure-soutenabilite-des-

materiels-terrestres/ ; https://www.eurosatory.com/france-frugalite-modernite-et-mutualisation-un-tryptique-au-service-de-lepaisseur-strategique-et-dune-meilleure-soutenabilite-des-materiels-terrestres-ii-de-ii/

(14) https://www.opex360.com/2025/03/22/le-17e-groupe-dartillerie-a-la-capacite-de-fabriquer-60-drones-fpv-par-jour-au-plus-pres-du-champ-de-bataille ; https://mars-attaque.blogspot.com/2024/11/17-groupe-artillerie-biscarosse-lutte-anti-drones-impression3d-transformation.html

(15) As quoted in: https://tdhj.org/blog/post/low-cost-modern-warfare. This part of the article is based on the following sources:
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• Naval Postgraduate School. “CAMRE helps Marines take 3D printing to new heights.” July 5, 2023. https://nps.edu/-/camre-helps-marines-take-3d-printing-to-new-heights

(16) https://3dprintingindustry.com/news/ukraine-deploys-3d-printed-drones-to-combat-russian-shahed-swarms-242362/

(17) For a quick overview of the various military applications in 3D printing, see in particular: https://amfg.ai/2025/04/24/portable-3d-printing-additive-manufacturing-in-the-field/

(18) Beyond mechanical parts and drone components, 3D printing is already paving the way for medical advances that are crucial to the survival and recovery of combatants: in the specific area of printed bioceramic bone substitutes, these are designed to replace or fill traumatic bone loss and are currently the subject of advanced clinical work, with customized implants made of calcium phosphate or bioactive glass (bioglass) demonstrating high potential for osseointegration. While most of these applications are currently limited to controlled hospital environments, several studies highlight the clinical feasibility of custom-printed cranio-maxillofacial grafts. Ultimately, these solutions could offer bone stabilization capabilities as close as possible to the injury site during surgery, reducing the need for emergency evacuation and preserving the physiological capital of the injured person before they are transferred to a higher level of care (Role 3). In concrete terms, such advances could make it possible to:
• stabilize complex fractures in the field;
• treat traumatic bone loss (explosions, gunshots);
• gain vital time before evacuation;
• limit disability.

For more information on this subject, see in particular:
https://www.nature.com/articles/s41368-024-00327-7;
https://pmc.ncbi.nlm.nih.gov/articles/PMC10047278/;
https://pubs.rsc.org/en/content/articlehtml/2023/bm/d3bm01214j

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