Additive Manufacturing

The strategic implications

by 2ndLt Matthew Suarez

[Additive manufacturing], if harnessed and employed correctly, would enable the Marine Corps and Navy not only to get to the battle faster, but also to arrive there with the capabilities and weapons to dominate. The Marines will be equipped to "innovate-in-place" and build mission-specific equipment to suit whichever "clime and place" in which they find themselves … The faster we build and replace broken weapons of war, the faster we win.

—Capt Matthew Friedell[1]

It is well known that additive manufacturing, better known as 3D printing, will help segue the military and modern technology into the future. The potential for the expedited manufacturing of materials will revolutionize how the global economy and supply chains operate. Goods normally manufactured across the world can now be printed in one's backyard, supplying necessary materials in a faster and cheaper manner than the current trading system. It immediately provides users with a strategic ability. The faster production of supplies locally resupplies units in need of materiel quicker—expediting supply chain capabilities, refurbishing and outfitting units faster, ultimately increasing their sustainability and lethality.

Many articles and reports focus on the implications of this technology printing other tools, machines, or objects right on the spot, failing to focus on the major, strategic consequences inherent of this capability. The broad focus of articles dictating the potential capabilities of additive manufacturing is on the tactical and operational benefits that accompany this production. 3D printing is more than just a convenient printer; it is a technology that will provide the U.S. military a strategic advantage.

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T.X. Hammes' article regarding the strategic implications of 3D printing briefly mentions the military aspect,[2] but his expansion on the subject a year later[3] further details the potential effects that localized production could have on the global trading system. He argues that 3D printing—in conjunction with artificial intelligence and autonomous robotic systems—would streamline production locally, potentially rendering the current global economy obsolete. The strategic significance of the reduced costs and streamlined production by these systems can have serious effects not only on the global economy but also on the finances for the military.

Furthermore, Dr. Aaron Martin and Ben FitzGerald published a report[4] focusing on streamlining the production of unmanned aerial systems through 3D printing supported by robotic systems and artificial intelligence to surge the battlefield with more assets at faster rates. They focus on the growing expenses associated with technological development and the procurement of newer weapons systems and provide a framework to reduce the costs and increase efficiency in producing aircraft—starting with unmanned aerial systems. The increased efficiency of reducing production costs and increasing production speeds outputs more aircraft to the operational forces, ultimately giving them strategic advantages. Martin, FitzGerald, and Hammes all illustrate

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SPMAGTF-Southern Command Marine is measuring a water nozzle as part of the training he received on 3D printing during a course conducted at Camp Lejeune, NC. The course provides hands-on experience with 3D printing, computer-aided design, files creation, and manufacturing. *(Photo by Sgt Ian Leones.)*

the significance of this capability in financial and economic terms, which is imperative to a military-industrial complex with rising expenditures.

Additive manufacturing has long been part of the Marine Corps' discussion. Former Commandant Gen Robert B. Neller understood the potential that it provides and has inculcated an attitude to expand on this technology.[5] Additionally, Sean Walsh published a fantastic article in the *Gazette* in 2015 detailing the potential for 3D printing in the Marine Corps. It is one of the few articles dedicated to taking a deep look into the future and provides a framework for the Marine Corps to follow.[6] However, it falls short of emphasizing the strategic implications associated with 3D printing for military forces. He understands that 3D printing will revolutionize the logistic capacity for the military, but the scope of the article focuses too deeply on the tactical and operational aspects therein. He fails to explain the true significance that 3D printing establishes: it will affect all organizational levels, revolutionizing logistic capabilities.

The application of 3D printing in forward deployed forces has significant strategic implications for the supply and logistical support for forward combat units. The famous aphorism "amateurs talk about tactics, but professionals study logistics" is integral in this situation. History shows that leveraging current technologies for combat support rather than warfare oftentimes provides the advantage to the victor. For instance, Napoleon revolutionized the way he organized his armies to reduce the logistical footprint.[7] Patton's "Red Ball Express" during World War II provided constant logistic support to forward units, facilitating greater sustainability for American and allied combat troops. Additionally, America's unprecedented mass production of Liberty ships during the same war increased the sustainability of Allied forces in both Europe and the Pacific; the German U-boat campaign could not sink enough ships to hinder continued supply. The U.S. submarine campaign in the Pacific initially experienced many difficulties yet resulted in the destruction of nearly 60 percent of the Japanese merchant marine capacity, effectively rendering the Japanese ability to sustain combat troops logistically impossible.[8] It remains imperative today, as it did in the past, that our logistics capability remain secure and intuitive.

It is apparent that 3D printing can revolutionize the logistic capabilities of the military. Streamlined production, reduced costs, and local manufacturing provide enhanced sustainability. Sustaining combat forces over longer periods of time is the key component that efficient logistic capabilities provide to the military, ultimately increasing the lethality of those forces. Localizing the production of key materials and stream-

These items were printed for the communications section, Combat Logistics Battalion 11, 11th MEU during deployment. *(Photo by Sgt Adam Dublinske.)*

Sgt Willis explains the functions of a 3D printer on board the USS* Wasp *while underway in the Pacific Ocean. *(Photo by Cpl Stormy Mendez.)*

lining repair allows the warfighters at the tactical level to be outfitted for sustained combat at faster rates and for longer periods of time at significantly lower costs, affording a long-term advantage logistically. As Walsh wrote, "3D printing has the potential to redefine military logistics support to operations,"[9] but it does not do so without true strategic significance. The longer forward troops are supplied with necessary materiel, the longer they are sustained and the longer they may remain lethal. 3D printing not only improves sustainability but, more importantly, lethality through means of supply.

The Marine Corps and the other Services are developing ways to integrate this new technology, but it is integral to understand the true implications and capabilities that additive manufacturing provides. The next conflict will be more complex than the last one, so achieving an edge over the next adversary is integral to achieving success. Additive manufacturing is fundamentally strategic in nature. While it can quickly provide tactical and operational forces manufactured logistic support and supply, it ultimately provides the sustainability of combat forces, increasing their lethality and effectivity. These inexpensive machines can produce critical parts in a matter of hours at significantly faster and more efficient speeds. The cost and speed of resupply materials will drop significantly and increase the sustainability of forces more cheaply. Cheaper resupply for forces allows those funds to be utilized in similarly creative ways to support achieving advantages over one's adversary. The economic and financial potential that additive manufacturing affords is so significant, one would be remiss to not attain and implement that capability sooner. Additive manufacturing is the future of logistics, but it is absolutely critical to recognize that the economic and logistical significance of additive manufacturing is fundamentally strategic in nature.

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Notes

1. Matthew Friedell, "3D Printing is a Game-Changer," *Proceedings*, (Annapolis, MD: October 2016).

2. T.X. Hammes, "3-D Printing Will Disrupt the World in Ways We Can Barely Imagine," *War on the Rocks*, (December 2015), available at https://warontherocks.com.

3. T.X. Hammes, "Will Technological Convergence Reverse Globalization?" Institute for National Strategic Studies, (Washington, DC: National Defense University, July 2016).

4. Ben FitzGerald and Aaron Martin, "Process over Platforms: A Paradigm Shift in Acquisition Through Advanced Manufacturing," Center for a New American Strategy, (September 2016), available at https://www.cnas.org/.

5. Sydney J. Freedberg Jr., "Marines' Love Affair With 3D Printing: Small Is Cheap and Beautiful," *Breaking Defense*, (March 2018), available at https://breakingdefense.com.

6. S.R. Walsh, "3D Printing," *Marine Corps Gazette*, (Quantico, VA: March 2015).

7. William H. McNeill, *The Pursuit of Power: Technology, Armed Force, and Society since A.D. 1000*, (Chicago, IL: The University of Chicago Press, 1982).

8. United States Strategic Bombing Survey, *The War against Japanese Transportation 1941–1945*, (Washington, DC: United States Strategic Bombing Survey, Transportation Division, 1947).

9. "3D Printing."

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