



An Instant PLA: Just Add 3D Printing

by Wilson VornDick

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For the full article, see: <https://jamestown.org/program/an-instant-pla-just-add-3d-printing/>

OE Watch Commentary: In the PRC, the promise of 3D printing has stretched the boundaries of possible future applications. The PRC is pushing ahead with innovative ways of employing 3D printing across all sectors of its economy, from prosthetics to titanium-based aerospace parts, to a sustainably-built bus stop shelter outside Shanghai. The PRC is also pioneering concepts and applications for 3D printing of materiel, weaponry, and munitions for use by the People's Liberation Army (PLA). As Wang Feiyue, a director at both the National Defense University of Technology and the Chinese Academy of Sciences states, quoting an old Chinese proverb, one must “cross the river by feeling the stones” (摸着石头过河)

3D printing falls under the broad umbrella of advanced manufacturing technology which is divided between “subtractive” and “additive” manufacturing. Subtractive manufacturing is the process in which an item is created by the removal of material through methods such as drilling or lathing. Conversely, additive manufacturing (AM) is the process of adding material to create an item. Pioneered in the 1980s but still considered a new form of AM, 3D printing is the ability to fabricate objects by constructing them over a period of minutes, hours, or days using a “printer” capable of laying down one very precisely defined layer of a material after another, eventually forming the completed object.

It is important to note that the field of 3D printing, as part of AM, remains dynamic as new concepts, technical definitions, standards, techniques, and follow-up technologies evolve. As such, PRC sources sometimes refer to 3D printing and AM as one in the same, while other sources make minor distinctions between the two based on the type of material created or process employed.

Even though Western standards identify upwards of ten 3D printing methods, the PRC sources reviewed in 2015 list only six 3D printing methods. The six processes include: Fused Deposition Modeling (熔融沉积成型), Selected Laser Sintering (选择性激光烧结), Selective Laser Melting (选择性激光熔融), Stereolithography Appearance (立体光刻), Electron Beam Melting (电子束熔化), and Laminated Object Manufacturing (分层实体制造).

AM aligns with China's national strategic objective to become a science and technology superpower (科技强国) through initiatives at all levels of government. Because 3D printing relies heavily on advances in both software and hardware, 3D printing falls squarely in broader efforts within China to promote “informatization” (信息化). Furthermore, advances in 3D printing can be used to boost not only civilian industries, but also military ones as well, making it a good fit for the PRC's program of “military-civil fusion” or “civil-military integration” (军民融合). Two especially noteworthy programs in the context of 3D printing and civil military fusion are “Made in China 2025” and the PRC's 13th Five-Year-Plan.

Linking his support to these state-directed efforts and the “Thousand Talents Program” (千人计划), Wang Feiyue champions the integration of fields such as big data (大数据) and 3D printing with Chinese intelligence and military capabilities. In Wang's view, 3D printing offers three advantages: flexibility, production of both simple and complex items, and production capability for a large inventory and a variety of items. Advancing his assessment beyond 3D printing, Wang augurs a broader swath of the future digital landscape in which advances in cyberspace synch with advances 3D printing. He concludes that existing military systems “must improve and transform” as a result. If that can be achieved, it will aid in the goals toward national rejuvenation and fulfillment of the “Chinese Dream” (中国梦). However, he ominously warns that if China does not properly align and balance between the civilian and military systems, such as 3D printing, then it could spell disaster on par with the Soviet Union's collapse.

Chinese sources appeared to be mixed on the potential of AM for China, viewing it as both a threat and opportunity. Some viewed 3D printing as a threat because it challenges traditional manufacturing techniques and interests within the PRC. Meanwhile, others expressed fear and anxiety that if China does not become a major player in 3D printing, it could lose critical ground in leveraging this new technology. At the same time, some found that 3D printing is pregnant with possibilities for China to “regain market share in advanced manufacturing” and “leapfrog” global competitors in this developing field. In a follow-up analysis on the aviation and aerospace industries, it was found that China has already achieved significant savings in production time, cost, and material on account of AM. 3D printed parts have been used in the COMAC C919 passenger jet and various military aircraft such as the Y-20 transport and J-15, J-16, J-20, and J-31 jet fighters.

Jin Dayuan from the No. 36 Research Institute of China Electronics Technology Group Corporation (CETC) contends that 3D printing will not replace traditional form of manufacturing, rather it will complement. Specifically citing American advances in 3D printing, which is common throughout Chinese sources, Jin holds up American efforts to 3D print parts for the F-35 fighter and SpaceX's Dragon 2 space capsule as examples. Jin also sees additional opportunities in space-based manufacturing (太空制造), thereby reducing loads for launch and greater mission flexibility; production of “mini-unmanned aerial vehicles (微型无人) and parts (无人机暂用零件);” military electronics such as a 2013 production of a satellite antenna by Shenzhen Weihang Magnetolectric Co., Ltd.; and the production of parts for regular and emergency repairs and general maintenance. In line with Jin's last point, the repair of damaged military materiel is echoed by writers in Tactical Missile Technology, a PRC military journal. Referencing American Naval proposals, the same analysts assert 3D printers could be deployed on ships and act as “factories” for materiel, such as drones, which will save space and inventory overhead. Around the same time as that publication, the PLA-Navy unveiled that it had used 3D printers onboard its naval vessels.

3D printing has an important role to play in the PRC's strategic objective of becoming a science and technology superpower, with significant implications for both civilian industries and for PLA capabilities. Although analysts within the PRC are divided between those who perceive 3D printing to be a threat to traditional manufacturing industries, and those who consider it an indispensable part of the PRC's superior military capabilities, collaboration between the PRC central government and PLA science and technology commissions has nevertheless resulted in the increasing incorporation of 3D printing technology in military manufacturing. **End OE Watch Commentary (VornDick)** *(continued)*



Continued: An Instant PLA: Just Add 3D Printing

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“Through use of the on-board 3D printer, though, sailors were able to create the replacement part in mere hours, getting the Harbin up and running and back to maneuvers.”

Source: Sarah Anderson Goehrke, “China’s PLA Navy Deploys 3D Printers Onboard Warships to Replace Small Parts,” *3DPrint.com*, 8 January 2015. <https://3dprint.com/35981/china-pla-navy-3d-printing/>

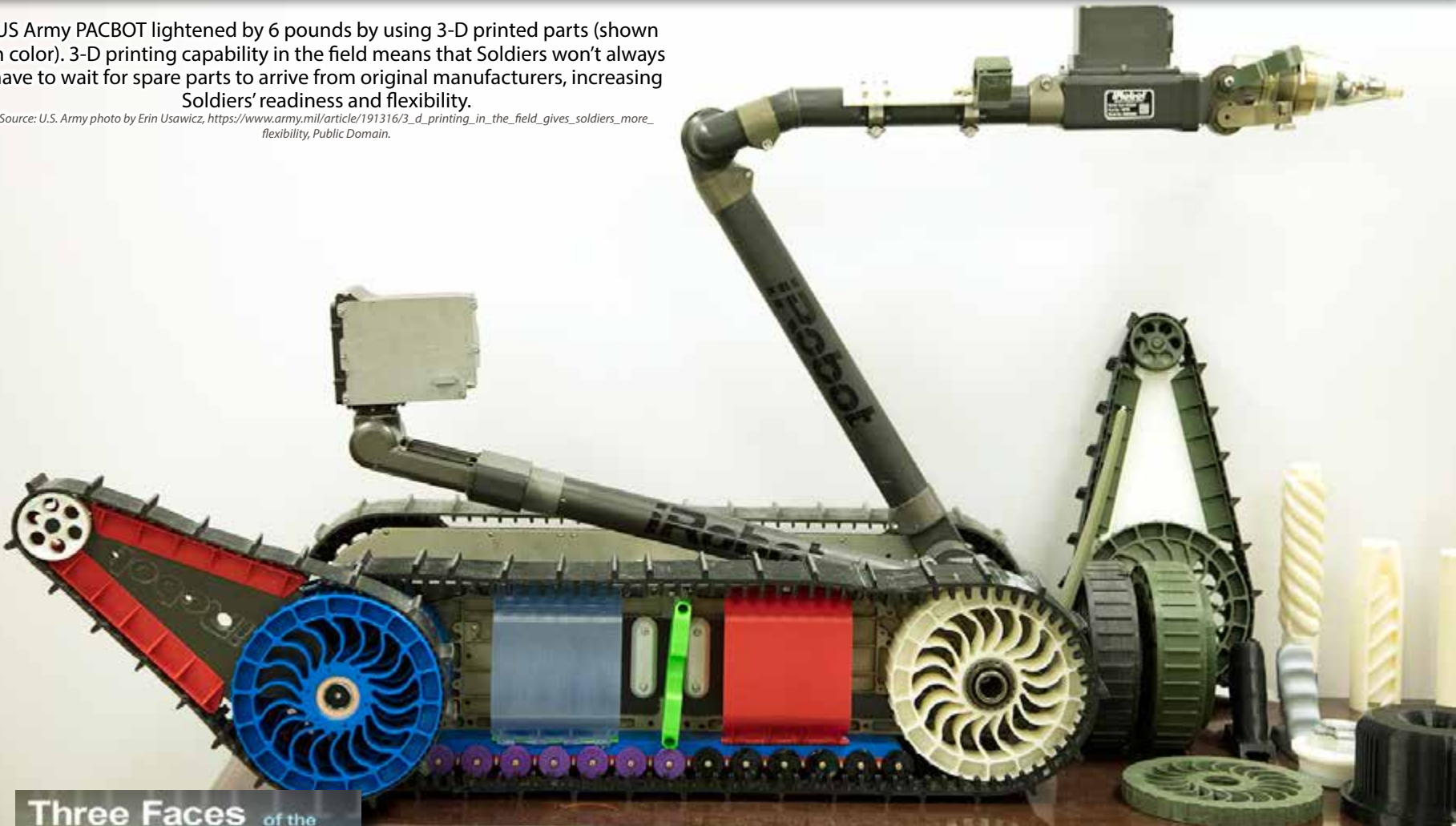
...We do know that China has been developing 3D printers since 2001, particularly for use in their military. The technology is utilized largely for prototyping, molding, repair of small parts, and weapons systems throughout the various branches of the country’s military...

Additionally, the J-15 carrier-based fighter jet used 3D printing to create new small parts to repair training flight damages...Today, we also learn that the People’s Liberation Army (PLA) Navy is utilizing 3D printers on their warships. The deployed 3D printers will be used to replace crucial small parts, and one destroyer has already taken advantage of the technology.

Last week, a wheel gear on the Harbin broke. The New Year’s Eve incident occurred in the Gulf of Aden, where the Harbin has been involved in counterpiracy maneuvers alongside the US Navy since mid-2013. The Harbin is a Type 052D destroyer; having the engine down in the far-off Arabian Sea, thousands of miles from parts suppliers in the ship’s home country, was a problem that required a fast solution...Through use of the on-board 3D printer, though, sailors were able to create the replacement part in mere hours, getting the Harbin up and running and back to maneuvers.

US Army PACBOT lightened by 6 pounds by using 3-D printed parts (shown in color). 3-D printing capability in the field means that Soldiers won’t always have to wait for spare parts to arrive from original manufacturers, increasing Soldiers’ readiness and flexibility.

Source: U.S. Army photo by Erin Usawicz, https://www.army.mil/article/191316/3_d_printing_in_the_field_gives_soldiers_more_flexibility, Public Domain.



China’s cyber policy appears to have three vectors —peace activist, espionage activist, and attack planner— that dominate China’s cyber policy. Some are always hidden from view while others are demonstrated daily. Three Faces of the Cyber Dragon is divided into sections that coincide with these vectors.

<https://community.apan.org/wg/tradoc-g2/fmso/m/fmso-books/195610/download>