

The Looming Robotics **Gap**

Why America's global dominance in military technology is starting to crumble.

BY MICHAEL C. HOROWITZ

MAY 5, 2014

In the summer of 2013, the X-47B -- an experimental, bat-winged, unmanned aerial vehicle -- flew over the Virginia coast, dove toward a 1,000-foot-long steel landing pad, then rolled to a stop on the USS George H.W. Bush without the aid of a single human. Given that touching down on the tiny, rolling deck of an aircraft carrier is a task given to only the world's most elite pilots, the UAV's landing marked a milestone in unmanned aviation for the United States. And it raised the bar in the military robotics revolution now under way around the world.

But perhaps not high enough.

Just four months later, China announced that its own bat-winged, next-generation UAV, dubbed Sharp Sword, had flown successfully. This test followed China's jaw-dropping debut of the Wing Loong at the 2013 Paris Air Show. The Pterodactyl, as it is known in English, shocked the audience because it looked just like the Reaper, the most advanced armed drone currently deployed by the U.S. military. And, according to the Chinese, it has the strike capabilities to match -- so precise that it can put a missile or laser-guided bomb into the side of a house from 10 kilometers above ground. The Pterodactyl, which

is reportedly operational, would give China the ability to do what only the United States, Britain, and Israel can do at the moment: keep 24-hour watch over adversaries and, when needed, use the very same platform to kill them.

The United States is currently the world's leader in military robotics, deploying some 11,000 UAVs and over 12,000 ground robots. But the Defense Department's investment in such technology is projected to drop more than 33 percent this year. In early 2014, Frank Kendall, the undersecretary of defense for acquisition, technology, and logistics, admitted that he is "very concerned about eroding technological superiority." China and more than 15 other countries, including adversaries of the United States like Iran, are fast at work developing new air-, sea-, and ground-based robots, many of which could be armed.

In 2012, the U.S. Defense Science Board warned of a global "race" to build unmanned military aircraft, singling out China's advances as particularly "alarming."

In 2012, the U.S. Defense Science Board warned of a global "race" to build unmanned military aircraft, singling out China's advances as particularly "alarming."

Meanwhile, companies such as Google have set their sights on developing consumer robotics to serve and fuel an international market that some estimate will generate \$6.5 billion in sales a year by 2017. Combined with an industrial robotics market projected to reach \$37 billion in annual sales by 2018, these are commercial developments that could have military ramifications. As automated technology becomes increasingly easy to procure, small militaries and even nonstate actors will be able to exploit robotics for military ends. And access to cutting-edge technology from Silicon Valley could very well give large countries with large ambitions, like China, the boost they need to surpass the United States.

Washington has led the field of military robotics because of the strength of investments made over the past two decades. But if it doesn't keep up, the United States could find itself facing that most dreaded of strategic boogeymen: a "gap" -- a robotics gap.

* * *

According to a recent study by research firm Global Industry Analysts, annual spending worldwide on military robotics will rise from \$5.6 billion in 2012 to \$7.5 billion by 2018. This growth will include everything from bomb-clearing robots to pack robots that can carry gear overland, unmanned underwater vehicles that can surveil the seas, and UAVs, more commonly known as drones. The Teal Group, a U.S. consulting company, speculated in 2013 that global spending on drones -- military and civilian -- could cumulatively reach \$89 billion over the next 10 years.

China's debut of the Pterodactyl and its test of the Sharp Sword, after all, were simply the tip of a spear in what seems like a confident stab into military robotics. The country has also developed unmanned ground vehicles, such as the Snow Leopard 10, which can detect and detonate bombs. These are similar to the ground robots that the United States has deployed in Afghanistan and Iraq over the past decade. According to the Defense Science Board, "every major manufacturer for the Chinese military has a research center devoted to unmanned systems."

China is looking not only to sidestep American superiority in manned fighter planes and aircraft carriers but to lock in a regional advantage. A series of simmering territorial disputes between China and its neighbors is incentivizing military investment in Tokyo, Seoul, and Singapore as well. Global Industry Analysts reports that spending on military robotics in Asia will increase 67 percent, to almost \$2.4 billion a year, by 2018, making it the fastest-growing segment of that market.

For example, Singapore's military research and development arm, the Defense Science and Technology Agency, has sponsored a series of competitions designed to encourage local companies to build so-called "urban warrior" robots that could enter a building,

climb stairs, and perform other nonlethal tasks to assist counterterrorism operations. These capabilities are similar to what U.S. companies have demonstrated in Pentagon-sponsored robotics competitions.

Israel is another notable investor in military robotics. It has already deployed an unmanned armed ground vehicle, the Guardium, which patrols its borders to detect and stop infiltrators -- potentially with lethal force. At sea, it uses the Protector, an unmanned integrated combat system that is armed with lethal and nonlethal weapons to intercept ships along the Gaza blockade. And, overhead, Israel has the SuperHeron, a drone much like the Reaper, and the Harpy, an autonomous weapons system that can track and independently target adversary radars.

Articles published in *Jane's Defence Weekly* and *Jane's International Defence Review* in 2014 suggest that Moscow will soon deploy armed ground robotic systems at its ballistic missile bases to increase security and may deploy unmanned airships to monitor Russian interests in the Arctic. For many European states, robotics could help compensate for the past five years of reductions in defense spending. Poland, for one, recently considered phasing out its expensive Su-22 fighter-bombers and replacing them with unmanned platforms over the next decade.

* * *

At the moment, however, the future of military technology seems much more likely to be influenced by developments in the commercial world than by technologies designed exclusively for the battlefield. This year, when I worked with the Center for a New American Security to poll 400 defense experts, we found that nearly three-quarters of them think the technological influence of commercial companies on the defense sector will grow significantly by 2030.

In 2013, Google bought Boston Dynamics, a company best known for its creation of advanced ground robots such as the WildCat, which can run alongside soldiers and carry their gear, helping them move faster and cover greater distances. Google followed up the

acquisition by picking up the artificial intelligence company DeepMind in January 2014. Its purchases triggered an average 25 percent jump in the average stock price of commercial robotics companies such as iRobot, maker of the popular Roomba floor cleaner, as market traders wondered which would be the next to be gobbled up by a deep-pocketed firm. Google's latest grab came in April, when it bought the drone company Titan Aerospace for an undisclosed amount.

Google did not purchase the maker of the WildCat to penetrate the military world, but rather to expand into what it thinks will be the even more lucrative commercial robotics market. Even in areas such as agriculture, the demand for robotics is growing, with a report by WinterGreen Research suggesting that the market will reach \$16.3 billion by 2020.

The issue is that there is no clear line between commercial and military developments in robotics.

The issue is that there is no clear line between commercial and military developments in robotics. Just as with electronics and communications, many technological advances in robotics will be usable in both worlds. For example, the commercial sector is leading the way in developing automated driving technology, and the software that governs a self-driving car might well facilitate the design of a remotely driven tank. As off-the-shelf robotics become increasingly advanced, it will become easier for foreign militaries to close the gap in capabilities with the United States.

Even more sinister is the possibility that commercially available robotics will make cutting-edge technologies available to terrorists. Even now, do-it-yourself drone technology is widely available, used by ordinary citizens and companies for everything from monitoring wildlife to filming snowboarders. In April, the FBI stopped a Moroccan citizen in the United States who allegedly was plotting to strap bombs onto simple consumer drones and fly them into a federal building.

The DIY trend in robotics will only continue to pick up speed. In 2012, a Japanese artist and engineer actually debuted a "killer" ground robot -- the Kuratas -- a 13-foot-tall, 4-ton exoskeleton that can be controlled by smartphone and armed with a Gatling gun that fires BBs. It is a toy more than a weapon, but it shows just how far the field of DIY robotics has progressed already.

* * *

The greatest threat to U.S. dominance in military robotics, however, may come not from foreign militaries or the commercial sector, but from sensitivities within the parts of the Pentagon itself that sense the specter of change. Their reluctance is not unusual. From the Union Army's initial lack of interest in the Gatling gun during the U.S. Civil War to the British Navy's vision of the aircraft carrier as a mere "spotter" for battleships in the interwar period, disruptive military technologies whose integration has required significant bureaucratic reorganization have often faced resistance.

As military robots shift from filling niche capabilities like bomb disposal to performing essential tasks throughout the military, they will challenge existing status hierarchies in the services. Likewise, as these devices become more capable of working with manned systems to multiply the effectiveness of U.S. forces or replace manned forces in some instances, they will require changes not only in the way the services fight, but also in the way they have thought about recruiting, training, and promoting since the creation of the modern American defense establishment in 1947. Those are threats to the military's very identity -- and they will provoke bureaucratic pushback.

Some of the resistance to date has been predictable. Drones have always had an unstable position in the U.S. Air Force. Pilots, of course, have traditionally dominated the branch, and fighter and bomber pilots have held its most senior leadership positions (all but one chief of staff has flown fighters or bombers). Drones capable enough that they could reduce the military's reliance on manned planes challenges the Air Force's core competency.

The Air Force is considering building new drones for surveillance. Reportedly, the RQ-180, a stealthy UAV, will enable the service to spy on potential adversaries at an altitude of around 50,000 feet, making it difficult to shoot down. But the service is shying away from strike technology. In 2012, the Air Force announced that it had terminated development of an armed replacement for the MQ-9 Reaper, the MQ-X, meaning it does not currently plan to build any new armed unmanned systems. At the time, *Defense News* reported that the branch was taking a "wait and see approach to how unmanned aircraft technology evolves."

The Air Force's reluctance places even more pressure on the U.S. Navy, which is the other service with the resources and potential interest in next-generation armed drones. The power projection that comes from aircraft carriers has made it difficult for some in the Pentagon to envision a Navy in which manned flight is not the centerpiece of naval aviation.

The X-47B -- the drone that can land on an aircraft carrier -- is impressive, but it is just a test airplane. A true sign of the Navy's commitment to robotics lies in the future of a drone known as the Unmanned Carrier-Launched Airborne Surveillance and Strike (UCLASS) vehicle. UCLASS is the only armed drone that the U.S. military is currently developing, but it is still not a "program of record" (Pentagon-speak for an officially budgeted acquisition). And the Navy is waffling over just how capable to make the new drone. The force could simply produce a Reaper-like UAV that is able to land on an aircraft carrier, or it could invest resources to make UCLASS a far more sophisticated system that is able to conduct advanced surveillance, carry a sizable weapons payload, and even evade air defenses. That is, UCLASS could have capabilities that start to approach those of manned fighters.

The problem is that many in the U.S. military see drones primarily as an adjunct to counterterrorism operations.

The problem is that many in the U.S. military see drones primarily as an adjunct to counterterrorism operations. Giving any drone the ability to take off and land on a carrier would be a step forward, but continuing to restrict the technology's mission set to surveilling and striking terrorists shows that the Pentagon considers robotics a sideshow, rather than the coming main event. According to a 2013 comment by Robert Work, then CEO of the Center for a New American Security, the desire to continue emphasizing counterterrorism operations, along with concerns about costs, has led some in the Pentagon to support the stripped-down, cheaper, Reaper-like version of the UCLASS program. (On April 30, the Senate confirmed Work to be deputy defense secretary.) Even if the Navy builds a more advanced model, the debate over UCLASS's intended capabilities, which has gone on for almost two years, demonstrates the U.S. military's ambivalence toward next-generation robotics. On a much smaller scale, the Navy is investing in unmanned underwater vehicles, including the Knifefish, a 19-foot-long torpedo-shaped minesweeper that can operate autonomously for days at a time. The system would represent a significant improvement on existing mine-clearing technologies, which generally require more people and cost more money. Yet even in this case, funding is at risk. In 2012, the U.S. Navy said it planned to invest in underwater drones even more advanced than the Knifefish -- larger vessels that can conduct underwater surveillance for long durations. But no money has been guaranteed yet.

As for the Army, there is strong cultural resistance to using robots instead of soldiers on the battlefield, especially in trigger-pulling roles. Gen. Robert Cone, who recently retired as the Army's head of training and doctrine, said the service might reduce the size of its basic fighting unit, the brigade combat team, from 4,000 soldiers to 3,000 by 2030, preserving front-line war-fighters while using ground robots for transportation and logistical functions. But spending on unmanned ground technologies currently comprises less than 1 percent of the overall U.S. budget for unmanned systems.

* * *

In the years following the 9/11 attacks, the growing U.S. defense budget made more resources available for everyone. Today is different. As the fight for defense dollars gets more intense due to sequestration, next-generation military robotics could easily end up on the chopping block simply because their capabilities are less proven than those of existing systems. The United States is currently the best at fighting on land, in the air, and at sea, so many in the military's bureaucracy view innovations that could change the character of warfare, like robotics, as particularly risky. In terms of battlefield dominance, it can seem like there is nowhere to go but down.

The problem, of course, is that other countries are not going to stand still, allowing the United States to maintain superiority. Unconstrained by a legacy of world-beating fighters, tanks, and aircraft carriers, they may well have an easier time exploiting advances in robotics. And if a robotics gap emerges, adversaries will become more likely to challenge the United States, its allies, and its partners, undermining peace and stability and placing American lives at risk on the battlefield and at home.

* * *

Even advances by friends and allies could be harmful. Global order has been kept for the past several decades in part by the tendency of so many countries to essentially free-ride on the U.S. military because it is too expensive and difficult for them to build advanced war-fighting capabilities of their own. A world in which advanced military robots are easily available is a world filled with an increasing number of modern militaries -- a world that may face a higher risk of arms races and conflict.

Foreign military efforts and commercial innovation may dull America's edge in robotics no matter what it does. But the United States shouldn't dither while its relative capabilities erode. It should increase funding for research, development, and testing of military robotics. Arguably even more important is that the Pentagon needs to better

harvest the best commercial innovations, bring them to the military services, and encourage experimentation with new technologies. The confirmation of Work, a leading advocate for military robotics, as deputy defense secretary is encouraging, but his effect on Pentagon priorities remains up in the air. Ultimately, investing in and then incorporating advanced robotics into the lifeblood of the military services is what will prevent a lead from turning into a gap.