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These Are the Drones You Are Looking For: Manned–Unmanned Teaming and the U.S. Army

by Richard Lim

When you look at the future, far-term vision for 2035 to 2040, you're looking at robots doing what robots do best [and] humans will still do what humans do best.

Lieutenant Colonel Matt Dooley
Former Chief, Lethality Branch and Robotics Integration,
U.S. Army Training and Doctrine Command

Introduction

Ever since its emergence as a world power, the United States has sought to maintain the most technologically advanced military in the world. In the 21st century, however, U.S. armed forces face a global threat environment of unprecedented complexity. A wide array of adversaries have greater access to more advanced capabilities than ever before, threatening to undermine the U.S. military's technical superiority. In response, the U.S. Department of Defense (DoD) is currently undertaking an "offset" strategy to maintain its dominance into the future. However, the rapid worldwide diffusion of technology introduces new challenges, potentially shortening the duration of America's technical superiority. The new offset strategy must develop technological capabilities that specifically create *enduring* superiority.

Unmanned systems are a critical component of that strategy. These systems, such as aerial drones and ground robots, are an increasingly regular feature of the 21st century battlefield. Potential adversaries are employing them to create more contested environments, potentially impeding freedom of movement. To "leap ahead" of these potential adversaries' unmanned capabilities, DoD is joining manned and unmanned systems to exploit the benefits of both the human dimension of warfare and modern robotics. "Manned–Unmanned Teaming" (MUM-T) will help create enduring technical superiority for the U.S. military. The U.S. Army is a leader in MUM-T and its efforts—which include combining the Apache helicopter with its unmanned aerial systems (UASs)—are helping to ensure that the U.S. military remains the most lethal and technologically advanced fighting force into the future.

Background

The First Two U.S. Offset Strategies

On two specific occasions during the Cold War, the United States sought military-technical superiority as part of a major offset strategy to counter and leap ahead of the capabilities of its adversary. The first occurred in the early 1950s under the Eisenhower Administration's "New Look" defense policy, which leveraged nuclear weapons, long-range airpower and ballistic missiles to deter the Soviet Union.[1] The second occurred in the 1970s and 1980s when the United States invested heavily in advanced technologies such as stealth, computer networks, space-based

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navigation and precision-guided munitions to counter the Soviet numerical advantage in conventional and nuclear forces. The success of the second offset strategy is credited as a key factor in America's ultimate victory in the Cold War and establishment of American military-technical superiority into the 21st century.[2]

Just as Soviet strength spurred the United States on to undertake its offset strategies, America's continued military preeminence has spurred other nations to modernize their own forces. For example, America's overwhelming victory in the 1991 Persian Gulf War, which showcased its superior landpower (due, in part, to the Army's "Big Five" weapon systems—the M1A1 Abrams battle tank, the M2/M3 Bradley infantry fighting vehicle, the AH-64 Apache attack helicopter, the UH-60 Black Hawk utility helicopter and the Patriot Air and Missile Defense System) and airpower capabilities, made a significant impression on the People's Republic of China's (PRC's) military planners and served as a catalyst for their technological investments over the past two decades. These efforts were made specifically to counter stealth aircraft, precision strike, electronic interference, enemy surveillance and reconnaissance and has led to what is sometimes described as Anti-Access/Area Denial (A2/AD) capability.[3]

The Current Operating Environment

While the United States remains the most technologically advanced military power in the world, it now faces a much more complex operating environment. A more diverse set of potential adversaries—nation states such as Russia and China, rogue states such as Iran and North Korea and nonstate actors such as the Islamic State of Iraq and the Levant (ISIL)—are employing a wider array of strategies (traditional, unconventional and hybrid) designed to avoid and disrupt U.S. advantages. These actors are operating beyond physical battlegrounds, such as space and cyberspace, and in highly contested environments such as urban areas.[4]

The U.S. military also faces a changing technological landscape. Advanced technical capability is proliferating at a faster rate than ever before. Potential adversaries have easier and less costly access to information, materials and manufacturing, allowing them to obtain technological capabilities once monopolized by the world's major powers. Part of this proliferation involves the illicit acquisition of U.S. military secrets through cyber intrusion.[5] In addition, the United States faces these new challenges at a time when an uncertain budgetary situation threatens the size, capability and modernization of its military. These trends are already undermining the U.S. military's technical advantage and could allow potential adversaries to offset or leap ahead American capabilities.

A Third U.S. Offset Strategy

In response to these developments and to the pressure of fiscal austerity, DoD has initiated a third offset strategy.[6] While the previous two offsets proved highly effective, current global trends pose new challenges to this latest effort. Even if the third offset proves successful, however, the faster pace of the diffusion of technology, fueled in part by cyber intrusion, could reduce the duration of America's resulting technical ascendancy.[7] These trends require DoD to identify leap-ahead technologies that not only restore but also prolong the duration of the U.S. military's preeminence.

Manned–Unmanned Teaming

MUM-T will help provide an enduring technological advantage necessary for the third offset strategy for two reasons. First, MUM-T helps establish technical superiority by exploiting the revolutionary potential of unmanned systems. Second, MUM-T can help prolong that superiority by exploiting the human dimension of warfare, which, when teamed with unmanned systems, is harder for potential adversaries to duplicate. Fortunately, the Total Army—active Army, Army National Guard and Army Reserve—has been developing MUM-T capability for several years.

MUM-T as a Means for Technical Superiority

MUM-T will contribute significantly to technical superiority because it harnesses the revolutionary potential of unmanned systems. This potential rests upon two key features. First, unmanned systems exploit the benefit of removing a person from a platform, which reduces the limitations on speed, maneuverability and endurance, all without risk to human life. Second, unmanned systems can provide the benefits derived from a myriad of related technological developments to the battlefield:

- **Advanced computing and big data**: Computers are now analyzing massive quantities of data—known as "big data"—faster than ever before.[8] Unmanned systems with advanced computing capability will provide Soldiers with unprecedented situational awareness and increased lethality.

- **Autonomy**: Unmanned systems are increasing their ability to act in the absence of human control. For example, UASs are now able to take off, navigate and land autonomously, especially with the Army's new Ground-Based Sense-and-Avoid (GBSAA) radar system.[9] By taking on more tasks traditionally performed by humans, including either dangerous or mundane missions, autonomous unmanned systems will likely reduce the risk to Soldiers while lessening their cognitive load.[10]
- **Cyber capabilities**: Offensive cyber capabilities can significantly disrupt and potentially shut down an opponent's command-and-control networks. In addition, the rise of the "Internet of Things," or increased machine-to-machine communications, is changing the way systems relate to one another in the physical space. Unmanned systems with increased communications and networks, along with cloud computing, will provide Soldiers access to useful intelligence in real-time and a significant situational awareness advantage over their adversaries.[11]
- **Electric/microwave weapons**: The U.S. military is developing electric weapons—e.g., rail guns and high-energy lasers[12]—and microwave weapons, such as those that exploit the electromagnetic spectrum. Unmanned systems armed with electric/microwave weapons will provide cost-effective defenses against large numbers of long-range guided missiles, swarm attacks by unmanned systems or sophisticated electronic weapons.[13] DoD is currently looking to expedite their development.[14]
- **Miniaturization**: The ability to manufacture smaller mechanical and electronic products will allow the military to reduce the size, weight and power (SWAP) of its systems.[15] Miniaturized unmanned systems can help increase precision[16] and survivability and reduce the force's logistical burden.

Unmanned systems have the capability to revolutionize warfare, first by exploiting the advantages of removing a human from the platform, and second by exploiting technological advancements in computing and big data, autonomy, cyber capability, energy/electronic weapons and miniaturization. These two features allow for greater speed, maneuverability, survivability, lethality, agility, precision and situational awareness while reducing logistical burdens, costs, risks and cognitive loads for Soldiers—in other words, more efficient, all-around superior performance. By providing these advantages, unmanned systems will allow the United States to maintain technical superiority against its potential adversaries.

MUM-T as a Means for Enduring Technical Superiority

In the era of the third offset, however, technical superiority is not enough. That superiority will inevitably be challenged at an unprecedented rate. Fortunately, MUM-T not only exploits the technical superiority provided by unmanned systems but also combines that superiority with the indispensable human dimension of warfare. While superior technology is a critical enabler of military power, it cannot replace the importance of leadership, training and teamwork.[17]

The advantage of MUM-T rests on the premise that with the pairing of robots with manned systems, Soldiers make more informed decisions faster. MUM-T envisions a symbiotic relationship in which human capability is enhanced, rather than replaced or usurped, by its robotic counterparts. A relevant, if imperfect, comparison can be seen in teaming human chess masters with computers, a combination that has, since 2008, routinely defeated computers processing chess games alone.[18]

MUM-T will require the integration of robots into operations and the training of military personnel to use them. While other nations may be able to steal or copy U.S. military software and hardware, it is much harder to replicate the skills of personnel who are trained to operate robots integrated in the force, potentially lengthening the duration of the technological advantages of a third offset.[19] The human dimension is truly a combat multiplier.

The U.S. Army and MUM-T

MUM-T combines the revolutionary potential of unmanned systems with the indispensable human dimension of warfare in an effort to create an enduring technological advantage. While the U.S. Army does not monopolize all of DoD's MUM-T efforts, it is playing a key role in developing this capability as part of the third offset strategy. The Army has enjoyed success in teaming Soldiers with UASs, combat missions included, and is developing similar capabilities with unmanned ground systems (UGSs). The Army's unmanned systems inventory reflects the fact that

DoD spending on UASs ($22 billion) dwarfs its spending on UGSs (only $0.8 billion) between Fiscal Year (FY) 2007 and FY 2013.[20] As a result, the Army's MUM-T capabilities with UASs are far more advanced than with UGSs.

UASs increase situational awareness, lethality and survivability for manned systems on the battlefield by helping them see beyond their visibility and providing them with increasingly near-simultaneous data. The Army has enjoyed considerable success in teaming manned systems with UASs and has even effectively employed this capability in combat. Since 2007, Army manned systems have logged 5.85 million flight hours with UASs, both in training and on the battlefield.[21] The 1-229th Attack Reconnaissance Battalion reported that, over seven months in 2014, its Apache helicopters were aided by drones in about 60 percent of its direct-fire missions.[22]

MUM-T with Apache Helicopters

The Army's primary MUM-T system consists of the Apache A-64D/E as the manned system, the MQ-1C Gray Eagle or RQ-7B Shadow as the UAS, the One System Remote Video Terminal (OSRVT), which transmits video and data, and the One System Ground Control Station (OSGCS),[23] which allows Soldiers to control UASs from the ground.

While Soldiers usually pilot UASs from OSGCSs, the Apache pilots are increasingly able to interact with the UASs at varying levels of interoperability (LOIs):

- LOI 1: Receipt and transmission imagery or data indirectly from the UAS.
- LOI 2: Receipt of imagery or data directly from the UAS.
- LOI 3: Control of the UAS payload.
- LOI 4: Control of the UAS during flight but not take-off and landing.
- LOI 5: Full function and control of the UASs to include take-off and landing.[26]

Under LOIs 3, 4 and 5, Soldiers on the OSGCS can hand off partial to full control of the UAS to the Apache pilots.

The MQ-1C Gray Eagle, the Army version of the MQ-1 Predator, is the Army's largest and main long-endurance UAS and can fly up to 150 knots with a ceiling of 25,000 feet, operate for more than 27 hours and carry multiple payloads, including four Hellfire missiles. It provides combatant commanders with real-time responsive capability to conduct long-dwell, persistent stare, wide-area reconnaissance, surveillance, target acquisition, communications relay and attack missions.[24]

The RQ-7B Shadow is a tactical UAS and can fly up to 110 knots with a ceiling of 15,000 feet, operate for nine hours and carry multiple payloads. It provides combatant commanders reconnaissance, surveillance, target acquisition and force protection for the brigade combat team (BCT) in near-real time during day, night and limited adverse weather conditions.[25]

The Army's Apache–Gray Eagle/Shadow combination consists of two specific configurations, each at a different LOIs, that have been deployed in support of Operation Enduring Freedom:

- **MUMT-2**: The MUMT-2 system, at LOI 2, allows the UAS or the Apache Modernized Target Acquisition Designation Sight (M-TADS) fire control system to transmit sensor video and metadata to another Apache or to ground forces with the OSRVT. This system provides the Apache AH-64D Longbow fully integrated multiband interoperability with the UAS, allowing pilots to receive off-board sensor video streaming from different systems in non-Tactical Common Data Link (TCDL) bands.[27]
- **UAS Tactical Common Data Link Assembly (UTA)**: The UTA system, at LOIs 3 and 4, enables AH-64Es to control UASs at long ranges, integrate them with mission computers, display, acquire, track and engage targets and receive UAS imagery. These capabilities provide increased situational awareness, net-centric interoperability and reduced sensor-to-shooter timelines, increasing the Apache's overall survivability.[28]

The 1st Infantry Division, which was the first to successfully team Apaches and Gray Eagles, has executed multiple tactics to demonstrate how MUM-T helps enhance the capabilities of manned platforms. First, three UASs coordinated a triangulation on a target and subsequently called in an air strike to take out the target. Second, Apaches hid behind a mountain and sent off UASs to locate a target. Once the target was located, the Apaches fired off missiles over the mountain to strike the target. Third, Apaches sent off UASs to conduct reconnaissance on a target. The Apache then attacked the target with superior firepower. In each of these scenarios, the UASs saved the Apaches time and fuel by acquiring the target, with less danger to the pilots.[29]

Recent developments serve to reinforce the Total Army's success in aerial MUM-T. In the fall of 2013, Soldiers assigned to the 2-13th Aviation Regiment and Army National Guard members assigned to the 1-285th Armed Reconnaissance Battalion from Silverbell Army Heliport in Marana, Arizona, conducted MUM-T exercises with Apache AH-64s, Gray Eagles and Shadows at Forward Operating Base Carlisle in the San Rafael Valley. Training included simulated combat conditions, basic battle drills and specific occupational specialty tasks.[30] In the fall of 2014, combinations of Apache AH-64Es, Gray Eagles, Shadows and OSRTVs, supported by the Aviation and Missile Research Development and Engineering Center (AMRDEC), successfully completed several tests at Redstone Arsenal in Alabama and the El Mirage Flight Test Facility in California. The tests demonstrated the ability of the Apaches to take full control of both Gray Eagle and Shadow UASs.[31]

In March 2015, the Army established its first MUM-T squadron, combining AH-64D/E helicopters with the Shadow UASs for the 1/501st Aviation Battalion of the 1st Armored Division's Combat Aviation Brigade (CAB), which was reflagged into the 3d Squadron, 6th Cavalry Regiment.[32] The 4th Battalion, 227th Aviation Regiment, reflagged into the 7th Squadron, 17th Cavalry Regiment (formerly part of the 101st Airborne Division at Fort Campbell, Kentucky)[33] and the 16th CAB are also scheduled to feature Apache–Shadow teams, the latter at the end of FY 2016. In addition, in the fall of 2015, the Army successfully demonstrated MUM-T between an Apache and a Gray Eagle in South Korea.[34] One test involved an OSRVT simultaneously receiving video from both an Apache and a Gray Eagle in diverse weather conditions.[35]

The Army National Guard continues to enhance its MUM-T capabilities. In November 2015, Army National Guard units from seven states—Arizona, Idaho, Missouri, North Carolina, South Carolina, Texas and Utah—participated in the inaugural Gunfighter Fly-in competition at Silverbell Army Heliport in Marana, Arizona. The event included MUM-T competitions with Apache AH-64Ds and the Army's UASs in a variety of graded flying and gunnery scenarios. Afterwards, the participating pilots and crews touted the event as an invaluable opportunity to share skills and build unit cohesion, crucial to the Army National Guard's contribution to the Total Force.[36]

Looking forward, the Army will continue to increase the compatibility of its data links between Apaches, UASs and video and data transmission systems. Next-generation Universal Ground Control Stations (UGCSs) will provide greater interoperability, mission flexibility and scalability for MUM-T.[37] The MUM-TX is currently in development and will replace the MUMT-2 and the UTA configurations. It will use new equipment, such as a Rover 6 modem, multiband radio frequency equipment and a directional antenna capable of relaying multiple video streams back to the command center.[38] This will allow Apache D/Es to transmit and receive data and video on a greater number of frequency bands.[39] The combination of new UGCSs and the MUM-TX will increase LOIs between manned systems and UASs, allowing more seamless operations. Through these efforts, the Army is working to fulfill DoD's vision to integrate MUM-T across the entire force.

Additional Army MUM-T Efforts

The Army is working with Sikorsky Aircraft Corporation, recently bought by Lockheed Martin, on the Manned/Unmanned Resupply Aerial Lifter (MURAL) project, which involves developing an unmanned version of the UH-60A Black Hawk helicopter that can undertake critical resupply missions. The unmanned Black Hawks are retrofitted with Matrix, a software and hardware platform that provides autonomous capability, including detection and maneuvering around obstacles. The first MURAL flight took place in the spring of 2014. In the fall of 2015, MURAL achieved a key milestone by successfully delivering a payload from one location to another.[40] The unmanned Black Hawks may soon be able to deliver cargo and perform other mundane or dangerous tasks. While the Army's MUM-T efforts with the Apache helicopter are focused on increased situational awareness and lethality, the MURAL project is focused on reducing the risk of danger and the cognitive load on Soldiers.

The Army also intends to incorporate MUM-T in its future fleet with the Future Vertical Lift (FVL) initiative.[41] FVL is the Army's effort to develop the next generation of vertical-lift aircraft for the joint warfighter that will replace the current fleet over the next 20–45 years. These aircraft will display superior performance and survivability with increased speed and range, carry heavier payloads and be less expensive to maintain. In addition, they will be capable of either teaming with unmanned systems or performing certain optionally-piloted missions. AMRDEC is currently undertaking the Joint Multi-Role Technology Demonstrator (JMR-TD) program that will help mature the

required technologies.[42] While MUM-T's role will become clearer as FVL further develops, it will play a critical role in the future of vertical aviation in the joint force.

The Challenges of MUM-T

While MUM-T will help provide revolutionary benefits for the nation that possesses it, unmanned systems in general pose significant challenges for the global security environment. Like any new game-changing technology, the effects of unmanned systems are likely to be unpredictable and possibly even destabilizing. As stated earlier, unmanned systems have the potential to enhance lethality and situational awareness. These capabilities will be critical to meet the challenges of the future, such as the increasing prevalence of urban warfare.[43] However, as unmanned systems are developed into more efficient killing machines, some commentators fear that their proliferation introduces new dangers to the world population and pushes the boundaries of ethical behavior.

Ban the Drones?

Use of UASs has been banned by the Federal Aviation Authority (FAA) over restricted airspace, such as national parks, military bases and near airports,[44] and governments at the local and national levels around the world have introduced or passed similar prohibitions.[45] A recent report by Harvard Law School and the Human Rights Watch called for an international ban on the development, production and use of fully autonomous weapons.[46] Some have invoked nightmarish visions of terrorists or "lone wolves" attacking civilians with swarms of cheap, easily obtainable commercial drones carrying improvised explosive devices (IEDs) from the sky.[47]

Future Implications

As greater levels of autonomy are developed, ethical dilemmas emerge. Soldiers are trained to make the decision to use lethal force. Future unmanned capabilities may allow such decisions to be automated. To what level will society delegate this authority to machines? Should the international community agree to prohibit the further development of autonomous systems lest it fall into the wrong hands? Or are planes safer with autopilots and driverless cars safer than cars with drivers?

What do unmanned systems mean for the geopolitical landscape? In September 2013, a Chinese military drone flew toward the Senkaku islands, which are at the center of a territorial dispute, provoking the scrambling of Japanese F-15 fighter jets.[48] Could drones provoke a future international conflict? If so, how will nations respond to them? Will drones render fighter jets obsolete, as suggested by a recent report by the Center for Strategic and Budgetary Assessments?[49] If so, will the U.S. military and allied militaries adjust their force structures and resources accordingly? Finally, how will the worldwide proliferation of unmanned capabilities affect deterrence? Such deterrence rests upon parity in the military–technical competition.[50] Can the nations of the world achieve relative stability with such potent killing machines accessible to a wide array of adversaries ranging from nation states to non-state actors?

Conclusion

The rise of unmanned systems raise questions that cannot be definitively answered prior to greater technological maturation. The fact of the matter is that unmanned systems are here to stay and will likely increase in importance on the battlefield, as evidenced by the Russian military's "massive use of drones"[51] in its incursion into Ukraine. Nations that seek military superiority in the 21st century have no choice but to further develop their unmanned systems. The U.S. Army is at the forefront of that effort. Through MUM-T, the Total Army is combining revolutionary technology with indispensable capabilities that only humans can bring to the battlefield and helping to ensure the ultimate goal of the third offset: a U.S. military that endures as the most advanced fighting force in the world. The United States should continue to develop unmanned systems in pursuit of that goal while concurrently examining their broader implications.

Richard Lim is a National Security Analyst with AUSA's Institute of Land Warfare.

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