Strategy Research Project

ROLE OF DOD UNMANNED AERIAL VEHICLES FOR HOMELAND SECURITY

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by

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ABSTRACT

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Ongoing operations in Iraq and Afghanistan resulted in an increased demand for intelligence, surveillance, and reconnaissance (ISR) capabilities for commanders. In an effort to satisfy this insatiable appetite for ISR assets, full motion video in particular, the Air Force increased its Program of Record for Unmanned Aerial Vehicles (UAVs). These assets, and the Airmen who operate them, maintain a high operations tempo during ongoing operations in Iraq and Afghanistan. Eventually, these operations will terminate and the demand for ISR will be greatly reduced. This paper seeks to identify roles in which the nation can leverage these assets in the defense of the homeland. Drug interdiction, port security, disaster relief, search and rescue, and border patrol are just a few potential roles. Finally, this paper looks at potential obstacles, both legal and policy, to implementing a proposed way-ahead.

ROLE OF DOD UNMANNED AERIAL VEHICLES FOR HOMELAND SECURITY

> We have just won a war with a lot of heroes flying around in planes. The next war may be fought with airplanes with no men in them at all. It certainly will be fought with planes so far superior to those we have now that there will be no basis for comparison. Take everything you've learned about aviation in war and throw it out of the window and let's get to work on tomorrow's aviation. It will be different from anything the world has ever seen.
>
> —General Henry H. "Hap" Arnold[1]

Current demand for intelligence, surveillance and reconnaissance (ISR) for operations in support of Operations Iraqi and Enduring Freedom resulted in the Air Force, and all of Department of Defense (DoD), investing heavily in Unmanned Aerial Vehicles (UAVs) and the crews required for their operation. As operations within the Central Command (CENTCOM) area of responsibility (AOR) wind down, demand for ISR will decrease resulting in these UAVs and their associated crews not "fully employed." This raises the question: How can the United States leverage DoD ISR assets to secure and defend the homeland.

The U.S. border with Canada stretches over 5,400 miles. To the south, the border with Mexico is in excess of 1,950 miles. Additionally, the U.S. has over 12,380 miles of coastline to defend.[2] These expansive borders and vast amounts of coastline present a large challenge to those agencies responsible for U.S. security. The difficulty with securing our southern border, in particular, is well documented. The U.S.-Mexico border has 43 legitimate crossing points. However the rest of the border consists of open desert terrain, rugged mountains and other geographic obstacles making surveillance. Inability of U.S. security forces to monitor the whole border all of the time makes it easier to smuggle drugs and illegal aliens into the United States.[3] Not only are drugs a menace to the U.S., a larger concern would be if terrorist organizations such as Al Qaeda choose to smuggle in their operatives and/or weapons of mass destruction (WMD) via the same routes used for drug trafficking.

Today, numerous federal and state organizations are charged with maintaining the security and defense of the homeland: Northern Command (NORTHCOM), Immigration and Customs Enforcement (ICE), Customs and Border Patrol (CBP), Drug Enforcement Agency (DEA), Federal Bureau of Investigations (FBI), Border Patrol, Coast Guard, state and local police departments. Many of these organizations operate under strained budgets and may lack sufficient funding and personnel to acquire and maintain all of the surveillance capabilities they seek. It is imperative to leverage existing capabilities and know-how in order to improve effectiveness and reduce redundant capabilities in an effort to save money. Specifically, one such capability is DoD's UAVs.

There are however certain laws and policies currently in place that may limit the ability to leverage DoD capabilities. Posse Comitatus which prohibits the use of the military in law enforcement is one of the better known such restrictions. The Federal Aviation Administration (FAA) places strict limits on the use of UAVs in the National Airspace System (NAS). This paper will review these restrictions, what exceptions exist that would allow UAS operations, and make recommended changes as necessary. In order to provide context, before presenting the above, the history of UAV development, current contributions to ongoing military operations in Iraq and Afghanistan, their capabilities, advantages, and current civil uses will be presented.

Before proceeding any further it will be beneficial to clarify a few terms as well as a definition for UAVs. The DoD definition of a UAV is "a powered aerial vehicle that does not carry a human operator, uses aerodynamic forces to provide vehicle lift, can fly autonomously or be piloted remotely, can be expendable or recoverable, and can carry a lethal or nonlethal payload."[4] It would also be helpful to understand several different terms found throughout this paper. For the purposes of this paper the following terms will be used interchangeably: UAV, unmanned aerial systems (UAS), unmanned aircraft (UA), remotely piloted aircraft (RPA), and remotely piloted vehicle (RPV).

History of UAVs

The first military use of an unmanned aircraft occurred in the second century B.C. when a Chinese general used kites to estimate the distance for a tunnel dug under his enemy's fortification.[5] Europeans first used kites at the Battle of Hastings in 1066, where they were used for signaling.[6] While neither of these two examples meet DoD's definition of a UAV in that they didn't carry a payload, they do demonstrate the early use of an unmanned aircraft for reconnaissance and communications purposes; missions UAVs are still used for today.

In a more modern period, balloons were used during the American Civil War as a precursor to cruise missiles. Balloons would be loaded with explosives and released with the hope they would land inside the enemy's supply or ammunition depot and explode. The Japanese during World War II would make similar attempts with high altitude balloons filled with explosives. Neither effort was considered effective.[7]

Early pioneers in the development of UAVs were Samuel Langley and Professor A.M. Low. In 1896, Mr. Langley invented the first unmanned model aircraft to successfully fly and Mr. Low's experience in radio technology led to remotely controlled pilotless aircraft that could be used for both interception and ground attack missions.[8]

Despite these early successes under Langley and Low, no revolution in UAV development followed. The Wright Brothers' history-making flight at Kitty Hawk, North Carolina, in 1903, instead sparked the revolution in manned flight. Since that time, the development of manned aircraft grew at a tremendous rate and took precedent over UAVs.

Soon after the beginning of World War I, the U.S. looked into possible missions that could be filled by UAVs. Numerous efforts were made to develop UAVs. However due to limited success and sporadic funding these programs were cancelled by the conclusion of the war.[9] Soon after the war, the U.S. Army Air Corps first introduced radio control in 1924 and eventually successfully piloted a Curtiss Robin Monoplane in 1928 to become the first remotely piloted, weapon-carrying aircraft. However this program was eventually cancelled as well due to lack of funding and the emphasis on manned aircraft.[10]

It wasn't until the Korean War the U.S. made significant progress in UAV development. The US employed UAVs deemed, "special purpose aircraft " for reconnaissance missions determined too hazardous for manned aircraft.[11] Following the Korean War, the loss of two U-2s, one piloted by Maj Francis Gary Powers over the Soviet Union, renewed interest in UAV development and led to the U.S. government initiating an urgent program to supplement the U-2 fleet. Within 90 days an UAV named the Lightning Bug was fielded and became the first operationally significant Air Force UAV.[12] The Lightning Bug was used for low and high altitude reconnaissance, electronic warfare, and leaflet dropping missions and eventually flew nearly 3,500 sorties during the Vietnam War.[13]

The emergence of surveillance satellites with near real-time capabilities overshadowed conventional aircraft reconnaissance platforms, manned or unmanned.[14] Following Vietnam, UAV funding suffered due to competition with cruise missiles and manned strike aircraft. In 1979, the over 60 UAVs in the inventory were deactivated and placed in long term storage, resulting in no UAVs in Air Force service.[15]

This turned around in 1982 when the Israelis successfully utilized unmanned systems in the Bekaa Valley, Lebanon. Israeli forces used unmanned systems for ISR and to activate Syrian air defense systems, allowing other aircraft and surface-to-surface missiles to destroy the now active air defenses.[16] Following this campaign, the United States began to develop its own unmanned systems as well as purchase Israeli systems, like the Pioneer. The Pioneer was the primary UAV employed during Operation Desert Storm. It provided imagery to tactical land and sea commanders allowing them to see the enemy's artillery positions, the location of enemy forces, provided battle damage assessment, searched for mines, and spotted rounds fired from U.S. battleships.[17] According to the Interim DoD report to Congress on Desert Shield and Desert Storm, the Pioneer system "appears to have validated the operational employment of UAVs in combat."[18] It subsequently supported operations over Bosnia, Haiti, and Somalia.[19]

The RQ-1 Predator ("Predator A") was a system developed as a joint program, with all Services providing manning. The Air Force in 1996 eventually took control of the program and deployed the system to the Balkans.[20] The Predator proved itself in operations in Iraq, Kosovo, and Afghanistan and became the first UAV in history to fire offensive weapons against enemy forces in 2001.[21]

Throughout the history of their development, UAVs were hampered by both technological deficiencies, which resulted in poor performance, and service culture. As technologies matured, institutional biases toward manned aircraft hampered UAV development. This began to change by the demonstrated successes of UAVs for the Israelis and later the U.S. during Desert Storm.

Today's UAVs and Capabilities

According to the Secretary of the Air Force, Michael Donley, and Air Force Chief of Staff, General Norton Schwartz, in the 2009 USAF Flight plan, "Unmanned aircraft systems (UAS) and the effects they provide have emerged as one of the most in demand capabilities the USAF provides the Joint Force."[22] In order to meet the insatiable demand for unmanned ISR assets, the Air Force accelerated procurement and currently flies 39 continuous combat air patrols (CAP)(31 MQ-1 Predator patrols, five MQ-9 Reaper orbits, and one Global Hawk patrol) in the CENTCOM area of responsibility and continues to build toward meeting Secretary of Defense Robert Gates' goal of 50 continuous CAPs by 2011.[23] In support of Operations Iraqi and Enduring Freedom, these USAF CAPs flew over 172,000 flight hours in 2008 alone tracking 17,617 targets and were integral in 501 troops in contact operations and 1,720 raids.[24]

DoD's UAVs not only support military operations in Iraq and Afghanistan. They also play a role in disaster relief. Shortly after a 7.0 magnitude earthquake caused devastation to the country of Haiti, the 480th Intelligence, Surveillance and Reconnaissance Wing, based out of Beale AFB, CA, assisted the disaster relief and recovery efforts in with high-altitude damage assessment imagery from a RQ-4 Global Hawk UAV. During a two day period, a Global Hawk flew 30 hours providing about 2,000 images of some 1,000 targets. The priority was to capture images of key infrastructure such as airstrips, bridges and ports throughout the country, where relief efforts could gain entrance to reach injured and trapped people.[25]

The demand for UAVs led to an explosive growth in the DoD fleet. In 2000, the DoD inventory of UAVs consisted of fewer than 50 aircraft. By May 2008, DoD had more than 6,000.[26] DoD UAVs flew a total of approximately 30,000 flight hours in 2000 and in 2008 that number rose to over 230,000 hours.[27] This trend will continue as DoD plans to spend in excess of $17 billion throughout the 2008-2013 Fiscal Year Defense Plan (FYDP) on UAV systems with expanded and new capabilities.[28]

The Office of the Secretary of Defense's (OSD), 2009-2034 Unmanned Systems Integrated Roadmap lists 34 different UAVs either already in the inventory, being evaluated or in development. Today's UAVs come in all shapes and sizes; each with varying levels of capabilities. These aircraft range in size from 16.5 inches to 259 feet wingspan, less than 1 pound to 32,000 pounds in weight, and can remain airborne for a little as 25 minutes or as long as 7 days.[29]

The capabilities of the above mentioned UAVs varies greatly and are dependent upon its size and payload capacity. Depending on each UAV, many of the capabilities that will be listed in the pages that follow are modular and can be swapped out depending on the needs of each mission. This capability alone enhances the diversity of missions UAVs are able to support. A great example is the WASP III.

Despite a wingspan of only 16.5 inches and weighing less than one pound, it is capable of forward and side looking, high resolution electro optical (EO) and infrared (IR) imagery.[30] The WASP can be manually flown or pre-programmed with global positioning system (GPS) guided navigation to perform day and night reconnaissance.[31] This EO/IR capability is inherent in nearly all UAVs.

Whether or not UAVs must be flown manually, semi-autonomous or along a preprogrammed GPS track is individual aircraft specific. Many of the UAVs, the smaller ones in particular, must be flown within line of sight (LOS). Larger UAVs such as Predator, Reaper and Global Hawk are flown LOS, up to 100 miles of launch/ recovery base, and beyond LOS (BLOS), via satellite datalink.[32] They include the capability to either remain aloft in a preprogrammed orbit or return to base in the event the satellite link is lost.

Many of the larger UAVs currently serving in Iraq and Afghanistan are equipped with external hardpoints allowing for the ability to carry a variety of weapons.[33] These UAVs are also equipped with a laser target marker and laser illuminators that enable the employment of laser-guided, precision weapons.[34] While there may not currently be a requirement for civilian UAVs to carry weapons, the capability exists and can be added to UAVs in support of CBP and other law enforcement activities should the need arise.

UAVs can also serve as a communications hub. The Battlefield Airborne Communications Node (BACN), currently onboard the RQ-4 Global Hawk, provides Internet Protocol networks that can interface and share content across both secure and open internet connections. It allows the capability to "cross-band" military, civilian and commercial communications systems and the ability for individual users or platforms without advanced communications systems to connect via cellular phones or existing narrow band radios.[35]

UAVs' success demonstrated with intelligence, surveillance and reconnaissance, targeting and attack have caught the attention of the DoD leadership, Congress and the American public and have cemented the future of UAVs in military operations. Their technical viability and operational utility are no longer in question.[36] The on-again, off-again cycle of UAV development appear to have come to an end. The 2006 Quadrennial Defense Review not only called for the doubling of UAV coverage but also states "approximately 45% of the future long-range strike forces will be unmanned."[37]

Advantages of UAVs

Now that we know and understand the history of UAV development, the big questions of "why UAVs" needs to be answered. There are many advantages UAVs have over manned aircraft. This section will concentrate on just a few of these advantages and nearly all of them carry over to civilian applications as well.

UAVs are best suited for, and should be the preferred asset, when the mission to be accomplished is defined by the following characteristics: dull, dirty, and dangerous.[38] Dull are those type missions of long duration that require continuous concentration. UAVs can also continue to operate in a 'dirty' environment denied to man by chemical, biological, or radioactive agents.[39] Dangerous missions are those which take place in an environment protected by complex air defenses that incorporate SAMs or fighter aircraft. UAVs eliminate most political and human costs associated with the latter two categories should the mission fail.[40]

The overarching advantage for UAVs is that, by definition, they do not have a human onboard. UAVs provide a level of endurance and stamina that exceed the capabilities of manned aircraft due to the physical limitations of its crewmembers.[41] Additionally, since we are no longer concerned with aircrew safety, mission planners can now explore options involving increased risk that normally would not be appropriate with manned aircraft.[42]

Since there is no longer a crewmember on board, UAV designers are not required to consider human physiological limitations into the design, reserve space for a cockpit, or include life-support equipment.[43] UAVs can be designed with greater maneuverability and/or increased payload capacity. This payload can take the form of additional fuel capacity resulting in increased endurance, additional sensors for greater ISR capability, or weapon systems providing strike or self-defense capabilities.

Long endurance offered by UAVs provide greater persistence for time-critical targeting than provided by manned aircraft or passing satellite systems. This endurance provides both ISR "persistent stare" at targets over a large area and a strike capability at targets of opportunity. UAVs can be rapidly and dynamically re-tasked to other areas if a target of higher priority presents itself.[44] These critical assets spend more time over the target and experience less "lost" time transiting to and from home base for refueling than shorter endurance aircraft. Therefore, they conduct less takeoffs and landings resulting in less wear and tear as well as reduced risk of accidents during these critical phases of flight.[45] Crew duty day, the time aircrew members can be performing flight duties, is no longer relevant and a limiting factor in mission duration. Crew change can be accomplished in the middle of flight and be based on optimum periods of human performance and attention.[46]

An additional advantage is that each UAV operator can control multiple vehicles simultaneously from great distances.[47] UAVs can be flown from home station to nearly anywhere in the world equipped with a ground station.[48] This results in a smaller in-theater footprint, requiring less logistics, force-protection, and support costs. In turn, fewer deployments are required, reducing stress on the family, resulting in better retention rates.[49]

While unit costs of each UAV type varies dramatically, UAVs, in many cases, are less expensive overall compared to manned aircraft. For comparison purposes let's examine the costs for UAVs and manned aircraft currently used in the Border Patrol mission. The RQ-7 Shadow UAV costs $350,000 and the Predator UAV costs $4.5 million. In contrast, the cost of a P-3 Orion aircraft is $36 million. Blackhawk helicopters which are frequently used on the borders cost $8.6 million per unit.[50]

Civil Use of UAVs

In addition to the military uses of UAVs in today's ongoing operations, there is great potential for these systems in the civilian sector. Such missions include border patrol, anti-drug warfare, chemical, biological, and radiological detection, and maritime vessel identification and interdiction, in support of homeland defense. Other potential missions also include civilian search and rescue, airborne telemetry collection and relay, weather data collection, environmental monitoring and other scientific research, national/international emergency management,[51] communications and broadcast services, digital mapping & planning, land management, fire detection and firefighting management, power transmission line monitoring, and environmental research and air quality management/control.[52]

Within months of being established in November 2002, the Department of Homeland Security (DHS) identified unmanned aircraft as a high interest capability for homeland security and law enforcement functions. That next year, the Secretary of Homeland Security directed Operation Safeguard be conducted to evaluate the utility of UAVs in border surveillance. In addition, DHS established an UAV Working Group to explore potential roles and define requirements that UAV could fulfill. Its first study, *Unmanned Aerial Vehicle Applications to Homeland Security Missions* (March 2004), highlighted potential applicability to border security, Coast Guard missions, critical infrastructure security, and monitoring transportation of hazardous materials.[53]

During the 14 days of Operation Safeguard, an Air Force MQ-9 Predator flew 15 missions from Arizona contributing to the capture of 22 illegal aliens, 3 vehicles, and 2300 pounds of marijuana. The DHS gained its initial experience with medium altitude UAVs and found them to be complementary to its existing manned fleet in detecting and apprehending criminals.[54]

Congress has also shown great interest in using UAVs for homeland security missions and has directed DHS to study the feasibility of using UAVs to surveil the border on numerous occasions. The Intelligence Reform and Terrorism Prevention Act (P.L. 108-458) called for a pilot program to study the use of technologies, including UAVs, along the northern border. The law also required DHS to present a plan to comprehensively monitor the southwest border with UAVs.[55] The 2003 DoD Authorization Act (P.L. 108-136) required the President to issue a report "on the use of unmanned aerial vehicles for support of homeland security missions." Rep. Jeff Miller, R-FL, a member of the House Armed Services Committee, also called for more UAVs along the border stating in 2006, "I can't believe we don't have 24-7 surveillance over the border."[56]

Today, Customs and Border Patrol (CPB) operates six Predator B UAVs; five from the UAS operations center in Sierra Vista, Arizona, and one from the UAV operations center in Grand Forks, North Dakota. Since 2004, CBP UAVs have flown more than 3,000 hours, directly contributing to nearly 4,800 arrests and the seizure of over 22,000 pounds of marijuana in support of the Department of Homeland Security's border security mission.[57]

The United States Coast Guard (USCG) began experimenting with UAVs of various sizes since 1999, well before the formation of DHS. These experiments were helpful in defining a CONOPs for future UAV use in roles varying from port security to open ocean fisheries protection in locations from the Gulf coast to Alaska.[58] The USCG then began its acquisition plan for UAVs as part of its Deepwater recapitalization program. Under this plan, the USCG would acquire 69 Bell Textron Eagle Eye ship-based tilt-rotor UAV in 2006 and would lease up to seven Global Hawks in 2016.[59] However in 2007acquisition of the Eagle Eye was cancelled due to financial reasons. A study now being conducted by the USCG to evaluate which UAV best suits their needs is expected to be complete in 2010.[60]

Cutter-based UAVs would increase operations effectiveness by extending a cutter's surveillance horizon. Both cutter-based and land-based UAVs are capable of performing, surveillance, detection, classification, and target identification functions.[61] Through simulation, the USCG discovered that UAVs improve surveillance effectiveness by some 35% which leads to increase in the service's ability to interdict illegal activities.[62] Conventional helicopters can cover about 9,000 nautical square miles while a UAV can extent that to 56,000 nautical square miles at less cost.[63] The requirement for cutter-based versus shore-based cutters is a tradeoff in capabilities. Shore-based UAVs offer greater payload and endurance. Smaller cutter-based UAVs are able to respond quicker.[64]

Despite the ongoing study, the USCG took delivery of its first MQ-9 Reaper in December 2009 and will receive another within the next year. The Guardian, as it will be called, is equipped with satellite communications, a maritime radar, and day/night video. These capabilities combined with a 30 hour endurance makes the Guardian particularly useful in day and night search and rescue.[65]

NASA, in 2007, acquired a Predator-B UAV, named Ikhana (native American meaning intelligent, conscious or aware), to be used primarily for Earth science studies. It will also be used for advanced aircraft systems research and technology development and, in concert with the United States Forest Service, will support wildfire fighting in the western United States.[66]

Later that same year, in response to a request from the National Interagency Fire Center and the California Office of Emergency Services, NASA employed Ikhana to assist firefighters in Southern California. Equipped with a thermal-infrared imaging system, Ikhana is capable of seeing through heavy smoke and darkness to identify hot spots, flames and temperature differences.[67] The data was sent to NASA's Ames Research Center where it was overlaid on Google Earth maps, then transmitted in near real time to the Interagency Fire Center in Boise, Idaho, to assist fire incident commanders in allocating their resources.[68] "The images from the flight demonstrated that this technology has a future in helping us fight wildland fires," said Mike Dietrich, Incident Commander.[69] "We could see little on the ground since the fire was generating a lot of smoke and burning in a very remote and inaccessible area. This technology captured images through the smoke and provided real time information on what the fire was doing," said Dietrich.[70]

NASA sponsored the Environmental Research Aircraft and Sensor Technology (ERAST) program that uses UAVs to monitor pollution and measure ozone levels.[71] NASA also demonstrated the use of UAVs to identify coffee fields in Hawaii that were ripe for picking as well as supporting a census of seals and sea lions on California's Channel Islands.[72] The Massachusetts Institute of Technology (MIT) is developing the technology for UAVs to locate and identify toxic substances while the Department of Energy announced that it will test UAVs to detect potential nuclear reactor accidents.[73] The list of possibilities of UAV use in the civil sector is endless. This section was not intented to provide an exhaustive list of mission areas but instead illustrate the possibilities where UAVs can play a major role homeland security as well as other government missions.

Limitations

While there is interest in expanding the use of UAVs into the civilian sector there are a few limitations that have slowed this process. Of particular concern are the restrictions placed on UAV access to the National Airspace System (NAS). Additionally, the Posse Comitatus Act places some limits on the use of military assets in support of law enforcement. In the next section we will look into the current status, the ongoing work to remove these limitations as well as a few recommendations to remove such barriers.

Access to National Airspace System. According to a Defense Science Board study, "DoD has an urgent need to allow UAVs unencumbered access to the National Airspace System (NAS) outside of restricted areas here in the US and around the world."[74] Currently UAV operations inside restricted and warning areas in the United States are conducted at the discretion of the Air Force. Operations outside these areas and within the NAS require a Federal Aviation Administration (FAA) Certificate of Authorization (COA), as well as a Letter of Authorization negotiated with the appropriate FAA region.[75] This process can take up to 60 days and COAs remain valid for no longer than a year.[76] Exceptions to this are the National COA issued to the Air Force for Global Hawk operations and the Disaster Relief COA issued to Northern Command's (NORTHCOM) Joint Force Air Component Commander for the Predator and Global Hawk UAVs along the southern and northern borders.[77]

Policy and procedures to allow UAVs routine access to the NAS is currently in development. However this change may not occur until 2020.[78] Currently airspace coordination must begin several months prior to planned missions. However in the event of an emergency response mission, exceptions can be made fairly quickly. UAV operations in airspace not requiring aircraft to participate with air traffic control (below 18,000 feet in the U.S.) will normally require the UAV to be followed by a chase aircraft and/or primary radar coverage until it reaches restricted or military airspace, which adds significant cost.[79] Furthermore, UAVs must avoid flight over populated areas and must remain clear of commercial air traffic corridors.[80]

The FAA's air traffic regulations are meant to not only ensure the safety of people in the air but also people and property on the ground.[81] For this reason UAV reliability is one of the first challenges needed to be resolved in order to be accepted in civil airspace, whether domestically or internationally. UAVs have historically suffered mishaps between one to two orders of magnitude greater than the rate incurred by manned military aircraft. Improvements in technology and increased flight experience have enabled UAV mishap rates to improve and now approach an equivalent level of reliability consistent with their manned military counterparts.[82] DoD is addressing this reliability challenge by urging manufacturers to use redundant, fail safe designs, and has made some progress in addressing human factors challenges by standardizing some UAS ground control stations.[83]

Another major challenge with unrestricted access to the NAS is that UAVs are currently unable to 'see and avoid.' As manned aviation increased through the years the ability to ensure traffic separation was needed in order to increase safety of flight. "Vigilance shall be maintained by each person operating an aircraft so as to see and avoid other aircraft."[84] This is the most universal means to ensure separations when all other means, to include air traffic control (ATC) radar, fail and holds pilots responsible when operating in a visual environment. This basic tenet will not be easily changed or waived for UAV operations.[85]

Since UAVs by definition do not have a person on board the aircraft, on-board equipment, radar, or direct human observation must substitute for this capability. No technology has been identified as a suitable substitute for a person on board the aircraft in seeing and avoiding other aircraft.[86] The FAA is assisting DoD efforts by sponsoring research on detect, sense and avoid (DSA).[87] Current situational awareness/collision avoidance technologies such as Traffic Collision Avoidance System (TCAS) and

Automatic Dependent Surveillance-B provide a level of DSA but only against cooperating traffic equipped with appropriate transponders. Additional DSA technologies will be required to detect general aviation aircraft not equipped with transponders. Systems providing protection from both may be required in each UAV to satisfy the FAA.[88]

In addition to resolving see and avoid, the FAA is also concerned with other safety issues. UAV's communications and control links are vulnerable to intentional and unintentional radio interference that can lead to accidents or loss of control and must be addressed to ensure safety to other airborne aircraft as well as the population on the ground. In the same manner that the FAA is concerned with ensuring manned aircraft cockpits are secure from unauthorized access, physical security of ground control stations will be required to preclude hostile takeover.[89]

It is the FAA's long term goal to resolve these issues and permit routine government and commercial UAV operations within the NAS. However due to the concerns listed, the FAA can only authorize civil government and military operations on a case by case bases under strict conditions. At this time regulations do not permit commercial UAV operations. DoD will continue to work with industry and the FAA to work solutions that address these issues.[90]

Posse Comitatus Act. Homeland protection has for a long time fallen under the jurisdiction of civilian law enforcement and other agencies at the Federal, state, and local levels. In the post September 11th environment however, particularly with a continued threat of terrorism, laws have either come under review or new laws aimed at protecting the American people have been enacted (Patriot Act). One such law that warrants review is the century old Posse Comitatus Act (PCA).

The PCA was enacted in 1878 with the original intent of prohibiting the use of the Army from domestic law enforcement. Following the Civil War, the Army was used extensively throughout the South to enforce Reconstruction era policies, crush any lingering sentiments of rebellion and ensure civil order. While trying to meet these goals, the Army became more involved in traditional police roles to include guarding polling stations during the contested Presidential election of 1878.[91] Democrats accused Republicans of forcing African-Americans to vote for the Republican ticket.[92] Following these allegations, Congress became concerned that the Army was becoming politicized and therefore passed the PCA to remove them from civilian law enforcement activities and instead return them to their primary duty of defending the borders of the U.S..[93]

The PCA prohibits the use of the Army and Air Force (added in 1956) for law enforcement, except in cases and under circumstances expressly authorized by the Constitution or an act of Congress.[94] While PCA is directed against federal troops it is understood that it does not apply to the National Guard when under the control of the state governor (Title 32).[95] The direct prohibitions include arrest; search and seizure; interdiction of vessels, aircraft, or vehicles; surveillance; stop and frisk; or any other active civilian law enforcement activity. Violations of the PCA carry a penalty of up to two years imprisonment and/or a $10,000 fine.

Over the years the Congress has enacted legislation that has chipped away at PCA allowing the military to provide support to civilian law enforcement. This legislation has created exceptions in the following areas: insurrections/civil disturbances, counterdrug operations, disaster relief, and counterterrorism/weapons of mass destruction.[96] Of particular interest, considering the subject of this paper, aerial photographic and visual search and surveillance by military personnel was not found to violate the PCA.

The Reagan administration recognized the inability of law enforcement to interdict drug smuggling into the U.S. and directed the use of Navy and Air Force assets to assist by reaching beyond U.S. borders in an effort to preempt smuggling.[97] Congress codified the use of the military in antidrug law enforcement in U.S. Code (U.S.C.) 10, sections 371–381. Amendment 4076 to the Comprehensive Immigration Reform Act of 2006 allowed state governors, with approval of the Secretary of Defense (SecDef), to order National Guard units to perform activities such as reconnaissance, training and construction during annual training duties along the southern border for border security purposes. Additionally, section 1026 of the Defense Authorization Act for Fiscal Year 2007 (H.R. 5122) allows the SecDef, upon the request of the Secretary of DHS, to deploy military forces to assist CPB in preventing terrorists, drug traffickers, and illegal aliens from entering the U.S..[98]

Despite limitation by PCA, the U.S. military has provided support to civil authorities in response to civil emergencies and natural disasters dating back to the Truman administration. While the name of this provision has changed numerous times throughout the years, today it is referred to as Military Support to Civil Authorities (MSCA) by DoD policy and doctrine.[99] DoD's Homeland Security Doctrine issued in August 2005 states, "MSCA is the most widely recognized form of DOD Civil Support because it usually consists of support for high-profile emergencies such as natural or manmade disasters that often invoke Presidential or state emergency/disaster declarations."[100] It goes on to state, "DOD assistance should be requested by a Lead Federal Agency only when other local, state and federal capabilities have been exhausted or when a military-unique capability is required."[101] MSCA is provided during natural disasters, accidental or intentional manmade disasters, and special security events when either the President or state governor declare a state of emergency.[102] While MSCA allows for use of the military and its assets during a declared emergency it does not necessarily accommodate lower level law enforcement challenges.

The DoD, DHS, and Congress need to continue to evaluate other areas where the military can lend assistance to improve security not just at the borders but throughout the country and remove any legal impediments that stand in the way.

Recommended Way Ahead

First and foremost, UAVs must be provided access to the NAS in a timely and cost effective manner. In order to accomplish this, efforts will need to be made by DoD, FAA, and industry. The Tri-Service UAS Airspace Integration Joint Integrated Product Team (JIPT) has been given that responsibility to coordinate related technology and standards development on behalf of DoD. The JIPT is divided into focus teams responsible for identifying gaps in standards and conduct the necessary activities to resolve those gaps.[103]

As stated previously, one of the primary concerns limiting access of UAVs to the NAS is the high mishap rate. DoD must develop acquisition requirements that address this challenge. System redundancy, component reliability, and an automatic recovery system in the event connection is lost are critical toward driving down the mishap rate to an acceptable level. Industry must deliver aircraft that meet or exceed the same safety standards as manned flight and be held accountable if they are unable to meet the defined requirement.

The FAA and DoD must continue to work together in developing an acceptable solution to ‘see and avoid.’ DSA is the logical answer using current off-the-shelf technology. Until a decision is made and UAVs can be retrofitted, an interim solution must be put in place that does not require requesting a COA months in advance of a planned mission or the costly practice of following a UAV with a chase aircraft. Potential solutions may include adding published climb/arrival corridors that provide UAV access to military/restricted airspace. When UAVs need to operate outside military airspace (border patrol, fire fighting, etc.), temporary airspace similar to an ‘altitude reservation’ (ALTRV) used for air refueling could be designated and published in the Notice to Airmen (NOTAMs). Creative solutions and non-traditional bureaucratic processes are necessary if we are to enable military and civilian agencies to utilize their UAVs to accomplish their missions.

Regarding the PCA and MSCA, legislation and policy is already in place that enables DoD to support CBP in their mission of securing our borders and civil authorities in response to declared emergencies. Other areas that should be investigated include use of UAVs to support local law enforcement tasked with providing security at major events that may not rise to the attention of the President. Local law enforcement would benefit from overhead UAV imagery, similar to firefighters mentioned earlier. Police personnel could be positioned in a more efficient manner, be warned of potential trouble, and gain access to real time imagery support during an incident.

Once ongoing operations in Iraq and Afghanistan begin to wind down, UAVs and their associated crews will return to their home stations. The decreased ops-tempo will in turn drive crew training requirements to increase. One way in which military services could meet the need of civil authorities is to support mission requirements in conjunction with training. UAV pilots and sensor operators could gain valuable training, continuity, and experience that carry over into military operations by supporting law enforcement, firefighters, CBP, USCG, and others during these scheduled training sorties. This type of effort would greatly increase civil authority capabilities without incurring significant acquisition, operations and maintenance, and personnel costs associated with building up their own fleet.

The primary concern with this arrangement would be the continued availability of UAVs. Should the military UAV ops-tempo increase, fewer assets would be available to support civil authority missions. Therefore organizations such as CBP could minimize their risk by maintaining a small fleet of UAVs that would enable them to accomplish their minimum requirements while military UAVs are not available.

Along these lines, efficiencies could be gained by evaluating UAV mission requirements, and where overlap exists, consideration be given to acquiring common platforms and sensors. This can result in less cost toward research and development (R&D), per unit acquisition costs, and training costs if military and civilian training programs were combined.

Conclusion

Despite their long road to acceptance, UAVs are here to stay and are the future of ISR and potentially aviation in general. UAVs have proven their worth in military operations in Iraq and Afghanistan and offer great promise in providing security for this nation. The capabilities that made UAVs so invaluable in military operations are the same capabilities that can help secure our borders and coastlines to ensure protection of the civilian population. UAVs can also be valuable in many other areas including: mapping, land management, earth science research, fire detection and firefighting management.

DoD must continue engagement with FAA, DHS, DOT, and industry to improve the mishap rate of UAVs and gain access to the NAS in a manner that does not impose cost prohibitive measures. DoD, civilian agencies and lawmakers must together seek mission areas in which UAV capabilities can be utilized and remove barriers inhibiting their employment.

Over the last several years, DoD has invested billions of dollars in developing UAV airframes, their sensors and their aircrews. Our nation's budget is already plagued by huge deficits and there is pressure to reduce spending. Leveraging the investment already made and using training time to support real world civil missions only makes sense.

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