MILITARY UTILITY, NATIONAL SECURITY, AND ECONOMICS

Working Group Report

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INTRODUCTION

The Military Utility, National Security, and Economics Working Group[I] examined the U.S. military and intelligence services' increasing reliance on and use of Unmanned Aerial Systems (UAS) technology. The working group considered the capabilities likely to be needed for U.S. military and national security planning in the future and the growing commercial market driving technology innovation. The group also considered the economic viability of UAS and whether they are an effective tool for fulfilling U.S. national security goals.

The primary scope of this working group was to consider the use of military UAS to conduct lethal operations. The working group limited its discussion to topics surrounding near-term lethal capabilities of UAS, and therefore issues pertaining to the potential use of autonomous UAS fell outside the scope of the group's efforts. Yet, as non-lethal UAS technologies continue to evolve and spur the advancement of lethal UAS, particularly in light of the rapidly growing commercial UAS sector, the working group did discuss other related domains as needed.

Controversy swirls around the use of drones, or as they are more formally known, UAS. But this controversy too often distorts the UAS debate, and concentrates solely on the use of UAS for targeted strikes off the hot-battlefield. In order to unpack the issues related to U.S. military and national security planning, the broader context of UAS utility should be considered — both from the military and civilian perspectives. While very real policy concerns exist and must be addressed, these concerns must be considered in the context of not just lethal UAS strikes, but from the value UAS provide in non-kinetic missions, which are too often overlooked by UAS critics.

UAS share some distinct attributes, which have made them attractive for military, domestic law enforcement, counter-drug, border protection, and counterterrorism operations as well as for commercial applications. These attributes are not mutually exclusive and thus have some overlap.

- *Persistence*: UAS have the ability to loiter over a specific area for extended periods of time, allowing them to capture and collect more information, allowing the user to observe, evaluate, and act quickly.
- *Precision*: In military applications, UAS sensor technology can provide for more precise information collection that facilitates more accurate targeting as well as battlefield and non-battlefield surveillance.
- *Operational Reach*: Because of longer flying times, UAS can be used to project force from afar in environments that may otherwise be inaccessible or too dangerous for manned operations.
- *Protection of U.S. forces*: UAS allow the user to have a military presence in areas that would be otherwise politically impossible, capacity/resource prohibitive, too dangerous to risk being shot down, or topographically inhospitable.
- *Cost effectiveness*: Although the actual costs of UAS vary depending on size, hardware, software, support crew, etc., some argue that UAS are more cost-effective than manned aircraft.

The Department of Defense's (DoD) 2013 Industrial Capabilities Report noted that many aspects of UAS make them a valuable tool for military and non-military markets in the near and long term:

[I] The report was produced by the Working Group Chair and Stimson staff based on input from group members, but the report does not reflect every individual view and was not "endorsed" by group members. This report is based on work undertaken by the working group during 2013-2014.

The Unmanned Aerial Systems (UAS) segment continues to evolve. As technology matures, operational lessons-learned are analyzed, and long-term strategies are developed beyond current conflicts. As evidenced by their extensive use in operations in Afghanistan and Iraq, UAS have proven themselves an effective tool for the Warfighter. The capabilities they bring — from providing constant imagery to serving as strike platforms — are now virtually indispensable to combatant commanders.[1]

The benefits of military UAS, which are used to provide intelligence, surveillance or strike capabilities, have been recognized by combatant commanders and intelligence services in the United States, but the technology remains only a small percentage of total investment in DoD research, development, and procurement.[II]

Non-military uses of UAS are vast and the commercial market for UAS will likely drive innovation in the near future, both in the United States and abroad. However, concerns about U.S. controls on UAS export and domestic restrictions have led some to worry that the future of the U.S. industry in UAS will be stifled and that foreign competitors will overtake U.S. dominance of UAS technology. Indeed, as the DoD stated in the 2013 Unmanned Systems Integrated Roadmap:

"…DoD's total research, procurement, and sustainment costs are relatively small compared to the spending on manned platforms… The civil UAS market also shows great promise and the potential applications are virtually endless, if regulatory standards, certification, and operational procedures can be resolved for full integration into the National Airspace System. Greater computing power, combined with developments in miniaturization, sensors, and artificial intelligence, have and will continue to dramatically boost UAS capabilities... However, there is concern that if the U.S. does not resolve export issues with respect to UAS, this segment will suffer a fate similar to that of the U.S. satellite industry, where a dominant position in the market was ceded to competitors because of unique U.S. export controls."[2]

After thoughtful consideration of the issues related to the military utility of UAS, the working group suggested the following recommendations for the U.S. government in its development of UAS policy:

1. Establish best practices for UAS use in military/national security missions.
2. Assess UAS-related technological developments and future trends, in order to develop a U.S. government interagency research and development strategy.
3. Ensure research and development funding for UAS is commensurate with national security, foreign policy, and defense industrial base needs and requirements in order to maintain U.S. competitiveness and domestic industry growth.
4. Identify potential UAS use for civilian and military applications that reflect innovative approaches for a broad spectrum of uses.
5. Review and reform UAS-related export control rules and FAA rules, to ensure that the regulatory obligations for the development of the U.S. UAS industry are not overly burdensome, with a view to safeguarding U.S. national security interests.
6. Establish a U.S.-led international effort through the ICAO (International Civil Aviation Authority) on global air traffic rules associated with UAS.
7. Accelerate FAA efforts to meet the requirements of the 2012 FAA Reauthorization Bill and ensure FAA coordination with export control reform initiatives and national security policies.

[II] Most military UAS could be used for commercial purposes like crop surveillance and cargo delivery. One distinguishing military UAS characteristic is whether it is weaponized.

BACKGROUND

Whoever first brings a technological innovation to the battlefield often enjoys a step function advantage over its foes as long as it monopolizes that technology. This advantage boosts the confidence of the innovator and affects conduct on and off the battlefield for the length of the monopoly. Consider the dominant position of the United States in the four-year period that ran from 1945, when it used the atomic bomb against Japan, until 1949, when the Soviet Union successfully tested its own atomic weapon. During this period, American diplomacy benefited from its nuclear monopoly. Like all warfare innovations, however, the monopoly was short-lived. The technology proliferated and within a short time, several countries were operating at a new, more lethal level.

The United States has enjoyed a localized monopoly in UAS in the uncontested theaters of Iraq and Afghanistan, and even across Southwest Asia outside of the combat zones. This monopoly has provided the United States a similar step function capability increase in terms of persistence and operational reach of force.

In the U.S. military, UAS perform a variety of missions. UAS operations have profoundly changed intelligence-gathering operations by combining satellite and sensor technology to deliver greatly improved situational awareness. DoD currently operates over 8,000 UAS[3] , which made up 41 percent of all DoD aircraft in 2010. It should be noted, however, that less than 1 percent of DoD's unmanned aerial systems carry operational weapons at any given time.[4] In addition, a number of U.S. government agencies use UAS for a variety of missions (see Figure 1). However, lethal capability is not shared by all agencies and services, certain services, such as the USMC and U.S. Navy do not currently operate lethal UAS. Their UAS fleets are focused on providing reconnaissance, or "over the next hill" surveillance that is vital for their combat operations. The Navy continues to expand its ability to monitor the world's waterways, especially in Asia, as part of the Broad Area Maritime Surveillance UAV program,[5] developing a Navy specific Global Hawk — the MQ-4C Triton.[6]

Figure 1: Use of UAS by Mission Type and U.S. Agency

		U.S. Department of Defense					Other U.S. Agencies	
		Air Force[1]	Navy	Army[2]	Marine Corps	SOCOM/ JSOC	CIA	CBP[3]
Mission Type	Intelligence	•	•	•	•	•	•	•
	Surveillance	•	•	•	•	•	•	•
	Reconnaissance	•	•	•	•	•	•	•
	Targeted Strikes	•		•		•	•	
	Close air support	•		•		•		

[1]Includes Air National Guard
[2]Includes Army National Guard
[3]CBP has flown missions to support both FBI and DEA

As exemplified by the U.S. Navy, DoD in general is expanding both its ISR and lethal UAS fleet. In its most recent budget, DoD requested an additional $2.9 billion for UAS acquisition. While the FY2016 requests (see Figure 3) are uniformly less than in FY2012 (pre-sequester), the FY16 request includes an expansion of the MQ-9 Reaper and the RQ-4 Global Hawk programs.[7] For the Global Hawk, around 55 percent of requested funds are allocated towards research, development, test and evaluation (RDT&E). For the Reaper program, only 16 percent of the requested funds are allocated for RDT&E while 84 percent are allocated for the procurement of twelve new aircraft and ten new ground stations. These advancements are part of a larger long-term strategy outlined by the U.S. Air Force in the 2014 RPA *Vector*:

"By 2020, the Air Force expects to have the smallest force structure in its history. Balancing future capability needs, significant decreases in future funding, and the transition of current operational capabilities from the Overseas Contingency Operations (OCO) funds to the base budget will require a disciplined, focused, and centralized RPA strategy."[8]

The majority of the United States' UAS missions have been for intelligence, surveillance and reconnaissance (ISR). Only a small fraction of missions are for targeted strikes of al Qaeda and associated forces, primarily conducted by the CIA. It is these targeted strike missions that have garnered the vast bulk of negative attention. UAS are being used increasingly in a variety of missions, including transportation and supplying forward base locations. The United States Marine Corps used 2 robotic helicopters for 24/7 resupply and retrograde operations for three years in Afghanistan, and these helicopters transported over 3 million pounds of cargo. UAS are becoming an integral part of the military's day-to-day operations and are being used in a variety of ways to both protect and aid soldiers on the battlefield.

While the uses of UAS are widely discussed in military operations, they also have a wide range of potential uses in the commercial sector. Developments within the civilian sector will be integral in developing non-lethal technology — hardening the platforms for operation in contested areas, increasing autonomous capabilities, and improving big-data collection and processing. The future of UAS both in terms of application and development is promising. The following sections will evaluate both the benefits of current and future lethal and non-lethal UAS, as well as the risks of continued and increased use of this technology.

Figure 2: U.S. Department of Defense Acquisition of UAS (in millions of USD)

UAS System[9]	FY12		FY13		FY14		FY15 (estimate)		FY16 (request)	
MQ-1B Predator/ MQ-1C Gray Eagle	Total: $1,039.1		Total: $710.7		Total: $654.9		Total: $337.5		Total: $402.1	
	RDT&E $176.4	Proc. $862.7	RDT&E $107.4	Proc. $603.3	RDT&E $48	Proc. $606.9	RDT&E $69.3	Proc. $268.2	RDT&E $13.9	Proc. $388.2
MQ-9 Reaper	Total: $1,076.4		Total: $1,112.7		Total: $538.4		Total: $722.8		Total: $903.6	
	RDT&E $129.1	Proc. $947.2	RDT&E $133.5	Proc. $979.2	RDT&E $117.3	Proc. $421.1	RDT&E $163.5	Proc. $559.3	RDT&E $141.6	Proc. $762
RQ-4 Global Hawk/MQ-4C Triton/NATO AGS	Total: $1,456.7		Total: $1,228.8		Total: $762.7		Total: $1,074.7		Total: $1,420.3	
	RDT&E $972.1	Proc. $484.6	RDT&E $1,045.5	Proc. $183.3	RDT&E $717.0	Proc. $45.7	RDT&E $931.1	Proc. $143.6	RDT&E $783.7	Proc. $636.6
RQ–7 Shadow/ RQ–11 Raven/ RQ-21 STUAS	Total: $318.7		Total: $173.4		Total: $258.9		Total: $295.8		Total: $280.8	
	RDT&E $64.4	Proc. $254.3	RDT&E $56.1	Proc. $117.3	RDT&E $34.8	Proc. $224.1	RDT&E $31.3	Proc. $264.5	RDT&E $20.4	Proc. $260.4

CURRENT AND FUTURE EMPLOYMENT OF UAS IN LETHAL OPERATIONS

UAS are used both in conventional military operations and in targeted strikes on and off the "hot-battlefield." Policymakers and military planners need to determine from the array of lethal tools available to the United States, including manned aircraft and special operation forces, whether UAS are the right tool for the specific mission. Planners and policymakers must take into consideration a variety of national security and military utility concerns that guide how and when UAS should be used effectively. UAS as weapons in combat are not without risk. The more commanders know about both the long- and short-term risks as well as the strategy guiding their use, the more effective UAS can be as a tool of war.

BENEFITS OF UAS USE

UAS are used increasingly in military missions because they provide several tactical benefits for current as well as future conflicts.

First, UAS provide precision for targeted strikes both on and off the "hot-battlefield." [III] UAS are a platform for tactical air-to-surface missiles, such as Hellfire II missiles,[10] which themselves are very accurate munitions for tactical strikes, regardless of whether they are launched from manned or unmanned platforms (they were originally designed to be launched from helicopters).

Second, UAS internal surveillance systems provide accurate and precise imagery and video for targeting. Combined with long loitering time, the employment of UAS allows pilots/operators to fire on targets when they determine the target and that non-combatants are not present — improving the assurance of proportionality and discrimination. These developments have resulted in the fact that UAS not only significantly reduce the length of the command chain, but shorten the kill chain (i.e., Find, Fix, Track, Target, Engage) by improving a pilot's ability to seek out targets and provide the intelligence and imagery, or fire — a process which, for manned aviation, may take two or more different aircraft, numerous individuals, and significant coordination.

Third, as with manned aircraft, UAS are able to execute a variety of missions in one sortie, including target or reconnaissance missions. While most UAS missions are merely for ISR purposes, if a target is located, that same UAS can fire without a new aircraft being sent in. This versatility combined with long range increases operational reach and allows for lethal sorties deep into anti-access and aerial denial (A2/AD) territory.

Fourth, UAS allow the user to project force from afar, keeping boots off the ground in the area of combat. The user can use force in inaccessible or inhospitable areas for ground forces, reducing the risks associated with setting up forward bases to execute strikes. While manned aircraft provide this capability, because of longer flying and loiter times, UAS extend the range and persistence of surveillance and increase the options for attack.

Fifth, lethal UAS are being used tactically on the "hot-battlefield", delivering lethal close air support (CAS) and providing commanders with accurate surveillance of the battlefield and precise targeting

[III] The use of UAS in non-conventional war has centered on the debate of using UAS outside of the "hot-battlefield." However, there is currently no international legal definition of "hot-battlefield," and thus the use of the term creates confusion. Broadly, the "hot-battlefield" can be understood as an area with continued overt and active conflict between troops on the ground. John Brennan in his 2011 statement at Harvard Law School stated that the United States was not "restricted solely to 'hot' battlefields like Afghanistan." Thus, it would appear the Obama administration's definition of the "hot battlefield" is delineated where the U.S. has troops on the ground engaged in continued overt and active conflict and not solely where there is active conflict (as in Yemen).

abilities in one system. In addition, UAS can serve as a force protector by potentially firing on enemy combatants when U.S. forces are engaged in battle. In the past, warfighters on the ground under imminent threat would have to navigate a complicated command hierarchy to call for air support. The soldier on the ground would have to relay coordinates to a Forward Air Controller (FAC), who would then talk the pilot's eyes onto a target in an extremely hostile environment. These missions have always been very dangerous for the pilot, who has to fly low and avoid multiple threats, and also for the people on the ground. It is a human-error rich environment, and even today it is not uncommon for the wrong coordinates to be relayed, resulting in the deaths of friendlies. To ease these difficulties, DARPA is currently investigating methods to replace the FAC and the pilot with a weaponized UAS that can be commanded by a soldier on the ground via a smartphone.[11]

Box 1: Cost of UAS

Discussions of UAS often assume that the unmanned system will always be less expensive to operate than its manned counterpart. For example, according to Air Force data, the "ownership cost per flight hour" in 2012 was $3,679 for the MQ-1B Predator and $4,762 for the MQ-9A Reaper, and $49,089 for the RQ-4B, Global Hawk. In contrast, the reported equivalent cost was $22,512 for an F-16C and $36,343 for an F-15E.[12] In addition, acquisition costs of a UAS platform tend to be lower than for manned platforms. Thus, the cost for replacing a downed UAS is likely to be less than replacing its manned equivalent. Properly assessing the cost and cost-effectiveness of aircraft, however, requires going far beyond these simple numerical comparisons.
One major problem in assessing the cost of UAS — or any aircraft, for that matter — is the fact that there is more than one way to define the "cost" of owning and operating a military aircraft. Cost estimates might include not only the direct fuel consumption of an aircraft but also various types of maintenance and personnel costs. These maintenance and personnel costs could include only the costs of pilots, ground crew working on the plane, and the equipment those ground crews use. A broader cost measure, however, could also include the costs for operating the base at which those aircraft are located, as well as broader infrastructure and training costs related to maintaining a fleet of aircraft.[13] For example, it costs the U.S. Air Force $2,109/training hour for a fighter or bomber pilot to learn to fly a Predator, but it only costs $150/training hour for commissioned officers with no previous flight experience to learn to operate the Predator.[14]

Costs, however, are not the whole story, as higher cost may simply reflect greater capability. For example, some UAS carry more sensors than their manned counterparts, which might translate into higher costs for personnel needed to monitor and analyze data streams that simply do not exist on other manned platforms as well as the costs for the hardware and software that go into the sensor packages. On the other hand, a manned F-16 may have higher costs partially because it consumes fuel more quickly than an MQ-1, but its far greater speed gives it air-to-air combat abilities that current UAS lack.

One way to address the question of relative cost is by comparing similar manned and unmanned aircraft. An appropriate comparison might be made between the MQ-1 and a manned MC-12 Liberty, a propeller-driven aircraft designed for ISR missions. The Air Force's reported ownership cost per flight hour in 2012 for the MC-12 was $3,973 after several years of declining costs per flight hour.[15] Yet while the MQ-1 and MC-12 have similar missions and similar costs using this measure, they still have significantly different capabilities. The MC-12, although more durable and capable in poor weather than UAS, can stay aloft for only 6 hours in comparison to an MQ-1's 24 hours.[16] Moreover, the MC-12 puts several humans at risk, who are also subject to physiologic constraints such as fatigue and hunger.

As this comparison shows, measures of cost-effectiveness can significantly vary depending on which criteria of effectiveness are used. In the case of ISR missions, for example, effectiveness might be measured by some combination of the aircraft's sortie rate, range, time on station, ability to operate in poor weather, the amount of data collected, the type of data collected, etc. Moreover, the measure of "effectiveness" may vary significantly from one ISR mission to another. A mission to get a picture of a particular distant target will not require the same capabilities as a mission to provide persistent overhead surveillance for a ground unit.

All told, any cost estimate will be subject to questions about whether it is accurately capturing the relevant costs associated with an aircraft, and costs alone are not sufficient for assessing the cost-effectiveness of a platform. Depending on the mission, a seemingly more expensive aircraft may in fact be more cost-effective than a less expensive platform.

RISKS OF UAS USE

While UAS are often lauded for their tactical and operational benefits within military circles, the use of UAS for lethal strikes also carries a variety of strategic risks. Though UAS are generally seen as providing more options for U.S. military operations, such as extending global reach and lowering the perceived human cost of various missions, their advantages could make such missions appear more attractive for military action and, as a result, encourage greater military involvement. These risks include the potential erosion of sovereignty, risks of creating a slippery slope, blowback, possible erosion of war powers, and proliferation to non-state actors. If left unchecked/if not adequately addressed in policy discussions, such risks could pose increasing challenges and concerns for U.S. national security goals and foreign policy objectives, and could hold many unforeseen policy implications.

It is worth noting, however, that because it is difficult to differentiate technological capability from policy impact, many of the risks associated with UAS should also be considered when discussing armed manned aircraft.[17] Arguably, the technology has leapt ahead of policies and strategy and poses potential costs that policy-makers have not fully considered or debated.

Erosion of Sovereignty

First, UAS may erode the norm of sovereignty in ways ultimately harmful to U.S. interests. The use of UAS for lethal strikes in denied areas has not grown in isolation, and the policy guiding UAS operations outside the battlefield falls under the larger counterterrorism policy and strategy that has developed in the post-9/11 world. U-2 aircraft, missiles, and even satellites have raised similar concerns in the past regarding sovereignty. In this sense, UAS do not represent a sharp break from the past, since both manned and unmanned aircraft are subject to the restrictions of access to the area of responsibility (AOR). The use of either a UAS or manned aircraft over a country outside a declared warzone could be declared an "act of war" or "hostile act," and nations may be within their sovereign right to shoot-down invading aircraft. Such an action, however, might lead the country in question to attack the aircraft in their airspace, register a diplomatic complaint such as a "demarche," or complain publicly such as at the United Nations. But UAS may seriously aggravate the problem because of the potential to operate at lower altitudes and possibly in increased numbers. U.S. violation of sovereign airspace over nations whose consent is questionable or nonexistent may encourage other nations to follow suit with their own military platforms or even commercial entities.

The issue of sovereignty is not unique to UAS. In the past, the United States has employed raids by Special Operations Forces (SOF) outside of designated war zones and across sovereign nations' borders. These raids can be seen as the manned alternative to the use of lethal UAS. However, while the bin Laden SOF raid was launched across a sovereign border without the permission of Pakistan, the raid was, for the most part, praised by the American public. Public attitudes, often stem from the use of UAS in strike missions that cross sovereign borders. However, as noted above, this view confounds the platform with the mission, as SOF raids or manned fighter aircraft could also be used to conduct targeted killings in or out of a warzone. The difference is that UAS offer the ability to conduct targeted killings on a greater scale than SOF raids and with less risk to human pilots when using manned aircraft. But perceptions matter, and illustrate the controversial nature of UAS operations where lethal force is involved.

In broad legal terms, the United States has argued that the targets it pursues pose an "imminent threat" to U.S. interests, or are legal combatants of al-Qaeda and its associated forces, and their actions are in self-defense. In other words, the Obama administration argues that sovereignty does not act as a shield, and the U.S. can legally pursue these targets outside the "hot-battlefield," but they do so with coordination (permission) from host nations, as a matter of policy. They reserve the "imminent threat" rationale if needed and cooperation is not forthcoming. Others may argue, however, that sovereignty comes more from one's ability to defend one's territory, and thus targeted strikes against security threats do not call national sovereignty into question.

The low risk, low cost missions that UAS provide may encourage the United States to fly such missions more often. The United States might more readily pursue a target with UAS that it would not normally pursue if special operation forces were required to be put at risk. However, use of UAS could have the reverse effect. Because shooting down just an airframe and not a person may not carry the same implications politically, other nations could be more likely to shoot down a UAS, which could ultimately discourage the use of UAS and decrease their attractiveness as a tactic.

Slippery Slope

Second, UAS may create slippery slopes into continual or wider wars. They could create an escalation risk since they may lower the bar to enter a conflict, but may not necessarily lead to a satisfactory conclusion. For example, the anti-American jihadists that U.S. UAS tend to hunt are mostly motivated by conflicts occurring in states with fractured political orders. The use of UAS to track and kill targets does little to repair those rifts. Extremist groups are difficult to fully eradicate in the best circumstances. Thus, UAS Hunter-Killer missions may continue indefinitely.

Blowback

Third, UAS use may result in blowback, creating additional enemies for the United States in targeted countries — such as Pakistan, Afghanistan Yemen, and now Syria — causing secondary impacts on broader conflicts with al-Qaeda and associated forces, and harming U.S. national security in general. (This risk applies mainly to strike missions outside war zones, which, as noted, constitute a small portion of UAS missions.) Friends and family of those attacked or harmed in strikes may become hostile to the United States, and their hostility may cost the United States over the years in terms of foreign cooperation, hostility to U.S. travelers and foreign business, and support for terrorism. UAS Hunter-Killer operations can go against the larger counterterrorism and counterinsurgency strategy of attempting to gain the support of local populations in efforts to deter them from supporting al-Qaeda and associated forces. However, even where strikes kill few people, the perceived assault of UAS on sovereignty in places like Pakistan may spark bitterness, feelings of nationalism, or other forms of identity politics violently hostile to U.S. military operations or Americans.[18] The advancement of the Islamic State in Iraq and Syria demonstrates the potential risk of blowback, but also illuminates how the risk of blowback does not preclude the use of strikes to conduct counterterrorism military operations.

The current campaign of targeted killings using UAS outside the hot-battlefield continues because the United States has at least the tacit approval of the countries where the strikes are occurring. In the case of both Yemen and Pakistan, various branches of their governments have both approved and denied the right of the United States to conduct drone strikes over their country — confusing the issue of who has the authority to approve the strikes. However, this does not seem to affect blowback, as in the case of Yemen, many feel that the president, who approved drone strikes, does not represent the views of the population.

While it is true that the U.S. has long used cruise missiles and other stand-off systems to strike outside of a war zone, these missions are generally retaliatory, punitive strike missions and not targeted killings. Examples of such missions include the 1986 Eldorado Canyon mission in which the U.S. sent fighter aircraft to attack Libya in retaliation for the bombing of a Berlin nightclub frequented by U.S. personnel, and the 1998 Infinite Reach retaliatory strike in Sudan and Afghanistan after the bombing of two U.S. Embassies. While these punitive military strikes bare semblance to targeted UAS strikes, they should not be conflated with persistent lethal UAS operations that can create enemies who aggregate over time. The use of a UAS to perform a targeted killing is for the most part immediately and publicly attributable to the United States. Because of this attribution, possible blowback should be considered before every strike.

Box 2: Military UAS Operations vs. CIA Operations

Since the days immediately following 9/11, the CIA is believed to be well equipped to respond to emergency situations in the U.S. operation against al-Qaeda. According to officials, the CIA's process for carrying out targeted strikes is less rigid than the military's. Under Title 50, CIA strikes and the process for determining targets is kept out of the public eye, which allows for more discretion when planning for and carrying out targeted strikes. The Department of Defense, on the other hand, has a robust procedure with outlined authorities and steps, and clear checks on individual targets. While the CIA may have a similar structure in terms of determining strikes, the lack of transparency on the process is concerning.

The authorization of a UAS strike by the military follows the traditional authorization to use force as with any other weapon systems, be that a MQ-9 Reaper or an F-16 fighter jet.16 UAS are employed no differently than traditional weapons of war — subject to the military's pre-strike target development, and post-strike assessment. The process of determining and executing a strike follows a specific set of steps (see Appendix 1) that cuts not only across services, but the entire government to ensure fidelity in target selection, strike, and post-strike review. The first step, target development, involves four functions: target analysis, vetting, validation, and nomination. By creating a cross-agency and service vetting process, the five step target development procedure ensures that one, the target achieves the objectives and goals dictated by the force commander, and two, a targeted strike does not conflict with the goals or objectives of other services or agencies. Within this process is a concerted effort to mitigate non-combatant casualties and to assure that the target's demise is strategically smart. Following a strike, a post-strike review is carried out both at the tactical level (with input from the unit) and the operational level — in order to determine whether the strike was in line with rules of engagement, as well as how the target's success or failure fits into the large operational strategy.

The Chain of Command within the military process is well defined, and helps ensure proper accountability.[20] Ultimately, the commander has authority and accountability for the strike, but is assisted at all steps in the targeting process by judge advocate general lawyers (JAGs). JAGS provide legal advice on the proper rules of engagement, including if the mission changes during the operation. [21]

In contrast, the CIA's process for targeted strikes remains unclear and opaque. Press reports, based on leaked information from administration officials, support the argument that CIA provides for more efficient targeting than the military, particularly because the CIA is able to react to "imminent threats" without the burden of multi-service and agency oversight. For example, when the CIA first began carrying out UAS strikes, intelligence experts were quoted as saying that the CIA "is quicker, more fluid and involves fewer decision-makers in its 'trigger-pulling' chain of command than even the nimblest military operation."22 While there is indication that the administration has a process for each strike, which includes an extensive review process, it remains unclear who is involved in the process, which agencies and departments provide checks and oversights, and in terms of accountability, who is ultimately responsible for the strikes.[23]

Erosion of War Powers

The use of UAS risks eroding the War Powers Resolution and Congress' check on the Executive's power to wage war. The United States' use of UAS in Libya brings this question and the power of the executive branch to wage war into stark relief. The administration, including the State Department's legal advisor Harold Koh, stated that the use of force (with UAS) did not fall under traditional hostilities necessary to enact the War Powers Resolution.[24] Thus, U.S. action was extended beyond the traditional 60-day period without Congressional approval.

Because UAS strikes do not put American lives at risk, U.S. voters seem largely indifferent to their military use — or whether they should be considered acts of hostilities abroad. There is therefore little pressure on lawmakers to inform themselves about these policies and the threats they aim to combat. That Congressional quiescence prevents skeptical media coverage and allows the president and his aides to secretly make UAS strike policies that avoid public debate.[25]

Un-scrutinized, secret policies are more likely to be ill-conceived.[26] The issue is compounded further by the fact that the CIA has not acknowledged its involvement in the UAS targeted strike program, creating an issue of Congressional oversight of covert actions. Congressional deference may become a habit that continues when more consequential uses of force are under consideration.[27]

Proliferation to Non-State Actors

UAS employment will continue to proliferate beyond the United States. The increasing use of UAS by the United States encourages others to try to acquire and use them as well, as with all advances in war technology. The wars in Iraq and Afghanistan have demonstrated how sub-state actors can frustrate the United States' political goals despite its military dominance. Future conflicts will see non-U.S. UAS in the battle space, such as the summer 2014 Hamas-Israel conflict where Hamas is known to have used drones.[28]

This increasing proliferation of UAS technology means that survivability concerns will become more of an issue as well. The Iranian capture of the RQ-170 is one example of the serious consequences of not addressing known vulnerabilities. A University of Texas professor demonstrated just how easy it was to spoof the GPS signal of a UAS and trick it into changing courses and destinations.[29] In addition to protecting the security of the UAS electronic environment, additional work is needed to develop survivability capabilities that provide UAS the ability to detect and avoid possible threats, such as surface-to-air missiles and anti-aircraft artillery, which will no doubt become more of an issue when UAS operate in non-permissive environments.

CURRENT AND FUTURE EMPLOYMENT OF MILITARY UAS IN NON-LETHAL OPERATIONS

Non-lethal UAS are being used increasingly on the battlefield and abroad to support operations, including providing surveillance, reconnaissance, and transport. UAS are an effective tool for operations now and will be in the future, providing unique capabilities that add to their overall military utility.

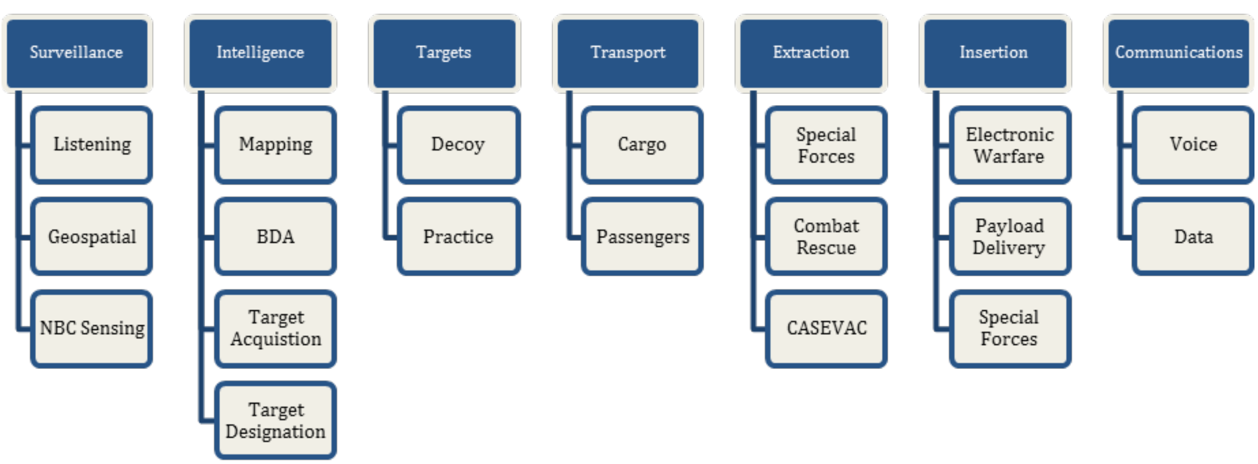
Figure 3 demonstrates those missions that UAS currently perform and could achieve in the future.[30] While non-lethal UAS have come under less scrutiny than lethal UAS, there are two primary concerns with their use. First, ISR UAS could be used increasingly in non-permissive airspace, impinging on a country's sovereignty. Invasion of sovereignty can create geopolitical problems for the user, and increase hostilities between nations. Second, many observers have expressed concerns with privacy and the infringement on 4th Amendment rights. While the 4th Amendment only applies to U.S. citizens, the issues of infringement of rights and of privacy guarantees in a variety of countries have led to widespread international concerns regarding increased UAS use.

Surveillance

UAS operations have profoundly changed intelligence-gathering operations, greatly improving situational awareness and significantly reducing the length of the kill chain. The technology has increased the ability of higher headquarters to make short cycle decisions and to impact the close-in fight quite literally by remote control. Simultaneously, lower echelon units now have greater access than ever to the same external information as higher headquarters and, aided by the use of locally controlled UAS, are able to dominate greater battle space and enhance their own situational awareness. This allows for both continued monitoring of a specific area, and the ability to monitor a large area.

For example, the Gorgon Stare, a persistent wide area surveillance system utilized by the MQ-9 Reaper, provides video imaging of a large area of land, while also providing useful on the ground detail.[31] Furthermore, UAS can focus on a smaller area for a long period of time, providing ISR for upwards of 24-hours. Unlike manned aircraft, which are limited by pilot fatigue and bodily risk, longer flying times allow UAS to reach more remote locations for longer periods of time, which has proven to be especially useful in areas such as Afghanistan and Pakistan. While ISR data is often integrated with other surveillance technology, including satellites, U-2 and RC-135s, in the airspace of adversaries, UAS have unique advantages. UAS are not as predictable as satellites, whose movements can be predicted by adversaries.

Figure 3: Current and Future UAS Missions



As UAS have enhanced intelligence-gathering operations, the U.S. military has adapted to the availability of UAS and communications technology by flattening their command structures, eliminating intermediate headquarters and making units at either end of the command chain more robust.

UAS can also provide valuable surveillance on the battlefield, providing CAS and intelligence to soldiers on the ground. While smaller UAS are often used to "look over the next hill," Predators and Reapers can be used to provide a more complete view of the battlefield for operation commanders. It is also viewed as a better alternative to manned aircraft, keeping one more service member out of harm's way. There is current work to determine how and when to use UAS as an over-the-horizon communication relay tool, as well as how to use UAS for chemical, biological, radiological, nuclear and explosives (CBRNE) detection.[32]

Military UAS are also employed for other mission areas, such as public service and disaster relief as was seen following the typhoon that devastated the Philippines in November 2013. For example, the Air National Guard has aided firefighters in combatting wildfires in California.[33]

Transport

UAS will be used with increasing frequency in transport missions both for cargo and for wounded soldiers. Transports are often weak targets, and manned transports are frequently attacked. Utilizing UAS instead will alleviate the risk to human life. As previously mentioned, a U.S. Marine Corps R&D UAS cargo effort relatively close to program of record status is the Lockheed Martin/Kaman KMAX helicopter. What started out as a U.S. Marine Corps experiment with two logging helicopters has evolved into an impressive demonstration of robotic cargo delivery, using external sling loads to deliver cargo in mountainous and hostile terrain. In 2013, two forward deployed KMAX helicopters in Afghanistan surpassed 3 millions pounds in cargo delivered.[34]

Transporting cargo is not the only R&D effort in this category, as the U.S. Navy is also researching how to transport severely wounded casualties in a robotic helicopter to field trauma units through a program called the Autonomous Aerial Cargo Utility System (AACUS).[35] The Army is examining similar applications for medical evacuation missions.

There are many other DoD R&D projects that cover the remaining possible missions in Figure 4. UAS are being used to provide additional discrimination and targeting information, such as in ballistic missile engagement scenarios.[36]

TECHNOLOGICAL DEVELOPMENT

Since the dawn of mechanization, militaries have sought to replace people with more effective machines. UAS have continued this pattern,[37] and rather than relying on individuals to survey a remote outpost for 24 hours at a time — an undertaking that is both expensive and inefficient — UAS replace on-the-ground soldiers not only to improve capabilities, but to help avoid casualties and additional costs as well. However, while a reliance on technology rather than manpower encourages technical progress, there is potential harmful infatuation with its outputs, leading to possible overconfidence in the technology to act as a silver bullet in a variety of situations.[38]

UAS technology is developing rapidly and for wider uses. In terms of future use of UAS for lethal operations, it is likely that an increasing number of weapons will be adapted for use on UAS platforms such that any weapon developed for a manned aircraft will be able to be launched from an unmanned aircraft.

Even from a non-lethal UAS perspective, the United States is looking towards future operations and considering how UAS will be used over the next decade. In 2009, Air Force Lt. General David Deptula, Deputy Chief of Staff for Intelligence, Surveillance and Reconnaissance, outlined four main points of an action plan to guide UAS development:

- "Unmanned aircraft that are fully integrated with manned aircraft across the full range of military operations
- UAS that use automated control and modular 'plug-and-play' payloads to maximize combat capability, flexibility and efficiency
- Joint UAS solutions and teaming
- An informed industry and academia — knowing where we are going and what technologies to invest in."[39]

System software is being modernized towards integrating multiple UAS across an entire "combat cloud." Advancing UAS interoperability provides a variety of battlefield advantages including improved situational awareness, transfer of surveillance data, coordination and self-organization for offensive capabilities, and navigation in respect to other aircraft.[40] UAS swarms — groups of UAS that communicate and perform coordinated tasks — can be used in a variety of missions, including providing more precise ISR. The Air Force estimates that the development of multi-aircraft control would decrease the number of total pilots needed by 56 percent.[42] It should be noted, however, that development in this area is still in its infancy, and problems persist including overloading the command and control link and lost data connections.[43]

The U.S. military is also looking towards interoperability between UAS and manned aircraft through Manned-Unmanned System Teaming (MUM-T). According to DoD "MUM-T will be essential as DoD makes a shift in geographical priorities toward the Asia-Pacific region while retaining emphasis on the Middle East."[44] There are a variety of advantages of MUM-T, including protecting manned aircraft by overwhelming enemy air defenses, or as some describe it, putting the hunting dog in front of the hunter.[45] Already Lockheed Martin developed a data-link between an AH-64D Apache Block III helicopter and a MQ-1C Gray Eagle, which allowed the pilot of the Apache to control the payload and flight-path of the UAS. In theory, this would improve U.S. capabilities in contested airspace, using the Gray Eagle to target anti-aircraft ground forces.[46]

An emerging, but controversial development is the increase in autonomous capabilities. Autonomy will be a major enabler in A2/AD zones, where remote piloting and the real-time link may be compromised.[47] Autonomy grants UAS the ability to generate a new plan of action if it loses connection with ground control, or the communication link is compromised over A2/AD areas.

Autonomy could also have some cost-saving effects. Autonomy combined with multi-aircraft control would help reduce the needed amount of manpower. The Air Force concluded that if 50 percent of CAPs were automated and the other 50 percent were part of the multi-aircraft control, manpower savings could be increased by 64 percent.[48] Importantly, automation allows the UAS to perform some tasks more accurately than if a human were to perform those same tasks with a UAS. For example, in July 2013 the Navy's X-47B successfully landed itself on an aircraft carrier. Notably, the UAS was able to sense when an error would occur, and could abort the mission. Autonomous capabilities such as this will be used with increasing frequency, including in the domains of on-board processing, exploitation and dissemination of sensor data, landing and takeoff, and sense and avoid, as well as in post-strike investigations.[49]

One question posited by many is whether DoD will continue to develop and improve UAS autonomous decision-making to the point when UAS can determine when to fire decisions without any human in the loop for approval. While many believe this capability is a long way off, the United States currently fields technology that can automatically engage with incoming missiles. The U.S. Navy MK-15 Phalanx is a radar-guided gun system, mounted on combatant ships that "automatically carries out functions usually performed by multiple systems — including search, detection, threat evaluation, tracking, engagement, and kill assessment."[50] Additionally, Israeli and China already employ a UAS called the Harpy that can automatically hunt anti-aircraft systems, concealed missile launchers, or incoming UAS.[51]

DoD released Directive 3000.09 that asserts that only "human-supervised autonomous weapon systems may be used to select and engage targets, with the exception of selecting humans as targets, for local defense …."[52] While it appears that as of now, no UAS will be able to independently launch any kind of weapon without human approval, the directive does contain a clause that allows for this possibility in the future. This caveat states that the development of a weapon system that independently decides to launch a weapon is possible but first must be approved by the Under Secretary of Defense for Policy (USD(P)), the Under Secretary of Defense for Acquisition, Technology, and Logistics, and the Chairman of the Joint Chiefs of Staff.

Given the futuristic and uncertain nature of the development of autonomous weapons, which are applicable to all robots, not just UAS, recommendations regarding this issue may be obsolete within a few years. [IV] But considering 3000.09 and the USD(P) clause, it is important to ensure that the United States develops rules and regulations for emerging technology to ensure that it complies with the rules of engagement and human rights law. Furthermore, the danger with autonomy is not just the ability for robots to make decisions to strike, but that autonomy potentially increases the tempo of conflict and allows for almost immediate decision making that could result in increased error. Developments in cyber technology and autonomy will only decrease the decision-making time for pilots to strike — thereby increasing the likelihood for error due to policy pressure to strike when a target is on the screen.

LOSING THE ADVANTAGE?

The use of UAS in the past decade provides a roadmap for the potential development of UAS in the future. Commanders accustomed to the shortened kill chain will seek better ways to influence the earlier phases of joint operations. [V] Shaping, deterrence and operations to seize the initiative rely heavily on air and sea power. UAS are and will continue to be developed to meet those needs, including increasing UAS stealth capabilities to operate in contested airspace. The combination of cyberwarfare with the qualities of UAS persistence and operational reach offers immense potential and is being explored in classified arenas as a further indicator of where UAS technology may be going.

Given time and the advancements in UAS technology illustrated above, changes in tactics will drive changes in technology, creating a feedback loop of tactics and technology. UAS are a rapidly evolving and disruptive technology, with their full potential and military utility not yet realized. Just as in the example of the atomic bomb, the United States will not be able to maintain its edge in UAS technology or its dominant operational exploitation of UAS for very long. Moreover, as UAS technology proliferates, the United States will lose its localized monopoly on uncontested airspace. Development of technology to counter UAS will also deny much of their permissive use. The commercial development of UAS will only accelerate this trend.

[IV] In February 2014, the Chatham House, a recognized world leader in defense policy analysis, held a conference on "Autonomous Military Technologies: Policy and Governance for Next Generation Defence Systems." The International Committee of the Red Cross held a similar conference in March 2014, and various human rights organizations and weighed in, opposing such systems (e.g., the November 2012 Human Rights Watch report, "Losing Humanity: The Case Against Killer Robots" http://www.hrw.org/reports/2012/11/19/losing-humanity-0)

[V] The phases of joint operations, according to Joint Publication 5-0: *Joint Operation Planning*, are Shape (0), Deter (I), Seize Initiative (II), Dominate (III), Stabilize (IV), and Enable Civil Authority (V). http://www.dtic.mil/doctrine/new_pubs/jp5_0.pdf.

Box 3: Overhead Imagery

For decades, the United States enjoyed a monopoly on high fidelity overhead imagery gathered by aircraft and satellites. Its allies came to the United States for their imagery needs and the United States controlled what would and would not be shared to include the quality and timing of release. The increasing need for commercial imagery coupled with broader access to space contributed to an upward spiral of technological development that today produces high-resolution (e.g., Skybox, Inc.), timely images that were previously only available in military and intelligence channels. Not only has the United States lost much of the intelligence advantage and diplomatic leverage that it once enjoyed over other nations, but now even non-state actors have access to almost the same imagery at very low cost.

In the case of commercial overhead imagery, the United States wanted it both ways: it tried to save money through commercialization of space while simultaneously restricting what U.S. companies could export in order to preserve its monopoly on high-resolution imagery. Foreign competitors arose to fill the overseas demand and, armed with increased capital, they have since steadily improved their capability. A similar situation in the field of UAS is about to develop. The floor of any large military trade show demonstrates that capable UAS systems are being developed all over the world.

Israel, in particular, has long been an innovator in UAS technology and is a close rival of the United States as a manufacturer. The country is the global leader in UAS exports, and accounted for 41 percent of all UAS exports from 2001 — 2011, delivered to 24 different countries.[53] Israel Aerospace Industries (IAI) fielded its first UAS in 1978, developed the first tactical UAS purchased by the U.S. military, and has 49 users of its UAS worldwide. It also manufactures the only UAS other than the American-made MQ-9 Reaper that is subject to special export controls under Category 1 of the Missile Technology Control Regime. Another Israeli firm, Elbit Systems, produces the Hermes 450 UAS that is in service with 10 nations.[54]

Europe is catching up in the development of UAS as well. In November 2013, France, Germany, Greece, Italy, the Netherlands, Poland, and Spain formed a "drone club" aimed at developing a "European generation" of UAS within 10 years. The European Defense Agency will be responsible for producing the initial list of military requirements for this effort.[55]

Because both Israel and Europe are U.S. allies, the adverse consequences of these countries surpassing the United States in UAS technology would largely be commercial and economic. Advanced military UAS from Israel or Europe would pose no threat to the United States and could likely be purchased by the U.S. military if necessary.

The same cannot be said of other countries advancing their UAS industries. China has been pursuing advanced military unmanned aircraft, allegedly even using hacking attacks against defense contractors to steal American UAS technology. It has reportedly even tested a stealth combat UAS.[56] Iran has also claimed to have developed increasingly sophisticated UAS, although the validity of these claims remains unclear. In November 2013, Iran announced its development of an unmanned aircraft with a range of 1,200 miles and the ability to remain airborne for 30 hours.[57]

CIVILIAN APPLICATIONS OF UAS

Although UAS are best known for their military uses, the technology is not inherently military. What separates today's true unmanned systems from yesterday's hobby airplanes is the advances in software and interconnectivity that allow them to fly out of sight of the pilot, and even out of line of sight signals — that is, they fly via satellite communications. In addition, flight control advances have replaced the need for a human to actually fly the aircraft. Instead, the human operator supervises the aircraft that is able to take off and land, and performs the bulk of navigation with no human intervention. These attributes offer advantages to UAS for civilian use, just as they do for military use.

Because of these attributes, unmanned systems large and small are already finding civilian applications, and could be applied even more broadly in the near future. Such uses may range from disaster relief such as assisting in combatting wildfires as recently seen in California, to providing for precision agriculture, helping law enforcement agencies, and even allowing for expedited package delivery — as has been discussed by Amazon as an alternative shipping method. In fact, a study by a UAS trade association concluded that the total economic impact of allowing widespread commercial use of UAS in American airspace would be about $82 billion between 2015 and 2025.[58] Other studies have projected that the global UAS market could grow to over $8 billion annually by 2018 and nearly $11.5 billion annually by 2024.[59] Even if these estimates prove overly optimistic, it still seems likely that UAS will constitute a large and growing industry with increasing commercial applications in coming years.

The most promising near-term commercial UAS application may be the agricultural sector, where UAS can be used to increase productivity by monitoring crop and soil conditions and applying agricultural chemicals with greater precision and safety than is possible with manned aircraft. In fact, the UAS trade association's estimated $82 billion economic impact from civilian UAS use consisted largely of an estimated $75 billion impact in the agricultural sector, dwarfing an estimated $3 billion in economic impact from public safety applications of UAS. Notably, this analysis was not purely speculative, as it was able to draw on significant Japanese experience with the agricultural use of UAS.[60]

In Japan, where airspace regulations on UAS are less restrictive than in the United States, farmers have been using unmanned helicopters for over 20 years, applying pesticides to over 30 percent of Japanese rice fields in 2010 and accounting for over 90 percent of all Japanese crop dusters.[61] American universities have been evaluating the application of Japanese agricultural UAS use to American agricultural methods.[62]

Nature conservation is another area that could benefit significantly from the use of UAS, as the relatively low cost and long endurance of some UAS platforms make them excellent tools for monitoring endangered wildlife, tracking poachers, locating illegal mining or logging activities, or finding lost or injured tourists. In fact, UAS have already been deployed in a number of nature preserves to track poachers or even herd animals away from hunters.[63] In the United States, the National Oceanic and Atmospheric Administration has tested using UAS to monitor maritime wildlife and marine debris.[64]

The possible applications of UAS are as diverse as UAS platforms, ranging from tasks like weather monitoring and forecasting that benefit from larger UAS longer loiter times to potential applications like food and medicine delivery where the platforms' small size and low cost are valuable. Other fields of growing or potential application include law enforcement, firefighting, environmental monitoring, cargo delivery, and perhaps even medical evacuation.

These current and future uses mean there is a market for commercial research and development that could advance UAS technology faster than efforts constrained to the military. Expanded civilian and commercial use of UAS, however, will only be possible if the U.S. government successfully integrates them into American airspace.

Box 4: Integration of UAS in American Airspace

In the United States, Federal Aviation Administration (FAA) regulations generally do not allow UAS to operate in the "national airspace system (NAS)." In cases where UAS are flown, the operators must have special permits that are often quite restrictive. In the UC-Davis agriculture study mentioned above, for example, it took five months for the university to acquire a permit that allows it to operate unmanned aircraft — which was a dramatic improvement over the years of waiting many universities have faced. Even then, the permit restricts flights to 20 feet above the ground within a given agricultural area and requires 48-hour advance notice to the FAA before any flight occurs.[65]

Congress moved to allow UAS to operate in domestic airspace with its passage of the FAA Modernization and Reform Act of 2012, which set a deadline of September 30, 2015 to integrate UAS into the national airspace system.[66] The FAA's response to this legislation has been somewhat slow. The Act required the FAA to produce a roadmap for the integration of UAS within a year of its enactment, effectively setting a deadline of February 14, 2013.[67] The roadmap, however, was not released until November 7, 2013, missing the deadline by nearly nine months.

While updating U.S. regulations slowly continues, other nations have already begun tests to address one of the most significant hurdles to integrating UAS in civilian airspace: determining how UAS pilots will avoid in-air collisions without the lines of sight and situational awareness available to a pilot in the cockpit, including testing "sense-and-avoid" capabilities. Notably, the European Defense Agency and European Space Agency sponsored an April 2013 test of just such "sense-and-avoid" capabilities, using an Israeli-made UAS and a Spanish military aircraft, and supported by a consortium of Spanish, German, Dutch, Italian, and French companies. In addition, an Israeli UAS manufacturer, Elbit Systems, has received dozens of permits from the Israeli government to test and operate unmanned aircraft in Israeli airspace.[69]

Should the FAA's months-long delays turn into years-long delays, the United States risks losing the edge and advantage in the development of commercial UAS technology. The "first-mover" to fully integrate UAS into national airspace may, if given enough of a lead, become a center for the development and sale of UAS, giving a competitive edge to its domestic manufacturers that are not restricted by tariffs or export controls. Should other countries obtain this role, the United States would then be in a position of playing catch-up in terms of establishing its market for commercial UAS, restoring American manufacturers' edge in the global market, and ensuring U.S. military UAS remain technologically more advanced than other nations.

THE FUTURE OF U.S. UAS DEVELOPMENT

Although the United States has a significant head start in the development of UAS technology, the concerted efforts of other countries to advance their own UAS industries mean that the United States cannot become complacent and must adopt policies, such as the integration of UAS into national airspace that will encourage the further development of UAS. The United States must harness the power of commercial development to maintain its technological edge in UAS. Basic UAS attributes such as airframes and current navigation systems are not that technologically sophisticated. This means that, unlike advanced military systems such as jet fighters or encrypted communications, there are low barriers to entry that allow many players — especially other nation-states — to advance UAS technology. Most importantly, in the future, the biggest advances in UAS technology are likely to come from software improvements, an area of development where U.S. military-funded efforts have the least advantage.

Commercial use of UAS will spur private research and development that can advance the technology faster than a military-only research and development process. Commercial development in the United States, however, will only flourish if and when regulations allow for widespread use of UAS, as current FAA regulations do not. If the United States is slow to integrate UAS into American civilian airspace, other countries may move more quickly to permit widespread commercial use of UAS, and might surpass the United States in UAS technology, even for military use. Indeed, other countries like Japan, the United Kingdom, and South Africa already have commercial UAS markets.

Despite this emerging commercial market, there will continue to be development of aspects of UAS that will likely remain exclusive to governments with advanced research and development programs, including the continued weaponization of these platforms for both lethal and non-lethal payloads. In addition, hardening of such platforms and imbuing them with the ability to operate in contested environments are still relatively nascent areas for UAS development.

There is a clear need for increased UAS research in the United States, both commercially and militarily. This is especially true given that China's overall commitment to R&D funding has dramatically increased, and is expected to surpass that of the U.S. by about 2022.[70]

CONCLUSION

Although the United States has a significant head start in the development of UAS technology, the concerted efforts of other countries to advance their own UAS industries mean that the United States cannot become complacent and must adopt policies, such as the integration of UAS into national airspace that will encourage the further development of UAS. The United States must harness the power of commercial development to maintain its technological edge in UAS. Basic UAS attributes such as airframes and current navigation systems are not that technologically sophisticated. This means that, unlike advanced military systems such as jet fighters or encrypted communications, there are low barriers to entry that allow many players — especially other nation-states — to advance UAS technology. Most importantly, in the future, the biggest advances in UAS technology are likely to come from software improvements, an area of development where U.S. military-funded efforts have the least advantage.

APPENDIX 1: TARGETING PROCESS FOR UNITED STATES AIR FORCE

PHASE	FUNCTIONS	PROCESS	PRIMARY ACTOR(S) RESPONSIBLE	PRODUCT
Target Development	Target Analysis	1. Consider desired effects of strike, identify specific targets using target system analysis with inputs from other agencies and divisions (including the ISR division) 2. Ensure that all nominated targets meet combined force commander's intent	Combined Air and Space Operations Center	Proposed target nomination list and No-strike or restricted target lists
	Target Vetting	3. Work with national intelligence community to verify intelligence information and analysis to ensure fidelity and continued accuracy of strike 4. Review compliance with laws of armed conflict and rules of engagement	Combined Air and Space Operations Center (CAOC) and national intelligence agencies	
	Target Validation	5. Ensure that all vetted targets achieve objectives of commander's direction, and ensure that the proposed action does not interfere with objectives of other agencies 6. Coordinate and integrate actions with other operations. Joint force special operations commander will deconflict special force with combined force commander and other commanders. CAOC will ensure targeting is coordinated with land component operations	Combat Plans Division Targeting Effects Team (TET) Combat Operations Division	Air Tasking Order (ATO)

	Target Nomination	7. Nominate targets through proper channels of approval 8. Compile all component and agency target nominations for a given ATO, and create a target nomination list (TNL) 9. Vet the TNL through joint force components and other agencies 10. Hold target coordination meeting, where component representatives justify their target selection. If there are differences in opinion, there should be coordination with higher levels 11. Determine collection and exploitation requirements, and ensure that target development, pre-strike, and post-strike requirements are include in the collection plan	Service Components TET TET TET and component representatives	Joint Integrated Prioritized List Joint Integrated Prioritized Collection List
Weaponeering and Allocation	Weaponeering	12. Consider what weapons should be used based on the desired outcome of the strike 13. Final weaponeering chose by master air attack plan (MAAP) team	Intelligence, Surveillance and Reconnaissance Division (ISRD) Combat Plans Division MAAP Team	
	Force Allocation	14. Decide total number of sorties or missions (by weapon type) available for each task	Combat Plans Division MAAP Team	Master Air Attack Plan (MAAP)
ATO Production and Dissemination		15. Finalize ATO based on commanders' guidance, MAAP and the services' requirements and disseminate to combat units		ATO

Execution Planning and Force	Execution Planning	16. Prepare necessary combat units to accomplish ATO (usually 12 hours before) 17. Revise the tasking of air forces as necessary 18. Retarget air assets to respond to emerging targets or changing priorities 19. Execution of ATO, including mission monitoring 20. Employ Blue Force Tracking to ensure no fratricide	CAOC Combined Force Air and Space Component Commander and Command and Control (when delegated) Combat Operations Division (COD) COD	
Assessment	Tactical Assessment	21. Carry out physical damage assessment (PDA) to estimate total physical damage, including using inflight reports and weapon system video data 22. Based on PDA, carry out functional assessment (FA) to assess the capability of the targeted object 23. Carry out munitions effectiveness assessment (MEA) to assess whether weapon functioned as intended, including whether it delivered the highest potential payoff. 24. Conduct estimated damage analysis (EDA) to estimate the weapons effectiveness to determine whether other collection assets are required to determine the level of physical and functional damage 25. Provide commander with logistics status (expenditure of munitions, fuel, etc.)	ISRD, with inputs from units and CODs Joint Intelligence operations center Units ISRD and Combat Plans Division	

	Operational Assessment	26. Carry out a target system assessment to estimate the effectiveness of force employment against the selected target by combining all FA products. Assessment should be based on desired effects of operation. 27. Conduct a risk assessment to consider the effects of strikes, including collateral damage and lost opportunities for pursuing target 28. Evaluate progress toward objectives (effects-based and qualitative evaluation based in empirical data) 29. Recommend future action- including whether to modify or change strategy	Strategy Division Operational Assessment Team Strategy Division Operational Assessment Team Strategy Division Operational Assessment Team and Commander	
	Campaign Assessment	30. Using Operational Assessment data, consider how all services' strikes and actions contribute to accomplishment of campaign objectives, and whether campaign strategy needs to be modified (similar process to Operational Assessment, but at a higher level)	Combined Force Commander (J-2)- with input from CAOC (Strategy Division and ISR Division)	

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NOTES

1. U.S. Department of Defense (DoD). Under Secretary of Defense for Acquisition, Technology and Logistics. *Annual Industrial Capabilities Report to Congress*. October 2013. Accessed February 23, 2014. http://www.acq.osd.mil/mibp/docs/annual_ind_cap_rpt_to_congress-2013.pdf. 14.

2. Ibid.

3. U.S. DoD. Unmanned Systems Integrated Roadmap: FY2013-2038. December 2013. Accessed January 6, 2014. http://www.defense.gov/pubs/DOD-USRM-2013.pdf.

4. Brannen, Samuel. *Sustaining the US Lead in Unmanned Systems*. Washington, DC: Center for Strategic and International Studies, February 2014. 8. Accessed March 4, 2014. http://csis.org/files/publication/140227_Brannen_UnmannedSystems_Web.pdf.

5. Naval Air Systems Command. "Persistent Maritime UAS: BAMS-D." Accessed February 24, 2014. http://www.navair.navy.mil/index.cfm?fuseaction=home.displayPlatform&key=624BC6D7-45CE-446C-BA1E-5818E57F9914.

6. Naval-technology.com. "MQ-4C Triton Broad Area Maritime Surveillance (BAMS) UAS, United States of America." Accessed February 28, 2014. http://www.naval-technology.com/projects/mq-4c-triton-bams-uas-us/.

7. U.S. DoD. Office of the Under Secretary of Defense (Comptroller) / Chief Financial Officer. *Fiscal Year 2016 Budget Request: Program Acquisition Cost by Weapon System*. February 2015. Accessed March 5, 2015. http://comptroller.defense.gov/Portals/45/Documents/defbudget/fy2016/FY2016_Weapons.pdf.

8. U.S. Air Force. USAF Headquarters. RPA Vector: Vision and Enabling Concepts 2013-2038. February 2014. Accessed March 17, 2014. http://www.af.mil/Portals/1/documents/news/USAFRPAVectorVisionandEnablingConcepts2013-2038.pdf.

9. U.S. DoD. Office of the Under Secretary of Defense (Comptroller) / Chief Financial Officer. Fiscal Year 2014 Budget Request: Program Acquisition Cost by Weapon System. February 2013. Accessed March 5, 2015. http://comptroller.defense.gov/Portals/45/Documents/defbudget/fy2014/FY2014_Weapons.pdf; U.S. DoD. Office of the Under Secretary of Defense (Comptroller) / Chief Financial Officer. Fiscal Year 2015 Budget Request: Program Acquisition Cost by Weapon System. March 2014. Accessed March 5, 2015. http://comptroller.defense.gov/Portals/45/Documents/defbudget/fy2015/fy2015_Weapons.pdf; U.S. DoD. Office of the Under Secretary of Defense (Comptroller) / Chief Financial Officer. Fiscal Year 2016 Budget Request: Program Acquisition Cost by Weapon System. February 2015. Accessed March 5, 2015. http://comptroller.defense.gov/Portals/45/Documents/defbudget/fy2016/FY2016_Weapons.pdf.

10. Lockheed Martin. "Hellfire II." Accessed December 18, 2013. http://www.lockheedmartin.co.uk/uk/what-we-do/products/HELLFIREII.html.

11. Defense Advanced Research Projects Activity (DARPA). Tactical Technology Office. "Persistent Close Air Support (PCAS)." Accessed December 18, 2013. http://www.darpa.mil/Our_Work/TTO/Programs/Persistent_Close_Air_Support_(PCAS).aspx.

12. Data provided by Air Force comptroller's office to Winslow Wheeler of the Project On Government Oversight. See Thompson, Mark. "Costly Flight Hours." Time Magazine, April 2, 2013. Accessed December 18, 2013. http://nation.time.com/2013/04/02/costly-flight-hours/.

13. See, e.g., Unger, Eric J. *An Examination of the Relationship Between Usage and Operating-and-Support Costs of U.S. Air Force Aircraft*. Santa Monica, CA: RAND, 2009. Accessed January 6, 2014. http://www.rand.org/content/dam/rand/pubs/technical_reports/2009/RAND_TR594.pdf. 12

14. U.S. Air Force Scientific Advisory Board. *Operating Next Generation Remotely Piloted Aircraft for Irregular Warfare*. April 2011. Accessed December 19, 2013. http://publicintelligence.net/usaf-drones-in-irregular-warfare/.

15. Thompson, "Costly Flight Hours."

16. Vanden Brook, Tom. "Newest manned spy plane scores points in war effort." USA Today, 2 June 2010. Accessed January 7, 2014. http://usatoday30.usatoday.com/news/military/2010-06-01-Liberty_N.htm.

17. Kreps, Sarah. "Ground the Drones? The Real Problem with Unmanned Aerial Vehicles." Foreign Affairs, December 4, 2013. Accessed December 16, 2013. http://www.foreignaffairs.com/articles/140318/sarah-kreps/ground-the-drones.

18. Posen, Barry. "The Case for Restraint." The American Interest, 3, no. 1 (November-December 2007); Pape, Robert.*Bombing to Win: Air Power and Coercion in War*. Ithaca, NY: Cornell University Press, 1995; Alexander, David. "Retired general cautions against overuse of 'hated' drones." Reuters, January 7, 2013. Accessed December 17, 2014. http://www.reuters.com/article/2013/01/07/us-usa-afghanistan-mcchrystal-idUSBRE90608O20130107.

19. Munoz, Carlo. "White House move to let Pentagon take over CIA armed drones sparks concern." The Hill, March 24, 2013. Accessed December 17, 2014. http://thehill.com/blogs/defcon-hill/policy-and-strategy/290049-white-house-plan-to-let-pentagon-take-over-cia-armed-drones-sparks-concern.

20. Blair, Dennis (Adm., USN). Interview by Rachel Martin. *National Public Radio*. May 26, 2013. Accessed January 17, 2014. http://www.npr.org/templates/story/story.php?storyId=186662741

21. U.S. Air Force. Legal Support to Operations. *Air Force Doctrine Document* 1-04. March 2012. Accessed January 17, 2014. http://www.fas.org/irp/doddir/usaf/afdd1-04.pdf. 21-28.

22. Priest, Dana. "CIA Killed U.S. Citizen in Yemen Missile Strike: Action's Legality, Effectiveness Questioned." The Washington Post, November 8, 2002.

23. Vanden Heuvel, Katrina. "Obama's 'kill list' is unchecked presidential power." The Washington Post. June 12, 2012. Accessed November 19, 2013. http://www.washingtonpost.com/opinions/obamas-kill-list-is-unchecked-presidential-power/2012/06/11/gJQAHw05WV_story.html.

24. U.S. Congress. Senate. *Statement by Harold Hongju Koh, Sterling Professor of International Law, The Yale Law School. Hearing before the Senate Foreighn Relations Committee Regarding AUMF for Iraq and Afghanistan*. 113th Cong,, 2d sess., May 21, 2014. Accessed February 12, 2014. http://www.foreign.senate.gov/imo/media/doc/Koh_Testimony.pdf.

25. Western, Jon. Selling Intervention and War: The Presidency, the Media, and the American Public. Baltimore: Johns Hopkins University Press, 2005. 15-20.

26. See e.g., Waltz, Kenneth. Foreign Policy and Democratic Politics: The American and British Experience. Boston: Little Brown and Company, 1967. 297-311.

27. On this problem, see Webb, Jim. "Congressional Abdication." *The National Interest*, no. 124 (March/April 2013): 8-15.

28. Kershner, Isabel and Patrick Lyons. "Hamas Publishes Photo of a Drone It Says It Built." Then New York Times, July 14, 2014. Accessed August 11, 2014. http://www.nytimes.com/2014/07/15/world/middleeast/hamas-publishes-photo-of-a-drone-it-says-it-built.html?_r=0.

29. University of Texas Austin. "Todd Humphrey's Research Team Demonstrates First Successful GPS Spoofing of UAV." Cockrell School of Engineering. Department of Aerospace Engineering and Engineering Mechanics. Accessed November 21, 2013. http://www.ae.utexas.edu/news/features/todd-humphreys-research-team-demonstrates-first-successful-gps-spoofing-of-uav.

30. Nehme, C., J.W. Crandall, and M.L. Cummings. "An Operator Function Taxonomy for Unmanned Aerial Vehicle Missions." Presentation at the 12th International Command and Control Research and Technology Symposium, Newport, Rhode Island, June 2007.

31. *Gorgon Stare: Persistent Wide-Area Airborne Surveillance [WASS]*. Sparks, NV: Sierra Nevada Corporation 2014. Accessed December 11, 2013. http://www.sncorp.com/pdfs/isr/gorgon_stare.pdf.

32. Johns Hopkins Applied Physics Laboratory. "APL Quick Response Created New Tool to Assess Nuclear Power Plant Crisis." Last updated February 20, 2012. Accessed January 29, 2014. http://www.jhuapl.edu/newscenter/stories/st120220.asp.

33. Danigelis, Alyssa. "Predator Drone Joins Yosemite Wildfire Fight." Discover News, August 29, 2013. Accessed January 29, 2014. http://news.discovery.com/earth/weather-extreme-events/predator-drone-joins-yosemite-wildfire-fight-130829.htm.

34. Atherton, Kelsey. "Are Autonomous Helicopters The Next 18-Wheelers?" The Popular Science Blog, May 14, 2013. Accessed January 30. http://www.popsci.com/technology/article/2013-05/kmax-and-drones-tomorrow

35. U.S. Navy, Office of Naval Research, Science and Technology Division. "Autonomous Aerial Cargo/Utility System Program." AACUS. Accessed January 29. http://www.onr.navy.mil/en/Science-Technology/Departments/Code-35/All-Programs/aerospace-research-351/Autonomous-Aerial-Cargo-Utility-AACUS.aspx

36. Butler, Amy. "MDA Eyes UAVs For Discrimination, Boost-Phase Kill." Aviation Week, August 16, 2013. Accessed February 3, 2014. http://www.aviationweek.com/Article.aspx?id=/article-xml/asd_08_16_2013_p01-01-607382.xml.

37. See, e.g. Weigly, Russell F. *The American Way of War: A History of the United States Military Strategy and Policy*. Bloomington, IN: Indiana University, 1973.

38. The U.S. Air Force's uniquely strong link to a technology makes it, or at least it's platforms, especially prone to this problem. See Cohen, Eliot. "The Mystique of U.S. Airpower," *Foreign Affairs* 73, No. 1 (January/February 1994):109-123. Covert actions have some similar attributes.

39. U.S. Air Force. *Air Force Unmanned Aerial System (UAS) Flight Plan 2009-2047*. By Lieutenant General Dave Deptula. Accessed January 13, 2014. http://www.defense.gov/dodcmsshare/briefingslide/339/090723-D-6570C-001.pdf.

40. U.S. Library of Congress. Congressional Research Service. *U.S. Unmanned Aerial Systems*. By Gertler, Jeremiah. January 3, 2012. Accessed December 5, 2013. https://www.fas.org/sgp/crs/natsec/R42136.pdf.

41. Werner, Debra. "Drone Swarm: Networks of Small UAVs Offer Big Capabilities." Defense News, June 12, 2013. Accessed November 19, 2013. http://www.defensenews.com/article/20130612/C4ISR/306120029/Drone-Swarm-Networks-Small-UAVs-Offer-Big-Capabilities.

42. U.S. Air Force. *Air Force Unmanned Aerial System (UAS) Flight Plan*,11.

43. Werner, Debra. "Drone Swarm."

44. U.S. DoD. Unmanned Systems Integrated Roadmap: FY2013-2038. December 2013. Accessed January 6, 2014. http://www.defense.gov/pubs/DOD-USRM-2013.pdf.

45. See, e.g., Brannen, *Sustaining the US Lead in Unmanned Systems*, 10; Shelton, Marty. "Manned Unmanned Systems Integration: Mission accomplished." Army.mil. October 24, 2011. Accessed October 1, 2014. http://www.army.mil/article/67838.

46. Lockheed Martin. "LONGBOW LLC's Data Link Controls UAS from Apache Block III Attack Helicopter for the First Time." Last updated November 9, 2011. Accessed November 11, 2014. http://www.lockheedmartin.com/us/news/press-releases/2011/november/LONGBOWLLCsDataLinkContro.html.

47. Brannen, *Sustaining the US Lead in Unmanned Systems*, 5.

48. U.S. Air Force, *Unmanned Aerial System (UAS) Flight Plan 2009-2047*, 11.

49. Brannen, *Sustaining the US Lead in Unmanned Systems*, 6.

50. Raytheon Corporation. "Phalanx Close-In Weapon System (CIWS)." Accessed February 17, 2014. http://www.raytheon.com/capabilities/products/phalanx/.

51. "Israel Unveils Loitering Anti-Missile Drone." Defense Update. Accessed February 17, 2014. http://defense-update.com/products/h/harop.html.

52. U.S. DoD. *Department of Defense Directive 3000.09: Autonomy in Weapon Systems*. November 2012. Accessed November 14, 2013. http://www.dtic.mil/whs/directives/corres/pdf/300009p.pdf

53. Stockholm International Peace Research Institute (SIPRI). "Arms Transfers Trade Registers." Accessed December 20, 2013. http://portal.sipri.org/publications/pages/transfer/trade-register.

54. Opall-Rome, Barbara. "International ISR: Israel Tackles The Last Frontier of UAV Technology." *Defense News*, June 3, 2013. Accessed December 13, 2013. http://www.defensenews.com/article/20130603/C4ISR01/306030015.

55. Watson, Leon. "Europe forms a 'drone club' to develop unmanned aircraft to rival the U.S. and Israel's military technology." Daily Mail, November, 19 2013. Accessed December 12, 2013. http://www.daily-mail.co.uk/sciencetech/article-2510180/Europe-forms-drone-club-develop-unmanned-aircraft-rival-US-Israels-military-technology.html?ico=sciencetech%5Emostread.

56. Wong, Edward. "Hacking U.S. Secrets, China Pushes for Drones." The New York Times, September 20, 2013. Accessed February 21, 2014. http://www.nytimes.com/2013/09/21/world/asia/hacking-us-secrets-china-pushes-for-drones.html.

57. "Iran unveils new 'biggest' drone." BBC News, November 18, 2013. Accessed March 13, 2014. http://www.bbc.co.uk/news/world-middle-east-24993269.

58. Jenkins, Darryl, and Bijan Vasigh. *The Economic Impact of Unmanned Aircraft Systems Integration in the United States*. Arlington, VA: Association for Unmanned Vehicle Systems International, March 2013. Accessed September 19, 2014. http://www.auvsi.org/econreport.

59. "Report: UAV Market Worth $8.35 Billion By 2018." AeroNews Network, June 27, 2013. Accessed January 8, 2014. http://www.aero-news.net/index.cfm?do=main.textpost&id=94e5cb06-679f-4078-9022-a90214ea2a3e; Teal Group Corporation. "Teal Group Predicts Worldwide UAV Market Will Total $91 Billion in Its 2014 UAV Market Profile and Forecast." Last modified July 17, 2014. Accessed August 5, 2014. http://www.tealgroup.com/index.php/about-teal-group-corporation/press-releases/118-2014-uav-press-release;

60. Jenkins and Vasigh, *Economic Impact of UAS*, 20.

61. Ackerman, Spencer. "Drone Boosters Say Farmers, Not Cops, Are the Biggest U.S. Robot Market." Wired, February 5, 2013. Accessed January 8, 2014. http://www.wired.com/dangerroom/2013/02/drone-farm/; Nobile, Casey. "The Drone Debates: New Rules for a New Frontier." Robotics Business Review. April 16, 2013. Accessed January 8, 2014. http://www.roboticsbusinessreview.com/article/the_drone_debates_new_rules_for_a_new_frontier/.

62. 21 American universities "focused on agriculture" had received certificates authorizing local use of UAS, as of February 2013. See Ackerman, "Drone Boosters Say Farmers, Not Cops, Are the Biggest U.S. Robot Market."; Szondy, David. "UC Davis investigates using helicopter drones for crop dusting." Gizmag, June 23, 2013. Accessed January 8, 2014. http://www.gizmag.com/uav-crop-dusting/27974/.

63. See,e.g., Spillane, Chris. "Using drones to thwart elephant poachers." Seattle Times, October 19 2013. Accessed January 10, 2014. http://seattletimes.com/html/nationworld/2022084649_elephantpoachersxml.html; Reinl, James "Anti-poaching drones to take off in Africa." Al Jazeera, January 20, 2013. Accessed January 10, 2014. http://www.aljazeera.com/indepth/features/2013/01/2013117135422298209.html.

64. Doughton, Sandi. "Northwest scientists using drones to spy on nature," Seattle Times, July 16, 2013. Accessed January 10, 2014. http://seattletimes.com/html/localnews/2021405556_dronessciencexml.html.

65. University of California, Davis. "Remote-controlled helicopter tested for use in vineyard applications." News and Information. Last modified June 5, 2013. Accessed January 10, 2014. http://news.ucdavis.edu/search/news_detail.lasso?id=10623.

66. FAA Modernization and Reform Act of 2012. Public Law 112-95. 112th Cong., 2d sess. February 14, 2012. Accessed December 18, 2014. http://www.gpo.gov/fdsys/pkg/PLAW-112publ95/pdf/PLAW-112publ95.pdf.

67. U.S. Department of Transportation. Federal Aviation Administration. "Unmanned Aircraft Systems." Accessed February 19, 2014. http://www.faa.gov/about/initiatives/uas/.

68. Opall-Rome, "International ISR."

69. Ibid.

70. *2014 Global R&D Funding Forecast.* Columbus, OH: The Battelle Memorial Institute, December 2013. Accessed January 14, 2014. http://www.battelle.org/docs/tpp/2014_global_rd_funding_forecast.pdf.

71. United States Air Force. *Air Force Doctrine Document 2-1.9.* June 2006. Accessed January 22,, 2014. http://www.fas.org/irp/doddir/usaf/afdd2-1.9.pdf.

MILITARY UTILITY, NATIONAL SECURITY, AND ECONOMICS

Working Group Report

The Stimson Task Force on U.S. Drones Policy issued its report and recommendations in June 2014. The task force was supported by three expert working groups focused on different aspects of U.S. drones policy: ethics and law; export controls and regulatory challenges; and military utility, national security, and economics. The three working groups met periodically and provided detailed background, invaluable insights, and context to task force members, including key data points, topics for consideration, and potential recommendations. Each working group has produced a background report with its own recommendations, conclusions, and issues for further research.

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