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Armed and Dangerous?

UAVs and U.S. Security

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Key Findings

- Understanding the characteristics and capabilities of armed UAVs will be critical to making future policy choices. The complexity and expense of long-range armed UAVs are quite different from short-range systems, which make them difficult to develop and even to operate. How UAVs will be employed is also important; UAVs that are expendable, like cruise missiles, are easier to use than those intended to be used again.
- Many countries are developing and acquiring UAVs. Short-range UAVs are going to spread, because they have attractive civilian uses. Only a few rich and technologically advanced countries will be in a position to develop the higher-technology and longer-range systems. Most of these are U.S. allies. Others, including U.S. adversaries, will likely find other weapons, such as aircraft, more militarily and cost-effective.
- Armed UAV systems are not truly transformative weapons, though they offer the United States some significant advantages today (and our more militarily proficient allies and adversaries in the future), particularly against enemies that lack air defenses. It is also plausible, though not necessarily likely, that a substate group might employ armed UAVs to create a significant psychological effect.
- Armed UAVs do not create the dangers and instabilities that have traditionally led to nonproliferation efforts, although the risks of proliferation cannot be dismissed entirely, as with any conventional weapon.
- The United States has an interest in how others use armed UAVs as they spread, and will need to address how its own use of these systems can be fit into a broader set of international norms to discourage their misuse by others.

Drones—or as they are also known, armed unmanned aerial vehicles (UAVs)—are in the headlines and provoking debates, especially for their use in U.S. targeted killings. They are spreading across the globe and others are beginning to use them. How dangerous is the proliferation of armed UAVs and what effect will they have on U.S. security?[1]

WHAT ARE THE CHARACTERISTICS AND CAPABILITIES OF UAVS?

A UAV has these characteristics:

- It is a powered, aerial vehicle that does not carry a human operator.
- It uses aerodynamic forces to provide vehicle lift.
- It can fly autonomously or be piloted remotely.
- It is designed to be recoverable.
- It can carry a lethal or nonlethal payload.
- It includes those components (necessary equipment, network, and personnel) to control the vehicle.

It is important to distinguish UAVs from cruise missiles designed for one-time use. The distinction can be subtle, since almost anything that flies could be fitted with some sort of explosive and crashed into a target; but generally speaking, it is more challenging to build a UAV that can deliver a munition and return to be reused.[2]

Technological Development of Modern UAVs

UAVs have been around as long as aircraft. Using radios to remotely pilot aircraft was an obvious idea that many countries investigated in the early 20th century, while radio-controlled model airplanes became a popular hobby in the

United States and elsewhere. In recent years, technological developments have spurred greatly expanded use of UAVs in military applications, and this is likely to spread to civilian applications. The key is technological development that provides certain capabilities at lower cost for the user—either in dollars or in payload weight, power, and cooling. There are four key technologies that have changed in recent years, making high-technology armed UAV systems like the MQ-1 Predator attractive.

This report is primarily concerned with armed UAVs, but it is important to note that most of the enabling technology crosses over; for example, armed Predators use the same technology that supports unarmed Predators. It is the aircraft that is new. The primary weapon of the armed Predator, the Hellfire missile, was designed in the 1970s.

Inexpensive, Precision Navigation

The development of inexpensive GPS receivers makes it possible for aircraft to gauge their position with considerable accuracy, eschewing the need for line-of-sight radio contact with a ground controller or expensive onboard navigation systems. This means ground controllers can now be well out of sight and unmanned aircraft can now fly long distances without concern about getting lost. This technology is available to practically anyone in the world, including powerful and weak states, substate groups, and hobbyists. There is little prospect that the proliferation of GPS use in this manner can be stopped.[3]

Inexpensive, Reliable Satellite Communication

Also widely available, this technology makes it possible to control UAVs and receive data from them over long distances. Users requiring only low-bandwidth communication (i.e., those who wish to know the UAV's location and how it is functioning) can meet that requirement with a simple satellite phone. Users requiring full-motion video of the target will require a higher-bandwidth link, which in turn requires relatively large antennas installed on the UAV. Such a link can likely be denied or intercepted by a technologically developed state.

Lightweight Surveillance Equipment

One great advantage of UAVs is their size. They can be very small, in part because they are not required to transport a human being. This results directly in relatively small costs. But this advantage is only significant if the weight of the mission equipment is on the order of, or less than, the weight of a person. Recent development of light yet powerful surveillance equipment thus makes UAVs more attractive. For example, the ScanEagle UAV, developed by the United States, employs the ImSAR NanoSAR A, a synthetic aperture radar that weighs only 2 pounds. The existence of such surveillance equipment means that small UAVs such as the ScanEagle, which has a maximum takeoff weight of 40 pounds, are extremely cost-effective.

Lightweight Target Designation Equipment and Precision-Guided Munitions

Prior to the development of modern precision-guided munitions ("smart bombs"), there were two ways for an aircraft to attack a military target on the ground. One was to deliver inaccurate weapons from high altitude, meaning above the roughly 15,000-foot limit for antiaircraft artillery. Since each weapon had a low probability of hitting anything, aircraft needed to carry large payloads. Alternatively, a bomber could dive-bomb, descending briefly to low altitude to deliver accurate bombs or strafing. This required highly maneuverable aircraft that would not be too vulnerable to inevitable antiaircraft gunnery and small-arms fire.

The development of precision-guided munitions and lightweight target-designation equipment changed the situation, making it possible for small aircraft, flying straight and level at medium altitude (i.e., above 15,000 feet), to deliver munitions accurately. UAVs can perform this mission well.

Types of Armed UAVs

Policymakers need to understand the differences among the four major types of armed UAVs (Table 1). In this typology, we do not include *very* high-technology stealth UAVs, such as the U.S. X-47B, which only a few countries can develop.

For this discussion, long-range UAVs have a one-way range of more than 300 km, consistent with the Missile Technology Control Regime (MTCR) threshold for Category I and Category II missiles and with the divide between internal combustion–powered vehicles, which have longer ranges, and battery-powered electric vehicles, which have shorter ranges.[4] In this analysis, as in the MTCR, we consider a system long-range if it can fly more than 300 km one way. Many systems capable of flying long distances, such as the Iranian Ababil or RQ-7 Shadow, are constrained in operation to locations within the line of sight of their ground stations, typically tens of miles.

Table 1: Types of Armed UAVs

Range	Technology	Examples
Long (>300 km range)	High (technology available only to major powers and their allies)	MQ-1 Predator, RQ-7 Shadow
	Low (widely available technology)	Ababil (Iran)
Short	High	RQ-11 Raven
	Low	Hobbyist model airplanes

This constraint is usually not a significant problem; in most civil and military cases, the people interested in the UAV's data are within 50 miles of its location. While Predators flying in support of U.S. troops in Afghanistan are controlled from Nevada, it would be possible to control them from Afghanistan, the way the United States operates the Shadow. Landing, which is one of the trickiest parts of Predator operation, is always locally controlled. Situations where it is desirable to operate a UAV from a distant base are unusual and require an expensive satellite link.

An important problem is that UAVs designed for short-range use (like the Ababil), which cannot receive commands or transmit data from long distances, can nevertheless be used on one-way missions as fully automated long-range cruise missiles. An aspect of all the reusable armed UAVs we consider is that they are generally easy to shoot down—so, while they can be attractive to states that enjoy clear air superiority, they are of limited utility for powers that cannot protect them during their employment.

Long-Range, High-Technology

This group of UAVs includes systems like the MQ-1 Predator and MQ-9 Reaper, which are classified as Category I systems in the MTCR. It also includes systems like the RQ-7 Shadow, which are technically similar to the Predator but classified as Category II in the MTCR.[5] The technology required to make armed UAVs of these two categories is not significantly different. They have proven themselves in combat numerous times. Although the technology for keeping the Predator, Reaper, and Shadow in the air is not particularly advanced, the mission equipment that allows them to have an impact on ground combat is more advanced and not widely available, including gyro-stabilized high-power telescopes, laser designators, synthetic aperture radars, and precision munitions. Some of these technologies are available in civilian versions: Hollywood action films often use gyro-stabilized cameras mounted on aircraft. But providing stability to a high-powered telescope requires system performance higher than commercial applications. It is also expensive.

UAVs like the Predator, Reaper, and Shadow are only useful for countries engaged in conflicts in which they have clear air superiority. The vehicles can easily be shot down even by older fighter aircraft technology. There are also stealthy UAVs, such as the X-47B, with technology far more sophisticated than that of the Reaper, but these systems can only be built by other high-end military powers.

Long-Range, Low-Technology

The classic example of this type of system is the Iranian Ababil. It uses basic radio remote control to allow unmanned flight and video recording. All of the key technology to build this class of armed UAV is widely available at hobby shops throughout the world. While these UAVs can include high-resolution cameras, they typically lack stabilization systems needed for high-accuracy steering and more advanced sensors. In addition, because such systems are easily shot down by U.S. and allied systems, and because the radio link is highly vulnerable to jamming or interception, it is not a significant threat to the United States or its allies when operating as a reusable armed UAV.

Short-Range, High-Technology

These armed UAVs have a range of less than 300 km, and the technology required to develop them is completely different from that of the long-range systems. Small, short-range systems, such as the hand-launched RQ-11 Raven, have recently been purchased in large quantity by the U.S. military.

Many companies in the United States and elsewhere have developed comparable small systems for assorted uses, such as law enforcement or commercial aerial photography. The low cost of these systems makes it likely that they will soon be widely used. Nevertheless, large-scale employment has been delayed by regulatory concerns, especially regarding flight safety resulting from poor situational awareness.[6] These UAVs usually cannot detect other aircraft in their immediate vicinity, making them particularly vulnerable to collisions with manned aircraft.

The technology in these systems is inherently dual-use. For example, very small UAVs use microelectromechanical systems [MEMS] as inertial navigation units [INUs]. This technology is widely used in commercial products, such as toy helicopters and Wii controllers. The availability of this technology means it is likely that states hostile to the United States will acquire it in the foreseeable future. They could use it for suppression of internal enemies, or to support ground combat units, the way the United States uses it today. This is not an insurmountable threat to U.S. operations, but the United States is not yet prepared to deal with it. Current U.S. doctrine for short-range air defense is primarily concerned with defeating attacking helicopters with missiles. The United States may have to develop new defensive systems as the threat from small UAVs emerges.

This discussion applies to small, short-range UAVs that are individually controlled. Small, loitering aircraft operating autonomously in enemy territory have also been proposed—the so-called "swarming use." Such systems might incorporate some of the same technology as small commercial UAVs. However, the requirements for target recognition and successful attack mean that any such systems could only be manufactured by a wealthy and technologically advanced military power. Previous RAND research suggests that small UAVs operating deep in enemy territory may be quite vulnerable to ground fires. Such systems are not included when we discuss short-range armed UAVs in this report because these are speculative concepts that even the United States has yet to turn into a practical system. Also, most of these concepts are not UAVs in the strict sense of a UAV being defined as an aircraft that can be reused. They are better described as loitering munitions.[7]

Short-Range, Low-Technology

Radio-controlled model airplanes have been widely available commercially for many decades. In principle, they could be used as weapons of terrorism, delivering a small payload to some sensitive site. Recent plots have included a 2011 planned attack on the Pentagon and a 2013 neo-Nazi plot in Germany. A successful attack has not yet been observed. Although cheap GPS does improve the ability of all UAVs to find targets, the inherent problem of recovering a UAV in the presence of stronger air defenses would make their use as reusable systems unattractive by powers lacking air superiority.

The Future

The technology behind Predator-class UAVs is relatively mature. Perhaps the biggest potential change would be a technological breakthrough making stealth cheap and easy, so countries like Iran could cheaply build aircraft with the radar signature of an F-22. This would have great implications for the future of airpower. But it is not an issue peculiar to UAVs, and there is no reason to believe such a breakthrough will happen any time soon.

The technology behind small and very small UAVs is evolving rapidly. The driver here is the dramatic improvement in the performance of small electronic devices. It is easy to think of many applications for something that could be described as an iPhone with wings. Improvements in electronics will not change the fundamental physics of delivering large quantities of munitions long distances. But they may make a large impact on short-range operations such as infantry combat and short-range intelligence, surveillance, and reconnaissance (ISR).

Comparison of Reusable and Expendable UAVs

Armed or unarmed, a reusable UAV could be employed for a one-way trip. Just as launching an aircraft and having it crash into a target is considerably easier than launching an aircraft and having it land safely, this is also the case with UAVs. When survivability is less of an issue, small systems can be launched in many ways, including from covert locations, creating a concern about their use. In fact, weak states and substate groups have employed these types of systems in this way in the past.[8]

Hezbollah has used them against Israel in several unsuccessful attacks, most recently on April 25, 2013.[9] As in previous incidents, the Israeli Defense Forces (IDF) detected the drone on radar and dispatched F-16 fighters to destroy it. The poor success rate of Hezbollah's UAVs contrasts with the effectiveness of primitive ballistic missiles fired from Gaza. It is important to recognize that Israel's success against expendable, low-technology UAVs is a result of the generally high state of alert that Israel maintains, including its aggressive rules of engagement. With the current, more-relaxed procedures with which the United States guards its airspace, it is possible that a terrorist group could launch an expendable armed UAV attack from within the United States or a neighboring country.

Technologies that make reusable UAVs such as Predators attractive are largely irrelevant to this application. An expendable UAV attacking a fixed objective does not need sophisticated target-finding technology or a long-range satellite link.

MQ-9 Reaper

Access to modern Predator technology also does not ease the building of expendable UAVs, in most cases.

A partial exception to the preceding generalization is GPS navigation, which does make it easier for an expendable UAV to hit a specific target—particularly for a surprise attack in which the defense is not able to take such precautions as jamming the GPS. However, if one is primarily concerned with the use of weapons of mass destruction (WMD) by terrorists, it is not clear that precise target location is all that important. Delivering chemical munitions to a random location within a large city may be sufficient to satisfy the terrorists' objectives.

All of the technology that is so important to the successful operation of long-range UAVs can be employed with manned aircraft. UAVs are nevertheless preferred for many missions for one overwhelming reason: They can be made smaller and therefore cost less. This advantage is only meaningful when the mission equipment is significantly lighter than the crew accommodation on a manned vehicle, as is the case with UAVs the size of the Predator and smaller vehicles. The upshot is that only limited interest is likely in UAVs much larger than the Reaper in the near future. If an aircraft is large, the advantages of having it unmanned are diminished, and in cases where they require a datalink to perform their mission, may even be less desirable if the security and protection of the link cannot be assured.

Impact of Air Defenses on Armed UAVs

Reusable armed UAVs such as the Predator are effective in a role often referred to as "hunter-killer," in which they fly and search for targets. When targets are found, they can engage them directly or pass cues to other systems that can then continue the surveillance or engage. Searching for targets can require flying for extended periods of time. Systems like the MQ-1 Predator and MQ-9 Reaper operate at medium-to-high altitudes to maximize survivability and minimize the chance of being detected.

In most of the inhabited world, systems coordinated by the International Civil Aviation Organization keep track of aircraft operating at other than very low altitude. The primary purpose of this system is to prevent collisions among civil aircraft, including both airliners and general aviation. If a Predator were loitering at, say, 15,000 feet in Colombian airspace, Colombian air traffic control would know about it—and if the Predator had not filed a proper flight plan, they would probably be quite concerned. The Colombian Air Force can easily shoot down a Predator-class UAV. A technologically advanced nation could also destroy or hijack a radio-controlled UAV with nonkinetic technologies such as jamming or spoofing.

Consider an extreme case: a Predator-class UAV operating over Somalia. Somalia has no air force and no air traffic control. When the Somali government collapsed in the early 1990s,

the United Nations passed responsibility for Somali airspace to the Civil Aviation Caretaker Authority for Somalia [CACAS], a UN organization based in Nairobi, Kenya. CACAS controls Somali airspace and would be aware of intrusions. If the United States objected to the UAV, interceptions could be conducted by Ethiopian aircraft or U.S. aircraft stationed in the Horn of Africa.

The situation for low-flying, expendable UAVs is different; they are difficult to observe with ground-based radar. As a result, airspace at low altitude is not strictly controlled except in the vicinity of airports, and it is possible for a low-flying UAV to penetrate the airspace of a nation without being detected. This threat can be mitigated by the use of airborne radar, but that solution is relatively expensive. Of course, the low-flying UAVs must still be flying high enough to avoid colliding with terrain, buildings, etc. As yet, nations such as Iran are unable to develop UAVs that can cruise high enough to avoid terrain yet low enough to avoid radar, especially against enemies on high alert, such as Israel or U.S. bases in the Middle East.

Again, it is important to note that the technologies that might enable UAVs to fly at low altitude and still evade terrain are largely different from the technologies that enable effective use of reusable Predator-class UAVs.

The assessment just discussed focuses on ways that nation states can defend themselves against UAV attack. What about insurgents? For example, it is possible that a nation such as Iran might supply armed UAVs to an ally such as Syria for use against insurgents supported by the United States. A key factor in such UAV use would be the altitude at which the UAVs could conduct attacks.

Insurgents almost always have some capability to defend against low-altitude aircraft. If an aircraft is low enough, it is vulnerable to small-arms fire. Many insurgents have employed conventional antiaircraft artillery—such as the ZU-23-2 and man-portable air-defense systems (MANPADS) like the SA-7, both of which are easy to obtain and effective up to several thousand feet. Such weapons could be quite effective against UAVs, depending on the visual, aural, and infrared signature of the UAV. However, insurgents usually do not have the ability to engage such a system at altitudes higher than about 10,000 feet. Such engagements generally require larger systems that are difficult for insurgents to conceal, especially when operating them, or more advanced MANPADS systems, which have been heretofore difficult for insurgents to obtain.

So the key to preventing UAV losses in engagements with insurgents is to conduct engagements from a safe altitude. This requires high-quality equipment for target detection and engagement. The optical stabilization system on the Predator uses sophisticated technology and is powerful and expensive, but it can conduct engagements from over 10,000 feet. A simpler system that could be purchased commercially or built by a less sophisticated power than the United States would require the UAV to operate at a much lower altitude. This would make the UAV vulnerable to insurgent ground fire. Indeed the U.S. UAV ScanEagle, which uses commercial components and operates at low altitude, has taken losses to insurgent ground fire.

Use of Armed UAVs in WMD Delivery

Although WMD technologies are well understood, there have been few examples of their use by terrorists. The reason is simple: Conventional technologies such as nail bombs and explosives are easier, cheaper, and can even be more lethal. The sophisticated 1995 attack on the Tokyo subway with sarin killed 13 people, while the simpler 2005 explosives attack on the London subway killed 52 people.[10]

Excluding fissionable weapons reaching critical mass, biological weapons are probably the most difficult to operationalize. Anthrax, for example, is easy to cultivate but difficult to weaponize (i.e., concentrate it in small dry grains suitable for aerial dispersal). And even if one were to succeed in spraying a large crowd with weaponized anthrax, the attack could be easily defeated by providing antibiotics, since anthrax only works if the victim does not know he or she has been attacked. So it makes sense for covert distribution by letter, but does not work at all in a bomb delivered someplace with at least minimal medical care available.

Chemical weapons can be easier to operationalize but are still difficult to control, especially outdoors. They can be static or disperse in the wind, and if their employed location is known, it is possible to avoid their areas of effect. In addition, antidotes are available, and if trained personnel are present (as they are at all U.S. military bases), they can readily prevent casualties. The August 2013 chemical attack in Syria would have required a coordinated military operation. Note that although Syria certainly could have used UAVs or cruise missiles to deliver chemical weapons, it chose to use ballistic missiles designed in Russia in the 1950s. Presumably they used these because they are cheaper, faster, more reliable, easier to coordinate, and more difficult to defend against than UAVs.

Radiological weapons are also ineffective. The biological effects of radiation are roughly proportional to the flux to which one is exposed and the duration of the exposure.

Avoiding prolonged exposure can minimize its effects. On the other hand, preparing and delivering the bomb requires the terrorists to spend a lot of time with the radioactive material. (For example, suppose one designed a radiological weapon that would produce artificial radioactivity doubling the natural background over an area of one square mile. If one stood about a foot from such a weapon, one would receive a fatal dose in about 35 minutes.) There are other problems with achieving dispersal. Overall, the threat is primarily psychological.

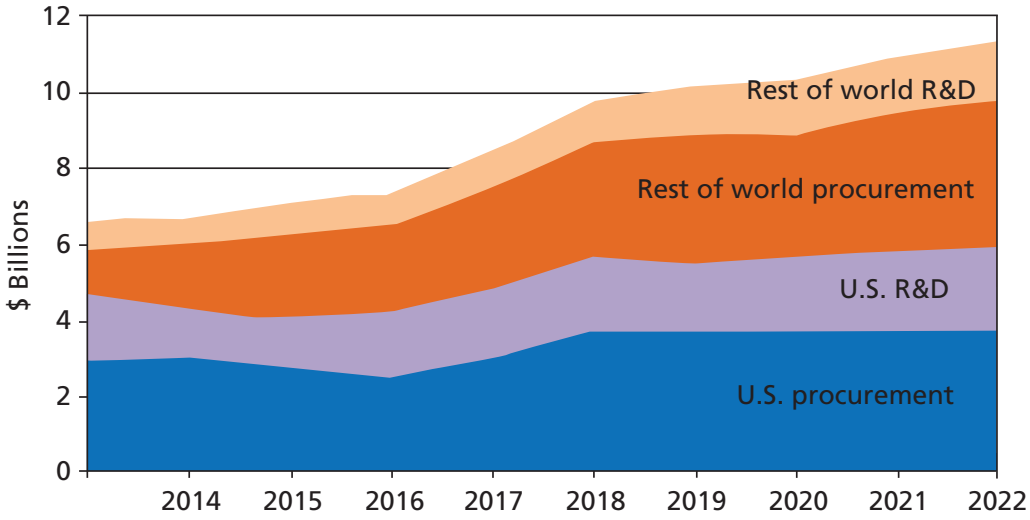
The most efficient weapon for a terrorist UAV intent on causing casualties is probably a conventional explosive bomb. Conventional bombs are much more effective when employed indoors. An open air nail-bomb delivered to a crowded outdoor event would, if all went as planned, probably produce effects similar to the Boston marathon attacks.

ARE ARMED UAVS PROLIFERATING AROUND THE WORLD?

Worldwide spending on military UAVs is projected to rise in the coming years. One report by the Teal Group forecasts an increase in spending on procurement and research and development (R&D) from $6.6 billion in 2013 to $11.4 billion in 2022.[11] Figure 1 shows the global UAV budget forecast, with specific segments to indicate U.S. procurement and R&D compared to spending by the rest of the world in the same areas. As the chart indicates, U.S. UAV procurement and R&D currently accounts for more than 50 percent of the total amount expended worldwide on military UAV procurement and R&D.[12] However, the total U.S. spending amount is not projected to increase significantly over time and remains relatively flat from 2018 through 2022. In comparison, the chart shows a gradual increase in spending on UAV procurement and R&D by the rest of the world, despite comprising a smaller share of the market over the next ten years.

Over the past several years, an increasing number of countries have been acquiring and developing UAVs for both civil and military applications. The top map in Figure 2 provides a snapshot of the number of countries that have acquired UAVs.[13] As the yellow shading in the figure indicates, more than 70 countries have acquired UAVs of different classes and for different purposes. Of these countries, the United States has the largest share of UAVs (corresponding with the data in Figure 1 indicating that they are also the largest spender in terms of UAV procurement and R&D) with more than 10,000 systems in the U.S. military inventory alone as of July 2013.[14] However, while the United States may account for the largest portion of the UAV budget worldwide, this amount is only a small percentage of the total U.S. Department of

Figure 1: World UAV Budget Forecast



SOURCE: Teal Group, *World UAV Systems 2012: Market Profile and Forecast*; Glennon J. Harrison, *Unmanned Aircraft Systems (UAS): Manufacturing Trends,* Congressional Research Service, January 30, 2013.

NOTE: Speculative unmanned combat aerial vehicle (UCAV) procurement not included.

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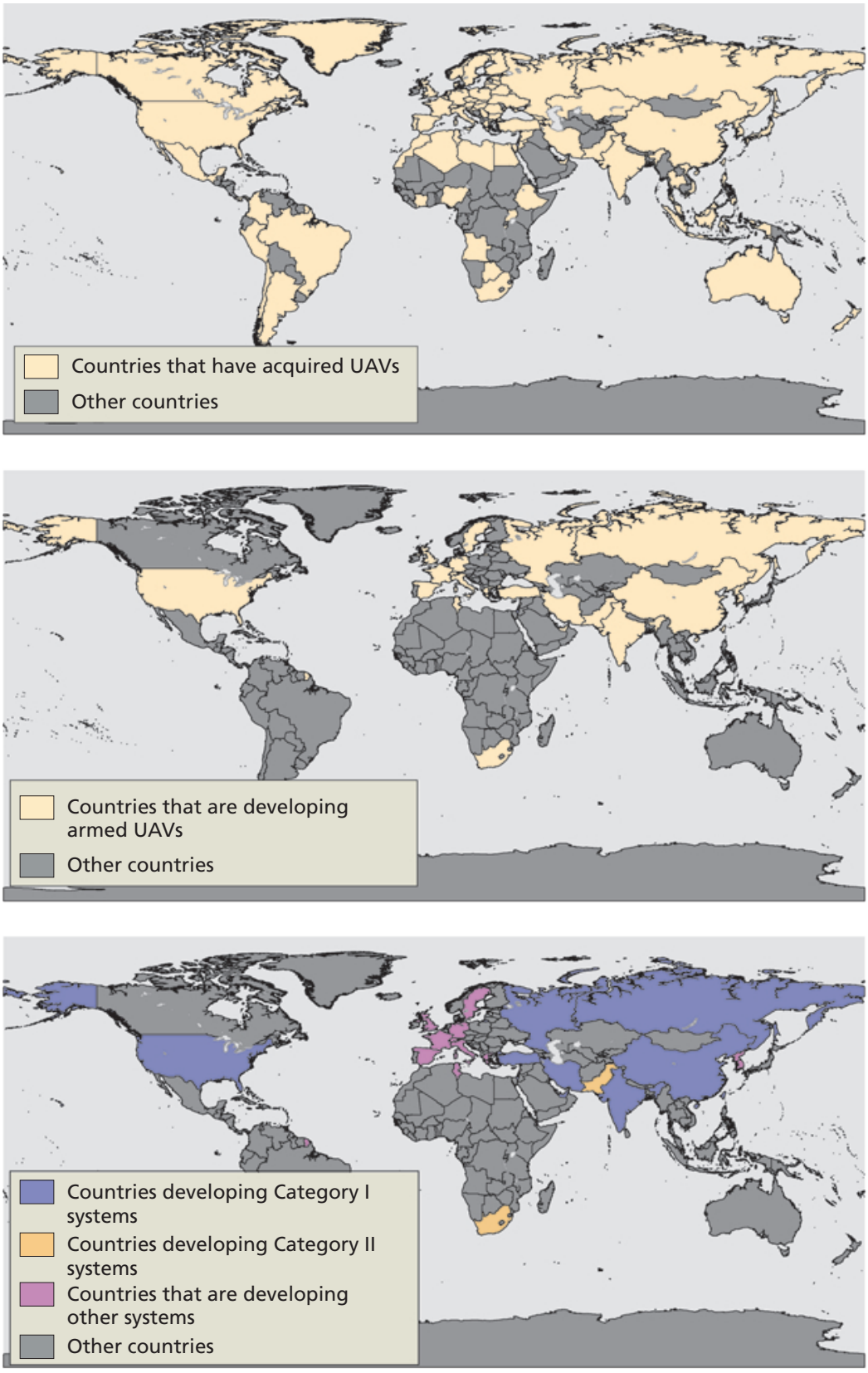
Figure 2: Countries That Have Acquired UAVs



NOTE: Countries developing Category I systems could also be developing Category II systems.

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Defense (DoD) budget. For example, we note that the fiscal year (FY) 2013 budget request for unmanned air systems was $3.8 billion out of a total FY 2013 DoD base budget request of $525.4 billion.[15] Furthermore, DoD funding for UAV research, development, testing, and evaluation (RDT&E) and procurement is expected to decrease in the near term.[16] The regions with the largest UAV markets include North America, Europe, and Asia.[17]

A smaller fraction of the countries that have acquired UAV systems (the top map in Figure 2) are themselves developing UAVs. In particular, more than 50 countries are developing UAVs, compared with more than 70 countries that have acquired various types of UAVs.[18] Many of these projects exist only as proposals by commercial firms, and this does not necessarily indicate a commitment by a national government or any probability that the UAV will be built. While there are few developers in Africa, there is a widespread manufacturing base across the globe and it is likely that the number of countries developing UAVs will continue to grow.[19]

We now examine who is or will be developing and potentially selling armed UAVs. Using open-source data, we compiled a list of UAVs in development throughout the world that could be characterized as "armed UAVs." This included UAVs designated in the databases as attack systems, precision strike systems, "hunter-killer" systems, unmanned combat aerial vehicles (UCAVs), UCAV demonstrators, and/or systems described as a "suicide UAV," or for use as a cruise missile.[20] In total, 23 countries were identified as potentially developing systems according to the criteria described above: They are shaded in yellow in the center map of Figure 2.

We now differentiate the types of armed systems being developed by these 23 countries. Armed UAVs vary in size, range, payload, lethality, and complexity, and categorizing these systems is important for understanding who is interested in them, for what purpose, how dangerous they are, and therefore the extent to which they pose a risk in terms of their proliferation. For the purposes of our analysis, we use the MTCR categories to describe the types of armed UAVs being developed by the identified countries.[21]

In addition to the MTCR categories for armed UAVs, we define another category, named "other systems," which accounts for technology demonstrators, concepts, research programs, smaller systems (micro-UAVs), and suicide drones ("cruise missile" UAVs). We categorize these systems separately for several reasons, relating back to how we defined armed UAVs for the purposes of our analysis. First, many technology demonstrators, concepts, and research programs are never intended to be sold and may not actually lead to an operational UAV, at least for many years. Second, micro-UAVs are limited in their use and size, and many would not consider these systems to be aircraft.[22] Third, as already noted, this paper does not focus on cruise missiles designed for one-time use (i.e., "suicide drones"), given that almost anything that flies could be fitted with some sort of explosive and crashed into a target (i.e., our definition primarily focuses on the characteristics of the system itself, not how it is employed).

The bottom map in Figure 2 uses colors to indicate the type of systems being developed by the 23 countries reportedly developing armed UAVs: blue indicates countries developing MTCR Category I systems and in some cases also Category II systems; gold indicates countries developing only Category II systems; and purple indicates countries developing "other systems" (technology demonstrators, concepts, micro-UAVs, etc.).

As the figure shows, eight countries are reportedly developing Category I systems: China, India, Iran, Russia, Taiwan, Turkey, the United Arab Emirates (UAE), and the United States. Such Category I systems include medium-altitude, long-endurance (MALE) UAVs designed for intelligence, surveillance, target acquisition, reconnaissance, and attack (ISTAR-A). One example of such a system is the Predator (MQ-1) produced in the United States by General Atomics. While full details of each system are not openly disclosed, we categorize these systems according to the open-source data we have on their characteristics, intended mission, and any reports of operational use.

Three countries are developing only Category II systems: Israel, Pakistan, and South Africa. These systems, such as South Africa's Seeker 400 UAV, carry a smaller payload than Category I systems but have a comparable range. Another example of a Category II system is Iran's Ababil, manufactured by Ghods Aviation Industries, which can carry a payload of 40 kg and is designed for reconnaissance, surveillance, and attack.[23] Further reports have listed this system as being exported to Hezbollah and potentially to Venezuela as well.[24]

Given our dependence on public reporting, we list Israel as developing Category II armed systems and not one of the countries developing a Category I armed system. Nevertheless, countries such as Israel, with a strong manufacturing base for UAVs, possess the technical wherewithal to develop Category I armed UAVs, and developing and operating such systems would not require much additional effort.

The remaining 12 countries are developing systems that fall within the "other systems" category: France, Germany, Greece, Italy, Lebanon, North Korea, South Korea, Spain, Sweden, Switzerland, Tunisia, and the United Kingdom. Technological advances have affected the size, reach, and lethality of armed UAVs, with a number of micro-UAVs emerging onto the scene carrying smaller payloads for limited distances, or intended for single use as a cruise missile. Furthermore, several of these countries are also dedicating resources toward UCAV demonstrators. For example, France, Greece, Italy, Spain, Sweden, and Switzerland are co-developing nEUROn, which is listed as having a range of almost 2,000 km, but additional characteristics are not yet fully defined given that the program is in its early stages.

With a better idea of the categories of armed systems under development, we now consider whether these countries are MTCR members and therefore bound by the MTCR Guidelines.[25] Of the eight countries developing Category I systems, three are MTCR members (Russia, Turkey, and the United States) and five are not (China, India, Iran, Taiwan, UAE). Of the three countries developing Category II systems, one is an MTCR member (South Africa) and the other two are not (Israel and Pakistan). Finally, of the 12 countries developing "other systems," eight are MTCR members (France, Germany, Greece, Italy, South Korea, Spain, Sweden, and the United Kingdom) and four are not (Lebanon, North Korea, Switzerland, and Tunisia).

Grouping these countries according to MTCR member status indicates that more countries developing Category I systems—those systems of greatest concern from a proliferation standpoint—fall outside of MTCR. However, this differentiation does not indicate the scope of development efforts within each country and whether multiple armed UAV development efforts are under way. As discussed earlier, the United States still holds the largest portion of the market when it comes to armed UAVs, and the United States is developing several Category I systems in particular. Few other countries have multiple Category I systems under development, and those that claim they do may not have sufficient evidence to fully substantiate their claims (such as confirmed operational use or fielding of these systems). In fact, while many of the systems reflected by the figures are under development, few are actually operational (i.e., ready for use or actually used in combat) and it may be years before they are.[26] As a result, the series of maps displayed in this report may indicate intent, interest, and some baseline capacity for developing armed UAVs, but the extent to which these systems are eventually deployed, fielded, or exported for operational use remains to be seen.

In terms of UAV sales, the United States has been cautious in exporting armed UAVs in terms of complete systems, but it has exported UAVs to partners and allies that can be reconfigured to carry weapons for operational use.[27] For example, reports indicate a U.S. sale of unarmed Reapers to France (with the potential for France to arm the systems once acquired).[28] Other major U.S. UAV sales include unarmed Reapers and Predators to Italy, and Reapers to the United Kingdom.[29]

MQ-1 Predator

Israel is the largest exporter of UAVs, with sales to more than 42 countries as of February 2010 (the majority being in Europe, Asia, and Latin America). As of 2012, these sales accounted for less than 10 percent of Israel's military exports.[30] Several other countries have also sold UAVs, with many more developing systems aimed at the export market. Interest in these systems is widespread, but there have been few confirmed reports about the actual sale of complete armed platforms to others.

ARE ARMED UAVS TRANSFORMATIVE?

A number of policymakers and experts have described armed UAVs as revolutionizing "the way nations conduct war,"[31] and as being "game changers,"[32] putting their development in the same category as the advent of airpower or even the atomic bomb.[33] Are they really transformative?

Those studying the history of warfare suggest that with the exception of nuclear weapons, no single new weapons system by itself changes the fundamental nature of warfare. However, new systems sometimes offer significant changes that do alter warfare to different degrees. Many commonly cited game-changing weapons (e.g., tanks, aircraft carriers) involved a combination of new technologies, doctrinal changes, and tactical shifts—the new technology or weapon system was only part of the overall change. Enemies adapted to the change, innovating in turn and otherwise limiting the impact of the new instrument.[34]

If armed UAVs are revolutionary weapons, then their presence on one side but not another should decisively tilt the battlefield in favor of their possessor, though they may not win the war by themselves. The possessor is likely to also need to make doctrinal changes and develop supporting technologies to make the systems transformative. In the end, any judgment is likely to be subjective to some degree: Historians hotly debate whether the tank and *blitzkrieg* was a revolution or simply an evolution in tactics. But if armed UAVs rise to the level of tanks and blitzkrieg—a case in which the technology and associated doctrine dramatically increased German military power until adversaries, particularly the Soviet Union, developed a commensurate capacity—then we will judge them to be transformative.

Several factors shape our judgments. First is the existence of alternatives to the effects the system creates. A new satellite system may offer excellent imagery, but similar (though not identical) information may come from high-flying airplanes or other platforms. A second question concerns cost and ease of use. Some weapons, like firearms, allow many individuals to fight with considerable lethality at low cost and with limited training; others, like an F-22, take years of training that only a small number of people can master. Moreover, high-performance aircraft are so expensive that many countries cannot afford to produce them. Third, some weapons may prove effective but can only be used in rare circumstances or are easy to avoid or counter. Kite balloons proved valuable for reconnaissance in World War I but were also highly vulnerable to enemy aircraft. Finally, not all weapons can be judged by their kinetic effects. Some, such as chemical and radiological weapons, also have a psychological impact that deserves consideration when determining their attractiveness. In addition, some weapons are not politically palatable to countries even when they might achieve significant battlefield effects. President Franklin Roosevelt rejected the use of chemical weapons at Iwo Jima despite a military judgment that they would be highly effective because the defenders were sheltering in caves.[35]

Benefits of Armed UAVs

As currently designed and used, armed UAVs offer numerous technical advantages that make them attractive to many states, the most obvious being that they are unmanned.[36] They carry no risk to the pilot and enable casualty-sensitive governments to conduct operations when they might otherwise shy away from involvement. The search-and-rescue packages that usually accompany strike aircraft in case a pilot is downed are also not necessary, further reducing risk and cost. Some UAVs can also loiter for long periods, enabling them to conduct persistent and real-time surveillance that can increase the chance of identifying the right target and avoiding collateral damage. Systems like Reapers and Predators are relatively easy to learn to fly and use with at least some degree of effectiveness—at least compared with comparable manned systems.[37] In part because they demand less extensive training and because the systems are relatively basic and proven, armed UAVs are also cheap compared to other air systems.

The U.S. use of Predators, Reapers, and other systems against the al Qaeda core in Pakistan illustrates many of this platform's advantages. UAVs killed much of the al Qaeda senior leadership and created fear among the remaining cadre, forcing the organization to adopt costly countermeasures inhibiting their command and control and overall organizational structure. Increasing efficacy and reducing noncombatant deaths,

the UAVs' loiter time enables operators to identify and verify targets. In addition, they do so at no combat risk to the pilot, allowing the United States to take risks with armed UAVs that it would hesitate to do with manned aircraft.

Armed UAVs would be valuable in fighting enemy states with poor air defenses. For example, armed UAVs alone would offer the United States few benefits in the early phases of a conflict with Syria as basic air defenses would prove lethal. An advantage would materialize after Syrian air defenses were suppressed by U.S. cruise missiles or other systems, although even then antiaircraft artillery fire could still be lethal to the UAVs depending on their altitude. As air defenses diminished, the United States could take advantage of the UAVs' loiter time and surveillance capabilities to deliver precise strikes on chosen targets, including the Syrian leadership. In addition, the armed UAVs could be deployed to provide close air support and battlefield air interdiction on behalf of rebel forces with no risk to the U.S. operator.

U.S. allies would benefit from armed UAVs. In July 2013, Congress approved the sale of up to 16 MQ-9 Reaper UAVs to France.[38] If France had possessed and used armed UAVs earlier in the year when it intervened in Mali to fight the jihadist insurgency Ansar Dine—or if the United States had operated them in support or otherwise passed on its capabilities—France would have been helped considerably. Ansar Dine has no air defenses to counter such a UAV threat. France, however, was able to use attack helicopters, fixed-wing aircraft, and special forces to fight Ansar Dine without armed UAVs.

Armed UAVs would be particularly beneficial to U.S. allies that, unlike France, have few alternatives. For example, upon withdrawal of most or all of its combat presence from Afghanistan in 2014, the United States could continue basing a large UAV presence there, leasing or otherwise providing the aircraft to the government of Afghanistan as it departs but maintaining forces and contractors to support the UAVs and assist with operations. Armed UAVs would offer alternatives that Afghan forces otherwise would not possess, given the poor quality of their rotary and fixed-wing aircraft and conventional forces. Because the Taliban lack capable air defenses, armed UAVs could strike leaders, massed troops, and heavy forces, making it hard for the Taliban to gain a lasting military advantage even over relatively weak government of Afghanistan forces. Given the likely Afghan skill levels, their abilities with the armed UAVs without significant U.S. support would be more limited, and they would be less able to integrate the range of intelligence as U.S. operators do. Nonetheless, the relative ease of using UAVs would enable them to gain considerable effectiveness and at far less cost than doing so with manned aircraft.

Small, armed UAVs that might be mass-produced in the future usually would cost less, so states or substate groups might be able to buy or develop them in large numbers and view them as expendable. Smaller systems could become the next IEDs: low-cost, low-tech weapons that are only of limited lethality individually, but attrite significant numbers of U.S. or allied personnel when used in large numbers over time. One can imagine U.S. forces fighting future insurgent movements that use large numbers of cheap UAVs operating with line-of-sight controls. Such UAVs could detonate near U.S. forces, posing a constant threat.

Short-range armed UAVs could work well for surprise attacks, perhaps by a state but also by a substate group. Moreover, because of their small size, and because some unusual systems might mimic less dangerous or harmless devices (such as model planes), they might better evade or fool U.S. or allied air defenses. It would be difficult for the United States to quickly stop a small armed UAV that appeared by surprise inside the nation's borders, assuming alert levels are not elevated at the time of the attack. Although al Qaeda or another terrorist group could not fly the UAV for long or do repeat operations (because the vehicle would be quickly and easily detected), a single strike might be conducted successfully.[39]

Armed UAVs may offer some political benefits for major powers and greater psychological impact for terrorists. Armed UAV strikes, though deeply unpopular, are perceived by many Pakistanis as violating sovereignty less than boots on the ground. In contrast, the raid on Osama bin Laden's compound by the U.S. SEAL team was deeply humiliating to the Pakistani government and generated more outrage among the population in general.

Some countries, and especially substate groups, attack primarily to terrorize or affect morale, rather than to advance their overall operations in a traditional military sense. A terrorist group may want to dramatically "take the fight to the enemy" in a novel way and "avenge" losses of its own from UAVs. A terrorist group like al Qaeda might find short-range armed UAVs an attractive way to target the United States. The novelty of the method might appeal to al Qaeda's leaders, demonstrating their cleverness and raising the psychological impact of the strike. Given the devastation that drones have wrought on al Qaeda's leadership, the symbolic value of giving America a taste of its own medicine might be appealing and powerful. They may reason, correctly, that the specter of "death from above" might

discomfit many Americans, maximizing the psychological impact, as well as any associated coverage of a strike. Al Qaeda could also strike at targets with guarded perimeters and evade these defenses.

A state actor might want to demonstrate that it is fighting back and believes a UAV strike would give it political credibility at home while the limited sovereignty violation would enable it to stop unwanted escalation. India is developing long-range armed UAVs, and it could consider responding to a terrorist attack emanating from Pakistan with an armed UAV. Because such retaliation might spark a broader conflict that could even spiral to nuclear use, Indian leaders might look for ways to strike a terrorist group in Pakistan while reducing the likelihood of further escalation. In other words, the UAV strike might be considered for conducting a symbolic retaliatory attack, giving the government greater stature at home but allowing Pakistan a way of limiting any escalation.

Limits of Armed UAVs

Despite these considerable and numerous advantages, armed UAVs are rarely transformative. Many of the capabilities of armed UAVs of all sizes can be found in other weapon systems, although the UAV may offer some advantages. Helicopters, cruise and ballistic missiles, and manned aircraft can perform many, if not most, armed UAV functions. Even the poster child for armed UAVs—fighting al Qaeda–linked terrorists and Taliban insurgents—demonstrates this point. The United States possesses several alternatives to UAVs—e.g., cruise missiles, airstrikes by fixed-wing aircraft, special operations forces raids—and has employed them all at various times.

Even lesser powers and terrorists usually have alternatives. For example, Iran might seek out armed UAVs because its other air assets are dated and of limited quality. Yet these systems might not greatly improve Iran's reach, as Tehran has already demonstrated an ability to use terrorism against its enemies in Asia, Europe, and the Middle East. In addition, Iran has ties to Shi'a groups and could try to stir up unrest against its foes in countries with large Shi'a populations, such as Saudi Arabia.

For terrorist groups, suicide bombings or use of IEDs would be simpler and more effective than armed UAVs. Many of these are proven tactics, and most are much easier to deploy. So far, the vast majority of jihadist attackers in the United States (only a few of whom have had links to al Qaeda itself) have proven poorly trained and ineffective, often to the point of absurdity. It is not likely they would be able to develop more than a limited capacity to use armed UAVs effectively. It is noteworthy that outside Hezbollah, which is more a mini-army than a classic terrorist group, terrorists in general have not expressed interest in acquiring and using these systems.

Even when using identical UAV platforms, countries will have different capabilities based on their doctrine, skill level, and supporting capabilities. Systems like the Reaper and Predator are integrated into the broader U.S. command, control, and intelligence networks and America's extensive human and signals intelligence capacities. Additionally, the U.S. global basing network enables greater reach and penetration for its systems. While most countries, or even substate groups, can achieve basic armed UAV capabilities, actual performance (and thus U.S. security ramifications) may vary considerably.

Perhaps most importantly, armed UAVs are highly vulnerable. In most situations, long-range armed UAVs like Predators and Reapers are relatively easy to shoot down, even with 1950s-era air defense systems. Also, even smaller UAVs operating in a "hunter-killer" role need a radio link to their controller and such links are easily jammed. As the vast majority of the world's militaries possess air defenses, using large numbers of armed long-range UAVs similar to current models would be almost impossible to do successfully on a regular basis in a conflict environment.

Because of the current systems' tremendous vulnerability to air defenses and the presence of high-quality alternatives, armed UAVs by themselves rarely would prove decisive. In a U.S.-China confrontation, for example, current armed UAV systems would be shot down in moments. In addition, both countries have more sophisticated, capable systems, such as fixed-wing aircraft and ballistic missiles, that can deliver bigger payloads and more easily overcome defensive systems. If Iran tried to use an armed UAV to target Saudi Arabia, it would not be likely to succeed, even if it developed a high capacity to use these platforms, which is currently lacking. Saudi Arabia has competent air defenses, many of which involve U.S. systems and direct and indirect U.S. military support. Iran tried to use an unarmed UAV over Iraq, and it was quickly downed by coalition jets.[40] Hezbollah has actually adapted the Iranian Ababil for use as a cruise missile, but it has been unsuccessful in its attacks on Israel.

Countermeasures for UAVs go beyond air defenses. Al Qaeda and the Taliban are exploring jamming technologies to disrupt control of the UAVs. They also often surround themselves with children or otherwise try to complicate U.S. targeting.

Nor are the psychological and political benefits guaranteed. The judgment that use of an armed UAV on U.S. soil would be more psychologically devastating than an IED or suicide bombing is conjecture. In the example of an Indian UAV attack after a Pakistan-based terrorist strike, the very premise of New Delhi's action—using a UAV strike to score political points at home yet avoid escalatory spiral—may be flawed. Some on the Pakistani side may seek an escalation for their own ideological, political, or institutional reasons, and they may see the UAV strike (should it manage to evade Pakistan's air defenses on the border) as a provocation. Table 2 summarizes some of the "illustrative" examples developed by the authors and provides an overview of the benefits and limits of armed UAV use for the United States, for U.S. allies, and for potential adversaries, including substate groups.

Armed UAVs: Attractive, Not Transformative

The benefits and limits of armed UAVs suggest that they offer their users significant capabilities but are only transformative in rare circumstances. But again: These conclusions could change with technological advances in automation, miniaturization, stealth, and other fields.

By themselves, armed UAVs do not win wars, and wars can be won without them. France did well against Ansar Dine without armed UAVs, while the United States has not gained victory over the Taliban despite using Predators and Reapers on a regular basis. Adversary air defenses often render armed UAVs almost irrelevant, and in most cases the United States and its more advanced allies have access to other systems that offer similar, though not always identical or equal, capabilities. Even if substate groups employed armed UAVs, the risk is as much psychological as operational—they have alternatives such as suicide bombings that are more proven and more likely to succeed.

Armed UAVs are more transformative, however, against insurgent movements or others that lack even basic air defenses. In these cases, the UAVs' greater precision and loiter time, as well as lower cost, can change the battlefield in favor of the counterinsurgent by enabling targeting that would otherwise be too risky or too costly. As such, they are beneficial for the U.S. campaign against al Qaeda and potentially even more advantageous for U.S. allies that lack the range and depth of air assets and other alternatives that the United States enjoys.

Armed UAVs are attractive to policymakers in most countries because they offer alternatives. Because armed UAVs are cheap and unmanned, losing them to accident or enemy action is less costly than losing manned systems or soldiers. In addition, action by an armed UAV seems to involve less of an infringement on sovereignty in some instances. Because of these advantages, armed UAVs are desirable to produce and acquire, and (at times) to use.

Perhaps more worrisome, possession of armed UAVs changes the calculus for the employment of force: Their impact shapes the politics of intervention. Leaders can deploy armed UAVs with less fear of loss and, as such, may be more likely to intervene in general. The United States and many other countries are often wary of counterinsurgency missions because they are manpower-intensive and risk casualties: Armed UAVs avoid both problems. As armed UAVs spread, other countries may be more likely to intervene in similar circumstances.

In some instances, however, armed UAVs are attractive to the United States or other countries because they are able to use less force. In parts of Pakistan where al Qaeda is active, for example, U.S. leaders would want to take action against the group even if it did not have armed UAVs. The alternatives include doing more raids with Special Operations Forces, attacking with manned fixed-wing aircraft, pushing the Pakistani government to do counterinsurgency operations, etc. Most of these would involve less target discrimination and more risk to U.S. or allied forces. Similarly, the United States can draw down much of its force in Afghanistan partly because it can use armed UAVs to achieve its goals.

In short, armed UAVs offer policymakers another option for intervention. They will use armed UAVs in some cases where they would otherwise do nothing, while in other situations they might use armed UAVs in lieu of a more costly and aggressive approach.

HOW SHOULD THE POTENTIAL RISKS OF UAV PROLIFERATION BE ADDRESSED?

Armed UAVs do not create the kinds of general or global dangers that have traditionally led to nonproliferation efforts (i.e., a weapon's value in the delivery of WMD, their broad effect on regional stability, their potential contribution to global arms races). For the most part, the proliferation of armed UAVs should be viewed comparably to the spread of most conventional weapon systems: They enhance capabilities, but they do so in a measured and evolutionary way.

Table 2: Summary of Armed UAV Benefits and Limits

User	Adversary	Possible Use	Benefits	Limits
United States	Al Qaeda core	Disrupt al Qaeda	Command disruption Low-risk intervention Target discrimination Force costly adaptations Less sovereignty infringement than alternatives	Alternative systems exist Adversary has potential countermeasures
Afghanistan (with U.S. support)	Taliban	Target leadership, close air support	Command disruption Target discrimination Force costly adaptations Few alternatives	Taliban countermeasures Less capability for use by Afghanistan forces Requires continued U.S. support
France	Ansar Dine (Mali)	Target leadership	Command disruption Target discrimination Force costly adaptations Enables less-costly intervention	Alternative systems exist Potential adversary countermeasures
India	Terrorist camp in Pakistan	Symbolic response to terrorist attack	Minor damage to group if successful Political demonstration at home of "action" Less potential risk of escalation	Easily downed by Pakistani air defenses Some alternatives exist Escalation avoidance not guaranteed
Iran	Saudi Arabia	Strike Saudi military and political infrastructure	Minor damage if successful	Alternatives via subversion or suicide bombing Saudi/U.S. air defenses likely to detect and down aircraft
Al Qaeda	U.S. homeland	Target symbolic infrastructure	Kill Americans Psychological impact Small systems might fool or evade defenses	Often (not always) vulnerable to air defenses Many easier alternatives Not a game-winner by itself Limited capacity for use Small systems pack less punch; large systems harder to acquire and use
Al Qaeda–linked insurgency	Deployed U.S. forces	Strike U.S. forces in IED-like swarm	Kill Americans Use cheap systems that are easy to replace	Limited lethality Currently not developed by adversaries Vulnerable to jamming, other countermeasures

The risks of proliferation cannot be entirely dismissed, however. Armed UAVs could be attractive to states as well as substate groups in internal conflicts and insurgencies. In specific circumstances, they could undermine stability and introduce new threats in regions already experiencing conflicts and rivalries. The introduction of new military capabilities anywhere has the potential of fueling an arms race.

The challenge for the United States will be to craft policies that address the potential risks of proliferation while being able to continue its own acquisition of armed UAVs and potential sales to allies and partners. Obviously, finding the right approach will not be as easy as in the case of ballistic missiles and cruise missiles, where there are clear and recognized dangers of proliferation. Armed UAVs in this light are actually more like aircraft, where the potential dangers are more case-specific and strong pressures for sales exist from the military services as well as industry.[41] What will be needed is for the United States to navigate the requirements of the MTCR and the Wassenaar Arrangement, where armed UAVs are covered in lists controlling exports. See the appendix of this report for more detailed background on these regimes, their purposes, guidelines, and members.

MTCR and Wassenaar Arrangement

It is important to keep in mind the fundamental character of these two regimes and their broad purposes. There is no question that member governments in the MTCR and the Wassenaar Arrangement can make transfers of UAVs, both armed and unarmed. Legally, export decisions remain the prerogative of national governments. Moreover, the language in the guidelines of both regimes has been crafted in ways to provide enormous latitude.[42]

Policymakers need to recognize that precedents will be set through UAV export decisions, whether they are transfers or denials. Transfers could affect the overall credibility of the regimes, undercut their existing broader nonproliferation norms and controls, and potentially increase the likelihood of UAV transfers by others. Denials of exports could in principle have the opposite effects. In navigating the export regimes guidelines, policymakers will need to differentiate among the different situations of potential transfers of armed UAVs.

Transfer to U.S. Allies

U.S. allies are all members of both regimes and share the overall goals of preventing exports that could endanger international peace and security. They are also members of all the other regimes created to prevent the proliferation of WMD, and their export policies and controls are consistent with these commitments. U.S. transfers of armed UAVs to its allies would create none of the dangers that the MTCR and Wassenaar Arrangement seek to avoid.[43] This would also be the case for Israel (a partner and producer of UAVs). While not a member of either regime, having not met the nonproliferation membership criteria, it has agreed to abide by the MTCR Guidelines and has in place the export controls mandated by the Wassenaar Arrangement.

While there is no entitlement with respect to missile transfers to other MTCR partners, the regime has recognized this possibility, and interpartner trade has occurred. In the language of the MTCR Guidelines, there is a presumption of denial; i.e., a review needs to occur and a case made for any transfer. No such issue even arises with the Wassenaar Arrangement, as its requirements (for export controls and information sharing) cover only nonparticipating states.

Transfer to U.S. Partners

None of the U.S. partners in the Middle East and Southeast Asia are members of the MTCR or the Wassenaar Arrangement because they are not producers of the missiles or conventional arms covered in these two regimes. The purposes of the two regimes and the flexibility that is inherent in their guidelines provide the basis for potential transfers to these countries.

In the MTCR, the purpose is clearly to prevent the proliferation of delivery systems capable of carrying WMD. For U.S. partners, who all abide by the various treaties banning WMD, there is really no danger that armed UAVs would be used for this purpose. The use of these weapons would be defensive, and thus comparable in many ways to U.S. sales of aircraft to these countries. To note again, aircraft are specifically excluded in the MTCR and receive no special attention in the Wassenaar Arrangement. There are also provisions in each of the regimes for instituting end-use assurances, and these could serve to increase confidence in how armed UAVs transferred to U.S. partners would be employed, both in terms of the type of weapon and, potentially, in terms of circumstances. This could provide an opportunity to gain support for international norms on the use of UAVs, which will be covered later.

Restrict Transfers

There is the possibility that the United States would wish to prevent the proliferation of armed UAVs in specific situations. Members of the two regimes already have (and apply) export controls and certain restrictions. In the aftermath of the September 11 terrorist attacks of 2001, the regimes took the unprecedented step of banning transfers to terrorists of all items on their control lists.

The MTCR restrictions cover long-range UAVs as well as short-range UAVs when the purpose could be the delivery of WMD. The Wassenaar Arrangement has a broad mandate, focusing on the dangers created by potential types of behavior on the part of countries or groups as well as those associated with the accumulation of individual weapon systems, and its guidelines cover UAVs of all ranges and types. In practice, restraint in transfers is exercised on only a few items on its Very Sensitive List. UAVs are not on this list and the characteristics of their technology would not place them in this category. If a consensus were to emerge to place restraints on UAV transfers, one approach (adopted in the past for MANPADs) would be for the members to define best-practice guidelines for transfers.

The United States has other options to bolster restraint in the regimes. It can use the "no-undercut" provisions in the regimes, even though these are not binding or enforceable. What this means is that MTCR members are obligated to "notify" others of a denied license and "consult" in advance of making an UAV export. In the Wassenaar Arrangement, members are obligated to "notify" others in advance of exports. If smaller, high-technology UAV systems were to pose new dangers in the future, the MTCR restrictions could be expanded to cover all UAV transfers. These systems could be added to the sensitive lists in the Wassenaar Arrangement, and transfer guidelines could be developed.

The United States would find it difficult to target a specific country for restraint, given the opposition that exists in principle among regime members to such restrictions. More generally, any effort to pursue restraint could be complicated if exceptions for transfers are made to certain other countries. Moreover, the ability of the United States to influence nonregime members in their exports is obviously more problematic; many producers fall into this group.

Achieving agreement on the need to restrict transfers of armed UAVs will require confronting the same overall question that has beset policymakers in setting up the two regimes and also in the design of their guidelines and control lists: Do the dangers created by the proliferation of armed UAVs require restraint, and should these systems be viewed or treated any differently from conventional aircraft?

In conclusion, both the MTCR and Wassenaar Arrangement provide the United States with the flexibility and controls to be able to balance its security and nonproliferation goals with respect to armed UAVs. Perhaps more problematic is whether the government interagency can strike a balance in future transfers and restraint, given the tendency of participants to promote their traditional equities: DoD/transfers for security reasons; State/restraint for nonproliferation; Commerce/sales for companies. This has been accomplished in the past, though often requiring the involvement of senior-level officials.

HOW MIGHT U.S. SUPPORT OF INTERNATIONAL NORMS INFLUENCE HOW OTHERS USE ARMED UAVS?

A decision by states or substate groups to develop or acquire armed UAVs will depend on many different considerations. One is how these weapons could promote military goals and overall security. Another is whether there are more cost-effective means (e.g., manned aircraft, air defenses) to achieve these goals. U.S. demonstration of the value and military effectiveness of armed UAVs in counterinsurgency and counterterrorism operations clearly adds to how others could view their need for these weapons. As a result, the United States will find it difficult to argue that others could not find the same value.

At the same time, the United States will have an interest in how these weapons will be used as they spread to other countries. The policy question is: What could the United States do to influence others through its own policies, internal processes, and actions—and how can it take the lead in gaining support for international norms? To answer this question, we will describe U.S. operations in the past as well as plans for future use of UAVs. We will then look at whether and how international norms might be designed—and with what purposes in mind. We will conclude by suggesting some steps that could reduce the risks of actions of other states.

U.S. Operational Use of UAVs and International Norms on Use of Force

U.S. operational use of armed UAVs generally have been cases in which the adversary has limited air defenses, but with important variations. In some cases, U.S. use has been in war zones;

in some cases not. Sometimes use of force has been authorized by Congress; other times not. Sometimes armed UAV strikes have been conducted by the Central Intelligence Agency (CIA); other times by DoD. Finally, the types of targets have varied.

The first successful armed UAV mission was the CIA's use of a Predator in Afghanistan on October 7, 2001. In 2002, the Air Force began using armed Predators to support enforcement of the UN-sanctioned no-fly zone over southern Iraq and again throughout the almost decade-long conflict in Iraq. Iraqi fighter jets shot down several Predators in 2002 and 2003, but the system proved more effective once Iraq's air defenses were eliminated during major combat operations in 2003 and the conflict shifted to a counterinsurgency operation. The first time that armed UAVs were used at the brigade level was in Iraq in 2008, when they could be directed by commanders on the ground to survey enemy movements and fire on them. Strikes have also been conducted in Pakistan, Libya, and Somalia.[44]

The conflicts in these six countries and the types of targets have varied in important ways. The primary motivation for armed UAV strikes has been to attack al Qaeda and associated movements (AQAM) or to provide combat support in Afghanistan, Iraq, and Libya. Armed UAV strikes also targeted insurgents battling allied governments, particularly in Pakistan, Yemen, and Somalia.[45] Particularly for AQAM, the United States has used two means of determining targets. Armed UAVs were initially only authorized to strike specific individuals, identified on a targeting list vetted by an interagency group. In 2008, President George W. Bush authorized "signature strikes" against individuals showing characteristics of al Qaeda and Taliban fighters in Pakistan, and President Barack Obama authorized the practice of signature strikes in Yemen.[46]

Table 3 highlights the different contexts in which the United States has conducted strikes with armed UAVs. As with most modern conflicts, simple categorizations are challenging. Nevertheless, the categories listed provide a useful tool for analyzing similarities and differences, with the goal of providing insights as to how U.S. use corresponds to the traditional norms of the use of force.

In the war zones of Afghanistan, Iraq, and Libya, armed UAVs are more likely to be perceived as simply another battlefield weapon, subject to the same rules that have governed warfare since the four Geneva Convention treaties were established in 1864, 1906, 1929, and 1949. Off the battlefield, the use of force—including by armed UAVs—is likely to raise concerns

Table 3: U.S. Use of Armed UAVs in Various Conflicts

Conflict	Recognized War Zone?	Use of Force Congressional Authorization Clear?	Targets[a]	Targeting Criteria[b]
Afghanistan (2001–present)	Yes	Yes	AQAM Combatants	Vetted List Signature Strike Combat Support
Pakistan (2004–present)	No	Yes	AQAM Insurgents	Vetted List Signature Strike
Iraq No-Fly (2002–2003)	Yes	Yes	Combatants	Combat Support
Iraq Combat (2003)	Yes	Yes	Combatants	Combat Support
Iraq COIN (2004–2011)	Yes	Yes	AQAM Combatants	Vetted List Signature Strike Combat Support
Yemen (2002 and 2010)	No	No	AQAM Insurgents	Vetted List Signature Strike
Libya (2011)	Yes	No	Combatants	Combat Support
Somalia (2011–present)	No	No	AQAM Insurgents	Vetted List

[a] AQAM and Combatants refer to war zones; insurgents refers to those fighting partner governments.
[b] Targets were chosen based on one of three criteria: Vetted List (identified by name on preapproved list), Signature Strike (unidentified individuals or groups based on suspicious activity), and Combat Support (targets in recognized war zone).

about risks posed to regional stability and the laws of war (especially those regarding risks to noncombatants). If other countries in the future were to use armed UAVs outside war zones or with more secretive, paramilitary forces, similar concerns could arise about risks to regional stability, risks to the laws of war, and risks to the role of domestic rule of law in decisions to use force.

Armed UAV strikes are also more likely to create rule-of-law concerns where congressional authorization for the use of force is weaker. For example, the Authorization for the Use of Military Force (AUMF), passed by Congress in September 2001, applies broadly to those who supported the September 11 attacks and aims to prevent future acts of terrorism against the United States. While the Obama administration interprets this authorization to apply everywhere it is conducting armed UAV strikes, others question its applicability to strikes in places such as Yemen and Somalia.[47] In the case of Libya, the Obama administration argued that it could use force without congressional authorization because its use of armed UAVs meant that no U.S. service members were put at risk. While the Obama administration also argues that forces "associated" with al Qaeda should be interpreted broadly, others warn that such a broad interpretation is used to justify strikes on low-level noncombatants, such as cooks and drivers.[48] Perhaps most controversially, some argue that this interpretation has been used to target other forces with no intent to strike U.S. targets but are instead engaged in conflict against their own government.[49] If controversies like these continue, the United States may find it more challenging to shape norms to discourage other countries from using armed UAVs with a controversial legal basis or as a way to interfere in third-party conflicts.

Finally, armed UAVs may be perceived as similar to other weapon systems when used to provide combat support for ground troops or as part of an air campaign. When used to carry out attacks based on a targeting list, however, there is greater likelihood for concerns, particularly if the targeting process is opaque. Concerns might be even greater should a manned aircraft violate a country's airspace to conduct a strike. In fact, some may argue that the normative concern is more about targeted killings, regardless of the method. Since it is estimated that more than 95 percent of all nonbattlefield targeted killing strikes since 2001 have been conducted by armed UAVs, however, the focus has been on these systems.[50] It is clearly one reason why the systems are perceived as different. As mentioned earlier, signature strikes are even more controversial, given that the targets are neither combatants in a war zone nor positively identified as al Qaeda leaders. Other countries seeking to use armed UAVs to target people not actively involved in combat could raise similar concerns.

One of the reasons countries try to establish international norms is they perceive a risk as to how a weapon might be used; for example, as a risk to regional stability, the laws of war, or to the domestic rule of law in decisions to use force. Any use of force that is perceived to create these types of risks is likely to generate concerns and subsequent calls for international restrictions or at least agreed-to norms. The greatest concerns about U.S. use of armed UAVs appear to arise from operations outside active war zones, less-transparent operations, lack of clarity about congressional authorizations, and targeting of those not clearly identified as combatants or al Qaeda leaders.

In terms of the use by other states, these concerns may be warning signs about future challenges the United States will face in shaping international norms that emphasize transparency, rule of law, and discriminate targeting. The United States may see future risk in countries or nonstate actors employing armed UAVs in a secretive fashion, without clear legal foundations, or against those not clearly identified as combatants in a conflict. While it is impossible to speculate whether particular U.S. actions would encourage or discourage controversial use of armed UAVs by other countries, it is possible these countries could point—rightly or wrongly—to U.S. actions as precedents and thus complicate promotion of norms that would otherwise be in U.S. interests.

Obama Administration Policy Changes

In 2012 and 2013, the Obama administration has sought to clarify its policies regarding its use of armed UAVs and other capabilities to target individuals outside traditional battlefields. Attorney General Eric Holder, in a speech at Northwestern University and in a letter to the Senate Judiciary and select members of Congress, described the Obama administration's legal basis for using lethal force in counterterrorism operations overseas. Holder noted that operations would be consistent with law of war principles.[51] These principles, of course, also reflect the behavior that the United States would wish others to follow when using armed UAVs. A speech by President Obama's counterterrorism adviser, John Brennan, emphasized that regarding armed UAVs, the administration is "very mindful that as our nation uses this technology, we are establishing precedents that other nations may follow, and not all of them will be nations that share our interests . . . If we want other nations to use these technologies responsibly, we must use them responsibly."[52]

Like Holder, Brennan described principles that reflect potential building blocks for international norms: ensuring an individual poses an imminent threat and is a legitimate target under the law, determining that capture is not feasible, recognizing the important checks on acting unilaterally overseas, and having high confidence in the identity of the target and the avoidance of civilian casualties.

Obama reiterated these principles and policies in his May 2013 speech at the National Defense University. He announced that he had codified a framework for use of force against terrorists in Presidential Policy Guidance, and he emphasized that every targeted strike outside Iraq and Afghanistan had been briefed to appropriate committees of Congress. Looking forward, Obama announced that his administration would "review proposals to extend oversight of lethal actions outside of war zones that go beyond our reporting to Congress" and engage Congress in efforts "to refine, and ultimately repeal, the AUMF's mandate."[53]

The devil, of course, is in the details, and the speeches by Obama and his advisers left important questions unanswered. Who is consistently included in the government's legal and policy reviews, and does this provide sufficient oversight? Are signature strikes still an option? Has the definition of "imminent threat" been narrowed? How are groups or individuals associated with al Qaeda determined? Many observers have expressed skepticism about these speeches, because of questions like these.[54] Nevertheless, the president's commitments to narrowing and institutionalizing the guidelines for armed UAV and other counterterrorist strikes and increasing transparency and oversight could—if consistently implemented—reduce the risks of domestic and international backlash that might restrict future U.S. actions. Moreover, such steps could facilitate a U.S. leadership role in establishing international norms that support U.S. interests.

Challenges for U.S. Efforts to Shape International Norms

While a majority of Americans (albeit a shrinking majority) support the use of armed UAVs, international public support is quite weak.[55] Public concerns and international controversy may make it more difficult for U.S. democratic allies to acquire and use armed UAVs in U.S.-supported military operations, while also making it more difficult for the United States to effectively criticize acquisition and use of armed UAVs by U.S. adversaries. Moreover, this lack of international support for the way the United States is using its armed UAVs could make it harder to take the lead in shaping international norms consistent with U.S. practices.

Past and Current Efforts in Designing International Norms for Military Technologies

As in past efforts to define international norms for specific weapon systems, another challenge will be balancing the twin goals in military operations of operational flexibility and restraint. In the case of armed UAVs, there is the specific issue of clearly defining norms that preserve the rights of countries to use these systems in legitimate ways against legitimate threats (e.g., senior al Qaeda–affiliated terrorists) while constraining illegitimate uses (e.g., political dissidents).

The Convention on Certain Conventional Weapons, the Mine Ban Treaty, and the DoD Directive on Autonomy in Weapon Systems are examples of technologies where this has been attempted, albeit with mixed results. But they provide useful background for the issues that the United States will need to consider in addressing armed UAVs, including how much of a leadership role that it will wish to take. For each of these regimes, Table 4 describes their guidelines on the use of the new technology, whether the United States played a leadership role in developing norms, and whether U.S. actions may have affected the actions of other states. In these examples, two kinds of norms predominate: norms that emphasize transparency and norms that restrict use.

What might be learned from these three examples for the potential design of international norms for armed UAVs? The examples of blinding lasers and autonomous weapon systems highlight the advantages of the United States taking a leadership role in shaping international norms to build general agreement on the risks of such systems and the advantages to implementing some restrictions on their use, while avoiding others.

In the case of blinding lasers, the United States was able to delineate legitimate and illegitimate uses of lasers, thereby protecting its ability to use and transfer many types of lasers critical to today's battlefields. In the case of autonomous weapon systems, the United States has established guidelines for future development, use, and international transfers and has removed some of the mystery surrounding these systems by describing what they are, their risks, and organizational roles and responsibilities (which are important to ensuring future accountability, transparency, and adherence to rule of law). The United States could take similar approaches with

armed UAVs, working with international partners to clarify the application of international law of war and domestic rule of law principles. It could also develop guidelines concerning development, use, and transfers.

U.S. reluctance to accede to the Mine Ban Treaty may serve as a warning about the diplomatic and political challenges that arise when the United States finds itself in the minority in resisting an international norm. One might argue that, at a minimum, the United States must make the best of a bad situation, should it find itself in such a position with armed UAVs in the future. As with the Mine Ban Treaty, the United States could follow standards unilaterally and promote responsible ways to reduce risk without acceding to an international regime. It could remain engaged in international forums even when it does not agree with the views of the majority or sign onto final agreements. In any event, the challenges it faced in discussions over the Mine Ban Treaty may provide important warnings about the potential pitfalls of international negotiations.

Based on lessons from these three cases, the United States could seek guidelines that limit a clearly defined set of practices that legal experts and political leaders agree violate international laws of war. At the same time, other uses of armed UAVs would not be restricted under such guidelines. They might also emphasize standards for military training, doctrine, and procedures that reduce risk of misuse and strengthen oversight. Finally, as in the case of the Mine Ban Treaty, guidelines might establish procedures that promote international cooperation and transparency.

A Possible Way Ahead

Ultimately, changes to U.S. armed UAV policies and efforts to shape international norms should be based on evaluating and balancing competing risks. On the one hand, decisionmakers must consider the risks to U.S. counterterrorism and other missions that might come from more transparent and restrictive armed UAV policies. On the other hand, there may be longer-term risks that—without U.S. policy changes and

Table 4: New Technologies and International Norms

Weapon Technology	International Regimes	Guidelines on Use	U.S. Role in International Norms Development	Role of U.S. Actions in Affecting International Use
Blinding lasers	Convention on Certain Conventional Weapons (CCW)	Prohibits use of lasers designed to cause permanent blindness; other lasers not restricted	No, then yes	Yes
Antipersonnel landmines	Mine Ban Treaty CCW	Ban on landmines used against people; anti-vehicle mines not restricted	No	Unclear
Autonomous weapon systems	DoD Directive on Autonomy in Weapon Systems	Restricts development of fully autonomous weapon systems and establishes guidelines for use	Yes	TBD

NOTE: For background on these regimes, see William Arkin, "U.S. Blinding Laser Weapons," Human Rights Watch Arms Project, May 1995. As of July 23, 2013: http://www.hrw.org/reports/pdfs/u/us/us955.pdf
Louise Doswald-Beck, "New Protocol on Blinding Laser Weapons," International Committee of the Red Cross, June 30, 1996. As of July 23, 2013: http://www.icrc.org/eng/resources/documents/misc/57jn4y.htm
Human Rights Watch, "United States: The Time Has Come to Ban Landmines," March 1, 2013. As of August 28, 2013: http://www.hrw.org/news/2013/03/01/united-states-time-has-come-ban-landmines
Human Rights Watch, "Review of the 2012 US Policy on Autonomy in Weapons Systems," April 16, 2013. As of July 23, 2013: http://www.hrw.org/news/2013/04/15/review-2012-us-policy-autonomy-weapons-systems
U.S. Department of Defense, "Autonomy in Weapon Systems," Department of Defense Directive 3000.09, November 21, 2012. As of July 23, 2013: http://www.dtic.mil/whs/directives/corres/pdf/300009p.pdf
U.S. Department of State, "To Walk the Earth in Safety," 2012. As of July 23, 2013: http://www.state.gov/t/pm/rls/rpt/walkearth/2012/index.htm
United Nations, "Protocol on Blinding Laser Weapons (Protocol IV to the 1980 Convention)," U.N. Convention on Conventional Weapons, October 13, 1995. As of August 16, 2013: http://www.icrc.org/applic/ihl/ihl.nsf/Treaty.xsp?action=openDocument&documentId=70D9427BB965B7CEC12563FB0061CFB2
United Nations, "Convention on the Prohibition of the Use, Stockpiling, Production and Transfer of AntiPersonnel Mines and on Their Destruction," September 18, 1997. As of August 16, 2013: http://www.un.org/Depts/mine/UNDocs/ban_trty.htm

without international norms—other governments and substate groups may acquire and use armed UAVs in ways that threaten regional stability, laws of war, and the role of domestic rule of law in decisions to use force.

For those concerned about these longer-term risks—particularly from operations outside war zones—the United States has these steps available to shift from a defensive position to a proactive approach, adjusting its own policies and processes to provide a foundation for shaping international norms.

International Norms

First, the use of lethal force in another country—including outside a recognized war zone—would generally be conducted by militaries and with a transparent chain of command. Second, national legislatures—as representatives of the public—would be set up with a clear, institutionalized mechanism to exert oversight for military operations conducted within and outside of recognized war zones. Third, law of war principles would be followed with a level of rigor that is recognized by citizens and international observers. Fourth, the legal basis for use of force would be made clear for each case in which force is used. Finally, use of force outside war zones would be limited to individuals who are positively identified as posing an imminent threat, are legitimate targets under the law, and cannot be feasibly captured, while civilian casualties are avoided. None of these norms would be unique to armed UAVs, but could require particular emphasis, given the concerns that have arisen over their use outside recognized war zones.

U.S. Leadership and Potential Forums

U.S. leadership in shaping norms like these is important to prevent either of two extremes. Overly restrictive norms may deter allies from obtaining armed UAVs and could restrict U.S. use. A lack of norms, on the other hand, may make it more difficult for the United States and its allies to discourage others from acquiring and using armed UAVs in ways that threaten regional stability or the laws of war.

The United States could help develop norms and shape behavior in two ways: through international forums and through its actions. In terms of armed UAV use, both the International Committee of the Red Cross (ICRC) and the United Nations are already involved in discussions about armed UAVs and other methods for targeted strikes. Strengthening its own transparency and oversight guidelines for using armed UAVs could place the United States in a better position to engage in these forums. At least in terms of use in war zones, the ICRC has indicated armed UAVs might offer advantages: ". . . any weapon that makes it possible to carry out more precise attacks, and helps avoid or minimize incidental loss of civilian life, injury to civilians, or damage to civilian objects, should be given preference over weapons that do not . . . This issue is the subject of ongoing debate—due, among other things, to a lack of information on the effects of most drone strikes."[56] Greater engagement could help the United States shape such efforts under way.

U.S. Actions

Another action would be for the United States to develop public guidelines modeled on DoD's directive on autonomous weapon systems. If the United States can set guidelines for systems that do not yet exist, it should be possible to establish a directive that defines policies, terminology, and organizational roles and responsibilities for systems that have now been deeply embedded into America's national security apparatus. In addition to such guidelines, the United States could produce a series of statements or a code of conduct based on the laws of war and U.S. policies. Such a code could serve as a foundation upon which the government could clearly and consistently articulate the standards and the rationale underlying all armed UAV strikes.

In addition, these norms could serve as internal U.S. guidelines for weapons transfer, and the United States could condition any future transfers of armed UAVs to other countries on the norms of use it develops. Most importantly, the United States could assess how well its existing policies line up with existing practices. If, as senior officials have said, it is targeting senior operational leaders of al Qaeda or associated groups who pose an imminent threat of attack on the United States, it might consider how it could publicly make that case as part of its process for developing targeting lists.

As Micah Zenko from the Council on Foreign Relations points out, "History shows that how states adopt and use new military capabilities is often influenced by how other states have—or have not—used them in the past . . . A well-articulated and internationally supported normative framework, bolstered by a strong U.S. example, can shape armed drone proliferation and employment in the coming decades."[57] Such an approach would pose numerous challenges but might strengthen the chances of long-term U.S. public support and allied cooperation, and strengthen the U.S. diplomatic hand when dealing with states that fail to follow international norms.

APPENDIX: DESCRIPTION OF THE MTCR AND WASSENAAR ARRANGEMENT

Concerns about the spread of missiles capable of carrying nuclear weapons in the late 1980s led to the creation of the MTCR.[1] Discoveries about how easily Iraq acquired industrial equipment for WMD and conventional arms prior to the first Gulf War led to the creation in the 1990s of an international regime to increase transparency in the global market in conventional arms, namely the Wassenaar Arrangement.

Armed UAVs are covered in each of these organizations. Thus, U.S. policymakers have available export control regimes and potential partners to limit their proliferation. At the same time, the guidelines of these regimes are not in any way legally binding, as the partners have carefully protected their sovereign right to make weapon transfers deemed legitimate.

Here, we describe briefly these regimes and the ways they seek to control the export of missiles (in the case of the MTCR) and to prevent the dangers associated with the accumulation of conventional arms (in the case of the Wassenaar Arrangement).

MTCR

Background: Guidelines and Control Lists

Created in 1987 to address the proliferation of nuclear weapons by preventing the transfer of the most destabilizing delivery system, MTCR covered both ballistic missiles and cruise missiles. Falling within the category of cruise missiles, UAVs are covered, and because unarmed UAVs can be deployed with weapons, both are included. Manned aircraft are explicitly excluded.

With growing concerns over the delivery of other types of WMD, the regime extended its mandate in 1992 to include missiles for the delivery of chemical and biological weapons. The regime also seeks to limit the risk of controlled items and their technology falling into the hands of terrorist groups and individuals.

To have confidence in preventing missile proliferation, the regime includes not only the missiles themselves but also their associated equipment and technologies. The MTCR has a set of "Guidelines for Sensitive Missile-Relevant Transfers" as well as a common list of controlled items in the "Equipment, Software, and Technology Annex." The Annex is divided into two parts (Category 1 and Category II) and includes virtually all equipment, materials, software, and technology needed for missile development, production, and operation. While the Guidelines consist of only eight paragraphs, the Annex goes into extraordinary detail with respect to the controlled items, and it is continually updated.

The Guidelines call for the exercise of restraint in transfers of items on its lists and consideration on a case-by-case basis, while being clear that individual governments will make these decisions in accordance with their national legislation. There is no legal obligation. Other partners do not have a veto on transfers, or even advance notice of transfers. There are no penalties for failing to abide by the regime requirements.

The regime makes a distinction in terms of the type of restraint to be exercised based on the missile performance (range and payload) and the intended purpose (delivery of WMD or not). Category I missiles are those with the capability to deliver at least 500 kg payload to a range of at least 300 km.[2] If a Category I item is included in a system, that system will also be considered as Category I, unless the item cannot be separated, removed, or duplicated. Category II missiles are those capable of a range of at least 300 km, regardless of their payload.

Using the language in the regime Guidelines and documents, this is how restraint is to be exercised:

- **Category I items:** "particular restraint" regardless of their purpose and strong presumption of denial[3]
- **All items listed in Annex and any missiles (whether or not in Annex) judged to be intended for use in the delivery of WMD:** "particular restraint" and a strong presumption of denial[4]
- **Other items listed in Annex and not covered above:** authorized "only on rare occasions" and with assurances from recipient government with respect to the intended end use.[5]

Translating these requirements into actual practice has proven to be difficult and often a matter of debate both inside governments and with other partners, not to mention by weapons manufacturers. The main reason is that while the purpose of the MTCR is to prevent the proliferation missiles capable of delivering WMD, the restrictions are based on missile performance. The link is that any missile with the specified Category I and Category II capabilities can inherently deliver WMD. The same restraint for Category I capabilities is also exercised for any missile (regardless of range) or related item, if it is judged to be for the delivery of WMD.

MTCR partners exchange information as to how they are applying the Guidelines, including notification of both transfers and denials of export licenses. They are also bound to consult before exporting an item that another member has denied, the so-called "no-undercut" provision.[6]

Over the years, these Guidelines have been interpreted through the actual practice of transfers, by the individual governments, and through the discussions of partners as to their licensing practices during annual meetings and technical working groups. The overall effectiveness of the regime has been enhanced by the regime expanding its membership, as partners commit to applying the Guidelines and introduce the necessary national export controls. The number of partners now totals 34 countries. In addition, Israel, Macedonia, Romania, and Slovakia have stated that they will unilaterally adhere to the MTCR. China has voluntarily pledged in the past to abide by the MTCR Guidelines, and its application for membership is under review. Partners also seek to encourage nonmembers to apply the Guidelines, and they have provided assistance in the introduction of missile export controls.[7]

The Guidelines are silent on how transfers to partners are to be treated, but supplemental MTCR documents make clear that membership "does not involve an entitlement to obtain technology from another Partner and no obligation to supply it." It goes on to state that partners are expected to "exercise appropriate accountability and restraint" in interpartner trade.[8]

Policies and Armed UAVs: Interpreting the MTCR

Applying the MTCR Guidelines for cruise missiles, and thus armed UAVs, becomes especially complicated for a number of different reasons. Technically, the basic technologies are similar to aircraft technologies, and manned aircraft are specially exempted from the MTCR controls. In the Annex, one finds complete UAV systems and production facilities listed under Category I items while certain types of other equipment, such as turbojet and turbo fan engines, listed under Category II items. Further, armed UAVs are inherently capable of delivering WMD, but that has never really been their purpose. So the dangers associated with long-range ballistic and cruise missiles differ from long-range UAVs as they will likely not be armed with WMD but like aircraft with conventional munitions.

Nevertheless, the general approach among MTCR partners has been to exercise restraint on UAVs (armed and unarmed) according to their range/payload, and apply the greatest restraint on Category I UAV items. At the same time, the Guidelines permit governments to take into account the purpose or intended use by the recipient country in their transfer decisions; i.e., whether it is likely to involve WMD. There is no explicit recognition of a difference between armed and unarmed UAVs in the MTCR guidance, for reasons having to do with how easily an unarmed UAV can be armed. But safeguards are included in the Guidelines to provide assurance as to the end-use of controlled items. One of these is through a postshipment inspection.[9]

MTCR restrictions are also not absolute, as in the language citing "rare occasions" and only a "presumption of denial" even for Category I transfers.[10] The United States has sold Category I items to its allies. There is also a report that the United States proposed UAV-related changes to the MTCR Annex in 2012 that would have involved moving some UAVs currently categorized under Category I to Category II. While no consensus was achieved, the United States apparently was looking to design more flexibility for UAV transfers.[11]

WASSENAAR ARRANGEMENT

Background: Guidelines and Control Lists

Not surprisingly, designing an international regime to control the transfer of conventional arms and technologies has been far more difficult, given the importance of such weapons to a nation's self-defense and how rarely consensus forms as to when sales are destabilizing.[12] There are also strong industry pressures in all countries for governments to sell conventional arms.

With the demise of the Coordinating Committee for Multilateral Export Controls (CoCom)—created during the Cold War to deny arms exports to the Soviet Union and Eastern European countries—the United States took the initiative to put in place a new organization, which came to be known as the Wassenaar Arrangement. The purpose of the organization is to "contribute to regional and international security and stability," and its charter is to "promote transparency and greater responsibility" in transfers of armaments and sensitive dual-use goods and technologies for military end-uses. It focuses on preventing "destabilizing accumulations" of conventional arms and dual-use technologies in a region or by a state whose behavior "is, or becomes, a cause for serious concern to the Participating States."

This carefully negotiated language represented a consensus on the part of the founding members to find ways, through discussions and exchanges of information, to cooperate on conventional arms transfers without naming individual countries for

export restraint or in any way giving up their national prerogative to make decisions. Like the other nonproliferation regimes, the Wassenaar Arrangement is based on national licensing decisions and export controls. Efforts on the part of the United States to introduce more stringent requirements, including for prior notification of transfers, were rejected.[13]

Since the beginning of the regime, the members have conformed their national policies and controls to prevent the transfers of conventional arms and technologies to Iran and North Korea. In December 2001, in the aftermath of the September 11 attacks, members took the formal step of agreeing to prevent the acquisition of conventional arms and dual-use technologies by terrorist groups and organizations. The regime has also agreed to "exercise maximum restraint" in exports to the Great Lakes region of Africa, designed best-practice guidelines to prevent destabilizing transfers of small arms and light weapons, called for maximum restraint in transfers of MANPADs, and defined nonbinding criteria to help governments determine whether exports could lead to destabilizing accumulations.

The members of the Wassenaar Arrangement have agreed to global control of all items set forth on a List of Dual-Use Goods and Technologies and on a Munitions List, with the goal of preventing unauthorized transfers or retransfers of these items. The dual-use list has two annexes: Sensitive and Very Sensitive. Governments have agreed to exercise extreme vigilance in trade on the Very Sensitive List, which includes, for example, stealth technology materials and advanced radar.

The provision for sharing information provides the basis for individual nations to raise countries and regions where the members could coordinate their transfer policies to prevent "destabilizing accumulations" of conventional arms and toward counties whose "behavior is, or could become, a cause for serious concern." The first appendix to the Guidelines describes the "principal elements of the general information exchange" and these apply only to non-Wassenaar states. This provides a basis for informing members about their national export policies (where there could be questions from other members), about projects in nonmember counties that are of concern (and thus call for attention in terms of potential exports), and about acquisition activities in nonmember countries (where concern could be warranted).

Coordination of policies is also enhanced by the provision for notifying transfers to non-Wassenaar states on the Sensitive and Very Sensitive Lists, and denials with respect to all items on the List of Dual-Use Goods and Technologies. Members can also request information on specific transfers, but this is to be conducted only through diplomatic channels. Denials of items on the Sensitive List and Very Sensitive List are to be made on an early and timely basis. A denial notification does not impose an obligation on other states to deny such a transfer themselves, though states must give notice when approving a license that has been denied by another member. Members exchange information every six months on deliveries to non-Wassenaar states of conventional arms on the Munitions List.

The Wassenaar regime has been plagued by differences over its scope and even the voluntary information exchanges and notifications, reflecting a fundamental lack of consensus on what policies should be in place to control the transfers of conventional arms. Most members resist singling out countries for restricting exports, and there is no agreement as to what constitutes a "destabilizing" transfer. While the membership does include many exporters of conventional arms and associated technologies, neither China nor Israel has been admitted because the criteria for participation include a country carrying out the guidelines of all the other nonproliferation regimes and having effective export controls in place.

Policies and Armed UAVs: Interpreting the Wassenaar Arrangement

The regime's Munitions List includes UAVs and related equipment, including launchers, ground support equipment, and equipment designed for command and control. The information to be exchanged on deliveries of UAVs to nonparticipating states covers "unmanned aerial vehicles, specially designed, modified, or equipped for military use including electronic warfare, suppression of air defence systems, or reconnaissance missions, as well as systems for the control and receiving of information from unmanned aerial vehicles."[14]

UAVs and related systems, equipment, and components are also listed on the Dual-Use Goods List, but not on the Sensitive or the Very Sensitive lists. So there is a requirement for the United States to have controls on the exports of UAV goods and technologies, but not for any notification of transfers. There would only be a requirement for notifying licenses that were denied.

NOTES

[1] In this report, we use the term UAVs—even though the more popular name is drones and the more correct term is unmanned aerial system (UAS)—because what we are looking at is a system that involves not only a vehicle but also the means of control.

[2] This report is not focused on cruise missiles, though we recognize they have played a vital role in modern warfare since the Cold War and will play an important role in future conflicts. Cruise missiles have been covered by arms control agreements and by export control regimes going back to the 1970s.

[3] Although flight control software has improved enormously in recent decades, the lack of software was generally not a major issue in the development of armed UAVs. Autopilots have been around for a century. They have been landing aircraft since 1947. What has changed is that aircraft equipped with GPS can easily locate a landing field without other assistance.

[4] MTCR defines systems according to their range and payload. Category I systems are capable of delivering a payload of at least 500 kg to a range of at least 300 km; Category II missiles are capable of a range of at least 300 km, regardless of payload. See the appendix of this report for a description of the MTCR. MTCR, *The Missile Technology Control Regime*, web page, undated. As of March 9, 2014: http://www.mtcr.info/english/

[5] It should be noted that while the baseline RQ-7 Shadow is an unarmed UAV, armed variants have been tested. More generally, UAVs initially designed to be unarmed can be adapted with relative ease to carry weapons, so we include them in our categories.

[6] The Federal Aviation Administration (FAA) has chosen development sites in six states to integrate commercial unmanned systems into the nation's airspace. Sean Reilly, "FAA Chooses Sites for UAS Testing and Development," *Federal Times*, December 30, 2013. As of March 9, 2014: http://www.federaltimes.com/article/20131230/MGMT06/312300002/FAA-chooses-sites-UAS-testing-development

[7] For background on such use, see John Arquilla and David Ronfeldt, *Swarming and the Future of Conflict*, Santa Monica, Calif.: RAND Corporation, DB-311-OSD, 2005. As of March 9, 2014: http://www.rand.org/pubs/documented_briefings/DB311.html

[8] For a discussion of the threat to the United States from nonstate actors using cruise missiles, see Brian A. Jackson, David R. Frelinger, Michael J. Lostumbo, and Robert W. Button, *Evaluating Novel Threats to the Homeland*, Santa Monica, Calif.: RAND Corporation, MG-626-DTRA, 2008. As of March 9, 2014: http://www.rand.org/pubs/monographs/MG626.html

[9] Gili Cohen, Barak Ravid, Jack Khoury, and The Associated Press, "IDF Shoots Down Drone from Lebanon Opposite Haifa Coast," Haaretz, April 25, 2013.

[10] See Dana A. Shea, *Chemical Weapons: A Summary Report of Characteristics and Effects,* Congressional Research Service, December 13, 2012; and Milton Leitenberg, *Assessing the Biological Weapons and Bioterrorism Threat,* Army War College, December 2005.

[11] Glennon J. Harrison, *Unmanned Aircraft Systems (UAS): Manufacturing Trends,* Congressional Research Service, January 30, 2013, p. 2.

[12] Harrison, 2013, p. 3; source of the chart on that page is Teal Group, *World UAV Systems 2012: Market Profile and Forecast,* 2012.

[13] U.S. Government Accountability Office, *Nonproliferation: Agencies Could Improve Information Sharing and End-Use Monitoring on Unmanned Aerial Vehicle Exports,* Washington, D.C., GAO-12-536, July 2012, p. 10; J. R. Wilson, *2013 Worldwide UAV Roundup,* American Institute of Aeronautics and Astronautics, July–August 2013.

[14] U.S. Department of Defense, *Unmanned Systems Integrated Roadmap: FY2013–2038,* Washington, D.C., December 2013, p. 5.

[15] Office of the Under Secretary of Defense (Comptroller)/Chief Financial Officer, *Budget Briefing: Fiscal Year 2013 Budget Request*, Washington, D.C.: DoD, February 2012.

[16] Reports indicate a 33.4-percent reduction from FY 2013 to FY 2014. See U.S. Department of Defense, *Unmanned Systems Integrated Roadmap: FY2013–2038,* Washington, D.C., December 2013, p. 4; Samuel J. Brannen, *Sustaining the U.S. Lead in Unmanned Systems*, Washington, D.C., Center for Strategic and International Studies, February 2014, p. 2.

[17] Dan Parsons, "Worldwide, Drones Are in High Demand," *National Defense Magazine*, May 2013.

[18] Wilson, 2013.

[19] Between 2011 and 2013, one report noted a 30-percent increase in the number of countries developing UAVs. See Wilson, 2013.

[20] Data were compiled using Wilson, 2013; Aeronautics and Astronautics, "2011 Worldwide UAV Roundup"; and information on unmanned aircraft systems in the Military Periscope database, undated. As of August 29, 2013: https://www.militaryperiscope.com/index1.shtml

[21] MTCR defines systems according to their range and payload. Category I missiles are capable of delivering a payload of at least 500 kg to a range of at least 300 km; Category II missiles are capable of a range of at least 300 km, regardless of payload. See the appendix of this report for a description of the MTCR.

[22] Indeed, many micro-UAVs can only be used indoors or in situations with little wind.

[23] Iran is developing longer-range (more than 1,000 km) armed systems that are characterized as Category I systems. Also, we note that the reported range of the Ababil is disputed, with some sources indicating a range of 150 km with others reporting a longer operational range. For our analysis, we group Ababil as a Category II system with consideration given to its potential maximum range.

[24] Military Periscope database, "Ababil," last updated May 1, 2012.

[25] MTCR website, undated.

[26] We note that the first Predator flew in 1994 and the first guided missile launch from a Predator was in 2001.

[27] One recent report indicates that the United States has exported armed UAVs to the United Kingdom, but no other countries to date. See Brannen, p. 12.

[28] Michel Cabirol, "France Expects U.S. Approval on Unarmed Reaper Sales by Year End," Reuters, April 5, 2013; Defense Security Cooperation Agency, "France—MQ-9 Reapers," Washington, D.C., June 27, 2013.

[29] The U.S. notification of sale for Italy lists these systems as unarmed (see Defense Security Cooperation Agency, "Italy—MQ-9 Unmanned Aerial Vehicles," Washington, D.C., November 19, 2009). The U.S. notification of sale for the United Kingdom does not explicitly state these as unarmed; however, there is no mention of a specific weapon as part of the sale. See Defense Security Cooperation Agency, "United Kingdom—MQ-9 Unmanned Aerial Vehicle Aircraft," Washington, D.C., January 3, 2008.

[30] Harriet Sherwood, "Israel Is World's Largest Drone Exporter," *Guardian*, May 20, 2013; "Israeli Military Exports Hit Record $7.5B," UPI, July 26, 2013.

[31] Peter Bergen and Jennifer Rowland, "A Dangerous New World of Drones," CNN, October 8, 2012. As of March 9, 2014: http://www.cnn.com/2012/10/01/opinion/bergen-world-of-drones

[32] Peter W. Singer and Thomas Wright, "Memorandum to the President: An Obama Doctrine on New Rules of War," Brookings Institution, January 17, 2013. As of March 9, 2014: http://www.brookings.edu/research/papers/2013/01/an-obama-doctrine-on-new-rules-of-war

[33] Singer and Wright, 2013; David Cortright, "License to Kill," *How Drones Are Changing Warfare*, CATO Unbound website, January 2012. As of March 9, 2014: http://www.cato-unbound.org/2012/01/09/david-cortright/license-kill

[34] For a discussion of so-called "Revolutions in Military Affairs," see, among others, Eliot Cohen, "A Revolution in Warfare?" *Foreign Affairs*, March/April 1996. As of March 9, 2014: http://www.foreignaffairs.com/articles/51841/eliot-a-cohen/a-revolution-in-warfare
See also Andrew Krepinevich, "From Cavalry to Computer: The Pattern of Military Revolutions," *The National Interest*, Fall 1994, pp. 30–42; and, for a more skeptical view, Stephen Biddle, "Afghanistan and the Future of Warfare," *Foreign Affairs*, Vol. 82, No. 2, March/April 2003, pp. 31–46.

[35] "The Shadow of Ypres," *The Economist,* August 31, 2013. As of March 9, 2014: http://www.economist.com/news/briefing/21584397-how-whole-class-weaponry-came-be-seen-indecent-shadow-ypres

[36] As previously noted, innovations involving stealth technologies could alter these conclusions, but none are likely to happen soon.

[37] Operating and maintaining advanced sensor, communications, and ground-station equipment systems could be a challenge for third-world air forces.

[38] "U.S. Readies Sale of Reaper Drones to France," SpaceWar website, July 15, 2013. As of March 9, 2014: http://www.spacewar.com/reports/US_readies_sale_of_Reaper_drones_to_France_999.html

[39] See the earlier discussion of terrorist use of armed UAVs for delivering WMD.

[40] Donna Miles, "Coalition Jets Shoot Down Iranian Drone over Iraq," DoD, March 16, 2009. As of March 9, 2014: http://www.defense.gov/News/NewsArticle.aspx?ID=53495

[41] See Presidential Policy Directive—United States Conventional Arms Transfer Policy, January 15, 2014, for a description of U.S. goals in transferring conventional arms as well as in promoting restraint. As of March 9, 2014: http://www.whitehouse.gov/the-press-office/2014/01/15/presidential-policy-directive-united-states-conventional-arms-transfer-p

[42] This is the case, notwithstanding Air Force documents and commentaries that refer to the MTCR as "not permitting the sale" and "limiting the export" of long-range UAVs to other nations. See Secretary of the Air Force, *The US Air Force Remotely Piloted Aircraft and Unmanned Aerial Vehicle Strategic Vision*, Washington, D.C.: Government Printing Office, 2005; Lt Col Ken Callahan, USAF, "Enhancing National Security Cooperation Policy with Remotely Piloted Aircraft," *DISAM Journal*, November 7, 2012. As of March 9, 2014: http://www.disamjournal.org/articles/enhancing-national-security-cooperation-policy-with-remotely-piloted-aircraft-786

[43] This is also the case for Russia and South Africa, which are members of the MTCR and are developing long-range armed UAVs.

[44] There have also been reports of a drone strike in the Philippines in 2006. See Mark Mazzetti, "The Drone Zone," *New York Times*, July 6, 2012. As of July 21, 2013: http://www.nytimes.com/2012/07/08/magazine/the-drone-zone.html?_r=3&pagewanted=1&

[45] Scott Shane, "Election Spurred a Move to Codify U.S. Drone Policy," *New York Times*, November 24, 2012. As of March 9, 2014: http://www.nytimes.com/2012/11/25/world/white-house-presses-for-drone-rule-book.html?pagewanted=all
See also Justin Elliott, "Have U.S. Drones Become 'a Counterinsurgency Air Force' for Our Allies?" *Pro Publica*, November 27, 2012. As of March 9, 2014: http://www.propublica.org/article/have-u.s.-drones-become-a-counterinsurgency-air-force-for-our-allies

[46] Micah Zenko, "Reforming U.S. Drone Strike Policies," Council on Foreign Relations, January 2013, p. 12. As of March 9, 2014: http://s3.documentcloud.org/documents/553587/drone-report-cfr.pdf

[47] Senate Armed Services Committee, "Hearing to Receive Testimony on the Law of Armed Conflict, the Use of Military Force, and the 2001 Authorization for Use of Military Force," May 16, 2013. As of March 9, 2014: http://www.armed-services.senate.gov/hearings/oversight-the-law-of-armed-conflict-the-use-of-military-force-and-the-2001-authorization-for-use-of-military-force

[48] Peter Singer, "Do Drones Undermine Democracy?" *New York Times*, January 21, 2012.

[49] Shane, 2012.

[50] Zenko, 2012, p. 8.

[51] "Attorney General Eric Holder Speaks at Northwestern University School of Law," Department of Justice transcript, March 5, 2012. See also Eric Holder, Attorney General, letter to Vermont Senator Patrick J. Leahy, May 22, 2013. Law of war principles include: (1) necessity—the requirement that the target have definite military value; (2) distinction—the idea that only military objectives may be intentionally targeted and that civilians are protected from being intentionally targeted; (3) proportionality—the notion that the anticipated collateral damage of an action cannot be excessive in relation to the anticipated military advantage; and (4) humanity—a principle that requires use of weapons that will not inflict unnecessary suffering.

[52] John Brennan, "The Efficacy and Ethics of U.S. Counterterrorism Strategy," Woodrow Wilson Center transcript, April 30, 2012. As of March 9, 2014: http://www.wilsoncenter.org/event/the-efficacy-and-ethics-us-counterterrorism-strategy

[53] President Obama, "Remarks by the President at the National Defense University," May 23, 2013. As of March 9, 2014: http://www.whitehouse.gov/the-press-office/2013/05/23/remarks-president-national-defense-university

[54] See, for example, Danya Greenfield, "Obama's Drone Speech Misses the Mark," *Foreign Policy*, June 4, 2013. As of March 9, 2014: http://mideast.foreignpolicy.com/posts/2013/06/04/obama_s_drone_speech_misses_the_mark

[55] A Pew Research Center survey released July 18, 2013, found that 82 percent of Turks disapprove of the Obama administration's international campaign of drone attacks against extremists. Craig Whitlock, "U.S. Shifts Drones to New Frontiers," *Washington Post*, July 21, 2013, p. 1. See also Washington Post–ABC News Poll, February 4, 2012. As of March 9, 2014:
http://www.washingtonpost.com/wp-srv/politics/polls/postabcpoll_020412.html
See also Pew Research Center Global Attitudes Project, June 13, 2012; and Zenko, 2012, p. 23. A March 2013 survey found that only 5 percent of Pakistanis approved armed UAV strikes targeting extremists, while 68 percent disapproved, with 74 percent expressing concern that the strikes killed too many innocent people. Bruce Drake, "Obama and Drone Strikes: Support but Questions at Home, Opposition Abroad," Pew Research Center, May 24, 2013. As of March 9, 2014:
http://www.pewresearch.org/fact-tank/2013/05/24/obama-and-drone-strikes-support-but-questions-at-home-opposition-abroad/

[56] ICRC, "The Use of Armed Drones Must Comply with Laws," interview with ICRC President Peter Maurer, May 10, 2013. As of March 9, 2014: http://www.icrc.org/eng/resources/documents/interview/2013/05-10-drone-weapons-ihl.htm
See also Philip Alston, "Study on Targeted Killings," United Nations Human Rights Council, A/HRC/14/24/Add.6, May 28, 2010.

[57] Zenko, 2012, p. 25.

Appendix Notes

[1] This description of the MTCR is drawn from the MCTR website. The site includes the Guidelines and Annex, as well as a list of partners, answers to frequently asked questions, and a description of MTCR and trade. See also NTI, *Missile Technology Control Regime*, June 27, 2013. As of March 9, 2014: http://www.nti.org/treaties-and-regimes/missile-technology-control-regime-mtcr/

[2] This combination of range and payload capability was defined initially as the minimum weight of a first-generation nuclear warhead and the minimum distance of a strategic strike. See Arms Control Association, *The Missile Technology Control Regime at a Glance*, August 2012. As of March 9, 2014: http://www.armscontrol.org/factsheets/mtcr

[3] "These items include complete rocket systems (including ballistic missiles, space launch vehicles and sounding rockets) and unmanned aerial vehicle systems (including cruise missile systems, target drones and reconnaissance drones) with capabilities exceeding a 300 km/500 kg range/payload threshold; production facilities for such systems; and major sub-systems including rocket stages, re-entry vehicles, rocket engines, guidance systems and warhead mechanisms." *MTCR Annex Handbook*, 2010, p. iii.

[4] The provision that includes missiles not in the Annex is referred to as a "catch-all export control" and was added to the MTCR Guidelines in 2003. See MTCR website, *Frequently Asked Questions*, Number 12, undated. As of March 5, 2014: http://www.mtcr.info/english/FAQ-E.html

[5] "The remainder of the annex is regarded as Category II, which includes complete rocket systems (including ballistic missile systems, space launch vehicles and sounding rockets) and unmanned aerial vehicles (including cruise missile systems, target drones and reconnaissance drones) not covered in Item [Category] I, capable of a maximum range equal to or greater than 300 km. Also included are a wide range of equipment, material, and technologies, most of which have uses other than for missiles capable of delivering WMD." MTCR, 2010, p. iii.

[6] MTCR, *Frequently Asked Questions*, Number 14.

[7] The MTCR goal of preventing the proliferation of missiles and their associated technologies is reinforced by UN Security Council Resolution 1540 (which requires all UN member states to have proliferation-relate controls, including on missiles), the Hague Code of Conduct Against Ballistic Missile Proliferation, and the Proliferation Security Initiative (where countries have committed to cooperate in interdicting trade in missiles and other dangerous weapons).

[8] MTCR, *Frequently Asked Questions*, Number 14.

[9] MTCR website, *MTCR and Trade*, undated. As of March 8, 2013: http://www.mtcr.info/english/trade.html

[10] See "Missile Control: An Interview with Deputy Assistant Secretary of State Vann Van Diepen," *Arms Control Today*, July/August 2012. According to Van Diepen, "The whole thrust of the guidelines for these Category I systems [is that] the first answer is no and then there has to be a really good reason to be able, on what you can justify as a rare occasion, to overcome that strong presumption of denial. We've been at this long enough that we've got sort of internal understandings and rules of the road that help us apply that on a reasonably consistent basis."

[11] U.S. Government Accountability Office, *Nonproliferation: Agencies Could Improve Information Sharing and End-Use Monitoring on Unmanned Aerial Vehicle Exports*, GAO-12-536, July 2012, pp. 20–21.

[12] This description of the Wassenaar Arrangement is drawn from its website, which includes pages on Guidelines and Procedures, Frequently Asked Questions, and Control Lists. See also NTI, *Wassenaar Arrangement*, undated. As of March 9, 2014: http://www.nti.org/treaties-and-regimes/wassenaar-arrangement/
See also *The Wassenaar Arrangement at a Glance*, October 2012. As of March 9, 2014: http://www.armscontrol.org/factsheets/wassenaar

[13] For background on the origins of the Wassenaar Agreement and the negotiations, see James A. Lewis, "Looking Back: Multilateral Arms Transfer Restraint: The Limits of Cooperation," *Arms Control Today*, November 2005. As of March 9, 2014: http://www.armscontrol.org/act/2005_11/NOV-LOOKINGBACK

[14] Wassenaar Arrangement, Appendix 3, 4.2.

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About This Report

Armed drones are making headlines, especially in their role in targeted killings. Some suggest that these weapons are transformative and others that they will proliferate widely, creating the kinds of global dangers that call for new arms control efforts.

This report focuses on the technologies that go into developing armed drones and how they might be used, concluding that while they offer significant capabilities to their users, especially in counterterrorism operations, they are really not revolutionary. While they will proliferate around the world, only a few rich countries will be in a position to develop the higher-technology and longer-range systems. U.S. adversaries and others will likely find weapons such as aircraft more militarily and cost-effective. Their proliferation will not create the kinds of global dangers that call for new arms control efforts, but the risks to regional stability cannot be dismissed entirely, as is the case of any conventional weapon. How the United States will use these weapons today and into the future will be important in shaping a broader set of international norms so as to discourage their misuse by others.

This report will be of interest to officials involved in the development and acquisition of armed drones and to policymakers engaged in their sales to allies and in preventing the dangers of their proliferation.

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