White Paper

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Liechtenstein Institute
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at Princeton University

DRONES FOR PEACE

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Abstract

Remotely Piloted Aircraft (RPAs), commonly referred to as "drones," have been the subject of much discussion surrounding potential operations in Syria, primarily in the context of enforcing a "no-fly" zone or enforcement role similar to their role in Libya and modeled after operations in Afghanistan, Pakistan, and Yemen. This LISD White Paper examines the prospects of the use of RPAs in Syria and possible future humanitarian crises. In conflict zones, deploying RPAs as currently operated would likely be counterproductive to political aims in an enforcement capacity. Smaller RPAs, however, operating in a number of tactical and other roles, could play a critical role in ameliorating humanitarian crises—for instance in Syria, Iraq, and elsewhere. Tasks may include monitoring key sites designated by the international community and allowed by the host country government, to providing humanitarian aid, to the over-watch of convoy movements and possible general surveillance functions. The stigma of RPAs given their use in other conflicts and elsewhere must be overcome to allow RPAs to be evaluated and used as an instrument for monitoring, assisting, and aiding in humanitarian crises among other roles, not just as (offensive) intelligence or weapons platforms. Examples of RPA use in natural disasters and relief operations in Southeast Asia and pending models for search and rescue operations in the United States and beyond provide a blueprint for similar RPA operations, with their scope limited by the mutual consent of parties to the conflict.

Foreword

The Liechtenstein Institute at Princeton University (LISD) herewith launches a new publication series, the LISD White Papers. Experts will be invited to address a specific subject relevant to LISD's work in a short-paper format discussing the matter conceptually and concomitantly offer real world assessments. The LISD White Papers will be available both in hard copies and in electronic format, and will soon be available also in a variety of languages. The opinions presented in the LISD White Papers are those of the authors only and do not represent those of LISD.

It is befitting, and hopefully indicative, that this first LISD White Paper offers a critical, detailed, and groundbreaking contribution to the analysis of a key technological innovation in our time: the drone, or remotely piloted aircraft (RPA). Few new (weapon-)flying machines have such significant ramifications on strategic and tactical planning, nationally and internationally, and their effects greatly shape discussions on political, legal, and moral-ethical grounds while, or perhaps because of being unmanned, they are only at the beginning of their technological and autonomous potential. Dr. Michael P. Kreuzer offers a painstakingly researched piece focusing on the intricacies of developing, launching, and integrating RPAs in the organization of the United States Air Force and beyond. He analyzes the potential of and various roles for RPAs, including considerable dual use capabilities. On the example of possible roles and capabilities in the conflict in and around Syria, Kreuzer describes more traditional military and security uses of RPAs, as well as possible humanitarian ones. He also demonstrates the real financial costs which—very much in difference to widespread assumptions—are much more elevated than generally assumed. This is not even to mention the political, technological and organizational complexities of deploying these highly advanced, partly autonomous devises. In addition, their vulnerabilities are much higher in a hot conflict situation. Again, in difference to general assumptions, RPAs can be neutralized relatively easily. Their role and capabilities thus depend on the level of hostility and/or on the risk (and willingness to accept) their loss. Nevertheless, they can assist in tasks from locating and removing WMD, to surveillance and neutralization of certain targets, to—according to Kreuzer—increasingly possible humanitarian assistance and convoy surveillance.

RPAs thus offer new, sophisticated, and increasingly effective tools—however with important legal, moral-ethical, and political ramifications. Many times, their operations as intelligence gathering tools or as deadly weapons platforms in sovereign airspace of recognized states have raised considerable moral, ethical and legal questions and related criticisms. The increased use of RPAs by the Obama administration in West Pakistan, Yemen, and Iraq are cases in point. Frequently they also served well in neutralizing internationally searched for targets, as recently seen in Somalia.

It is to be assumed that many more states and forces will have RPAs soon. As Kreuzer demonstrates, RPAs, equipped with appropriate technologies can have potentially far-ranging new applications from employment in natural disasters, to assisting in relieve operations or in search and rescue missions, to delivery capabilities. In the conduct of crisis diplomacy and international negotiations, RPAs furthermore offer intelligence, intermediary, or tripwire functions to support negotiations and diplomatic efforts in tensed settings where their employment can indicate the preparedness to use "all options on the table" while still remaining below full military operations. The recent use of Austrian RPAs by the Organization of Security and Cooperation in Europe (OSCE) to supervise and monitor the shaky ceasefire between Ukrainian and armed militant separatists is a case in point.

Today an RPA represents the most visible form of the introduction of (semi)autonomous intelligent systems as weapons or other platforms. They can vary in size from being as small as a butterfly to as large as a conventional airplane, with landing capabilities from vertical and/or short takeoff and landing (V/STOL) to landing on aircraft carriers, or simply being caught by a net. Defense against RPAs range from shooting them down to successfully breaking into their software systems while they are airborne, as happened to the "Beast of Kandahar." The development of drones emphasizes robotics, the autonomous operation of intelligent man-made systems (even with the increasing ability also to autonomously make moral decisions), and the capability to assist and/or replace humans on the battlefield, in other inherently dangerous environments, or in theory, anywhere. RPAs contribute to a further reduction of geographical distance and to permit global operation in real time, any time, and increasingly independent of climatic conditions.

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Introduction

Following the relative success of coalition forces in Libya removing the Qaddafi regime through a combination of allied air power and coordination with ground opposition groups, a number of analysts in the United States spoke of the prospect of applying the "Libya Model" to Syria. In August 2011, a *Washington Post* article on the Syria conflict began with the passage "[t]he success of Libya's rebels in toppling their dictator is prompting calls within the Syrian opposition for armed rebellion and NATO intervention (Sly, 2011)." That same day, the *New York Times* ran an article outlining the prospects of such a model being applied elsewhere, noting President Obama's March 2011 speech outlining principles for humanitarian intervention. Key to intervention was a responsibility to stop "looming genocide," in that case in Benghazi, conditioned on the qualifier that the U.S. was not acting alone (Cooper and Myers, 2011). Though an anonymous senior administration source quoted in that article noted that it would be hasty to apply the "Libya model" directly to Syria, they did caveat "[h]ow much we translate to Syria remains to be seen."

Despite the broad rejection of military intervention under the Responsibility to Protect (RTP) doctrine,[1] calls for outside intervention to stop the ongoing violence in Syria have continued. In February 2012, Anne Marie Slaughter, recognizing the opposition to intervention on the grounds that "Syria is not Libya," outlined a strategy for intervention because Syria is more strategically relevant than Libya. Her proposal consisted of the creation of "no-kill zones" near the Turkish, Lebanese and Jordanian borders, the arming of opposition forces to create the zone, and for Turkey and Arab allies to enforce the zones "through the use of remotely piloted helicopters, either for delivery of cargo and weapons—as America has used them in Afghanistan—or to attack Syrian air defenses and mortars in order to protect the no-kill zones" (Slaughter, 2012). As the use of chemical weapons triggered an international crisis, and as problems with enforcement of the agreement to destroy chemical weapons stockpiles bogged down, leading U.S. Ambassador Robert Mikulak to state the effort to remove Syria's toxic agents had "seriously languished and stalled (CBS News, 2014)," and as the Obama administration has signaled that the al Qa'eda-aligned al Nusra Front appears increasingly to be a direct threat to the United States (Rohde, 2014), speculation has risen and fallen as to whether a military option may be back on the table for Syria. While any military option would be fraught with a number of obstacles to planning, execution and potentially justification, the semi-regular talk of remotely piloted aircraft (RPAs) as a key instrument in many of these options is especially problematic. This stems in part from a limited popular understanding of the roles and capabilities of RPAs, and a lack of imagination for other ways in which RPAs could be a positive good, both for humanitarian disasters in warzones like Syria and for other humanitarian crises globally.

This paper examines the potential uses of RPAs in Syria[2] and as a model for intervention in future conflicts as a tool to alleviate human suffering. While RPAs are generally looked at through the lens of U.S. military operations against al Qa'eda, which in this case could be characterized as a "peace making" or "peace enforcement" mission,[3] I conclude that such a mission would be counterproductive given the constraints on such operations in Syria. However, small unarmed RPAs could play a limited role in specific operations with the consent of parties to the conflict to reduce human suffering and to provide for international observation of activities such as the removal of chemical weapons in situations where manned alternatives would be impractical. Small RPAs, with limited ranges and limited payloads, could provide a legal, low-cost, relatively low-risk and accountable means of monitoring ceasefire accords, providing food and medical supplies to civilian populations who could not be otherwise reached by ground forces, increasing communications between peacekeeping forces and displaced populations, and providing assistance to search and

1. The RTP has developed as an international norm over the past two decades, referenced by the United Nations in the *2005 World Summit Outcome* as "the international community, through the United Nations, also has the responsibility to use appropriate diplomatic, humanitarian and other peaceful means … to help protect populations from genocide, war crimes, ethnic cleansing and crimes against humanity. In this context we are prepared to take collective action, in a timely and decisive manner … should peaceful means be inadequate and national authorities manifestly fail to protect their populations from genocide, war crimes, ethnic cleansing and crimes against humanity (*2005 World Summit Outcome*, 2005)." President Obama's statement from 2011 mirrors this language as justification for intervention in Syria, relying on broad international support but not explicitly UN approval as the 2005 statement requires.

2. This discussion primarily pertains to regions of Syria where temporary ceasefires have been agreed to in the past and generally excludes eastern Syria and fighting with the Islamic State of Iraq and Syria, with whom the prospect of a peacekeeping force for humanitarian purposes appears nearly non-existent.

3. U.S. military doctrine defines peace enforcement as "[a]pplication of military force, or the threat of its use, normally pursuant to international authorization, to compel compliance with resolutions or sanctions designed to maintain or restore peace and order" (Joint Chiefs of Staff, 2012, I8).

rescue operations. To facilitate RPAs as a tool of peacekeeping[4] versus peace enforcing, policymakers must move away from the (negative) mythology of the "drone" and toward an appreciation for the spectrum of airframes and potential roles unique to RPAs over manned aircraft.

4. U.S. doctrine defines peacekeeping as operations "undertaken with the consent of all major parties to a dispute, designed to monitor and facilitate implementation of an agreement (cease fire, truce, or other such agreement) and support diplomatic efforts to reach a long-term political settlement" (Joint Chiefs of Staff, 2012, I8).

Understanding Classes of RPAs

Clouding the discussion of the use of RPAs is the association of the word "drone" with a particular application of RPAs, the move toward Unmanned Combat Aerial Systems (UCAS or UCAVs for the individual airframes) capable of long-range precision strikes with high loiter times in a given combat area. However, just as strategic bombers such as the B-2 represent only one class of aircraft, the UCAS represents only one limited application of RPAs. Understanding the array of RPAs and differentiating capabilities and limitations of systems is necessary to overcome the stigma of the RPA as a tool of war or a specialized tool of neutralization/assassination, and appreciating its potential uses in humanitarian crises. As has been the case so many times in human history, a technological instrument can be both to the good and the bad of humanity.

I divide RPAs as platforms between tactical and strategic RPAs based on their connectivity to their operator, which differentiates those that are reliant on global communications and intelligence infrastructure and are capable of long-range, extended duration operations, and those that are more simple locally controlled line-of-sight RPAs. The naming convention used here is problematic for some airpower scholars as the airpower notion of "Effects Based Operations" defines all platforms as fundamentally tactical which in turn can have strategic effects based on the exploitation of the mission. But, for my basic purposes it suffices as stressing that some RPAs will be limited to a narrow radius for operations in an environment where their operators are vulnerable (tactical RPAs) compared to those that are the focus of air campaigns through a global operating system (strategic RPAs). The terminology here defines the character of the airframe rather than the nature of the mission it performs. In addition, countries can develop RPAs which have the appearance and payload of strategic RPAs, but due to a number of technological and organizational barriers they are unable to achieve the same capabilities. The strategic requirements and organizational capacity of states will dictate which types of RPAs they will pursue, while the rate of diffusion can be predicted by applying Michael Horowitz's Adoption-Capacity Theory (Horowitz, 2011).

Adoption-Capacity Theory projects the rate of diffusion of a military innovation by evaluating its costs to implement versus its organizational capacity to adopt the change. Costs to implement are a factor of the dual-use civilian-military applications of the innovation, and the per-unit cost of the asset. Organizational capacity, meanwhile, is a function of the organization's age, willingness to experiment, and critical task focus. The division of RPAs into two categories as previously defined allows us to evaluate both the diffusion of RPA platforms, as well as the potential uses of those platforms given the array of potential users.

Tactical RPAs, owing to their low cost and the potential for numerous applications beyond the military sphere, are likely to rapidly diffuse and consequently see the most independent innovation in terms of their potential usage. In the United States, a strong community of RPA enthusiasts already exist who are experimenting with a variety of commercial, recreational, and government applications for smaller RPAs. While Amazon.com recently made news with talk of 30-minute delivery from time of order using RPAs,[5] other initiatives are at work to allow citizens to use

5. This claim is likely unrealistic and meant to garner headlines. Although Amazon is reportedly also working to patent a system that can predict customer orders in advance, for a small RPA which flies at under 100 mph, Amazon would have to pre-position warehouses with most of their inventory on hand roughly every 30 miles, or at least within 30 miles of every major market in order to make such a system a reality even before processing and loading. At that point Amazon may as well allow in-person pickup which begins to look more like a catalog store.

RPAs to monitor crops, take overhead images for commercial purposes, and to assist in search and rescue for as low as $740 for a single system (Kelly, 2014). Lily Hay Newman noted the potential for such small RPAs to assist in Search and Rescue missions providing both search and improved communications capability in isolated or hazardous environments (such as fires), and for delivery of small cargo such as heart defibrillators and medicine among other positive uses for such RPAs (Newman, 2013). Because of the civilian applications for tactical RPAs—local law enforcement, property security, aerial photography, etc.—and the relatively low financial costs per unit, the tactical RPA has a low financial intensity. Smaller battlefield RPAs equipped with limited sensors such as full-motion video and basic offensive weapons are easy to operate by individuals and small units, and thus require low amounts of training or modifications of existing organizations. They represent a significant increase in existing scout capabilities.

Strategic RPAs differ from tactical RPAs in that they require significantly higher costs both to procure and to operate, which applies both to the unit and to the larger global intelligence and communications system involved in operating the asset. This results in significantly higher per-unit costs, depending on how it is calculated comparable to or exceeding those of similar piloted airframes. As employed by the United States, a single Reaper orbit requires four airframes, and approximately 200 personnel supported by a global reachback communications infrastructure as illustrated by Figure 1. Given the reachback and precision engagement requirements, the military-only applications of these airframes and the resulting high per-unit costs, these RPAs will be very slow to diffuse and innovation within the class of RPAs will likely be slow and incremental.

In evaluating the per-unit costs of RPAs, Table 1 and Table 2 illustrate the challenges of a direct cross-comparison of strategic RPA platforms with manned alternatives. Table 1 shows the costs, capabilities, and assets of the MC-12 Liberty, a manned ISR collection platform, the F-22 Raptor (a 5th generation air superiority fighter), and two of the most prevalent strategic RPAs that are operational today, the MQ-1 Predator and the MQ-9 Reaper. As the table shows, the MC-12 costs roughly between what an MQ-1 and an MQ-9 cost per unit, but this excludes the tradeoffs with most of the sensors and controls being aboard the airframe, reducing the costs associated with the forward Ground Station and Mission Control Elements. There are also tradeoffs in terms of capabilities, as the MC-12 is capable of flying in weather conditions which would ground the RPAs and can transit to a new location faster, but cannot remain aloft as long. A direct comparison is also challenging as operators have been shown over time to take more risks and fly RPAs longer than they would manned aircraft, driving up main-

FIGURE 1: Reaper Manning

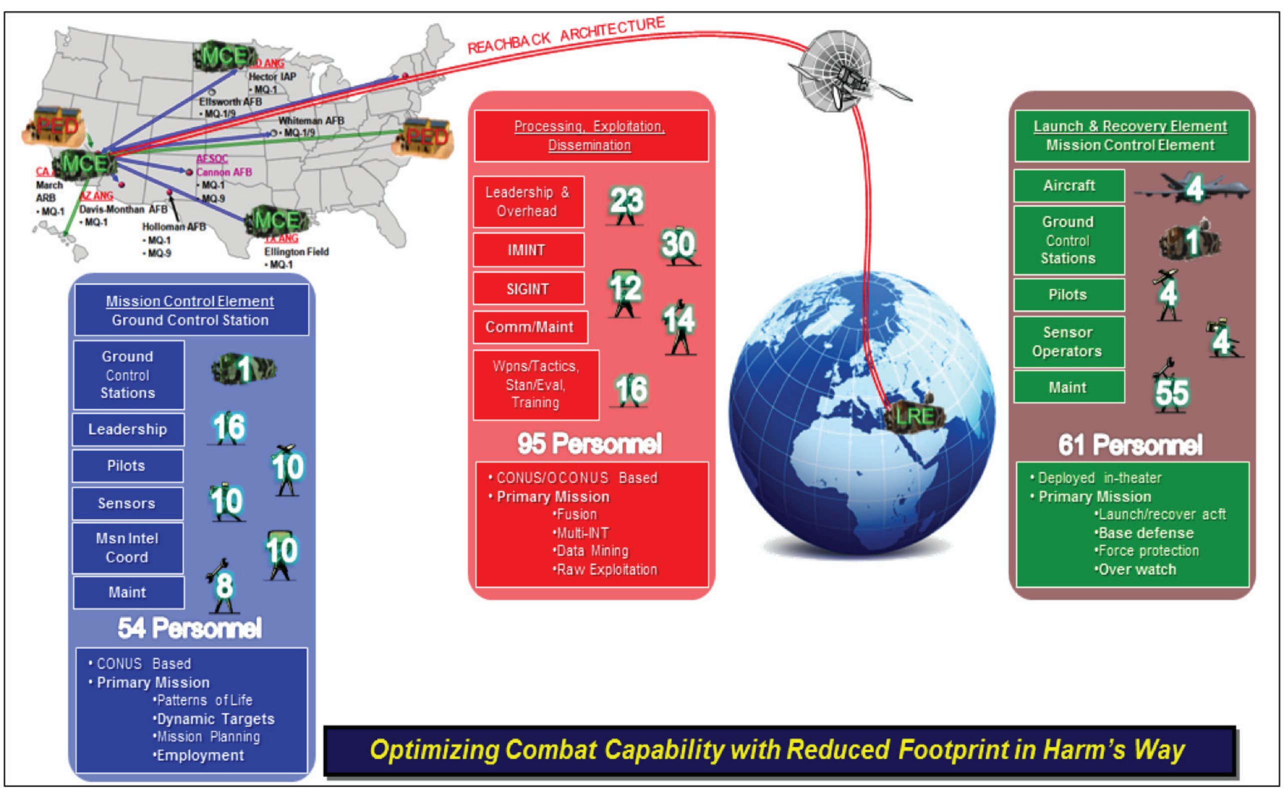


Figure 1 derived from an unclassified Air Force slide provided to the author by Lt. Gen. David Deptula (USAF, Ret.).

TABLE 1: Cost Comparison of Strategic RPAs and Manned Airframes

	MC-12 Liberty[1]	MQ-1 Predator- Gray Eagle variant	MQ-9 Reaper	F-22 Raptor[2]
Cost	$7.4 mil/acft	$4.33 mil/acft[3]	$11.4 mil/acft	$137 mil/acft[4]
Ceiling	35,000 ft	29,000 ft	50,000 ft	50,000 ft
Msn Duration	6-8 hrs	25 hrs	27 hrs	6-8 hrs
Airspeed	300 KTAS	167 KTAS	240 KTAS	Mach 2 with Supercruise
Armament	None	4 Hellfire missiles	14 Hellfire or 4 Hellfire & 2x GBU-12 Paveway II[5] or 2 JDAMs[6][7]	1 M61A2 20mm cannon, 2 AIM-9 air-to-air missiles 6 AIM-120 (air-to-air) or 2 GBU-32 JDAMs & 2 AIM-120 (air-to-ground)
ISR Sensors	MX-15 FMV, undisclosed SIGINT payload	EO/IR with laser designation, Synthetic Aperture Radar, communications relay	EO/IR, Lynx Multi-mode Radar, Electronic Support Measures, laser designators	

TABLE 2: U-2/RQ-4 Cost Comparison

	Procurement Cost	Flight-Hour Cost
U-2	Classified/no longer in production	$31,000[8]
Global Hawk (2010)	$46.4-80 million	$40,600[9]
Global Hawk (2013)	$46.4-80 million	$18,900

1. Information derived from airforce-technology.com (MC-12W Liberty ISR Aircraft, United States of America).
2. Information derived from Air Force Factsheet (F-22 Factsheet, 2005).
3. Cost for MQ-1 and MQ-9 is for aircraft alone, not including ground station and support personnel (MQ-1 Predator/MQ-9 Reaper).
4. This is the per-unit estimate not including development costs, which could raise the cost to over $300 million. However, similar cost analysis would likely raise the cost of Predator and Reaper by a similar factor (Axe, 2011).
5. Laser-guided bomb.
6. Joint Direct Attack Munitions, GPS-guided bombs.
7. Information derived from BGA-Aeroweb online, available at http://www.bga-aeroweb.com/Defense/MQ-1-Predator-MQ-9-Reaper.html.
8. Information from DailyTech report (Hatamoto, 2011).
9. See Shalal-Esa (2013) for Global Hawk flight-hour costs.

tenance costs and increasing procurement numbers.

It is common for Predator or Reaper to be compared with the F-22 Raptor,[6] but in that case the tradeoffs are much greater, as the Raptor is designed to fight air-to-air in contested airspace, while the RPAs require airspace control to enable operations.[7] Further, it appears that as the capabilities rise in RPAs, the costs associated will rise significantly as well. Given the systems on board the F-22, building an RPA with similar capabilities is unlikely to come at much cost savings. The closest case to a direct comparison of costs for comparable missions is the RQ-4 Global Hawk and the U-2 Dragon Lady, depicted in Table 2, but even here there are tradeoffs for speed and more capable sensors on the U-2 compared to longer loiter time in the RQ-4.

Taken together, strategic RPAs have a high cost to operate and a significant organizational infrastructure required to execute complex precision missions at long range. Tactical RPAs, on the other hand, are cheap and can be operated by a single individual with limited training. Evaluating these classes of RPAs through Adoption Capacity Theory suggests that tactical RPAs are most likely to diffuse rapidly, but in a wartime environment with the least impact in terms of

6. Horowitz (2011, 221), Singer (2009), and Benjamin (2013) each make this comparison, with only Benjamin of these three clarifying the flaw in the direct comparison.
7. In 2003 some Predators were armed with AIM-92 Stingers for air defense against Iraqi fighters in the run-up to the Iraq War, with one RPA engaging a MiG. It is unlikely that the missile acquired the aircraft as a target and the RPA was ultimately shot down (Cosgrove-Mather, 2003).

TABLE 3: Projected Diffusion of RPAs

		Level of financial intensity required to implement major military innovation	
		Low	High
Level of organizational capital required to implement major military innovation	Low	Rapid diffusion, high innovation - Tactical RPAs - State and non-state actors	Moderate diffusion, low innovation - Prestige RPA platforms - State actors; economic powers
	High	Moderate diffusion, high innovation - Strategic RPAs acquired through partnership - Primarily state actors	Slow diffusion, low innovation - Strategic RPAs - State actors; existing military powers

a relative gain in power as all parties to the conflict should have relatively the same access to the innovation. Strategic RPAs, such as Predator and Reaper, are likely to diffuse slowly and thus have a greater impact on relative military capabilities. As applies to RPAs, however, due to the narrow mission set of operations in controlled airspace fewer states than might otherwise pursue the full innovation will likely opt to do so. Those lacking the financial capacity to adopt will be more likely to work with adopters to gain access to the capability, while those who have the financial capacity but may be unable or unwilling to build the organizational capacity may instead adopt just the platform as a prestige technology. This is illustrated in Table 3.

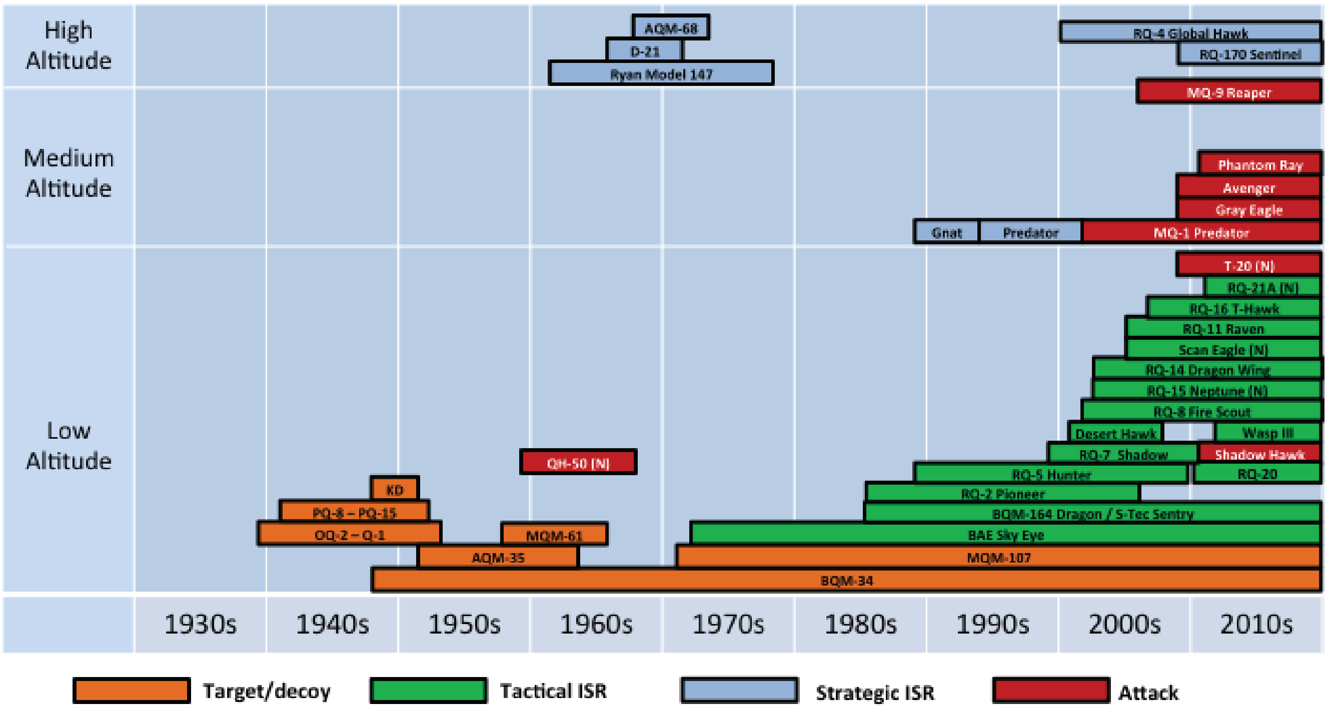
The implications for diffusion are normally examined in terms of how the innovation will diffuse among states, but the relative costs and level of financial intensity required to implement the innovation also provides significant clues for how diffusion and innovation will occur within states and among non-state actors. Due to their high costs and the significant infrastructure requirements needed to build and operate such RPAs, innovation occurs with these RPAs slowly and deliberately, with new innovations regularly referred to as "using only proven technology." Discussing the development of the U.S. Air Force's next generation bomber and the prospects for an unmanned variant, Lt. Gen. Charles Davis emphasized the need for developing the manned capable aircraft first. "Very rarely should we be out maturing new technologies in new platforms … Once we are certain that a technology is at a usable level, then our acquisition programs can do the hard work of integrating. We have a hard enough time integrating engines, air frames, sensors; we should not be inventing things that have not been developed" (Osborn, 2013). The costs associated with the satellite data link and need for anti-jamming capabilities to protect control of the asset itself is likely sufficiently prohibitive for many actors to pursue only low-cost, line-of-sight controlled RPAs.[8]

This trend can be seen within the U.S. RPA force, which even though it has only gained widespread visibility since the beginning of the RPA campaigns associated with the War on Terror in 2007, in fact dates back decades. Figure 2 shows the growth of U.S. RPAs, to include target drones, tactical, and strategic reconnaissance RPAs since the 1930s. The "RPA boom" begins in the late-1980s, with the development of Predator's predecessor the GNAT along with a number of smaller RPAs developed by the U.S. Army in conjunction with CounterLand doctrine. Of note from this chart is that the bulk of strategic RPAs fall into two families, either the Predator line or the Global Hawk line. MQ-1 Predator, Gray Eagle, Avenger, and even Reaper were developed based off of the Predator platform and mission, with the Reaper being designed to emphasize the attack role and being built larger to carry more munitions, while the others incrementally change the basic Predator model to make it either faster and more stealthy (in the case of Avenger) or more tactically focused (in the case of Gray Eagle). Tactical RPAs have, on the other hand, been adopted across a wider variety of missions and from multiple platforms, as their lower cost and limited operational capacity requirements has enabled both private sector and tactical operations innovations to allow a number of platforms to supplement existing operations.

Given this classification of RPAs and the implications of the model for the diffusion of the technology, both among states and with non-state actors, we are better positioned to evaluate the prospects for RPAs in both peacetime environments and in humanitarian crisis situations. Traditionally, RPAs in general are categorized as being ideally suited

8. See "Data linked functions and Attributions of an unmanned aerial vehicle system using both ground station and small satellite" for a brief discussion of the tradeoffs of line-of-sight versus satellite control (Saeedipour, Said, and Sathyanarayana).

FIGURE 2: U.S. Military RPA Development



for missions that are "dull, dirty, or dangerous."[9] However, given the high cost of strategic RPAs, low cost of tactical RPAs and the capabilities and vulnerability associated with each class of RPA, strategic RPAs are best suited for those missions which can be categorized as "dull," with tactical RPAs better suited for those which are "dirty" or "dangerous." "Dull" missions require the lack of a threat and are enhanced by the persistent nature associated with the dwell time of strategic RPAs. The high cost of strategic RPAs precludes them in many cases from being used in dangerous environments unless deemed absolutely necessary given the risk of loss. Tactical RPAs, however, are relatively expendable given their low per-unit cost, while in many cases the shorter dwell times associated with these aircraft as well as the shorter range limited by line-of-sight control makes them less optimal for "dull" missions. They can, however, be fielded by a wide range of actors who are free to innovate a wider variety of uses for the airframes.

9. Noted first in *Unmanned Aircraft Systems Roadmap 2005–2030* (2005), accessible online at http://www.fas.org/irp/program/collect/uav_roadmap2005.pdf. Singer and others readily use this phrase when describing the utilization of RPAs.

The Challenge to RPAs as Peace Enforcers

The RPA appears advantageous to those who advocate for its use as it is seen by some as less of a violation of sovereignty than manned aircraft, or worse a ground force. Slaughter notes, "Turkey is rightfully cautious about deploying its ground forces, an act that Mr. Assad could use as grounds to declare war and retaliate. But Turkey has some of its own drones, and Arab League countries could quickly lease others." This is likely due to perceptions of U.S. operations in Pakistan and elsewhere, where the United States has been regularly accused of violating the sovereignty of other nations with no recourse or justification.[10] The realities of RPAs are more complicated however, and the likelihood of tacit Pakistani approval of operations as outlined by David Ignatius in 2008 (Ignatius, 2008) and more recently by the International Crisis Group (Drones, 2013) both undercuts the likelihood of sovereignty actually being violated and

10. Prominent examples include the report *Living Under Drones: Death, Injury and Trauma to Civilians from US Drone Practices in Pakistan* and UN Investigator Ben Emmerson's report from March 2013 (Abbot, 2013).

which should in turn serve as a warning to future RPA operations actually violating sovereignty.

The Paris Convention of 1919 and the Chicago Convention of 1944 both make clear that the airspace above a state's territory, both land and maritime, are the exclusive sovereignty of that state. The Chicago convention states in its opening section "[t]he contracting States recognize that every State has complete and exclusive sovereignty over the airspace above its territory" (Convention on International Civil Aviation, 1944). This pertains to control of the airspace and is not limited solely to manned flight. If Turkey were concerned that a ground intervention would constitute a violation of Syrian territory and thus *causus belli*, there should be no reason to believe that Syria would be less justified in declaring *causus belli* based on a similar violation of sovereignty by a remotely piloted air asset.

Should an incursion by an RPA not rise to cause for war by itself, Syria would not be without recourse. The low speeds, lack of defenses, and mission requirements of extended loiter over a fixed area as Predator and Reaper are generally employed would make them easy targets for a state with an active air defense system and the will to employ it. Syria maintains a significant, though likely ill-maintained Integrated Air Defense System (IADS) capable of engaging a variety of targets. The June 2012 shoot-down of a Turkish RF-4 which violated Syrian airspace briefly illustrates Syria's general willingness to shoot down aircraft in defense of its territory, though Syrian sources at the time stated they believed it was an Israeli aircraft and had no desire at that time to shoot down a Turkish aircraft operating over the Mediterranean (Times of Israel Staff, 2012).

The shoot down of an RPA in contested conditions would not be without precedent, as Israel, Armenia, and Russia have all shot down RPAs either violating their airspace or contested territories. While this has been highlighted by opponents as a sign that RPAs used in such a role might be a threat to peace by lowering the cost of conflict, the practical experiences of these states to date suggest the truth may be the opposite: the RPA, by virtue of being unmanned, demonstrates low commitment on the part of the state employing it and lower costs for states which shoot it down than may have been the case were the airframes manned. In 2008, in the run-up to the Russia-Georgia war, four Georgian RPAs were shot down in the vicinity of Abkhazia.[11] Georgia followed these incidents with a series of highly publicized videos and press outreach touting Russian aggression in violation of treaties regarding Abkhaz airspace. While the UN Observer Mission in Georgia investigation did find Russia to be in violation for the shoot down based on the evidence available, they also held Georgia at fault for violating the Moscow Accord, stating "the overflight of the zone of conflict by surveillance aircraft constitutes a breach of the Moscow Agreement … However legitimate this purpose may seem to the Georgian side, it stands to reason that this kind of military intelligence-gathering is bound to be interpreted by the Abkhaz side as a precursor to a military operation, particularly in a period of tense relations between the sides."[12] This likely represented a significantly lower level of admonishment against Russia than Georgia had anticipated, allowed Russia to publicly accuse Georgia of being the "root cause" of hostilities in the area,[13] and ultimately likely weakened Georgia's position internationally in advance of the August conflict. Given this precedent and statements from Russian and Syrian officials, any RPA flown over Syrian territory would be seen as the aggressor, no matter the stated intent of the mission.

In the run-up to a possible strike in August 2013, both Russia and Iran stated, somewhat ironically many have charged, that any foreign intervention in Syria would be a violation of international law, while Syria vowed to repel any foreign intervention (Dagher, Abi-Habib, and Knickmeyer, 2013). Russian President Vladimir Putin was among the most explicit, stating "[a]ny outside use of force would be a grave violation of international law, which in the language of the UN Charter is referred to as aggression" (Foreign military intervention in Syria a form of aggression: Putin, 2013). In her 2012 piece, Slaughter prebutted this critique by saying all forms of intervention must be purely defensive, "only to stop attacks by the Syrian military or to clear out government forces that dare to attack the no-kill zones (Slaughter, 2012)." This framing aside, it is hard to see how any military operation designed to limit the Syrian government's sovereignty anywhere within Syrian territory would be viewed by Russia, China, or Iran as anything but an offensive move.

RPAs, seeking to enforce a no-kill zone from inside Syrian airspace against the will of the Syrian government would find themselves highly vulnerable to Syria's air defense network. The lack of a pilot on board the RPA might lead some to argue that the loss of RPAs could be absorbed, but the high costs associated with the platforms necessary for such enforcement missions would quickly make the operation prohibitively expensive and at the opportunity cost of other missions that are reliant on a finite RPA force.[14] The likelihood of effectively deterring the shoot-down of RPAs

11. Each of these were likely Israel-procured Hermes 450s, similar in capabilities to the unarmed RQ-4 Predator but with a shorter range (UN report on the Georgian drone downed in Abkhazia, 2008).

12. Ibid.

13. Russian Envoy on Downed Georgian Drone (2008)

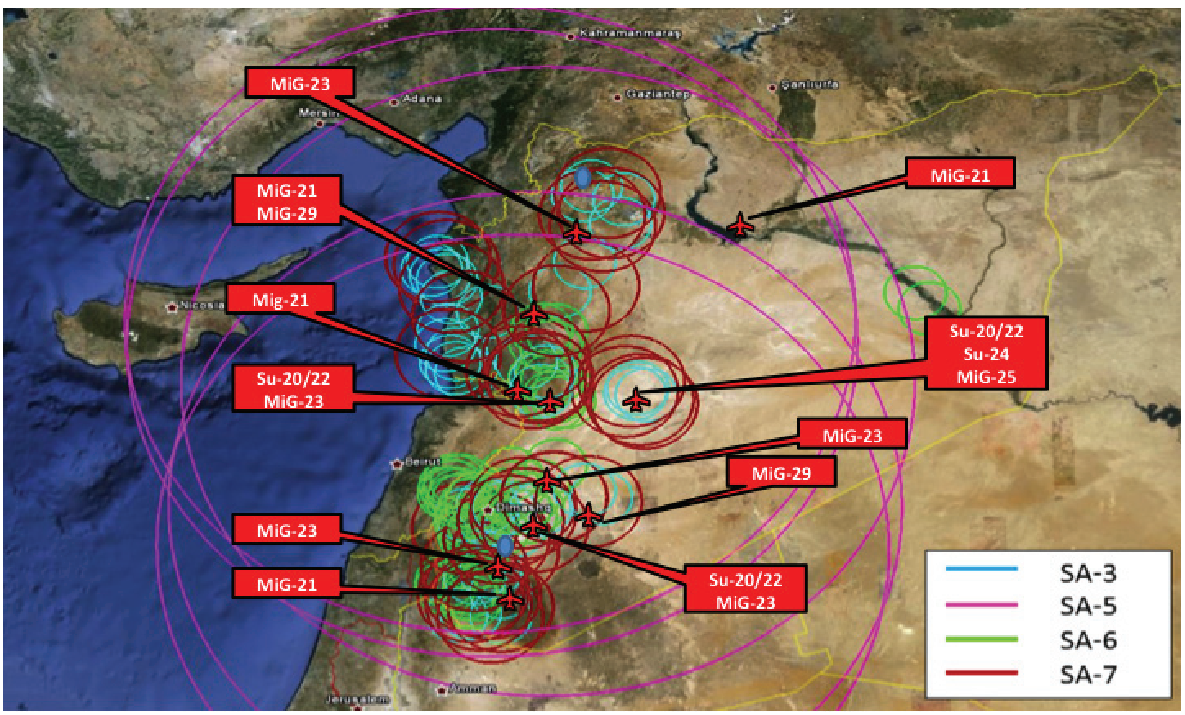
14. The Air Force missed repeated deadlines to increase its capacity to 65 Combat Air Patrol orbits, indicating an insufficient capacity to meet current requirements and prompting calls to lower the target (Lee, 2013).

would also appear to be low given the low resolve to respond militarily to the use of chemical weapons and the fact that the use of RPAs might be seen as a sign of weak resolve by not putting humans in danger.[15] This leaves suppression of the Syrian IADS network as a necessary precondition for the use of RPAs to enforce no-kill zones or no-fly zones. Figure 3 shows the strategic surface-to-air missile component of the Syrian IADS system, which is complemented by an array of air-to-air fighter aircraft capable of operating throughout Syrian airspace. Successful RPA operations would require neutralizing this threat to RPAs, either by physical destruction or relying on deterrence through threat of escalations of military force should RPAs be attacked by the Syrian IADS system. Missiles could be temporarily thwarted by electronic jamming through a Suppression of Enemy Air Defense system, but this is unlikely to work for sustained, 24-hr operations. In short, an RPA campaign would require a large-scale air campaign to destroy most of the Syrian Air Force before operations could proceed.

15. While the lack of a pilot on board clearly impacts this calculus politically, the military utility of the RPA remains its persistent coverage of a given area vice the risk to a pilot. Nevertheless, the perception matters most with respect to signaling resolve.

Due to the likely lack of UN approval for an operation, the threat posed by the Syrian IADS system and the necessity to secure airspace in advance of operations, and the implications of the loss of even a few strategic RPAs in Syria, RPAs as a tool for enforcement of either a no-fly or no-kill zone in Syria should be viewed as a non-starter. This, however, is but one way of using RPAs in Syria framed entirely by offensive military operations in Libya and elsewhere. Tactical RPAs, on the other hand, could play a significant non-military role in the conflict.

FIGURE 3: Syrian Surface-to-Air Missiles



Map derived from *Air Power Australia* (O'Connor, 2012). Not all missiles depicted on this map would necessarily be threats to RPAs, as SA-5s would likely be reserved for other potential threats.

The Potential Impact of Tactical RPAs on Peacetime Crises and Humanitarian Disasters

The Libya model for an airpower-led support to uprisings, combined with the RPA role in air campaigns in the U.S. War on Terrorism, has led much of the discussion for the application to focus on similar roles in Syria. This has generally come to the exclusion of other potential roles outside a military role that RPAs can play in such situations which may in fact be more effective at attaining limited objectives while producing strategic effects. Rather than looking for a silver bullet technological solution to what is seen as a problem primarily through the military lens, an incremental approach aimed at limited purely humanitarian aims should be the objective for planners interested in stopping the humanitarian crisis. Unarmed tactical RPAs can play a key role in advancing this objective.

The possible commercial and domestic applications of small RPAs has become a hot topic over the past year, fueled in part by Amazon's aforementioned plans to use RPAs for delivery, and also by fears of government agencies using them for domestic surveillance. Under current Federal Aviation Administration (FAA) regulations, RPAs cannot be used for commercial purposes, but the FAA has signaled its intentions to revise these regulations to allow for commercial RPAs in U.S. airspace by the end of 2015. In December of 2013, the FAA announced six testing sites that would test RPAs in a number of roles and environments to lay the groundwork for such regulations. Included in the list were sites like the University of Alaska, Fairbanks, which both offers a variety of environments in which to test (with locations in Oregon and Hawaii as part of their testing grounds) and is closely tied to austere industrial sites such as the Alaska oil pipelines and drilling sites which could greatly benefit from RPAs, both for surveillance and resupply. Other sites included Griffiss International Airport in New York, which will be used to test RPAs in congested airspace among other issues (Associated Press, 2013).

Tactical RPAs could potentially fill a number of domestic roles beyond government surveillance. Aerovironment, one company which develops small RPAs for government and military users today, touts the potential of small RPAs in the future for public safety providing local situational awareness to first responders in all weather conditions, wildlife and environmental monitoring for resource management, infrastructure management, and scientific research such as monitoring volcanoes, sinkholes, and other areas which would be either difficult to reach or hazardous for human operators (Aerovironment, n.d.). Similar small RPAs have been used by sheriff's offices in the United States. to assist in search and rescue missions already (Ban, 2012). Larger RPAs such as Predator drones were used in the aftermath of the hurricane Katrina, while rotary-wing RPAs equipped with radiation sensors, infrared thermometer,s and cameras assisted at Japan's post-tsunami Fukushima nuclear facility (Drones to the Rescue!, 2012). Across a wide area, a fleet of smaller tactical RPAs could be networked by a cloud system to enable a strategic picture of the crisis area. Equipped with thermal imaging, electro-optical sensors and potentially threat detection systems to monitor for surface-to-air threats, tactical RPAs could be well suited for a variety of non-military humanitarian missions in environments such as Syria.

In the absence of a broader peace accord, modest interim agreements to limit fighting, protect civilians, and achieve other objectives such as eliminating chemical weapons appear to be feasible near-term objectives. In early 2014 a 72-hour truce was reached to evacuate civilians from the city of

TABLE 4: Potential RPA humanitarian missions

	Potential Humanitarian Missions for RPAs
High	Wide-area Surveillance
|	Site monitoring (weapons, etc.)
Potential level	Route Clearance / Convoy Over-watch
of controversy	Communication nodes / Wi-Fi relays
|	Food / medicine / equipment supply
Low	Search and Rescue support

Homs, a limited ceasefire that was extended as peace talks faltered (Agence France-Presse, 2014). Similar evacuations have been thwarted by violence in the surrounding areas, while the removal of chemical weapons from storage depots in Syria were similarly delayed by such threats, in addition to accusations of stalling on the part of the regime. In each of these cases, tactical RPAs similar to those used for search and rescue in the United States could have been used to supplement the operations in order to increase transparency of operations and assist in the delivery of vital humanitarian supplies of food, medicine, and other aid items to besieged communities and hard-to-access locations.

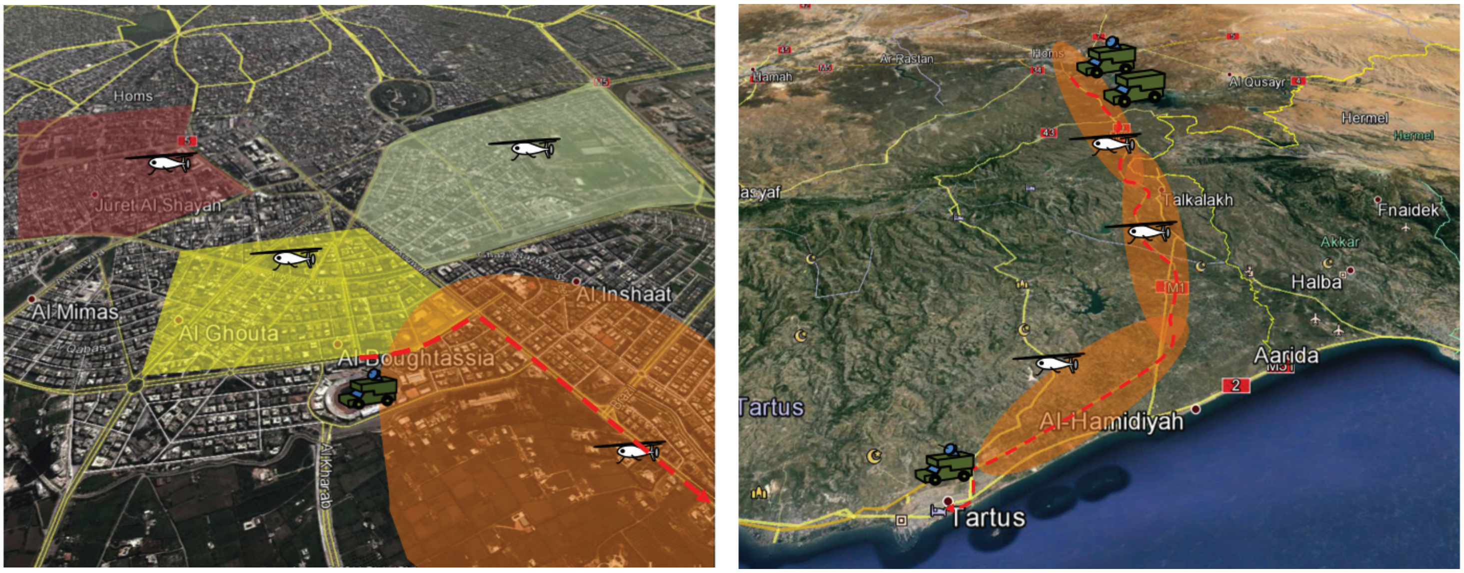
Here, the aforementioned distinction between peace enforcing operations and peacekeeping operations is critical, and in a sense the vulnerabilities of RPAs that were a vice for strategic RPAs can be a virtue for tactical RPAs. Unarmed RPAs could only be used with the consent of parties to the conflict, and thus would need to be approved as part of a concept of operations with the approval for the intervention, be it removal of chemical weapons or humanitarian relief. This should significantly reduce the threat to operations that would exist for RPAs in a peace enforcement role, which would be specifically targeted for their mission. The primary goal of a mission like convoy support would be to increase transparency both of the relief operation and the emergence of threats to the operation, which in part should serve as a deterrent to the emergence of threats. However, given the relatively low cost of tactical RPAs, were deterrence to fail resulting in RPAs being lost, the economic cost would be relatively small while the likelihood that sensors aboard the RPA could identify the origin of the threat would in turn lead to greater clarity in assignment of blame for the attack and with it the potential to shape future negotiations to the violators detriment. The small size of tactical RPA payloads, limited range, and local control of operations would also allow for increased transparency to parties to the conflict for inspections of payloads to ensure no contraband is shipped in violation of agreements.

For many of these operations, lessons can be learned from military applications of RPAs in conflicts like Iraq, but narrowly tailored to a neutral role. In 2006, the U.S. Army developed Task Force ODIN as a specialty team to detect and neutralize threats to convoys in Iraq. In its early years, this consisted primarily of coordinating ISR operations with convoys to secure route clearance, but over time evolved to a broader mission to identify and track insurgent networks to defeat cells before they could even emplace bombs (Glass, 2009). While the latter mission would involve direct intervention to proactively eliminate threats as part of a military campaign, lessons learned from early operations to clear routes and monitor activities in the areas of convoy movements could be tailored to meet the needs of international teams performing missions in Syria. For humanitarian relief, the lessons learned from search and rescue missions in the United States could provide a first step for developing concepts of operations to employ RPAs in those environments.

In the case of a future humanitarian operation to provide support for a besieged city like Homs, tactical RPAs could be used in the initial phases of the operation to provide overwatch in order to reduce violence. A ceasefire limited to an area such as a stadium would allow peacekeeping forces to set up a base of operations, to include an RPA ground station and launch/recovery zone, sufficient to enable several orbits of RPAs with both electro-optical and infrared sensors. These RPAs would allow for intelligence preparation of the operating environment to increase visibility of levels of destruction, identification of areas where people have taken shelter, and in addition could deter violence through increased visibility of ongoing operations. The RPAs themselves could be vulnerable to man portable surface-to-air missiles (MANPADs), but given the relative cost of the RPAs versus the information that could be gleamed from a shoot-down of an RPA by a MANPAD may justify the cost by both aiding to identify those who would violate a ceasefire agreement and by increasing visibility of the types of arms being brought into Syria and the levels of violence associated with the conflict. Figure 4 shows what a sample CONOP might look like, with multiple RPA orbits over selected areas of the city to be evacuated with additional orbits providing route pre-clearance for convoys of vehicles moving displaced persons to the port city of Tartus.

One major challenge to this point has been the stigma of “drones” combined with the expertise residing largely in the military community or with military and government contractors. Many countries are uncomfortable with the United States. flying “drones” over their territory due to this stigma, even in crisis situations. The examples of RPAs as peace enforcers in the previous section illustrate that even if a legal justification to allow for RPAs to be used could be established, this would not preclude the states from attacking those RPAs with the result harming the state flying them more than the defender. The shift in the RPA from a peace enforcer role to a tactical peacekeeper role is critical to alleviate these concerns by gaining unambiguous legal authority to fly over a conflict or humanitarian crisis, establishing firm protections of the RPAs through mutual consent, providing oversight of operations by observers from parties to the conflict to ensure the limited aims of the aircraft. The RPA would be capable of handling missions that a traditional peacekeeping force would be unable to accomplish due to the risk to peacekeepers and other limitations. The low cost of the tactical RPA versus a more

FIGURE 4: Sample Simplified CONOP for Humanitarian RPA Operations



capable strategic RPA would make the loss of one aircraft a minor problem for the state employing it, but technology on board the RPA could be designed to pinpoint rapidly the cause of the loss of aircraft and hold parties violating the agreement accountable.

Even in such environments, non-government organizations may be unwilling to use RPAs for fear of being associated with military equipment which might negatively impact their mission. To break this impasse, the best solution may be for a state widely regarded as neutral, or with no major stake in global intervention, to begin building its own RPA force for the purpose of humanitarian relief in support of the needs of the UN and other organizations. Austria, Switzerland, and even Liechtenstein could play a role in supporting such a peace force given their aerospace industry with indigenous RPAs such as the Schiebel CamCopter (CamCopter S-100) and possible domestic needs for search and rescue/humanitarian relief in mountainous areas. Scandinavian countries such as Norway, already playing a key role in the removal of chemical weapons, could similarly develop their own surveillance forces to monitor future operations.

The prospect for such RPAs go beyond their actual use in observing crisis situations, but extend to having a credible and reliable tool that the international community would have available to monitor ceasefire agreements. This could be used in the diplomatic process to negotiate a ceasefire earlier in the process both through the option of a transparent and sustainable observer process and through adding pressure to parties to accept the terms of international observers by removing traditional arguments against peacekeeping soldiers as potential parties to expanding the conflict.

Conclusion

Discussion of RPAs and the Syria conflict is heavily clouded by the images of Predator and Reaper as weapons of war, both by those who would like to see greater U.S. involvement in the conflict that may see them as a virtue, or by those who fear involvement and worry about escalation. The limited image of "drones" has become a hindrance to their effective employment in humanitarian crises, a stigma which must be overcome to allow for their effective use in crisis situations. Smaller RPAs, flown by neutral operators, with the consent of parties to the conflict or impacted by the crisis, can play a major role in humanitarian relief, from search and rescue to increasing transparency.

While I have examined RPAs here from a perspective of how they can be used for humanitarian assistance, I recognize that as tools with a wide variety of applications they can be used for ill as well as good. Just as attack RPAs as a tool for international intervention in the conflict could backfire and expand the conflict, tactical RPAs could similarly be used by authoritarian regimes such as Syria and elsewhere to tighten their control over the population and limit the forces of self-determination in the future. The shoot-down of a tactical RPA in Syria could lead to calls for punishment/retribution, but similarly so could a strike on a manned convoy. The question is, would the relative expendability of a tactical RPA lead to more targets of opportunities for those seeking to provoke an international incident, and would the international response to repeated attacks be the same?

For all these reasons, understanding the nature and characteristics of the tool is vital to understanding its potential for both good and ill in humanitarian crises. Overall, given the stakes involved in the humanitarian crisis and the demands of the international community to "do something," the potential of unarmed tactical RPAs to be a force for peace in Syria, in cooperation with limited international peacekeeping efforts, appears to be a risk worth taking.

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