THE DRONE PRIMER

A COMPENDIUM OF THE KEY ISSUES

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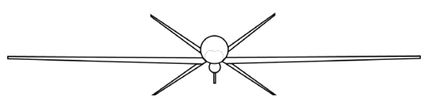
Contents



INTRODUCTION

The single surviving photograph of Boston from James Black's balloon flight in 1860

The Center for the Study of the Drone was created in 2012, before the drone buzz in media, popular culture, and politics hit high-pitch. It was clear that drones were going to be important, and that they would raise interesting and difficult questions. We wanted to answer those questions, or, at the very least, ask them.

This report compensates for what we believe is a shortage of impartial, basic, one-stop readings on the main drone points. It represents the culmination of what we have learned and taught over the past two years, presented in an accessible, straightforward way. Our hope is that the reader will gain a basic, comprehensive understanding of the key issues and, more importantly, a desire to keep learning about them.

Understanding the drone is prerequisite to developing the right policies and attitudes to govern its use. And to understand the drone, it's important to know its history, how it works, and how it's used. One should have a sense of the main themes and patterns, and hear one or two informed predictions about the future. It also doesn't hurt to look at some drone art.

Each chapter is accompanied by a short online reading list to guide further learning and, perhaps even inspire original research. These readings also represent our key sources and references for the project. The readings can be found at dronecenter.bard.edu. We hope that for the reader, this is where the learning about the drone begins, and not where it ends. We are an institution for learning and teaching. We focus our efforts on inquiry and open debate. We have no political agenda. We want to see good policy, and we think that the only kind of policy that's good is well-informed policy. While each of this report's authors has his own opinions about the issues at hand, in here, we just want to inquire and teach.

The Center for the Study of the Drone is a non-profit, non-partisan research and education project based at Bard College in Annandale-on-Hudson, New York.

HOW DRONES WORK

The word “drone” stretches to include a great diversity of vehicles. It is therefore impossible to define the drone on the basis of its technical features alone. That being said, there are certain technical features which are common to the majority of vehicles that are referred to by this name.

The same principles of dynamics that apply to manned aircraft, submersibles, and ground vehicles obviously apply to unmanned vehicles, drones. What concerns us are the mechanisms that permit the operation of the craft without a pilot being physically present onboard. At its most basic, the system that makes a drone a drone consists of the combination of sensors, which gather information about the environment and the drone’s position and orientation relative to that environment, and actuators, which are small mechanisms that create movement of some part of the vehicle (say, for example, a rudder).

In basic remote-control vehicles, a human stands between the sensors and the actuators. That is, the human receives the environmental information and, based on that information, sends instructions to the actuators. The human receives information by either looking at the drone (this is called line-of-sight) or by looking at video being taken from onboard the drone (this is called first-person view). In most unmanned vehicles, the human is still present, but a computer is placed between him/her and the actuators. This computer receives instructions from the pilot and communicates them to the actuators. This is called a fly-by-wire system. Some fly-by-wire systems correct or adjust human instructions to account for other environmental information that it receives directly from the sensors. Together, these interacting elements create feedback loops that connect information received by the drone, both from its environment and its pilot, and the eventual behavior of its actuators. Some systems will block instructions that could potentially cause an accident—say, for example, a steep turn that would cause a stall.

In the case of the large U.S. military drones such as the Reaper, the Predator and the Global Hawk, two teams of operators and a complex information network are required to fly a single aircraft.

A Launch and Recovery unit at the drone’s home base controls the aircraft during takeoffs and landings via C-band radio frequency. Once the aircraft passes beyond their line of sight, a team at a Ground Control Station, usually at an airbase in Virginia or Nevada, takes over. The distance from a GCS and the drone sometimes exceeds 7,000 miles. When a pilot at a GCS presses a button, that information is transferred along fiber-optic cables to a satellite terminus that relays the information on high-frequency Ku-band signals to the aircraft. During a flight, operators may also be in simultaneous radio communication with ground forces and with central command. A giant amount of bandwidth required to transmit near real-time video from the aircraft to the operators. A single U.S. Air Force Global Hawk surveillance drone requires 500 mb/s of bandwidth; during the first Gulf War, the entire U.S. military required just 100 mb/s.

Certain unmanned vehicles do not have a human present in the feedback loop. These drones are what are often referred to as “autonomous” drones, though there are questions about what qualifies as true autonomy. There is no clear line dividing non-autonomy from autonomy, or between automation and autonomy—it is more like a gradient. Engineers measure the degree of autonomy in a machine by its ability to negotiate John Boyd’s OODA Loop—Observe, Orient, Decide, Act.

The most simple autonomous drones just automate the act of moving about. An example of this might be an unmanned aerial vehicle that is instructed, prior to the flight, to travel between certain waypoints. Usually using GPS coordinates, the drone determines how to best reach its waypoint from its location. Such drones can be used to monitor, patrol, or survey large areas for extended periods of time without needing a live pilot in the loop at all times. In a sense, this is similar to the live-pilot system, except that there is a delay between the time that the instructions are given and the time when they are acted upon. There are more complex variations on this theme: drones that can be programmed to respond in a particular way to particular stimuli (and thus exhibit what we think of as decision-making capabilities), such as drones that are instructed to follow a target; drones that can complete complex, multi-step activities; drones that can play tennis; and drones that can communicate with other drones in order to collaborate on group projects or fly in large swarms without any human intervention. (More on this in ”A Closer Look at Autonomy”.)

THE DRONE IN MILITARY HISTORY

Aircraft were first introduced into military service on a broad scale in the First World War. By 1914, each of Europe's major powers had created dedicated aircraft corps for aerial intelligence. "The single use in war for which the machines of the Military Wing of the Royal Flying Corps were designed and the men trained was... to operate with an expeditionary force and to furnish that force with eyes," wrote Walter Raleigh in The War in the Air.[1] Aerial imagery was first used comprehensively to plan an engagement in the early months of 1915 at the Battle of Neuve Chapelle. British intelligence distributed 1,500 photographic maps of the German trench fortifications to British infantry commanders and, for the first time, aerial observers coordinated artillery barrages with an infantry advance. In the remaining years of the war, a system for developing and processing aerial imagery evolved, establishing the basic structures and principles of military intelligence that remain in use today.

The Second World War witnessed the first mass-produced remote-controlled aircraft in the United States. The Radioplane OQ-2, which was developed by a British inventor named Reginald Denny, was used by the Army as a target drone. Two other important technologies were developed during this time that contributed to the creation of drones: the V-1 bomb and the Norden bombsight. Carl Norden's bombsight, a complex machine similar to an analog computer, was meant to bring precision to aerial bombing. Even though the device—which cost $1.4 billion to develop, half of what it cost to create the atomic bomb—failed to improve the accuracy of bombardiers, it set the course towards greater accuracy in the use of aerial force, a key feature of modern drone strikes.

Germany's V-1 flying bomb, guided by a simple autopilot system, was successful in terrorizing southern Britain, but was only moderately capable of striking the right target. Nevertheless, it was a cheap and effective weapons system, and many of the missile's features, from the automated flight controls to the catapult launch pad, are still seen on modern unmanned aircraft.

Precision and affordability, the two guiding priorities that inspired the development of the Norden bombsight and the V-1 bomb, are the principal reasons why the Predator and Reaper drones are valued by the U.S. military today. During the Vietnam War, the U.S. developed laser-guided munitions, a crucial technology that improved the accuracy of aerial bombing and that remains in service in American drones. The U.S. first used laser-guided munitions in combat to destroy the Thanh Hoa Bridge, a target that had previously survived 300 direct hits from bombs. The MQ-9 Reaper drone used by the U.S. Air Force today is equipped with two kinds of laser-guided ordnance: the AFM-114 Hellfire air-to-surface missile and the GBU-12 Paveway II 500 lb. bomb. These "smart" weapons—particularly the Hellfire missile—are crucial for the targeted, surgical missions that the drone is predominantly used for.

During the Cold War, unmanned reconnaissance aircraft began to play a prominent role in military tactics and strategy. After the 1973 Yom Kippur War, Israel's Tadiran Industries developed the Mastiff UAV in order to give ground forces an extra pair of eyes in the sky.[2] Israeli Aircraft Industries (IAI) began testing an unmanned aircraft of their own soon after. The resulting drone, the IAI Scout, saw action during the 1982 Lebanon War. It was particularly effective during Operation Peace for Galilee; the Scouts were used reconnoiter Hezbollah's surface-to-air missile sites in the Bekaa Valley. Israel also used the drones as decoys to set off Hezbollah's anti-aircraft systems, opening a safe path for manned aircraft. In 1986, Israeli Aircraft Industries worked with AAI Corporation to develop the RQ-2 Pioneer, a medium-sized reconnaissance drone. The Pioneer was the first modern surveillance drone to be acquired by the American military; the U.S. deployed the aircraft in the first Gulf War and kept it in service until 2007.

The Predator drone can also trace its origin to Israel. In the 1980's, Abraham Karem, an Israeli expat engineer who had spent years working for IAI developing drone decoy aircraft to fool radars, developed the Gnat 750, an unmanned glider with a small engine, in his garage in California. American defense contractor General Atomics bought Karem's design in 1990. A few years later, the Central Intelligence Agency, which had purchased several Gnats, asked Karem and General Atomics to modify the Gnat with a quieter engine and a satellite antenna so that it could be flown by operators further away. The result was the first generation of the Predator drone.

During secret deployments over Bosnia in 1995 and Kosovo in 1999, the Predator drone impressed a joint team of CIA and Air Force operators with its long endurance and dwell time. At that point, the Predators were armed only with Sony video cameras. In 2000, Cofer Black, the head of the CIA's Counterterrorist Center, coordinated a live demonstration in which U.S. Air Force Predator pilots, who previously had to be based near the target area, could fly the aircraft over Afghanistan, via satellite connection, from CIA headquarters in Langley, Virginia.

The 2000 al-Qaeda bombing of the USS Cole brought new urgency to the search for Osama bin Laden and ignited a debate within the intelligence community over how to best use drones against this new enemy. Some, like then Under Secretary of State for Political Affairs Thomas Pickering, feared that the intelligence community was biased towards "a near-term technical solution, rather than the long-term buildup" of human intelligence sources.[3] Others, like Richard Clarke, the counter-terrorism advisor to President Clinton at the time, were frustrated with the lack of actionable intelligence on bin Laden that could justify a cruise missile strike, which was a relatively slow and imprecise method of hitting the enemy. "Instead of depending on unreliable human assets to find bin Laden, why not fly an unmanned aircraft around," recalls Clarke in *Against All Enemies: Inside America's War on Terror*. Along with the CIA's Cofer Black, Clarke pushed Clinton to use unmanned aircraft to find the leaders of the terrorist group.

In 2000, a drone flying over an al-Qaeda training ground at Tarnak Farms in Afghanistan spotted a man who looked strikingly similar to Osama bin Laden. Despite the urgings of his counter-terrorism advisors, Clinton decided against a cruise missile strike after noticing a child's swing set in the video feed. In other attempts on Bin Laden's life, cruise missiles took too long to reach the target. The Agency, the Pentagon, and the executive branch debated whether to arm the surveillance drones that had been flying over Afghanistan, as a way of combining surveillance and strike capacities in a single aircraft. Armed drones were sent into Afghanistan for the first time on September 12, 2001.

[1] Raleigh, Walter. The War in the Air : Being the Story of the Part Played in the Great War by the Royal Air Force. Oxford: Clarendon Press, 1922

[2] Sanders, Ralph. "An Israeli Military Innovation: UAVs." JFQ: Joint Force Quarterly, no. 33 (2002): 114.

[3] Coll, Steve. Ghost Wars: The Secret History of the CIA, Afghanistan, and Bin Laden, from the Soviet Invasion to September 10, 2001. New York: Penguin Press, 2004. 524.

[4] Clarke, Richard A. Against All Enemies: Inside America's War on Terror. New York: Free Press, 2004.

DRONES IN STRATEGY

Despite enjoying unparalleled military supremacy in the wake of the Cold War, after the September 11 terrorist attacks in 2001, the U.S. military found itself in a conflict that it was largely unprepared for. The members of al-Qaeda and the affiliated insurgency movements in Iraq and Afghanistan did not bear any of the marks of a conventional military force in terms of organization or appearance. In Pakistan and Yemen, the leadership of al-Qaeda and of forces associated with al-Qaeda were outside the reach of American forces. To seek them out, the U.S. needed an eye in the sky that could loiter for long periods of time and, if the opportunity arose, strike; a task for which the modified Predator and the Reaper drones were well suited. On the battlefields of Iraq and Afghanistan, drones supported U.S. forces on the ground with aerial intelligence and strike capabilities while in Pakistan and Yemen, drones helped destabilize the safe havens of the Taliban and al-Qaeda.

Imagine for a moment that you are seeking a taxicab in New York City. But instead of being painted yellow, all of the cabs look like normal non-commercial vehicles. How are you to tell from standing on the street which vehicles are taxis and which are family cars? Imagine, instead, that you were aided by a drone. Loitering up in the sky, the operator can pick out which cars are making frequent stops at specific locations that are likely to be visited by taxis, such as hotels. Suddenly, signature behaviors and patterns emerge from what was, from the ground, an indistinguishable mass.

In Iraq and Afghanistan, a primary responsibility of the crews of drones was to identify suspicious activity that might indicate the presence of the insurgency, just as a drone over New York City might identify cabs. While a conventional military might draw its strength from more advanced weapons or tactics, the strength of an insurgency is hidden within a complex web of relationships. Unlike conventional militaries that follow a hierarchical command structure, insurgencies are organized as networks, a horizontal structure that allows for greater flexibility and resilience in the face of a conventionally stronger military force. Unraveling a network requires identifying the nodes–those individuals within it who play key commanding or supporting roles--as well as locating the safe houses and control centers that make up the infrastructure of the insurgency. Intelligence analysts combine the imagery from drone aircraft with human and signals (telephone and radio communications) intelligence to create a “nodal analysis” of the connections that comprise the network.

In providing persistent aerial coverage and intelligence, drones help ground forces distinguish between civilians and combatant. In order to counter an insurgency, the occupying force must win the trust of the local population by avoiding unnecessary civilian casualties, thereby denying the insurgents their bases of support. Drone operators and intelligence analysts develop a “pattern of life” analysis in order to understand an individual’s place within the insurgency network. In the often uncompromising urban warscapes of Iraq, all of this was achieved without having to risk the lives of dozens of men to conduct the same surveillance mission on the ground.

In Pakistan, Yemen, and Somalia, drones play a similar role in identifying and tracking members of al-Qaeda and the Taliban as a means to deconstructing their networks. In the northwestern tribal areas of Pakistan, the semi-autonomous regions where al-Qaeda and the Taliban fled after the American invasion in 2001, targets are beyond the reach of conventional military forces. The Central Intelligence Agency embraced drones as a means of destabilizing and diminishing the networks of al-Qaeda and the Taliban. After the election of Barack Obama in 2009, this strategy was given greater emphasis; more drone strikes took place that year than during the entire George W. Bush presidency. In a May 2009 speech at the White House, President Obama subtly acknowledged the change in counterterrorism strategy: “For the first time since 2002, we're providing the necessary resources and strategic direction to take the fight to the extremists who attacked us on 9/11 in Afghanistan and Pakistan.”

In the eyes of the Obama administration, the drone enables the U.S. to take the offensive against al-Qaeda in the inaccessible mountainous of Pakistan and in Yemen where a ground operation would be politically fraught. As the war in Iraq came to a close and the campaign in Afghanistan stalled, Panetta saw the Agency as “the tip of the spear.” The drone fueled the rise of the CIA’s targeted killing campaign, creating an attraction to lethal action that some within the Agency feared obscures the primary mission which is the collection and analysis of intelligence.

Israel has employed targeted killings for longer than the United States; it established the precedent of using aerial strikes as a means of dismantling the organization of a non-state actor. The practice has become so established in Israeli strategic doctrine that they refer to it as “mowing the lawn.” At one point, the United States criticized Israel for targeting of Hamas operatives. “It is the policy of the United States to oppose these killings,” said then-White House spokesman Ari Fleischer at a briefing in August 2001. Today, as the United States adopted targeted killings, this phrase has found a home in the United States, too. “The problem with the drone is it’s like your lawn mower,” said

Bruce Riedel, a former CIA analyst and Obama counterterrorism adviser, in an interview with the Washington Post. “You’ve got to mow the lawn all the time. The minute you stop mowing, the grass is going to grow back.”

A large number of militaries—by 2013, 87 in total, though that number has likely grown—are either developing or acquiring military drones. These drones have a variety of forms and are intended for either surveillance, intelligence, or combat missions. Some, like the U.S. Air Force Global Hawk, the Israeli Heron, and China's Lijan (Sharp Sword) are large, high-altitude, long-endurance crafts capable of surveilling large areas for extended periods of time and, in some cases, strike missions. These drones are expensive and require information technology and infrastructure that only wealthy developed countries possess. These drones are often referred to as Medium Altitude Long Endurance (MALE) and High Altitude Long Endurance (HALE) platforms. Others, such as AeroVironment's RQ-7 Raven, are small, low-altitude unarmed craft that are used for short reconnaissance or surveillance sorties lasting no more than a few hours. These small drones are relatively cheap, and do not require complex and expensive communications systems like the large MALE and HALE drones. These small drones are not subject to international weapons export restrictions, which have so far prevented the sale of large capable drones to most countries, and do not require complex communications systems. The bulk of proliferation happens in this category.

It is still difficult to measure the full extent of drone proliferation, especially when it comes to "indigenous" drone development (that is, when countries develop drones in-house, rather than importing them). Ecuador, Pakistan, Peru, North Korea, and Nigeria (to name just a few) all claim to be developing unmanned aerial vehicles, but details about the true capabilities of the systems in these countries are hard to come by, and those that are available must be treated skeptically. Military propaganda often elevates the particulars of these programs into the realm of fiction. Iran's military drone program, which dates back to the Iran-Iraq war, is one of the longest-running in the world.

Some of Iran's drones do indeed fly—others quite obviously do not. In 2014, Iran claimed that it has successfully reverse-engineered a U.S. RQ-170 spy drone that crash-landed in its territory in 2011. There is no evidence that the reverse-engineered drone actually works. All claims about the extent of drone proliferation, and the attendant threats to international peace and security, must be approached cautiously. Nevertheless, though military drone proliferation is hard to measure, it seems to be accelerating.

Even if estimates of the extent of diffusion are overblown, as they likely are, the potential threat of enemy drones is being taken seriously, particularly by the U.S. and Israel. In anticipation of someday having to confront foes equipped with capable drones, the U.S. Army has issued a Request for Information to spur defense contractors to develop counter-drone technology. The U.S. Marine Corps is developing anti-drone laser systems, as is the U.S. Navy. In recent military exercises, the Israeli Air Force practiced shooting down enemy drones, and earlier this year, Israeli military contractor Rafael displayed the Iron Beam, a high-energy laser that can shoot down small munitions and aircrafts such as drones.

Two academics at the Council on Foreign Relations, Micah Zenko and Sarah Kreps, contend that the proliferation of military drones poses new threats to international peace and security because they could change how conflicts traditionally escalate. Since an army does not risk any personnel when it sends a drone out on a mission, argue Kreps and Zenko, it will be less hesitant to deploy drones where it would have held back previously. For example, in September 2013, China flew a surveillance drone into Japanese airspace. Japan responded by stating it would shoot any Chinese drones that entered its airspace. In response, a Chinese official declared that if Japan were to shoot a Chinese drone, it would consider it an act of war, though it would not cause the loss of a Chinese life. But, in the first place, China flew the drone into Japanese airspace knowing that it did not risk a pilot's life. The proliferation of drones could lower the threshold for military action.

At the same time, drones are bringing down the cost and technology barrier for aerial surveillance capabilities, which play a crucial role in any military engagement. Iranian-made drones are regularly spotted flying over conflict zones in Syria and, more recently, Iraq. Syrian rebel groups believe the Syrian army uses drones to scout targets for artillery strikes. A decade ago, these kinds of conflicts would have had much less of an aerial dimension. A crashed North Korean surveillance drone recovered in South Korea was found to be not much more sophisticated than a remote control hobby plane; nevertheless, it had managed to overfly and photograph the presidential palace. The kind of increased surveillance power that these drones might provide has the potential to change the nature of conflicts which had previously lacked an aerial dimension.

The falling cost threshold of drone technology increases the possibility of drones falling into terrorist possession, groups which tend to lack large defense budgets. In 2013, protesters in Germany managed to fly a small quadcopter near German chancellor Angela Merkel during a campaign rally. Commentators noted that if the drone been equipped with even a small explosive device, it could have been an effective weapon. In 2006 during the Lebanon War, Hezbollah flew a drone packed with explosives into an Israeli warship, causing a fire that lasted several hours. This year, Hamas released a video showing what it claims is a weaponized drone.

DRONES & THE LAWS OF WAR

Though the United States' use of armed drones against non-state actors outside of declared war zones might not seem to count as traditional warfare, it is still subject to the combination of domestic and international laws that govern the use of military force.

The CIA's targeted killing campaign is based on the executive branch's interpretation of the Authorization for Use of Military Force (AUMF), passed by Congress in the aftermath of the 9/11 attacks. The AUMF, which is a mere 60 words long, grants the executive branch permission to pursue the perpetrators of the 9/11 attacks and the nations that aided or harbored those individuals or groups. The AUMF, like previous Congressional authorizations for the Vietnam or Korean wars, served in lieu of a formal declaration of war. (Congress has not issued a declaration of war since the outbreak of the Second World War.) Depending on one's interpretation of the AUMF, the United States is either engaged in a borderless armed conflict or it is not, and different sets of laws apply in each condition.

When the remnants of al-Qaeda's leadership fled to Pakistan following the U.S. invasion of Afghanistan in 2001, those individuals moved outside the territorial boundary of the Afghan war. Pakistan and Yemen, which are sovereign territories, are not engaged in an armed conflict with the United States. Critics of the Obama administration argue that if Pakistan and Yemen do not consent to the drone strikes, the use of force in these countries is in contravention of Article 2(4) of the Charter of the United Nations, which protects the sovereignty of member states. Members of the Obama administration argue that targeting members of al-Qaeda and the Taliban in Pakistan is permissible because these individuals are engaged in armed conflict against the United States.

Under international humanitarian law, the United States may use lethal force against individuals outside of an active war zone but only if these individuals are actively involved in hostilities that pose an imminent threat to the United States or its interests. The term "targeted killing" was first used to describe Israel's campaign against the leaders of Hamas in the early 2000's. The Israeli Defense Forces–and, in 2006, the High Court of Israel--defended the practice, arguing that Israel was engaged in a state of war with Hamas and that the Palestinian Authority had failed to apprehend terrorists who posed a direct threat to Israel.

Traditionally, enemy combatants may be identified by their uniforms or by their activities. As a matter of strategy and survival in the face of an overwhelmingly superior conventional military power, members of terrorist groups and insurgencies hide in plain sight by adopting civilian clothing and using civilian homes as safe houses and command centers. Drones enable the targeted killing campaign by making it possible to use lethal force against suspected terrorists in Pakistan, Yemen, and Somalia without risking the lives of American service members. Drones also permit the operators greater flexibility in discriminating between the targets and civilian bystanders.

This enabled a type of operation known as "signature strikes." These particular strikes are not aimed at a known individual (say, a known senior operative), but instead target people who appearto be involved in hostilities. While the CIA's guidelines for how to identify these individuals are not publicly available, based on the record of strikes, "signatures" likely include activities such as participating in known terrorist training camps, transporting weapons, meeting with known combatants, and planting improvised explosive devices. These individuals need not wear a uniform, and they may even be civilians; according to the International Committee of the Red Cross, if an individual, civilian or combatant, is serving in a "continuous combat function"—meaning a sustained record of participating in hostilities over time—that individual is targetable.

From a legal perspective, the U.S. considers its targeted killing operations in Pakistan to be an extension of the war in Afghanistan. Yemen, which is far from any active war theaters, therefore presents an additional legal problem. In Yemen, the targets of drone strikes are members of al-Qaeda in the Arab Peninsula (AQAP), a force allied with what is known as al-Qaeda "central," located in Pakistan and Afghanistan. Even though AQAP had no direct involvement in 9/11 attacks, under the AUMF, the Obama administration claims that it has the authority to pursue members of AQAP because the organization is an "associated force" of al-Qaeda. The reasoning goes like this: if Nation A is at war with Nation B and the latter is joined midway by Nation C, then A is automatically also at war with C.

The debate inside the United States over the White House's targeting procedures became national news after the killing of AQAP cleric Anwar al-Awlaki, a U.S. citizen. Some commentators and law scholars argue that the President overstepped his bounds by deliberately targeting an American.

They argue that the targeting violated al-Awlaki's Fourth Amendment rights. A Department of Justice White Paper leaked to the public summarized the executive's rationale for the strike. The authors argued that al-Awlaki posed a continued and imminent threat to the U.S, and contended that the killing was an act of self-defense. According to International Humanitarian Law, these two standards (imminent threat and self-defense), if met, justify an extrajudicial killings outside of a "hot battlefield."

Neither the DOJ White Paper or the DOJ drone memo (released to the public in June 2014) establish a strict definition of the conditions of "continued" and "imminent" threat. Furthermore, the conditions that are laid out in these papers are legal justifications and should not be considered hard and fast rules. For example, in the White Paper the authors chose to interpret "imminence" as a condition that "does not require the United States to have clear evidence that a specific attack on U.S. persons and interests will take place in the immediate future." Without knowing the standards of evidence or burden of proof, the internal rules and mechanisms by which a U.S. citizen—or any individual—is deemed targetable remain opaque.

Chapter 6.

A CLOSER LOOK AT AUTONOMY

While a human can make complex decisions nearly instantaneously, the task of deciding what to do next is much more challenging for a machine, particularly when the environment is constantly changing. For example, a machine might—using sensors—observe and orient itself without any human intervention, but then be completely lost when it comes to making a decision and carrying it out. A machine might seem to be doing very well on its own until some simple obstacle completely flummoxes it. To be autonomous, a machine must be capable of sensing the environment, drawing conclusions from those observations, weighing between possible actions and, finally, acting upon that decision. A machine must be able to adapt.

No machine--within the military or without--is capable of full autonomous decision-making. The military's Predator and Reaper drones, like most aircraft, combine human intervention with pre-programmed instructions. And yet, as computer processing power grows stronger, the requirements for machine autonomy are becoming ever clearer and closer to realization. In Wired for War, Peter W. Singer argues that "All the rhetoric ignores the reality that man started moving 'out of the loop' of war a long time before robots made their way onto the battlefields." For the military, there are two strong motivations for acquiring autonomous systems. For starters, the communications signals that link the human with a UAV could be a source of weakness to enemy attack. The second motivation is the need for speed: an autonomous robot can potentially process more information and make decisions much faster than a human ever could. In increasingly fast-paced battlefields, this is crucial.

Opinions diverge on the ethics of autonomous warfighting machines that could be make life and death decisions without a human in the loop. Ron Arkin, an American roboethicist at the Georgia Institute of Technology, argues that autonomous machines will act more ethically than humans in war because they can adhere to the rules of war. Others, such as the members of the Campaign to Stop Killer Robots, would like to see an international ban on these machines, arguing that machines lack the ability to negotiate complex ethical situations. On July 13, 2013, Northrop Grumman's X-47B, a stealth combat drone in development for the U.S. Navy, landed on an aircraft carrier without a pilot operating the aircraft remotely. Guided by GPS, advanced navigation software aboard the X-47B processes the data on the position and movement of the ship as the aircraft approaches the landing deck. In terms of autonomy, the X-47B is on a different level than the Predator and the Reaper. The X-47B is considered the first in what many predict will be a new generation of advanced drones that mostly remove the pilot from the equation.

Some of the most high-profile advancements in autonomous machines have been happening in the private sector. Google is developing autonomous cars that can carry passengers safely without needing a human driver. To create its self-driving cars, the company has outfitted test vehicles with an assortment of radars, sensors and the Velodyne LIDAR, a 64-bit laser. The radars receive information from the environment while the LIDAR uses remote-sensing to map and classify any obstacles.

On certain roads, the Google Self-Driving Car can autonomously negotiate 90-95% of situations that occur. However, the Google Car--and any vehicle aspiring to autonomy–not only requires the hardware on the vehicle, but also a huge library of data that includes highly-detailed digitized maps of the area. Before the car is able to drive itself, Google employees must circle the planned route several times in order to put together a virtual recreation of the area that is precise down to the inches. "We tell it how high the traffic signals are off the ground, the exact position of the curbs, so the car knows where not to drive," said Andrew Chatham, a project lead, in an interview with the Atlantic. "We'd also include information that you can't even see like implied speed limits." For a machine to draw its own conclusions, it requires a massive data set.

Chapter 7.

DRONES IN CULTURE

The drone's physical characteristics do not fully explain why we are, in one way or another, so terrified and fascinated by it. Targeted killing may be startling, and the idea of being watched from above without knowing it is rather unnerving. But targeted killing existed before the drone, and we are constantly being watched without knowing it. Why, then, has the drone inspired so much furor and hype? Why do we fear the drone? Why do we also find it so compelling?

It is impossible to answer this question by merely looking at technical and policy dimensions. We must turn, also, to the cultural dimension. Humans have good reason to fear the sky and the things that inhabit it. Until very recently in human history, it was a physical domain that we absolutely couldn't freely access and explore. As a result, it became a space of mystery. And like all mysterious spaces—dark forests, caves, the deep sea—it was thought to be inhabited by strange and often dangerous creatures.

Numerous traditions, from the Philippines to Ancient Persia, feature flying creatures that are either fearsome, invisible, or both. The drone is the metallic embodiment of this genus of mythological aerial creature that humans have spent several thousand years imagining with a combination of fear, awe, and worship. The secrecy surrounding CIA drones has particularly leant itself to the mystery and awe we feel toward the technology: we are sure that these drones exist, but we never actually see them. Even in areas with a persistent military drone presence, they are rarely seen, though they are constantly heard; the continuous hum from the sky has become an ominous fixture of everyday life.

It is hardly surprising that we fear the drone, born as it is from a legacy of fear and mysteriousness. In ancient Greek mythology, fear of sky-dwelling creatures was represented in the form of the harpy, a winged monster that was dispatched by the Gods to terrorize earth-bound souls. In the Argonautika, the winged harpies, "like bitter blasts or lightning flashes, suddenly out of the clouds they sprang, with a raucous scream." This account mirrors the witness accounts collected by researchers in places with a military drones presence, such as Pakistan: "We are afraid at night as we lie in our beds," a Pakistani villager named Rasul Mana told Reprieve. "The drones are going around and around over our heads."

This fascination and fear of the drone also emanates from its futuristicness. Though variations of the mechanical drone have existed since the mid-nineteenth century, it is still treated as a futuristic technology; the idea of unmanned flight hasn't ceased to be a novel proposition. Unmanned aircraft are a fixture in the Western science fiction tradition. George Orwell described flying machines in 1984. The drone is persistently regarded as a science-fiction technology, and media outlets, drone-makers, and key players continue to use the language of science fiction to describe this technology. Amazon.com acknowledged the tight marriage between the drone and science fiction when it unveiled its planned delivery drone system PrimeAir: "It looks like science fiction, but it's real."

Chapter 8.

DRONE ART

"The policy discussion is a highly specialized system with its own language and its own elite—almost a priesthood—who understand it and can explain it. By bringing back that analysis, by demystifying it, by looking at how we can explain it better and have clearer discussions around it, I think art has the potential to perform a very important role in policy." - James Bridle

Over the past few years, artists have responded to the drone in various mediums. Art that treats the drone as its subject, or an art-making tool, has served to interrogate, protest, and promote this technology. This art has been well received by the public and has earned institutional recognition, to the extent we could confidently claim that it is an art trend. The art that makes up this movement is most commonly referred to as drone art.

Because of its cultural resonance, the drone has embedded itself in the popular visual vocabulary. Visions of the drone—usually some kind of variation on the U.S. Predator or Reaper—pop up in graffiti murals, collages, animations, and conceptual art with increasing frequency. Its distinctly sharp, cockpitless form has become a visual motif representing technological advancement, state power, and the spectre of autonomous technology.

In established art practices, we have seen drone art range from straight-served activism—as in the case of Heather Layton and Brian Bailey's exhibition Home Drone, which asked its American audience to imagine what it would be like to live under drones—to more subtle forms, as Mahwish Chishty's drones are painted in the aesthetic of Pakistani truck art—to the oblique, like Himanshu Suri's song "Soup Boys":

That drone cool, but I hate that drone
Chocolate chip cookie dough in a sugar cone
Drones in the morning, drones in the night
I'm trying to find a pretty drone to take home tonight.

A key feature of the drone art movement is that the drone has served a dual role as both a subject of the artwork and a tool for creating it. In the case of artist and vandal KATSU's drone graffiti, a drone is the graffiti-making tool. One of the earliest examples of drone art was the Natalie Jeremijenko and the Bureau of Inverse Technology's BIT Plane project (1995). The team flew a camera-equipped, remote-control plane over Silicon Valley, capturing footage of large tech campuses that, on the ground, were closed to the public. In an interview with the Center for the Study of the Drone, Jeremijenko described the project as an "an exploration into this new territory called 'information space." The artistic product was a grainy, black-and-white video containing very little useful information about Silicon Valley, but it was a powerful statement about aerial technology and its surveillant potential.

Tomas van Houtryve's drone-made aerial photographs of American domestic scenes are similarly bi-layered. On one hand, he is, like Layton and Bailey, experimenting with the idea of hypothetical drone strikes in the U.S. and protesting what he believes is a violent and unjust U.S. policy. On the other hand, his compositions flex the power of the drone, and in doing so point at what he considers to be the worrying implications of unmanned aerial technology. Van Houtryve protests the targeted killing campaign by partially demonstrating what the killing machine can do.

This project diverged from aerial drone art that celebrates the machine for its photographing ability without raising objections or concerns. Drone aerial photography, much of it created by amateurs, is a burgeoning field. While aerial photography has been practiced in various forms since the 19th century, its accessibility and popularity has exploded in recent years. Drone aerial photography was popularized by Raphael "Trappy" Pirker, who in 2010 grabbed U.S. headlines for flying a camera-equipped drone over the Statue of Liberty, the Brooklyn Bridge, and parts of Lower Manhattan.

While Trappy contends that his interest is in flying rather than art, his videos have inspired an aesthetic that disabuses itself of the political discussion and focuses instead on the sheer beauty of the aerial perspective.

A still from Bureau of Inverse Technology, "BIT Plane," 1995

The Drone Art movement is important because it has contributed a vibrant visual vocabulary to the drone debate. It is also a test case of how different sectors of the art world—from fine gallery art to conceptual virtual art—respond to (and sometimes incorporate) a new technology.

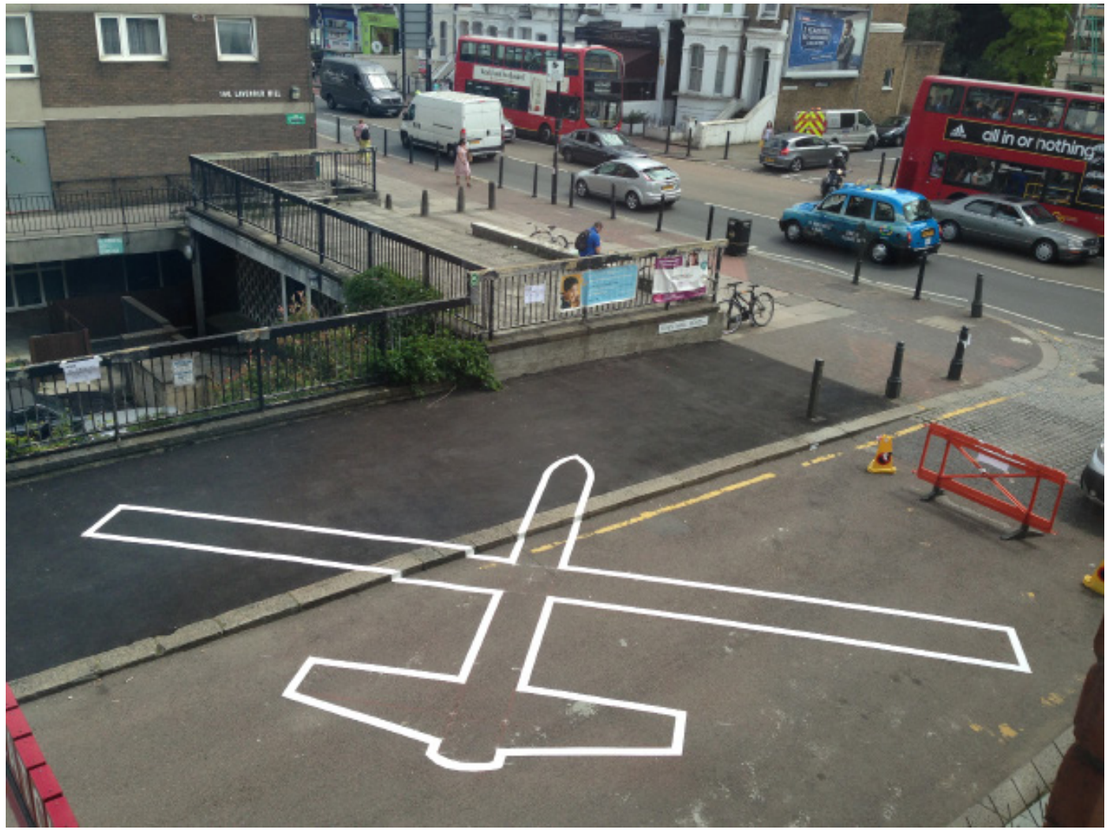
Pakistani artist Mahwish Chishty relays the image of the drone through a classic Pakistani truck art aesthetic; in doing so, she raises questions about how the continuous presence of drones over parts of Pakistan have earned the drone a place in the country's culture.

The BIT Plane project made use of the drone as a flying tripod, but in doing so also made a statement about the technology itself. Fernando Brizuela's watercolors create a space of intersection between an old-fashioned, high art practice and a commentary on modern warfare.

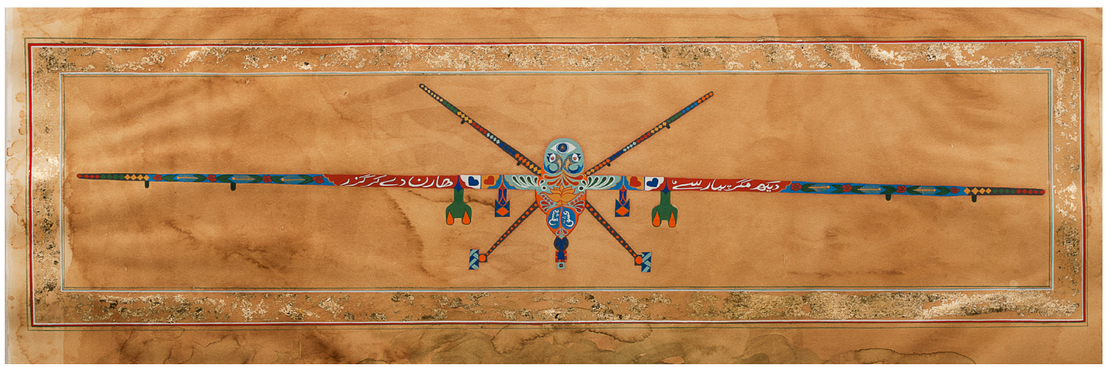
James Bridle and Trevor Paglen, two seminal drone artists, meditate on the invisibility of the drone. Paglen takes super-long-range photographs of U.S. military drones flying at high altitude. In the resulting images, the drones often appear as nothing more than dark specks in the wide desert sky.

Bridle, on the other hand, traces 1:1 scale outlines of military drones in public spaces--he calls them Drone Shadows. "The Shadows are not really about what the drone looks like," Bridle told the Center for the Study of the drone. "They're about the absence of the drone in the contemporary discourse."

Trevor Paglen, "Untitled (Predators; Indian Springs, NV)," 2010 [Detail]. Credit: Altman Siegel



James Bridle, “Drone Shadow 007: The Lavender Hill Drone” 2014



Mahwish Chishty, “MQ9/1,” Gauche, tea stain and gold leaf on paper, 8” x 28.5” 2011

Fernando Brizuela. "drone," Watercolor on Paper, 2013.

DRONES & THE DIY ETHOS

The speedy ongoing development of small drone technology is driven, in part, by a growing community of Do-It-Yourself innovators. The DIY-drones culture has its roots in the community of remote-control aircraft builders and flyers, which has long had a strong DIY ethos, priding itself on being a hub for the open exchange of know-how. That ethos has inspired a growing number of drone hobbyists and, crucially, has formed much of the technological bedrock for a burgeoning market of start-up drone manufacturers. In the same way that Little Leagues feed the American baseball culture, the DIY world has fueled the drone technology industry.

A number of successful drone startup companies have evolved directly out of the DIY community. In 2007, Chris Anderson, who was at the time the editor of Wired, found that he could build a capable aircraft at home for less than $1000. So, with a group of volunteers, he created diydrones.com, an online forum for DIY drone hobbyists to exchange information, techniques, and open-source technology. Anderson's company 3D Robotics, which builds components, as well as ready-to-fly aircraft and multirotors, is a product of the discussions on diydrones.com.

Meanwhile, the Pocket Drone, a small tri-copter, emerged out of the collaborations of the Drone User Group Network, an online community of thousands of drone enthusiasts. TJ Johnson, together with partners Timothy Reuter and Chance Roth, came up with the idea of a miniature drone, made with 3-D printed parts and open-source software, that could be sold for less than $500.

When the three organized a Kickstarter to fund their idea, they ended up raising 25 times their initial goal. The Pocket Drone is something of a poster child for the DIY drone business community, demonstrating the commercial power of DIY. Innovations in hardware and software are no longer just happening in the Research and Development departments of large, established companies; much of the exciting work is happening in garages and basements. Team Black Sheep, a hobby drone company formed by the Swiss flyer Raphael "Trappy" Pirker, got its start when Pirker and his friends started making daredevil flights across mountain ranges and cities around the world using homemade remote-controlled aircraft. TBS helped popularize the flying system known as "first-person view," in which the pilot is able to view a live video feed from the aircraft. Today, TBS has its own line of drones and parts that they market to their fans. The Maker Movement is another manifestation of the DIY ethos. The philosophy of the Maker Movement is that, as technologies like 3D printers and micro-controllers become cheaper, regular people will be able to create their own goods without having to rely on the industrial model of supply and demand. At Maker Faires, which are held regularly across the country, vendors and individual creators show off their creations, and children and teenagers are given a space to experiment with technology in a collaborative environment. By capitalizing on the DIY and hacker ethos and the ease of access to new technology, the Maker Movement seeks to create a new breed of artisans and inventors that reshapes the way electronics are made. The term "Maker" has become a widely-used title for anyone who builds technology for themselves instead of buying it off the shelf.

Ten years ago, the do-it-yourself ethic was far from mainstream. Some aspects of DIY today can be traced to its roots in American punk counter-culture, which rejected consumerism and corporatism and embraced manual labor and skilled crafts as a means of anti-capitalist activism.

The DIY, hacker, and model aircraft communities used to be relatively small, self-selected and self-regulating. In the past, building a remote-controlled aircraft entailed a huge commitment of time and energy. Enthusiasts met in flying clubs where piloting norms and behavior were enforced. As low-cost drones have become commercially available, the growing popularity of ready-made remote-controlled quadcopters and aircraft are lowering the cost of entry into the DIY club and eroding the self-regulating ethos of the modeling community. The average drone hobbyist today may be less interested in building than putting a camera in the sky. Nevertheless, in spite of the growth and commercialization of remote-control aircraft, the DIY ethos remains a core driver of innovation in the drone industry.

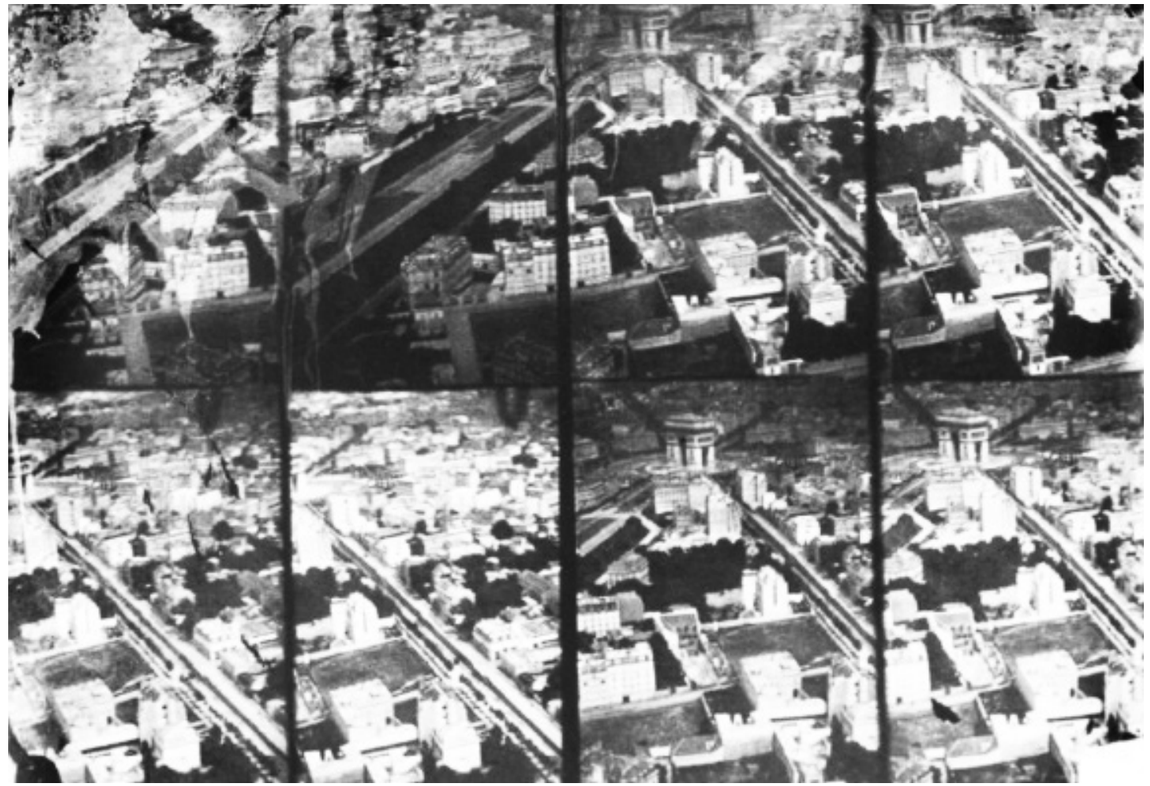
DRONES & THE FEDERAL AVIATION ADMINISTRATION

In 2012, Congress passed the Federal Aviation Administration Modernization and Reform Act, which set the FAA with the unenviable responsibility of safely integrating drones into American skies. The law requires the FAA to create specific regulations that would allow businesses to fly drones in the National Airspace System by 2015. Safely integrating unmanned vehicles into the national airspace is an extremely complex challenge. Since drones (and their pilots) do not have situational awareness, they add a new dimension of complexity to the challenge of keeping airspace safe. The FAA created six drone test sites to encourage the development of safety systems, and is working to expedite the integration of small drones under 55 pounds—the most popular type of aircraft for businesses.

But the 2012 law coincided with a boom in commercially available drone technology. As the FAA rushes to figure out how to have drones safely work and play alongside manned aircraft, drone technology has has become much more advanced and affordable. A number of quite capable "ready to fly" drones can now be acquired for as little as $500. These small drones can be flown with little to no training. Thousands of people nationwide have begun flying drones recreationally, and aerial photography companies and other small businesses that use drones have popped up everywhere. As a result, there has been a marked increase in close run-ins between drones and manned aircraft, not to mention drone crashes in populated areas. But the FAA hasn't written any ironclad regulations, and its attempts to control small drone use have been met with multiple legal challenges. Individuals and companies are therefore operating in an environment where official regulations don't yet exist. This is a time of regulatory limbo.

So far, an unmanned aircraft has never crashed with a manned aircraft in the United States. For decades, the FAA and the remote control aircraft community more or less left each other alone, but this has changed in recent years as model airplanes gave way to hexacopters and quadcopters equipped with cameras and long battery lives. The fear that a drone will crash into a plane, or into a crowd of people, has prompted the FAA to release a series of policy statements about safe drone use. These statements serve as a stand-in for future regulation, which must go through a long period of public commentary and revision. Unlike true regulations, policy statements aren't legally enforceable. All federal agencies put out such policy statements as guidance for the general public, and, generally, few people disobey them.

That hasn't been the case with drones, however. The FAA's small drone policy statements are often ignored. In response, the FAA has tried to enforce its policy statements as though they were regulations. In 2011, the FAA tried to fine a Swiss commercial drone pilot named Raphael Pirker for flying his drone "recklessly," but a federal judge with the National Transportation Safety Board threw it out, ruling that the commercial drone business is legal until the



Undated aerial photographs of Paris, taken by Nadar (Gaspard-Félix Tournachon).

FAA codifies its policy statements into actual regulations. That codification is expected to happen later this year.

Citing safety concerns, the FAA has tried to stem the spread of commercial drone use by sending a series of (thus far also unenforceable) cease-and-desist letters to commercial drone pilots whom it deems are operating dangerously. The FAA generally finds these companies and organizations through YouTube videos, news reports,and social media accounts. In February 2014, the agency ordered an organization called Texas EquuSearch, which had been using drones to search and rescue missions for several years, to cease and desist. The case was especially complicated because the group, a non-profit, is neither commercial nor a "hobbyist" entity. In July of this year, a federal judge ruled that the FAA's order against EquuSearch was not valid. Inspired by this and the Pirker ruling, drone pilots have increasingly been ignoring these cease-and-desist orders. So far, the FAA hasn't issued any other fines.

The FAA has said it will begin offering a small number of "waivers" for those who want to use drones to film movies, monitor crops or fly over pipelines. In June 2014, the FAA approved a commercial drone—a military-grade aircraft—to be flown to monitor BP oil pipelines in Alaska. For the most part, however, businesses continue to fly in the grey area. The FAA remains frustrated with people who fly without its permission, while the industry remains frustrated that the FAA is moving slowly to implement actual regulation for hobby and commercial drone use.

Chapter 12.

DRONE JOURNALISM

Reporters and hobbyists are keen to use drones to cover news events. Aerial coverage is informative, and news helicopters are expensive. Until the FAA creates comprehensive drone regulations in 2015, federal laws bar journalists from using drones for commercial purposes inside the United States. But some mainstream media outlets are tired of waiting. In June 2014, CNN and Georgia Institute of Technology announced a joint collaboration to study how drones can be used safely for reporting. The pioneers of drone journalism—hobbyists and freelance photographers—have already used drones to cover major events; in doing so, they have raised safety and ethical concerns.

So far, most drone journalism has been practiced outside of the United States, in countries where there are fewer legal restrictions. In December 2013, several Thai drone hobbyists and freelance photographers captured aerial images of clashes between protesters and police. The drones hovered above the tear gas, water cannons, and stones being exchanged in the melee below. This footage, and other aerial shots of the protests, were later shown on British and European news channels.

In November 2013, The Telegraph's Lewis Whyld flew a drone over the Philippine city of Tacloban, which had been devastated by Typhoon Haiyan. Whyld was able to fly his drone over areas that were inaccessible on foot, offering viewers a comprehensive view of the damage. Six months later, he returned with his drone to document the reconstruction process.

Drone journalism faces a number of challenges. First, it can be dangerous. A drone flying over the June 2013 demonstrations in Istanbul had to avoid objects that were being thrown by protesters. The drone, a commercially available quadcopter made by DJI, was finally shot down by police over a demonstration at Taksim Square. At the Geraldton Endure Batavia Triathlon in Australia, an athlete was injured when a drone operated by a local photographer struck her in the head. Some observers, like South African digital journalist Justin Arenstein, worry that the hobbyists and journalists who experiment with drones at public events put too many people at risk of injury. [1]

The use of drones for journalism is further hampered by privacy concerns. In August 2013, Toto Marti, a Swiss photographer, captured a series of photographs of American singer Tina Turner's wedding in Switzerland before police found him and asked him to stop. In the United States, in addition to federal bans on commercial drones, some state legislatures have already limited the ways unmanned aircraft may be used by members of the public and by local law enforcement.

In spite of a federal ban on commercial drones, hobbyists in the United States are engaging in unofficial drone journalism. They have covered tornado damage in Arkansas, a train derailment in Virginia, and the collapse of a building in New York City. In February 2014, a reporter for a Connecticut radio station flew his personal drone over the site of a car crash in Hartford, toeing the line between hobbyist and reporter. In the United States, the affordability and popularity of drones as tools for reporting has butted against the Federal Government's attempts to regulate the airspace.

[1] Pead, Sydney. "PBS: Public Broadcasting Service." The Debate on Drones: Navigation for Journalists. July 16, 2014. Accessed August 14, 2014. http://www.pbs.org/mediashift/2014/07/the-debate-on-drones-navigation-for-journalists-2/.

Chapter 13.

DRONES & PRIVACY

It has been much commented-upon that the introduction of sensor-laden drones into national airspace has serious implications for privacy rights. Many have voiced concerns about the extent to which privacy protections will figure in the FAA's research and regulatory goals. According to a docket describing the UAS Test Site program, "[t]he FAA's mission is to provide the safest, most efficient aerospace system in the world and does not include regulating privacy." On the other hand, there are those who argue that the privacy protections that are already built into U.S. law will go a long way to cover the potential threats that drones pose to privacy.

The United States Constitution does not establish an explicit right to privacy, nor does it offer a concrete definition of what privacy is; in the words of Justice William Douglas in 1965, the concept "emanates" from the Bill of Rights. This vagueness was foregrounded in the landmark 1967 case Katz v. U.S., which held wiretapping without a warrant to be unconstitutional, reversing the 1927 ruling in Olmstead v. U.S. Though Katz seemed to be a victory for privacy rights, Justice John Marshall Harlan maintained that the right to privacy is subjective. He described two conditions for privacy: first, a person must exhibit an expectation of privacy, and second, that society must be willing to recognize that expectation as legitimate. These two premises, reasonable individual and societal expectations, set a legal precedent that made the right to privacy relatively malleable. Instead of being a fundamental right, privacy was established as being subject to social and technological change.

With the onset of the drone era, individual expectations of privacy now have to accommodate the fact that the aerial perspective is a public perspective. If we don't want people to see into our backyards or greenhouses, then we need to cover them with a roof, just as we should draw the curtain on a window if we don't want those on the street to see what we're doing inside.

Meanwhile, societal expectations of privacy have had to change, and will continue to change, according to what technologies are publicly accessible. Thermal imaging, satellites, and sophisticated cameras don't just require a warrant because they are unusually invasive, but also because, to borrow from a 2001 Supreme

Court case, they are not in “general use.” But taking a camera phone photo of a stranger in Times Square is completely legal.

A wide variety of surveillant technologies that weren’t previously accessible to the public are becoming cheaper and more sophisticated at an exponential rate. This includes drones. These “off-the-shelf” technologies are likely to become commonplace, bringing them closer to the condition of being publicly available. The growing interest in commercial and private drone use, and the proliferation of high powered sensor technology such as hyperspectral and thermal imaging, facial recognition and laser spectroscopy, will challenge both individual and societal expectations of privacy. These factors underlie the argument that the premises of privacy under the law are inadequate to regulate the right to privacy.

Drones also change the nature of aerial surveillance. They are unlike helicopters and airplanes: they are smaller, more versatile, cheaper to fly, quieter, and can maintain surveillance for 24 hours, hovering or tracking. While it is true that we are in the midst of a frenetic—and at times hyperbolic—public reaction to the prospect of drones emerging in domestic space, it is very possible that society will in time become accustomed to this technology, just as those in urban centers have acclimatised to an environment of prevalent police surveillance platforms such as CCTV systems.

Understandings of privacy shift according to norms, and norms are subject to the development and proliferation of technology, which doesn’t always proceed along predictable or planned lines.

That being said, drones may also change the nature of discussions on privacy, as they make these issues more acute; as a result of the unique capabilities of drones, and because of the prevailing public perception of the drone, their introduction presents a qualitative change in the experience of surveillance. We are, as a result, seeing a proliferation of local- and state-level legislation that attempts to protect privacy from intrusions by drones. It of course remains to be seen whether these regulations, as well as those set forth by the FAA, will be enough.

Chapter 14.

WHICH AGENCIES HAVE DRONES?

Unmanned aerial vehicles offer government agencies at the federal, state, and local levels a range of advantages over manned aircraft. These include drastically lower equipment costs, lifetime savings on fuel, insurance and maintenance, a smaller body for discrete missions, drastically decreased risk to pilots and onboard staff, as well as potential for automation of tasks like surveillance and scanning through a range of sensor payloads.

Given these advantages, it is no surprise that UAV acquisition and use by government agencies has followed an upward trend in recent years. The available data on government drone proliferation is piecemeal. As the Federal Aviation Administration continues to develop its UAV regulatory frameworks, it has been slow to release data on the government actors that already fly drones. Nationwide, as of December 2013, the FAA reports that there are a total of 545 active Certificates of Waiver or Authorization, the approval necessary for a government agency to operate unmanned aircraft in domestic airspace. The FAA approved more than 370 COAs in 2013, compared to 257 in 2012 and 313 in 2011.

COAs ISSUED:

2009	146
2010	298
2011	313
2012	257
2013	373 (as of Oct 31)

There were 545 COAs active as of Dec 4, 2013

Source:
http://www.faa.gov/news/fact_sheets/news_story.cfm?newsId=14153, Accessed AUGUST 8, 3013

These figures seemingly understate the upward trend in COA approval. As of February 2013, the FAA indicated that there were 327 active COAs across the country — in ten months, then, the number of active COAs increased by more than 60 percent.

Such COA figures provide only a rough idea of how many government entities own and operate UAVs. A given government agency must obtain a separate COA for each model of UAV it flies, as well as for separate blocks of airspace. The FBI, for instance, has obtained at least 8 separate COAs since 2010, according to materials released by the FAA. And while most COAs are issued for two March 29, 2014 years, the FAA also grants approvals of shorter duration for emergency public safety operations or equipment testing. The FBI has obtained both long-term and emergency COAs.

The FBI has experimented with UAVs since 1995, and has used them in operations since 2006, but it is mostly unwilling to release information about its drone programs. Following a FOIA lawsuit, the FBI released documents about its research into and deployment of surveillance drones. The Bureau has not released specific details about its drone operations, including historical inventory figures, privacy impact assessments or reports from past missions. The FBI told Congress in July 2013 that its agents had used drones in 10 operations—eight criminal and two national security cases—since October 2006, and authorized another 3 missions that did not ultimately require a flight.

The FAA has much more granular, agency-by-agency data on UAV deployments and approval applications, but it has released lists of proponent agencies as the result of Freedom

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The FAA has much more granular, agency-by-agency data on UAV deployments and approval applications, but it has released lists of proponent agencies as the result of Freedom of Information Act litigation or in response to congressional inquiry. The most recent such listing from September 2012 includes a total of 228 government agencies that have applied for a COA, including large agencies like the Air Force, the Defense Advanced Research Projects Agency, Customs and Border Protection, the Seattle Police Department and the U.S. Forest Service, as well as smaller entities like the Soil and Water Conservation District in Becker, Minnesota and the North Little Rock Police Department in Arkansas.

The most recent FAA list does not indicate which agencies were approved or denied to fly UAVs, or how many COA applications each particular agency submitted. The FAA has yet to provide a more recent listing in response to subsequent FOIA requests, or to release flight log data each approved agency is required to submit per COA stipulations.

14. WHICH AGENCIES HAVE DRONES?

It is also difficult to ascertain which government agencies benefit from UAV services without flying or owning any units themselves, though there is evidence that this has occurred. The best-known example involves Customs and Border Protection deploying its UAV fleet in support of other agencies. Through a FOIA request, the Customs and Border Patrol, which maintains a fleet of 9 Predator and Reaper drones, released logs of agencies for which it had flown its unmanned aircraft: the list, which is heavily redacted runs through the end of 2012, includes flights for the Drug Enforcement Administration, the Coast Guard, the Bureau of Land Management, the U.S. Geographical Survey, and the Bureau of Indian Affairs.

From 2010 to 2012, CBP conducted 687 support flights for federal agencies including the Coast Guard, Immigration and Customs Enforcement and the Drug Enforcement Agency, as well as state law enforcement bodies in Arizona, Minnesota, North Dakota, and Texas. Such support flights included the 2011 flyover that the CBP conducted in Grand Forks, North Dakota at the request of the local sheriff, a mission which resulted in the first reported domestic arrest—in that case, of an alleged cattle thief—pursuant to domestic drone surveillance flights. CBP also supported 21 county and municipal agencies in those three years, all presumably in border communities, but the particular localities and agencies involved were redacted from released logs.

MuckRock's Drone Census, which uses tiered crowdsourcing to make information about government agency use publicly available, has collected evidence of agencies conducting UAV operations without FAA authorization (Shawn Musgrave, one of the authors of this report, is an editor at MuckRock). For example, the Maine State Police and the Brunswick Police Department in Georgia purchased inexpensive UAV models marketed as toys without pursuing a COA. The project has also found agencies that have recently purchased or are considering purchasing UAVs, such the Nashville Police Department, San Diego County Sheriff's Office, Alameda County Sheriff's Office in California, and the Suffolk County Police Department in New York, none of which appeared on FAA lists of COA applicants. Most public safety agencies purchased UAVs via grant funds from the Department of Justice or the Department of Homeland Security.

As of May 2014, 35 states have introduced legislation to prohibit or restrict the use of drones by government agencies. To date, a total of 12 states adopted such legislation, including a complete moratorium on government UAV deployments in Virginia until June 2015. While the majority of agencies continue to indicate that they neither own nor operate UAVs, federal data and Drone Census findings suggest that a growing number of government agencies are researching, acquiring and flying UAVs.

Confusion remains around authorization requirements for government agencies to deploy UAVs, and the FAA has overlooked some agencies that operate UAVs without authorization, including the state police in Maine as well as police in Brunswick, Georgia.

The widespread reluctance to release information about agency drone use means we only have an incomplete picture. The FAA has opted to limit information released to the public about UAV deployments. Likewise, a number of the most prominent agencies that are known to either use drones or which are currently interested in acquiring drones—such agencies the CBP, New York City Police Department, the San Diego County Police Department and the North Little Rock Police Department—have all rejected records requests outright or released minimal documentation.

THE DRONE DEBATE

Drones court controversy. Questions of privacy, human rights, and safety accompany the drone wherever it goes, from the backyards of private users to the battlefields of Afghanistan. Unmanned aerial technology has spurred a number of debates in the the public and policy arenas.

The most controversial use of drones, and the one that has been accompanied by the fiercest debate, is the CIA's program of targeted killing. Richard Clarke, who as the counterterrorism czar in the years immediately preceding 9/11 advocated for the use of weaponized drones, now promotes the view, shared by many, that strikes—the "mowing the lawn" strategy, as some officials refer to it—not only violate international humanitarian law, but also breed new terrorists. The Stanford/NYU report Living Under Drones and the Columbia Law School HUman Rights Clinic report The Civilian Impact of Drones fuelled such criticisms by describing how drones wreak psychological havoc on civilian communities in Pakistan, while reports by Amnesty International and Human Rights Watch pointed to human rights abuses in the targeted killing program.

These reports have been met with resistance by experts, commentators, and officials, who point to evidence that drones are in fact popular among communities that dislike the presence of Al-Qaeda groups. Speaking to alleged psychological trauma, some experts noted that drones fly so high as to be almost, if not totally, inaudible, and that the perpetual noise in the skies likely came from manned aircraft operated by local militaries. Polls have shown that over half of all Americans support the use of drones, though a 2013 survey found that in the rest of the world, support for U.S. drones was far lower.

In part, the CIA debate has been hindered by the U.S. government. Sarah Knuckey argues that the drone debate impasse is a direct result of the U.S. government's refusal to release information about its targeted killing program. But, as the experience of other national debates has proven, open access to the facts does not cure the problem of a failing public debate. There is, in fact, a great deal of publicly available, verifiable information about the history of the War on Terror, U.S. intervention outside of declared wars, and the AUMF. The New America Foundation and the London-based Bureau of Investigative Journalism have compiled extensive statistics on drone strikes that, while imperfect, provide a great deal of information about the scope of the program and the casualties incurred by it. While the U.S government flatly rejects these casualty figures, they are the most credible statistics that we have until official figures are released.

Meanwhile, critics of the drone as a military tool contend that drones lower the threshold for lethal action, remove the pilots from the battlefield, and sanitize the act of killing. Defenders of military drone use, on the other hand, contend that drones are much more surgical and precise than the lternatives. They argue that rather than lowering the threshold for action, the drone's ability to

loiter over a target for hours enables a much more intimate and considered mode of targeting. They support this argument by calling on research that shows drone pilots experience equivalent rates of PTSD to pilots of manned aircrafts, proving, they say, that drone pilots are no more removed from the reality of war.

On the domestic front, the debate pits concerns about privacy and safety against the argument that drone technology, if properly embraced, will create jobs, save lives, and deliver new services to the public. State and city legislatures across the country are debating anti-drone bills, while businesses warn that too much regulation could kill America's ability to compete in an industry that's predicted to be worth billions. Drone hobbyists and businesses have waged a fierce campaign against the FAA, alleging that its attempts to regulate drone use in the lead-up to the 2015 integration deadline are illegal. While this is technically true, the FAA contends that it is simply attempting to keep the skies safe.

As with many debates around complex issues, both camps have fair points. But the drone debate, and particularly the debate around domestic drones, suffers from a reluctance on the part of both camps to fully engage with each other, and, more significantly, a failure to find a common vocabulary. Case in point: the use of the word "drone" is itself a matter of heated debate. If you search for the word "drones" on Twitter, you'll see a conversation that is largely dominated by anti-drone and drone-neutral sentiments. None of the big defense and aviation companies use the word. But if you look up "UAV"—which stands for Unmanned Aerial Vehicle—the feed is largely dominated by tech companies and drone advocates sharing news about developments in the field. These two conversations are essentially happening in isolation of each other: head-on engagement is therefore difficult.

Note: Our decision to use the word "drone" does not reflect our wish to align with the anti-drone camp; rather, it reflects our desire for a common conversation. We think that "Drone" is simply a better word. As Steve Gitlin, VP of Communications at drone maker AeroVironment--a company that chooses not to use the word–put it, the word is good because "it's short and memorable."

THE AIR FOR ALL, AN ESSAY

The first aerial photograph was made in 1858 by the artist and critic Nadar, who used a balloon of his own invention to fly eighty meters above the French village of Petit-Becetre. Nadar's artistic and somewhat bohemian leanings belied a more utilitarian motive: three years earlier, he had patented the idea of photographic mapping, and the following year he was proposing to take photographs for the French Army during its campaign in Italy. Flying with a camera wasn't easy (Nadar had to install a miniature darkroom in the balloon basket) and it wasn't always safe (his second flight ended in a landing that dragged him and his wife for a kilometer). But he was on to something. By the First World War, the cultural theorist Paul Virilio wrote, aviation had ceased to be about breaking flight records and had become an essential, a determinant aspect of modernity and "one way, or perhaps even the ultimate way, of seeing."

The price point for that way of seeing has dropped dramatically in the past few years. The continued development of the components that go inside smartphones—sensors, optics, batteries, and embedded processors—has brought the cost of an able quadcopter with a camera and a thirty-minute battery life down to roughly $700, within reach of many gadgeteers and amateurs. The FAA has predicted that by 2018, around 7,500 drones will fly over the U.S., and that's not counting many smaller, lower-flying consumer systems. Just as the computer giants vied to put a computer in everyone's pocket, some upstart drone companies dream of putting a drone joystick in everyone's hand.

"We are entering the drone age," declared Chris Anderson in 2012, as he left his job editing Wired to run 3D Robotics, a drone kit company, and DIY Drones, an associated website where drone hobbyists share mostly open-source designs. The site has over 30,000 members. Now armed with small cameras and GPS navigation systems, homemade and commercially-available remote aircraft are used as affordable tools for filmmaking, farming, environmental sensing, wilderness patrol, and searching for missing people. They have been used by realtors to make

One of the first aerial photos of Paris, taken in 1868 by Nadar (Gaspard-Félix Tournachon).

dramatic videos of homes, and by Silicon Valley entrepreneurs to take epic video selfies. "Our goal is to put flying robots in the hands of as many people as possible," Tim Reuter, a drone hobbyist and one of the founders of AirDroids, one of many drone startups based in San Diego, told TechCrunch in January. (In a Kickstarter campaign, the company raised over $50,000 overnight.) "We think it's empowering to democratize the sky," he added.

In the months before the revelations about NSA surveillance, the specter of drones "democratizing" aerial surveillance sparked a public privacy debate in legislatures around the country. Even if the vision of skies filled with what some have called "flying lawnmowers" may be overblown, concerns about the public safety hazards have alarmed pilots of manned planes, who have in dozens of cases reported near-misses with drones. And of course, in the hands of novice pilots or terrorists, drones could be used to wreak havoc.

The explosion of drone use has been accompanied by a restrictive regulatory reaction. Many U.S. states have responded, at times drastically, by limiting drone use by hobbyists, police, and government agencies, or banning their use outright. Ahead of FAA guidelines due in 2015, the agency has attempted to prohibit the commercial use of drones, and warns operators to keep drones below 400 feet, within visual line of sight and away from populated areas and airports. It has forced certain operators, including journalists, filmmakers, and independent search and rescue teams to cease and desist from flying (though many of these actions have been struck down.) The prospect of a sky filled with flying cameras, then, has also had a disempowering effect.

If new technologies extend new powers to the masses—consider what the web meant to researchers, or what the 3D-printed gun represents in the context of Americans' right to bear arms—the personal drone represents, to some, the technological emblem of the freedom of the press and of speech. Drones in the hands of citizens, for instance, have exposed the pollution of industrial farms and challenged the legality of the ag-gag rules that keep the insides of those farms concealed. Journalists, citing FAA warnings, have been wary of using drones, but a recent brief filed in federal court by The New York Times, The Washington Post, The McClatchy Company, and other news organizations contends that those rules, which restrict drone use for "a business purpose," are in violation of the Fourth Amendment.

Beyond "sousveillence" and journalism, a drone can also be used to expose things that were previously unseen, and reach things that had been previously untouched. Arm one with a spray can, as the artist KATSU did, and you have expanded the canvas of the street artist and further exploded the boundaries between public and private space. And simply by making new perspectives possible—just search YouTube for "FPV" or "first-person view"—drones permit a new kind of visual-spatial liberation. While drones, like robots, are often touted as useful for dull, dirty, or dangerous tasks, they have less tangible, more human attractions too. They allure with a particularly modern sensation: the pleasure of looking down on Earth. Seeing like a bird (or a god) can be exhilarating, and the drone can become an irresistible tool for observation and control.

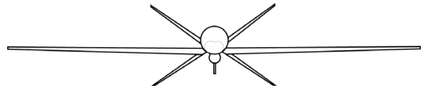
The recent clampdown on drones hasn't dulled the enthusiasm of several Internet companies who have turned to the drone as a way of extending the real-world reach of their networks. Amazon and DHL talk about sending packages by drone, and Google and Facebook intend

to use drones to broadcast internet to the unconnected parts of the world. For the moment however, Silicon Valley's new drone exuberance is little more than a marketing arms race, proving, if nothing else, just how far the drone crept out of the shadows of covert war and into the mainstream. But even in the hands of Silicon Valley giants, the drone remains an instrument of power, a tool for extending not only one's vision over the Earth but one's reach over it, too.

The drone raises the stakes in the tension between information and privacy. When Google's Street View cars were found to be collecting massive amounts of data in Germany without proper authorization, they became a symbol of the massive and otherwise invisible network of sensors that spans from the street corner to our inboxes. And yet these cars—someday, per Google's driverless dream, bound to be drones themselves—bring us value: they allow anyone to view the streets like a kind of drone pilot.

Google's satellite maps, meanwhile, have done for the Earth what Google's web crawlers did for the Internet. They allow us to scan the Earth on a map that is, per Jorge Luis Borges' famous short story "On Exactitude in Science," as large as the world itself. (The U.S. government, with its satellites, can have something like a real-time version of this map.) In 2012, the artist James Bridle underscored the drone-like power of Google with Dronestagram, bird's-eye-view photos of the locations of drone strikes taken from Google Maps and tinted like a scenic cell phone selfie. It contemplated two sides of the drone, bringing the people closer to a way of seeing typically reserved by the state.

There is a serious political implication to all of this—this sense of liberation, democratization, autonomy, sensing and control. For now, the drone, all-seeing but rarely seen, remains a ghostly symbol of a technology both distant and close, virtual and tangible, a sign of a world sensed remotely and often secretly. As the drone expands the power of flight and surveillance further into the public realm, it also has the potential to provoke a more robust public discussion about remote control and surveillant power. In this sense, drones don't just promise people a new tool for farming or for filming or just a beautiful bird's-eye-view; they also represent the appearance of new kinds of authority, and the continuing challenge of maintaining a more general kind of oversight over the powers above.



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