Denis Soloviev School special of war as a combat drone operator

Chapter 1: Pilots, soldiers, gamers: how UAV operators work

The fact that UAVs are the future of the world's air forces is as obvious as the fact that no true unmanned reconnaissance or combat aircraft yet exist. Every UAV has an operator, and in many cases more than one, and this human-machine combination poses many problems and causes a number of

difficult questions.

A few years ago, given the growing importance of unmanned aircraft in U.S. combat operations the U.S. government created the Distinguished Warfare Medal specifically for military UAV operators and cyber warfare specialists. The reaction of veterans of real combat operations was immediate: how can sitting at a computer screen thousands of miles away from where explosions rumble and machine-gun rattle be equated with combat merit?! The argument was heard, and the medal was quietly canceled.

The robot crew

This event very clearly demonstrated the duality of the human position in "remote warfare". On the one hand, one of the main tasks of the UAV is not to endanger the pilot's life, on the other hand, even sitting in a safe place, at the command center of the UAV, the operator is dealing with life and death issues and often exposes his psyche to serious stress. It's like being in a war.
Studies by medical professionals and psychologists show that despite their distance from the battlefield, UAV operators can sometimes suffer from post-traumatic stress disorder, similar to hotshot veterans.

Of course, humans can simply be "taken out of the game". By 2030?2035, the U.S. Air Force wants to have a fully autonomous robotic automaton that will do

everything itself without human intervention and even make decisions on launching missiles.

However, it is likely that moral and legal issues, rather than technical problems, may be the main obstacle to the emergence of such weapons. According to accepted practice on

Silent flight

In addition to control functions, the operator's workstation equipment allows the operator to generate and then enter the flight task, replenish the data bank, and conduct pre-flight training. In their work, operators interact by means of speech exchange, as well as interactive exchange of information formats of their multifunctional displays. The use of helmet-mounted target designation systems is also being developed for control purposes.

The world experience of operating unmanned aerial systems (UAS) of the Shadow, Hunter, Hermes, and Predator types has shown that a team of operators with three specializations is the most effective. First, it is the UAV pilot operator, the one who directly controls the flight. Second, the onboard target payload operator. He works with sensor systems of different spectral range of round-the-clock application - they serve for battlefield observation, search, detection and identification of objects of interest. The same operator makes the decision to aim and launch weapons. Third, an intelligent support operator with experience in UAV control, who is proficient in the technology of expert systems of the "pilot-assist" type
and having a quick reaction time to make decisions.

Operators' workplaces are united in a local area network and are based on multifunctional monitors-displays, multifunctional control panels, well as manual controls such as hand airplane handles with HOTAS technology, as well as flytsticks.
Operational-tactical LHC command posts shall be established in
mobile version on a vehicle chassis. In addition to the basic equipment, the stations are also equipped with unified remote terminals, which provide additional options and flexibility in management.

One of the problems is overloading payload operators and intelligent support with information from UAVs, which must be responded to in real time and is now growing at an avalanche rate. In particular, as multispectral, multi-aperture airborne sensors are becoming available on drones

sensors.

Ace vs. Console Master

However, no matter how sophisticated and perfect the control equipment is, there is one nuance in piloting an aircraft from the ground, which can be called "sensory hunger". Pilots say that they feel the airplane with their "fifth point", and this is no joke: the sensation of overload gives a lot of information about changes in the position of the aircraft in space. Hearing is also involved - the sound of the engine is also very informative. Much more data is received by vision: the pilot can, for example, look through the side window of the airplane. This whole range of sensory signals allows the pilot to quickly recognize changes in the situation and react instantly.

The UAV operator has mostly only visual information in front of him: a coarse-grained picture, usually from the UAV's nose camera, which is broadcast with a delay of a few seconds if the control is via satellite, plus a map and various digital data on displays that need to be interpreted. So, of course, the UAV operator's response will most often lag behind that of a pilot in a manned aircraft.

One solution to this problem could be the use of so-called multimodal displays - systems in which visual information is complemented by other sensory data. How, for example, can a UAV operator sense turbulence? Directly - only in the form of shaking of the picture coming from the camera. But if the picture is supplemented, for example, by the vibration of the flytstick, the operator will react much faster to an unfavorable situation in the air. This effect is well known to owners of game consoles and even smartphones!

Who is the best candidate for a UAV operator position? The first thing that comes to mind is a former or active Air Force pilot. And it is from this category that the operators of the large UAVs operated by the U.S. military have largely been recruited. However, as the demand for
of "unmanned pilots" found that, for one thing, the Air Force simply wasn't capable of
Secondly, young people who are experienced in Playstation and XBox battles are better suited for the role of operators than pilots. The point is that it is difficult for an air force pilot to control an airplane without the usual "prompts" (sound, overload, etc.), and those who are skilled in communicating with virtual reality, can easily do without the sensations of the "fifth point". Back in 2004, a group of American researchers led by Kaisar Varaich found that operators with experience in piloting conventional airplanes made more mistakes when controlling UAVs than those who mastered the control equipment from scratch. The authors of the report believed that UAV controls should be unified with traditional computer interfaces rather than the familiar aircraft controls.

Ground command posts (GCPs) are made in a mobile version on a vehicle chassis. Currently, there is a trend towards mobile unified UGCs with an open architecture, which allows for an increased capability to use different types of UAVs, including their joint use, as well as the use of mixed teams of UAVs and manned aircraft. Such UAVs will allow a single operator to operate several UAVs at once, for example, four.

What will the drone say?

But the more the UAV control tools resemble virtual reality joysticks, the more often people without piloting experience will appear among the operators of combat drones, the more acute the issue of psychological and moral responsibility of operators for giving the "fire" command will become. The NATO standard STANAG-4586, which regulates the operator's interaction with , recommends ten levels of automation, ranging from full subordination of the UAV to the operator to full autonomy. In other words, it is far from always possible for the operator to be responsible for a particular action of the drone. And it is in this area that a psychological, moral and legal problem arises, which is not easy to solve. If all actions are left to the human operator, then he or she also responsible for the drone strike. If a large scope of action is left to automation, its failure or error may lead to senseless victims. The very fact that the UAV operator is forced to kill without putting his own life at the slightest risk becomes the source of serious psychological suffering, the very same post-traumatic syndrome.

Operators tend to land the drone on steeper than standard glideslopes. But this is a landing with increased vertical velocity of touching the runway and, consequently, with increased impact overload, which may simply break the UAV. It is clear that such conditions will be better "accepted" by UAVs with reinforced landing gear and hull, and it is such UAVs that will be easier for the operator to cope with.

We have to resort to all sorts of tricks. For example, it has been observed that when communicating with a robot with anthropomorphic features, a person tends to see the machine not as a tool but as a partner with whom he or she can share responsibility. It is unlikely that combat UAVs will ever be made in the form of Superman or Iron Man, but partly anthropomorphic features can give the drone the ability to talk. The U.S. Air Force Research Laboratory is working on a voice interface for the operator and UAV to communicate. So before launching a Hellfire missile at the next suspicious object, the operator and the robot will be able to "discuss" the topic.

For the near future, the general rule of thumb will be to reduce the degree of autonomy of UAVs when the task is very certain or when there is time to expand situational awareness. Naturally, while increasing the operator's role in control. One illustrative case is a UAV landing.

The experience of Predator and Reaper UAVs shows that during automatic landings they tend to approach the runway with increased roll, nose down, first contact with the ground with the front wheel, and hopping when the main landing gear touches down again. As a result, wheel struts may burst and other mishaps may occur. In this case, direct operator intervention is highly desirable. In fact, this has become the rule - very expensive UAVs (worth tens of millions of dollars) are often landed manually by operators of U.S. airbases.

Chapter 2: Fundamentals of commercial quadrocopter combat applications

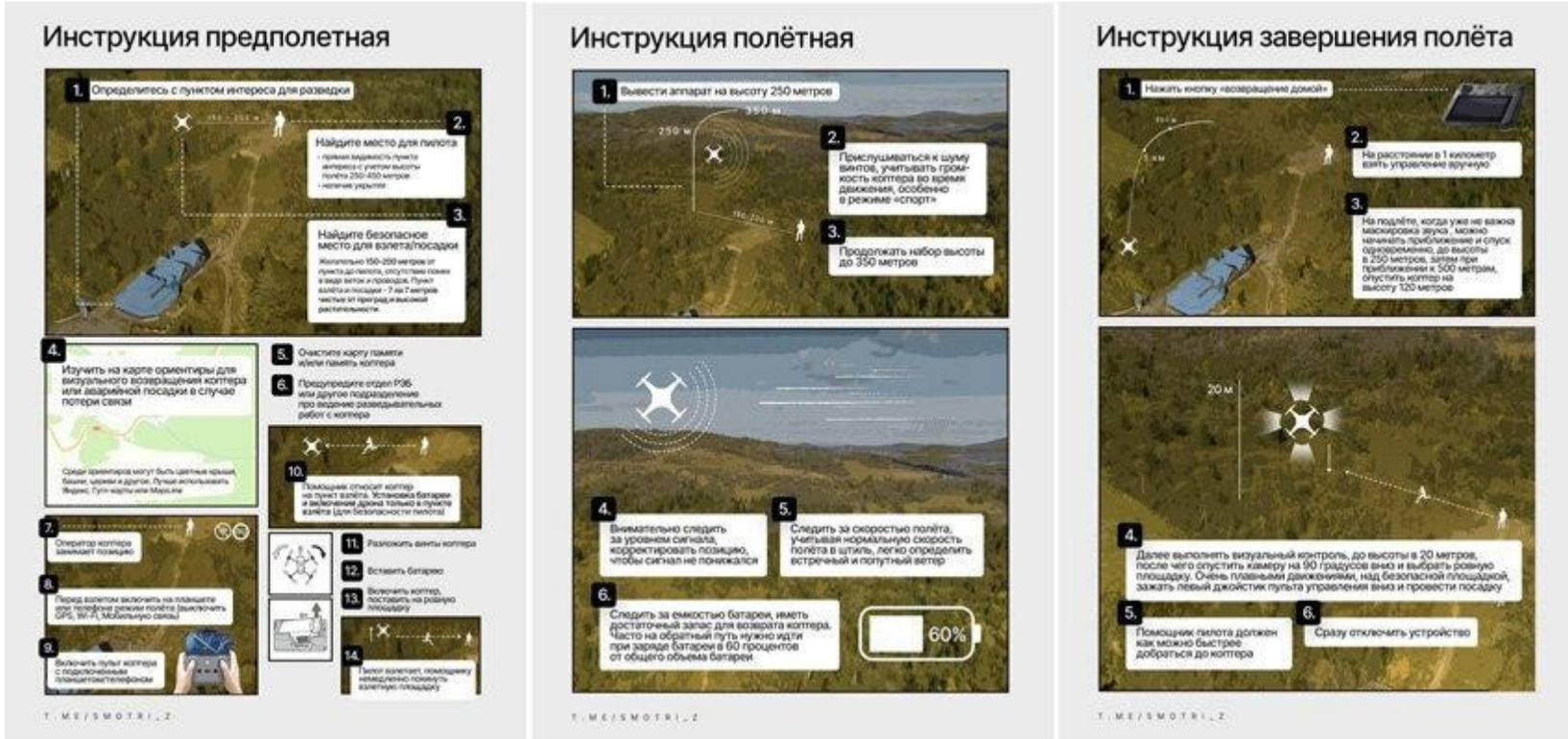
To succeed in modern combat, motorized infantry need two things in addition to weapons: good communications and good optics, including night vision devices. Recently, a third requirement has been added - quadrocopters, ordinary commercial quadrocopters, which can be bought, for example, in NIKS stores.

Tens of thousands of such quadrocopters are now being used in Ukraine on both sides of the front line. They successfully accomplish battalion-level reconnaissance tasks. Yeah, they have a lot of drawbacks: they are noisy, afraid of strong wind and darkness, their range, as a rule, does not exceed 3 km, and the speed - 80 km / h, optics on them such that it is pointless to go above 500 meters up - nothing to see, in the air they can last no more than 30 , but they weigh only a couple of kg, fit in a , or even in a pouch, can hang in one place, and most importantly - they are relatively cheap, they do not require a highly skilled operator to pilot them, and they can take off and land from any point. Moreover, with the help of simple devices in the form of a glass with a grenade placed in it with the check pulled, quadrocopters are turned into shock drones. At the desired point, the glass is dropped, falls, shatters, releases the grenade lever, and then the explosion occurs.

There is, however, one more unpleasantness: after February 24, the Chinese manufacturer of the most affordable quadrocopters in Russia DJI introduced a forced inclusion of the transponder on its devices, which means that if there are certain technical means, the enemy can detect not only the drone itself, but also the launch point and even the location of the operator with the remote control.

In general, there are many subtleties that must be taken into account in the combat use of commercial quadcopters. This experience is summarized in the form of instructions. We bring to your attention the text and pictures posted online by the Novorossiya Assistance Coordination Center, a public organization that deals with the procurement and supply of Russian troops with some things that, for some reason, the state has "forgotten" about. For example, this is the case with quadrocopters. Since they have not been adopted by the Russian army, the Ministry of Defense cannot officially purchase them. Once upon a time in Afghanistan, our soldiers used their own money to buy sneakers to climb mountains.

Today in Ukraine, someone has to collect donations to buy a
of quadcopters, providing their gifts with instructions like these.



Chapter 3: Fundamentals of Commercial Quadrocopter Combat Applications

I. Tasks solved by quadcopters.

It is very important to decide in advance what exactly you are going to do with the UAV and what result you intend to achieve. Based on the result to be achieved, we roughly divide UAV tasks into three types. These are not rigid and can flow into each other during the course of the battle. Again, you must not just fly over the battlefield, you must influence its course and outcome.

Types of tasks:

1. Artillery reconnaissance and fire correction. The result of artillery reconnaissance is the coordinates of the target in the desired coordinate system. The enemy uses the international coordinate system WGS 84, we use the Russian army standard SK-42. Artillery correction involves you observing the bursts of our shells near the target and making appropriate corrections if necessary.

2. Reconnaissance of terrain. The result of such reconnaissance is the detection of the enemy, traces of their presence and other facts about which the relevant units should be warned. For example, a UAV unit may be supporting a convoy of vehicles and the important thing here is a timely warning that something suspicious is happening at some distance to the left or right of the route.

3. combat management. UAV calculations can help the unit commander see the situation from above in real time and control forces and assets in real time. Important Notice. To command from above, it is important to train personnel to operate from clear landmarks. There is no point in shouting "run to the right," because from the top
Everyone's "right" is different.

II. A set of additional equipment for the successful use of quadcopters.

Experienced operators have already formed wishes for a set of equipment to go along with the "bird" itself.

Additional rechargeable batteries. The total number of batteries in a copter should at least 5. It happens that experienced teams make 20 combat sorties per day. This is not possible on one battery.

Spare screws.

Tablet and tablet protective case. There are different opinions here. Some people

prefer a smartphone, others prefer a remote control with a screen (DJI has one called Smart

Controller), but we equip all our drones with tablets. We believe that it still gives a better view of the map.

Tablet holder. It is convenient to attach a smartphone to the standard remote control. A special holder is required for a tablet.

Sun visor. There are special visors with which you can equip your tablet so that even in bright sunlight you can see what is happening on it. Don't forget that tablets also differ from each other in terms of image quality.

MicroSD memory cards3 per set. 32 or 64 GB, UHS-I, U3 and Class 10, with SD adapter. It is better to equip the memory cards with a USB card reader. The card is inserted into it, and it is connected to the computer via USB. Not all laptops are now equipped with a standard card reader. The cards themselves are inserted into the quadrocopter and allow you to bring high quality video from flights.

Car battery charger.

Cigarette Lighter. A device that allows the car charger to be powered directly from the car battery.

USB Type-C (m) to USB (m) cable. You can also have a spare cable like this.

Micro USB (m) to USB (m) cable. You also have a spare.

A good backpack for storing and carrying all your gear.

III..

For effective work with DJI brand UAVs, DJI Pilot software is the most suitable, it allows you to get the largest amount of data for operational decision-making by the operator, but this software is compatible only with the industrial line of equipment of this manufacturer, which is about 2 times more expensive with similar specifications.

By trial and error, a set of several program complexes was assembled to solve the main tasks:

DJI GO

. Standard software for controlling the copter, operation is possible only when communicating with the remote control. It is possible to remove the 500 m altitude limitation, remove no-fly zones, re-flash to the American FCC communication standard in order to increase the range. The simplest instrument except for the need for a scholar's record (although formal) and the requirement for a minimum knowledge of English by the operator.

Litchi. An app with advanced functionality for copters that support DJI GO. Here everything is more interesting. It's in Russian. For a working peasant army this is a huge plus. Shows the coordinates of the board in real time (WGS 84). It has a conditional grid on the screen, allowing you to quickly determine the distance depending altitude. There is a diagonal (simply , crosshairs) serving as target guidance when the camera is lowered strictly downward. Automatic point-to-point flight without communication with the operator is realized.

Geodesist" software. Serves for operational conversion of coordinates from international WGS 84 to Russian SK-42.

OfflineMaps software. A simple application that allows you to save a large volume of maps to your smartphone and make adjustments to artillery systems using a handy ruler indicating azimuth and distance from burst to target. The

special value is in the indication of coordinates of the selected point at once in SC-42.

IV. The basics of using software for various tasks.

Objective: to cover the convoy with the purpose of reconnaissance of the terrain along the movement at a distance of 1km (DJI GO software).

Technology: the operator, moving in a convoy, performs visual observation of the terrain in real time using a copter moving in front of the convoy. The nuances include the need to periodically update the home point so that in the event of signal loss, the copter is not lost.

Task: escorting a hiking group (software litchi+ need for stable radio communication with the group).

Technology: the operator leads the group online, illuminates targets, transmits visual landmarks via radio communication.

Task: targeting of artillery systems (litchi software+ software "Surveyor").

Technology: the operator searches for the target, then takes the coordinates from the device screen, transfers them to the SC-42 using Geodesist software (on another device - smartphone or tablet) and sends them to the fire control center.

Task: correction of art systems (litchi software+ software "offlineMaps").

Technology: while the artillery system is operating, the operator indicates the locations of bursts on the software, receives corrections in azimuth and distance from the target, and transmits them to the fire control center.

Task: intelligence gathering in the environment of REB means (litchi software).

Technology: in areas where positioning signals are suppressed, it is critical to fly at minimum altitude, thus significantly narrowing the radius of the flight-operator communication channel. On this basis, the operator builds an autonomous flight task with a single pass over the target at maximum speed and minimum allowable altitude. Data analysis is performed after the flight returns.

V.DJI Aeroscope drone detection platform.

The Ukrainian side is actively using a DJI drone detection tool - DJI Aeroscope - in the air defense zone. The peculiarity of this system is that it shows the coordinates of all copters of this brand and the location of operators in the zone from 5 to 30 km depending on the version (stationary or portable). A system to minimize threats from this equipment has been developed in cooperation with current operators, but it is the most dangerous for the operator. This system does not allow to intercept the control (as well as all applied REB means), but immediately after turning on the copter at its location and the location of the operator start to work actively. The only sensible reaction of the operator, if shortly after turning on the remote control they started firing at it, is to turn off the remote control and hide. Unfortunately, no Aeroscope rescue firmware exists, although there is a lot of talk about it. DJI, as a drone manufacturer, did create an effective means of detecting them.

As an appendix, we publish Ukrainian instructions for operators in the form of comics. The color version is in Ukrainian, the black-and-white version is in Russian. However, the Ukrainian instruction coincides with the Russian one almost word for word. It is not known who copied it from whom. Pay attention to the image of the drone in the Ukrainian instruction. This is a product of the American company Autel, which actively supplies the Ukrainian armed forces with its copters.

Drone control (UAV) or "Gamers at war"

A UAV is an unmanned aerial vehicle. They are also called drones or simply drones. In fact, there are no drones. Any UAV has its own pilot operator, and some drones have two or three operators each. In this case, the term "unmanned" means that the pilot is not on board the aircraft (UAV). But a human is still operating a reconnaissance or strike drone.
In recent years, the use of UAVs in military conflicts involving the U.S. Army has increased dramatically. In this regard, the U.S. Congress in 2013 planned to introduce a medal "For Special Combat Merit", which was supposed to be awarded to drone operators and specialists of cyber combat units who took part in military conflicts. But the just indignation of real veterans, participants of real battles, was so great that the medal was quietly canceled without special pomp. This speaks, firstly, about the participation of operators in combat , and, secondly, about the emerging conflict in the UAV-operator system.

So who is a drone pilot operator? A military man making responsible decisions about the use of weapons? Or just a gamer virtually controlling an expensive toy from a distance? The task of the drone is not to endanger the person sitting in the cockpit. Indeed, there no physical danger to the operator, who is many miles away from the . However, as American psychologists and medics have found out, a UAV operator who has conducted combat operations using weapons is subject to serious psychological stress. He is even susceptible to post-traumatic syndromes, similar to a fighter who has been directly involved in combat operations. No matter how automated the drone is, a human being is responsible for its actions, for the use of weapons. The experience of operating operational tactical unmanned aerial systems (UAS) has shown that a team of three people for control and decision-making is the most effective.

The first is the pilot himself, who controls the UAV, while the second member of the team is the combat systems operator. He is responsible for detecting, identifying the target, and deciding whether to use weapons. And the third member of the team is the intelligent systems operator, who has experience flying the UAV and has the

Intelligent support systems to assist the pilot with excellent decision-making reactions. This team, with their workstations, are networked and located in the same operator's room.

The room is mobile and equipped with all necessary multifunctional controls, multifunctional monitors, and hand controls. The manual controls include hand-held airplane handles and flysticks in the manner of game joysticks. Despite the huge amount of modern equipment, it is clearly not enough for the large amount of incoming and processed information. This is well understood by pilots who know the difference between a flight simulator and real flight. No matter how perfect the flight simulator or simulator is, it has one significant disadvantage, the so-called "sensory hunger". This is, first of all, the absence of overloads, which the pilot feels in flight with his "heel".

An imperceptible change in the airplane's space immediately becomes clear to an experienced pilot just by this very notorious "fifth point", and this is not an anecdote, the author of these lines has experienced this sensation himself. A small vertical or lateral load says more about the flight than all the instruments taken together. So, the UAV operator is deprived of this sensation. If we add to this the absence of engine sound, and the inability to cast an instantaneous glance left-right, up-back, the term "sensory starvation" becomes clear. Work on UAV-pilot feedback is now in full swing. For example, the shaking of the picture on the screen and the vibration of the flystick can tell the operator that the UAV has entered turbulence zone, which will allow him to react more quickly to unfavorable situations in flight.

Initially, operators were recruited among former or current pilots. But as time went on, it became clear that professionals were much inferior to simple gamers with experience in handling flight simulators on computers or game consoles such as Playstation or XBox in terms of reaction speed, without the "fifth point" feeling. Operators learning to fly UAVs from scratch were quicker to master the complex hardware and controls, in contrast to pilots who made more mistakes and were slower to learn.

However, this raises not a technical problem, but a moral and ethical one. A professional military pilot spends many years not only mastering complex aviation equipment, but also preparing to make responsible decisions in extreme combat conditions. He clearly realizes all the measures of responsibility for the use of combat weapons, for the management of very

with an expensive . He himself is in the thick of things, exposed to danger, for him it is not a virtual reality. The operator from civilians, attracted to the service of gamers, does not always realize the line between virtual and real space. For him, there remains a gaming moment in controlling a multi-million dollar drone. There are now ten degrees of automation in the operator-UAV system. From full control and making all decisions by the human operator, to complete autonomy of the drone, where the human is just an observer, not making any decisions. If in the first variant all moral and legal responsibility for giving the command "fire" is borne entirely by a human, then in the second variant the automation, the robot. And then cases of failure or malfunction, can lead to fatal consequences. Now in the U.S. laboratories are researching and developing a voice interface for communication between the operator and the robot drone. And in order to make a responsible decision on the use of weapons, they can work out a joint decision beforehand.
"discussing" the situation.

Nowadays, the trend of greater responsibility of the human operator for the decisions made continues. Even the landing of heavy multi-role UAVs is done by the operator. Drones are prone to a steeper glide on landing, to higher overloads and tougher touchdowns, which often leads to the failure of takeoff and landing devices, or simply landing gear. And now UAVs are mostly landed by pilot operators, because the cost of a heavy drone is tens of millions of dollars.

By 2030, it is planned to design a fully autonomous robotic drone, making all decisions autonomously, up to the selection of the target, and striking a military strike. In the meantime, the leading place in UAV control is still occupied by a human, a pilot, an operator, who realizes the full measure of responsibility for someone's life.

Chapter 5. What drones are made in Russia

The operator who controls a strike or reconnaissance drone has recently become one of the key figures in modern warfare. There are already movies being made about these people, their profession is being debated: whether they are combat pilots or a

gamers? And where do they teach military UAV operators in Russia? The answer is simple - in Kolomna. And here a lot of things have to start again.

Strictly speaking, the topic of unmanned aviation is not new for our country at all. The USSR started using cruise missiles right after the Great Patriotic War (by copying the FAU-1 "flying motorcycle"), and now we are the world leaders in this field. And what is a cruise missile but an unmanned airplane? USSR built the Buran space shuttle, which, long before the Boeing X-37, flew unmanned into orbit and returned.

Reactive and disposable

Domestic UAVs with reconnaissance functions also have a long history. In the mid-1960s, tactical unmanned reconnaissance drones (TBR-1) and long-range unmanned reconnaissance drones (DBR-1), which became a development of target drones, began to enter service with combat units. These were serious aircraft of not at all compact size. TBR weighed almost three tons, could fly at an altitude of up to 9000 m at speed of up to 900 km/h, for which it was equipped with a turbojet engine. The target was photographic reconnaissance with a range of 570 km. The launch was carried out from guides at an angle of 20 degrees to the horizon, and powder gas pedals were used for acceleration. The DBR-1 flew at supersonic speed (up to 2800 km/h) and had a range of up to 3600 km. Takeoff weight - more than 35 tons! At the same time, the first-generation reconnaissance UAVs had poor accuracy in reaching a given object, and these vehicles - heavy, turbojet - were... disposable, and therefore their use proved to be a matter of overhead.

In the mid-1970s, the Soviet Army adopted the VR-3 unmanned reconnaissance system, which was based on a turbojet UAV
"Flight." It was already a reusable system designed for aerial reconnaissance of objects and terrain in tactical depth in the interests of ground forces and strike aviation. The aircraft was lighter than its disposable predecessors - takeoff weight of 1410 kg, had a martial speed of up to 950 km / h and technical range of 170 km. It is not difficult to calculate that even with full refueling flight "Flight" could last no more than ten minutes. The device is capable of photo, television and radiation reconnaissance with data transmission to the command center in almost real time. The UAV landed on the command of the onboard automatic control system. It is worth noting that the Reis is still in service with the Ukrainian army and has been used in the so-called ATO.

In the 1980s, the world began to develop the third generation of UAVs - lightweight inexpensive remotely piloted vehicles with reconnaissance functions. It cannot be said that the USSR was left aside from this process. Work on the creation of the first

domestic mini-UAV was started in 1982 at the Research Institute "Kulon". By 1983

A reusable UAV has been developed and flight tested "Bee-1M (Stroy-PM complex), designed for television reconnaissance and electronic jamming of communications equipment operating in the VHF range. But then perestroika began, followed by the 90s, which were lost for the development of domestic unmanned aviation. By the beginning of the new millennium, the old Soviet developments had become obsolete. We had to urgently catch up.

In the simulator class, servicemen undergoing training at the Kolomna Center learn how to operate a UAV in virtual space. Only after training on the simulator, the operator is allowed to operate a real UAV. Such training can take from 2.5 to 4 months.

For real aviators

In the ancient Russian town of Kolomna, next to the museum-factory of the famous apple pastila, the State Center for Unmanned Aviation of the Defense Ministry is located. This is, as it is commonly said nowadays, the main Russian center of competence for training and retraining of technicians and operators operating military UAVs. The predecessor of the center was the Inter-Service Center for Unmanned Aerial Vehicles, a structure that has existed under different names and with different locations for three decades. But it is now that UAVs have come under the special attention of the country's military leadership. This is at least by the fact that the military town inherited by the Center (previously it belonged to the Kolomna Artillery School, established under Alexander I) is being actively rebuilt and equipped. Some of the buildings are being demolished (others will be built instead), some of them will be thoroughly reconstructed. A new club and stadium will be built on the territory of the unit. All the unmanned equipment coming to the troops passes through the Center, the Center's specialists study it in detail and then pass their knowledge to the cadets coming to Kolomna

from all over the country.

Working with UAVs (at least those service with our Armed Forces) requires the efforts of three specialists. First, there is the control operator - he sets the flight course, altitude and maneuvers. Secondly, it is the target load control operator - his task includes directly conducting reconnaissance with the help of one or another sensor units (video/IR/radio reconnaissance). Third, prepares the UAV for flight and carries out the launch of the UAV technician. Training of all these three categories of servicemen and is conducted within the walls of the Center. And if the technician's place is always near the
"hardware," operators are initially trained in classrooms behind displays simulators. Interestingly, the actual vehicle control operator changes the UAV's course by drawing lines on an electronic map of the terrain, while the target payload control operator receives a real-time picture from the camera.

Unlike the U.S. Army, which has recently started to invite gamers-aviation simulators to become UAV operators, our Armed Forces still maintain a conservative approach. According to the Center, gamers do not have the experience in dealing with the real elements that real pilots have, who have a very detailed understanding of UAV behavior in adverse weather conditions. We still believe that people with professional aviation training - former pilots and navigators - are more suitable for UAV control. The training period at the Center varies from 2.5 to 4 months and depends on the size, range and functional load of the aircraft.

As long as small forms

The American movie "Good Kill" tells about the fate of the Reaper UAV operator - this man, who was at the control point in the USA, had to make missile strikes on people on the other side of the globe. The superiors, whose orders the hero of the movie was obliged to follow, considered these people as terrorists. The human drama unfolds against the background of very beautifully and effectively shown scenes of remote warfare with the help of attack UAVs. Our servicemen to be in the shoes of the hero of "Good Kill"
in the near future, fortunately or unfortunately, is unlikely happen. Prototypes of attack drones are being actively developed in our country, and some of them are already being tested, but they are still far from being adopted into service. The post-perestroika "rupture" has set Russia back in the field of military unmanned

aviation by 10 to 15 years compared to the West, and something

We are only now starting to catch up. This is why the range of UAVs used in our army is not yet very wide.

When it became clear that it would not be possible to quickly bring domestic technologies up to the minimum modern requirements, our defense industry decided to establish cooperation with , one of the world leaders in the development of military UAVs. According to the agreement concluded in 2010 with Israel Aerospace Industries Ltd., the Ural Civil Aviation Plant began licensed production of the BirdEye 400 lightweight wearable UAV and the SEARCHER medium-class reconnaissance UAV under the names of "Zastava" and "Forpost" respectively. "Forpost", by the way, is the only one UAVs (UAVs are accepted by our Armed Forces "for supply" as ammunition, not "in service" as military equipment), which take off and land in the aircraft style, i.e. with run-up and . All others are launched from catapults and land by parachute. This shows that so far our army has been operating UAVs mainly of small size with small payloads and relatively small range.

The UAV set from the Navodchik-2 complex is illustrative in this sense. Four UAVs are used here under the common name "Granat" and with indices from 1 to 4.

"Granat 1 and 2 lightweight (2.4 and 4 kg) wearable UAVs of short range (10 and 15 km) with electric motors. "Granat-3" is a vehicle with a range of up to 25 km, and it uses a gasoline engine as a propulsion system, as in "Granat-4". The latter has a range of up to 120 km and can carry a variety of payloads: photo/video camera, infrared camera, REB and cell phone direction finding equipment. The control center of the Granat-4, unlike the "junior" models, is based in the cab of an army truck "Ural". Nevertheless, this UAV, as well as its Orlan-10 counterpart, are launched from metal rails using a rubber harness.

All four Grenades are produced by the Russian company Izhmash - Unmanned Systems, which is certainly a step forward compared to the cloning of Israeli vehicles. But, as the Center admits, there is still a long way to go before full import substitution in this area. Such high-tech components as microchips or optical systems have to be bought abroad, and even compact gasoline motors of the required parameters have not yet been mastered by our industry.

At the same time, our designers demonstrate a world-class level in the field of software. It remains to finalize the "hardware".

Dissolved in the sky

Practical training on UAV control takes place at the training ground located on the outskirts of Kolomna. On the day of the visit to the Center, the control of lightweight wearable vehicles - BirdEye 400 (aka.
"Zastava") and "Granatom-2". Launch from a rubber harness - and soon the device disappears into the sky. Only here you realize the main advantage of UAVs of this class - low visibility. The operator, sitting under the tent, does not look at the sky. He has a control panel in front of him, which can be conditionally called a "laptop", and all information about the UAV's location is reflected on the screen. The operator only has to actively work with a stylus. When BirdEye descends to a low altitude and becomes visible, it can be confused with a bird of prey, cutting circles in search of prey. Only the speed is clearly greater than a bird's. And then the landing command is given - the parachute opens and the UAV lands, softening the impact on the ground with the help of an inflated "airbag".

Of course, our army needs UAVs with longer range, longer range, longer payload, and strike functions. Sooner or later they will enter service and will definitely arrive in Kolomna. Here they will be taught to work with them. But for now there is an active study of the available arsenal. The subject of military drones is clearly on the rise in Russia.

Chapter 6. Drones: Disguise and Countermeasures

Modern combat operations and wars in any part of the planet and of any scale do not do without mass use of UAVs (Unmanned Aerial Vehicles), in the West referred to as "Drones".

UAVs can purely reconnaissance functions, adjust artillery fire, missile and air strikes, etc., search for enemy facilities, sabotage and reconnaissance groups, provide communications, use REB means and even strike targets.

As we can see, the range of application of these vehicles is wide and diverse. And since this is the case, must be effective methods of fighting, counteraction and camouflage

from UAVs. Special army means, usually expensive, science-intensive and belonging mainly only to large military units of the state, will not be considered or will be touched upon only partially.

Today we will focus on the methods of camouflage that can be used by a serviceman (DRG when performing a combat mission behind enemy lines) without using (or with their minimum) special means.

The material contains silhouettes of the main UAVs service with NATO countries, their satellites and the PLA.

So, ways to camouflage from UAVs:

1. Daytime camouflage: Hide in the shadows of buildings or trees. Use dense woods, dugouts, and covered crevices as natural cover or use camouflage nets.

2. Nighttime camouflage: Hide inside buildings and structures or under the cover of trees and foliage. Do not turn on hand-held flashlights or car headlights. They can be easily spotted by UAVs at night.

3. Thermal camouflage: life blankets (so-called space blankets) made of mylar do not transmit infrared radiation. At night, wearing a life blanket as a poncho will help you hide from being detected by an infrared camera. In hot weather, when the air temperature is 36°-40°C, the infrared camera cannot distinguish a person. In hot weather, you should also hide in the thermal shadow of heated objects (stones, walls of buildings, .) In cold weather, a thick cotton overcoat or an old Soviet overcoat significantly reduces body heat radiation.

4. Wait for bad weather. Many drones can't operate in high winds, smoke or thunderstorms. But there are several models of all-weather strike UAVs currently available.

5. No wireless communication. Using a radio, cell phone or GPS devices can give away your location.

6. False Targets. Use human-sized dummies or scarecrows to fool aerial reconnaissance.

Methods of combating UAVs.

UAV hacking. Drones are remotely controlled. Their pilots may be thousands of kilometers away in ground control centers. The pilot controls the aircraft through a satellite data link. By jamming or intercepting the communication channel, it is possible to interfere with the control of the drone. The communication channel may be encrypted, but often is not.

Interception. A more sophisticated method is to use a satellite dish, a TV tuner and a skygrabber program to intercept the drone's frequencies. Both data sent from the satellite to the drone and in the opposite direction can be intercepted.

Interference. By broadcasting on the frequencies used by the drone, communication with its operator may cut off.

Spoofing GPS signals. Handheld GPS transmitters can send false GPS signals and disrupt the UAV's navigation system. This can be used to steer the drone on a trajectory where it will crash or even intercept and land on a runway.

UAV blinding. It is possible to blind the search and reconnaissance equipment (TV and IR cameras) of a drone by means of a laser, even of non-industrial power.

Electromagnetic radiation. Information has recently appeared in the network about the creation of an electromagnetic grenade for the Russian army, the detonation of

which "burns" the entire

electronics within a certain radius.

Experience in any business is one of the best methods. Therefore, it should also be paid attention to.

The residents of Afghanistan and Pakistan, and now the African country of Mali, have the most experience living under hundreds of UAV strikes. After the Americans began hunting mostly cars in an effort to reduce collateral damage, al-Qaida operatives began thinking about how to hide cars from electronic eyes. Thus, on jihadist forums on the Internet there appeared a guide to camouflaging cars ... carpets that would supposedly hide the car from drone cameras.

In Mali, rebels also use carpets made from local grasses. These peculiar camouflage nets blend in really well with the color of the terrain. This camouflage can, of course, hide a vehicle from visible cameras. Thermal imaging cameras, however, are more difficult. In the previous version of the camouflage manual, the militants suggested putting pieces of ordinary window glass on the roofs of cars, which is known to be bad at transmitting infrared rays. Apparently this method was deemed ineffective, and now the "trend" is plant carpets and a thick layer of dirt.

Of course, it is impossible to hide a moving car from thermal imaging cameras using improvised means - you need a high-tech camouflage system like Israeli Black Fox, and there is still the problem of hot engine exhaust. Cars covered with carpets, glass, dirt, etc. will appear as light/dark moving stripes on the thermal imager screen, which will attract the attention of the UAV operator.

However, there are some advantages to this kind of camouflage. For example, if you do manage to reach your destination, a carpet made of a thick layer of dirt or grass will help to better hide the heat of the car with the engine off. There is another, more important plus of homemade camouflage. The fact is that most UAVs usually "hover" over key points like road intersections, busy freeway streets, etc. Thus, the "white stripe" of a camouflaged car, flashed across the intersection, can go unnoticed - the operator simply will not pay attention to it. However, there is no special revelation in this - this nuance is known, and computer algorithms that will detect such targets automatically are being actively developed.

Well, the most effective method of countering a UAV is to shoot it down.

MANPADS are effective against large drones (accordingly, when planning an operation using a DRG behind enemy lines), it is necessary to provide the group with such a system in addition to the standard armament.

Against small drones operating at low altitudes, the methods of barrage fire from conventional small arms, described in the manuals of the World War II era, have proven themselves.

Also, if it is possible, all available air defense means ("Shilki", Tunguski", ZU-23, large-caliber machine guns such as "Utes", "Kord", DShK, KPVT, etc.) should be used against UAVs.

Conclusion: UAVs are actually not as scary as they are portrayed. Simple and effective methods of countering them exist, because the main weapon of any soldier is spirit and ingenuity.

Chapter 7. Learning how to fly a quadcopter quickly, safely, and on a budget

Since the post about choosing your first drone (quadrocopter) was so much liked by everyone, I decided to continue writing guides about the fastest way to learn how to fly such machines.

Recently, I changed my occupation and after expeditions to the poles of our planet, I got a job at Geoscan (geoscan.aero). Here serious drones of various kinds are created, software for spatial data processing is developed, and projects are carried out all over the world. At the moment, our country is beginning to form a methodology of training specialists in unmanned aviation. This specialty will be in great demand in the future, and there is already a shortage of normal UAV operators. So I, as a university teacher and a graduate student, decided to research this issue and worked out the most effective ways to teach drone control. My lessons may not be absolutely effective, but they are all based on experience, including my experience teaching students.

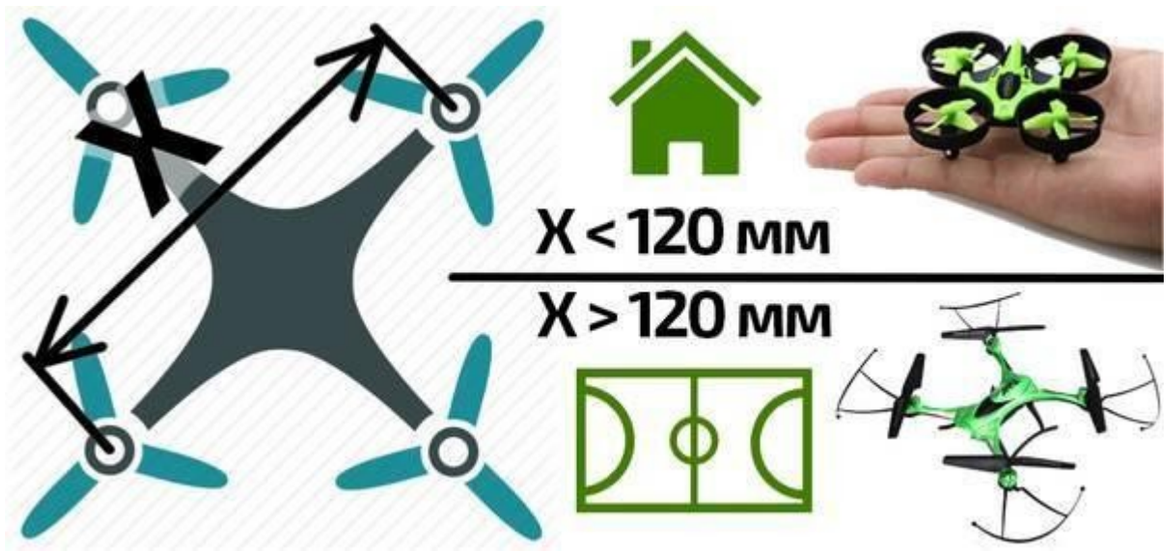
The guides will be presented in two types - text format and video, as everyone likes their own type of content. Well, not everyone may like to watch long videos.

Ok, done with the intro, let's continue. In the last guide I told you about choosing your first multirotor drone. And if have never flown before and you took my advice, then you are already waiting for your toy drone, or maybe you already got it.

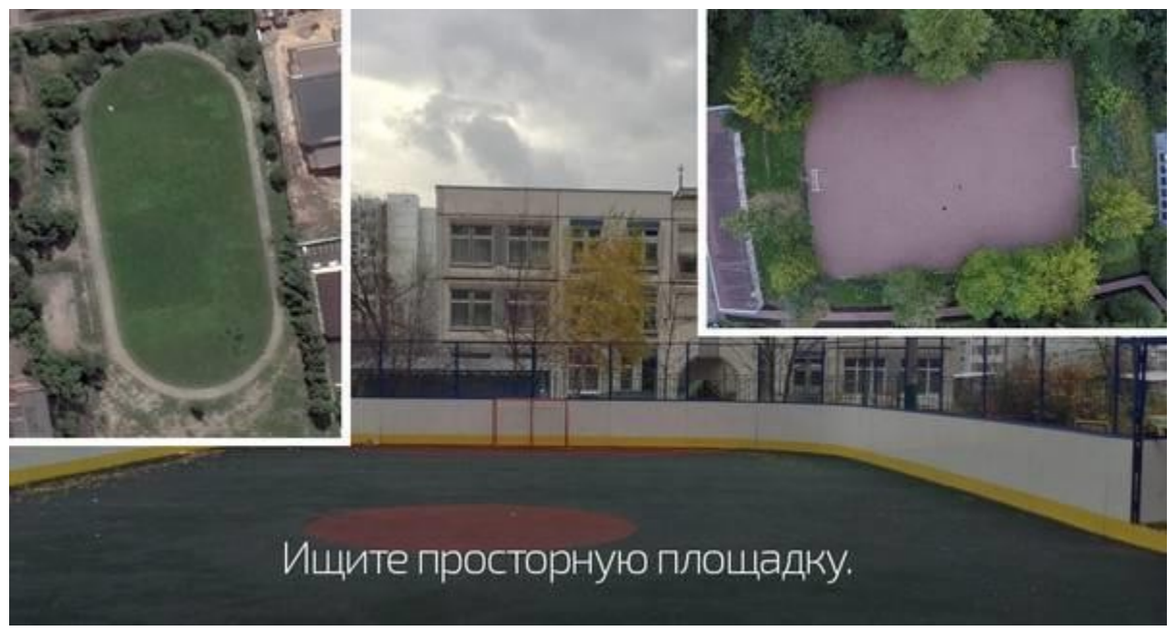
Good medium-sized drones for beginners are Syma X5 and JJRC H31, but these quadcopters need a lot of space and are better to fly outdoors. If you often have bad weather (hello northerners!), you can learn on an indoor drone, a good choice here is Eachine E010 or Eachine E012. All these models cost about 1000-1500 p., but are quite sturdy and interesting for a beginner. Small and light toy is practically not dangerous, but still be extremely careful and the first thing you should remember is the rules of safe operation of any drone:

Accuracy and attentiveness are excellent qualities of a drone operator (even a small one). The multirotor drone has many flight and control modes, it can be controlled from the side visually (Line Of Sight - LOS) and from the first person view (First Person View - FPV). The first thing we need to master is the "classic" mode of control from the side (LOS) in Stabilize mode. In this mode the quadcopter will automatically stabilize in the horizontal plane, but will not hold altitude, position or direction. This will be the base and foundation for further training.

Now you need to find a place to practice. If you took a drone larger than 100-120 size (this is the distance in millimeters between the motors diagonally), you should learn to fly outside. Smaller drones with propeller protection fly better at home, so there are ample opportunities to build a training field here too.



Outdoor soccer or hockey fields, as well as courts and small stadiums are perfect. The main thing is that there should be no people on them. I easily found a convenient playground in a neighbor's yard.



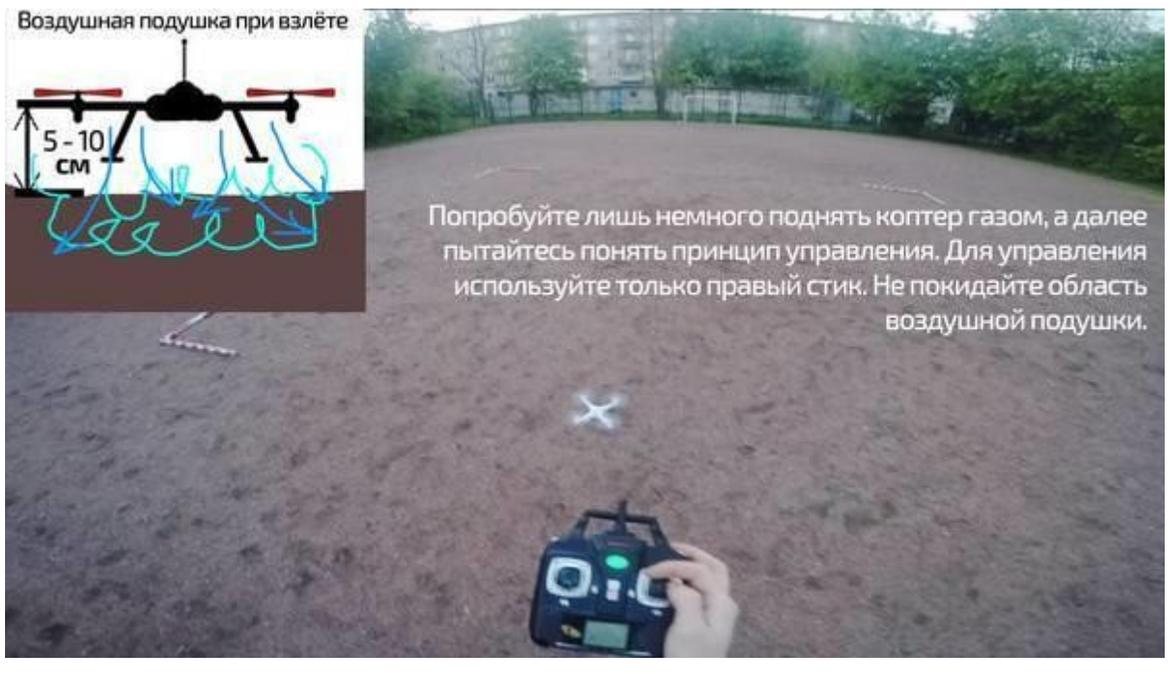
I suggest you designate a 10 by 10 square somewhere in the center of the site. I used plumber's store tubes and brightly colored tape for this, but you can do simpler things. For example, you can buy disposable cardboard plates, or just cut corners out of cardboard boxes. The main thing is that they should clearly visible and not blown away by the wind.

Now a little bit about controlling the multicopter. The remote control or radio transmitter usually has 2 sticks and several buttons and toggle switches. In order to understand what is what I recommend to study the manual. For example, the drone is taken SYMA X5, it is cheap, but for a beginner is very good. Here is the usual control scheme of a toy quadrocopter (may not coincide with your control scheme - be sure to read the manual!):

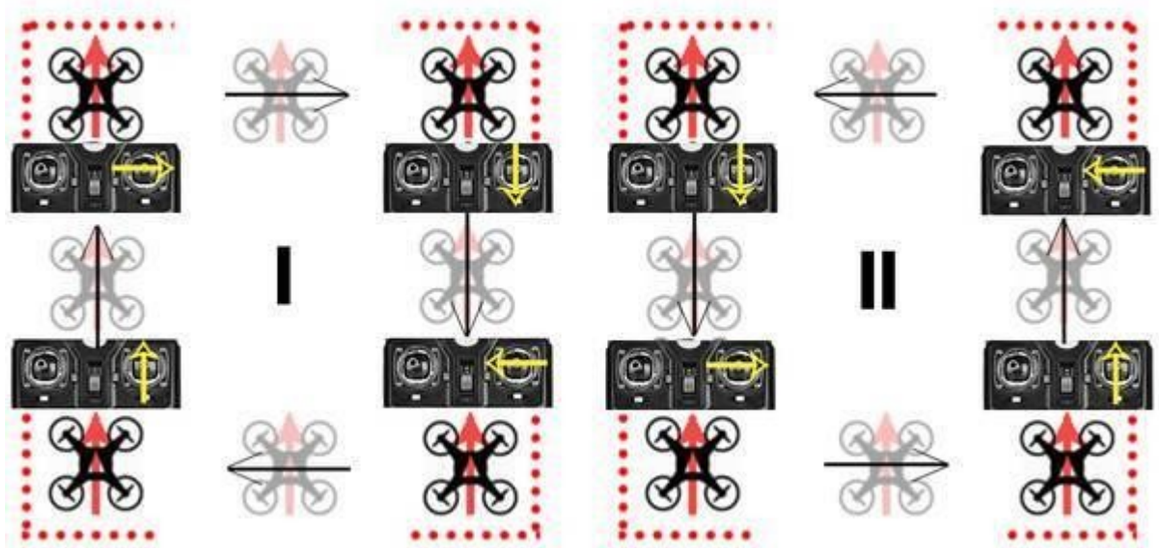
The drone's sticks can be deflected in a variety of ways, but the most effective are "pinch" or "thumbs up". Try both and decide which you prefer. Almost everyone who's ever played on a console gamepad

prefer to use their fingers. The debate about which is more effective continues to this .....

Set the drone on the launch point with its rear end facing you, turn it on. Now slowly raise the throttle stick until the drone is literally 5-10 centimeters off the ground. At this height, an air cushion is formed and the drone hovers stable due to the close ground surface.



Now let's try to smoothly move the drone to the next corner using only the right stick. When you deflect the stick, the quadcopter deflects and starts to glide to the corresponding side. If the drone clings to the ground you can add a little more throttle, but don't overdo it. Try to keep your fingers on the control sticks. Do not rotate the copter around the vertical axis to avoid confusion while you are inexperienced.

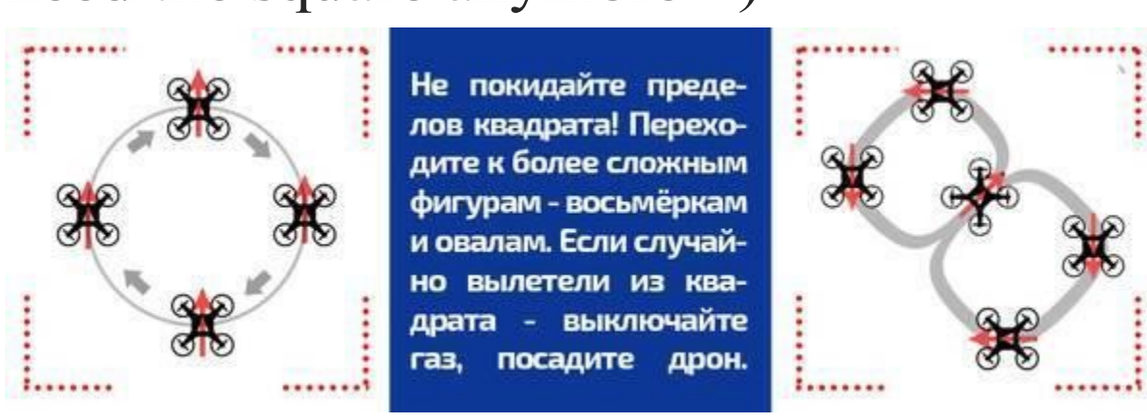


If you mess up the controls, twist the quadcopter around the vertical axis, gain too much altitude, or leave your quad, just turn off the throttle (by deflecting the throttle stick down) and the drone will fall. That's okay - these toys are quite sturdy and can withstand many falls. Do the same when the quadcopter gets caught on something and flips over, or when it gets tangled in the grass/bushes and touches objects. Just drop the throttle to 0! You don't need to hammer the propellers on the ground or anything else, so the simple collector motors of the toy will last longer.

Try moving from corner to corner until you can fly the whole square steadily. Further you can try to increase the height a little and control the throttle and inclinations. But do not go higher than two meters.

Now you can rotate the drone around the vertical axis, in this case it becomes more difficult to control, because you must be sure to give control commands relative to the position of our aircraft. Try to master the square in other positions of the quadcopter. For example, with the front of the drone facing you.

And now you are already moving perfectly around the perimeter of the square in any direction! Now you can either increase the height, or try to fly certain geometric shapes inside the square, such as eights and circles. And you won't need the square anymore =)



Why do you need a square when you can just fly on the court? Well, it's a bit of a discipline. I have seen a lot of pictures when a beginner gains a lot of altitude at once, thinking that he is over the field. And then the drone loses contact or is away by the wind. And if you fly along the very borders of the site, you often cling to branches, fences and other things, especially if you have little experience in control. A square is a small object in the middle of the site and if you always land or drop the copter when flying outside of it, you will save a lot of time and money. If you are flying at home, just designate a square in the middle of the room.

That's enough for the first lesson, in the next lesson I will talk about the first steps in mastering FPV flight and I will also talk about a budget quadcopter build that will teach you how to fly.

Chapter 8: How to become a professional quadcopter pilot without owning a quadcopter

Which simulator to choose? Features of quadrocopter control. How and where professional quadrocopter pilots are trained.

Quadcopters are no longer just an interesting hobby, they are actively used by cameramen, photographers, landscapers and delivery services.

With the growing popularity of drones, a profession such as a drone operator or UAV operator or UBLA has emerged.

Drone video and photography is well suited for capturing celebrations, memorable moments and weddings.

Anyone can become a professional quadcopter pilot, even without owning their own drone.

There are many simulators designed to teach you how to pilot a copter at home. Most of these apps have options to select the drone, map, and even customize the physics of the environment.

There is no age limit in drone piloting simulators, so even a child can learn, but the recommended starting age is usually 8 years old.

Which simulator to choose?

DRL Simulator - has quite high quality tracks modeled based on real objects.

Huge locations with tons of obstacles perfectly simulate real cities, abandoned factories, rivers, bridges and more.

Users note the slightly unfamiliar physics, which takes some getting used to.

Veloci Drone is a simulator with small rich locations and good physics. Provision is made for drone fine-tuning and camera angle compensation.

The simulator is supported by Windows 7,8,10 and Mac OS X platforms.

Liftoff - the simulator is available in styme, has a quality track editor, multiplayer, a large selection of drones with customization and good physics.

In the engine editor you can create tracks of any complexity, which allows you to simulate situations that require from the user not only reaction, but also the ability to adjust in time to the generated environment.

Supported by Windows 7,8,10, Mac OS X and Steam OS platforms.

FPV Free Rider - features three-dimensional, detailed locations.

The simulator is designed for training and practice, so there is no multiplayer or track editor in it.

It is supported by Windows, Mac OS and Linux platforms.

FPV Event or Rotor Rush is a simulator with very believable physics.

The tracks used are virtual replicas of qualifying tours from around the world.

Beautiful, lightweight graphics allow you to immerse yourself in your workout without performance sags.

The simulator is paid, with no demo access.

The first 10 tracks come with the basic supply, upgrading will require additional investment.

It is supported by Windos 7,8,10 and Mac OS X platforms.

Separately, it is worth noting DCL The Game simulator - it is a full-fledged game where users can not only learn how to pilot a drone, but also try out many models from leading manufacturers.

Maximum realistic physics and stunning visuals are provided by Unreal Engine 4. This approach allows you to choose the most comfortable copter for specific tasks. The multiplayer mode supports up to 30 players and opens up the possibility of cyber sports competitions.

Features of quadrocopter control

You can control the copter in the simulation either using the keyboard or by connecting a full gamepad or joystick of a real drone. Although keyboard control is allowed in the simulator, it is not recommended for learning how to control drones. When controlling a copter, it is important to develop hand motor skills - all maneuvers should be performed automatically, without thinking about where and what to press.

Gamepads are a good solution in this case. Despite the fact that they are designed for computer games, the gamepad control is almost indistinguishable from the copter joystick.

Most gamepads are supported by simulators out of the box and do not require any add-ons. However, not all simulators support copter joysticks - some devices require a special adapter.

Chapter 9. How and where professional quadrocopter pilots are trained

No specialized training institution other than Rosaviatsia is authorized to issue genuine external pilot certificates. There is only a certain number of specialized secondary and higher educational institutions accredited by Rosaviatsia that are able to issue certificates. The period of training in such institutions varies from 34 to 44 months.

Most companies that need the services of such specialists have to train and train them themselves. Training takes up to three months, two months of which are allocated for theoretical part and piloting in simulators.

During the third month, trainees learn to operate real drones of the hiring companies by performing simple tasks. Upon completion of the training, the trainee is hired.

Having your own quadrocopter helps you get used to it faster, learn the basics of piloting.

But, if desired, anyone can become a professional pilot, regardless of owning their own drone.

The rapid development of technology over the past decade has allowed drones - unmanned aerial vehicles (UAVs) - to become an important component of warfare and industrial espionage. And while at the beginning of their "career" drones performed auxiliary functions of reconnaissance, today they are an independent strike force that can cause a lot of trouble. UAVs are becoming smaller, smarter and cheaper to produce. The market for civilian vehicles is actively growing. Therefore, the issues of defense against drones are very relevant.
Rostec enterprises offer their own options for solving the problem.

Drone warfare

Two high-profile drone-related events took place in 2018. In January, a group of drones attacked the Russian military base Hmeimim in Syria. Some of them were destroyed by the Pantsir SAM system, some were neutralized by means of electronic warfare. And while earlier militants used commercial copter drones, during this attack homemade UAVs of the airplane type, more sophisticated and capable of causing more damage, were used. As reported later, the Russian military regularly repels drone attacks on its Syrian bases.

The second landmark incident occurred in London in December, when two drones blocked the work of Gatwick Airport for a day. More than a thousand flights had to be canceled, and the owners of the drones were never found. After that incident, the UK Ministry of Defense promised to allocate about 2 million pounds

sterling for the fight against UAVs.

Modern air defense means are not effective enough against drones, as they do not have the necessary speed and can only be used against large drones. It is also difficult to detect UAVs using conventional radio-technical reconnaissance means due to the small size of drones. Obviously, new specialized devices and methods of combat are needed.

Russian companies rely on electromagnetic suppression complexes that help detect malicious drones, identify them and disable them.

Chapter 10. "Kalashnikov on defense against drones

Specialists of ZALA AERO GROUP, a division of Kalashnikov Holding, the leader of the domestic market of unmanned vehicles, have developed the REX 1 electromagnetic gun for defense against drones. Externally, the device looks like a familiar automatic rifle, the weight of the device ? just over 4 kg. The gun is activated by pressing one button and is able to work without recharging for 3 hours.

The REX 1 works suppressing the signal of navigation and communication systems used by drones. The weapon has a built-in unit that jams GLONASS satellite navigation signals and similar foreign systems within a radius of two kilometers. The device is also capable of blocking GSM, 3G, LTE signals at a distance of one kilometer and interfering with the frequencies of 900 MHz, 2.4, 5.2- 5.8 GHz. In this case, the drone is not physically destroyed, but loses communication with the control panel and lands.

The weapon is equipped with a mounting system, so it can be additionally fitted with sights, flashlights, target designators, as well as objective control devices. The REX 1 can also be used in demining operations to improvised explosive devices that are activated by a cell phone signal.

"Pischal-PRO and Taran-PRO: Concern Avtomatika vs. UAVs

The Avtomatika Concern has a similar development. Its specialists have created the Pischal-PRO wearable UAV countermeasures system, which also visually resembles an automatic rifle, but in a more futuristic form than that of the Pischal-PRO.

"Kalashnikov" design. The hand-held complex can be used both stationary and on the move. The weight of the weapon is about 3.5 kg.

The Pishchalya-PRO requires no training and is also based on the suppression of signals from navigation, communication and control systems. It can be used to target drones at a distance of up to two kilometers in line-of-sight conditions.

For purely stationary protection, Avtomatika developers suggest using the Taran-PRO complex. Such equipment can be used at secret facilities or during events that need to be protected from drone interference. The principle of operation of "Taran-PRO" is the same as that of "Pishchali-Pro" - it affects the navigation and control channels of UAVs within the protected area. This creates a drone-impenetrable "dome" with a radius of at least 2.7 km over the object.

The Taran-PRO complex can operate under wind loads and in temperature conditions from -40 to +50 degrees Celsius. Additionally, the equipment examines radio signals in detail, localizes their sources, and also creates and maintains archives of radio emissions of unmanned aerial vehicles. "Pischal-PRO" and "Taran-PRO" have passed preliminary state tests and received positive evaluations.

"Solaris-N: a drone-free zone

What to do if you need to protect a large territory from drone interference for a long period of time? The solution is offered by the Sozvezdiye Concern of the holding company
"Roselectronics". "Solaris-N" ? Russia's first automatic complex of electronic warfare against drones. The latest development provides protection from drones over an area of up to 80 square kilometers.

A special feature of Solaris-N is the application of artificial intelligence principles. This means that the complex will self-learn in order to distinguish drones among all aerial objects as clearly as possible. The complex's equipment detects an object, analyzes its movement and outgoing signals, and on the basis of this information determines its type and further actions with respect to the object.

Once the drone is identified, the complex's hardware begins to interfere with it with radio interference, blocking the data network and navigation equipment. Then the drone loses control, falls or lands. It is worth noting that the complex can operate in automatic mode, excluding the participation of people and human factor.

"SERPom" on drones: another development of "Roselectronics"

The SERP radio-electronic cannon was developed by the Vector Research Institute, part of the Roselektronika holding company. It is a system of radio-electronic suppression of small unmanned aerial vehicles, which in combination with a passive coherent locator (PCL) provides automatic tracking and suppression of onboard equipment of drones at a distance of up to 20 km. The uniqueness of the PCL lies in the fact that the complex does not have its own

transmitter, which means that it

remains "invisible" to enemy equipment. The locator catches signals reflected from an aerial object, which fill the airwaves, and can detect small-sized drones even in urban areas.

Several "CERP" systems combined in a complex can cover with protective "large objects - power plants, stadiums, large enterprises, and military bases. "CERP" is capable of suppressing the drone's control channel, breaking communication with the operator, disabling navigation equipment, disorienting the UAV in space and disrupting the fulfillment of the flight mission. The system suppresses GPS and GLONASS (L1, L2, L5), GSM900 and WiFi signals.

The radio monitoring module serves as an addition to the "SERP" and PKL complexes
"Cheremukha", which allows not only to detect the drone, but also to calculate the location of its control point. The module determines the directions in which the drone and its operator are located with an error of only 2 degrees.

"Attack-DBS": protection of civil interests

Specially for the suppression of drone operations on civilian objects in the NPP "Almaz of Roselectronics Holding has developed the Ataka-DBS complex. The equipment is available for purchase without a license. It is important to note that the complex operates selectively without disrupting the surrounding communication and navigation systems, which allows it to be used freely in city conditions, airports and other technologically complex facilities.

The Ataka-DBS complex can operate in an automated manner, calculating drones and blocking communication channels and satellite navigation. The drone loses control and either returns to the launch point or lands in emergency mode. The owner of the complex will be notified of a detected attack via sms or email.

"Ataka-DBS" detects and suppresses control channels in the frequency range used by UAVs of general civilian use - from 2 to 6 GHz. One unit monitors drone operations within a radius of 1.5 km and can disarm a drone at a distance of 1 km. Each module can be used as an independent cell or included in a whole system providing security of a given territory. At the same time, the system settings allow regular drones to work in normal mode. The complex will only react to foreign drones.

Chapter 11. History of Combat UAVs

UAVs allow force to be used where it was not used before (or was used much less frequently). Thus, we now routinely see the search and pursuit of individuals in territories where the pursuing state's judicial order is otherwise ineffective. The relatively narrow focus of modern precision-guided munitions (PGMs) allows the technology to be used to kill such individuals. It's not that states haven't done this sort of thing before, it's that UAVs are normalizing it. This is a change.
Military action now replaces conventional security/police operations or is taken where previously there would have been no action because there was no "opportunity" to do so. So, for example, we are seeing extrajudicial executions rather than due process or a conventional military operation. The advent of UAVs has dangerously lowered the threshold for military-scale violence, both in terms of crossing borders and the scale of the target.

A new kind of warfare

This kind of nanowarfare against individuals is not something the international system has ever seen on a large scale. War, as Rousseau reminds us, is between things - states, political communities.

- and those fighting them are there as combatants, that is, representatives of the cause for which they are fighting. Terrorism is a method, not a cause, and those involved in it have traditionally been fought by law enforcement and the judiciary - only occasionally have governments sent their national military forces for policing tasks. After 9/11, however, the U.S. exercised its right to use military force in self-defense to pursue bin Laden terrorists in Afghanistan, claiming that its actions were authorized by the UN. Legal experts argued that UN resolutions did not actually authorize the use of armed force and that the mechanisms provided by the criminal justice system were sufficient because the terrorists were committing criminal acts of terrorism, not acts of war.

Thus, from the outset, the war in Afghanistan was legally problematic, but even so, since 9/11, the U.S. has continued to manifest itself militarily in situations that not war, meeting minimal resistance, if not acquiescence.
Along with UAVs, special forces units and private military companies have been part of this expansion, and as with drones, much of their appeal is that they can be denied. Small interventions are only slightly controversial, and all are ways of spreading coercive military power without causing costly political (or military) consequences.

As the "Fall of Blackhawk" incident in Mogadishu in 1993 showed, when manned operations go , they cannot simply be swept under the rug. This attempt by special forces to capture two Somali militant leaders

led to a battle that killed hundreds, drove the U.S. out of Somalia, and deterred Washington from intervening in the Rwandan genocide the following year. While the post-Sept. 11 disasters have not been repeated on this scale, they have caused political headaches. When contractors working for the private military company Blackwater opened fire in Baghdad in 2007, killing 17 people, the ensuing outcry led to changes in how private military companies were licensed and deployed, and included legal changes to hold contractors accountable under U.S. law (as of October 2013the four men were still on trial). Another contractor, Raymond Davis, became the newfound Gary Powers: as part of a top-secret CIA spy mission in Pakistan, he killed two people in Pakistan in 2011 and languished in a prison in Lahore while the Pakistani and U.S. governments argued over whether his diplomatic passport should really protect him from prosecution.
Special Forces invasion of Libya in October 2013 to capture a suspect terrorist was immediately condemned by the Libyan president, and a simultaneous raid in Somalia failed. And, course, the relationship that was marred by the May 2011 U.S. Special Forces raid on bin Laden's residence in Pakistan has yet to be restored.

Unmanned vehicles simply do not create such political nightmares. Throughout all these ups and downs, U.S. drones have continued to routinely kill civilians and militants in Pakistan, Somalia, Yemen, and of course Afghanistan, patrol international airspace, and penetrate enemy skies while avoiding closer scrutiny and discussion. It was only when a book was published in 2009 by P. W. Singer "Wired for ", the implications of the robotization of combat have come to be seen in a broader geopolitical context, even as President Obama has expanded the drone program he inherited from his predecessor. Still, drones fired and/or shot down in Iran and Somalia are hardly surprising, and despite the ongoing furor over U.S. drone policy in Pakistan, no one was surprised to find Islamabad secretly approving the strikes while publicly condemning them variously - as less provocative - by both the party using them and the countries in which they are used.

"Wednesday is the message."

These observations about how UAVs are perceived and used have led us to think about them in the way suggested by Canadian media theorist Marshall McLuhan, who advises against focusing on the putative purpose or content of a technology or environment (he uses the terms interchange), skillfully); we do not care, as he puts it, whether a factory produces "cornflakes or Cadillacs." Instead, we should try to identify the unintended, real social consequences that flow from the introduction of "every extension of ourselves or any new technology," looking at the mental and social consequences of constructs or patterns as they enhance or accelerate existing processes. For the "message" of any tool or technology is the change in scale, pace, or pattern that it brings to human affairs.

For Sclove, then, the important message of the pipes was not the delivery of water, but rather a new kind of social division. For McLuhan, the message of the Gutenberg press was not simply its content, that is, the reading materials it produced and the messages they contained, but something much more: the tools of the

for study and rational discussion were taken out of the hands of those power particularly the church, and put into the hands, , of anyone who could read. Reading became ubiquitous, and the Reformation, revolution, and enlightenment followed. Distributing the products of the two worlds represented in existing books, ancient (Greco-Roman) and medieval, McLuhan argues that "the printed book created a third world, the modern world".

Thus, the message of the printing press is not the book, but modernity. This is a loud statement, but it reflects a large modern intellectual tradition. Marxism can also be technologically deterministic: for example, as Marx saw it, "the windmill gives you a society with a feudalist; the steam mill, a society with an industrial capitalist."

We are neither so absolute in our technological determinism nor so bold in our conclusions, but rather see this as a way to begin to uncover the potentially large-scale changes made by drones by documenting what is specifically new or different about this particular environment.

There are also land- and sea-based unmanned systems, and it is likely that the biggest innovations and effects will eventually occur in the civilian sector, although civilian airspace regulations currently severely restrict the use of unmanned technologies, whether drones, cars, or quadcopters for pizza delivery. We limited our investigation to airborne systems performing military missions to obtain details that may reveal their impact on global security. The literature on UAVs is vast, diverse, and scattered across disciplines, spanning the spectrum from philosophical musings on robotics to the scientific intricacies of human-machine interfaces to the interpretation of legal regimes that allow the president of the United States to decide whom to killb each week. To capture this diversity, we modeled McLuhan's "probing" approach, designed to open up discussion and debate, as opposed to presenting the
A "package" of comprehensive findings on a particular aspect of the hostilities drones.

UAVs, given their current scale and effectiveness, are a new phenomenon, and even within these limits it is difficult to assess their expected impact on the armed forces and states that operate them, let alone the broader unintended side effects. difficulty is to determine what changes drone technology is bringing about, as opposed to changes that are linked to the evolving nature of global violence. It is impossible to decisively separate technology from its use, to imagine what the Predator story might have been had 9/11 not occurred and had Western militaries not joined the highly asymmetrical battles against "global terrorism." For the purposes of analysis, we have attempted to outline some of the various areas in which the specific properties of drones produce unique effects that in turn affect the way wars are fought by looking at the history of drones, current military doctrine, and how ethics, legal regimes, and military culture are adapting to these new weapons.

The history of UAVs is instructive in terms of how they are seen by their users and the range of distinctive applications they offer, and the first three chapters of this book trace their military development and the impact of digital technology on warfare, both in terms of weapons and doctrine.

Drones originally originated as attempts by both the United States and Britain to remove the pilot from an airplane in the carnage of World War I, turning the airplane itself into a kind of flying bomb that does not risk anyone's life in its delivery. At this stage, the effectiveness of controlling an airplane, whether at a distance by radio or with autopilots based on internal gyroscopes, is really inadequate, and the experiments are not moving into the field. What they are suited for is training anti-aircraft gunners, and most of the drones used before the end of World War II are used for this mission, which requires an "unmanned" quality UAV to provide the disposability needed for this dangerous Activity.

While some minor but successful combat applications of UAVs occurred during World War II, including, of course, the technology used in the flying bombs of the German "V" program, these experiments were largely put on the back burner in the characteristic conditions of the Cold War. War. At this time surveillance, or more specifically espionage, becomes key. Attempts to create high-flying, long-range drones for this mission were very expensive and had limited success, working within a black budget controlled by the intelligence services rather than the military. The primary advantage of the drone over manned aircraft seemed to be both its unmanned disposability and its special deniability. In various Cold War situations, neither side felt that such a purely technological intervention put as much at stake, whether it was the Soviet Union or China. The drone was somehow less "out there" than the manned airplane, and its utility as a "low-imposed" technology was already obvious.

As data processing and networking technology evolved with the Revolution in Military Affairs (RMA) technological revolution, the ability to accurately navigate as well as collect and transmit useful amounts of data increased the versatility of the drone. As a result, the use of UAVs began to expand. One of the first users was Israel, which remains a leader in the field. UAVs helped solve certain problems in Israel's local security environment - for example, their disposability meant they could be used to suppress enemy air defenses in conventional wars with neighboring states. But it was Israel's role as the dominant power in the region that led to the proliferation of UAVs. In the not entirely sovereign territory of the West Bank and Gaza Strip, UAVs are used to observe, target, and destroy those individuals and groups identified as Israel's enemies.

Demonstrating the same hegemonic behavior on a global scale, the U.S. has also become dependent on UAVs. Following Israel's example, both technologically and mission-wise, the current adoption of the

This risk-free, low-imposed technology is based on its success in extremely asymmetric conflicts: first in Kosovo, later in Iraq and Afghanistan, and in countries involved in one way or another in the U.S. "war terrorism," especially in equally ambiguous conflicts, territories such as the tribal lands of Pakistan.

Types of UAVs have been widely distributed. The controversial Predator and Reaper attack drones, which have generated much of the public debate, are only the tip of the iceberg. The vast majority of UAVs are used exclusively for intelligence, surveillance, and reconnaissance (ISR) purposes. For military purposes, they currently range from Global Hawk with wingspans larger than a Boeing 737 airliner to nanocopters weighing a few grams and everything between. Many soldiers now have access to some kind of specialized aerial reconnaissance even at the smallest patrol level, and these small drones open up surveillance/intelligence access to areas previously inaccessible to such activities, such as deep "urban canyon" and even indoors. UAVs promise effective cover at sea - even the smallest warships can easily carry a high-performance UAV such as the Scan-Eagle, providing commanders with their own persistent aerial reconnaissance. Increased stealth, speed and autonomy promise higher levels of combat capability and ever lower levels of imposition.

As part of the broader RMA and with their own special qualities of accessibility, through quantity, persistence, and scale, UAVs have greatly expanded the information available to military decision makers at all levels. This is, of course, an expected effect. There is some indication in recent thinking by the U.S. military that the unintended effect is to shake the promise of the (always elusive) end to the need to make decisions in the fog of Clausewitzian warfare. This can create an unrealistic expectation of situational clarity, resulting in a reduced willingness to take risks on the part of military decision makers faced with continued complexity of the real world. The desire to implement systems with greater autonomy that could significantly reduce reliance on human action is also problematic in terms of expectations and possible consequences.

McLuhan's associate Neil Postman said that "technological change is not additive; it is ecological. New technology doesn't just add something; it changes everything." 9 Going far beyond narrow considerations of how wars are fought, drones affect the way we think about war itself: what makes someone a soldier, a warrior, a combatant? In a networked, decentralized assemblage of people and machines, who is responsible for any particular civilian death, war crime, or human rights violation? Chapters 4-8 of this book explore some of the cultural, legal, and ethical implications of drone warfare for , as well as the existing laws and norms governing the use of force in the international system.

While the vehicle itself is of course unmanned, there's a crew sitting somewhere on a ground station controlling the machine and overseeing the mission - be it ISR or kinetic - unwind in front of them on computer screens. Physically they are far removed from the dangers of war, but mentally the implications of being warrior drones are not well understood. Reports operators psychologically traumatized by the daily routine of killing people by remote control are beginning to appear in the media. Clinical diagnoses of post-traumatic stress disorder (PTSD), which have typically been based on the effects of exposure to mortal fear, are being revised to account for the "moral trauma" inflicted on drone pilots who are required to routinely, launch missiles in groups and

to individuals thousands of miles away, watch them die, and then return home each day at the end of their shift to their regular lives and families.

This is just one of many challenges that the U.S. Air Force (USAF) military culture is trying to adapt to in the face of new conditions created by drone warfare. Operators are praised and even rewarded for their kills; but they are also overworked, undervalued, and ridiculed as "force chairmen." There are other areas to be addressed regarding responsibility and accountability in the decision-making chain; whether the distance between a soldier and his or her target, or the fact that the relationship is virtual, makes any qualitative difference between the execution of manned and unmanned missions; and indeed, on the other side of the equation, whether it matters whether a person is killed by a Hellfire missile fired by a drone or by a manned aircraft (the U.S. Air Force doesn't think so).

The whole point of drone missions is that they reduce risk for pilots, and this supposedly allows them to make better decisions. If emotional burnout, post-traumatic stress disorder, and general difficulty recruiting UAV operators begin to negatively impact military effectiveness, such human frailties will be another argument in favor of removing not only soldiers' bodies but also their minds from the dirty business. of killing people. There is a strong push to introduce more autonomy into the weapons of the system, so that mere soldiers no longer be required even to fight wars. Replacing soldiers with so-called killer robots, designed to decide who to kill based on programming specifications embedded in the machines themselves, is a near-term prospect, as ethical and legal considerations lag far behind the current research and development programs currently underway that make such weapons possible.

At the other end of the drone kill chain are targeted populations. drones are renowned for their counterterrorism capabilities - their ability to track and kill individual militants from among the civilians under their watchful gaze - they do so by putting the entire population under surveillance, and this ubiquitous threat is driving changes in the way people live their lives under the drones. The scale of civilian deaths in non-military zones in Pakistan, Yemen, and Somalia is alarming, but the Obama administration claims that only militants or terrorists are killed, an oft-repeated fiction that seems to largely satisfy U.S. public opinion. In the countries attacked, however, there are signs that drone strikes are undermining security as well as social structures and creating far more problems than they are meant to solve. Nabil Khouri, the former deputy head of the US mission in Yemen from 2004 2007, recently suggested that "the US creates about forty to sixty new enemies for every militant [in the Arabian Peninsula] killed by drones."

Meanwhile, a wave of increasingly revealing reports claim that the US is flouting international laws and committing war crimes in this supposedly safe mode of warfare. If global opposition does not unite around limiting its practice, it is likely that new international norms will emerge under which other states will also be free to wage nano-warfare against populations they are uncomfortable dealing with. As UN human rights expert Christof Heyns said in a major UN report:

The widespread use of armed drones by the first states to acquire them, if , could structurally damage the cornerstones of international security and set precedents that undermine the protection of lives around the world in the long term.

McLuhan noted, "Controlling change seems to be moving not along with it but ahead of it. Anticipation makes it possible to deflect and control force".

In attempting to anticipate the impact of UAVs, directions for future policy, use and regulation may become clearer. Thus so far, reports about drones are deeply troubling: the reasons that make this technology attractive to the military and policymakers are troubling. Their technical qualities provide access to a wide range of scenarios, allowing them to provide a greatly expanded source of ISR data at every level of military operation. Their strike/combat power, while limited militarily, has clearly been very useful for political purposes, and this is where unanticipated large-scale effects manifest themselves. When used to target individuals in acts of nanowarfare, drones increase instability in the international system. This increased propensity to resort to force risks a spiral of proliferation as other states rush to take possession of such systems, while the commission of war crimes and human rights violations, as well as the erosion of international regimes and legal standards, threaten the fragile security that the world has managed to achieve.

Chapter 12. From Balloons to the Big Safari: UAV Development

The U.S. intelligence community is the largest contributor to the development of operational UAVs in the United States. Air power, as U.S. Air Force Major Carl Baner puts it, allows for "observation...data and information gathering. The altitude and extent of air and space gives the pilot a perspective of the theater that is not available to the soldier or sailor." As he notes, it also provides the means to act on that information. UAVs in particular have evolved since 2001 to the point where they now provide commanders with effective tools to address both aspects of air power. However, the path has not always been smooth, with manned aircraft and satellites competing for key missions and expensive failed programs lying in the way. UAVs seem to have finally found their niche, as technological capabilities and the appropriate operational environment have converged in the asymmetric conflicts of the twenty-first century. However, this niche is highly controversial, involving the extension of imperialist surveillance and militarized violence to situations previously inaccessible to such actions.

Although UAVs have only become public knowledge in the last couple of decades, they have been part of the military arsenal for much longer. The history of unmanned flight is certainly longer than the history of manned flight, and the use of unmanned flight in war also predates the use of manned aircraft; in fact, its development has been linked to military applications from the beginning. The Mongolfier brothers, to whom the development of the balloon is credited, were inspired by the potential they saw in the use of such a craft in warfare.

This potential was confirmed by the fact that unmanned aerostats made first verified air raid in history when, in 1849, during the Austrian siege of Venice, the Austrians attempted to drift aerostats carrying 30-pound bombs over Venetian territory, a defense. The bombs were dropped either by timer or, according to a contemporary's report in The Scientific American, by an electrical switch connected via a long loop of copper wire. The unguided and unmanned attempt failed, as wind changes threw most of the balloons off target, and some even returned over Austrian positions.

The balloon has had a long manned history as a military surveillance tool, but even during World War II both the Allies and the Axis powers used unmanned balloons to each other. Curtis Peebles describes how the British Operation Outward sent nearly 100,000 small balloons toward Germany, carrying either a small (6 pound) incendiary device or pulling wires in order to cause short circuits in power lines - a task in which they had some success, leading, for example, to the destruction of a power plant in 1942. A byproduct of the program was attempts by German fighters to intercept the balloons, costing the Luftwaffe much more than the simplest balloons were for the British an early example of how cheap UAVs could overwhelm air defenses.
The Japanese tried to do the same thing, but with a more advanced device, operating at intercontinental distances when, at the end of the war, they released more than 9,000 balloons carrying small bombs - incendiary or anti-personnel bombs - which then crossed the Pacific Ocean by jet airplane, creek. Three hundred are known to have reached North America, although they caused little damage, the most serious event being the killing of six curious picnickers in Oregon. The only control these devices had was to estimate the speed and direction of the jet stream, as well as a timing device.

However, the real path to effective UAV delivery from the air is through heavier-than-air aircraft, lightweight engines, and wireless technology. The radio control system was first patented by Nikola Tesla in 1898, a system he demonstrated on a radio-controlled boat in front of an astonished audience at Madison Square Gardens. Radio-control experiments followed the Wright brothers' first manned flight, aviation came, and war again drove technology. Archibald Lowe, an eccentric British engineer and inventor known as the "father of unmanned guidance systems," worked to develop radio control for airplanes during World War I, conducting the first demonstration of wirelessly controlled unmanned flight in 1917 for the British military, codenamed Aerial Target - the plane was actually intended to be used as a flying bomb, a kind of cruise missile. The project was not adopted.

This development ran in parallel with another technology in the US, where the Hewitt-Sperry automatic airplane made a number of test flights 1917 and 1918, again with the intention of acting as a flying bomb, especially to attack enemy ships. The U.S. Army ordered a similar airplane,

Kettering Bug, for use as an aerial torpedo at a range of about 40 miles. Eventually 45 12-foot biplanes were built, but they were not used in combat. None of these aircraft were remotely controlled, but rather flew on a programmed course using an autopilot system consisting of a newly developed Sperry gyroscope, barometer, and timer to control altitude, heading/position, and distance. As Thomas Muller notes, this made the Kettering Bug "the first aircraft capable of stabilizing and controlling itself without a pilot on board."

This approach calls Hewitt-Sperry and Kettering's beetles the real deal "drones" because, while this term is common to describe modern drones, a more accurate term for most aircraft this type today is "remotely piloted" to reflect the fact that decisions about course, altitude, etc. are made by a human responding in real time. The drone is required to do what it was programmed to do (however, we will follow common practice and use the terms interchangeably). The advantage of this type of autopilot control at this stage of development is range: the aircraft can fly out of sight of any human controller, whereas radio control depended on the remote controller being able to see the aircraft he or she was controlling.

This means that the range is limited (or that the dispatcher must accompany the airplane on another manned airplane). The third category would be "autonomous," meaning that here there is no human pilot, remote or otherwise, but the aircraft does not simply follow a course by heart: rather, the machine makes choices based on changing conditions, responding perhaps to changes in terrain, or enemy radar signals, or maybe even target recognition. This will come much later, and today it is only a partial reality.

Experiments in radio control continued between wars, on land, at sea, and in the air. The Soviet Union developed teletanks, a system in which a manned tank controlled an unmanned partner tank by radio control. They were used in the Winter War with Finland. 5 The U.S. Navy used radio control to guide target ships for firing, such as the obsolete warship USS Iowa, sunk in 1923. The radio control system in this case was developed by John Hayes Hammond, Jr. a protégé of Thomas Edison and Alexander Graham Bell. 6 Military experimentation with unmanned aircraft also continued between the wars. The British Navy acquired a radio-controlled target aircraft based on parts from a pair of manned aircraft, the de Havilland Tiger Moth and Moth Major. The task is eminently suitable for basic radio control as it does not require the aircraft to fly long distances, but perhaps fly around a ship no more than a few miles away. The airplane known as the Queen Bee (some sources suggest that this name was the original source of the term "drone") first took to air 1935 and was very effective in its role. Over 400 aircraft were built in both land and seaplane form, the latter being launched using a steam catapult.

Robin Braithwaite reports that the plane had an automatic landing system, which allowed an airplane to land safely in the event of loss of radio control, and that "in its heyday it was not uncommon to find an orphaned bee uterus, devoid of fuel but otherwise serviceable. bobbing quietly in the sea." Writer and aviation

engineer Neville Schuthe The Norwegian company Airspeed was commissioned to build a specialized UAV as a successor to the Queen Bee, the Queen Wasp. This aircraft, also designed in both float and ground versions, was much less successful and no more than a few prototypes were built.

Many of these early developments are as much about guided missile development as they are about unmanned aircraft, as both Lowe's radio-controlled aerial target and Sperry's American gyroscopic guided airplane were developed as weapons, not aircraft designed to be returned for reuse. This technology would be developed during World War II, both as guided weapons and as reusable drones. To some extent it was still the domain of the talented amateur.
Reginald Denny was one of these, a Brit who, after serving in the Royal Flying Corps during World War I, emigrated to the United States to become a movie actor (in which he was successful, appearing in many famous films).
He developed an amateur's interest in radio-controlled airplanes, opened a model store on Hollywood Boulevard, and promoted his belief that drones played a useful shooting role for the U.S. military. He made his first sale in 1940, and during the war some 15,000 were produced
"Denny's Radioplanes. These aircraft were conventional-looking single-engine monoplanes with a 12-foot wingspan. Few survive, a testament, as one commentator put it, to the accuracy of trainee shooters. 8 The company was later acquired by Northrop, which today, as Northrop Grumman, remains in the UAV business. A number of other manned aircraft-based radio-controlled target drones were used during World War II, from the U.S. Navy's Curtis N2C-2 biplane, which first took to the air in 1937, to the Culver PQ-8/U.S. Air Force (USAAF). 14 based on a light civilian monoplane. These were operated from an escort aircraft and were successful in their role: over 2,000 later variants of the PQ-14 were built. In a footnote to the history of UAVs, Marilyn Monroe was discovered by an Army photographer who photographed her assembling a Denny radio plan while she was working at the Denny plant in 1944.

The U.S. military also continued to experiment with radio-controlled "aerial torpedoes." But the Navy team that developed the N2C-2-based target drone took a fundamental step forward.
The officer in charge, retired Rear Admiral Delmar S. Farney, U.S. Navy, writes: "Returning to the Naval Aircraft Factory in April 1939 as the officer in charge of Project Fox, I began to plan, design, and develop work. on a guided missile that be successfully guided beyond line of sight." 9 The key to this move was television, and Farney records how a contract with RCA led the provision of a small television transmitter. By 1941, successful flight tests had been carried out and the development of what they called the 'assault drone' had begun. He describes how in 1942 a TG-2 biplane torpedo-bomber, converted into a drone and controlled by an operator looking at a six-inch television screen on an accompanying aircraft, conducted a successful demonstration of a torpedo attack on an American destroyer. Since the drone did not act as a missile itself, this can be considered the first use of a combat unmanned aerial vehicle (UAV). B

In later tests, they also flew directly at the target, playing a secondary role, essentially as cruise missiles.

Lawrence Newcom, who was heavily involved in the Pentagon's UAV development program, describes how, almost immediately after the initial success with the TG-2, the Naval Aviation Plant sought to overcome the limitations of the new TV drone, namely its inability to handle night flying or bad weather. They did so by adding a radar guidance system, and developed two drones capable of utilizing both systems: the TDN-1 and the TDR-
1. They were fairly simple plywood monoplanes, capable of carrying about 2,000 pounds of bombs, but they proved the value of the UAV concept in the war in the Pacific. Three Special Operations Air Groups (STAGs) with 99 control aircraft, 891 drones and over 3,000 personnel were deployed in 1943, and in 1944 STAG-1 was deployed near Guadalcanal and quickly demonstrated the value of their aircraft by directing four drones at a halted Japanese ship. This led to further successful attacks on a number of stationary targets, often attacking with heavy anti-aircraft fire, while, as Newcomb writes, "their [Grumman] Avenger base ships rotated 6-8 miles away."

In this type of attack, the drone weapon is deployed like a missile: it is destroyed in the process, as it is aimed at the target as a kind of flying bomb - modeled after the better-known German Fau-1, which, however, used a gyroscope and compass along with a range counter to fly automatically. But most interestingly, especially given the long postwar emphasis on the drone as a surveillance tool, the STAG-1 also experimented in action with using the drone as a bomber rather than just a bomb. Newcomb describes how "armed with combination of ten 500- and 100-pound bombs, one TDR-1 dropped bombs on firing points and then headed for home." Although it crashed on the way back due to battle damage, this key event "proved the operational suitability of the combat unmanned aerial vehicle (UAV)." Later attacks used a combination of approaches, with drones dropping their bombs on targets and then heading toward Japanese ships, which Newcom calls a
"a drone prelude to the Japanese kamikaze attacks that began a week later
later." He assesses the impact of drone attacks follows:

Of the 50 drones sent by STAG-1 into combat, 15 were lost mechanical/technical causes, three were lost to enemy fire, and 31 hit or damaged their targets. More importantly, a single STAG airman was lost or wounded on these missions during some of the bloodiest engagements of the war in the Pacific.

The significance of this seems twofold: these aircraft proved the value of UAVs, and even the concept of UAVs as they worked, of accurately hitting a weapon on target without a human pilot on board. Second, fact that Newcomb draws attention to the lack of U.S. casualties involved points to one of the fundamental advantages of UAVs: they can conduct dangerous combat operations without risk to the military personnel operating them.

However, not all UAV operations were safe at the time. The U.S. approach to unmanned vehicles involved adapting large military

aircraft at the end of their service lives, such as the four-engine Liberator and Flying Fortress bombers. General H. H. Arnold, commander of the U.S. Air Force, supporting efforts to put "as much pressure on the enemy as possible," wrote in a 1944 staff memo, "If you can get mechanical machines to do it, you save lives from the start." 13 Unfortunately, that was not quite true in this case. These planes required a crew of two aboard for takeoff, who were then rescued. This allowed the escorting baseship to control them by radio, and the dispatcher had the benefit of new control technology: a television image of the view from the cockpit of the controlled aircraft, as well as a view of the control panel to assist them in the control, task of guiding the explosives-laden aircraft to the target. Despite this assistance, the program had limited success, posing great danger to American crews, escorting aircraft, and the towns surrounding the British airfields from which they were launched, as well as to the enemy. Perhaps the greatest historical impact of these "Tired Willies," as they were nicknamed, was the premature detonation of one such converted B-24 Liberator, resulting in the death of Joseph Patrick Kennedy, intended by his family for the job, President of the United States. The task then fell to his younger brother John.

Newcom finds additional and provocative significance in the the drone program was conducted during the war, which he suggests is not unusual even today. First, he identifies an apparently positive way to quickly add new capabilities to the drone (television, radar, etc.), a phenomenon "requirements sprawl," which delays availability, complicates production, and increases costs. He also saw institutional resistance to supporting this new and untested technology, as well as a failure to engage operational commanders early in the process. All of this occurred in the context of warfare, which he characterizes as a matter of "come as you are," in which several major technological developments, and most major weapons systems were produced before the outbreak of war.

As Rebecca Grant notes in the introduction to Thomas Erhardt's study, 50 years elapsed between the end of the war and the appearance of the Predator in the Bosnian War, a period when UAVs seemed to fall out of favor. "Disappeared from view" might be a more accurate term, as key programs, if not yet the drones themselves, became secretive, operating somewhat under the umbrella of black or secret programs of shadowy organizations such as the National Reconnaissance Office (NRO) or, later, the Defense Airborne Reconnaissance Office (DARO), and in some cases operated by the CIA rather than the U.S. Air Force. In fact, as Erhard notes, "the U.S. intelligence community has been the largest contributor to the development of U.S. operational UAVs."

Newcom describes how the special needs of the Cold War had some influence on the development of UAVs after World War II. One factor was the realization that the next war would be a nuclear war. The experience of flying manned aircraft over the nuclear tests at Bikini Atoll demonstrated the

the danger of putting the flight crew in such a radioactive environment to see what was going on, and so out of this scenario arose the need for unmanned reconnaissance aircraft to combat such "dirty," missions. "The 'cold' nature of the Cold War also meant that such operations conducted by US forces over hostile territory were reconnaissance flights and not strike missions. Thus, Newcom notes that these reconnaissance flights were some of the hottest missions of the Cold War, posing a real danger to the pilots manning the aircraft involved: between 1946 and 1990, 23 aircraft and 179 crews were lost, incidents if personnel were captured.

According to Newcom, these three factors - nuclear war planning, risks to the flight crew, and the potential for diplomatic embarrassment - "helped make the reconnaissance mission a logical candidate for transfer to unmanned aircraft." 16 , the early turn toward UAVs that occurred in hot warfare has been overshadowed. Nevertheless, hot wars certainly occurred during the Cold era and involved UAVs. The Korean War provided another occasion for the use of obsolete manned aircraft loaded with explosives (in this case Grumman Hellcats) adapted for use as radio-controlled missiles. These were dropped from aircraft carriers and then remotely piloted to well-defended targets from an accompanying aircraft. Such

Radio-controlled Hellcats were also used to observe mushroom clouds during tests at Bikini Atoll in 1946. One of the first potential reconnaissance drones failed for one of the reasons given by Newcom above. The high-altitude Northrop/Radioplane B-67 Crossbow began as a target drone, was adapted for suppressing enemy air defense missions, and was being considered for a reconnaissance mission when it was cancelled in 1957 as costs rose and performance deteriorated, the result of "attempting to specify too many missions from a design optimized for one: i.e., the notorious death of the program due to 'requirements sprawl'."

More successfully, Newcom notes that Radioplane installed cameras on the successful OQ-19 drone during the war and sold 1,445 of the resulting SD-1 Observers to the U.S. Army as well as 32 to the British Army. This aircraft was a key element in the UAV technology suite, as it carried a radar beacon that allowed it to be tracked and radio commands sent to a dispatcher on the ground far beyond line of sight. A number of other unmanned reconnaissance aircraft (SD-2 through 5) were developed in the US at the time, but none entered service.

According to U.S. Air Force Major Christopher Jones, "The UAV origin event was the shooting down of Francis Gary Powers' U-2 reconnaissance aircraft over the Soviet Union on May 1, 1960, by an SA-2 missile." 18 The U-2 was produced specifically in response to the Soviet Union's development of nuclear weapons; capable of flying at altitudes beyond the reach of Russian interceptors and anti-aircraft missiles, for four years it could collect data on Soviet military activities with impunity and even without formal complaint from the Russians because, as Jones put it,
"to blame the United States for the overflights would be to recognize the inability of the Soviet armed forces to defend the Soviet Union against U.S. aircraft." 19 Everything changed with the advent of the Russian SA-2 surface-to-air missile (SAM) and its successful interception of Gary Powers' intelligence-gathering mission. Powers survived

incident and appeared to the world as a self-proclaimed spy, much to the embarrassment of the United States. As a result, Eisenhower stopped overflights of the Soviet Union. UAVs were not immediately seen as a solution because the U.S. had other "iron" in the fire, notably the CIA's high-speed manned reconnaissance aircraft (later known as the SR-71) and the Corona Discoverer 14 satellite, which Ehrhardt points out flew just three months after the Powers incident. He writes that "the competition between the three types of strategic intelligence - drones, satellites, and manned aircraft - continues to this day," and adds that "drones lost all the early battles."

However, at this stage, satellites did not provide all the answers because the resolution of the images they provided was very low and their ability to observe a given target was always limited. The SR-71's images were of higher quality, but its high cost and limited availability also meant that coverage was limited from a tactical point of . Then another U-2 was shot down by an SA-2 over Cuba during the 1962 missile crisis; the pilot, Major Rudolph Anderson, U.S. Air Force, was killed, giving him the unfortunate honor of being the only person killed by enemy fire during the crisis. Jones suggests that this event gave another boost to UAV development, resulting in the most successful reconnaissance drone of the Cold War. It was developed from the existing Ryan Firebee jet-powered target drone. Known as the Lightning Bug, it became operational in 1962 after a short period of development by the office of
The U.S. Air Force's "Grand Safari" under the auspices of the NRO. On the test, he immediately showed its advantages over manned aircraft. Being small and, in Erhardt's words, "strengthened in low-observability," it was able to avoid radar pickup by opposing fighters during tests against American fighters. Later versions had quite impressive performance: they could reach altitudes of 50,000 feet and fly at speeds of over 600 miles per hour. Launched either from the ground or, more typically, from a C-130 underwing vehicle, they could cover a pre-programmed course of up to 1,300 miles before parachuting up - either descending to the ground with a thud or, again, more often when collected in mid-air by a helicopter. Resistance to the concept from senior Air Force officers led to a struggle to find someone to operate it, but eventually the commander of a Strategic Air Command unit succumbed to the idea. As Ehrhardt says, "He just bought the most significant operational UAV system in history." Northrop Grumman is still modernizing the aircraft for use as aerial targets by U.S. forces today, five decades later.

The airplane was first used for reconnaissance flights over China as part of the Blue Springs mission. Erhard describes a special unit sent to Japan to overfly China in search of intelligence on China's nascent nuclear weapons program and its air defenses. In the early days, success was limited: planes were lost, damaged in recovery, or simply too inaccurate in their navigation to be useful. But changes were made, and in late 1964 Blue Springs moved on to Vietnam, flying missions to China. "China had minor success in shooting down this robotic intruder, but unlike the Powers incident, it didn't seem to make a political difference." Thus

Thus, these operations have become something of a test of the concept of an unmanned reconnaissance mission in an environment far from war.

Although developed as a response to the need unmanned strategic reconnaissance in the Cold War context, the Lightning Bug proved itself during the Vietnam War under the name of the Buffalo Hunter program, flying tactical missions in North Vietnam from 1965until 1975. They operated both as reconnaissance aircraft, mostly at low altitude (model AGM-34L, 28 feet long and 13 feet in wingspan) and as what Ehrhardt calls "decoys" to force enemy air defenses to reveal their targets, a position when they engaged drones. But the primary mission was low-altitude aerial reconnaissance at altitudes between 500 and 3,750 feet. Air Force Major Paul Elder reports that at 1,500 feet, the Fairchild camera provided a 120 nautical mile swathof imagery that covered a 3 nautical mile swath and resolved objects as small as six inches.

Lawrence Spinetta notes that in ten years, these relatively simple UAVs flew 3,450 sorties. Some 544 aircraft were lost - two-thirds to enemy action, one-third to mechanical failure - which was far better than expected: "The drone, dubbed Tom Cat, set a record with 68 combat sorties before it was lost in September 1974." He also reveals an unforeseen element of the drone's success: even though they were unarmed, several Lightning Bugs managed to earn MiG "kills" as North Vietnamese fighters sometimes crashed or were hit by errant SAMs while attempting to intercept the drones. One drone actually earned ace status as it contributed to the loss of five enemy fighters." 23 In another twist on this story, Elder writes that "some Air Force officers assumed that North Vietnamese artillerymen were using U.S. drones for training purposes and MiG pilots were using them to practice interceptions. In essence, they got a target drone, which, after all, was Firebee's original mission.

That many other UAV programs have failed, unlike the Firebee Lightning Bug, may be due in part the fact that the program did not exceed technical capabilities. , the aircraft was not an unqualified success, as it failed reach a reconnaissance target more 50% of the time. This was partly due to a focus on low-altitude operations to minimize SA-2 risk and to operate in monsoon weather and to obtain the highest resolution imagery. According to Elder, with an on-board drone guidance error of about 3 percent, this meant that after 100 nautical miles, the drone was off course 3 nautical miles, which was enough miss target, given a distance of 3 nautical miles, the width of the coverage area. The course could be corrected using the microwave guidance system from the C-130 carrier ship, but it had problems determining its own position with the necessary level of accuracy, and the telemetry from the drone was not always good.

It should also be noted that despite its relative simplicity compared some other drone projects of the time, the Lightning Bug could not be called cheap. For example, its launch and lift procedures required both equipment and . Due in part to its success and the large number of UAVs built, Erhard called it "the most expensive UAV of its time." As many subsequent programs have shown, removing the pilot from the

of the airplane doesn't necessarily save money. In the end, however, in a classified report for the Air Force declassified in 2006, Elder was able to conclude that "the Buffalo Hunter is a combat-proven unmanned system that has functioned effectively in combat conditions," and part of its merit is that they "never lost a crewmember." Elder quotes Gen. John Vogt Jr., commander of the U.S. 7th Air Force in Vietnam 1972: "I know of no other way to get the information we needed... [during] the intense fighting of the December period."

In contrast to Lightning Bug, one of the very ambitious secret UAV programs that Erhard describes as having begun under the auspices of NRO in the 1960s was the D-21 Tagboard. Faced with the difficult task of overflying the Chinese nuclear weapons facility at Lobnor, in Xinjiang, northwest China, the CIA-sponsored surveillance program using nominally nationalist Chinese U-2s resulted in five aircraft being shot down by dangerous SA-2 SAMs. An unmanned aircraft capable of handling the demands of this mission was needed, and the famous Lockheed company offered a solution. The Tagboard was an extreme design: a disposable UAV with a speed of Mach 4, launched at Mach 2 to fire its straight-through air-jet engine, off the back of an SR-71. Four sorties were flown over China and four drones were lost. This program went down after one copy had a fatal collision with a launching baseship. Other even more expensive programs followed with little success, such as the disastrous $1 billion for a copy of the Advanced Airborne Reconnaissance System (AARS). Finally, in 1974, as Erhard describes it, NRO washed its hands of the drone business, becoming solely a satellite organization, reflecting the fact that satellite technology was improving in many ways. It transferred its drone operations as well as manned reconnaissance aircraft to the Air Force, specifically, by 1976, to Tactical Air Command.

On the other side of the Cold War, the Soviet Union also experimented with UAVs. The National Museum of the U.S. Air Force notes that "in 1950, the Soviet Air Force began developing a radio-controlled aerial target for training fighter pilots." 26 Production of the high-speed, high-altitude Lavochkin La-17 began 1954. Initially air-launched with basic radio control, a crude straight-through air-jet engine, and a strictly limited flight duration, the La-17 underwent numerous improvements until the last one was built. in 1993. These included the addition of an autopilot and a new turbojet engine, which led to the development of a ground reconnaissance variant (La-17R) in the early 1960s. It carried "a variety of payloads, including high-resolution cameras, real-time television cameras, and radiation monitoring equipment." The specimen in the museum was found floating in the Black Sea by the U.S. Navy after it crashed while flying from a Soviet test site.

The superpowers were not the only ones developing UAVs during this period. China's experience UAVs drew on both Soviet and U.S. programs. Kimberly Hsu explains that in 1950s, when relations between the two communist powers were good, the Soviet Union provided the PLA with La-17 target drones. When those supplies were discontinued after 1960, when relations soured,

the Chinese redesigned the aircraft to create the Chang Kong-1 target drone. The Firebee program also played a role in the development of UAVs in China. Hsu notes that when "the PLA detected an American AQM-34 Firebee UAV in North Vietnam in the 1960s. Chinese reverse-engineering yielded another early Chinese UAV platform, the low-altitude Wu Zhen-5 (WZ-5) deep-sea platform." 27

Today, Israel has become one of the world powers in UAV development and manufacturing, and the industry has its origins in the events and technology of 1960s. Firebee, the drone of the international UAV industry, played role in building this capability. Following Israel's strategic successes in the 1967 Six Day War, the conflict with Egypt escalated into three years of the so-called War of Attrition. The Israel Air Force (IAF) notes that with Soviet assistance, Egypt deployed SA-2 and SA-3 SAMs, resulting in losses to the IAF and the "undermined the Air Force's ability to gather intelligence from the front lines. In search of a way to gather that would not jeopardize the lives of the crew, the possibility of acquiring a UAV was explored." In 1970, a contract was signed with Teledyne Ryan for a Firebee-based UAV, which began to arrive in 1971.

Also in 1971, the U.S. Air Force acquired the Northrop Chukar (Telem in Israeli usage), designed as a target drone for the U.S. Navy, to fulfill another of the UAV's central missions: helping to suppress enemy air defense missions. At about 12 feet long, the Chukar was half the size of the Firebee and was launched directly from a ramp with a rocket and then lifted off by parachute.
It combined autopilot with radio control for guidance. The U.S. Air Force says that "the main purpose of the Chukar was to attract enemy anti-aircraft fire, making it easier for combat aircraft to detect and destroy missile batteries." And in 1973, as they put it, "the Chukar received its baptism of fire during the Doomsday War." At first, the system was used to fool the Syrians into believing they were under attack. Overall, the Air Force says that each group of 2-4 Chukar decoys led to the launch of 20-25 enemy missiles. Other NATO powers have also been involved in UAV development. In a joint project funded by Canada, Britain and Germany in the 1960s, Canadair developed the CL-89 artillery detection reconnaissance drone (later converted to the CL-289, which was also sold to France). Known as the "midge," the 12-foot UAV was a rocket launched from the back of a truck, with a small jet engine that fired once in flight. It was a real drone, following a pre-programmed flight path. The plane was parachuted in, protecting itself with airbag deployment on landing. Reg Austin writes that "the primary requirement for the UAV was high survivability in the face of a sophisticated enemy." With its small diameter (0.33 m), short wingspan of 0.94 m, and high speed (740 km/h), it [the Midge] was difficult to detect and destroy" . the first Gulf War and with the French and Germans in the conflicts in the Balkans.

The way UAVs were developed and funded in the U.S. during the Cold War seems to have been a mixed blessing. Erhard notes that the secret wealth of the NRO - "an agency so secret that even its name was classified immediately after the end of the Cold War" - was channeled through the newly formed CIA (with its foreign intelligence mission) and the Air Force (a new independent service), both products of the 1947 National Service.

The SAFE Act has enabled the development of sophisticated UAV technologies. 30 However, it also led to a certain distortion of the missions pursued and the tools developed: "NRO UAVs cost billions, yet NRO produced designs ill-suited to the Cold War priority of conventional warfare," Erhard writes. The costs, though buried in the black budget, were astronomical enough to cause surprise, and the failures were many.

Since the 1970s, conditions seemed to be shaping up in favor of unmanned military flights. First, the air defense challenge proposed by the Soviet Union was considered very serious after the Vietnam experience, and UAVs offered a possible solution to combat this threat. In , it seemed that science was about to realize what Erhard calls a technological revolution in the form of the
"microprocessor-based automated flight control and real-time broadband communications." This, of course, is part of the broader RMA. Despite this favorable scenario, Erhard suggests that the U.S. Air Force as the keeper of the UAV dream has succeeded little better than the NRO, with several expensive programs, such as the ambitious Compass Dwell high latitude and long endurance (HALE) and Compass Cope programs, collapsing without delivering a usable aircraft. They remain interesting in that they attempted to tackle some problematic (i.e., high cost) areas of UAV use using conventional runways under remote pilot control, while Compass Cope experimented with using satellites for control, an approach that promised to extend this remote control globally. Another program that was not successful at the time was the BGM-34C multi-purpose drone, noteworthy in that one of those missions was weapons delivery - in other words, it was another example of a UAV development plan long before the CIA tied Hellfire to the Predator.

Erhard attributes the failure of these ambitious programs to two factors: one is "the myth of affordability that plagued UAV programs in the 1970s (and persists to this day)," and the other is that the technology still did not meet specific requirements. UAVS. Thus, the U.S. Air Force was continually confounded by the rising costs of its UAV programs and, lacking deep NRO pockets, sought to reduce those costs, resulting in lost opportunities and program failure. On the technology side, while microprocessor processing power was increasing, it remained insufficient for automated flight at the time, and communications with UAVs formed a
"an airy thread" that "could be cut quite easily with a
electronic countermeasures. 33 Similarly, location was still largely determined by insufficiently accurate inertial systems. Interestingly also (and this forms a constant element in UAV development, especially with regard to autonomy), some of the proposed UAVs and the way they were used did not comply with European air traffic control regulations. All this meant that the new post-Vietnam focus on NATO's demanding European theater of operations showed that UAVs still could not cope with either the complex air defense environment or the busy civilian airspace.

Despite the looming problems, the improved communication and command and control technologies available began to deliver real benefits in terms of the transmission of digital images from the surveillance drone. This allowed analysts and commanders to see what was happening on the ground as it happened, rather than waiting for the drone return, be recovered and its film processed. By the 1980s, there was a dramatic change in the effectiveness of UAVs.

A group of Israel Aircraft Industries (IAI) engineers writes that "one of the major lessons of the 1973 war was the lack of good operational intelligence." 34 The IAF notes that it was "the growing use of unmanned aerial vehicles for real-time intelligence gathering on the front lines" that prompted IAI to develop its own UAV capable of broadcasting images from a stabilized camera: the IAI Scout. In 1979, 20 of these small (12 feet long) machines were purchased. Initially, the Scout required the assistance of a rocket to launch, but the extension of the wings allowed for a conventional takeoff controlled by a remote pilot. In addition, all of these airplanes have the characteristic double tail beam. IAI engineers write that "it can be said to have become a 'home configuration,' explaining their choice in terms of 'ease of modification - engine replacement, plumage modification, wing modification' and 'ease of payload integration, including nose space' and the use of booms for antennas and installations."

The scout provided effective assistance to Israeli forces in Lebanon in 1982, and it transitioned to U.S. use when it was converted to a Pioneer UAV for the U.S. Navy, which used it in Operation Desert Storm in 1991.
One example became famous as the drone that a group of Iraqi troops surrendered (now exhibit at the Smithsonian Institution). Israeli expertise will be important in the next generation of UAVs in the U.S. and Europe, as the advent of satellite global positioning system (GPS) and digital flight control systems have led to significant increases in range and effectiveness.

The development of UAVs up to the 1990s reveals certain patterns. From beginning there has been a basic choice between automated aircraft and remotely piloted aircraft, a choice that is now sometimes combined in a single mission. This mission may be driven partly by the capabilities of the technology and partly by the nature of the conflict in which nations were involved: during World War II there was a great need to train anti-aircraft gunners, and so the direct target of the drone was something that was emphasized. But while experiments with UAVs were conducted during the war, they were largely delayed due to the various demands of the Cold War, where the key becomes observing an enemy you're not actually at war with. The events of the Cold War also indicate that UAVs offer not only a military solution but also a political solution. If a UAV crashes or is shot down while violating sovereign airspace, it is a much less important diplomatic (and domestic political) event than if a pilot were involved. This type of activity is both strategic information gathering and military intelligence, and in the US it was managed by the intelligence community, not the military. became spies, and the black budgets that were available for such projects highlighted one of the fundamental misconceptions about drones: they were not necessarily cheaper than manned aircraft, and they were as vulnerable any other kind of device to mission creep that

attached to so many military projects. As a result, many costly ventures failed. The fast, jet-powered, automated Lightning Bug foreshadowed the successful tactical UAV, although its accuracy was marginal for the missions it was tasked with. Some form of corrective control during the mission would have helped immensely, and it was the technical capability for this development that propelled the UAV to the next stage. The next logical step... arming the UAV.

Gen. John P. Jumper, former chief of staff of the U.S. Air Force

Over the past 15 years or so, UAVs have been involved in variety of conflicts. A number of classes of UAVs have also been developed in response to the demands of these conflicts. This chapter will attempt to explain how UAVs finally became mainstream and describe how they have been used in the modern battlespace. It will also point to some trends in future UAV design.

While the drone itself is nothing new, its prevalence in the military and in the broader security environment is new. In recent years, drones have evolved from an often problematic niche player into the mainstream, effectively performing a range of missions, in some cases replacing or supplementing existing manned aircraft, and in others fulfilling new roles not previously performed by aircraft. Growth has been rapid, with the U.S. Department of Defense increasing the number of UAVs in service from 167 in 2002 to nearly 7,500 in 2010, representing 41 percent of all U.S.-operated aircraft. The fact that the number of countries operating UAVs has grown from 41 in 2004 to 76 in 2012, mostly small tactical types, 2 and that, in addition, 50 countries are developing drones of thousands of different types, 3 shows that the U.S. is far from alone, although it may have traveled that road the fastest and farthest. 4 In a Congressional Research Service report, Jeremiah Gertler explains this growth as follows:

Advanced navigation and communications technologies were not available just a few years ago, and the increased bandwidth of military communications satellites has made remote control of UAS [unmanned aerial systems] more practical. The nature of the wars in Iraq and Afghanistan also increased the demand for UASs, as they required identification and strike against targets hiding among civilians, constant surveillance, and the ability to strike quickly to minimize collateral damage. In addition, UASs provide an asymmetric and relatively invulnerable technical advantage in these conflicts.

Thus, there is a new technical capability, part of the digital revolution that led to the universal RMA, and there is a new security reality: the U.S. war on terror and the collateral conflicts it spawned. However, this security reality is not the only reason for the emergence of drones: to some extent, the actions of concerned states, organizations, and individuals have led to the adoption of the new technology. For example, Mika Zenko of the Council on Foreign Relations told National Journal , that "responsiveness, persistence, and no risk to your personnel is what makes [the drone] a different technology." He added: "When other nations get this technology, if they follow U.S. practices, it will lower the threshold for them to use lethal force outside their borders. Thus, they will be more likely to commit targeted killings than in the past."

6 Thus, in his view, the availability of drones changes the behavior of states, making it more likely that they will do what the U.S. does with drones in quantities that are completely unthinkable by any other means (conventional bombing.) , assassins, special forces raids, etc.) in military scenarios other than war, such as Pakistan, Yemen, and Somalia, but also possibly in the insurgencies that the wars in Iraq and Afghanistan have quickly turned into.

Along with US, the other major innovator in UAVs is Israel, and the two countries are closely linked in this field. Gertler notes the impact of Israel's activities in its own "small wars" on U.S. attitudes toward drones. He wrote:

For many years, the Israeli Air Force led the world in the development of BAS and tactics. U.S. observers noticed Israel's successful use of the BAS during operations in Lebanon in 1982, prompting then-Secretary of the Navy John Lehman to purchase the BAS for the Navy. Interest also grew elsewhere in the Pentagon, and the Reagan administration's FY 1987 budget called for much higher levels of funding for the BAS. This marked the transition of U.S. BAS from pilot projects to acquisition programs.

If, as we have seen, the early Israeli experience with UAVs was based on the importation of US equipment such as Firebee and Chukar, the favor was returned, and not only as an example: there was a direct technical link. In 1996, the US Army acquired the IAI Hunter tactical reconnaissance UAV, as well as the US Navy's Pioneer. development of decoy drones during the Doomsday War. Named in the Economist
"drone father," Karem arrived in the U.S. in 1977, where, following in the tradition of masters like Lowe and Denny, he founded Leading Systems, a UAV manufacturing company, in his garage.

At a time when extremely expensive U.S. government-funded programs were stalled, the relatively cheap, reliable, and durable Albatross drone that emerged from this process caught the attention of the Defense Advanced Research Projects Agency (DARPA), which funded its development, development into a more sophisticated machine known as Ember. Success was not immediate, however, as this program also fell victim to U.S. agency reorganization when all military UAV programs were placed under the auspices of the Joint Program Office for UAVs in 1989. The main program left under the Joint Program Office was a joint Air Force and Navy project known as the Medium Range UAV, "a small, fast jet aircraft that was a more stealthy Lightning bug with data transmission." 9 It was another failure, as competing requirements from the two services increased costs to the point where Navy withdrew in 1993, destroying the program and damaging the Joint Program Office.

Chapter 13. The battle drone takes off

Meanwhile, Leading Systems was sold and sold and eventually became General Atomics, for which Karem built a low-cost but effective UAV known as the GNAT 750, six of which were sold to Turkey in 1993. Then came the war in Yugoslavia. The U.S. need covert surveillance led the U.S. to purchase GNATs off-the-shelf that

gave the CIA a useful near-real-time video source, although the potential duration of the device's operation for 40 hours or more was limited by the need for an accompanying manned aircraft to transmit the information, signal to a ground station. The Federation of American Scientists summarized the situation follows: "The GNAT system offers a combination of long life, high payload capacity, ease of use, and low operating costs at a very low cost per flight hour."

Erhard describes how in 1993 the civilian agency DARO, operating under the Office of the Secretary of Defense, was given the budget and control of all aerial reconnaissance programs, including UAVs. They inherited a UAV acquisition plan divided into three "tiers." The first tier, the lowest level, was executed by GNAT. The super-ambitious third level slot was occupied by what was considered the Global Hawk "third level minus". Coming out of the DARPA/DARO era, this Ryan-designed UAV (taken over by Northrop Grumman) is a large HALE jet UAV with a 40-meter wingspan, intercontinental range and endurance, and a 65,000-foot ceiling capable of scanning "large areas" with its sophisticated array of sensors.

It is also extremely and controversially expensive, to the tune of $222 million per unit, a price that has caused later versions to be canceled or downsized. The plane first took to the air in 1998, but to the need for the war on terror, it was rushed into service in 2001. It served in Afghanistan and then Iraq, where one particular operation shed light on its capabilities. Journalist John Croft describes a moment at the start of the war when Iraqi troops were still considered a threat. He wrote:

According to Air Force Secretary Roche, JSTARS [Joint Target Surveillance Radar System] detected a line of troops and equipment approaching, using the sandstorm as cover to reinforce the Medina Division that the Republican Guard so feared. The switch from JSTARS to AV-3 [Global Hawk] allowed analysts linked via satellites and chat channels at the Air National Guard's 152nd Reconnaissance Squadron in Reno, Nevada, to see through the storm and help air operations experts in Qatar direct fighter. and bombers with GPS-guided bombs to the scene; the Medina Division was essentially neutralized.

He also claims that this one particular aircraft alone identified 55 percent of time-sensitive targets and caused significant destruction to Iraqi air defense equipment. It identified 13 complete SAM batteries, more than 50 SAM launchers, 300 SAM containers, and more than 70 SAM transporters. And it provided intelligence that led to the destruction of more than 300 tanks - 38 percent of Iraq's known armored forces.

It is in service with the US Air Force, US Navy and NASA, but NATO's plan to acquire five Global Hawk for its Alliance Ground Surveillance (AGS) program is in some jeopardy now that Germany has canceled its plan to buy the radio reconnaissance version known as Euro Hawk at a loss of €1 billion. The decision was partly due to problems with integrating the aircraft into European management rules

air traffic, a problem that had previously caused UAV programs to be halted.

The second tier in this three-part scheme was seen as a larger, flyable, and more powerful version of GNAT, and in 1994 a GNAT derivative known as Predator was ordered from General Atomics. The Predator added cloud-penetrating synthetic aperture radar (SAR) to GNAT's electron-optical turret and for the first time was able to use GPS positioning along with commercial satellite feeds, pushing both control and data delivery beyond line of sight, a sight independent of any other aircraft. By 1995, it was operating in the Balkans under the auspices of a special Army Intelligence battalion, but after seeing the Predator's success in that theater, the U.S. Air Force insisted on taking over operations "Predator." It succeeded in 1996, in part due to the lack of surveillance from the air after the development of satellites and the retirement of some key older aircraft; for, as Air Force Chief of Staff Ronald R. Fogleman put it, "we were gradually losing air-jet reconnaissance capability."

In 1998, the U.S. Air Force Air Combat Command assumed full control of Predator, and under pressure from Congress, the acquisition was handed over to Big Safari, an Air Force agency with a long history in the UAV business. Journalist David Gulgam explains that:

This shadowy organization has developed a small number of secret cargo and specialized aircraft for covert intelligence missions. It operates under special rules that avoid much of the onerous acquisition process in exchange for new, rapidly deployable technical capabilities.

Richard Whittle describes it as achieving success by striving for an "80 percent solution" while ignoring "administration." Perhaps it should be noted that the missing 20 percent was not always trivial: the control panel of an early Predator was described as such a mess of buttons that pilots perceived it as a child's toy, Mr. Potato Head, with a button to shut down the engine a half-inch away from the button to launch a Hellfire missile. UAVs remained an unconventional technique happening on the sidelines of the military establishment.

number of events accelerated the Predator on its journey from reconnaissance to combat and to the mainstream. For Whittle, one of them was the war in Kosovo and the accompanying air war over Serbia. One of the new F-117 stealth fighters was shot down, and although the pilot was rescued, it led to increased caution in air operations with a mandated minimum altitude of 15,000 feet. This kept the aircraft above cloud and the Predator was delivered to this vulnerable lower zone. Thus, once again, one of the keys the development of unmanned was to make them completely unmanned: reducing the threat to personnel and eliminating the Gary Powers problem.

However, the images produced by the Predator were inaccessible to manned strike aircraft, so Predator dispatchers had to try to control them verbally, which was inefficient. This led to the rapid development of a system "Operational Support Data," allowing dispatchers to send such airplanes to their targets using Predator video with much greater accuracy. Whittle describes how Air Force Gen. John Jumper, then commander of Air Combat Command, suggested adding a laser designator,

so that the Predator could illuminate targets for PGMs from manned aircraft. Big Safari quickly applied a labeled turret designed for U.S. Navy Seahawk helicopters. About a month later, the system was in action when the Predator "strafed" (i.e., marked) a building housing a Serbian military vehicle, which it tracked for a smart bomb delivered by an A-10 aircraft.

There would seem to be a number of issues worth noting here: what distinguished a working military UAV system in the modern sense from the restrictive functioning of a system like the earlier Firebee family was the information network, a new ability to share data that the Predator produces in near real time. Another aspect to note is that UAVs do not deliver a different technology to the battlefield: the surveillance and targeting equipment on the Predator was off-the-shelf, the same as on manned aircraft. The difference is in how the UAVs are used because of the lack of crew. The story of this first direct involvement of the Predator in a strike also sheds light on one of the distinctive characteristics UAVs bring to the battlefield: persistence. The UAV tracked individual vehicles over time-perhaps possible for a manned reconnaissance aircraft, but bread and butter for UAV warfare, especially in contested airspace and where casualty tolerance is limited.

This use of the laser designator on the Predator led to a significant and controversial development that General Jumper called "the next logical step ... equipping UAVs with weapons." This logicality was supplemented by what Whittle identifies as pressure from the Clinton White House, which
"pressed ... for months to find a way to capture or kill al Qaeda leader Osama bin Laden "16 as a result of the 1998 embassy bombings in Kenya and Tanzania. As a result, Big Safari took a Hellfire AGM-114 missile from a Seahawk helicopter (already, therefore, working in conjunction with a target designator from the same source) and worked on arming the Predator with it.

This key moment in the evolution of the drone from a surveillance system to a combat system is controversial. Article 36 of the Geneva Convention requires new weapons to be reviewed for compliance with international law. The U.S. did not review its armed Predator because it argued that both Hellfire and the Predator itself had already been independently reviewed to assess their compliance. But Human Rights Watch points to the International Committee of the Red Cross' guidance to Article 36, which states that "verifications should cover 'existing weapons modified in such a way that their functions are altered, or weapons that have already been legally verified but are not subsequently modified.'" Human Rights Watch adds that "this rule is particularly important for robots because they are complex systems, often combining many components that work differently in different combinations."

Also of note is the fact that while this work was going on, teams from Big Safari and General Atomics (the manufacturer of the Predator) were in Uzbekistan to launch, land and maintain the aircraft, as well as in "another country that was within beam range. satellite in orbit over Southwest Asia" for the launch

missions in a "split operations" mode. This established the current practice whereby, for example, the Reapers would be based in, say, Kandahar, and maintained and controlled for takeoff and landing by a team there, but operated during the mission by a team in Nevada. The mission of Afghan Eyes was to search for bin Laden in Afghanistan, a country with which the U.S. was not then at war. After Bin Laden was spotted twice, and on those occasions there was no way to send cruise missiles, resulting in a lost opportunity, the CIA became interested in arming its drone. CIA Director George Tenet told the 9/11 commission that by arming the Predator with Hellfire missiles, "we will have the ability to respond accurately and quickly to future sightings of important targets." 18 From the outset, the Predator weapon was designed to hunt and execute individuals in the territories of states with which the United States was not at war and over which the hunter had no jurisdiction. This became a key part of the Predator and its successor, the Reaper, as part of the CIA's drone strike program.

In February 2001, the first combat shot was fired from a Hellfire with a "Predator," even there was debate the legality of using such a weapon under the circumstances (there was a question of whether it would become a cruise missile in doing so, subject to the Intermediate Nuclear Forces Charter).
Then 9/11 happened, and according to Whittle, "Three days later, the Big Safari-led team was in Uzbekistan with three armed Predators, and a few days after that, the Big Safari-led team started flying over Afghanistan with a GCS [ground control station] in a CIA parking lot. On October 7, 2001, they fired their first missile." 19 In 2012, the number of annual drone strikes in Pentagon's ongoing campaign in Afghanistan reached 506. The CIA's more covert missions in Pakistan, Yemen, and Somalia added more than 400 strikes throughout the war on terrorism. 20 Predator quickly became a major weapon in the U.S. arsenal. By 2005, Whittle saw the program become a
"normalized," and by 2010 the U.S. Air Force was training more UAV pilots than the pilots of conventional airplanes.

Along with the HALE Global Hawk and the medium-altitude long-range (MALE) Reaper and Predator, U.S. forces in Afghanistan have had success with a tactical catapult-assisted UAV (TUAV) known as Shadow, which is variously described as the smallest of the large drones. and the largest of the small drones. It is used "to gather intelligence on Taliban movements, as well as provide 'eye in the sky' surveillance of U.S. and Afghan National Army troops while they patrol."

Shadow has also been used Iraq. In a 2008 article for the U.S. Army website, Sgt. Jason Dangel of the 4th Infantry Division's Combat Aviation Brigade writes that "since the initial development of the UAV about a decade ago, its use in the global war on terror has increased tenfold and provides vigilant reconnaissance of nearly all combat operations in MND-B [Multi-National Division-Baghdad], thereby helping to provide troops an additional advantage against the enemy." 22 Interestingly, the types of operations he discusses in the most detail involve detaining individuals rather than supporting anything like conventional combat. He quotes Maj. Jonathan Schaffner, a brigade aviation officer: "For the most part we have a

UAVs for most missions involving the capture of important targets or terrorists."

An operation is described in which The Shadow aids in the capture of such persons: Upon entering the suspect's home, the military discovered that the perpetrator was not there. At the same time, however, The Shadow targeted a suspicious automobile near the scene. With a camera mounted on the vehicle, the TUAV operator reported to ground commander a situation in which two men ran out of the vehicle and attempted to hide in a nearby canal. With pinpoint accuracy, the Shadow operator reported the whereabouts of the two men to ground soldiers who then apprehended the suspects, one of whom was the criminal they were looking for.

This combination of military power and apprehending criminals, and in other cases killing them, is an example of how drones are applying military technology to essentially police situations in the ambiguous zones of the war on terrorism. Derek Gregory applies this thinking to allied operations during Operation Iraqi Freedom in a political landscape he calls the
"post-colony."

The drone, with its relatively low initial cost and low operating costs, seems well suited for such situations; Dangel emphasizes how this efficiency allows the drone to do something that would be difficult to achieve with a manned aircraft, that is, pay close attention to a human. Improved situational awareness also reduces risk to ground troops, and all of this is accomplished without risking the pilot's life. He quotes UAV platoon sergeant David Norsworthy: "The key is to keep soldiers safe on the battlefield. It's definitely a technology that will always be a part of combat."

The larger aircraft are typically operated by the U.S. Air Force, but the Army has its own high-end armed drone derived from the Predator, the Grey Eagle, which has recently entered service in both Afghanistan and Iraq. The history of this program suggests that the UAV acquisition problems in the U.S. military have not been fully resolved, with the defense industry. Daily reports are that the U.S. Air Force has tried to shut down the project.

John Young, The former chief of defense acquisition at the U.S. Department of Defense reportedly said before leaving that "the lack of interagency coordination of drone programs wastes millions of dollars and slows down much-needed modernization." He pointed to the Grey Eagle program as an example, noting that the Army's automatic landing system has resulted in far fewer accidents than the U.S. Air Force's closely related Predators and Reapers, but nothing has been done to share the tool. He reported that one-third (65) of the Air Force's Predator aircraft (costing $4 million each) have crashed due to accidents, most often on landing.

The larger and more powerful successor to the Predator in US service, the Reaper, is also being used in Afghanistan by the British Royal Air Force (RAF), which currently operates five Reaper UAVs there and which by November 2012 deployed 297 Hellfire missiles and 52 laser guided fighter bombs against Afghan targets. The UK Ministry of Defense emphasizes that British drones have not been used

nowhere except Afghanistan. The UK also operates a MALE observation unit, the Hermes 450, acquired from Israel's Elbit under a contract to "service provision" with European defense contractor Thales. In 2011, when the Hermes had flown more than 4,000 sorties, Col. Mark Thornhill, commander of the British Army's 1st Artillery Brigade, the Hermes' operator in Afghanistan, said:

To date, we have achieved 50,000 [now 75,000] hours of Hermes 450 operations, helping to meet the significant amount of intelligence requirements that TFH [Task Force Helmand] generates every day. This capability has been absolutely key to many TFH operations.

The Hermes 450 was acquired as part of an urgent operational requirement for use in Afghanistan. A more advanced development of the Thales-led aircraft, known as the Watchkeeper, with automatic takeoff and landing and a wide range of sensors, has been ordered for the Army, but it is three years late, not yet ready. see service, and may yet miss the Afghan mission.

Like the Americans, the British had their own problems with the technology. The Guardian reported after a Freedom of Information request that nine large, complex and expensive (£1 million) Hermes 450-type aircraft had been lost in Afghanistan, halving the fleet.

(However, respected aviation journalist Craig Hoyle reported that this figure was given erroneously, and that the real figure represents only one loss, with the rest damaged but repairable due to hard landings, etc.).

The Royal Air Force has also crashed its 16 million Reapers, although perhaps its supposed usefulness is indicated by the fact that it is now doubling its fleet to ten and transferring control from Nevada to the UK.

While only the US and UK have used combat drones in Afghanistan, all major powers involved in these operations have used drones ranging from mini- to medium-sized drones for reconnaissance and surveillance. The Germans use aircraft such as the IAI Heron, which "allow the Bundeswehr and its NATO partners to monitor the entire northern half of Afghanistan, an area of more than 300,000 m 2, which is almost the size of the Federal Republic of Germany."

The Canadians used the Sperwer, a medium-sized tactical UAV. The French use the Harfang MALE UAV, derived from the Israeli Heron, for day and night missions, including "village surveillance, convoy escort, improvised explosive device search, helicopter landing site preparation, and tactical reconnaissance for troops engaged in combat operations.

There are also plenty of projects that leverage the rotorcraft's versatility in the UAV business, from the Northrop Grumman Firescout in service with the U.S. Navy as a ship-based reconnaissance and strike aircraft to the Kaman K-Max being tested in Afghanistan as a supply aircraft.

The Hybrid Airship Vehicle (HAV), an airship-like vehicle that combines a lifting body with helium gas to provide very cost-effective and versatile flight, is another technology that is being planned for use as an unmanned aerial vehicle. The U.S. Long Endurance multi-purpose intelligent vehicle based on this technology promised a high level of

endurance and potentially significant payload capacity, but after failing to meet planned performance metrics, it was canceled October 2013 and the $297 million aircraft was sold back to the U.S. British manufacturer for US$301,000.

Having developed UAV operations in the hot wars of the 1970s, Israel has also used UAVs extensively in its smaller and ongoing conflicts with or within its neighbors. Lt. Col. Ido, commander of the U.S. Air Force UAV Training Center, pointed out the centrality of UAVs to modern thinking on the official IDF blog:

UAVs account for a large percentage of the IDF's operational flying hours, sometimes even the majority them. At all times, 24 hours a day, seven days a week, drones are flying in the air, performing the activities that IDF forces are engaged in3.

In the controversial Operation Cast Lead in 2008, ground operations with the stated aim of suppressing Hamas rocket fire into Israel were accompanied by waves of airstrikes, including the use of drones. Michelle C. Esposito of the Institute for Palestine Studies describes three types of UAVs used for intelligence, surveillance, target acquisition, and reconnaissance (ISTAR) during the Gaza operation: the Hermes 450, Heron, and Searcher 2, capable of maintaining combat space for 20-40 hours at altitudes ranging from 9,500 to 35,000 feet. 35 They are equipped with systems to intercept messages and other electronic data, as well as day and night vision. The IDF also uses drones for strike missions in Gaza: like the US and UK, they use Reaper UAVs armed with Hellfire missiles, but Esposito also points out that they have used an armed version of the Elbit Hermes 450 firing Hellfires and "domestically produced". missiles. She notes that Israel "allegedly" used an assault version of the larger IAI
Heron TP armed with Spike missiles (typically used for anti-tank infantry purposes), and reports that according to agencies such as Human Rights Watch, Drone-launched missiles appear to have caused a large number of Palestinian civilian deaths during Operation Cast Lead.

then, other Israeli operations have utilized UAVs both surveillance and attack modes. It is perhaps worth noting that the narrow focus of a precision drone attack after potentially long periods of close surveillance offers no guarantee of safety to non-combatants, whether in Gaza or Pakistan. Human Rights Watch has detailed many such civilian deaths. For example, a 2012 report on Israels Operation Pillar Fire states, 'Human Rights Watch field investigations found 14 drone or other aircraft strikes for which there was no indication of a legitimate military target on the ground at the time of the attack. '. The report said that seven of attacks in Gaza were UAV strikes, and that 'Israeli drone strikes on Nov. 19 in Deir al-Balah killed three men in a truck carrying tomatoes and a science teacher who was sitting in his front yard with his 3-year-old son on his lap talking to an acquaintance - only the toddler survived but was seriously wounded.'

By far the largest number of drones in action are in a class that is little discussed - the mini, micro and even nano drones that fly at the opposite end of the scale to the Global Hawks, Predators and Reapers that get all the media attention. These small lightweight

devices are designed to be portable and provide even small units of troops with their own specialized aerial reconnaissance.

U.S. troops rely on Aeroenvironment's Raven RQ-11 in the classroom
a mini-UAV, Defense Industry Daily reports that "the U.S. military uses Raven extensively for tasks such as base security, route reconnaissance, mission planning and force protection." In a helpful summary, it lists the Raven's attributes as follows:

Useful at the battalion level, but so easy to operate that one of the best pilots in the Iraqi theater was a cook.

Perfect for a quick view of what's the other side of rugged terrain - like a city block in Iraq or the hills and mountains of Afghanistan.

Switchable IR cameras that some call better than an AH-64 attack helicopter.

Small and inconspicuous (wingspan just over 4 feet, weight just over 4 pounds), with low noise levels compared to larger UAVs. No letters to write if the plane goes down. Specialist Joshua Phan, a U.S. Army Raven operator, described how his unit used the system:

Because we have SFAATs [security force assistance teams and advisers] with Afghans in charge, we can do reconnaissance a little bit ahead of them so they are not in danger. We can use that together and benefit them.
If you toss up Raven and see enemy activity where you do so
you didn't expect, you can save your entire team or platoon.

Sgt Skyler Rose, Raven's forward observer-operator, added: "As far as the regiment is concerned, by taking still images, I'm giving them the most up-to-date and accurate images they can get at the time.

They get satellite imagery month to month or week to week, but I can provide it to them right now."

The British mainly used another mini-drone, the Desert Hawk from Lockheed Martin, a similar type of small, handheld device used for patrol, around-the-corner, over-the-hill reconnaissance missions. It is a tool that, like the Raven, delivers aerial reconnaissance as needed to small units of soldiers. The British Army recently received what they call a "nanodrone," a helicopter-type device known as the Black Hornet, purchased from a Norwegian company. This tiny flying device, two of which, along with a controller, fit into a case the size of a book, enhances a soldier's ability to look around corners, behind walls, and deep into the complex terrain of an "urban canyon."
Alleyways and even buildings become accessible to this small and unobtrusive presence with its steerable electro-optical camera providing live video. With a 20-minute range and a range of up to 1,000 meters, the Black Hornet, like its mini siblings, can be configured to fly an autonomous route or controlled remotely via video. British Army Sergeant Carl Boyd told the BBC it had been used in Afghanistan to study the types of walled complexes common there. He described it as "a good piece of kit" and
"lifeguard".

He also added that it is very sensitive to wind, as you would expect from such a tiny device, but its auto return to base feature

has helped solve this problem. This class of aircraft seems to be accident prone. The U.S. armed forces have begun marking their Ravens with a request to return them to U.S. forces if they are found. In total, the British have lost nearly 450 UAVs in Afghanistan, 412 of which are Desert Hawk s. A defense ministry spokesman told The Guardian that:

Lightweight mini or nano UAVs such as the Desert Hawk 3 and Black Hornet can more susceptible to harsh environments, and if they fail to land outside of a safe zone, they are sometimes not recovered to prevent any risk to life during its retrieval. This can result in a higher casualty rate than larger tactical or strategic UAVs such as the Hermes 450.

Still, at $50,000 to $100,000 per airplane, it's not a trivial loss. The glory days of mini-drones, which have been in service by the thousands, may be over. Yasmin Tajdeh quotes aerospace analyst Phil Finnegan: "For mini-UAVs ... it's going to be a tough military market challenge," he said. "The U.S. market is going to be depressed because you already have a lot of commodities in stock and the services have budget deficits."

It seems likely, however, that even if the numbers drop, this tool will not go anywhere; its obvious utility in improving situational awareness with the consequent likely reduction in casualties, at least of certain types, will take care of that. What is much harder to understand about these smaller aircraft is the broader impact on the battlefield, the nature of warfare, and public attitudes toward military action. One likely consequence, however, is an added emphasis on force protection and a reduced tolerance for casualties. The more soldiers can know about their environment, the more they may need to know. This may lead to a reduced propensity to take risks.

These small aircraft are relatively cheap and easy to acquire, and many hundreds of different types of varying sophistication are available, including from your corner electronics store. All military forces, regular and irregular, will have access to some device of this type, so it seems inevitable that an increased emphasis on UAV countermeasures will be part of future military operations. The half-ounce Black Hornet is unlikely to be the culmination of efforts to reduce the size of UAVs. Experiments with insect-sized machines continue. In a 2008 paper, consultant Richard B. Gasparre proposed a new range of "levels" to describe small drones, based on the ability of soldiers to recognize an artifact for what it is:

Level 1: recognizable in flight

Level 2: indistinguishable in flight, but distinguishable at rest in a relatively small room such as a living room.

Level 3: Indistinguishable at rest, but recognizable at arm's length or by touch and inspection.

Science fiction nowadays, perhaps, but his last category, Tier-4, is described as "recognizable only when checked by CSI teams or their equivalents."

Next generation: stealth and autonomy

Downsizing is one way to make drones less conspicuous. But some of the tasks performed by larger UAVs do not lend themselves to

miniaturization. Nevertheless, modern tactical and strategic UAVs are quite vulnerable to attack. A U.S. Air Force Scientific Advisory Board report notes that "a modern IADS [integrated air defense system] would quickly destroy the current Predator / Reaper fleet and become a serious threat to the high-flying Global Hawk." 43 But another way to reduce the threat posed by larger tactical and strategic UAVs to more advanced air defenses than those they have faced in Iraq and Afghanistan is to make the drone faster and/or harder to detect by these defenses.

General Atomics has developed the Predator/Reaper series, which is already undergoing flight testing. The Predator C Avenger is described by the company as follows: "Its unique design, reduced conspicuity and speed increase its survivability in higher threat environments and provide potential customers with enhanced rapid response armed reconnaissance capabilities."

Stealth technology includes a number of measures designed to make an object more difficult to detect. Radar is the primary tool for detecting aircraft and directing defenses to respond to them, so many efforts to make an aircraft stealthy are aimed at reducing its radar reflection. Small size is one aspect of this, but the apparent size of the aircraft can be reduced by careful tilting and bending of surfaces to help the structure scatter radar waves rather than reflecting them back to the source. This is further reduced by the use of radio-absorbing coatings, the latter of which actively interfere with the radar signal. Color is also important in making the aircraft less conspicuous.

Such stealth technology has been successfully used in manned aircraft. However, the technology is not infallible, as the F-117 incident in Kosovo showed. But the technique has improved - the hefty F-22 Raptor fighter is supposed to have a radar cross-section like a bumblebee, and it is claimed that the B2 stealth bomber was never detected by enemy radar. The obvious next step was to apply stealth to unmanned aircraft. The US already has one such aircraft in service, the Lockheed Martin RQ-170 Sentinel. This reconnaissance aircraft gained notoriety 2011 when Iran displayed a nearly intact example that they claimed had been hijacked by remotely controlling it as it flew over their airspace. The U.S. acknowledged that the aircraft was lost and asked for its return, but the Iranians denied the request. This story further points to the kinds of activities that UAVs allow, in terms of the (relatively) low diplomatic risk of interfering with sovereign airspace. It also, although there is no confirmation that it happened, points to the potential vulnerability of UAVs - the electronic "kite string" that offers to cut. The Iranian RQ-170 incident may point to a continuing vulnerability in the UAV's control system. Undoubtedly, according to the Washington Post , al-Qaeda is attempting to exploit this gap in the UAV's armor. 45 This insight comes from a document obtained from Edward Snowden, a former National Security Agency (NSA) employee who is now in political asylum in Russia. The report, entitled "Drone Threats," summarizes a number of U.S. intelligence assessments. According to Post reporters Craig Whitlock and Barton Gellman, who have read the report (and decided to keep it to themselves

some details of the specific vulnerabilities of drones), "guidance
"Al Qaeda has tasked teams of engineers to find ways to shoot down, jam or remotely hijack U.S. drones, hoping to exploit technological vulnerabilities in a weapons system that has inflicted huge losses on the terrorist network."

The US also has a flying wing combat aircraft of this type being developed for the Navy in the form of the Northrop Grumman X-47B. Another key trend for UAVs is that this aircraft is also being used to achieve a much higher level of autonomy than current generation aircraft, that is, the ability to respond to the environment without the intervention of human pilot, however remote. In July 2013, the X-47B demonstrated its ability to autonomously take off and land on the deck of an aircraft carrier, which will free U.S. drones from the need to be locally based. DOD's FY 2011-2036 Integrated Unmanned Systems Roadmap suggests that this shift to autonomous systems represents not only an evolution of the existing information technology-based RMA, but could possibly form the basis for the next RMA:

Significant advances in support technologies suggest that unprecedented levels of autonomy can be introduced into existing and future unmanned systems. This advance may portend dramatic changes in military capabilities and force composition comparable to the introduction of the
"network-centricity."

The roadmap reports that the U.S. Air Force sees this trend toward increased autonomy as "the single greatest theme" in its technological development.

The U.S. has competitors in this advanced area of UAV technology. The nEUROn program, led by Dassault, and BAE Systems' Taranis stealth UAV demonstrator program are designed to meet joint British-French demand for a combat-ready stealth UAV. Both Taranis and nEUROn are also aiming high levels of autonomy. BAE is similarly experimenting with autonomous systems in areas such as detection and avoidance, weather avoidance and emergency landing functions, building on its already flying (albeit stealthy) Mantis demonstrator. 48 The British-French agreement also covers a MALE-class aircraft called Telemos, which is likely to draw on the Mantis program.

Outside NATO, both China and Russia are also experimenting with stealth drones. In April 2013, China unveiled a stealth-configured UAV in the form of a tailless flying wing similar to the X- 47/Taranis/nEUROn aircraft. Commenting on the aircraft, named LiJian (Sharp Sword), Douglas Barry of the International Institute for Strategic Studies commented, "If any further evidence is needed of the strides China continues to make in aerospace defense, the taxiing test of what appeared to be a tailless "stealth" unmanned combat aerial vehicle (UCAV) created last month certainly provided it."

In May 2013, Russian company MiG signed a contract with the Russian government to develop a UAV based on a prototype of a low-observable flying wing
"Scat," according to RIA Novosti, which described the aircraft as capable of

to operate in "autonomous modes" and which is "designed to perform tasks to defeat stationary targets, especially air defense assets in high-threat areas, as well as mobile land and sea targets."

Clearly, U.S. technological leadership in this area will not last long. The war terrorism and the resulting large-scale conflicts in Afghanistan and Iraq, as well as Israel's ongoing conflicts both inside and outside its borders, have created an ideal environment for UAV operations in Israel and the U.S. (with its broader coalition of allied) forces) have completely dominated the air. The weakness of the Predator and its turboprop brethren, designed for prolonged effective barraging over a surveillance target, lies in their vulnerability to enemy air defense assets, whether ground-based missiles or combat aircraft. This threat does not arise in these highly asymmetric conflicts, whereas the needle-in-a-haystack scenario that counterterrorism operations entail requires good intelligence to succeed. With very limited sources of intelligence among these hostile and extremely "other" populations, aerial surveillance has become a vital resource for waging conflict by any means necessary. The security arena created by the War on Terrorism seemed to accompany developments. in technology from a command and control perspective in favor of the use of UAVs. The availability of UAVs, in turn, affected the way the war was fought, expanding the military user's reach in ambiguous airspace to pursue people almost without incident and in situations where manned aircraft or special operations forces would only be used exceptionally.

Chapter 14. UAVs and NATO military doctrine

Thus, as counterinsurgency weapons, hunter-killer drones appear to be failures. They create more fighters than they kill, and their escalating use repels or "loses the hearts and minds" of civilians in Afghanistan and Pakistan.

Jeffrey Sluka, political anthropologist.

One way to answer the fundamental question of what drones are doing - what changes they are bringing to the battlespace and to the actions of armed forces and governments; to the way we all potentially think about conflict, territory and related concepts - is to consider what users of this new equipment are saying about the issue. The fact that defense ministries around the world find it necessary to publish reports that examine and describe their use of drones is a testament to the novelty of this technology, to the fact that it matters in some sense, that it needs to be discussed. Part of this may be genuine exploration of the phenomenon by interested parties; part of it may be a more or less reluctant response to the broad public perception that drones are indeed a new and perhaps disturbing addition to the tools of war, a perception that needs to be managed. That change is coming is indicated by Colonel John D. Jogerst, who writes, "At some point we must reduce our reliance on mounted cavalry (A10/F35?) and utilize the mechanized mental capabilities of the UAS force."

In March 2011, the UK Ministry of Defense issued a report in the form of a Joint Doctrine Note (JDN) entitled "The UK's Approach to Unmanned Air Systems." An introductory statement on the context of such the report said the following:

Unmanned aerial vehicles are now playing a central role in modern warfare, and there is a real possibility that after many false starts and unfulfilled promises, a technological tipping point is approaching that could well lead to a real revolution in military affairs.

So the British armed forces, as one of the most experienced users of a range of unmanned systems, at least in the context of real-world combat, see the possibility of such systems becoming something a game changer at the military level.

This military experience has caused the UK some conceptual problems. Until the long-awaited Watchkeeper becomes operational in the future, the procurement of all current systems was in response to urgent operational needs arising from military requirements in the conflicts in Iraq and Afghanistan, rather than as a carefully argued doctrinal approach, a reaction to a new technology and its importance to UK capabilities. Nevertheless, the paper describes a widespread view in defense, academia, and industry that UAVs "will become more pervasive and eventually take over most or all of the tasks currently performed by manned systems."

The report acknowledges that there is a conceptual gap with drones, even in their current state, let alone what may emerge in the future, but cites the 2010 UK Strategic Defence and Security Review, which highlights that even in the face of reduced spending investment, unmanned systems will see increased spending.

The JDN raises a number of issues that indicate the views of the UK military establishment and their concerns about the changes brought about by this new technology. The authors highlight a number of emerging issues that they consider to be key:

As drones become more functional and automated, complex issues arise. What command and control systems will be required to authorize and control the release of weapons or, in peacetime, to ensure privacy? How will such systems integrate with manned air operations and civil air traffic structures? How will data generated by various sensors and analyzed by specialists in different locations around the world be combined into a final product. Is a common ground control station compatible with any national or allied unmanned aircraft possible?

While these issues are indeed important and usefully addressed by JDN, here we will focus on what she says drones do or can do - what they bring to the table in terms of new opportunities.

The reasons given for this wholehearted acceptance of UAVs show where the benefits lie, at least from the British perspective:

The primary motivation for the shift to unmanned systems is the desire to provide new or enhanced capabilities through the use of new technologies while reducing costs and threats to personnel." The clear hope is also that this shift provides an opportunity to "reduce the size of the force structure due to a lower acquisition-to-deployment ratio."

6 One factor is that training for this virtual flight could be entirely virtual, not requiring dedicated gliders for this purpose. But this comes with the caveat that the UK's experience as a new technology remains statistically limited, and it is difficult to draw reliable conclusions from what they recognize as limited data. So they believe that UAVs are cheap and protect their people, although in fact we know little about how cheap they are.

Another positive for the JDN is what the document calls "a reduced workforce in theater."

This gets to what may be the heart of the UAV advantage - and an obvious one at that. Fewer or no are required in the area involved. This makes it possible to operate where politics or security concerns would otherwise prevent it.

In terms of the planned role of UAVs, in contrast to these unintended side effects in behavior change, UAVs are particularly suited to tasks that JDN characterizes as "boring," "messy," "dangerous," and/or "deep."

"Boring" tasks include low-intensity and time-consuming activities such as constant surveillance. In exploring the differences that UAVs make, it is worth elaborating on this list of tasks - the full set of "boring" tasks in the report is as follows:

- Schematic of life observation tasks at fixed locations or in support of coastal maneuvering.

- Maintaining permanent anti-submarine or surface radar barrages, including anti-piracy tasks.
- Monitoring arrays of hydroacoustic buoys or other sensors.
- A set of electronic warfare tasks that serves as a communications repeater.
- Air refueling.

It should be noted that not all of these challenges are currently being met by drones - rather, the potential is there. The new phenomenon here is the "life-surveillance pattern". The relative low cost, at least for some types, and high survivability of UAVs allow for this type of activity. This is largely the result of a particular concern of the War on Terror, where cheap delivery of high-resolution products allows routine targeting of individuals, an activity that blurs the distinction between police/security and military roles.

"Dirty" missions are those that need to be performed in environments unfavorable to human health, including chemical, biological, radiological, and nuclear missions (or smoke-filled buildings at the other end of the spectrum). UAVs can be completely decontaminated or even abandoned if too dangerous. Thus, both size and disposability, which are themselves aspects of price, define the UAV's differentiators for a dirty mission.

The third category, "dangerous," describes one of the most obvious military advantages of UAVs: performing missions where the balance between importance and risk to personnel does not justify exposing human operators to the

Hazards. The document identifies two philosophies regarding the use of UAVs for hazardous missions: either they should be "cheap, simple, and disposable," or they will be "sophisticated and therefore likely to be expensive, but with high survivability." The latter implies stealth characteristics and some self-defense capability. Such aircraft are already flying: for example, the Lockheed Martin RQ-170 Sentinel and the European (Dassault-led) nEUROn demonstrator.

The UAV's often dangerous mission has been defined by the need to deal with a sophisticated surface-to-air air defense system. The JDN defines the tactics the UAV offers when suppressing such a system:

- Numerous cheap drones can be sacrificially used to jam the enemy's detection and command and control system or to force the enemy to expend large numbers of missiles.
- Infiltrate enemy missile kill zones to collect electronic guidance and fuse data, observe enemy firing tactics, and relay data back to intelligence collectors they are destroyed.

This utilization of the number of relatively cheap, simple, small UAVs in "swarms" is one of the innovative capabilities that UAVs promise. Quoting Stalin, the authors note that "quantity itself has a quality." Rather using complex, all-purpose large aircraft, which in most cases underutilize their capabilities in a particular mission, low-cost, focused, single-purpose UAVs can be an effective way to increase throughput in "new ways." They caution that such swarming capability is still being developed. However, as we have seen with Israeli tactics, UAVs have already been used to force defenders to open their defenses and even direct missiles at attacking drones.

Other possible future tasks noted for UAVs in high-risk environments include the following:

- Tactical resupply of troops in contact.
- Combat recovery of personnel or casualties.
- Accompanying tactical supplies.
- Search for improvised explosive devices (IEDs).

The U.S. Marine Corps is experimenting with an unmanned helicopter in this tactical supply mode in Afghanistan. The K-MAX is an unmanned version of the existing Kaman helicopter, adapted to fly according to a pre-programmed flight plan using GPS, requiring human intervention only for launch. The aircraft is used to deliver supplies to forward bases and had flown more than 1,000 sorties by May 2013. Lockheed vice president Dan Schultz told Reuters that the K-MAX "saves lives by reducing Marines' exposure to improvised explosive devices in cargo convoys." 11 Obviously, manned version could do almost the same thing, but would require paying a pilot to be safe, whose weight would reduce payload capacity somewhat, and which would apparently require an additional two hours of maintenance, per flight.

"Deep" missions are those performed far inside enemy territory. The JDN suggests that "when operating in uncontested airspace

deep target space can be ideal for surveillance or drone attack." The benefits are eliminating risk to crews and preventing them from being exploited if captured. He points out that UAVs simply leave debris, which can be denied. For some "static, well-studied" deep targets, existing technologies (e.g., cruise missiles) work perfectly well; and manned aircraft remain useful for more mobile, time-sensitive targets requiring a high degree of discretion, with stealth aircraft such as the F-
35. But anticipating higher levels of autonomy, JDN suggests that by 2030, "unmanned aircraft will eventually have the ability to autonomously detect and attack mobile targets with appropriate proportionality and discrimination." 12

Lower cost is one of the factors encouraging the British to move to UAVs, even though the force structure implications of UAV acquisition remain somewhat unclear. The data shows that developing and deploying UAVs is far more expensive than anyone expected. The report is clear that the cost advantages of modern unmanned systems can easily be eroded by platform-centric rather than capability-centric thinking, leading to the typical increase in defense acquisition costs, with some UAVs already competing on price with manned systems. The British document somewhat astutely points to the costs of the Global Hawk as an example of this - less than a year after the document was published, the U.S. Air Force canceled the Block 30 version of the aircraft, just months after it was first announced as operational. U.S. Air Force Chief of Staff General Norton Schwartz, speaking at a U.S. Department of Defense briefing on January 27, 2012, commented on the decision as follows:

The reality is that the Global Hawk system has proven to be just as expensive to operate as the U-2. And in many ways, the Global Hawk Block 30 system is not as sensor-efficient as the U-2.

Nevertheless, the perception remains that UAVs offer an opportunity to reduce costs overall; as noted in Research and Markets' fourth quarter 2011 report on U.S. defense and security, "the likely scenario as a result of years of cost reductions is a shift in procurement toward unmanned systems."

The authors of the UK JDN also note that along with platform price increases, there are other less obvious costs associated with UAVs. For example, no pilot does not necessarily mean fewer personnel, as they recognize the possibility that UAVs may end up requiring more personnel than manned systems, especially if the aircraft's ability to sustain long periods of airborne flight is fully utilized: a 24-hour flight cannot be accomplished by a single crew. Doubling the Reaper fleet to ten aircraft would require 40 crews. RAF operations at Creech Air are currently managed by a crew of 90.

A power base in Nevada. In addition there is a team in Afghanistan working physical aircraft. Nevertheless, the U.S. Department of Defense's basic view remains that UAVs can be a good value because, as this document states, "relatively cheap and simple unmanned aerial vehicles are already

are capable of providing situational awareness at a tactical level that simply cannot be provided by manned assets."

One technology trend that has implications for reducing costs is increased autonomy. In 2009, the U.S. Air Force released what it called a "flight plan" for its UAVs, and one of its main focuses is autonomy, which will lead to what the U.S. Air Force calls "multi-aircraft management." To support 50 combat air patrols with the MQ-9 Reaper currently requires 500 pilots plus 70 for transiting aircraft. This number will decrease in the near future as multi-aircraft control is reduced to 250 and halved to 125 in the future. With these systems, one pilot will be able to control multiple aircraft on their missions and they will not need pilots for transits.

Change in this technology is rapid and it is costly to manage. JDN points out that the Royal Air Force operated the Predator for only five years before switching to the MQ-9 Reaper, and that this change in procurement practices has a significant economic impact. Aircraft are being procured in much smaller numbers "blocks" than is typical for manned aircraft - in the case of the U.S. there are only enough to equip troops as needed for training and deployment. The next generation of aircraft will be ready for the next deployment, so the cost of obsolescence is controlled and new technologies are brought to the forefront quickly.

An interesting aspect of JDN's analysis that is particularly relevant to this discussion is its approach to the size of the UAV and its relationship to the changes the device brings. There is a tendency to focus on innovation in terms of the capabilities and policies brought by the largest and most sophisticated aircraft, especially the Predator/Reaper, especially in relation to US operations in countries with which it is not at war, such as Pakistan, or Yemen. However, JDN suggests that this may be the least interesting part of the UAV spectrum. It points out that Class II and III drones, such as the Watchkeeper/Predator, "share the characteristics and capabilities of manned aircraft." These are usually so obviously similar to manned aircraft that it is obvious how they will be used and for what missions."

The choice of whether to use a UAV or a manned system will largely depend on cost/policy. This perhaps explains the Global Hawk phenomenon. After all, it was no different than the U-2, and was actually more expensive than the U-2, so the U-2 becomes the obvious choice - apparently despite Gary Powers' question. Its technological identity is ultimately limited.

The potential for change, coupled with the underdevelopment of current doctrine, is seen in the explanation of the other two groups, mini and micro. With regard to mini-UAVs (weighing 2-20 kg), it is believed that while they may have some of the same capabilities as manned aircraft, they "may also provide completely different capabilities or have the ability to operate in a completely different way", while the most radical capabilities are seen in the smallest micro-UAVs weighing less than 2 kg, where "comparisons with manned aircraft are untenable". Another attractive aspect of these small devices is the ease of entry into this market - they are relatively cheap to develop and produce, which means attitudes are changing as the

costs are approaching the "use and discard" level. In , even though the JDN does not do this, there are problems with the distribution of these small tools.

Testimony by Sharon Pickup and Michael Sullivan of the U.S. Government Accountability Office (GAO) to a House subcommittee in 2006 provides some insight into the utility of smaller types:

Small UAVs such as Pointer and Raven have been instrumental in enabling troops to find, locate, and destroy multiple targets.

Moreover, the use of small UAVs has allowed ground forces to perform their missions at greater distances from enemy positions, effectively increasing the standoff distance and thereby reducing the risk to U.S. military personnel on the ground.

This type of small UAV appears to expand the situational awareness of soldiers without having to expose themselves danger to develop that awareness. Information from UAVs about enemy locations allows for more effective targeting and protects a unit with UAV support from the risk of becoming a target. In this sense, UAVs provide an increase in effectiveness, thereby working as a force multiplier.

Raven and mini-UAVs like the Desert Hawk can be carried in a backpack - they are about the size of a model airplane, with a wingspan of 55 inches and weigh about 4 pounds. They are very widely used, in service with several thousand with U.S. troops. these vehicles get smaller, they potentially become even more interesting. At the next level of miniaturization, the JDN authors believe that biological mimicry will be key to the development of nano aerial vehicles (NAVs). These , which can weigh less than 25 g, will be highly specialized and in addition to miniaturized sensors for intelligence and reconnaissance tasks, could be equipped with weapons to act as anti-personnel devices. low cost of such devices will be critical as they are effectively disposable.
Detecting and countering such systems will be difficult, especially if the they're deployed in large numbers.

The British military is already in the nano-UAV game. A November 2011 call for research proposals from the Ministry of Defense stated the following: "The UK Armed Forces need the capability to perform intelligence, surveillance and reconnaissance (ISR) missions in very challenging environments such as inside buildings and deep within urban canyons."

According to the manufacturer, the Black Hornet pocket-sized nanocopter weighs 15 grams, including the camera. Together with the base station, the entire book-sized system weighs less than a kilogram and was put into service fairly quickly. According to a U.S. Department of Defense article in February 2013, Sgt. Christopher Peterbridge of the British Intelligence Brigade in Afghanistan said:

The Black Hornet definitely adds value, especially considering its light weight. We've used it to find insurgent firing points and check open ground before crossing over, which is a real advantage. It's very easy to operate and offers amazing capabilities for guys on the ground.

There are 324 Black Hornets in service with the British Army. Perhaps there is an inverse proportion between the size of the UAV and the novelty of the capabilities it offers. Our eyes are drawn to the familiar outline, scale and action of Predator-type aircraft, but the real action may take place beyond the radar, literally and figuratively. It should be noted, however, that JDN elsewhere discusses the particular impact of the much larger Predator on military action (although it should be noted that Predator attacks in Pakistan are being carried out by the CIA, not the military), noting that the recent widespread use of drones over Pakistan and Yemen may already be heralding a new era. The fact that these actions are being carried out exclusively with drones, even very capable manned aircraft are available, and that the use of ground troops to their detriment has been avoided, suggests that the use of force is entirely a function of the existence of drones, capabilities - it is unlikely that such a scale of force would be used if these capabilities were not available.

Thus, even large UAVs do much more than just mimic manned aircraft - they enable different behaviors, reducing the risk to your personnel, making war less horrible, and thus risk making war "more likely," as the JDN authors put it. This is a key observation. Military thinkers themselves believe that UAVs cause a McLuhanian change in human behavior, and that this change lowers the threshold for the use of military-type violence.

Also of note is the special operational characteristics of UAVs and the associated endurance capability. Removing the pilot from the aircraft frees designers in many ways: the weight of the pilot/crew and the physical space they require is removed, allowing more room for other uses such as fuel, equipment, etc., although as JDN points out, at the top end of the UAV classification this may be a modest proportional gain as other elements (engine fuel, sensors, etc.) may dominate the payload. But removing the pilot from the cockpit has design advantages for innovative or more aerodynamic shapes. Ultimately, the overload limitations imposed by the person on board can provide increased maneuverability. Pilot fatigue is also better controlled, allowing the aircraft to operate at peak efficiency throughout the mission.

The key factor here, however, is that all of this allows the UAV to remain stable for much longer - what JDN calls the drone's unique advantage. The Royal Air Force's Reapers have already been in the air for more than 18 hours, while British company QinetiQ's Zephyr demonstrator can stay in the air for weeks. Supporting this kind of capacity, of course, increases labor costs per aircraft, as mentioned earlier. But, as JDN writes, "it is this ability of drones to persist above the battlefield that has proven so effective in Iraq and Afghanistan."

In time, they believe this will change the delivery of air effects, and commanders will be able to select services (strike, surveillance, etc.) from an air "cloud" on the ground, which is the physical analogy to the current remote location, somewhere-there-but-always-available, computer cloud. This very idea seems to break down some of the binary schemes of warfare. Potentially the air force would in some sense always be up and running, always available

for planners and decision makers. Permanence becomes permanence. The date for this to happen? Sometime after 2030.

Even now, the degree of surveillance coverage in time and space that UAVs provide has an important impact, producing what a Defense Department source in 2012 called improved "past event analysis" that allows, for example, analysts to view the site of an IED, an explosion before it happened, and, if they are lucky, capture the bombers planting their device. There is a price to pay for this massive data stream, and it lies in analyzing these terabytes of images. But automation of the process is growing: a source in the Defense Department said that software specializing in "change detection" is evolving "like yeast."

Clearly, this concept of persistence is central to the UAV concept and is widely used in military analysis of UAV operations in the United States. The term is related to the UAV phenomenon in more than one way. In 2010, the U.S. Army released a substantive document they called the Roadmap on "how the U.S. Army will develop, organize, and employ ALS from 2010 to 2035 in full-spectrum operations." With the subtitle "Eyes of the Army," it opens with a quote from Maj. Gen. James O. Barclay III, commander of the U.S. Army Aviation Center of Excellence (USAACE) and Fort Rucker, Ala:

We can send UAVs to look around alleys, around buildings, in backyards or on rooftops to see what's up there, greatly enhancing the Soldier's defense and preserving strength - a life force multiplier in this era of incessant conflict.

A useful characteristic of the UAV is its persistence as a surveillance tool, but this persistence is oddly useful because of the relentless nature of today's conflicts: in times of endless conflict, the UAV's patience makes it particularly valuable. However, the data generated by unmanned aerial systems also drives the need for "unmanned" analysis. It seems that one level of automation entails another.

In addition to its sustainability over time, the aircraft's longer range, reduced costs (ideally), and relative political insensitivity, its availability in geographic space is a key value. But smaller aircraft deployed at the platoon level and below offer something new to soldiers in the field - the ability to use the "literally a pair of flying binoculars." JDN says, "The advantage to the platoon leader of being able to create images from behind a wall or right around a corner, on demand, should not be underestimated." It is also noted that there is a price to pay for this advantage - the added burden of carrying and operating the system. However, it is clear that the smaller and more complex they become, the less onerous this burden is.

These smaller aircraft also have an advantage in accessing certain types of spaces. JDN points out that this is particularly important in urban canyons, the dangerously confined spaces of urban environments, where such devices can unobtrusively "sit down and watch," eventually, perhaps for extended periods of time, recharging from the sun. They could also access buildings and possibly deploy precision weapons in the future. Very small "nano" devices possess a new set of poorly understood

capabilities due to their small size - not least the great difficulty in detecting them, exacerbated by the current shift to biological mimicry.

The inherent ability of access and persistence that drones offer is enhanced, at least for the U.S., by the expansion of drone bases overseas. The relatively low infrastructure requirements for drone operations have led to the widespread adoption of such bases. Reporter Nick Turse claims that there are now 60 CIA military and drone bases around the world, many of which are in places where the U.S. military has not previously had bases, such as the , although there has been no official confirmation of this confidential information. Turse suggests that this "tells us a lot about America's military future." From command and control and piloting to maintenance and weapons, these facilities perform key functions that allow drone campaigns to continue to expand, as they have for more than a decade."

Thus, drones, due to some inherent characteristics terms of size, lack of risk to pilots, and the way they are perceived, allow access to spaces inaccessible to manned aircraft. Thus, the extension of the drone's view over time allowed by their persistence is complemented by this extension of access in terms of space.

One of the problems in discussing UAVs and the difference they make is separating the qualities that are in their
"unmanned," from qualities inherent in the technology they deploy that can be deployed with a manned device: the U-2 vs. the Global Hawk Problem. Each can carry the same sensors and generate the same information product that is processed by the same system. The changes in those sensors and that processing system may be where the difference lies as much as the "U" "AV" - it just so happens that UAVs are now usually the most efficient way to deliver the capability that would have been delivered, even in the absence of a drone.

However, in that word "effectiveness" lies the real difference. The availability of drones at every level of combat reflects an innovation: platoons, companies, battalions, brigades and even divisions have not had their own dedicated aerial reconnaissance assets. They are beginning to acquire this capability as a matter of course. This capability would not have been delivered or delivered without UAVs because scale and cost mean that this capability would have remained on a high organizational tree and remained limited in number.
Thus, the number is another change that the UAV makes.

Coupled with digital information technologies that allow such machines to collect a wide range of data, there is a need to do something with all this information so that it does not go to waste. What this amount of information, combined with the need and growing ability to integrate it, does to the military's perception of its area of operations may ultimately lead some leap forward in what the military does and how it does it.

British efforts in this regard include the DataMan system deployed in Afghanistan, which integrates information from a wide range of sources (UAVs, manned surveillance assets such as Sentinel, agent-based

exploration) in up to 350 "layers" from which the user can select the types of information of interest to them in the form of a digital map interface called Geo Viewer.

Such efforts help users access useful data, but the information is inevitably lost in volume. Sifting through such large volumes of data with human analysts would be prohibitively expensive, so the solution is to process this data automatically: automation or
"unmannedness" needs to extend from collection to analysis, and this is where efforts are now being made. . most advanced example of this approach lies in systems such as Gorgon Stare and BAE Systems' more advanced visualization system Argus (real-time autonomous ground surveillance), which combines input data from a large number of sensors to track multiple individual targets citywide. According to a BAE press release, "the on-board data processing system can simultaneously and continuously detect and track the presence and movement of thousands of small or large targets over an area of tens of square miles."

The system is housed in a 15-foot capsule that can be carried by an unmanned A160 Hummingbird helicopter, which can fly at 20,000-30,000 feet and stay in the air for up to 20 hours. The system's 368 five-megapixel video chips provide both wide coverage and high resolution, meaning multiple people in a city can be tracked. To reduce bandwidth consumption, the system only transmits data on locations and objects of interest. This system allows users to select areas and times of interest from the system's simultaneous wide coverage.

The emphasis on the ability to focus on people may be characteristic of drone time, but this capability is not unique to UAVs - a capsule can fly on a manned aircraft. Nevertheless, the persistence and relative cheapness of providing this capability with UAVs makes it much more accessible, and it is this accessibility, manifested in a variety of ways, that forms the distinction of UAVs.

The fact that UAVs are (in many cases) relatively inexpensive military air assets available in rapidly growing numbers raises or replicates an old air warfare problem: who controls the aircraft? Soldiers on the ground understandably want their own dedicated air support, whether for reconnaissance or combat purposes. However, military experience since World War II has shown that this is an inefficient way to mobilize such resources and that centralized air command allows for the most effective support. Nevertheless, the U.S. Army, faced with the kind of scenarios that combat units hate - when, for example, air support that was promised for a long-planned operation is suddenly reassigned by that central authority to address an emergency elsewhere - has begun acquiring its own sophisticated UAVs that it uses "organically," which raises airspace coordination issues, among other things. U.S. Air Force officer Maj. Travis Burdine writes:

The Army's solution to this airspace coordination problem requires the establishment of a restricted operational zone [ROZ] around the ABC The downside of this model is that it uses airspace inefficiently, which

does not allow airspace controllers to maintain situational awareness within the ROZ and which makes it difficult for other aircraft to navigate through the shared airspace. According to joint doctrine,
"efforts should be made to integrate UAVs with manned flights to provide a more flexible and adaptable airspace structure."

This, according to Burdine, "represents a step backward toward independent and non-conflict operations that lack the synergy that properly integrated aviation should bring to the joint fight." Part of his solution is emphasize that "we must treat the Armys theater-capable UAS the same other manned aircraft with similar capabilities." Thus, it seems that part of the content of UAVs is a regression to a less centralized air power environment as a result of the proliferation of these systems within and among the U.S. military. Burdine sees the solution in eliminating the distinction between UAVs and manned aviation - they should be treated equally. InterestinglyBurdine explains his concern as follows: "The day that the enemy starts flying remote-controlled improvised explosive devices, for the first time in more than 50 years, the Army will have to worry about enemy threats from the air."

In other words, the internal proliferation that creates this more confusing air environment is a problem because of the inevitable external proliferation, for the same reasons of cheapness and efficiency for which they are expanding so rapidly in the U.S. inventory that is going to put UAVs the hands of U.S. enemies.

David Kilcullen defines an insurgency as "a struggle for control of a contested political space between a state (or group of states or occupying powers) and one or more non-state claimants based on the people". Clearly, the wars in Afghanistan and Iraq, which began as interstate conflicts, developed into insurgencies as numerous more or less popular groups rebelled against the new occupying power.

The use of drones in both of these small American-led wars comes at the intersection of two doctrines regarding these conflicts, or the two regimes in which they are fought: counterterrorism (CT) and counterinsurgency (COIN). CT is focused on the Western countries fighting the war, in that its goal is to target the perpetrators and supporters of terrorist acts in and against the West; COIN is more focused on the nation and population from which these "terrorists" arise, with the intention of building a strong Western-friendly state in which insurgents will not be welcome and therefore cannot function there.

The problem with these two modus operandi is that they are opposites to some extent. CT emphasizes going after individual insurgents, and in places like Iraq and Afghanistan, that usually means using military force to kill them rather than capture them, given the difficulty of policing operations in those environments (especially given the problems the U.S. has had dealing with captives of those conflicts). Such operations, conducted far from any notional battlefield, outside of a notionally declared war, often in the middle of residential neighborhoods, look like killing. Such actions, however effective they may be compared to past low-tech military actions, still involve

with the risk of targeting errors or the deaths of bystanders and targets, compounding the grievances that insurgency and the accompanying terrorist feed on. Consequently, COIN looks at the bigger picture, viewing insurgency as fundamentally social and political, and seeks to address these sociopolitical issues by utilizing military tools to the minimum extent necessary. The U.S. Army and Marine Corps Counterinsurgency Field Manual notes that "sometimes the more force used, the less effective it is."

UAVs enter this picture in both modes in which they operate, ISR and strike, and potentially as a tool for both doctrinal approaches. David Kilcullen described a new model of Iraq-style insurgency that differs in many respects from the classic Malayan state of emergency model (which the British used against communist guerrillas in 1950s) and therefore requires an adjusted approach to UAV operations. One of these differences is the transnational nature of insurgency today, Kilcullen points out that "border security, remittances, ungoverned territories, ethnic minorities, refugees, and media in neighboring states can play a key operational role for insurgents - hence the counterattack." - The insurgent must be able to influence them." 36 Kilcullen also suggests that "legal and political considerations are likely to prevent military activities outside the "zone of operations" of a single country," those areas of operations in a single country, such as the greater border from Afghanistan to Pakistan. One of the main reasons for this erroneous prediction is the existence of UAVs. For the U.S., especially under the Obama administration, UAVs have become a favored (though not exclusive) tool for targeting individual warfighters, whether at the center of a conflict or in a constellation of other countries where task forces are operating. Thus, narrowly interpreted, it is a very useful CT tool to gain access to wherever US enemies can be found, wherever they be.

But it may be that this is very counterproductive from a COIN perspective, as this low-risk (to the user) use of military scale force actually generates widespread public anger toward the U.S., undermining other efforts to engage with same population. align them with U.S. interests rather than (say) those of the Taliban or al Qaeda. Jeffrey Sluka notes that civilian casualties from UAVs (700 in 2009 alone) alienate the Afghan population and serve as a recruiting tool for militants.

Sluka also argues that the existence of the drone itself creates this approach: it is a "technology" replacing strategy, as he puts it. Because drones can be used to target people in ambiguous territory with ambiguous legal justification, they are used in this way.

It should be noted, however, that the vast majority of UAVs not combat aircraft - rather, they operate solely as reconnaissance assets. Effective ISR is a prerequisite for accurate targeting for air forces, including . No matter how accurate a weapon is, it is still necessary to know what to aim it at. Thus, a constant and extensive UAV presence is useful in identifying targets for precision weapons. In the absence of reliable intelligence sources, drones may be the most important tool available to military or intelligence services to gather information from physically and culturally inaccessible populations in areas such as tribal areas.

Pakistan's lands along the North-West Frontier Province. The United States has used this type of information to create targets in two ways, both of which clearly affect the ability of UAVs to deliver a plethora of relatively inexpensive imagery in legally ambiguous situations. First, these are "personal strikes"; that is, targeted assassinations of named individuals: essentially, the killing of specific people for certain actions that intelligence agencies attribute to them. Second, and perhaps more interesting and even more controversial, are "character strikes": people are targeted not because of any specific information about them as individuals, but rather because the "lifestyle" they exhibit makes them look like members of a notional society, a class called "terrorists." That lifestyle would not be available without the constant and relatively inexpensive presence of UAVs.

Micah Zenko of the Council on Foreign Relations describes this activity outside the main U.S. area of operations in terms of counterinsurgency. He told the New York Times, "We're not saying we're the counterinsurgency air force of Pakistan, Yemen and Somalia, but we are."

He points out that U.S. policy may be driven by the demands of insecure foreign governments rather than its own interests, but the fact is that these kinds of assassinations, with their understandable tendency to antagonize their subordinate populations, work against the goal of COIN operations, which fundamentally seek to separate the insurgents from the general population or perhaps reduce insurgent tendencies in that population by appealing to what Anderson calls the pre-insurgency. The presence of an ISR UAV, however, would also be useful for this COIN mission, as knowing the territory in which the counterinsurgents are located and the insurgents they are fighting against is fundamental to the success of the operation. Mission MONET. But that doesn't seem to be what's happening. The Department of Defense report on this problem states:

In fact, intelligence and reconnaissance support to APD is not as much of a priority for combatant commands, military departments, and defense agencies as counter and force protectionnegatively impacting the effectiveness of APD operations.

UAV and other reconnaissance operations are driven by the CT mission, spot kills and the like, as well as another key attribute of UAVs: protecting U.S. soldiers. The eye in the sky above the patrol is not for counterinsurgency management, but for U.S. or International Security Assistance Force (ISAF) casualty management.

The special characteristics of UAVs as a military tool their ability to cope with monotony, their relative disposability that allows them to operate in dangerous environments, and their relative unconcealability/reduced political value in the case of illicit operations. There are also a number of performance factors, such as the potential for high-overload maneuvers and greater endurance.

The use of smaller and cheaper UAVs in far greater numbers than manned aircraft seems to offer the best opportunity for innovative tactics and capabilities such as those that arise from "swarming" behavior. And this is where the biggest change in human capabilities occurs as a

The result of this new "extension to humans" may arise as such devices appear on the scene with very limited understanding of the implications or consequences of this innovation.

The current ultimate difference the UAV provides is its persistence capability. The JDN authors write that "the most obvious contribution of UAVs has been to revolutionize the Air Force's primary role of reconnaissance and situational awareness." This has largely been accomplished through the ability of large numbers of to remain in the battlespace for extended periods of time, creating transformative details in the military's understanding of their area of operations. In an ongoing war that stretches across time and space, the continued presence of UAVs, the ubiquity afforded by their endurance at one end of the spectrum, and which offer new levels of access and cheapness at the other end, means that military air presence can become available both everywhere and 'always'. This ubiquity has implications in terms of data volume, leading further automation of analysis.

The use of this technology as a weapon adds what may currently be militarily marginal but socially and politically significant, an additional capability to engage in behavior that previously required higher stakes, lowering the threshold for military action. The fact that on January 24, 2013, Ben Emmerson, the special rapporteur, announced a UN investigation into the effects of drone strikes on civilians from Pakistan to Yemen is an important indicator that this change has been noticed. According to the BBC, Emmerson told reporters that "the increasing use of drones
"represents a real challenge to the system of international law," the confusion in the the very doctrine by which the war on terrorism is waged in its various forms and locations.

Chapter 15. The indirect warfare of combat drones

Holly Martins: Do you ever see your victims? Harry Lime: The victims? Don't be melodramatic. Look down at the bottom. Say this. Would you really regret it if one of these dots stopped moving forever?

We explore whether UAVs bring large-scale changes to human interaction. The purpose of this chapter is to begin to uncover the nature of the relationships between humans - operators and targets - that come together in the "death embrace" (Gregory's expression) of UAV technology during surveillance and combat.

Here we focus on operators' experiences, examining how they fit into existing conceptions of soldiers, warriors, and fighters, and where their experiences deviate from prevailing cultural expectations. The operational variables are space (i.e., distances between fighters) and time (i.e., shift patterns for drone operators, who are replaced their mediated battlefields according to discipline of the clock and return to a recognizable normal state), lives at the end of the shift).

In McLuhan's media parlance, drones extend soldiers' senses - and lethality - through space. The most commonly cited distance between combatants is about 7,000 to 7,500 miles, the distance between Task Force 732d, where U.S. Air Force Predator operators are based at Creech Air Force Base in Nevada, and the decidedly target-rich environment along the

the Pakistan-Afghanistan border. Drones also increase a soldier's reach over time: the MQ-1 Predator 732d is a quiet and responsive combat platform that can loiter over an area for up to 24 hours, sending intelligence back to its crew, who can react what they see on their screen. video monitors by firing two laser-guided Hellfire missiles if required. The time lapse between the decision to fire and the missile reaching the target is about 30 seconds.

Whether the person pulling the trigger is thousands of miles away or in an airplane directly overhead is widely debated: is killing people with drones easier or harder, more intimate or more abstract, less or more ethical? These are tough questions. After centuries of technological innovation, the military has finally deployed weapons that typically completely eliminate human risk on one side of the equation and exponentially expand it on the other. At the same time, the relationships that have bound combatants throughout history are changing. Anyone who comes under the Predator's gaze is a potential target or victim who cannot respond to that violence with a similar response. Furthermore, the combatants we once thought of as pilots and flight crews moving through space are now grounded, separated from their gliders as well as their targets, and bodily detached from these extensions of their senses. At this point, our evidence must be based on what little we know about how the military culture of the US and, a lesser extent, the UK has struggled to negotiate the consequences of removing individual soldiers from their airplanes and hence the dangers of the traditional battlefield. .

The technological horizon sees the massive replacement of traditional military equipment with increasingly autonomous weapon systems. This move on the one hand adds value to a soldier's life by moving him to safety, but it also undermines his value and identity as a soldier by making him interchangeable and replaceable by other soldiers or even civilian contractors and ultimately more vehicles. Williams gave the example of having to change crews multiple times in time for a single UAV mission. The overall function of the system (crew and vehicle combat assembly) requires only certain human abilities - seeing, monitoring, deciding and, only occasionally, flying. She suggests that this "introduces the idea that crewmembers' bodies become less important. Instead, they work more like machine components" and so "the human elements of UAV assembly are thus considered commonplacefurther reducing their importance in the assembly compared to its machine elements."

As Moltz puts it, "communication technology spans distances in ways that bodies don't need to," and many human interactions are becoming more and more accessible dependent on their use.

The militaries that use drones for combat rely on technology to do their bidding. Kills are made on computer screens: the only hint of the 7,000 miles separating soldier and target is the 1.7-second delay between the operator's command and the aircraft's response. There is no conceivable threat to the operator's personal safety as events are transmitted, monitored, recorded, and stored. On the other hand, destruction (at least in the initial phase when drones were not) occurs literally on flat ground, as in this description of USAF Predator pilot Matt Martin on a combat mission somewhere over Afghanistan:

The two [Terrorist] leaders stopped, plopped down on the ground and leaned back on their backpacks. It was break time. The other two caught up with them and formed a small circle, completely that doom had already been released and was screaming at them from the sky ... When the smoke and fire cleared, I saw four mangled and burned bodies thrown back to the ground, the contents of their backpacks scattered across the landscape.

Geographer Derek Gregory notes that drones are the latest step in a long history of technological innovation that has brought us to our current state of globalization. He combines "death at a distance" - the way technology compresses time and space - with a more literal "death at a distance," where the old image of the soldier firing and the enemy falling remains true, but the experience is now divorced from the reality, the danger and discomfort of real combat.

In the case of drones, there is an absolute geographic distance, a measurable space that remains a significant, perhaps insurmountable, obstacle between opposing forces. This geographic distance necessarily affects political and military decision-making.

Western culture is increasingly familiar with what indirect war looks like to the American soldier (and, thanks to the abundance of widely available videos of jihadists, how it is represented by the opposing side). Less obvious are the cultural practices that inform and shape this new relationship with conflict. Observing smart bombs during the first Gulf War, Judith Butler noted that "the aerial view will never come close to seeing the consequences of its destruction" because the smart bomb screen "conveniently destroys itself."

Now several cameras continuously record the moment of destruction, as well as the halo of preceding and following actions. Smoke and debris, poor picture resolution, as well as short-term blurring of the picture caused by the thrust of the fired missile, briefly disrupt the view, but these are problems that the technology can already largely solve.

What warfare in the mediated operational environment looks like and what its consequences are is much debated. Like "real" war, different people experience virtual warfare differently. Some, like CIA drone advocate Hank Crumpton, view the carnage to find ways to make killing more efficient. About the CIA's first experiments in
to drone warfare in Afghanistan, Crumpton writes that in analyzing the aftermath of Hellfire missile attacks, "we realized that some of them had survived the hit. We could see them injured and stumbling around. That was unacceptable. We needed more fragmentation at the point of impact." Within two weeks, the modifications increased both fragmentation radius and "kill zone" radius by 25 percent: "We analyzed several strikes ... No one got away."

But for others, the experience of remote-control warfare is intense and sometimes disturbing - there has been evidence of stress and possibly post-traumatic stress disorder (PTSD) among U.S. Air Force operators, as well as suggestions that the "intimacy" of spending hours and days observing targets and learning the consequences takes a psychological toll.
Traditional pilots complete their assignments and return to base, while the drone operators, despite the vast distance separating them from the actual battle, seeing it up close and personal on their video feeds. "No squad," the commander said shouting for his Predator crews:

Those who use this system are very involved in combat on a personal level. You hear an AK-47 shot, a loud voice on the radio calling for help. You look 18 inches away from him, trying to do everything in your power to that person out of trouble.

Although UAVs provide physical distance between operator and target, their cameras and sensors simultaneously bring the operator - and even prolonged proximity - closer to the target. By giving operators a closer view of the consequences of their actions than is available to crews on traditional platforms, Williams found that drone crews actually become "unrealistically close to the detonation of the weapon they were firing."

Gregory quotes Mary Favre, who noted that in mediated situations.
"violence at a distance becomes at once strange and familiar, intimate and distant, real and yet not quite here."

This is not peculiar to drones, but is true for the increasingly global and nuanced understanding of other people's experiences, driven by the steady improvement of communications and media technologies. Our concern comes from a deeper realm than the semantics of whether a drone pilot is different from a bomber pilot. We are penetrating the history/mythology of who soldiers are and what they do. So we will begin by exploring how drones affect the location of the soldier both in the battlespace and in our cultural representations of combat.

Alison Williams suggests that observing the lived experiences of operators can help us better understand how the aggregate of humans and UAVs exert geopolitical control over space. How missions are accomplished, by whom, and how, varies from country to country and service to service and is constantly changing, but in general we can make some observations about the experiences of Predator pilots simply because that is where most research and testing is focused. In the U.S. Air Force, the crew of a typical Predator includes a pilot and one or two sensor operators. Because missions last an average of 18 hours and qualified crews are scarce, shifts are long and crew changes occur in the middle of a mission.
The Predator ground control station is located inside a trailer that can be loaded onto a C-130 Hercules for transportation. The cabin, which resembles an airplane cockpit, consists mostly of seats surrounded by screens and control panels. One large screen displays what the Predator sees live. The resolution is sharp, but not that sharp - the general outlines are clear enough to distinguish gender, but the facial features are somewhat unclear.
Additional screens display system information (altitude, fuel level, temperature) and layer upon layer of collected intelligence and data from multiple sources, including maps, locations of other sites in the area, and images and chats.

The controls were not designed with convenience, ergonomics or intuitiveness in mind, and some commands are difficult to execute, requiring dozens of keystrokes. Depending on the system, there may be rudder pedals, joysticks, and computer keyboards. The trigger is colloquially referred to as the "brine." Operators sit in comfortable Naugahyde 'La-Z- Boy' type chairs, a detail that is relevant because fellow soldiers are dismissive of the so-called 'Chair Force', viewing war as an experience that requires soldiers to be real. Danger.

The ability to operate a drone depends in part on the experience of the operator. Airplane pilots are familiar with the controls of some systems, but are used to relying

on the

sensory cues - side wind, turbulence - associated with sitting in an airplane. The drone has no physical connection to the vehicle - instead, it has significant time lag, spring-loaded controls and a narrow field of view on the screen that is often compared to looking through a soda straw. During his first attempt to land the Predator, traditional airplane pilot Matt Martin got up from his chair to look over the nose of his plane to get a better view of the runway, forgetting that the only view he was really seeing was on the screen in front of him. And in a program designed to train retired pilots to fly UAVs, a 65-year-old man reportedly broke his hip by falling to the floor of his trailer as he tried to "eject" from his rapidly falling
"Predator."

A study of whether Predator operators need to be proficient pilots at all points in different directions is likely because some systems are more similar to traditional airplanes than others. 14 Missy Cummings, an MIT expert on human interaction with unmanned vehicles, found that pilots sometimes have problems with negative transfer of training and are more likely to crash than people without training.

The unexpected solution of hiring gamers on the one hand and making flying drones more like games on the other is problematic. Inevitably, the media as well as the operators themselves draw parallels between drone combat and games, but the similarities are superficial and it doesn't make sense to have an easily understood analogy to hand. US Air Force pilot Matt Martin compared his first Predator combat sortie to the "computer game Civilization "16, trying to convey the "surrealism" of his experience, while in a rather different cultural context, following the November 2012 Gaza skirmish, the Israeli military made much of its "star" missile interceptor, a 22-year-old who attributed his mastery of the Iron Dome anti-missile system to hours playing World Of Warcraft.

In the latter case, Israel clearly needed to mobilize mass support for military action in the face of Hizbullah threat, and promoting the player-warrior model serves a useful purpose. On the other hand, the U.S. manages public anxiety about its "drone wars" by demonstrating the seriousness with which it carries out its missions-the presence of pilots and officers rather than players confirms this message.

The question of who should fly the drones goes far beyond the technical skills needed for the job. Public Relations (PR) Optics reported on the decision to use pilots to fly Predator, and this is not a new story. The candidates originally proposed for U.S. space missions were far from the "right stuff," but chimpanzees and circus performers - the decision to use pilots was allegedly instigated by President Dwight Eisenhower for PR reasons. The moon mission required no real piloting skills, nor trained pilots to fly the drones. The alternative - using teenage zombies to destroy American enemies - is more economical but currently unacceptable from a PR standpoint, and research into fully autonomous killer robots has already generated considerable backlash. The question whether the "death at a distance" facilitated by UAVs will be accompanied by more fundamental cultural and/or moral changes in the concepts of soldiering. While some

mocked by the Chairman's Force, the soldiers working under its watchful eye and kinetic potential find the Predator's presence reassuring.

While gamers may be more familiar with the mediated environment of combat, they are not accustomed to the tedium of flying long missions where nothing happens. Boredom is a serious occupational hazard that not only affects the health and well-being of drone crews and makes and retention difficult, but even more threateningly increases the risk of error and thus the risk of civilian casualties.

The primary mission of drones, referred to as "remotely piloted vehicles" (RPVs) by the U.S. Air Force, is to perform "boring, dirty, and dangerous" missions with minimal risk: target or identify "normal" activity in an area so that unusual activity can be detected."

There are many reports of the stultifying boredom of doing long ISR missions, and even the action on the ground doesn't always make for an exciting spectacle. Martin described a boring two weeks of watching from above as Marines completed the sweep of El Fallujah, "going from house to house, digging out errant enemy militia. Sure, it's agonizing enough for those on the ground, but from the air it's a real yawner. Some days it was all I could do to stay awake for my shift in the chair." 19

Boredom and burnout are attributed to poor human-machine interfaces and overworked crews. Armed drones were launched into the theater of war in Afghanistan and Iraq their controls could be optimized for efficiency and comfort. Trained operators were scarce, so there were huge demands on competent operators like Martin.

Shifts were typically 12 hours long, 50-60 hours per week, with 30-day shifts. High levels of visual and auditory alertness were required. A 2006 study found that UAV crews experienced chronic fatigue, with nearly 40% reporting a medium to high likelihood of falling asleep at the controls of their aircraft. 20

More personnel, better ergonomics and interfaces, etc. may alleviate some of these problems, but indirect combat has other consequences, the effects of which we are far from understanding. After long hours spent in the mediated intimacy watching warfare, the transition from shift change to daily life among civilians has been hypothesized to contribute to operator stress, but has yet to be proven. In manned aircraft, crews operate in an environment that is still recognizably culturally militant. The pilot returns to a paramilitary base, which may also be threatened (and will necessarily be protected from threat), where he may encounter similar crews who have experienced similar dangers, or even learn that others have died. It's hard to quantify whether this makes combat more real, but people who have flown combat missions and flown drones recognize that combat from an aircraft feels . Cummings, a former U.S. Navy F/A-18 Hornet pilot, told Salon magazine:

When I was a pilot and you were coming back from a mission, you'd go back to the aircraft carrier to be with people who were doing the same thing were doing. You were all in it together. On your own it's harder to keep that in perspective ... We don't know,

whether PTSD is more common among drone pilots than airplane pilots. It's just different.

Drone operators returning home and to their families are not allowed to talk about their "day at the office." Martin described how his wife noticed that he "didn't laugh as much anymore." He can't explain, and so she can't understand the extent of his psychological involvement in the wars in Iraq and Afghanistan, which he is fighting, from his trailer in Las Vegas: "At end of the day, we 't shot at, wounded or killed. Even if we were shot down, we weren't really shot down." 22 Other operators tell similar stories, but again it is not at all clear whether this is simply a case of learning how to adapt to the new and specific demands of remote warfare, or whether there is some deeper change lurking.

Officially, the U.S. Air Force suggests that despite the inevitable problems associated with the rushed adoption of UAV technology, there is nothing new to worry about here. A study completed for the U.S. Air Force in 2011 found that "much of the occupational stress reported was related to operational stress rather than combat (e.g., live video coverage of the destruction or death of enemy combatants and ground troops)." 23 Working conditions such as long hours, shift work, and career uncertainty were cited as the most likely sources.

Specific concerns about how fatigue and burnout can affect operator's performance, especially with the politically fraught issue of collateral damage, have been merged into more general U.S. Air Force troubleshooting exercises on this front. A U.S. Air Force investigation into the use of drones and other platforms for irregular warfare found that collateral damage was caused by targeting errors and lack of
"tactical patience," an important tool in successful counterinsurgency, which includes ensuring sufficient situational awareness to avoid deadly mistakes. The U.S. Air Force report stated that tactical patience can be undermined by the lack of available ISR and the degree of urgency associated with action (i.e., the urgency of the threat is balanced by the consequences of not responding to mitigation opportunities).

On paper, drones should increase reconnaissance and response time and therefore increase tactical patience, but the cases we can study show that it may not be that simple. Unfortunately, the U.S. Air Force report not "accurate" about civilian casualties in Afghanistan, and furthermore, it did not specify the number of civilian casualties caused by drone strikes as opposed to conventional airstrikes. It argued that the distinction was irrelevant in any case: "A missile fired (such as a Hellfire missile) from an RPA is no different than a Hellfire missile fired from other platforms such as the AH-64 Apache," it argued, emphasizing that concerns about collateral damage are not unique to drones.

Nevertheless, the distinction is significant, as the big advantage of drones that they are "better" for civilians because they provide a high level of accuracy and reconnaissance capability, thereby improving situational awareness and solving the problem of tactical patience. . This is not an empty marketing ploy: in just war theory, the moral imperative is to prevent civilian casualties

populations, and this can be expanded by deploying systems that reduce the risk of collateral damage.

It remains difficult to know whether being in a combat zone, rather than in a trailer in Nevada, affects the quality of an operator's combat abilities. Drone operators have been criticized for being poor judges of the operational environment. Mistakes made by the UAV crew have been blamed in part for a botched operation in Uruzgan, Afghanistan, that killed at least 23 : the crew mistakenly identified a convoy of vehicles as containing insurgents and then "downplayed or disregarded" information that should have led them to correct their mistake.

Military analysts are quick to point to these kinds of examples as evidence that there is no substitute for the human intelligence that comes from being on the battlefield itself. Of course, Martin hoped to "learn more about Muslim culture and our enemy" when he was deployed to Iraq, demonstrating that for individuals, the authenticity of service inside a war zone is important.

However, the Nevada trailer shows tactical patience in a different way because of the different pace of drone operations. UAVs can hang around over their targets for hours, but there are still time constraints: fuel reserves will eventually force the drone to return to base, and the nature of shift work means that operators must decide whether to surrender their mission or launch an attack after hours of emotional and operational investment in the mission. In Martin's first kill. "The Predator" involved a suspected insurgent in Sadr City, Iraq, who had parked his truck in a densely populated area: although Martin was authorized to fire, "we had to be careful about firing in the area so as not to kill a group of people" who didn't necessarily deserve to be killed."

Martin and the team waited for the target to drive away to a less populated area, but when night fell and the Predator ran out of fuel, they decided to attack rather than risk losing the target. In the 30 seconds it took for the missile to reach the truck, an elderly man entered the target area. The video footage was briefly blurred by the explosion and then reassembled to show the aftermath. The target in his truck was destroyed, and the old man, "who must have been the unluckiest son of a bitch in Sadr City because he happened to walk by at the wrong time," was thrown into the middle of the street. Martin didn't stick around to see if the old man survived, but told us:
"The people who would call this a Nintendo game have never sat in my seat." There were real people down there. Real people with real lives."

The personality type that is best suited for the first key task of monitoring dim drone activity over long periods of time may not be best suited for the second key task of making hard and fast decisions about who, what, and when to kill. The U.S. Air Force's initial decision to use pilots and officers as drone crews speaks to the recognition that making life-and-death decisions in accordance with legal and moral precepts is considered very much part of the operator's job. However, outside of U.S. military circles, the use of private contractors and civilians to fight the CIA's drone wars distorts the legal and ethical boundaries surrounding such decision-making; the legal and moral quagmire surrounding the Obama administration's targeted killing program simply

adds another layer of complexity - and uncertainty - to how drones could change the nature of warfare.

Even at a distance, operators can triangulate their location relative to a legitimate enemy target and civilians in the crosshairs of the scope
"Predator," and as Martin suggests, they recognize that it's unique: "Flying on the Predator allowed me the extraordinary prospect of being not only a
"a 'combatant,' albeit 7,500 miles away, but also a wide-eyed observer." 30 Michael Walzer's classic account of the "naked soldier" shows why time and distance are so important to the relationship between combatants.
Walzer explored what is behind soldiers' decisions not to pull the trigger when the enemy appears in circumstances where he is not threatening but rather painfully human. In Walzer's examples, the enemy sometimes appears in the scope naked, or smoking a cigarette, or drinking coffee, or enjoying a sunrise. He quotes Orwell, who said of a Nazi enemy he saw pulling up his pants, "He's obviously as human as you are, and you don't feel like shooting him." Such sentiments prompted Walzer to draw a distinction between the work of a soldier and being a human being:

Two soldiers shooting at each are very similar; one is doing what the other is doing, and both are engaged in what might be called specifically human activities. But the feeling of being a "fellow soldier" depends, for obvious reasons, on a different kind of identity, one that is completely detached from anything threatening.

Reciprocity is an important brake on the decision to shoot. Human targets of Hellfire missiles cannot threaten the source of their destruction. This is seen as undermining the traditional equality of soldiers, and therefore questioning the combat status of those operating UAVs. Asparo writes that by "waging war by pressing a button, one does not fully become a combatant because it does not conform to the norms of warfare, in which both sides agree to risk death in resolving a dispute." The just war tradition requires that both sides be willing to sacrifice lives, so in practice, drone combat
"may be considered unjust because those who kill are themselves unwilling to die."

But as technology changes us, so must our cultural concepts, and that is the painful process the U.S. Air Force is trying to go through. Serious efforts have been made to erase the notion that drone operators away from the front line occupy a slightly different rung of the combat ladder than those serving closer to the battlefield, but there has been serious resistance among the ranks. In a decision that caused great anger in the ranks, in February 2013, outgoing U.S. Defense Secretary Leon Panetta announced the award of the Distinguished Combat Service Medal for
"outstanding accomplishments that directly impact combat operations,
but not involving valor or physical risk associated with combat" entails".

The medal, which surpasses the Purple Heart and Bronze Star, recognizes the changed nature of warfare and the contributions of both drone operators and cyber warriors in post-9/11 military operations. The announcement sparked an immediate reaction in the military, with the national commander of the two million-member Veterans of Foreign Wars group objecting that medals earned in direct combat would be degraded and troop morale could suffer. The proposed medal was withdrawn. A month earlier, Congress had demanded an explanation of

why the U.S. Air Force did not

promote UAV pilots as often as fighter, bomber and cargo pilots. The explanation was that drone operators are caught in a catch-22 where a shortage of pilots means long shifts and therefore fewer opportunities for career , which in turn leaves pilots reluctant to move into roles, exacerbating the shortage.

While UAVs are a valuable asset, the U.S. military struggles with how their crews fit into their combat culture. Many arguments revolve around the (lack of) exposure of drone crews to danger, and attempts are being made to transform the traditional concept of combat risk into one of combat responsibility. To make this argument, U.S. Air Force Major David Blair writes in the U.S. Air Force Professional Journal Air and Space Power , Air Force culture must evolve to embrace the new realities of drone warfare and cyber warfare: what is the differential risk between 10,000 feet and 10,000 miles in current conflicts? When a manned aircraft with two spare engines glides over the top of a combat zone that is well beyond the reach of any real threat, why do we consider this scenario "combat" and a Predator firing a Hellfire in anger as "combat support"?

Blair argues that the important issue is what soldiers do, not the platforms on which they do it. He suggests that a sortie qualifies as a combat sortie if it involves "(1) live men directly on the front line (2) against an enemy in wartime." The operator, he notes, may not risk his own life, but may sacrifice another - he has discretion and responsibility for both enemy and friendly troops in the theater, as well as civilian life. Blair's arguments were met with strong resistance - comments on his article, mostly written by soldiers, were overwhelmingly against this attempt to equate drone operations with combat on the ground. Even at 10,000 feet, there are risks, the counterargument argues.

Blair proposes a rethinking of how we think about war, and suggests that while drone pilots perceive battle as a fully mediated experience, they should nevertheless be categorized as combatants. In a direct battlefield encounter, if an attacked American soldier calls in a drone strike, the operator is fully engaged in saving the lives of his side. But Blair notes that.
"it's interesting that people may not realize they're going to be in a fight until mid-flight."

War has been de-territorialized; as a result, he suggests that combat is now a process rather than a place, and argues that a drone operator enters combat when he or she has influence over another's life. However, "Because these complex and integrated systems are software driven, determining agency and action and therefore tracking or understanding responsibility for each aerial target is virtually impossible." 37 In other words, the nature of the weapon itself has implications for operators' activities and their status as combatants. On the one hand, this means resistance to rewarding drone operators for their contributions combat. On the other hand, traditionally, responsibility for life-and-death decisions may have been located somewhere in the kill chain: an important caveat to weapons systems that decentralize decision-making is that apportioning blame and assigning responsibility for war crimes is also no longer possible. .

The inequality between target and operator models the power asymmetry caused by previous military-technical advances. McLuhan identified the discovery of perspective as an important step in the creation of modern weaponry: the spears and arrows of the past required close contact, while the science of perspective opened up the possibility of extending reach over ever-increasing distances. Panopticon researchers have examined the power relations that exist and operate according to perspective, air power researchers have considered the cultural effects of viewing from altitude and how these manifest themselves in the construction of aerial targets. Kaplan suggests that the aerial view of modernity postulated "a belief in that private eye, freed from its limited attachment to the ground, in motion, [which] can see almost limitlessly and therefore with extraordinary clarity." This view, she says, implicitly and explicitly (when manifested as air power) is imperialist,
"promising to connect objects with a single eye for the purpose of observation and, hence the exploration of a world hitherto unknown or unobserved."

While the air force originally represented rival air forces in contests between nations, UAVs reflect the grotesque imbalance now emerging in the global war on terror, in which the "superpower and powerlessness of " must compete. 39
The drone pilot's view is augmented by the recorded memory and dense detail provided by the Predator.

From Nevada, Martin's war shifted from scrutinizing the urban terrain of combat in the most densely populated areas of Iraq to patrolling the desolate and inaccessible expanses of Afghanistan, depending on his daily assignments. His job was mostly to keep an eye on the heavily automated Predator for 12-hour shifts, week after week. Occasionally, something would happen. Feeling immortal in his trailer, he considered human frailty:

I knew the people down there. Every day through my camera I looked around and recognized the faces and figures of our soldiers and Marines, unbeknownst to most of them ... I did feel a little bit like an omnipotent god with a god's throne over it all.

Martin's account shows how he set about constructing a heroic, almost comic book-like narrative to give meaning to the debilitating boredom of his days an imaginative construction based more on civilian conversations about fighting in Afghanistan and Iraq than on military assessments. With the caveat that this is just one man's experience, Martin's emotions and reactions seem understandable. Perhaps seeking to compensate for his inauthenticity as a combatant, he finds purpose in responding to a agenda that demands public enemies with recognizable faces.
Narrating the whereabouts of Osama bin Laden, Martin is excited: "I was actually chasing Osama bin Laden! How much closer can you get to war?

Many of his dramatic (un)encounters name major luminaries of the War on Terror - for example, he obsessively "hunts" Abu Musab al-Zarqawi to bring justice for the murder of Nicholas Berg and others.

Martin is immersed in mediated combat, which is combined with the entertainment of war provided by the media. Drone crews

are subject to the psychological problems of having to be fully present both in war/at work and at home/outside of work, and Martin's narrative suggests how soldiers try to fit into this new structure of the warrior-intermediary. He crafts a compelling narrative for himself, enduring his boring surveillance flights by pretending to hunt for kidnap victims or bin Laden. These are indeed real people, but he has no real relationship with them, the civilians he's supposedly helping, the soldiers of the same side he's essentially spying on, or the enemies he's targeting.

Kaplan discusses how the "enemy monster" is constructed through the aerial view, quoting Keane's observation from "The Face of the Enemy ": "The lower in type the animal image descends, the more the soldier is sanctioned to become a pest exterminator."

In military slang, a "bug sign" is used to describe a person killed by a drone strike, which presumably describes what a crushed body looks like in a transmitted computer image. Martin describes the first insurgent he tracks down and kills in Sadr City in similar language - "like a rat, he slid" and so on. The civilian life he is supposed to respect is not given much more attention, though he recognizes that he must protect it. From 10,000 feet above Sadr City, he sees "children, stray dogs and rats ... piles of garbage ... old cars." He notes children rolling a tire, a woman hanging laundry, people walking by, and compares it all to "a summer day in Garden City, Kansas," but adds: "Leave it to me to ruin their day."

It is not easy to confront the lethal danger of the enemy, and every fighter must come to terms with his decision to kill or not. If there is an argument that UAV flight is more like Call of Duty than F-16, it is because we cling to these familiarities as a way to explain the complex cultural and ethical negotiations that take place as a new kind of soldier. struggles to reconcile the complex currents of a highly mediated twenty-first century culture. Drone warfare adds another dimension to the problematic of reconciling the abstraction of aerial targeting with the concreteness of its effects: as the smooth, machine-like, and impassioned representation of these abstractions is here called into question, what emotions, affects, feelings, and rationalities not only intrude into the tumultuous results of aerial targeting processes, but actually constitute the targeting process and add tension and torsion to its unfolding?

Soldiers both fear and crave danger. Martin can appreciate the power he has over life and death from his trailer in Nevada, but it is only when he is sent to Iraq for forward operations that he becomes a warrior in his own eyes: "I would take the same risks as other" soldiers combat

For the first time since the war began, I felt a direct with the troops I had supported from a distance for so long." In Iraq, he was still participating in the war via video link, but now - reliably - under fire from enemy missiles. Only by becoming a target does he fulfill the traditional role of a soldier.

Persistence, precision, and long range combine in the Predator in such a way that the soldier's senses are constantly and safely expanded into remote and inhospitable regions. The traditional reciprocity of soldiers facing each other in battle is currently severely disrupted by this advent of technology, and Western militaries are struggling to catch up,

trying to redefine old images of danger, courage and heroism. New World. Cultural issues are joined by moral ones as both legal and ethical principles are pulled up and stretched to accommodate new practices. It does not take much imagination to extrapolate a near future when other militaries and irregular groups can afford the same liberties in time, space, and political violence. The consequences that such an unrestricted approach to military action might have when these deeply asymmetric relationships are rebalanced are rarely discussed.

We don't even sit together to chat anymore. The failure of the U.S. to make any serious gains in the war zones of Afghanistan and Iraq, its destabilization of Pakistan, and the resilience of movement-inspired terrorists in Yemen and Somalia all point to deep-seated problems in U.S. policy since 9/11. /11, including the use of high-tech weapons for security. "Ordinary" people have long baffled military strategists by refusing to be or act as planners expect, though perhaps for the rest of us their reactions are entirely predictable. People living under the influence of drones behave like other populations that have survived aerial attacks: they are more likely to be angry and resistant than cooperative and compliant, and this creates problems not only for the creators of their misery but also for themselves, their own governments failing to protect them. The limitations of drone warfare are already written into the history of aviation in general.

Drones promise to revolutionize , but this is not the first time such promises have been made. Early proponents of airpower believed that strategic bombing "could be revolutionary in its effects it would enable a new kind of warfare that would go right over the heads of armies and navies and right to the sources of the nation's strength," wrote historian Tami Biddle. "Bomber aviation can ... - quickly and single-handedly - destroy the combat infrastructure and popular will of an enemy nation."

In other words, killing civilians was part of the war plans. In the summer of 1917, Germany put this theory into practice and bombed London from the air, killing 227 people and injuring 677, including children in elementary school. Instead frightening Londoners, it inflamed them. British newspapers published pictures of child victims and "reprisal maps" of German cities. Revenge and London's lack of air defense became the subject of public gatherings.

Government leaders were worried about its troubled rear: its citizens were frightened, yes, but also angry - and not just at Germany, but at the failure of the British state to protect them. Would morale hold? It did, but it also helped the civilian population develop its own sense of identity as a special interest group - and in this case special threats. As the government's conduct of the war was criticized by the British public, the revolutionary upheavals in Russia provided a dramatic example of what popular power could achieve. Ordinary people intervened, unwillingly, in the calculations surrounding the conflict.

The century of "death from above" that followed demonstrated, first, that public morale was generally stronger than military planners believed, and second, that the killing of civilians, intentional or

no, problematic from a PR perspective. The right way to calibrate a military mission that intimidates but does not kill or completely alienate a population remains elusive, although many different approaches have been tried.
The strategy of "overkill," in which U.S. and South Vietnamese warplanes flew 3.4 million airplane missions between 1964 and 1972, failed to win Vietnam for the West. 3 Belgrade citizens flocked to the city's bridges with targets on their backs, acting as human shields to repel NATO attacks during the Kosovo war in 1999; The initial "Shock and Awe" campaign of the U.S. war against Iraq in 2003 was a "blatantly performative demonstration of aerial violence," the hollowness of which became all too apparent when the long, fierce and violent ground insurgency began. strikes in Pakistan exacerbated existing political divisions and created new ones: ending U.S. bombing of its people became a key issue in Pakistan's 2013 elections. Faced with overwhelming technological superiority from the air, people - even unarmed civilians - refuse to comply, and that is their strength. By limiting the range of options political and military leaders can exercise, they have proven their ability to influence the course of war. Looking at the notable lack of success in achieving victory or even security in the global war on terror, early evidence of drone warfare suggests that, once again, death from above creates more problems than it solves.

Chapter 16. Targets below for combat drones

I was used to the sound of them. It was there all the time. During the day it was mostly absorbed by the hum of everyday life, but in the quiet of the night, only the buzzing could be heard.

Although they are not usually named or counted in the official history of the War on Terror, the most important people in the loop are those who fulfill the drone's destiny by being at the end of a potential kill chain. While a drone can be used to kill one person, it can only do so by observing a wider population, which in turn means that assumptions about that population have been made prior to any deployment. The very presence of UAVs in the region suggests problems. There is a feedback loop in which strikes kill civilians and militants, rhetoric inflames emotions, and the consequences cannot be controlled. While the U.S. drone program could be called counterterrorism, many of its intentions and results resemble counterinsurgency. Anderson writes that "always by definition too late because it reacts after an insurgency has emerged, counterinsurgency operates once a population has acquired the tendency to become either enemy or friend." 6 Pursuing its enemies across the Afghan border into Pakistan, the CIA apparently , has brought with it its own assumptions about the reliability of the population as a whole. And a population caught in the crosshairs of a drone is a population with a question mark, if not a crosshair, on its back.

Drones "are used to collect data on risk probabilities and then manage populations or eliminate network nodes deemed to exceed acceptable risk thresholds," Wall and Monahan write, shifting to the clinical language of biopolitics to describe the ostensibly counterterrorism approach used in nanowarfare beret.

Systematic control and systematization of people's behavior reduce them to execution
"patterns of life," their conversations become "atmospheric," their "surroundings"

assessed as either "enabling" or "hostile," chickadees are "slacker"-a term, Williams notes, that "refers to the ability to pose a threat solely by their presence." 8 As other forms of data surveillance, these people and their lives are flattened and reduced to machine-readable binary forms. While drones thus promise the machine-readable benefits of precision and accuracy, as Walls and Monahan argue: in practice, these surveillance systems and their agents actively interpret ambiguous information that consistently defies exact correspondence or clear answers. In doing so, UAV systems can induce homogenization of differences, thereby reducing variation to functional categories that fit the needs and biases of the operators rather than the objects of observation.

It's all too easy to view a person who becomes the object of a drone's gaze as a potential threat or potential collateral damage - or, at best, as a non-existent entity, a misplaced body in the ongoing war games.

There is a huge difference between wide-angle bombing of cities and populations and the newfound ability to "put a warhead to your forehead"
by drone, but the morality and legality of killing civilians remains fundamentally unchanged. What has changed is the scale of destruction: mass bombing of populations is now unacceptable and may never have been acceptable, but in the form of the drone we have a weapon that makes such close and personal nano-warfare not just possible, but mundane. . body counts in single figures in obscure places are barely counted, while an aggressor 7,000 miles away is taking no chances, so there are no headlines to contend with. The CIA and the U.S. military have been conducting regular drone strikes since 2002. In non-military zones in Pakistan, Yemen and Somalia, the civilian death toll, confirmed by the Bureau of Investigative Journalism as of January 2014, ranges from 440 to 1,038. For the U.S. Bush and Obama administrations, PR on the home front was not a problem. Even now, U.S. citizens overwhelmingly support the practice: mid-2013 poll found that 66% of respondents favored using drones to take out terrorists, while only 16% opposed strikes.

The problem, of course, is that it's not just terrorists who are being killed. As body count, so carefully collected, climbed upward and details trickled out, resistance and retaliation were more evident on the killing fields than on the home front. For the White House, drones offered a safe, covert, and deniable way to conduct small-scale attacks in Pakistan and elsewhere without risking the wrath of the American electorate: when the simple requirement to kill only the bad guys doesn't appease also offers questionable, convoluted legal justifications.

However, this comfortable PR position may not last long. A partial but increasingly difficult to ignore picture of what it means to live under the constant threat of drone attack and/or to continue living after an attack is beginning to emerge and become a topic of debate. As the negative consequences of this seemingly low-cost use of force become more apparent, nanowarfare may become increasingly difficult to wage. The important work of recording and publicizing the experiences of people living under drones is being done by groups that include researchers, scientists, lawyers, and investigative journalists.
This broader counternarrative is vital to challenge the

how the US administration and the mainstream media present drone warfare. Beyond the headlines, it is clear that drones are not just killing the bad guys, but the broader impact on the population is extensive, uncontrollable and, in terms of providing any real, lasting security, counterproductive.

One of the most high-profile recent episodes of unguided drone warfare occurred in March 2011. U.S. drones launched a missile strike on a gathering of tribal elders in Datta Khel, North Waziristan, Pakistan, killing some 42 people and injuring 14, the mainstream media grossly underreported the strikes, Living Under Drones' account of the attack is worth reproducing in some detail:

Ahmed Jan, who was sitting in one of two circles of about 20 people each, told our researchers that he remembered hearing the hissing sound made by the rockets just seconds before they crashed into the center of his group. The force of the impact threw Ian's body a considerable distance away, rendering him unconscious and killing everyone in his circle. Several additional missiles were fired....

One survivor from another circle, Mohammad Nazir Khan, told us that many of the dead appeared to have been killed by flying pieces of broken stones. Another witness, Idris Farid, recalled that "everything was destroyed. There were pieces lying around - pieces of bodies. There was a lot of flesh and blood.

Unable to identify the body parts lying on the ground, Khalil Khan could only "pick up pieces of flesh and put them in the coffin". Idris Farid ... explained why the funerals of the March 17 strike victims were "strange and different from the previous ones." The community had to collect the body parts and bones [of the victims] and then bury them that way, doing everything possible to 'identify the parts and body parts' so that the relatives at the funeral would be sure that they had the 'right parts', of the body and of the right person."

Unnamed U.S. officials reportedly told local media that those killed were deliberately targeted as enemies: "These people were not going to a bake sale. They were terrorists" and "These guys were terrorists, not the local men's choir." The gathering was actually a jirga, a decision-making meeting called in this case to address a dispute over a local chromite mine. After extensive research, the Living Under Drones Project concluded, "All relevant stakeholders and local leaders were present, including 35 government-appointed tribal leaders" as well as four local Taliban members; the nearest Pakistani military post was informed of the jirga ten days in advance; and although participants knew that drones were operating in the area, they felt safe because, in the words of one victim's son, "the drones were targeting terrorists or those working against the government."

Despite clear evidence to the contrary, officially the U.S. administration still maintains that all those present at the jirga were insurgents and therefore enemies of the United States. This denigration of legitimate public gatherings is . It is possible because access to reliable information is limited, applicable laws are complex, and the U.S. government refuses to provide the evidence on which its targeting decisions are based. In this example, we have more information than usual, and in many

the devil is in the details. As the best propagandists know, it is better to build a big lie on a small truth. The Dushmans present included Sherabat Khan Wazir, a high-ranking local commander with ties to the powerful Taliban group in North Waziristan led by Hafiz Gul Bahadur. Bahadur's group operated across the border in Afghanistan and was closely linked to the Afghanistan-based Haqqani network and thus posed a real threat to U.S. forces. This is the sort of evidence Washington will cite to justify the strike, hoping that mere guilt by association will do the rest.

, in Pakistan, Bahadur's group was considered a "good Taliban," meaning it was pro-government and had signed a peace agreement with Islamabad many years earlier. As local influencers, its members were considered an important element for inclusion in the jirga. After the strike, the Pakistani government strongly protested to the US and Bahadur threatened to tear up the peace agreement with Pakistan; and it emerged that even the US ambassador tried to stop the strike, but the CIA him. 13 In May 2013, the Peshawar High Court found the U.S. government and the CIA guilty of war crimes and violations of Pakistan's sovereignty in a case brought by the families of the Dutt Khel victims.

The CIA may have succeeded in destroying one or four enemies in Datta Khel, but in the process it created many new ones.

This is by no means an isolated incident. In July 2013, another man in another country not at war with the United States sought answers about family members killed by S. drones. This time, the attack took place in Yemen and prompted Faisal bin Ali Jaber to write to both the Yemeni president and Barack Obama on behalf of his dead family members:

Why... did you both send drones to attack my innocent son-in-law and nephew? Our family is not your enemy. In fact, the people you killed were strongly and publicly opposed to al-Qaeda. Salem was an imam. On the Friday before his death, he gave a guest sermon at the Hashamir Mosque denouncing the hateful ideology of al-Qaeda. It was not the first these sermons, but sadly, it was the last.

Even as Yemen staggers toward democracy, it sends clear signals to the U.S. about the consequences of the U.S. drone campaign, which ostensibly targets only al-Qaeda militants. In August 2013, the Congress of National Dialogue, a U.S.-backed precursor body to help restore democracy in Yemen, voted almost unanimously to criminalize drone strikes and extrajudicial killings. Despite this clear message that drones are not welcome, within a week two children were among the dead in a series of strikes apparently carried out in response U.S. intercepted "chatter" about a possible al Qaeda attack - somewhere in the world - that led to the closure of 19 U.S. embassies in the Middle East and North Africa.

In Somalia, U.S. drones were firing until June 2011, although reconnaissance drones had been providing intelligence since early 2007, when, for example, a Joint Special Operations Command AC-130 attack helicopter attacked a suspected al Qaeda convoy being tracked by a Predator. At least two civilians, possibly children, were killed in that attack.

Civil slaughter continues despite international human rights regimes specifically designed to protect non-combatants from the ravages of war and extremism. Human rights in non-war zones are primarily guaranteed by the states themselves; the U.S. has been able to pressure weak and, in the case of Somalia, failed governments to
"authorized" drone strikes, circumventing charges of sovereignty violations and war crimes , according to legal experts. Habermas, referring to the U.S. war in Iraq in 2003, described a "radical violation" of international law because the U.S. administration instead turned to relying on "its own ethical values and moral convictions; it replaced prescribed legal procedures with its own normative values." While the Obama administration has brought legal arguments back into play, it has not returned to a traditional understanding of existing legal regimes, but has instead reconstructed their meanings to suit American objectives. The emergence of Pakistan as the epicenter CIA drone wars demonstrates how skillfully governments and states are undermined in the process.

The US has conducted drone strikes in non-drone war zones such as Somalia and Yemen, but the epicenter of its drone war is in Pakistan's Federally Administered Tribal Areas (FATA) bordering Afghanistan. It is important to consider the problem of how sovereign territory is organized here, as the area offers a wealth of detail in the scant information environment surrounding U.S. drone policy. FATA is a region that lies within Pakistan's national borders, though the central government has never exercised effective control and Afghanistan has never recognized the colonial-era Durand Line that became the modern border. Access is difficult, travel is restricted, conditions are dangerous, and body counts are unreliable they are highly politicized. In the absence of official, verifiable figures, local investigators face threats from both the military and militants: 'We can't portray drone strikes in a positive light; we don't want to die,' said one journalist." 18 Due to a lack of reliable information, many competing scenarios of violence have been written about FATA, but it is not an imaginary place - real people are trying to live their lives there. To understand why Pakistan occupies such an ambiguous position in the (ongoing) global war on terrorism, that it can be both an ally and a target, some background is required.

First is Pakistan's own security situation. The main threat to Pakistan has always been India. Pakistan's management of its borders and support for groups outside its borders, such as the mujahideen fighting the Soviets in Afghanistan, was designed to keep itself safe from its great rival. If the aphorism "the enemy of my enemy is my friend" has ever been applied anywhere, it applies to Pakistan, although "enemy" is probably too strong a word. Pashtun tribes and Islamist politics are part of the political landscape, and they have supported the Taliban regime in Afghanistan as a useful bastion against the possibility of a more pro-Indian government.
It was the September 11 attacks that necessitated the abrupt turnaround of Pervez Musharraf's military government. When President George W. Bush famously declared on September 20, 2001: "Either you are with us or you are with the terrorists." From that day forward, any country that continues to harbor or support terrorism will be

viewed by the United States as a hostile regime". Pakistan no choice but switch sides and try to deal with the domestic fallout as best it could. The alternative was to observe the US alliance with India and declare Pakistan a terrorist state. , the choice was so difficult that the U.S., realizing that it would take a significant push to make sure Pakistan chose the right side, offered billions of dollars in aid in exchange for material support for Islamabad, including access to airspace, military bases, transportation, roots, and intelligence. Neither side was particularly happy with the deal.

In November 2001, the Afghan terrorist government fell and northwest Pakistan, i.e. FATA, North West Frontier Province and Balochistan, became the destination of fleeing militants. Later these areas became bridgeheads for Afghan insurgents. At U.S. instigation, Pakistani military units reluctantly went into the tribal areas to try to root out the militants, but largely unsuccessfully, perhaps due to a lack of confidence that this was an effective way to solve America's terrorist problem, and certainly realizing that they were more than likely to exacerbate their own. As expected, in response to the military crackdown, disparate militant groups in Pakistan grew, spread, and began to coalesce into a much more potent threat to Pakistan itself. By 2007, terrorists in Pakistan (the Terrorist Movement of Pakistan or TTP) and other groups had launched counterattacks, staged terrorist attacks, and gained control of areas to the where the federal government was forced to enter into peace treaties with radical groups and hand over governance to them.

Pakistan's double game of trying to cooperate with the Americans without inflaming factions in its complex border zones has failed, while American actors - diplomats, the CIA, the U.S. military, and even private contractors - have followed conflicting strategies depending on who their Pakistani counterparts were and how they see the depth of their commitment and reliability.

The International Crisis Group describes the 'schizophrenic' nature of the Pakistani view of the drone program, exemplified by the remark of one of its interlocutors: 'The truth is that the Pakistani military has approved both terrorist safe havens and U.S. drone strikes against them'. 20 The CIA's drone strategy, as it became intertwined with Pakistan's own relationship with the FATA, distorted the decision-making process in both states.

The human cost of this illegitimate alliance is high: although figures vary, between 2,500 and 3,500 people were killed by U.S. drones between 2004 and mid-2013, and perhaps 20 to 30 percent of them were civilians. Even if the rest were "legitimate" militant killings, civilian casualties are unacceptably high, according to Pakistanis' own estimates. In a 2013 Pew Research poll, 74 percent of Pakistanis believe too many innocent people have been killed, 68 percent oppose the U.S. drone program, and only 11 percent view the U.S. favorably-a new low; 98 percent now consider terrorism a serious problem for the country and rated the threat posed by the Taliban on par with that posed by their traditional enemy, India, for the first time since Pew began polling on the issue.