Remotely Piloted Vehicles

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Outline

Thesis: Remotely piloted vehicles will replace soldiers on tomorrows lethal battlefield.

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Remotely Piloted Vehicles

Seismic vibrations increased from a faint noise to an incessant clamor. A small sensor went from the passive mode to active and began transmitting urgent signals. An enemy company of armored vehicles was attempting a reconnaissance in force. At the division command post, the alerted operations officer examined the video map.

He had several options, but he first decided to gather more information. The first order redirected several reconnaissance remotely piloted vehicles (RPVs) over the sector where the invasion occurred. The video images clearly verified the presence of enemy armored vehicles and more. There were also several anti-aircraft vehicles with the tanks. The duty officer ordered the anti-armor battalion to ready a platoon of Fireants for launch. Additionally, he ordered a Hellfire II missile platoon to alert status and prepare for launch. Additional targeting RPVs moved in to locate the intruding tanks. Meanwhile, two downed RPVs caused the duty officer to vector in replacements.

After uploading five Fireants with the image and approximate location of the anti-aircraft vehicles, the operations computer launched them. At their maximum ground speed of 120 kilometers per hour, the Fireants needed twelve minutes travel time. The Hellfire II missiles needed less than two minutes to reach their targets. The battalion duty officer loaded preset flight commands to allow automatic launch. The division computers calculated and controlled the Hellfire missiles exact launch time. After ten minutes, the duty officer's console suddenly identified missile launch. Immediately, the lower half of the map screen went to real-time imaging and he watched the battle.

The enemy tanks saw the approaching Fireants and tried to destroy them with their main guns. The evasive Fireants dodged and weaved through the enemy formation ignoring the tanks seeking only the anti-aircraft vehicles. A tank hit a Fireant which suddenly exploded. In quick succession, another Fireant and an anti-aircraft vehicle exploded. The tanks tried to protect their remaining air defense vehicles but another was hit leaving them only one. The two remaining Fireants began to close in on the last air defense vehicle. At this point the first of the Hellfire II's appeared and the tanks went into the air defense mode. With the sudden lifting of enemy fire, one Fireant quickly took out the last air defense vehicle.

Reconnaissance RPVs then assessed the destroyed air defense vehicles. The operations officer started the analysis program. He reported five tanks and three anti-aircraft vehicles destroyed. He also noted that no humans were in the attacking forces. The sensors returned to the passive mode and continued their vigil. The operations officer was thankful that no letters had to be written to someone's next of kin. Is this science fiction or just a dream? No, it is a very real description of roles for soldiers on tomorrows battlefield.

But exactly what is an RPV? The terms, Remotely Piloted Vehicle (RPV) and Drone, identified pilotless aircraft and helicopters. Originally, the guidance systems provided a clear distinction between the two. An RPV remained under the control of a ground based pilot. A drone obeyed the commands stored in the memory of its guidance system. Later however, the two guidance systems often overlapped. RPV's on long distance flights became drones after they were out of radio contact with the ground station. From then on, they operated on their preprogrammed course to guide them back to the ground station. Many drones launched on preprogrammed courses later landed under ground control. The term Unmanned Aerial Vehicle (UAV) replaced RPV and drone. In addition to air vehicles, there are ground (UGV) and water (UWV) vehicles (Fahlstrom 4).

In order to examine the impact of UAVs on the battlefield, we must look at their history. Napoleon and American Civil War generals used balloons as a method of observing the enemy. They tried to get a tactical advantage by observing their enemy's movements. An altitude of 1000 feet allows observation of 20 miles around the balloon. Early attempts for a true UAV failed because they were not controllable from a distance. In World War I, England launched aircraft with large amounts of explosives and fixed controls toward Germany. These proved expensive and accomplished little. Then in 1922, the development of the radio relay switch made true UAVs possible.

The English were the first to develop UAVs. They established two unmanned vehicles called the Queen Bee and Tiger Moth. Both aircraft required line-of-sight operation. The purpose of these vehicles was to carry large amounts of explosives to the target. The UAV field was England's from 1923 until 1933 (Swann).

When Hitler came into power, the Germans soon took a commanding lead in UAV development. The first V1 pulse jets had radio controls and a camera for reconnaissance. However, Hitler wanted a "Terror Weapon" and launched V1s with simple preset controls against England. With preset flight controls, the V1 was no longer an UAV but a drone. Later, they used the V2 rocket as a "Terror Weapon" in the same way.

The Germans also developed a vehicle that could explode openings in wire barriers, walls, or mine fields. This was a Remote Ground Vehicle or RGV. The Goliath, as the Allies knew it, demonstrated limited success when used in Italy and the Balkans.

American research took off primarily with the aid of German scientists and technicians. The first major use of UAVs was as targets for anti-ballistic missiles and manned aircraft. The Army first used them as air defense systems. German scientists, working for the Air Force, resurrected the UAV for reconnaissance roles as the U.S. became involved in Vietnam.

During Vietnam, UAVs flew over 3000 active combat missions in the late 1960s and early 1970s during Vietnam. They are unofficially credited with the destruction of five enemy aircraft. The MIG pilots over-extended themselves in their attempt to shoot down the UAV. Following the diving UAV, pilots crashed into the ground at full speed (Swann).

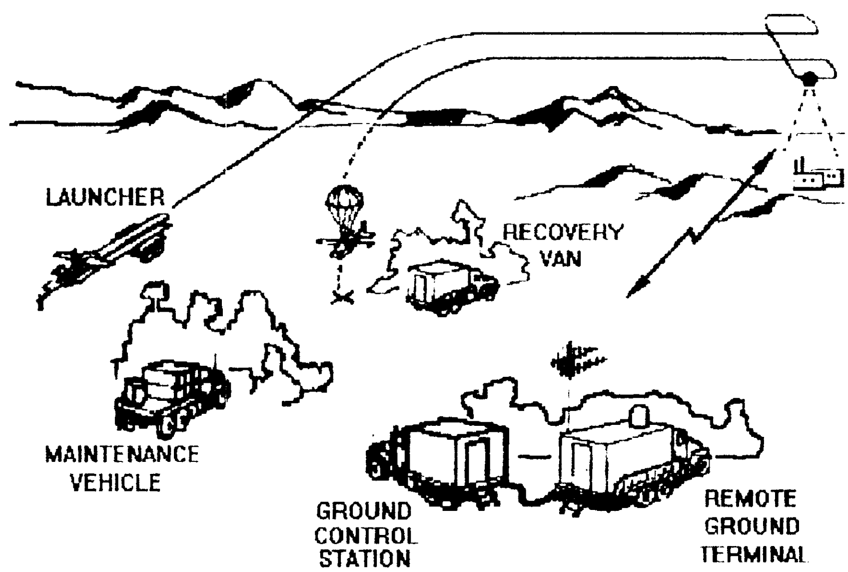
After Vietnam, the Israelis continued the most active development and research of UAVs. They used several models extensively during their conflicts. The Israeli UAVs were not only used for reconnaissance, but also in an active combat role (Geisenheyner 77-79). They preceded an attack in order to draw enemy aircraft and air defense missiles. As the enemy air defense systems committed their missiles and manned aircraft, Israeli forces would attack the now unprotected installations. UAVs could also attack radar installations by following the radar signals to their source.

Advances in computers, communications, and electronics, the capabilities and uses of UAVs to continue to grow. On today's battlefield, the UAV can fill a wide variety of missions. The roles of UAVs fall into two major arenas; lethal and nonlethal.

Nonlethal UAV capabilities include: observation, infra red surveillance, relay station, target designation, electronic counter measure, and aerial target training. Other uses of UAVs are as air defense decoys and for high altitude weather data collection.

UAVs used by the military usually have autopilots or navigation systems that maintain attitude, altitude and groundtrack. As a minimum, a typical UAV system includes the air vehicle, ground control, payload, and a communications or data link. In addition, many systems include launch and recovery sub-systems, air vehicle carriers, and other ground equipment.

Airborne terminals receive command signals and return video signals to the ground control station (GCS) via a remote ground terminal (RGT) (Employment 8). The remote ground terminals generate and relay command data. The ground control station is the operational control center of the UAV system. This is where they process and display telemetry and video data from the aircraft. The environmentally controlled shelter contains a mission planning facility, control/display consoles, video/telemetry instrumentation, a computer, and signal processor. It also has internal and external communications, ground data terminal control equipment, environmental control, and survivability protection equipment.



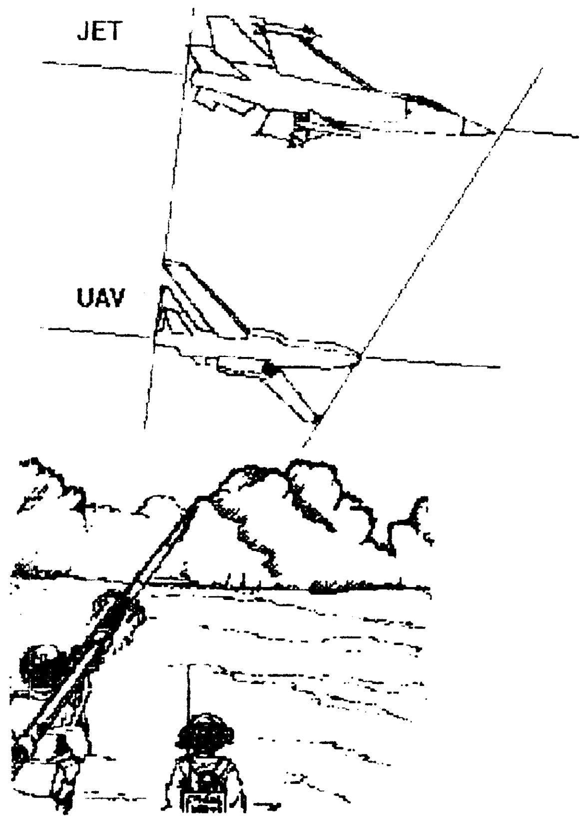
The ground control station serves as a command post. The mission commander can plan missions and receive mission assignments from supported headquarters. The GCS also provides the commander with resources to report acquired data and target information to weapon fire direction systems. The GCS has positions for the air vehicle and mission payload operators to perform monitoring and mission execution functions. The GCS includes nuclear, chemical, and ballistic vulnerability protection.

The remote ground terminal (RGT) is a trailer mounted microwave antenna. It provides line-of-sight communications between the GCS and the UAV. Fully redundant fiber optic cables connect the RGT and GCS. The RGT transmits guidance and payload activation commands and receives flight status information on UAV altitude, speed, and direction. Most importantly, it interprets mission payload sensor data, including surveillance and target range. Airborne eyes are important but are not the only eyes for a commander.

Several data collecting unmanned vehicles can help the commander control the battlefield. The capability exists to operate all-terrain vehicles miles from the front lines. Turret-top video cameras rotate 360 degrees to look over hills, trees, and other line of sight obstructions. These vehicles can also carry an array of weapons from small arms to anti-tank and Viper missiles. The Navy can use a UAV called the Sentinel. It provides over the horizon targeting of long range anti-ship missiles and electronic warfare tasks.

Typical electronic counter measure (ECM) missions for UAVs include: defense suppression, decoy, and saturation. In the ECM mode, the UAV can simulate an incoming full-size aircraft. During the 1971 Israeli war with Syria, several UAVs preceded the manned aircraft missions. As Syria concentrated air defense systems on the UAVs, the manned aircraft penetrated and gained control of the airspace. Currently, Israel is the only country which deploys these UAVs.

Another UAV ECM mission is to trigger defensive measures against a nonexisting threat (Gourley). Other UAVs, equipped with radar jammers, reduce the lock-on range of surface-to-air radar systems.



The smaller and slower UAV draws out the air defense systems because they accurately simulate the larger and faster jet. There are great advantages for using UAVs in high threat roles. They are much cheaper to develop, build, and use when compared to manned aircraft. UAVs can be especially inexpensive if they are expendable. They don't require recovery systems and can fly on one way programmed memory flights. Such UAVs are cheap enough to purchase in plentiful quantities (UAVs 83).

UAVs are ideal for hazardous missions such as reconnaissance behind enemy lines or destroying heavily defended targets. Robot

UAVs have the ability to repair runways, fight fires, and work freely in a biological or radiological environment. As the enemy gets advanced weapons, more missions fall into the "extremely dangerous" category. Needlessly exposing valuable aircraft and highly trained personnel is more than a risk, it's a losing gamble.

A major factor of UAV success is the availability of the technology. Technologies like Very High Speed Integrated Circuits, artificial intelligence, optical sensors, and robotics are now maturing. Some weapons have "fire-and-forget" capability. This frees ground troops from flying and recovering UAVs during the heat of battle. Instead, they are maintaining or launching more UAVs. This produces low-cost, field-ready applications, which must expand to battlefield robots and smart weapons.

The Aquila program provided a production test bed for the evaluation of UAV technology (Jane's 187). The Aquila's design included the following missions; find and illuminate the target, provide artillery designation, and provide damage assessment. The main payload is a daylight camera with three different focal lengths, laser range finder, and laser illuminator. This system locates, automatically tracks, and laser illuminates fixed or mobile targets. The laser paints the target for guided ammunition or normal tube artillery. Although the Aquila was never put into production, it provided valuable lessons for UAV designs and uses.

Desert Storm validated the concept of using UAVs to perform reconnaissance, surveillance, and target acquisition tasks. The Navy and Marine Corps employed Pioneer UAV systems. They demonstrated that a relatively simple, inexpensive UAV system can extend the commanders eyes and significantly increased combat effectiveness. Pioneer located useful targets which naval guns, land based artillery, and close air support assets engaged. Real time UAV imagery adjusted fire on targets and assessed effectiveness (Unmanned 7).

Pioneer and the Joint Surveillance Target Attack Radar System worked well together. UAV imagery mapped the entire southern portion of Kuwait. This contributed to the Marines' ability to successfully bypass Iraqi minefields and defensive barriers with minimum damage and delay. Overall, Desert Storm confirmed the worth of UAVs in combat and provided proof of battlefield usefulness (Unmanned 8).

Another UAV, called the Pointer, was less successful in Desert Storm. The lessons learned however, will help to develop an effective close range UAV. System improvements needed include the following:

1. Increase the range to extend the eyes of the commander in flat desert where visibility is nearly unlimited.

2. Provide on-board location capability to quickly determine position, even when few terrain features are present for orientation.

3. Improve sensor resolution to allow target identification in relatively featureless terrains which lack

contrast.

4. Provide ability for day and night operations.

5. Provide ability to operate in windy conditions.

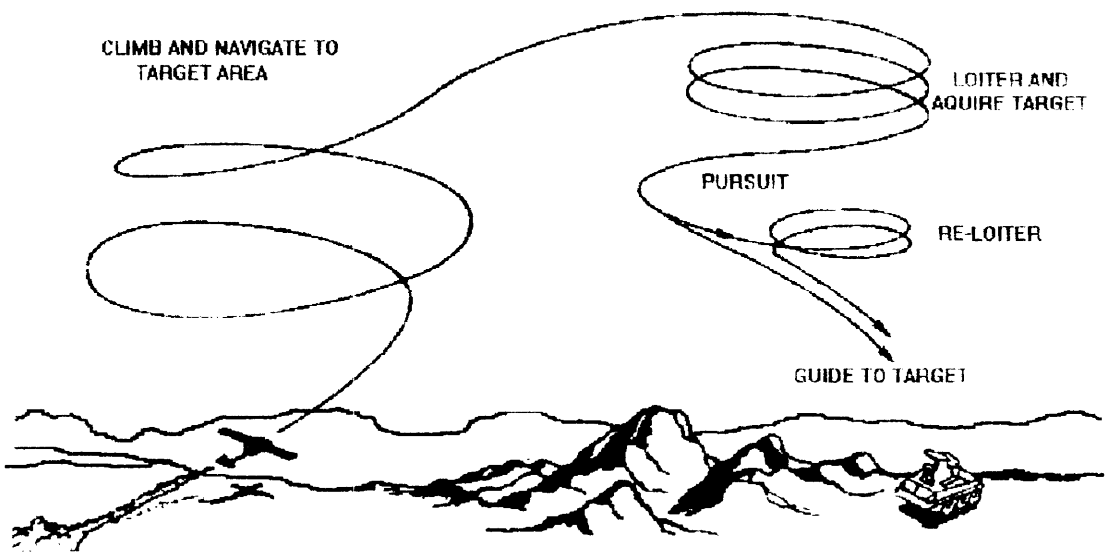
The Pioneer system can provide both day and night imagery. It uses a Forward Looking Infrared camera for night missions. The average mission duration is over three hours with an operational range of 180 km from the ground station (Unmanned 9).

There are many other uses for UAVs in the air. The Locust suppresses enemy air defense in order to reduce the risk for manned aircraft missions. Its design simulates the radar signature and speed of a fighter aircraft. It flies in ahead of manned aircraft to force the enemy to use their air defense systems. Once they turn on their radar they are vulnerable to attack (Noack 14).

During the Lebanese War, the Israelis used the Mastiff and Scout UAVs with great success (Planes 19-21). The Israelis placed great emphasis on the information gathered by UAVs. These UAVs stayed in the air or on station for 6 hrs, with a range of 100 km. The Scout has a service altitude up to 10,000ft but works best at the 3,000ft level. By staying around 3,000ft the Scout can use its camera to cover a 50 square kilometer area. The Israelis neutralized Syrian surface-to-air missiles with apparent ease and without losses to their manned aircraft. They used unmanned aircraft decoys to saturate their missile systems.

Even more critical is the ability of the UAV to continue surveillance in the area after the attack. This assessment of battle damage is very important in the planning of future operations. Proper collection of battle damage keeps a long range plan on target and prevents future complication of the operation. Good damage assessment leads to accurate strength projections of the enemy forces and equipment.

Not only are UAVs the eyes and ears of the commander, but they can be his fists. The second major catagory of UAVs are the lethal UAVs. Electronic data provided by UAVs can give clear guidance to conduct air strikes and destroy enemy targets.



These UAVs, armed with a passive radar seeker and a warhead, fly toward the predetermined target area. They loiter until they acquire an emitting radar emplacement and then attack. They fly at high speeds and in great numbers to confuse the enemy. UAVs are valuable because critical targets are heavily defended. These defenses threaten pilot safety. It is much safer to let a UAV attempt to take out these targets.

Commanders can use a lethal UAV as a force multiplier on the battlefield. A UAV can destroy a critical target in a densely populated area with a high probability of success. Weapon accuracy was instrumental in the success of Desert Storm. The Gulf War displayed the capability of the UAVs already in service. The significant advantage of UAVs is their lethality. Future conflicts require weapons capable of hitting accurate, hitting hard, and hitting far. The challenge for battlefield commanders is to use the correct amount of force to preserve human lives on both sides. With the wide use of UAVs we can achieve this goal.

There are several lethal weapons for use on the battlefield. During Desert Shield/Storm UAVs flew over 500 sorties for over 1,600 hours. At least one UAV was airborne at all times during the period prior to the war (Unmanned 9). Some examples include:

1. USS Missouri fired eight 1.25-ton shells to destroy command and control bunkers that Iraq was moving into Kuwait. Pioneer UAVs provided the gun fire spotting. This married the first use of UAVs to gun fire spotting in a hostile environment.

2. USS Wisconsin fired 50 rounds off Khafji to destroy a command complex. UAVs spotted targets and provided coastline reconnaissance. USS Wisconsin provided the "Sunday punch" that helped soften the upcoming battlefield.

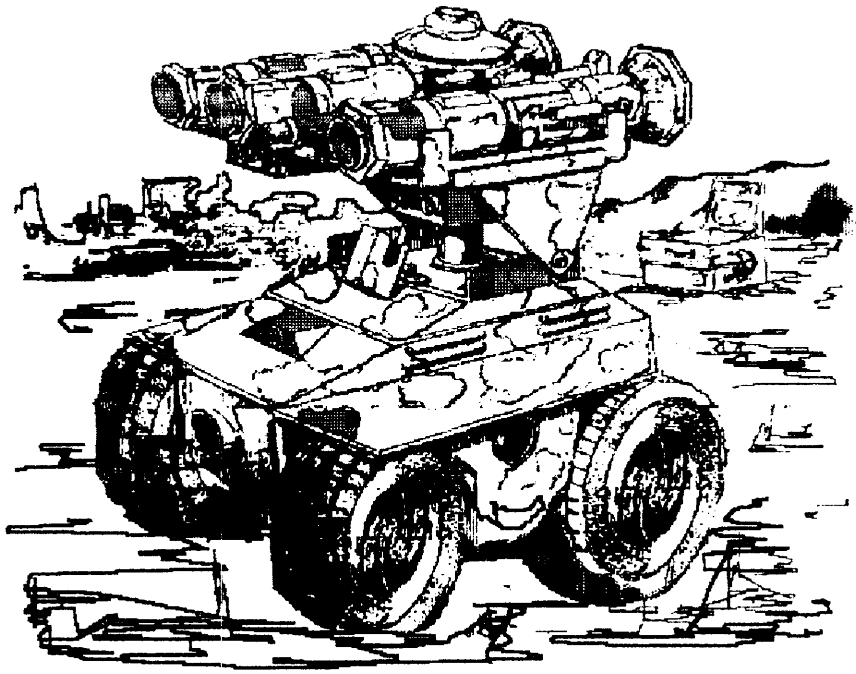
Their uses included: real-time battle damage assessment, artillery and naval gunfire adjustment, reconnaissance, and advanced warning. They also coordinated ground and air operations. There are several other weapons available to commanders.

A unique guided dispenser, called the Fireant, is radio controlled. The Fireant is a "kamikaze" type vehicle operated by a soldier concealed in a protected area. This "ordnance crammed" vehicle rams a tank or personnel carrier at speeds of up to 85 mph. It locates specific targets then explodes on contact.

The Sprinkler is an offensive UGV. This machine gun carrying vehicle, which is about four feet long, rolls into enemy areas and rains destruction. It will, on command, spray 720 rounds per minute in every direction. The Sprinkler's cost is around $2,000 and it knows no fear.

Another lethal UAV is the Ranger. It is a three-wheeled off-road UGV that travels at ten miles per hour. The Ranger picks up the sights and sounds of the enemy. One advantage of the Ranger is its ability to perform sentry duty. During testing, a Ranger successfully took on a number of simulated infantry targets. It is equipped with a 7.62mm machine gun, Doppler radar, infrared sensors, electromagnetic motion detectors, and seismic monitors.

Additional features of UGVs are the powerful zoom optics system and remote firing capability. With these systems weapons like the AT-4 Light Armor Weapon (LAW) is a much more effective weapon. The soldier-operator can remotely fire a LAW from the UGV. State of the art fiber-optic guidance systems allow control beyond the line of sight. This system lets the operator see what the UAV sees.



The operator can maneuver the vehicle from miles away. The UGV effectively increases a weapons range.

Lethal unmanned vehicles are not only on the ground but also in the air. Visualize a UAV flying miles ahead of the fighting force. This offensive weapon is the Matra Apache (Signal 88). The Apache flies a terrain-following profile. Which allows low altitude attack using terrain for cover. As the Apache approaches the target area, its radar briefly scans the overflown areas at predetermined points. The radar compares the terrain with satellite digitized mapping data stored in its memory prior to launch. As it locates the target, it begins carpet bombing the area. It can also eject eight high explosive rounds laterally and two from underneath for a better impact pattern density. The Apache is ideally suited for other long range missions such as heavily defended or very high value targets. Strike capability of lethal UAVs dramatically changes and extends the commanders control of the battlefield.

Tomorrows battlefield offers many challenges. We may not pick the location of a future battlefield. However, we can choose how we will fight on that battlefield. Our primary objective employ the principles of war. We must learn to use long-range sensors to find the enemy before they are aware of our presence. We must shape the battlefield by separating enemy forces in space and time using UAVs. Then we can commit our forces to the decisive close battle, at a time and place of our choosing. This warfare gains an advantage over the enemy by hitting them wherever they show vulnerability.

Fewer forces, increased lethality, and range of modern munitions, puts a premium on gathering information. We must be able to see the enemy force location in near real time. Only then will the commander be able to shape the enemy for destruction. A sequence of four critical stages must occur (Siuru 15).

In the first stage, the commander will attempt to gain all available intelligence to seize, retain, and exploit the initiative. Using new, improved intelligence sensors and reconnaissance capabilities, commanders see the battlefield throughout its 400-to-500km depth. Commanders must employ long-range artillery fire with Army attack helicopters and joint Air Force and Navy fighters. This massive firepower permits centralized rapid massing and movement of division-controlled, combined arms maneuver units into the battle zone.

After the commander develops the plan, they can shape the enemy forces for decisive operations. Long-range fire will separate the enemy forces. UAVs will perform battle damage assessment, locate targets, monitor enemy command centers, and perform additional deep reconnaissance.

When the commander determines the time is right, combat forces will focus to destroy the enemy in close combat. Division UAVs may lead maneuver units through gaps to vulnerable flanks or rear areas. They may monitor other enemy forces entering the battle zone. Corps UAVs will continue deep surveillance, target acquisition, and damage assessment.

After the battle, combined brigades must disperse and secure themselves and begin restoring their combat power. UAVs can conduct surveillance by maintaining contact with the retreating enemy. This allocates the minimum essential combat forces to secondary efforts. At the same time, long range systems will monitor or search for the location of enemy operational forces. Future successes require this coordination of soldier and machine.

We must invest a significant amount of time and money to take full advantage of UAVs. Control of the airspace over the battlefield is critical. UAVs have the potential for reconnaissance and engagement of airborne targets. We must also expect high loss rates during deployments over enemy territory. Do we have to lose a pilot with the machine? The loss of a UAV is far cheaper than losing an expensive weapons system or more importantly, a life.

Recent global events make it clear that we must project armored, light, and special operations forces worldwide. We must train, lead, organize, and equip forces to handle threats ranging from peacetime competition to conflict and war. Budget reductions also require us to accomplish this with a force about one-third smaller.

UAV technology can help our smaller Army accomplish varied and demanding missions. Improvements in sensor and automation technology enhance the use of UAVs. Mobile and survivable command and control operations allow coordinated offensive and defensive actions. More accurate and lethal long-range weapons contribute to a smaller and effective force.

A smaller army reduces the initial forces available for conflict. A reduced forward presence is another impact of a smaller force. This means fewer forces available in the initial stages of a conflict. Destruction of our own forces may occur unless they can remain undetected and protected. Unfortunately, potential adversaries can obtain UAV technology.

There is also an alarming trend when we look at demographic predictions. By 1995, the pool of 17 to 21 year olds will drop by nine percent (Siuru 3). That is about 1.8 million fewer men and women for the recruiters to work with. The answer is to do more for each soldier. Future weapons must be force multipliers.

The long endurance UAV must be developed. A long-endurance, high-altitude, heavy-payload vehicle would allow the UAV unit to fully contribute to the battle. Technological advances in optics, sensors, computers, robotics, and artificial intelligence make UAVs effective and affordable. America's economic conditions demand less expensive weapons in the future. Increased usage of UAVs, UGVs and UWVs will reduce the cost of operation, support, and training.

The United States retains the technological advantage. We are making advances in key areas such as: computers, microelectronics, robotics, artificial intelligence, and optics. The industrial complex is investing in smart weapons, advanced sensors, unmanned vehicles, and battlefield robots. These advances replace sheer firepower and manpower with electronic and computer power.

In summary UAVs fly a preprogrammed course with remote commands given only periodically to update the flight or make corrections. Remotely piloted vehicles show that they can perform dangerous missions without putting a pilot or costly aircraft in jeopardy. They allow conventional weapons to replace the previous nuclear deterrent.

The unmanned vehicles exploit efficient and effective operations on the battlefield. The primary role of the UAV is as a force multiplier, operating in high threat areas without regard for self preservation. UAVs perform risky, time consuming jobs that are better left to machines. They will not completely remove the human factor from conflict. The UAV can reduce soldier exposure, project lethal power with pinpoint accuracy, and watch enemy movement. The UAV is the gunpowder of the 21st century replacing soldiers on the deadly battlefield of tomorrow.

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