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AirLand Battle Future

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See Deep Shoot Deep

UAVs on the Future Battlefield

Miles A. Libbey III and
Major Patrick A. Putignano, US Army, Retired

A key part of the emerging AirLand Battle Future doctrine requires the optimum use of technology to effectively operate on the envisioned nonlinear battlefield. The authors point out that unmanned aerial vehicles (UAVs) have capabilities that can significantly enhance operations. They describe several available and emerging UAV technologies and their potential uses on tomorrow's battlefield.

The unmanned vehicle today is a technology akin to the importance of radar and computers in 1935.
—Edward Teller, 1981[1]

THE ARMY has been very forward thinking about unmanned aerial vehicles (UAVs) over the last decade and is still the leader among the US services in their practical and conceptual development. The US Army's emerging concept for warfighting on a nonlinear battlefield, AirLand Battle Future, is the first operational concept that naturally lends itself to integrating UAVs smoothly into a US service war–fighting doctrine. UAVs will play a significant role in AirLand Battle Future because the proposed doctrine emphasizes deep reconnaissance, target acquisition, lethal UAVs and smart munitions. In addition, the characteristics of the nonlinear battlefield—fewer forces, rapidity of action, fluidity and flexibility—will put a premium on UAV capability.

The Aquila Remotely Piloted Vehicle (RPV) still comes to the minds of many when discussing RPVs in the Army. On one hand, Aquila was a disappointment because it was never deployed. On the other hand, Aquila laid a firm foundation on which to build affordable and deployable UAV systems. The message in this article emphasizes the positive—forget Aquila and let us get on with the business of improving our war–fighting capabilities.

The Aquila program entered a full–scale development in 1979, but became too costly for a number of reasons. Industry and the government shared in the inability to solve development and procurement problems that eventually stretched the program to intolerable lengths and prevented production because of unacceptable costs. Several Aquilas are still in storage in Army depots, disappointing many because available technology never came to fruition. Nevertheless, the mission for which the Aquila had been designed is as valid today as it was in the late 1970s: "to detect targets in enemy territory and to direct conventional artillery and laser-guided munitions against them."[2]

UAVs in the military have a longer history than this example of Aquila would suggest. The era of UAVs was born in the United States soon after the Wright brothers conducted their first manned flight at Kitty Hawk, North Carolina, in 1903. In 1917, the Army Signal Corps had the Dayton Wright Company build the Kettering Bug—an unmanned biplane capable of delivering a bomb.[3] However, with the end of World War I, the first era of UAV development ended in the United States, lacking full acceptance. It began a pattern that has been repeated. During the heat of combat, UAVs are developed; yet when the loss of life ends, interest fades.

As a result of World War II, the United States reentered the unmanned system arena by requiring large numbers of target drones for Army and Navy gunnery practice. In addition, B-17 and B-24 bomber aircraft were modified for remote control bombing missions (after the pilot bailed out) against targets in Europe. Following World War II, UAV efforts in the United States centered on converting manned aircraft into target drones. During the Korean conflict, standard aircraft were modified to carry explosives by remote control to a target, but the efforts never obtained a stronghold in any of the US services.

In the 1960s, conflict again stimulated the US need for UAVs. The escalation of the Vietnam War required the operational and mission capabilities provided by reconnaisance drones. The need for this capability was readily apparent, and more than 3,000 UAV missions were flown in Vietnam using many versions of the Firebee.[4]

Paralleling the US experience, Israel (the only country to aggressively develop, use and improve UAVs) has been motivated by the realities of combat. The Israeli investment paid off in June 1982 during the invasion of Lebanon. The relatively simple Mastiff and Scout mini-UAVs led the advance into the dangerous Bekáa Valley, undertaking key decoy work and gathering reconnaissance data on Soviet-supplied surface-to-air missile (SAM) sites.

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Flying into the Bekáa Valley, the UAVs emitted electronic signals that mimicked radar signals from Israeli jets. When the Syrians activated their short-range radars in response to the perceived threat, the UAVs identified and passed on their locations and characteristic radar emissions via an E-2 Hawkeye, enabling Israeli missiles to destroy 29 SAM sites in a single hour. With the enemy air defenses crippled, fighters then swept into the valley for cleanup operations, as the UAVs continued to monitor for bomb damage and the movement of Syrian forces. Not a single Israeli aircraft was shot down that day.

These combat lessons learned from the Bekáa Valley renewed US focus on unmanned systems. The United States is pursuing several lethal and nonlethal programs. Their procurement and employment in AirLand Battle Future is a departure from peacetime neglect that has characterized UAV development in the past.

UAVs on the Nonlinear Battlefield

The commander will require a variety of systems to support his operations on the battlefield. These systems can vary widely in range, time on station and payloads, and thus support him in

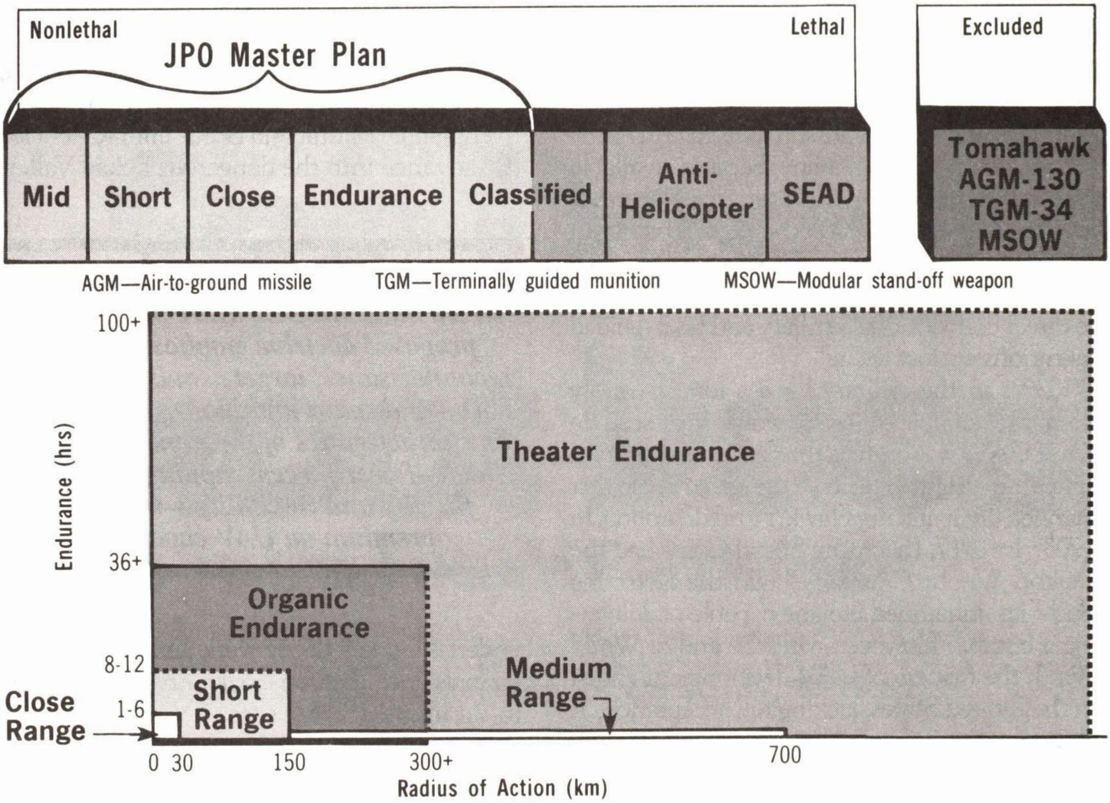


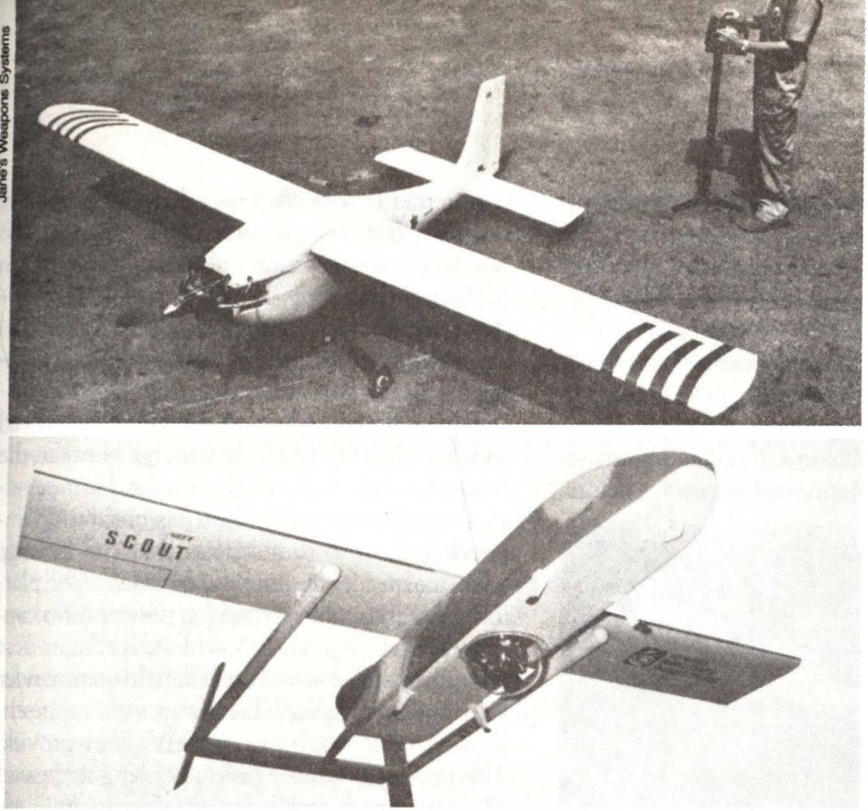
Figure 1. UAV Spectrum

different situations. There are four principal UAV configurations that define some major system parameters: fixed–wing propeller; fixed–wing jet; rotary wing; and ducted fan. These can be lethal or nonlethal systems.

Fixed–Wing Propeller. The fixed–wing propeller system is popular because it is simple, yet effective. It can loiter for long periods of time. It can perform a variety of missions such as reconnaissance, surveillance, targeting and electronic warfare. Illustrative of this burgeoning UAV market is the AAI Pioneer, currently deployed and in daily operational use by our Navy at sea and the Marines and Army ashore. Pioneer has 8 hours' maximum endurance, a 100–pound payload and a range of 300 nautical miles one way. Reportedly, the Sixth Fleet commander felt Pioneer had performed "flawlessly" in a recent deployment to the Mediterranean. It is also a regular component of the US Marine Remotely Piloted Vehicle Company.

Fixed–Wing Jet. Jet engines can provide speed that can be important, for instance, to increase survivability on the battlefield or to gather information quickly at long ranges. The range for these systems is no less than 300 nautical miles at medium to high subsonic speeds. The Teledyne Ryan Scarab TRAA–324 is a nonlethal turbo jet, medium–range UAV that is used by several countries as their baseline system. It has an endurance of 6 hours, a range of 1,400 nautical miles and carries a camera as its payload. It is a reconnaissance UAV, which complements manned aircraft. The lethal "Tacit Rainbow is a jet–powered, programmable, day/night long–endurance, long–range missile able to loiter and suppress radar and jammer emitters, attacking them autonomously."[5]

Rotary Wing. These systems are ideal for shipboard or restricted battlefield situation use because of their vertical takeoff capability. This class of UAVs is most often a system of counter-



Mastiff (*top*) and Scout mini-UAVs used by Israeli forces during the 1982 invasion of Lebanon. The Mastiff followed conventional miniature aircraft design and could take off and land on any piece of level ground while the Scout was launched from a truck–mounted catapult and recovered by a net at a ground station. Both UAVs were able to perform a wide variety of surveillance and reconnaissance missions and have since been significantly upgraded. The Mastiff has also been reconfigured and more closely resembles the Scout than the version flown over the Bekáa Valley.

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rotating blades. The Canadair CL–227 Sentinel is one example, nicknamed "Peanut" because of its shape. It carries a selection of payloads: TV daylight or low–light–level camera, laser designator, thermal imager, radiation detector and real–time data link. Its maximum range is 31 miles and its maximum level speed is just over 80 miles per hour. It can be used for reconnaissance, battlefield surveillance or target acquisition.

Ducted Fan. Ducted fans have the advantage of low observability and could be used in urban or other restricted terrain. The Sikorsky Cypher was recently made public after four years of development under wraps. This doughnut–shaped UAV is optimized for reconnaissance roles and uses a coaxial rotor system encircled by a shroud. The shroud increases the power of the vehicle, protects it from enemy fire and sudden wind blasts.[6] If procured, it would permit the commander to spot enemy forces more than 12 miles away, allowing him to increase his situational awareness of the battlefield.

Nonlethal UAVs

In the nonlethal portion of the UAV spectrum, the Joint Program Office (UAVJPO) master plan categorizes four families of systems that have evolved to meet operational and mission capabilities required by the commander. These categories are medium (pictured as MID), short, close and endurance UAVs, corresponding to the order of their procurement (fig.1). Both lethal and nonlethal UAV systems can be used to support the nonlinear battlefield.

The UAVJPO has handled the tough challenge of melding these diverse requirements and hardware together while trying to satisfy disparate nonlethal customers. It has weathered the first two years well, which is reflected by a $10 million increase from the $82.1 million administration request for 1991—a notable achievement in times of declining budgets. Yet, to get UAVs to the men with muddy or sandy boots in the times of dramatically decreasing budgets, proponents must overcome the same pressures that have faced these innovative systems before.

Northrup Corporation

A Tacit Rainbow defense-suppression missile banking into a turn during a test flight.

The best example of a lethal UAV is the Tacit Rainbow emitter attack weapon, which has some missile–like capabilities with its small turbine engine. It also has a capability to fly autonomously, loiter in a predetermined area and then detect, classify and attack. In essence, this form of a lethal UAV becomes an aerial minefield, set to kill when cued properly.

The JPO recognizes that pitfalls remain. For example, the sequence of the family of systems is an important issue. To what extent should the close system be funded in parallel with the short–range system when the short–range system has not yet proved itself? Finally, commonality is a dicey problem at component, system, subsystem and end–item level. It will be easier to achieve commonality with ground stations that direct the UAVs than it will be within a single family of UAVs. For example, naval and ground close requirements are sufficiently different to make it unlikely that a single air vehicle can meet the needs of both. These are the dimensions of the problems that face the UAV community today—and this is only the beginning. Interoperability with other combat equipment will complicate the equation.

Both industry and the Army laboratories need to work together to create synergy between the sensors and platforms to give the field commander a useful weapon. Industry is constantly improving the design of sensors that can identify, enhance and locate targets. However, the platform that is capable of carrying these sensors cannot always integrate or download its data where it is most needed—to the battlefield commander. He is the one who can benefit most from the enhanced peripheral vision UAVs can provide. The process of sensor fusion is being addressed. The commander who can use these gaps in enemy lines—and protect his own—will win. This is one of the biggest challenges on the nonlinear battlefield—the fusion of intelligence assets, target acquisition and the commander's situational awareness. Clearly, UAVs will play a role here, as will the all–source analysis system at division.

The Army has used foreign comparative testing to investigate the CL–227 (Canada) and the Sprite and Raven (United Kingdom) systems. There is a significant data base from these evaluations and from prior experience with the QH–50C Dash, Aquila and the Marine Corps airborne remotely operated device.[7] The initial operational capability for the close systems was expected in FY 96. However, the Army has recently made a persuasive push to move up the Initial Operating Capability (IOC) date to FY 94 on the basis that there are already sufficiently developed systems to bring to the battlefield—at least to start dealing with the real–world doctrinal problems likely to emerge.

Lethal UAVs

Lethal UAVs are tested differently in the Department of Defense, as they are included in the conventional weapons standoff master plan and not in the UAV JPO master plan. So, although the Tomahawk cruise missile could be considered a lethal UAV, for reasons of convenience, it normally is not. Probably the best example of a lethal UAV is the Tacit Rainbow emitter attack weapon, which has some missile–like capabilities with its small turbine engine. It also has a capability to fly autonomously, loiter in a predetermined area and then detect, classify and attack. In essence, this form of a lethal UAV becomes an aerial minefield, set to kill when cued properly.

The Army's interest lies primarily with the ground–launched version of the Tacit Rainbow (GLTR). This system is fired from the tracked multiple launch rocket system (MLRS). The GLTR will add to the MLRS' "shoot and scoot" defense against counterbattery fire and give it the capability to maintain a corridor sanitized of emitters.[8] The total program cost of the developmental GLTR program is estimated to be about $4.7 billion. Several challenging missions have been postulated for this sophisticated system.[9]

UAVs in Support of the Nonlinear Battlefield

Lethal systems are often left out of discussion of UAVs, yet they can play a crucial role in the Army's war–fighting doctrine. At the same time, as computing power gets smaller, cheaper and faster, sensors will get better and smarter. Warheads will get smaller and more lethal; airframe and engine technology will get cheaper. It is reasonable to expect that any distinctions today between the lethal UAV in the missile and weapon categories will become increasingly blurred.

The nonlethal classifications are more clear. The close–range UAV system will satisfy lower–echelon tactical units—divisions and brigades. The operational requirements for the system suggest that it be deployed at an echelon where the intelligence and targeting functions are introduced directly into existing reporting channels. In addition, there should be sufficient standoff from the battle zone to preclude posing a stationary target requiring frequent moves. In recent discussions with light infantry units, division staff members felt that lethal and nonlethal systems should be division assets, while the corps staff felt they should be corps assets! The point is that each level of command seems to want the information and killing capability that UAVs offer.

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The medium–range UAV is designed to complement manned strike aircraft by providing near–real–time reconnaissance data necessary for prestrike and postsrike planning. The UAV will be a high subsonic vehicle that has a moderate to high resolution imaging payload. It will have preprogrammed mission capability and navigational accuracies required to support targeting for weapon delivery. The vehicle will be ground– or air–launched and will have a 700–kilometer radius of action. This ideally suits the need to find them, fix them and in conjunction with manned strike aircraft, fight them. Clearly, this has a place in the nonlinear battlefield, providing a closed loop system in the battle zone.

The endurance UAV will generally operate within 300 kilometers of the dispersal area of a ship and have the capability for extended flight time of up to 36 hours and at altitudes above 20,000 feet. The system not only will provide a capability for wide area surveillance with single or multiple sensors (such as imagery, radio/data relay and SIGINT [signal intelligence]), but also will be interoperable with the short–range UAV.

Today the Army is looking beyond parochial manned aviation interests that have so far prevented the US Air Force and US Navy from integrating UAVs into their current war–fighting doctrine. The integration of both lethal and nonlethal UAVs on the future nonlinear battlefield envisioned by US Army Training and

Doctrine Command (TRADOC) planners and doctrine writers is nonetheless a substantial challenge. As these new unmanned capabilities enter the force, it will take many bright and innovative minds to tailor our doctrine to make UAVs most effective in supporting tomorrow's ground commander.

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In a presentation to the annual meeting of the Association for Unmanned Vehicle Systems, on 31 July 1990 in Dayton, Ohio, Major General Stephen Silvasy Jr., TRADOC deputy chief of staff for combat developments, sketched how UAVs would fit into the depth array of the nonlinear battlefield (fig. 2). The characteristics that highlight the battlefield's nonlinear quality from a UAV perspective are:

- Paucity of forces (fewer forces fielded).
- Flexibility (evolution beyond traditional branch missions).
- Rapidity of action.
- Fluidity.

Today's company commander influences much more terrain by virtue of longer range, more accurate fires and highly maneuverable weapons' platforms. Consequently, maneuver warfare does not have to be a head-to-head confrontation. Advanced systems such as UAVs can provide us the capability to strike at the enemy's weak points at opportune times and locations. Informed risk taking and offensive action are the watchwords of the day.[10]

In the parlance of the nonlinear battlefield, these are the systems that will be the commanders' scouts, enabling them to look over the next ridgeline to find and to fix the enemy. The system must be fairly simple and provide significant capability with minimum training. The close range UAV must be launched, recovered and operated with a minimum impact on deployed units. If UAVs are to be used for local area operations and deployed in large numbers, they must be affordable since they will probably encounter heavy enemy activity and the possibility of heavy vehicle losses.

The AirLand Battle Future concepts, which derive from the nonlinear battlefield, center on the role of technology, particularly sensor technology, to fill the gaps temporarily between widely dispersed forces that are interconnected with sensors of various types. Electronic sensors alone are of little value if they are not backed up by reconnaissance forces, UAVs and real-time imaging. This allows for the enemy to be attacked by fire and rapidly moving combined arms teams; subsequently, maneuver forces can be committed to fight the decisive battle. Thus,

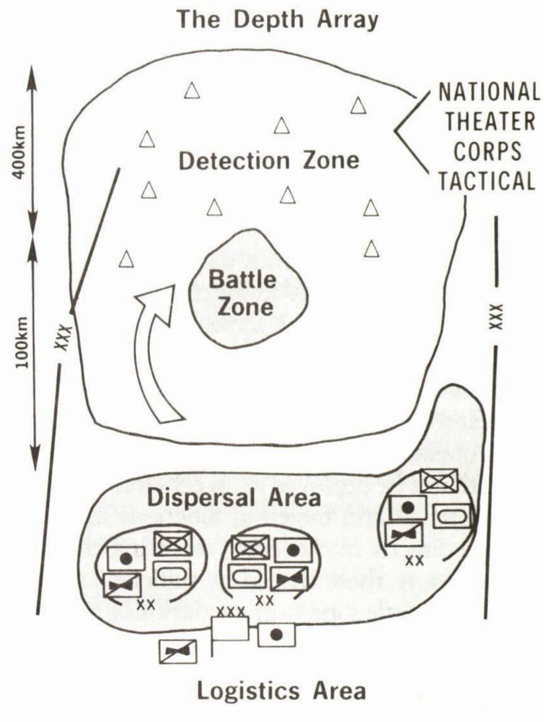

Figure 2. TRADOC's nonlinear battlefield

The complete system for the Pointer man-portable UAV can be carried in two hard-shell backpacks and assembled in less than five minutes. The JPO received six systems for field testing. They include the aircraft, a video downlink, video monitors and a joystick control.

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as the initial defender, our deployed forces are in a position to grab the initiative and force the pace for the main body. The defender can choose the decisive engagement, using UAVs and recon units to develop the situation for the main fight. In trying to characterize the nonlinear battlefield cycle and the tempo it dictates in this article, we have borrowed heavily from TRADOC's work, but the following interpretation is ours alone.

Find 'em. In the detection zone, out to 500 kilometers forward of the corps dispersal area, the corps commander would begin to use national, theater, corps, Guardrail (airborne radar system) and Joint Surveillance and Target Attack Radar System (JSTARS) assets to find the enemy. Endurance UAV systems would be key here, and it is useful to think of them as low-flying satellites. Therefore, the commander on the ground may not be the direct beneficiary of these systems. They will likely pass through corps and national technical means that have at least a three-day window on the enemy.

Since exact mobile radar locations will be tough to track continuously, two options are air- or ground-launched Tacit Rainbow systems or another, slower suppression of enemy air defenses (SEAD) weapon like the Israeli Harpy, a lethal UAV that is capable of long loiter and autonomous firing. Speed plays a role because it translates, through fuel usage, to range. Range is important because the INF (intermediate-range nuclear forces) Treaty between the United States and Soviet Union effectively limits the range of ground-launched weapons to 500 kilometers. Open sources indicate that the Israeli Harpy has a propeller engine, which gives it substantial endurance as it cruises to the target area looking for radars and increased persistence when acting like an aerial minefield.[11] The fast and slow approach to SEAD may be complementary on the nonlinear battlefield.

Shortly after the hostilities, sources in US Southern Command stated that "Soldiers' lives were compromised during the recent *Just Cause* operation in Panama due to the lack of Unmanned Aerial Vehicles."[12] Use of short–range systems could have improved the situation. For example, short–range requirements call for a system that can reconnoiter 150 to 300 kilometers forward of the dispersal area. This vehicle will conduct missions at low altitudes and transmit data to a ground control station within line of site or via an airborne relay if the vehicle is below the horizon. The short–range system vehicles may be configured to carry mission specific payloads or have unique survivability characteristics. In addition, it is to be the common architecture to achieve interoperability of all categories.[13] Such UAVs would have enhanced US forces reconnaissance, targeting and attack capabilities. Now, two contractors have been selected to compete for a short–range 1991 flyoff and production decision.

Today's company commander influences much more terrain by virtue of longer range, more accurate fires and highly maneuverable weapons' platforms. Consequently, maneuver warfare does not have to be a head–to–head confrontation. Advanced systems such as UAVs can provide us the capability to strike at the enemy's weak points at opportune times and locations. Informed risk taking and offensive action are the watchwords of the day.

Fix 'em. On the future battlefield, the UAV can fix the enemy by keeping him from moving, communicating or interrupting the movement of combat formations. As a precursor attack, autonomous, lethal UAVs can attack enemy air defenses and crucial enemy communication nodes and command posts. Lethal UAVs being considered as sensor technologies are being paired with both fast jet turbines and slow propeller UAVs that can fix the enemy. For example, a UAV that marries the Army's developmental infrared terminally guided sub munition (IRTGSM) with a loitering, lethal UAV might be useful to fix and destroy helicopters, tanks, command vehicles and other selected targets without attacking the main body. The close–range UAV will maximize the brigade commander's killing power.

At the 100–kilometer area, the commander must fix the enemy, interrupting his opponent's march table and forcing him to deploy. Reconnaissance UAVs and air and ground cavalry all contribute to this function. There are a variety of missions: target acquisition, designation, battle damage assessment (BDA), electronic warfare, command and control, decoy and meteorological/nuclear, biological and chemical deployment. The medium UAV will complement the manned aircraft and, as such, help it decisively engage in the main battle area. Its imaging payload provides a closed loop on real–time engagements, adding to the success on the nonlinear battlefield. The importance of the closed loop system is the identification of targets before engagement, followed by an assessment of target kill after engagement. This ensures minimum ammunition expenditure.

Fight 'em. Within 100 kilometers of the dispersal area, enemy maneuver units are dispersed and moving. This makes it difficult to target enemy formations. Close air support and battlefield air interdiction are primary means of aerial fire support. In addition, aerial mines of lethal drones can be effective against the enemy. The longer the loiter time, the more effective lethal UAVs can be because it will take time to locate the targets.

Then, corps–controlled long–range fire support, aviation and attack helicopters can be committed to the battle zone assisted by the short–range UAV. Finally, division–controlled maneuver forces and supporting fires are brought to bear in the battle zone, again using the targeting data from the UAVs. This cycle can repeat itself. The concept is to keep the enemy responding to our tempo. By using UAVs to monitor the progress of the battle and to determine the lethality of long-range fires, focused reattacks may be particularly effective. In any case, unmanned aviation should be the system of choice to conduct BDA for two reasons: first, it is hard to imagine a tougher task than to observe an enemy that has just been stirred up by an attack; second, the UAV will be under the direct operational control of the corps, division and brigade commanders who can ensure they get the information they need, when they need it.

Refit. To avoid counterattack and to return to the dispersal area for logistical support, units disperse and reconstitute. Reconnaissance UAVs are recovered and subsequent flights are used to monitor the enemy's reaction and to assess the optimum time for the next attack. The UAV would help the friendly commander reconstitute his own forces by observation of their movement and strengths.

The challenge for UAVs lies as much on the conceptual side as it does on the technical—in fact, perhaps more so. In general, many of the technical challenges appear to be within reach in the next decade or so. Later refinements will likely take the UAV along the same path followed by its more mature, manned aviation cousin over the last 70 years.

In the area of doctrine, however, it is not obvious how clever tacticians will be in the use of this revitalized information and killing tool. History has already shown that it has only been the imperative of combat that has forced commanders to turn to innovative technology like unmanned systems. The new and challenging nonlinear battlefield concept may be the first ground and air doctrine developed in peacetime to demand the unmanned system be used to its maximum potential. It only awaits bright US Army minds to lead the unmanned charge. ***MR***

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NOTES

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5. DMS Market Studies, RPVs/Drones/Targets 1989/90, Fourth Edition, Tom Lydon, project director, 377.
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11. *Defense Daily* reports that because of "potential high costs with the Raytheon-developed ground-launched version of the Tacit Rainbow loitering cruise missile, some Army officials have begun to look at the Harpy unmanned aerial vehicle (UAV) to perform the suppression of the enemy air defense (SEAD) mission," 13 August 1990, 233.
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Miles A. Libbey III is the director of the General Dynamics' UAV Program Office, Arlington, Virginia. He received a B.S. from the US Naval Academy and an M.A.L.D. and Ph.D. from the Fletcher School of Law and Diplomacy. He is a captain in the US Naval Reserve.

Major Patrick A. Putignano, US Army, Retired, is manager, Military Requirements and Special Projects in the General Dynamics' UAV Program Office, Arlington, Virginia. He received a B.S. from the US Military Academy and was a commander of a cavalry troop. He received a master's degree from the Woodrow Wilson School of Public and International Affairs, Princeton University and was a White House Fellow during 1984–1985.