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What factors would contribute most significantly to the effective use of UCAVs by the Combatant Commander, and how can they be most effectively employed to maximize their capabilities in support of operations? This paper will provide a brief background of UCAVs and their mission, as expressed in current Joint doctrine. Following this introductory information I will examine the role of UCAVs in supporting operational factors and functions.

The employment of UCAVs also raises significant issues of integration, deployment and legal questions, which must be addressed if UCAVs are to be used to their full potential. In concluding I will present several recommendations, which might make UCAVs more valuable to the Combatant Commander in future operations.

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UCAVs: SILVER BULLET OR FLASH IN THE PAN?

by

Juan Hogan
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A paper submitted to the Faculty of the Naval War College in partial satisfaction of the requirements of the Department of Joint Military Operations.

The contents of this paper reflect my own personal views and are not necessarily endorsed by the Naval War College or the Department of the Navy.

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Abstract

UCAVs: SILVER BULLET OR FLASH IN THE PAN?

What factors would contribute most significantly to the effective use of UCAVs by the Combatant Commander, and how can they be most effectively employed to maximize their capabilities in support of operations? This paper will provide a brief background of UCAVs and their mission, as expressed in current Joint doctrine. Following this introductory information, I will examine the role of UCAVs in supporting operational factors and functions.

The employment of UCAVs also raises significant issues of integration, deployment and legal questions, which must be addressed if UCAVs are to be used to their full potential. In concluding I will present several recommendations, which might make UCAVs more valuable to the Combatant Commander in future operations.

Introduction

The use of Uninhabited Combat Aerial Vehicles (UCAVs) in Afghanistan, and more recently Yemen, has made them seem to be an ideal new weapon in support of the Combatant Commander. While the future of UCAVs is bright, there are significant operational issues that must be addressed to ensure that the Combatant Commander will be able to get the most out of this much improved upon weapons system. Following the success of UCAVs against the Taliban and Al Qaeda in Afghanistan and Yemen, it seems almost certain that UCAVs will figure prominently in all future operations. What factors would contribute most significantly to the effective use of UCAVs by the Combatant Commander, and how can they be most effectively employed to maximize their capabilities in support of operations?

Definitions/Assumptions

UCAVs are a subset of the definition for Unmanned Aerial Vehicles (UAVs). According to Joint Publication 3-55.1, Joint Tactics, Techniques, and Procedures for Unmanned Aerial Vehicles, the definition of a UAV is, "a powered, aerial vehicle that does not carry a human operator, uses aerodynamic forces to provide vehicle lift, can fly autonomously or be piloted remotely, can be expendable or recoverable, and can carry a lethal or nonlethal payload."[1] The significant difference between the two being: UCAVs are specifically tasked to employ lethal force, and UAVs are normally only used in an Intelligence, Surveillance and Reconnaissance (ISR) role, or for target acquisition/designation. The Air Force, which has taken the lead for much of the development of UCAVs, commonly refers to UCAVs as "uninhabited" vice "unmanned." The reason is that, although there is not an aviator aboard the UCAV, there is

certainly a man in the loop, at the very least for weapons release. While future plans for UCAVs envision some sort of fully autonomous mode, whereby a UCAV would possess automatic target recognition (ATR) technology and be able to engage targets without human intervention, this paper assumes that the technology and rules of engagement (ROE) to allow this will not be available in the near term.[2] Although not a force planning paper, I will also assume that UCAVs will be fielded at a more accelerated rate than had been previously anticipated due to their positive performance and support in Congress, which will likely provide increased funding for UCAV research and development as well as acquisition.

Background

It may seem as though UCAVs are a very recent innovation in warfare, with all the attention they have recently received, but they have been around in one form or another since World War I. "Just eight days after declaring war, the Navy consulting board recommended that $50,000 be allotted to Elmer Sperry's Flying Bomb project….Sperry used the N-9 seaplane and a control system that he developed based on his work with gyroscopes to create the Flying Bomb, and early ancestor to modern UCAVs."[3] "The Army was quick to follow the Navy's lead and ordered 25 Kettering Bugs in 1918. The Bug could carry 180 pounds of explosives and cruise at 55 miles per hour with a range of about 40 miles. It was guided to its target by preset controls and had jettisonable biplane wings."[4] These predecessors to our current UCAVs were plagued by numerous problems and did not achieve much success during the war. Following World War I, innovations in aviation, specifically radio-controlled aircraft, did increase the effectiveness of the early UCAVs. Both the U.S. Navy and Army employed UCAVs during World War II,

mainly converting bomber aircraft into guided missiles. The Navy's Special Task Group One (STAG-1), operating in the northern Solomon Islands, with modified bombers, was able to successfully attack a Japanese merchantman with two direct hits, and achieved a 50 percent hit rate between September and October 1941.[5] However, the results in World War II were still decidedly mixed, and most UCAVs were employed on one-way missions, much as modern day TLAMs have been employed, though with obviously much less accuracy.

It would not be until the Vietnam War that UCAVs would achieve some measure of success in the form of the Ryan 147 Lightning Bug. While used primarily in a reconnaissance role, the Lightning Bug also, "played a role in the propaganda war against North Vietnam."[6] They were used to drop leaflets and even served to boost the morale of U.S. prisoners of war who reported that, "They were the only aircraft we heard for a long time and about the only thing that did lift our morale during those years."[7] Following the Vietnam War, as in many interwar years, UCAVs/UAVs experienced a drop in resources and interest. UAVs would be used again extensively in both Desert Storm and Kosovo with a fair amount of success. Here again they were used mainly for reconnaissance, but also for Bomb Damage Assessment (BDA) and target acquisition, operating predominately at the tactical level. One of the reasons for the ups and downs of UCAV employment and development is the dearth of doctrine on the use of UCAVs and a relatively poor understanding of how UCAVs can be effectively used. While most would agree that UCAVs have a potentially significant role in the support of operations, it is not at all clear how they should be most effectively used and incorporated in operational plans. In answering this question my paper will address some of the potential uses of UCAVs for the Combatant Commander, specifically focusing on the roles UCAVs could play in supporting

operational factors and functions in a commander's given theater of operations.

Mission

The greatest challenge facing the future of UCAVs is how they will be incorporated into plans and employed by the Combatant Commander to achieve the greatest results? One of the significant advantages the Combatant Commander can gain through the use of UCAVs is that they can be sent into an area, if necessary, where the risk to a manned platform may be excessive:

> *When US Air Force Capt Scott O'Grady's F-16 was shot down over Bosnia in June 1995, Americans watched anxiously as aircraft and helicopters searched for the missing pilot. When O'Grady was retrieved safely from a Balkan forest, television networks cut to special bulletins.*
>
> *Two months later, an Air Force reconnaissance aircraft also crashed in hostile territory. No attempt to search for the crew was made. The incident rated two lines near the back of most newspapers. Rather than dodging Serbs and eating bugs to survive comfortably, the operators of the Predator unmanned airplane were sitting in an air-conditioned shelter at the USAF's base at Aviano, Italy.*[8]

Determining risk is an essential element in operational planning. UCAVs allow the Combatant Commander to assume less risk to his personnel and still accomplish the mission. According to JP 3-55.1, "The primary mission of UAV units is to support their respective Service component commands as a tactical RSTA system providing the commander a capability to gather near-real-time data on opposing force position, composition, and state of readiness."[9] It should be noted however that JP 3-55.1 is dated 27 August 1993 and does not address UCAVs, dealing specifically with non-lethal UAVs. As Andrew Krepinevich pointed out in testimony to the Senate Armed Services Committee, "While UCAVs have great promise, it is far from clear how many missions they can assume from the manned combat air arm, or how quickly they can be made to do so."[10]

Operational Factors

Perhaps one of the best methods to analyze the usefulness of UCAVs is to evaluate their potential in terms of the operational factors of time, space, force and the operational functions they can support. The three operational factors of time, space and force may all be affected by UCAVs to one degree or another. By identifying the operational factors in a given theater of operations, the "proper balancing of these factors with the objective would allow one's operational commander to enhance his freedom of action in planning and execution of a campaign or major operation…."[11] In examining the UCAVs role in supporting operational factors, I will bound the analysis by looking specifically at their potential contribution against mobile targets.

Time: UCAVs give the Combatant Commander a tool to compress time from detection of a target to engagement because of their inherent ISR capability coupled with an onboard weapons system. UAVs, during Desert Storm, were able to identify targets and pass that information back to decision makers who would then have to direct aircraft to destroy the target. UCAVs, however, have the capability to identify a target and then destroy it. They also have the capability to loiter for long periods of time in support of time critical targeting, which makes them an excellent platform to use in addressing the mobile missile problem. This ability to remain on station for long periods of time and react quickly may enable the Combatant Commander to get within the observe, orient, decide and act (OODA) loop of the adversary and gain a decisive advantage.

Space: "The main characteristic of modern warfare is the continuous expansion of space

in which military movements and combat action took place."[12] UCAVs are able to reduce some of the space considerations of the Combatant Commander within a given theater of operations. With them the Combatant Commander can monitor a large area for long periods of time. This ability is vitally important in a scenario, such as a new conflict with Iraq. If, as in 1991, Saddam Hussein launched SCUDs from desolate areas in western Iraq against Israel, or against U.S. forces in the theater, the area that would have to be searched for SCUDs is enormous. UCAVs, in addition to their ability to loiter on station, can also transmit imagery to planners and decision makers in theater and around the world. Thus, not only do UCAVs allow a JTF commander or Combatant Commander in theater to enhance his situational awareness, but intelligence analysts in CONUS are able to evaluate UCAV video as well.

Force: The factor of force is not directly connected to how many UCAVs are flown in support of operations, but rather what their contribution is to accomplishment of the mission. In this case, how would UCAVs support the mission of destroying mobile targets? Numbers alone would certainly be part of the equation, but perhaps more significant is the freeing up of manned platforms to conduct missions, such as close air support, combat air patrol and defensive air patrols that UCAVs are poorly equipped to support. During Desert Storm, vast resources were expended in support of "Scud hunting" missions to the detriment of other equally vital missions. UCAVs can appreciably enhance the Combatant Commander's flexibility in dealing with mobile targets, and how his forces are allocated to support that mission, without degrading his capability to provide forces in support of other equally important missions. UCAVs also have the advantage of being able to operate in environments where sending in a manned aircraft may be undesirable because of a high level of risk. For example, if it is suspected that chemical or

biological weapons have been used, UCAVs could be sent into the area to continue operations without endangering aircrew. They may also be equipped with sensors to determine if chemical/biological agents are indeed present.

Operational Functions

In addition to the operational factors, there are six operational functions for the Combatant Commander to consider in planning and execution at the operational level of war. "Successful employment of combat forces across the operational continuum requires the existence and an effective organization of functions in support of the employment of combat forces. These functions are theater-wide; hence, the term operational functions.[13] UCAVs do not play a major role in all of the operational functions, but they can contribute significantly in several areas.

Operational Command & Control: General Curtis E. LeMay once said, "Without communications, I can't command anything beyond my desk."[14] Today the opposite problem may exist for the Combatant Commander. Not only does he have the Command and Control (C2) to effectively manage operations below him in the chain of command, but his superiors have the C2 to influence his activities as well. Because of their inherent ISR capabilities, UCAVs figure prominently in this operational function. The President, SECDEF, JCS, and others, will all be able to receive UCAV imagery and see targets engaged and destroyed. At what point will they be involved in deciding if a target is "strategic" and whether or not they should control the employment of the asset? While specific issues of micromanagement of forces are beyond the scope of this paper, the Combatant Commander would certainly need to be aware of where UCAV video is being broadcast and who is seeing it. This is important not only to

preclude micromanagement from above, but also to be cognizant of the fact that it is easy for his staff to focus too much at the tactical level because of all the information they are receiving from UCAVs and other ISR platforms.

Operational Intelligence: Because UCAVs, especially in the case of the Predator, must relay information to a "man in the loop" in order to be given the order to fire on a target, they inherently possess the communications necessary to provide valuable information in support of intelligence collection efforts as well. This information, when fused and analyzed with other intelligence sources, can assist the J2 in his initial joint intelligence preparation of the battlefield (JIPB) and enhance collection throughout operations. The UCAV's ability to loiter over a target also makes it an excellent platform for providing BDA, not only in support of its own mission, but for strikes from other platforms as well. Once a UCAV has expended its munitions, it may still have a relatively long loiter time remaining. If properly taken into account in planning, the Combatant Commander and J2 can use these platforms to respond to multiple missions in support of operations. The J2 should be cognizant of when and where UCAVs will be operating and plan on integrating UCAVs into the collection plan.

Operational Command and Control Warfare: Suppression of enemy air defenses (SEAD) is viewed as the most likely role in which UCAVs would contribute significantly in support of operational plans. Dr. Michael Andrews, chief scientist for the Army, envisions UCAVs playing a vital role as force enhancers for the Combatant Commander in defeating an opponent's Integrated Air Defense System (IADS). "Our Unmanned Combat Air Vehicle (UCAV) programs are another example of our Operational Dominance investments. We are working jointly with the Air Force and the Navy to develop autonomous unmanned systems that

will be able to work with manned aircraft to effectively and affordably suppress enemy air defenses…"[15] The role of UCAVs in SEAD is vital to virtually any future operations. Following Desert Storm, the USAF made the decision to do away with its dedicated SEAD platforms, the EF-111 and F-4G Wild Weasels, placing most of the burden for SEAD on the USN EA-6B Prowlers. Since then, Prowlers have been formed into expeditionary squadrons, in addition to the requirement for carrier-based squadrons, stretching this high value asset very thin. UCAVs have the potential to alleviate some of that pressure and provide additional assets in support of operational plans, nearly all of which require SEAD support to protect strike aircraft against enemy IADS. "Members of the DARPA ATD program believe that a successful SEAD UCAV project would take some pressure off the Air Force, which has had no dedicated SEAD platform for seven years."[16]

Operational Fires: The final operational function in which UCAVs can provide significant support is in the area of operational fires. Operational fires are different from tactical fires because they are planned at the operational level in order to conduct a specific operational purpose, ranging from shaping the battlespace, and diminishing enemy morale to protecting friendly areas of operations.[17] Again, the mobile target example I used earlier provides a good framework for examining how UCAVs are used in support of operational fires. At the operational level, the Combatant Commander may decide that SCUDs are of such importance that their elimination will significantly shape the battlespace, and additionally will provide enhanced security for his bases of operations. His staff will plan how operational fires will be used in order to eliminate the SCUD threat. UCAVs are a tool that the Combatant Commander can use, in addition to many other assets, such as manned aircraft and special operations forces,

to prosecute SCUDs. The UCAV's unique capabilities will allow the Combatant Commander more flexibility in planning and would likely reduce the number of manned aircraft and risk required to accomplish the mission.

Employment Issues

Thus far, I have identified many roles for UCAVs in supporting Combatant Commander requirements at the operational level. While the potential for UCAVs is great, there are important considerations that must be taken into account in order to effectively integrate UCAVs into operational plans. Chief among these is developing doctrine that accurately reflects UCAV capabilities and how they may be most effectively employed. As discussed earlier, current doctrine for UCAV employment is non-existent. Joint Pub 3-55.1 addresses UAVs, but not UCAVs, and is nearly a decade old. In 1953 I.B. Holley's book, Ideas and Weapons, outlined many of the problems the USAF was experiencing with incorporating new aircraft and weapons into the force in the most effective manner possible. His thoughts fifty years ago on doctrine seem especially relevant when applied to today's UCAVs:

> But it has sometimes happened that new weapons have been developed, adopted as standard, issued, and then neglected for lack of accepted doctrine regarding their use. It has probably more often happened that new weapons have been adopted and even used to a certain extent but that their full potential value has remained unexploited because higher policy-making echelons have failed to modify prevailing doctrine to embrace the innovation. New weapons when not accompanied by correspondingly new adjustments in doctrine are just so many accretions on the body of an army.[18]

UCAVs have proven themselves valuable in Afghanistan and Yemen, and if a conflict with Iraq occurs in the near term, they are likely to be used extensively. The question becomes, what will happen to UCAVs after that? Updated, well-thought-out doctrine will go far in ensuring that the

role of UCAVs in future operations is understood and fully exploited to our advantage. Without that, it seems to me that UCAVs will continue to be developed and employed in an ad hoc manner, rather than as an integrated asset performing missions in support of Combatant Commander operational functions.

Integration: Proponents of UCAVs envision them leading the way for strike aircraft by performing SEAD, thereby allowing the manned aircraft to successfully strike their targets with a reduced level of risk. The process of integrating UCAVs into operations with manned aircraft is something that as of yet has not been accomplished, but is being planned. The X-45 is one of the UCAVs under consideration as a SEAD platform. "The X-45's graduation exercise—now expected in about 2004—will involve multiple vehicles, working with manned aircraft in a Red Flag-type scenario.…The UCAV will have to demonstrate its ability to work alongside manned aircraft, serving as an escort SEAD platform."[19] UCAVs are already incorporated into the Air Tasking Order (ATO) for deconfliction with manned aircraft, but flying in direct support of a strike package is a much more difficult proposition than relatively simple deconfliction of airspace. One of the disadvantages of UCAVs is that they have a relatively low level of situational awareness (SA). They are effective when flown to a specific target, or when loitering in their own "box" looking for targets. In a more dynamic situation, however, their lack of SA could prove detrimental to mission accomplishment, but perhaps more importantly to the safety of aircraft flying in close proximity to the UCAV. Not only is their field of vision very restricted, but the idea that an operator in an air-conditioned van in the rear will have the same level of SA as a pilot flying an aircraft on scene seems to be rather doubtful at best. An illustrative example might be a UCAV in a SEAD role for a strike. If the strike aircraft were

forced to quickly change plans because of a developing situation (i.e. enemy aircraft) the pilot of that UCAV may or may not be aware of the situation and be able to react appropriately. The loss of SEAD support could result in the failure of the mission or cause it to be aborted. Many of these issues can be mitigated by tests and training, such as the one with the X-45, and by establishing doctrine to address potential integration issues.

Bandwidth: The use of communications bandwidth in any operation is a serious concern and planning factor, and one that must be considered when planning for the use of UCAVs. "The primary disadvantages of UAVs are their need for large bandwidth communications, vulnerability to jamming, and low survivability in military operations."[20] Proponents of UCAVs, such as DARPA program manager Col. Michael Leahy, USAF, argue that, "…concerns over bandwidth are unnecessary since the UCAV will require less than combat involving manned aircraft. Since the UCAV will have onboard intelligence, only small amounts of data need to be broadcast to battle commanders, he argues."[21] While increased levels of autonomy and ATR may lessen bandwidth requirements for control of UCAVs and weapons release, these technological improvements are still some distance in the future. The use of ATR, or some form of onboard intelligence, may indeed reduce the requirements for bandwidth, but they introduce other problems as well.

Legal/ROE Issues: "At present, no serious thought has been given to the legal implications of a condition in which command-like functions are exercised by an entity other than a human."[22] Will ATR be sufficient to determine if a target is legitimate, and will a UCAV be able to make collateral damage assessments in terms of both infrastructure and personnel? The technologies necessary to enable a UCAV to determine if a vehicle is a SCUD Transporter

Erector Launcher (TEL) and engage it autonomously do not seem to be overly difficult to develop. The larger problem is, will that UCAV be able to discern what the collateral damage will be, and is it acceptable? This inability to determine collateral damage brings up a potential conflict with the Law of Armed Conflict (LOAC), specifically the LOAC principle of discrimination. "The Principle of Discrimination ….requires the parties of the conflict to distinguish between civilians and combatants; distinguish between civilian objects and military objectives; and direct operations against military objectives only. Therefore, an attacker must not employ weapons that would cause excessive collateral damage."[23]

For the Combatant Commander, operating within the LOAC is obviously fundamental and necessary, and the way in which these legal restraints and constraints are passed along to his forces is through the ROE he is provided and modifies as allowable. "ROEs are the final legal issue that must be addressed before deployment and employment of UCAVs is …. Each Commander in Chief (CINC) augments SROEs as necessary to authorize certain actions or place limits on the use of force.…The most critical area that must be addressed is authorization to release…."[24] These legal issues are clearly important, but may tend to be overlooked as more emphasis is placed on employment of UCAVs and specific tactics, techniques and procedures. This is a further reason why comprehensive doctrine must be developed and tested so that Combatant Commanders and their staffs are cognizant of the issues they must address with future UCAV technologies.

Deployment Issues: Like any other weapons system, UCAVs have to get to the theater in order to conduct their mission. In a speech at the Air Force Association Symposium, Gen. John P. Jumper, CSAF, addressed the UCAV deployment issue by saying,

The picture you see is this unmanned vehicle that is swarming over the landscape

> of enemy territory undetected brave and indestructible. How did it get there, you as the people who build it? Well, we put it in a large box and we load up C-5s with it. Oh. You mean the C-5s are going to transport the Army and the Navy and everybody else during the early days of the war? Well, yeah. I don't think so. When you get them there, what has to happen? Oh well, we take them out of the coffin. We assemble them and we test fly them. We check them all out. I said, "where did the rapid go?" Where did the rapid and air power go with this? Maybe we'll fly them over there. Oh ok, you've got the automatic air refueling system perfected yet. That is somebody else's problem. We have got a few steps left to go.[25]

Gen. Jumper brings up an excellent point for Combatant Commanders and their staffs to consider in their planning and Time-Phased Force and Deployment Data (TPFDD) development. The planners will need to determine how important UCAVs are to their overall operational concept and when they must be flowed into the theater in order to be ready to conduct operations when required. Some long range UAVs, such as the Global Hawk, will likely have the capability to self deploy, but as of now, UCAVs do not have that ability.

Conclusion

So, what factors would contribute most significantly to the effective use of UCAVs by the Combatant Commander, and how can they be most effectively employed to maximize their capabilities in support of operations? I have presented my analysis of the operational factors and functions that UCAVs can support for the Combatant Commander at the operational level. Even at the relatively simple level of current UCAVs, they have proven to be effective tools in the planner's toolkit. The challenge becomes how to integrate UCAVs into operational plans, and developing doctrine that will address some of the issues that I have identified for UCAV employment. In testimony before the Senate Armed Services Committee, Gen. Jumper voiced his support of UCAVs, and his intent to continue their development. He noted that, "The UCAV

holds great promise for the future. Many challenges remain in terms of how we operationalize its capability.…I intend to see the development of a low life-cycle cost, mission effective system design and demonstrate the critical technologies, processes, and system attributes for a UCAV weapon system.…"[26] I would recommend that joint doctrine be developed specifically for UCAVs, in coordination with the Combatant Commanders, that addresses the issues of employment, integration, deployment, bandwidth and legal issues. That UCAV lessons learned from Afghanistan and Yemen need to be documented, and any resultant issues addressed in doctrine and training. Finally, UCAVs, such as the X-45 and Predator, must be fully integrated in pre-deployment joint training. UCAVs are not a silver bullet that will win a conflict for the Combatant Commander, but they can support his mission and act as a force multiplier.

[1]

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