REPORT DOCUMENTATION PAGE

1. Report Security Classification: UNCLASSIFIED			
2. Security Classification Authority:			
3. Declassification/Downgrading Schedule:			
4. Distribution/Availability of Report: DISTRIBUTION STATEMENT A: APPROVED FOR PUBLIC RELEASE; DISTRIBUTION IS UNLIMITED.			
5. Name of Performing Organization: JOINT MILITARY OPERATIONS DEPARTMENT			
6. Office Symbol: C		**7. Address**: NAVAL WAR COLLEGE 686 CUSHING ROAD NEWPORT, RI 02841-1207	
8. Title (Include Security Classification): The UAV and the Operational Commander (U)			
9. Personal Authors: LCDR Michael A. Tluchowski, U.S. Navy			
10.Type of Report: FINAL		**11. Date of Report**: 4 February 2002	
12.Page Count: 29 **12A Paper Advisor (if any):** Lt. Col. Joseph Dill			
13.Supplementary Notation: A paper submitted to the Faculty of the NWC in partial satisfaction of the requirements of the JMO Department. The contents of this paper reflect my own personal views and are not necessarily endorsed by the NWC or the Department of the Navy.			
14. Ten key words that relate to your paper: UAV, Operational Commander, Command and Control, Operational Functions, Battle Space Awareness			
15.Abstract: This paper will address the UAV's evolution into a valuable asset for the operational commander. The writer argues that the integration of UAV sensor data into a common network was pivotal in underscoring the UAV's ability to support the operational commander. The UAV has improved and continues to improve the operational commander's capabilities. Today's UAV has the capability to enhance operational command and control (C2) by improving the commander's battle space awareness. The operational commander's ability to plan, sequence, synchronize and orchestrate joint and combined activities is enhanced by UAV technologies. This paper will explore the UAV's impact on the operational commander using a past and present approach. It will provide the reader with a brief history of the UAV and its current capabilities. It will explore the UAV's recent operational and C2 contributions in both Bosnia and Kosovo. And finally, it will take a speculative look at how the UAV can provide the operational commander with the ability to support operational functions.			
16.Distribution / Availability of Abstract:	**Unclassified** X	**Same As Rpt**	**DTIC Users**
17.Abstract Security Classification: UNCLASSIFIED			
18.Name of Responsible Individual: CHAIRMAN, JOINT MILITARY OPERATIONS DEPARTMENT			

19.Telephone: 841-6461	20.Office Symbol: C

Security Classification of This Page Unclassified

NAVAL WAR COLLEGE
Newport, R.I.

The UAV and the Operational Commander

By

Michael A. Tluchowski
LCDR, U.S. Navy

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.

Signature: ______________________________

4 February 2002

____
Lt. Col. Joe Dill
Faculty Advisor

Report Documentation Page

Report Date	Report Type	Dates Covered (from... to)
04 Feb 2002	N/A	-

Title and Subtitle The UAV and the Operational Commander	**Contract Number**
	Grant Number
	Program Element Number
Author(s)	**Project Number**
	Task Number
	Work Unit Number
Performing Organization Name(s) and Address(es) Joint Military Operations Department Naval War College 686 Cushing Road Newport, RI 02841-1207	**Performing Organization Report Number**
Sponsoring/Monitoring Agency Name(s) and Address(es)	**Sponsor/Monitor's Acronym(s)**
	Sponsor/Monitor's Report Number(s)
Distribution/Availability Statement Approved for public release, distribution unlimited	
Supplementary Notes	
Subject Terms	
Report Classification unclassified	**Classification of this page** unclassified

Abstract

This paper will address the UAVs evolution into a valuable asset for the operational commander. The writer argues that the integration of UAV sensor data into a common network was pivotal in underscoring the UAVs ability to support the operational commander. The UAV has improved and continues to improve the operational commanders capabilities. Todays UAV has the capability to enhance operational command and control (C2) by improving the commanders battle space awareness. The operational commanders ability to plan, sequence, synchronize and orchestrate joint and combined activities is enhanced by UAV technologies. This paper will explore the UAVs impact on the operational commander using a past and present approach. It will provide the reader with a brief history of the UAV and its current capabilities. It will explore the UAVs recent operational and C2 contributions in both Bosnia and Kosovo. And finally, it will take a speculative look at how the UAV can provide the operational commander with the ability to support operational functions.

Classification of Abstract unclassified	Limitation of Abstract UU
Number of Pages 31	

Abstract of

THE UAV AND THE OPERATIONAL COMMANDER

This paper will address the UAV's evolution into a valuable asset for the operational commander. The writer argues that the integration of UAV sensor data into a common network was pivotal in underscoring the UAV's ability to support the operational commander. The UAV has improved and continues to improve the operational commander's capabilities. Today's UAV has the capability to enhance operational command and control (C2) by improving the commander's battle space awareness. The operational commander's ability to plan, sequence, synchronize and orchestrate joint and combined activities is enhanced by UAV technologies. This paper will explore the UAV's impact on the operational commander using a past and present approach. It will provide the reader with a brief history of the UAV and its current capabilities. It will explore the UAV's recent operational and C2 contributions in both Bosnia and Kosovo. And finally, it will take a speculative look at how the UAV can provide the operational commander with the ability to support operational functions.

Contents

THE UAV AND THE OPERATIONAL COMMANDER

Introduction

The rapid pace of advancing technology has influenced the way warfare is conducted. General Tommy R. Franks, Commander and Chief (CINC) U.S. Central Command (CENTCOM), commented that the war in Afghanistan is "truly a different war."[1] "One of the most unconventional aspects of the U.S. war in Afghanistan is that its commander usually has been on the other side of the planet."[1] General Franks is commanding the war on terrorism from his headquarters in Tampa, Florida. He wrote that keeping the command post in Tampa "has been very effective in our view because of technology assists, which promote 24/7 situational awareness. These communication leaps have permitted us to provide intent and guidance without doing the tactical work of subordinate commanders."[2] The unmanned aerial vehicle (UAV) is a byproduct of advancing technology and one of the reasons why war is so different today. The UAV's impact and influence during conflict has been and continues to be **significant**.

> "Our information and our ability to see the battlefield as a result of things like the Predator (unmanned reconnaissance aircraft) and the communications off the battlefield have radically changed everything we know. The result is that Franks can sit in his headquarters in Tampa and watch on screens things you couldn't have seen even 10 years ago by actually being on the ground."[3]
>
> \- *A Senate aide involved in military affairs*

This writer's hypothesis is that the UAV (when deployed and in concert with modern communication technologies) has improved and continues to improve the operational commander's capabilities. In addition, UAV technology has enhanced operational command and control (C2) by providing the operational commander a flexible, responsive and accurate view of the battle space. The operational commander's ability to support operational functions, plan, sequence, synchronize and orchestrate joint and combined activities is enhanced by UAV technologies.

This paper will support this hypothesis by exploring the UAV's impact on the operational commander using a past and present approach. First, it will provide the reader with a brief history of the UAV and its current capabilities. Then it will explore the UAV's more recent operational and C^2 contributions in Bosnia and Kosovo. Finally, it will provide a speculative look at how the UAV can provide the operational commander with the improved ability to support his operational functions.

History of the UAV

To appreciate the UAV's value to the operational commander it is important to understand its capabilities and see from where it evolved. Unmanned aircraft (in both a belligerent and non-belligerent role) have a history dating back as early as World War I.4 Acting as an instrument of war, the UAV's potential has increased rapidly over the past forty years. On 1 May 1960, during the height of the Cold War, Air Force Captain Francis Gary Powers was shot down over Russia while gathering Intelligence in a U-2 reconnaissance aircraft.5 The political pressure to not put pilots in harm's way coupled with the need for strategic and operational intelligence provided the U. S. with motivation to begin an unmanned, remotely guided drone program to support strategic and operational photographic surveillance missions. The first real success occurred in the mid-1960's with flights over China and Vietnam in a Teledyne-Ryan Model 147 AQM-34 "Lightning Bug".6 The "Lightning Bugs" were used from 1964 to 1975 to collect imagery, provide electronic countermeasures, fly decoy missions, and drop propaganda leaflets.7

The UAV missions of the late 1960's and early 1970's were planning intensive. A drone flight required lengthy planning time and significant turn around time to process and validate captured intelligence products. While this process was beginning to improve, the war in Vietnam was coming to a close. The U.S. military underwent a weighty post-conflict downsizing; the future of the UAV was bleak. In 1979 more than 60 air-launched recoverable UAVs were sent to the mothball fleet.8 General awareness of the UAV and its value to military operations tapered off and became almost non-existent during the 1980's.

The UAV played an important role in the Persian Gulf War.9 As happened in conflicts from World War I to Vietnam the UAV became a viable option when the U.S. realized that air operations in a high threat environment had the potential to produce large casualty rates. The Israeli-made Pioneer UAV provided operational commanders and their staffs with live video capability to examine the battle space.10 The Navy used the Pioneer in support of operational fires including 16-inch gun shore bombardments, Bomb Damage Assessment (BDA) and naval gunfire spotting. "UAVs were used to map Iraqi minefields and bunkers, thus allowing the Marines to slip through and around these defenses in darkness, capture key command sites without warning, and speed the advance into Kuwait City by as much as two days."11

While the UAV provided the US military with many success stories, its potential was still in its infancy. The Pioneer had limited capabilities in capturing video and still imagery at a rudimentary ground control station. Videotape and pictures would then be recorded and forwarded to intelligence and operational experts for analysis. These UAVs were line of sight (LOS), endurance and communication limited. While mission and production times improved over Vietnam platforms, time critical information still reached commanders late. The Gulf War proved to be an important watershed in UAV operations and led to the development of today's UAV family: Outrider, Predator, and Global Hawk.12 Overall, the DOD's final report of the Gulf War concluded that the UAV "proved excellent at providing an immediately responsive intelligence collection capability." 13

UAV Capabilities Available to Theater CINCs

The UAV success during the Gulf War coupled with a boom in computer and communications technology enticed theater CINCs and Congress to push for further UAV exploration. The United States launched two UAV investment programs in the mid 1990's and the UAV Battle Lab was opened by the Air Force at Eglin AFB. "Battle Lab members are pilots, intelligence officers, and other specialists charged with exploring the future of UAVs."[14] The Battle Lab explores UAV capabilities, reports on findings, and makes recommendations to the Air Force on what future actions should be taken. [15]

The DOD, in turn, created its own think tank with support from the Defense Advanced Research Project Agency (DARPA) and the Air Force's Advanced Concept Technology Demonstration Program (ACTD).[16] "The goal of this program was for the Air Force and DARPA to work together to demonstrate the technical feasibility…to effectively and affordably prosecute 21st century missions within the emerging command and control architecture." [17] The Predator, Global Hawk and Outrider are all products of the ACTD Program.[18]

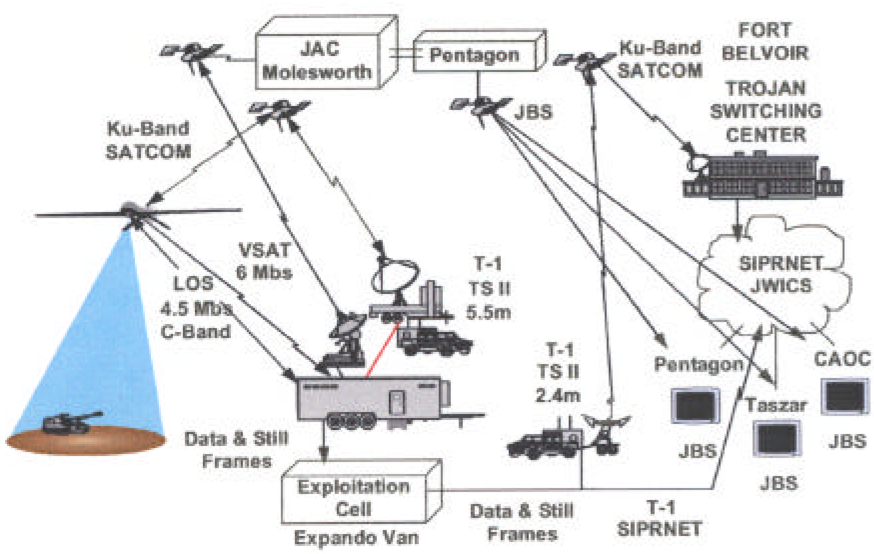
There are two general types of UAVs: *Tactical* and *Endurance*. The **Tactical UAV** (TUAV) has a reconnaissance, surveillance, and target acquisition capability during day and night; however, this type of UAV has limited bad weather capabilities.[19] The TUAV operates at or below 15,000 feet using line-of-site or relay line-of-sight control.[20] The payloads may vary but most TUAVs have electroptical/ infrared sensors and a variety of VHF and UHF communication components.[21] TUAVs have one to five hours of endurance and a radius of action of up to 200 nautical miles.[22] Today the most prevalent TUAVs used in the United States are the Pioneer, Hunter, Outrider and Dragonfly.[23]

The **Endurance UAV** (EUAV) provides near real-time synthetic aperture radar, electro-optics and infrared imagery for extended time periods.[24] The EUAV has an endurance period from 12 to 38 hours via command and control nodes.[25] The EUAV is capable of operating at altitudes of 15,000 to 65,000 feet.[26] The *Joint Tactics, Techniques, and Procedures for UAVs* publication Joint Publication 3-55.1 provides a more in-depth and broader breakdown of UAV categories and their capabilities. Appendix A presents a description of UAV class categories and their capabilities. The chart in Appendix B enumerates a wide spectrum of UAV capabilities available to today's operational commander.

The most significant operational level improvement made to the UAV system was the ability to link real time information to military commanders at various levels, as well as to numerous intelligence users. The Defense Airborne Reconnaissance Office (DARO) developed two types of ground control stations (GCS) in an effort to standardize UAV operations and streamline the flow of vital mission data.[27] A Tactical Control System (TCS) supports all TUAVs and a Common Ground Segment (CGS) supports the High Altitude Endurance (HAE) UAVs.[28] These two GCS types support the system requirements for two complementary UAV classes. The TCS has a small footprint and is very mobile, adequately suiting the needs of the tactical commander. Conversely, the CGS is large and has the ability to control multiple HAE UAVs and process high data rates associated with multiple missions and the large data flow of the HAE UAV. [29]

The TROJAN SPIRIT II (TS II) satellite communications (SATCOM) network integrates sensor data from the Predator UAV into the C4I architecture. Figure 1 illustrates how the Predator C4I network provides near real time video simultaneously to numerous theater and national intelligence users. To disseminate real time data the network uses the Joint Broadcast System (JBS) or the TS II switch at Fort Belvoir, Virginia.[30]

Figure 1



Source: Air Combat Command Concept of Operations: For Endurance Unmanned Aerial Vehicles, Ver. 2 Sect. 6:6.1, "Communication Integration And Interoperability." Available from http://www.fas.org/irp/doddir/usaf/conops_uav/part06.htm.

Today's theater commander has the ability to put UAV sensors in the air equal to (if not better than) those found in many of our combat aircraft with less risk and more flexibility. The commander is able to use and share collected data on a near real time basis in any given area of responsibility (AOR).

> *I was looking at Predator [imagery displays] yesterday. It was flying over an area…at 25,000 feet. It had been up there for a long time, many hours, and you could see the city below, and you could focus in on the city, you could see a building, focus on a building, you could see a window, focus on a window. You could put a cursor around it and [get the GPS latitude and longitude very accurately, remotely via satellite. And if you passed that information to an F-16 or an F-15 at 30,000 feet, and that pilot can simply put in that latitude and longitude into his bomb fire control system, then that bomb can be dropped quite accurately onto that target, maybe very close to that window, or, if it's a precision weapon, perhaps it could be put through the window… I'd buy a lot of UAVs in the future.* [31]
>
> -- Admiral William A. Owens
> Vice Chairman of the Joint Chiefs of Staff
> June 1995

Bosnia - UAV Impact on Operational Command and Control (C2)

C2 is a widely used term covering a plethora of activities throughout an organization. "Folded into this term is everything from inspiring and motivating the individuals in the organization to setting and conveying a common sense of purpose, to assigning responsibilities, to assessing how well the organization is performing."[32] The UAV's contribution to command and control is the ability to give the decision maker a clear and accurate view of a given situation in a timely manner, which in turn gives the decision maker time to make an informed decision and appropriate action. Col John Boyd, (USAF, Ret) coined the term and developed the concept of the "OODA Loop"[33] (Observation, Orientation, Decision, Action), which is displayed in Figure 2. When applied to the operational commander's decision process, the UAV enables the operational commander to shorten his OODA loop by keeping him oriented to the battle space and allowing him to take advantage of timely and relevant sensor data (which supports an appropriate decision).

Boyd's OODA "Loop"

Sketch

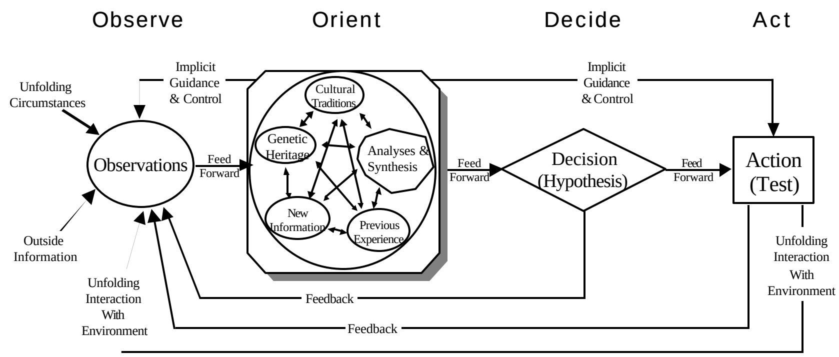


Figure 2

Source: "Boyd's OODA Loop Revealed." Available from http://www.d-n-i.net/FCS_Folder/boyds_ooda_loop.ppt.

In his book, *Operational Warfare*, Professor Milan Vego defines operational command and control as**:** **"**Theater-wide or operational command and control (C2) is the principal means by which a theater commander sequences and synchronizes joint force activities in peacetime and orchestrates the use of military and non-military sources of power to accomplish assigned strategic objectives." [34]

The UAV's contribution to operational C2 centers directly on the commander's ability to monitor the theater and has nothing to do with the structure of the organization. The UAV supports and enhances a working command structure, but in no way is a replacement or in-line fix for a badly structured organization or a poorly designed span of control. Professor Vego further enhances his definition of operational C2 as follows: "It binds together all other functions with the joint forces and assets deployed in a given theater. A sound C^2 ensures that the operational commander can continuously monitor the situation in the theater and supervise the actions of his subordinates, but without interfering in their work." [35]

Having Predator sensor data integrated into the C4I structure in Bosnia, the UAV had a broader more significant impact on operational command and control than ever before. The U.S. CINC European Command (EUCOM) was able to task a reconnaissance platform without having to rely on national level assets, regardless of threat or crew limitations. The UAV also provided the commander with the flexibility to alter or adjust to emergent higher priority tasking while airborne and share that information with component and tactical commanders. Suddenly, the CINC had the ability exploit rudimentary snippets of a common operational picture (COP), albeit on a limited scale. To assert that the UAV data alone is capable of developing a COP is a major stretch, however, a more accurate assertion is that UAV sensor data used to confirm national and manned asset data on a real time basis improved the operational commander's battle space awareness and provided him with improved flexibility. The UAV provided the operational commander with the capability to lessen the effects of fog and friction in war. "The fog of battle is about the uncertainty associated with what is going on, while the friction of war is about the difficulty in translating the commander's intent into actions. Much of the fog of war… is referred to today as a lack of battlespace awareness…."[36]

The UAV contributed to EUCOM's C2 by providing the ability to monitor and supervise operational progress with little impact on his subordinate commanders. The Predator and Pioneer combined for a total of over 650 missions in Bosnia from 1995 through February 1998, supporting NATO, United Nations and US operations. "The Predator system and its operators showed steady improvements in operational utility to the theater commanders. The system's unique live video and dynamic retasking capabilities increased the commander's battlefield awareness and allowed him to focus his assets at the right place and time."[37]

In addition to daily intelligence, surveillance, and reconnaissance (ISR), the CINC was provided with ISR data used to support the synchronization of military and civilian activities during the following pivotal events:

- "Surveillance to assist route planning and force security operations, to include the Pope's visit in April;
- Monitoring trouble spots to help provide early warning of crises;
- Monitoring of polling stations and access routes during September's municipal elections;
- Supporting U.S. Secretary of State Madeleine Albright's October visit to Brcko with security assistance, force protection and force monitoring; and
- High-resolution day/night imaging of weapons cantonment areas, to ensure compliance with the Dayton Accords."[38]

UAV contributions in Bosnia culminated in September 1995 after multiple diplomatic and military efforts failed to prevent the shelling and intimidation of civilians in the Sarajevo area. All previous agreements to remove artillery and weapons from the area had failed because NATO forces were unable to provide evidence holding the violators responsible.[39] "With Predator, however, weapons movements became subject to long-dwell video surveillance and continuous coverage of area roads showed no evidence of weaponry being withdrawn."[40] Predator was credited with providing NATO commanders the key piece of intelligence that supported their decision to resume the bombing campaign.[41] Predator's efforts directly influenced the Dayton, Ohio, Peace Accord of December 1995.[42]

Kosovo - UAV Impact on Operational C2

NATO experienced one of the largest UAV deployments in its history during Kosovo operations in the summer of 1999. U.S. Air Force Predators, U.S. Army Hunters, U.S. Navy Pioneers, German and French Turbo Jet CL239s, and the British Phoenix were all involved in the 78-day air operation against Yugoslavia.[43]

> "No matter where Serb forces moved in Kosovo, they were under the eye of NATO forces. Pilots' sitting in ground control vans hundreds of miles away kept cameras and other sensing devices trained on Serb forces through use of the Predator unmanned aerial vehicle. NATO and U.S. Air Force officials called the UAV one of the "stars" of Operation Allied Force. Predators collected intelligence, searched for targets and kept cameras aimed at Kosovar-Albanian refugees. The aircraft helped planners assess battle damage and sort out the chaos of the battlefield. The UAV flew over areas deemed too hot for manned aircraft. The almost constant surveillance provided by the aircraft forced Serb forces into hiding. If the Serbs moved from their positions, they were spotted and reported."[44]

When Operation Allied Force began there was a change in the operational commander's mindset regarding UAV employment.[45] Prior to Allied Force, routine surveillance and intelligence missions were conducted out of the Combined Air Operations Center (CAOC) at Dal Molin AB in Vicenza, Italy.[46] These missions forwarded captured sensor data to the Joint Analysis Center (JAC) in Molesworth, England. However, the Allied Force operational commander's mindset shifted to include a direct coordination role. The underlying goal of the operational commander was to attack Milosevic's operational center of gravity (Serbian military, communications and police forces.)[47]

To accomplish this goal, the operational commander had to overcome several obstacles. After years of regional conflict, the Serbian air defenses were non-cooperative, dispersed, well concealed and effective.[48] NATO commanders set a minimum hard deck at 15,000 feet for all manned aircraft, which limited their sensor ability.[49] Coupled with effective Serbian air defenses and weather this limitation made it difficult for the manned aircraft to provide accurate ISR data. In addition, "the orbit cycles of reconnaissance satellites could not provide long duration observation and could be defeated by the enemy's operational security measures."[50] At the onset of Operation Allied Force the United States was committed to an air only operation. "The lack of significant ground threat allowed the highly mobile Serbian forces to spread out and hide their equipment (e.g. tanks, trucks, and armored personnel carriers) in and among houses, barns, sheds and foliage. Additionally, the Serbian forces mixed in with local populace and used their vehicles in many cases."[51] The combination of these obstacles forced the air component commander to take advantage of the UAV's strengths by adopting a "hunter-killer" strategy.[52]

The UAV proved to be an ideal asset to hurdle the multitude of obstacles surrounding Operation Allied Force. The "hunter killer" approach required real time data and the Predator and Hunter were the only UAVs (with real time capability) available to the CAOC.[53] Live broadcasts via GBS afforded General Wesley Clark, CINC EUCOM the ability to focus on and synchronize assets in his AOR. Once again, the commander at the operational level was able to monitor events and provide intent and guidance. Meanwhile, his boss and subordinate commanders were able to observe (via JBS) a common picture displayed at all three levels of war (Washington, Mons Belgium and Dal Molin).[54]

An unfortunate and accidental civilian bombing by NATO aircraft put even more limitations on aviators and commanders at all levels.[55] The criteria for Kosovo attacks required dual confirmation on all targets and the second confirmation required either a Forward Air Controller Airborne (FACA) or a UAV with live feeds to commanders in the CAOC.[56]

Once again, the UAV significantly improved the operational commanders' capabilities and ability to plan, sequence, and synchronize joint and combined activities. Lt. General Michael C. Short (USAF, ret.), commander of the allied air forces in Kosovo spoke bluntly about shortfalls during Operation Allied Force. "I came out of this conflict as an enormous fan …UAVs offer us so many things…. long-dwell capability, but at not near the cost of a manned platform, …they do not incur the risks to our people that a manned platform does …I think this nation needs to explore that."[57]

Operational Functions Supported by the UAV

According to Professor Vego, "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."[58] The UAV has the ability to support the operational commander in the sequencing and synchronizing of operational activities and combat forces. In the previous section we examined how the UAV supported the operational commander in the function of operational command and control. Professor Vego stresses that "operational command and control is perhaps the most critical and at the same time all-encompassing of all operational functions. It is the principal means by which the operational commander sequences and synchronizes the actions and activities of both military and non-military sources of national power in a given theater."[59] With Professor Vego's words in mind, this paper will now look at the UAV's potential to support operational functions.

Operational Intelligence and the UAV

"Operational intelligence represents a fusion of national- and theater-strategic intelligence with tactical intelligence to provide accurate, comprehensive, relevant, and perhaps most important of all, timely depiction of the military and non-military situation in a given theater or area of operation."[60] The UAV is perhaps the most well rounded intelligence-gathering platform in history because of the flexibility it provides. While it will never be able to replace or even substitute human intelligence, the UAV has capability and promise in several other sources of intelligence gathering. Signals Intelligence (SIGINT), Imagery Intelligence (IMINT), and Technical Intelligence (TECHINT). Across the board, the UAV provides the theater commander with the ability to service his theater at his request. Currently, the HAEUAV (such as the Global Hawk) has the ability to provide IMINT and TECHINT and has the potential to relay SIGINT data in the near future. Today's family of UAVs can significantly support the operational commander in the Joint Intelligence Prep of the Battle Space (JIPB). From this improved data, made available by the UAV, the operational commander can develop a better commander's estimate.

Operational intelligence is approached as a five-step process: planning, direction, collection, processing and production.[61] The UAV provides the operational commander with the ability to provide his theater an accelerated source of IMINT and SIGINT. In addition, the C4I network (supported with JBS and TSII) affords the theater CINC with the ability to speed up the five-step intelligence process. Today, the UAV systems streamline the planning and direction phases and take the collected data into real time processing and production stages. More importantly, the operational commander is able to share a common picture with all three levels of war.

With the UAV plugged into the C4I structure, the possibility of intelligence stove- piping is lessened. Now, intelligence users throughout a given theater have the ability to share the same information simultaneously. The UAV supports all three levels of war and provides a common operational picture to the entire theater thus allowing for a synergistic look at the battle space. The TUAV and EUAV both feed individual information into a common intelligence center. This ability to share battle space information through a common network provides the theater CINC with immense capabilities. The CINC now has the ability to survey an AOR, to locate key terrain features, to bring to light potential hostile actions, and to determine potential centers of gravity. The UAV is a powerful and flexible operational intelligence asset.

Operational Command and Control, Warfare (C2W), and the UAV

"Deny the opponent the effective use of his operational C2 capabilities, while at the same time protecting friendly C2 functions."[62] The UAV's ability to support operational C2W is also very promising. Operational C2W is broken down into five key components: psychological operations (PSYOPS), military deception (MILDEC), operations security (OPSEC), electronic warfare (EW), and Physical Destruction.[63] The UAV enhances the theater CINC's C2W capabilities in four out of the five components.

PSYOPS – If the early 1960 Lightning Bugs could drop propaganda leaflets then surely the UAV of today has the same potential. It would not be a stretch of technology to put a loud speaker on a low flying UAV and broadcast various PSYOPS related messages.

MILDEC- During the Gulf War, several Iraqi soldiers surrendered to our TUAVs because their presence was associated with follow on bombardments. UAV patrols could produce and create a myriad of deceptive operations once they are perceived to be associated with a particular action.

EW - The UAV also has the potential to act as an electronic warfare (EW) system. "In contrast to manned aircraft EW systems, such as the EA-6B, a UAV equipped with a radio frequency (RF) jammer payload can provide capabilities that are not feasible for the manned aircraft systems."[64]

Physical Destruction - for years we have looked at critical special operations missions designed to destroy and confuse the enemy's C2 structure. Just recently, the Predator was armed with a Hellfire missile and successfully attacked targets on two different occasions. The first attack by the Predator occurred in a controlled range environment against a target tank and the second was a combat engagement against Al Qaeda forces in Afghanistan. In limited high-risk missions the UAV has the ability to deliver forward firing weapons in support of C2W by destroying critical enemy C2 nodes.

Operational Fires and the UAV

The flexibility provided to the operational commander by the UAV affords ample support in the function of operational fires. One of the most common and effective uses of the UAV in support of operational fires is to provide key geographic or otherwise decisive point information within the battle space. This information could in turn prevent the enemy's operational maneuver. Likewise, UAV data or live maneuver direction could facilitate friendly operational maneuver. The operational commander's ability to shape the battle space is enhanced by UAV technology.

Operational Protection and the UAV

The UAV assists the operational commander in his mission of operational protection in the area of force protection. The eye in the sky also allows the tactical commander to provide self-protection using less manpower because of superior UAV surveillance. Through economy of force, the UAV becomes a force multiplier and in turn affords the operational commander a more potent fighting force. The theater commander also has the ominous task of reacting to the use of weapons of mass destruction (WMD). The UAV allows the CINC to thoroughly survey damage and make determinations regarding his AOR contamination; it allows for contamination assessment without utilizing a manned asset.

Operational Logistics and the UAV

The UAV provides the operational commander with real time surveillance data to support the synchronization of theater wide logistic efforts. Throughout a given battle space or AOR the operational commander has to be able to provide logistical support at a decisive time and place. The UAV allows the operational commander to survey lines of communication (LOC) s and supply lines and adjust to last minutes changes in the battle space. In addition, the UAV can provide the theater CINC with critical terrain, weather, and line of communication planning data, which is especially important in an immature theater. The operational commander's ability to provide decisive, time-critical, and synchronized logistics throughout the theater is greatly enhanced by his use of the UAV.

The unlimited potential of the UAV and its proven utility to support operational functions and activities continues to grow and improve. Its impact on the operational commander's ability to carry out his operational functions is considerable.

Recommendations

The following recommendations are provided to current and future operational commanders for further consideration:

Increase use of the UAV to support theater CINCs worldwide. UAVs have a proven utility and potential to support the CINC's theater functions and enhance his overall capabilities.

Rapidly pursue a revised addition to Joint Pub 3-55.1, the 27 August 1993 edition of the U.S. Joint Chiefs of Staff publication: *Joint Tactics, Techniques, and Procedures for Unmanned Aerial Vehicles*. This publication is outdated and significantly out of touch with today's platform and mission capabilities.

Integrate UAV technologies into all world wide joint and combined exercises. Just as Joint doctrine has failed to keep pace with the UAV technology boom, so have today's warriors. Tactical, operational, and strategic leaders alike have also failed to completely embrace the ability of the UAV. It will take years of practice to realize and develop the UAV's total potential; joint and combined exercises provide an excellent opportunity for the integration process.

Incorporate UAV capability training into joint and service training centers. Operational level improvements will occur as a result of a building block approach. For the UAV to be fully embraced at the operational level a concerted training effort is also required at the tactical and strategic level. Our training centers are an excellent place to continue maximizing the UAV's potential

Conclusion

The theater commanders of today are faced with a world attempting to absorb the rapid pace of globalization. Technology and information are being developed and disseminated exponentially. The Internet has burst the *information* doors wide open. The local investor of yesterday now has the ability to access tomorrow's world markets from his home PC. Boundaries are more and more flexible and containers are more porous. There will come a time when we will be able to see everything in a given space on a real time basis. The world is evolving at a pace more rapid than ever before. In order for the theater commander to support political and military activities in this environment, it will require the utmost in situational awareness. The UAV has and continues to have a significant positive impact on the theater commander's battle space awareness. Additionally, the theater commander's ability to plan, synchronize and monitor his AOR has improved due to UAV technology. Integration of the UAV into the C4I structure has given commanders the ability to make more informed decisions in a timelier manner. The UAV will *continue* to improve the capabilities of tomorrow's operational commanders.

APPENDIX A

Close-Range UAV (CR-UAV)

Addresses the needs of lower level tactical units for a capability to investigate activities within their area of interest and influence. The systems in this category will be easy to launch, operate, and recover. They will require minimum manpower, training, and logistics, and will be relatively inexpensive.

Shore-range UAV (SR-UAV)

Supports Army divisions, including detached battalion and brigade task forces and corps, Navy and Air Force combatants, and Marine Air-Ground Task Forces (MAGTFs), meeting the need to cover enemy activities out to a range of 150 kilometers or more beyond the forward line of own troops (FLOT) or launch platform (in naval operations). The UAV systems in this category are more robust and sophisticated, can carry a wider variety of payloads, can consist of more than one air vehicle, and perform more kinds of missions than the close-range systems.

Vertical takeoff and landing UAV (VTOL-UAV)

Formerly referred to as Maritime or VIPER (vertical takeoff and landing integrated platform for extended reconnaissance), will be designed to complement the SR-UAV inventory with a VTOL-capable vehicle and provide a low cost extension of warship sensors, enhance maritime warfighting capabilities, thereby increasing the security of high value naval assets.

Medium-Range UAV (MR-UAV)

Addresses the need to provide prestrike and poststrike reconnaissance of heavily defended targets at significant ranges and augment manned reconnaissance platforms by providing high quality, near-real-time imagery. MR-UAV systems will differ from other UAV systems in that they will be designed to fly at high subsonic speeds and spend relatively small amounts of time over target areas.

Endurance UAV (E-UAV)

Provides high altitude, heavy payload, multimission, and surrogate satellite support across all mission areas with a flight duration in excess of 24 hours. E-UAV systems will be capable of employing the widest variety of sensors and payloads in support of joint forces.

Source: Joint Chiefs of Staff, Joint Tactics, Techniques, and Procedures for Unmanned Aerial Vehicles, Joint Pub 3-55.1 (Washington, DC: 27 August 1993), 5.

APPENDIX B

	CHARACTERISTICS	PIONEER	HUNTER	Tier II, MAE UAV PREDATOR	Tier II+, CONV HAE UAV GLOBAL HAWK	Tier III-, LO HAE UAV DARKSTAR
Operational	**ALTITUDE**: Maximum	15,000 ft	15,000 ft	25,000 ft	65,000 ft	50,000 ft
	Operating	≤15,000 ft	≤15,000 ft	15,000 ft	50,000-65,000 ft	50,000 ft
	ENDURANCE (Max):			20 hrs	38 hrs (20 @3000nm)	12 hrs (8 @500nm)
	RADIUS OF ACTION:	100 nm	144 nm	400 nm	3,000 nm	>500 nm
	SPEED: **Maximum**	110 kts	106 kts	110-115 kts	>345 kts	300 kts
	Cruise	65 kts	>89 kts	65-70 kts	345 kts	300 kts
	Loiter	65 kts	<89 kts	60-65 kts	340 kts	130 kts
	CLIMB RATE (Max):	800 fpm	761 fpm	450 fpm (912 eng) 800 fpm (914 eng)	3,400 fpm	2,000 fpm
Air Vehicle	**WEIGHT**: Empty	276/304 lb	1,200 lb	1,200 lb	8,900 lb	4,360 lb
	Fuel Weight	66/70 lb	300 lb	660 lb	14,700 lb	3,240 lb
	Payload	75/75 lb	200 lb	450 lb	1,960 lb	1,000 lb
	Max Takeoff	430/452 lb	1,600 lb	2,500 lb	25,600 lb	8,600 lb
	DIMENSIONS: Wingspan	17.0 ft	29.2 ft	48.7 ft	116.2 ft	69 ft
	Length	14.0 ft	23.0 ft	26.7 ft	44.4 ft	15 ft
	Height	3.3 ft	5.4 ft	7.3 ft	15.2 ft	5 ft
	AVIONICS: Transponder	Mode IIIC IFF	Mode IIIC IFF	Mode IIIC IFF	Mode I / II / IIIC / IV IFF	Mode IIIC IFF
	Navigation	GPS	GPS	GPS and INS	GPS and INS	GPS and INS
	LAUNCH & RECOVERY: Land	***RATO, Rail; Runway, (A-Gear)***	RATO Unimproved Runway/200m	***Runway (2,500ft)***	***Runway (5,000ft)***	***Runway (<4,000ft)***
	Ship	***RATO, Deck w/Net***				
	GUIDANCE & CONTROL:	Remote Control/Preprogrammed	Remote Control/Preprogrammed	Prepgmd/RemoteControl/Autonomous	Preprogrammed/Autonomous	Preprogrammed/Autonomous
Payload & Links	**SENSOR(S):**	EO or IR (w/new sensor)	EO or IR	EO, IR, and SAR	EO, IR and SAR	EO, IR and SAR
	DATA LINK(S): Type	Uplink: C-band LOS & UHF LOS Downlink: C-band LOS	C-band LOS	***UHF & LOS*** Ku-band SATCOM	UHF LOS & SATCOM: X-band CDL LOS; Ku-band SATCOM	UHF LOS & SATCOM: X-band CDL LOS; Ku-band SATCOM
	Bandwidth:	C-band LOS: 10 Mhz UHF: 600 MHz	20 MHz	UHF & LOS: 20 MHz Ku-band SATCOM: RL/CL: 5/9MHz	UHF LOS/SATCOM: 25/25 kHz X-CDL LOS: RL/CL: 137/64 MHz Ku-SATCOM: RL/CL: 3-69/.26 MHz	UHF LOS/SATCOM: 9.6/25 kHz X-CDL LOS: RL/CL: 137/64 MHz Ku-SATCOM: RL/CL: 26/(n/a) MHz
	Data Rate: **-Analog** **-Digital**	C-band LOS: 10 MHz UHF: 7.317 kbps	20 MHz	UHF & LOS: 20 MHz Ku-band SATCOM: RL: 1.544 Mbps CL: 64 kpbs	UHF LOS/SATCOM: 9.6/9.6 kbps X-CDL LOS: RL: 137 Mbps CL: 200 kbps Ku-SATCOM: RL: 1.5-48Mbps CL: 200 kbps	UHF LOS/SATCOM: 4.8/1.2 kbps X-CDL LOS: RL: 137 Mbps CL: 200 kbps Ku-SATCOM: RL: 1.54 Mbps CL: n/a
	C2 LINK(S):	Through Data Links	Through Data Link	Through Data Links	Through Data Links	Through Data Links
System & Support	SYSTEM COMPOSITION	5 Avs, 9 payloads (5 day cameras, 4 FLIRs), 1 GCS, 1 PCS, 1-4 RRSs, 1 TML (USMC unit only)	8 Avs, 8 MOSPs, 4 ADRs, 4 RVTs, 3 GCS/MPSs, 2 GDTs, 1 LRS, 1 MME	Avs, 1 GCS, 1 Trojan Spirit II, Dissemination System, GSE	Avs (TBD); HAE CGS	Avs (TBD); HAE CGS

urce: Christian M. Cupp, ed., “Unmanned Aerial Vehicles,” The DTIC Review, Vol.4, No.2
Fort Belvoir, Va.: Defense Technology Information Center, September 1998), 22-23.

NOTES

[1] Thomas E. Ricks, "A War That's Commanded at a Distance," *Washington Post*, 27 December 2001, p. 16.

[2] Ibid.

[3] Ibid.

[4] Ibid.

[5] Richard M. Clark, Uninhibited Combat Aerial Vehicles, CADRE Paper No. 8, (Maxwell AFB, Alabama: Air University Press 2000), p. 7.

[6] Christopher A. Jones, "Unmanned Aerial Vehicles (UAVs) An Assessment of Historical Operations and Future Possibilities," (Research paper presented to Research Dept., Air Command and Staff College, Maxwell AFB, Alabama, March 997), p. 1.

[7] Clark, p. 16.

[8] Ibid.

[9] Ibid., p. 28.

[10] Ibid., p. 35.

[11] Ibid.

[12] David A. Fulghum, "UAVs Pressed into Action to Fill Void." *Aviation Week & Space Technology*, 19 August 1991, 9; quoted in Richard M. Clark, Uninhibited Combat Aerial Vehicles, CADRE Page No. 8, (Maxwell AFB, Alabama: Air University Press 2000), p. 35.

[13] Ibid.

[14] Ibid., p. 35.

[15] Ibid., p. 36.

[16] Ibid., p. 35.

[17] Ibid., p. 37.

[18] Ibid.

[19] Christian M. Cupp, ed., The DTIC Review, vol. 4, no. 2, *Unmanned Aerial Vehicles* (Ft. Belvoir, Virginia: Defense Technical Information Center, 1998), p. 19.

[20] JD R. Dixon, "UAV Employment in Kosovo: Lessons for the Operational Commander," (Research paper submitted to Faculty of Naval War College, Newport, RI., 8 February 2000), p. 2.

[21] Ibid.

[22] Ibid.

[23] Cupp, p. 23.

[24] Ibid.

[25] Dixon, p. 2.

[26] Cupp, p. 23.

[27] Ibid.

[28] Ibid., p. 28.

[29] Ibid., p. 35.

[30] Ibid.

[31] Greg S. Lamb and Tony G. Stone, *Air Combat Command Concept Of Operations: For Endurance Unmanned Aerial Vehicles,* Ver. 2 Sect. 6:6.1, "Communication Integration And Interoperability" [on-line]; available from http://www.fas.org/irp/doddir/usaf/conops_uav /part06.htm; Internet; accessed 14 January 2002.

[32] Jones, p. 23.

[33] David S. Alberts, John J. Garstka, and Frederick P. Stein, Network Centric Warfare: Developing and Leveraging Information Superiority, 2d ed. (Washington, D.C.: C4ISR Cooperative Research Program, August 1999), p. 69.

[34] John Boyd, "Boyd's OODA Loop Revealed" [on-line]; available from http://www.d-n-i.net/FCS_Folder/boyds_ooda_loop.ppt; internet; accessed 14 January 2002.

[35] Milan Vego, Operational Warfare, (Unpublished Paper, U.S. Naval War College, Newport, RI., 2000), p. 187.

[36] Ibid.

[37] Alberts, Garstka, and Stein, p. 71.

[38] Jones, p. 32.

[39] *The DTIC Review*, p. 5.

[40] Ibid.

[41] *"About Edwards – History, Bosnia"* [on-line]; available from http://www.edwards.af.mil/articles98/docs_html/splash/may98/cover/bosnia.htm; Internet; accessed 13 January 2002.

[42] Ibid.

[43] Ibid.

[44] William S. Cohen and Henry H. Shelton, "Joint Statement On The Kosovo After Action Review," United States Department of Defense News Release, 14 October 1999, [news release on-line]; available from http://www.defenselink.mil/news/Oct1999/b10141999_bt478-99.html; Internet; accessed 13 January 2002.

[45] Jim Garamone, "Predator Demonstrates Worth Over Kosovo," American Forces Information Service News Articles, 1 September 1999, [article on-line]; available from http://www.defenselink.mil/news/sep1999/n09211999_9909212.html; nternet; accessed 13 January 2002.

[46] Dixon, p. 4.

[47] Ibid.

[48] Ibid., p. 5.

[49] Ibid.

[50] Ibid.

[51] Chatry D. Perry, "Unmanned Aerial Vehicle: A Tool for the Operational Commander," (Res. paper submitted to 'aculty of Naval War College, Newport, RI., 16 May 2000), p. 4.

[52] Dixon, p. 5.

[53] Ibid.

[54] Ibid.

[55] Ibid., p. 6.

[56] Ibid.

[57] Ibid.

[58] Linda de France, "UAVs Hold Key To Future Conflicts, Kosovo Air Commander Says" [article on-line] *Aerospace)aily*, 15 November 2000; available from http://ebird.dtic.mil/Nov2000/ s20001115uavs.htm; accessed on 15 November 2000.

[59] Vego, p. 185.

[60] Ibid., p. 198.

[61] Ibid., p. 215.

[62] Vego, p. 204.

[63] Perry, p. 12.

[64] Vego, p. 222.

[65] Perry, p. 12.

BIBLIOGRAPHY

_____. *"About Edwards – History, Bosnia."* On-line. Available from http://www.edwards.af.mil/articles98/docs_html/splash/may98/cover/bosnia.htm. Accessed 13 January 2002.

lberts,David S., John J. Garstka, and Frederick P. Stein. Network Centric Warfare: Developing and Leveraging Information Superiority, 2d ed. Washington, D.C.: C4ISR Cooperative Research Program, August 1999.

oyd, John. "Boyd's OODA Loop Revealed." On-line. Available from http://www.d-n-i.net/FCS_Folder/boyds_ooda_loop.ppt. Accessed 14 January 2002.

lark, Richard M. Uninhibited Combat Aerial Vehicles. CADRE Paper No. 8. Maxwell AFB, Alabama: Air University Press, 2000.

ohen, William S. and Henry H. Shelton. "Joint Statement On The Kosovo After Action Review." U. S. Department of Defense News Release, 14 October 1999. News release on-line. Available from http://www.defenselink.mil/news/Oct1999/b10141999_bt478-99.html. Accessed 13 January 2002.

upp, Christian M., ed. The DTIC Review, vol. 4, no. 2, *Unmanned Aerial Vehicles*. Ft. Belvoir, Virginia: Defense Technical Information Center, 1998.

e France, Linda. "UAVs Hold Key To Future Conflicts, Kosovo Air Commander Says." Article on-line. *Aerospace Daily*, 15 November 2000. Available from http://ebird.dtic.mil/Nov2000/ s20001115uavs.htm. Accessed 15 November 2000.

ixon, JD R. "UAV Employment in Kosovo: Lessons for the Operational Commander." Research paper, Naval War College, Newport, RI., 8 February 2000.

ulghum, David A. "UAVs Pressed into Action to Fill Void." *Aviation Week & Space Technology*, 19 August 1991, 59. Quoted in Richard M. Clark, Uninhibited Combat Aerial Vehicles, CADRE Page No. 8, (Maxwell AFB, Alabama: Air University Press 2000), p. 35.

aramone, Jim. "Predator Demonstrates Worth Over Kosovo." American Forces Information Service News Articles, 13 September 1999. Article on-line. Available from http://www. defenselink.mil/news/sep1999/n09211999_9909212.html. Accessed 13 January 2002.

ones, Christopher A. "Unmanned Aerial Vehicles (UAVs) An Assessment of Historical Operations and Future Possibilities." Research paper, Air Command and Staff College, Maxwell AFB, Alabama: March 1997.

amb, Greg S. and Tony G. Stone. *Air Combat Command Concept Of Operations: For Endurance Unmanned Aerial Vehicles*, Ver. 2 Sect. 6:6.1, "Communication Integration And Interoperability." On-line. Available from http://www.fas.org/irp/doddir/usaf/conops_uav/ part06.htm. Accessed 14 January 2002.

erry, Chatry D. "Unmanned Aerial Vehicle: A Tool for the Operational Commander." Research paper, Naval War College, Newport, RI., 16 May 2000.

icks, Thomas E. "A War That's Commanded at a Distance." *Washington Post*, 27 December 2001, 16.

.S. Joint Chiefs of Staff. Joint Tactics, Techniques, and Procedures for Unmanned Aerial Vehicles. Washington, DC., U.S. Joint Chiefs of Staff, 27 August 1993.

ego, Milan. Operational Warfare. Unpublished Paper, U.S. Naval War College, Newport, RI., 2000.